Integration and Analysis of Resource Inventory Data for Risk Assessments of Environmental Contamination in Mixed Use Landscapes in Pakistan

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Abstract

This paper examines the various metals that are associated with land contamination for instances arsenic, cadmium, lead, chromium, nickel, and mercury that are well known as the ingredient of contamination of the ecology in the region where there is a high rate of anthropogenic burden. The study investigates land contamination in Pakistan's context. The researches have used the quantitative method to analyze the most recent literature available on the land contamination of Pakistan following funnel approach. The three main steps followed to analyze are first, assessment of the site initially, secondly, assessment of the exposure of the contaminated site that also contains a survey of few places and the amount of contamination found and lastly, remediation of the site.

The finding revealed that the contamination in Pakistan is both men made as well due to the terrain they belong to that contains various anthropogenic elements, which are harmful to live beings. Additionally, it is evident that the different elements, which can cause soil contamination, are higher in many places in Pakistan than the standard or tolerable rate mentioned by WHO and other survey board. Lastly, the paper confirms that the pollution can be reduced only if there is a reduction in the manmade cause of the land contamination such as oil spill and other industrial emissions that constitute most of Pakistan's land contamination.

Keywords: *Environmental Contamination, Landscapes, Resource Inventory Data, Risk Assessments, Pakistan*

Introduction

Background

The fast industrialization, improvement, and urbanization have specifically influenced the earth (Seto et al., 2011). The corruption and pollution of the biological community have, today turn into a key danger for all life on earth (Seto et al., 2011; Jiang et al., 2013). It is not just the blame of industrialization just yet additionally the botch and absence of the arranging, particularly in Pakistan, which has lead humankind to the point where the condition that once manage life is currently sign of rot, illness, and demise (Shabbir, 2013). Universally the lithosphere and hydrosphere have been sullied with overwhelming metals (HMs) through different human exercises, which have turned into a noteworthy human wellbeing danger. In Pakistan, overwhelming metal debased soils, surface, and groundwater are progressive because of fast industrialization and increment utilized of pesticides and manures in rural exercises. Drinking water has gotten from either surface or groundwater (Amin & Ahmad, 2015). Yet, the groundwater has more significance as 65% of Europe while 49% of USA populace is utilizing groundwater for drinking reason. Nevertheless, water is occasionally discovered uncontaminated. The serious agrarian exercises may bring about the expansion of substantial metals in soils and groundwater because of the utilization of composts and pesticides. Part of examines has been completed all around the world to describe the water and soil quality. Remarkable discoveries of such research contemplates are evaluated here.

Overview:

This paper will discuss the pollution or degradation of land which has happened in Pakistan over a few years which has affected public health as well as added up to environmental pollution. As per articles reviewed over the years, the country has a high level of land contamination which is affecting public health and further causing health hazards. The paper will discuss the different chemical composition which is creating land water and other environmental contamination and adverse effect on humanity.

Aim

The aim of this paper is to discuss the different literature review available resources, inventory data is reviewed to ascertain the actual situation and its condition, and proper recommendation can be made which will help in solving the problems. The paper aims at the proper analysis of the land contamination situation prevailing in Pakistan, its effect, reasons, and a recommendation made to go through the situation.

The Significance of Research

The paper is based on the land contamination in Pakistan and the following metals that form a part of this contamination like arsenic, cadmium, lead, nickel mercury and other metals that do not support the growth of the plant in the soil which is contaminated with the help of the above metallic components. The paper signifies or discusses the land contamination problem of Pakistan. The nearness of follow overwhelming metals in the climate, soil, and water can make major issues all creatures, and the omnipresent bioavailability of this substantial metal can bring about bioaccumulation in the natural way of life, which particularly can be profoundly perilous to human wellbeing (Chakraborty et al., 2015). The analysis checks the substantial literature, which is available about Pakistan land contamination. This is done to evaluate overwhelming

materials that degrade land and creates a problem for living world. Degradation of the vegetable grown on degraded land, the water table which is also being contaminated for that reasons will be reviewed in this paper which will help to know the state of land contamination and their effect on land.

Literature Review

In some research works, it was found that arsenic is the reason behind contamination of soil, groundwater, cultivated crops fishes, and other eatables in the area of Sindh in Pakistan. The guidelines provided by who was exceeded by the countries certain places. The concentration or the contamination of the soil with the element arsenic ranges from 11.3 mg/kg to 46.2 mg/kg, which is observed to be very high and harmful (Rasool et al., 2017).

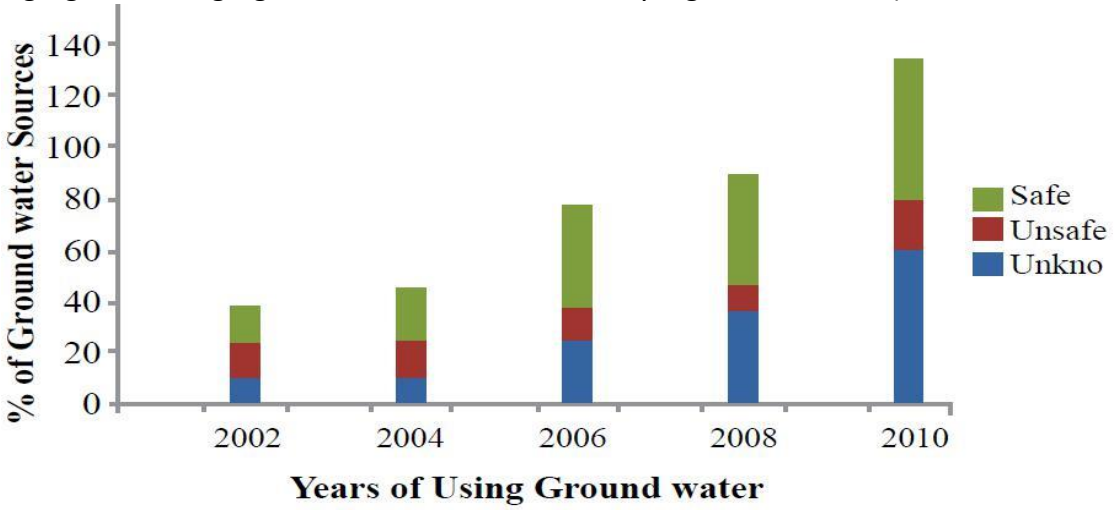
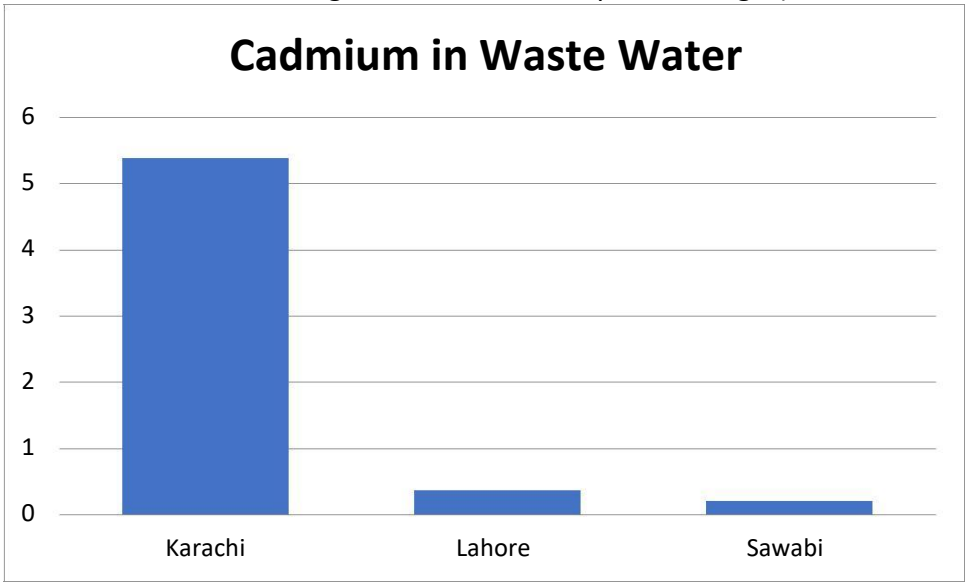


Figure 1: Drinking water condition in Karachi, Sindh Province (cited from Sanjrani et al., 2017)

Recently studies were carried out that the bodies belong to Indus were contaminated with lead and arsenic at considerable level, from the northernmost territory of Gilgit-Baltistan to the lower parts of Sindh (SAFWCO, 2003). Similarly communities belong to different areas of Pakistan facing severe public health problems related to it (Sanjrani, et al., 2017). Survey had been conducted about soil and it showed variations in surface and deep soils related to such concentrations in soil samples (ibid), It was relatively higher in surface soils than deep soils even the samples were taken from the same location. The highest average arsenic content was found to be 46.2 mg/kg in soils in the agricultural areas of Sindh (irrigated with As-rich lake water) (cited from Sanjrani, et al. 2017). In other survey it was concluded that sediments play a vital role for arsenic spreading in water bodies (Masuda et al., 2010). Total arsenic level in sediment and soil irrigated with lake water in some parts of the Sindh was higher than the threshold effects level as reported by interim sediment quality assessment values and USEPA (Sanrani, et al., 2017). The mean values of total arsenic were found in the range of 11.3-55.8 µg/L in Manchar lake sediment in Sindh province (SAFWCO, 2003). The cities in Sindh, Khairpur, Gambat, Kotdiji, Dadu, Sehwan, Johi, Sukkur, Nawabshah, Hyderabad, Karachi, and Thar were highly affected by water pollution in different aspects (Sanjrani et al., 2017). Moreover, Drinking water condition is worst crossing WHO guideline in Karachi city in Sind province, previous results showed that less than 40% of drinking water comes from groundwater is safe, other is either unsafe or unknown, this survey was done in 2014 (Nadees et al., 2011).

Moving to the Asian perspective, in the coastal soils of Shanghai, China sources of cadmium are found in the amount which is similar to the amount found in portions of Pakistan. The method they used to find the range of soil contamination by the method of the multivariate statistical report (PCA, CA, and correlation analysis).The metals are anthropogenic in nature, for example, Cu, Ni, Pb, As and Cd (this is mainly due to overuse of chemical fertilizer and pesticides, industrial discharges as well as municipal discharges).



The highest concentration of 5.35 mg/L Cadmium in wastewater reported from Korangi area, Karachi, exceeded the permissible limit of 0.10 mg/L set by NEQS-Pak for industrial and sewage wastewater (Iqbal, et al., 2016). Moreover, in north and east zones of Lahore, Punjab province, the concentration of Cd in wastewater was also above the safe limit set by NEQS and is in the range of 0.18 to 0.37 mg/L. In another study on wetland efficiency for heavy metal removal from industrial wastewater in Gadoon, Amazai Industrial Estate, Swabi (KPK province), showed the variation of Cd in the range of 0.19–0.62 mg/L (Kabir et al., 2016).

Water Pollution and the Environment

Karachi's untreated family disposed waste water unit excrement and assembling bequest is release into the waterways of Layari and Malir, which joins the Arabian Sea. This waste has started to counterfeit a genuine danger to the oceanic condition, as the water of the channel is filthy with microbes as well as with noxious chemicals (Brambilla et al., 2017).

Water pollution likewise stretches out a savage threat to verdure of the country. Creatures drink water out of tainted water bodies, wiped out lake, waterways and other waterways. This sickens the regular world and some may even bite the dust. Oil spill kills several species of water animals in the ocean. Extreme contamination of river Ravi has decimated the once existing 42 types of fish and the feathered creature life roughly the waterway has moved to different regions. Continuance of little spineless creatures, small-scale fern, and green is additionally debilitated.

Soil Pollution

The soil is a kind of biological system unto itself, and it is generally touchy to outside issue being connected to it. That is beneficial for us on account of needing to include soil alterations, manure, and fertilizer to make the dirt more advantageous, however not very great with regards to soil contamination. There are many different ways that soil can become polluted, such as:

- Discharge from the disposal of landfill Waste discharged from industries.
- Contaminated water percolation into the soil Damaged storage tanks situated underground
- A huge amount of use of fertilizers, pesticides, and herbicides Disposal of solid waste

The most common pollutants that add on to the land contamination are:

- Petroleum
- Hydrocarbons
- Heavy metals
- Pesticides

Notwithstanding when the soil isn't being utilized for sustenance, the matter of its defilement can be a wellbeing concern. Particularly this is so when that dirt is found in parks, neighborhoods or different spots where individuals invest energy. Wellbeing impacts will be distinctively relying upon what sort of toxin is in the dirt. It can go from formative issues, for example, in youngsters prone to lead contamination, to protectiveness from chromium and a few chemicals found in compost, regardless of whether those chemicals are as yet utilized or have been restricted yet are as yet found in the dirt (Alam et al.,2015).There are certain elements that contaminate land as well increase the danger of diseases like leukemia, kidney related diseases, the ill-functioning of the liver and an effective change in the focal sensory system. These are the longest and strongest impact of land contamination. Prompt cerebral pains, queasiness, weariness and skin rashes can be caused by the impact of land contamination. They are generally noticed in the land contaminated in Pakistan.

Research Methodology

In this research, mainly the researcher followed the approach of Haque & Aston (2016), and Haque, Faizan, & Cockrill (2017) by considering "Funnel Approach" to filter the results from the literature at hand. As part of funnel approach, inductive-deductive approach was taken by narrowing it down to concentrate on the Pakistan' context. Later, the researcher followed Faizan

& Haque (2015) "Polar Diamond" strategy to explain the research problem. However, the research also consider the strategic approach by adopting step wise pattern to investigate research problem by following Sekaran & Bougie (2012) guidelines. As a part of basic outlines method, first step was consideration of reviewing the available data on land contamination of Pakistan, including (a) Assessment of the site initially, (b) assessment of the exposure of the contaminated site, and (c) remediation of the site.

Assessment of the Site Initially

The target of this progression is to gather data on the site conditions, existing releases, potential releases and saw a presentation. Specialists utilize this data to decide whether it

requires or an end of the week on the site or to distinguish basic zones with broad investigations. The data gathered amid this stage and is the reason for deciding if the following stage is fundamental (Rehman et al., 2015). Evaluation at the Preliminary basis and inspection of the site phases are distinguished.

Assessment of the Exposure of the Contaminated Site

Hazardous Sites (LSP) which can then include and a National Priorities List (NPL PA is intended to perceive (in light of restricted information) destinations that have almost no risk to human well-being and nature, and also locales that might be a danger and require broad research. The PA likewise recognizes locales requiring evaluation for conceivable crisis reaction activities. In the event that the PA prescribes broad research, at that point, the site review (SI) will be performed (Rehman et al., 2017).

The Statistical Survey of the contaminated site

Serial Number	Places Reviewed	Source of Samples	Turbidity NTU	Chloride (mg/L)	Alkalinity (mg/L)	Calcium Hardness (mg/L)
1	Hassan Town	Well Water	2.41	3.41	117	43
2	Gujian	Well Water	1.76	3.76	313	200
3	Masjid	Well Water	2.08	5.08	288	108
4	Banda Darzak Khan	Well Water	2.51	6.51	280	36
5	Banda Jat Khan	Well Water	2.78	7.78	463	192
6	Narrian	Well Water	1.90	7.90	307	58
7	Lower Malikpura	Well Water	2.89	9.89	339	96
8	Gujri Meta	Well Water	13.47	21.47	125	106
9	Phool Gulab	Well Water	2.50	11.50	335	153
10	Shah Zaman Colony	Well Water	2.28	12.28	331	92
11	Supply	Well Water	20.62	31.62	296	83
12	Kakul Bilal Town	Well Water	6.80	18.80	374	108
13	Banda	Well Water	2.04	15.04	206	75
14	Mirpur	Well Water	16.53	30.53	381	163
15	Kehal	Well Water	2.26	17.26	230	98

In the above statistical survey it is found the well water of most of the places reviewed contain a high level of turbidity, chloride, Alkalinity and calcium which is related to the contaminated land that they belong to.

Statistical Modeling

The issue is of essential significance regardless of whether the arsenic focus in groundwater represents a wellbeing peril, we utilized strategic relapse examination to demonstrate arsenic fixation in groundwater being above or beneath the WHO rule of 10 and 50 µg/liter. We utilized our own particular groundwater quality information (n = 1184) and in addition those from the beforehand specified investigations, which constitute 69 extra examples altogether.

The information were first accumulated into 1-km squares by taking the geometric mean of estimations falling inside each square, which brought about 743 information focuses. The 1-km × 1-km measurements relate to the finest determination (30″) of informational index utilized as a part of the strategic relapse examination. Since the deliberate arsenic fixations in groundwater were utilized as the needy variable in the strategic relapses, they were relegated the estimation of 1 if the focus is more prominent than the WHO rule of 10 μg/liter (49.8% of information focuses) or 0 if the focus is not exactly or equivalent to 10 μg/liter (50.2% of information focuses).

Calculated relapse utilizes a strategic capacity, which goes up against free factors that can go between negative endlessness and positive boundlessness and produces a result in the vicinity of 0 and 1 (1)where $0 \le P \le 1$, and (2)where x1 … xn are the autonomous factors and β1 … βn are the relating relapse coefficients. P is translated as the likelihood of the needy variable being 0 or

1. Strategic relapse investigations were directed utilizing the summed up straight model capacity of R.

To help correlation of various examinations, the AIC gives a relative examination regarding the exchange off amongst unpredictability and decency of fit where k is the quantity of parameters and L is the probability. For a given suite of examinations, the one with the most reduced AIC gives the best mix of demonstrating execution and straight forwardness.

Data set	Resolution	Correlation (*P*)	Logistic regression (*P*)
Potential evapotranspiration (PET) (*72*, *73*)	30″	0.730 (<0.05)	<0.05
Precipitation (*74*)	30″	−0.776 (<0.05)	<0.05
Aridity [precipitation (*74*)/ PET (*72*, *73*)]	30″	−0.779 (<0.05)	<0.05
Irrigated area % (*75*)	5′	0.967 (<0.05)	<0.05
Slope (binary, 0.1°) (*76*)	30″	n/a	<0.05
Fluvisol probability (%) (*70*, *77*, *78*)	30″	0.704 (<0.05)	<0.05
Soil organic carbon (*70*, *77*, *78*)	30″	−0.778 (<0.05)	<0.05
Soil pH (*70*, *77*, *78*)	30″	0.977 (<0.05)	<0.05
Soil clay % (*70*)*	30″	−0.338 (>0.05)	>0.05
Soil silt % (*70*)*	30″	-7.22×10^{-2} (>0.05)	>0.05
Holocene fluvial sediments (binary) (*69*)	Polygon	n/a	

Generating a List of Hazardous Sites (LSP)

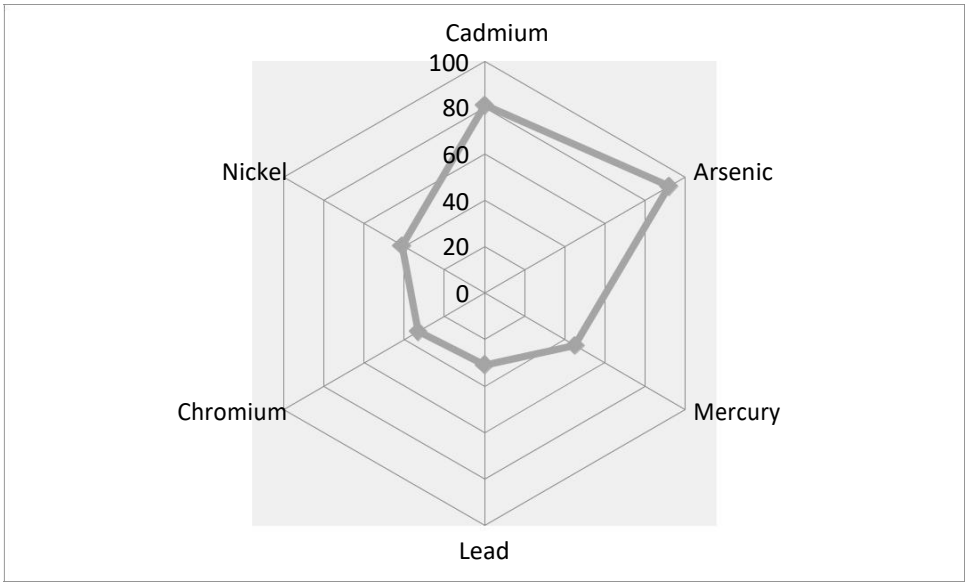
The following is displayed a framework for an LSP. The absence of data is the primary restriction in light of the fact that it makes numbness in the framework. Such numbness is surpassed as they are finishing the natural examinations plans to make in the following periods of the system. Therefore, numbness ought not to be a hindrance to getting a posting. Besides, the posting requires region contemplates; mindfulness propels leaders and encourages anticipation designs. With this foundation, it ought to be evident that the rundown was tidy contains data of possibly hazardous destinations and just the real level of threat of every one of the locales recorded, in the wake of having acquired the investigative information would be prepared. This can be characterized as the plausibly unsafe place to any territory, which is full of risky substances potential element, which can cause soil degradation at large. The substances can be strong, vaporous, or fluid and its starting point can be anthropogenic or common. This technique is connected basically for the examination and treatment of polluted soil and groundwater.

To create an LSP, the first proposal is the development of a gathering of people whose obligation is to get the main state list. The gathering will comprise of individuals from the focal, nearby government and the private division will moreover be viewed as a few specialists speaking to various substances of common society gatherings and individuals from non - legislative associations intrigued by the subject (Waseem et al.,2014).

To join the gathering, you should have a few necessities, for instance, have involvement in ecological issues (Environmental Engineers - concoction - Geographers - Agricultural - Forestry - Agricultural - Industrial - Civil, scientists, designers, and so on), known area and have valuable attitude to work with individuals from various controls and with various interests. Notwithstanding your capacity, all individuals ought to get gather instructional class in the prioritization strategy, to build up criteria understanding or specialized definitions essential for the activity. The gathering ought to select an organizer to set up measures gatherings.

Results of the Contamination Created

The Polar diamond approach of Faizan & Haque (2015) undertaken in this study is to demonstrate the results of the contamination in Pakistan's context.



Arsenic is an element which is always known as the health hazard that it causes. It is one of the carcinogenic elements that belong to group 1 elements. In Pakistan Arsenic is found in the groundwater, which can create a heavy health hazard in the population all to get her.

Cadmium is a metal, which is associated with several health hazards, the cadmium element can be classified as a toxic element, which is the reason behind various health issues such as chronic health effect in human life. This metal occurs naturally in seawater as well as earth crust in a certain specific area in the world. However, it can also be man-made in nature. As it is very harmful the standard rate which can be tolerated is 0.2 mg/kg but a bit of this element can be a reason behind cancer as well as kidney diseases. In Pakistan, this element is found in at times a high concentration of cadmium is found in areas where there is a have concentration of industries. Discharges from industries of steel, iron, marble, aluminum are the reason behind the contamination of these harmful elements in groundwater as well as the soil of Pakistan.

Copper is not a threat to Pakistan, as copper is not found in the groundwater at such a level that it can harm mankind as most of the reports that are made after conducting research work it is found that the rate of copper contamination is less than the standard limit that is prescribed by WHO/NSDWQ- Pak. The standard level is 2mg/l and no places in Pakistan have more than that level so the land and the water is not contaminated with copper. Usman et al., 2017 said that there is a study which can detect the level of dissolved copper in groundwater. By that, it was found that municipal water in Pothi Bala of AJ&K has a high level of copper concentration which was about 2.8 mg/l.

If the surface water available has a high rate of iron content that is about 5.46mg/l which is generally found in various regions of Pakistan. The estimated iron content that is allowed that has been estimated by NEQS is 8mg/l. The research which was done on available water revealed that the water in Pakistan contains a very high amount of iron content which is more than the allowable estimation and is harmful to the masses only excepting certain special cases. The metals mostly found are to paid maximum attention due to the dangerous properties that toes metals possess and attention should also be given to the metals which are necessary for human well-being are present in the soil or not (Afzal et al., 2014).

(Less water availability in the lake), though as because introducing groundwater and water from the lake had an access in the range of 241– 390 µg As/4L/day. Thus, there are reports which likewise clarified huge accountability of the groundwater that is being used and As fixing of those in scalp hair from sub locale area (Southern Sindh, Pakistan) (Alamdar et al.,). In a similar portion investigation, a connection between unending arsenic introduction through drinking groundwater and decrement in lung work among grown-up populace was accounted for in Gambat, area Khairpur, Sindh region, in Pakistan. Few investigations have been done in Pakistan on the impact which is generally created by lead by making certain research on the different lead presentation sources, albeit unreasonably it is found that there is the high level of lead content in drinking water which is used by the masses in different territories of the nation. One examination based on a group of people theorized that a high level of such content in the blood can be a reason for hypertension among a percentage of the population in Pakistan.

Some research people made certain examination, it was found by them that over 80 % of infants have led in their blood (>10 µg/dL, with a general mean of 15.6 µg/dL) because of the noticeable lead contamination in the air as well as soil the things consumed by the human population gets contaminated further contaminating the blood of human being (Subhani et al., 2015). This is the reason why the mean level of lead in blood is also found altogether greater in rush hour gridlock constables from Karachi city (47.7 µg/dL) when contrasted with Islamabad city (27.2 µg/dL) than control (3.22 µg/dL). The outcome of this contamination creates a lot of problems and diseases like neurological problems physiological problems and also a certain issue regarding behavior which is seen mainly in that population who have a concentration of lead in their blood (Achakzai et al.,2017).

Conclusion

Pakistan is a land prone to contamination due to various reason that are discussed in this paper however it can be said all the reason behind these environmental contaminations are generally man-made therefore we can assume that these manmade contaminations can be stopped only if some correctional steps are taken with reference to all those environmental contaminations which are degrading the environment of Pakistan. These can be well evaluated and solved by taking certain steps to avoid the consequences of the problem faced by the human population of the country.

Recommendations

The certain solution can be recommended to reduce the amount of land contamination. These can prove helpful to handle the prevailing situation, in turn, reducing the risk of the consequences faced due to the effect of land contamination prevailing in Pakistan. Few such recommendations are as follows:

- Introduction of biodegradable material that can be reused as well as recycled. This will help to reduce the pollution of the land and the water table in turn as will reduce dumping of the non-biodegradable material (Achakzai et al., 2017).
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- Oil spills are to be controlled to control land contamination. Chemical like oil and other chemicals which are waste products of the industries should be controlled or recycled or reused instead of dumping into nature (Abeysinghe et al., 2017).

- Pesticides which are the reasons behind land contamination if he uses safe pesticides are used that will control most of the contamination in the Sindh region of Pakistan.

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