ASSESSMENTOFPESTICIDESANDHEAVYMETALSINGRO UNDWATERINPARTSOFDISTRICTPATIALA

A

PROJECTREPORT

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Underthesupervision

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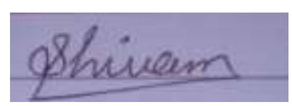
STUDENT'S DECLARATION

Weherebydeclarethattheworkpresentedinthe Projectreportentitled**"Assessmentofpesticidesandheavymetalsingroundwaterinpartsofdistrict Patiala"**submittedforpartialfulfillmentof therequirementsforthedegreeofBachelorofTechnologyinCivilEngineeringat**JaypeeUniversityofInformationTechnology,Waknaghat**isanauthenticrecordofmyworkcarriedoutunderthesupervisionof**Dr.RishiRana**.Thisworkhasnotbeen submittedelsewherefortherewardofanyotherdegree.Wearefullyresponsibleforthecontentsofmy projectreport.





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ABSTRACT

The rate at which the rate of population is increasing has led to decline in number ofnatural resources as well as causing impact on the sources. Ground water is the largestsource of fresh and usable water and India being the largest user of ground water in theworld. A classified study for the identificationof heavy metals (Cadmium, Chromium,Nickel, Arsenic, Lead, Selenium, Aluminium) in drinking water of district Patiala, Indiawasaccomplished.The qualityof ground water was determined using water samplescollected from various sites.Heavy metals were determined byAtomic AbsorptionSpectrometer.The level of Nickelwas found to be upright in sample which was inagreementwith World Health Organization standards (WHO).Chromium , Lead , Arsenic andSelenium levelswere found tobe below the permissible limits of World Health Orgamozation. In water sample, the level ofCadmium,Aluminium were found (0.006 mg L^{-1}) and (0.034 mg L^{-1})respectively which were above the permissibles level (0.005 mg L^{-1}) and (0.03 mg L^{-1})as given by Bureau of Indian Standards for drinking water quality.Demographicalanalysisof the heavy metalcontents in ground water showedunsymmetricaldistribution in the area. High concentrations of aluminium and cadmium helps in determining the quality of ground water and additionally this study helps different areas in understanding the potential dangers to their ground water assets. The study area is underconstant threat of agricultural exploitationandthere is also a decline in water table up to30 to 35 cm per year. Patiala lies incentral alluvial zone of the state and falls in thedark category (stage of ground waterdevelopment is more than 85%). The outcomes from the study suggested that the data can be utilized by the government authorities for measuring and improving current conditions.

KEYWORDS: Ground water resources, Heavy metal contamination, Hazard index.

CONTENTS

LISTOFTABLES

LISTOFFIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AAS	Atomic Absorption Spectrometer
HGS	Hydride Generation System
ERC	Earth Resources Communities
WQI	Water Quality Index
WHO	World Health Organization
EC	Electrical Conductivity
TDS	Total Dissolved Solid
DO	Dissolved Oxygen
EUD	European Union of the Deaf

CHAPTER 1
INTRODUCTION

1.1 General:

This chapter consists of brief introduction to the heavy metals and pesticides of ground--water of districtPatiala and heavy metals presents in outer layer of earth.

1.2 Background:

Ground water plays a major role in day to day life of people. We thepeople are responsiblefor destroying the ground water sources which were earlier available to us in abundance. Increasing population, industrial wastes including chemicals are some of the reasons behind the contamination of water sources like submersible, hand pumps etc **[1]**. Furthermore, in all environmental quality assessments, there is uncertainty because of the conflicting nature of the environmental risks associated with each ground water pollutant **[13]**. Many studies have shown that developing country like India largely depends on the ground water sources for fulfilling its water needs. India uses relatively 240 cubic kilometers of ground water per year, over a quarter of the comprehensive total. More than 85% of drinking water supplies and 60% of irrigated agriculture bank upon ground water **[14].** Rocks bearing minerals which is one of the major causes of heavy metal epidemic in ground water these rocks are natural resources; anthropogenic sources include mining, heavy metals also contain fertilizer and extensive use of pesticides in agricultural fields, industrial drainage containing toxic metals, as well as metal chelates from different industries and exposure from service pipes**[16]**. In India Ponds, rivers, and groundwater are major sources of water used for the private and agriculture purposes in India **[6]**. In many developing countries like India, urbanization and mechanization has resulted in many problems, one of which is environmental pollution **[6, 7]**. The major source of environment pollution is improper administration of solid wastes and effluents. Dumping these toxic wastes into local water bodies results in aggregation of toxic and hazardous metals in local groundwater **[8]**. Heavy metal is a general collective term which applies to the group of metals and metalloids with an atomic quantity greater than 4 g/cm^3. Heavy metals in subsurface environments come from instinctive and anthropogenic sources **[9]**. Natural sources include weathering of minerals whereas, anthropogenic sources include fertilizers, industrial effluent, and leakage from service pipes**[14]**. Industrial and agricultural activities are the major contributors of epidemic. Other factors which may playmajor role includes high density of buildings and comprehensive construction of subsurface drainage systems**[19]**. Permissible limits for these heavy metals in drinking water given by Indian standard institution and WHO. Many studies of heavy metal epidemic borrowed from mining activities have been undertaken for rivers and ground water in India **[17]**. In India, herb medicines are popular among rural people as they are freely applicable and hence can be used by anyone. Heavy metals toxicity in bacterium, aquatic environments, plant and animals have been recognized for old time **[24]**. The natural water analysis for the disclosure of heavy metals is very important for public health studies. Literature also depicts about the contamination due to heavy metals andit was found the absorption of heavy metals (Nickel, Cadmium, Aluminium, Lead, Arsenic) in drinking water samples in these Earth Resources Communities. Due to the conflicting health effects of heavy metals (Nickel, Cadmium, Aluminium, Lead, Arsenic), detection of even trace amount of these elements in any environmental samples can contribute to future research for excluding these toxic metals from polluted samples **[13]**.At present, many methods are adopted globally,and these method have proven to be authoritative in Water Quality Association, such as statistical analysis method **[15]** , the water pollution index method, principal component analysis , entropy method **[16]**, grey clustering method and others. In the same manner , the methods above have their own merits and demerits, but these methods are less achievable and challenging to popularize in the regional ground water pollution assessment due to changeable and the complicated environmental problems.Heavy metals in ground water are toxic even in low concentration. Human activities expand the concentration of heavy metal in environment**[29]**. Groundwater can be contaminated naturally and human- caused **[27].** According to World Health Organization , consumption of contaminated water leads to around80% ofthe diseases and deaths in the developing countries. Drinking water with high concentration of heavy metals has the potential of causing critical diseases **[34]**. In the Tribune report published on 7th February 2018, reported that 88 percent of habitations affected by heavy metals in groundwater of India belongs to Punjab state. According to the data compiled by the

Central Ground Water Board, the total number of villages affected by heavy metal pestilence is 2420 in India, out of which 2139 fall in Punjab **[38]**. In ground water, the concentration of fluoride occurs naturally and provide protection against dental caries especially in children. Nitrate concentration above 45 mg/l causing nephrology (blue babies) while High concentration of sulfates cause diarrhea and intestinal disorders **[42]**.Elevated concentrationsof Iron in natural water resources may cause harmful health effects like cancer, diabetes, liver and heart diseases. Occurrence of Arsenic in drinking water is related to skin problems **[47]**. Heavy metals are natural component of earth's crust and in general term applies to the group of metals and metalloid with atomic density greater than 4000 kg/m^3 or 5 times more than water. During the weathering of rocks and sediments followed by subsequent leaching and run-off arsenicgets introduced into soil and aquifer system. Heavy metals are non-biodegradable in nature and form stable complexes and cause undesirable effects **[48]**. The presence of hazardous heavy metals in water usually affects its potability. The temporal aquifers of the state have been announced to have high concentration of As which has been correlated to cancer fatality in many districts of Southwest Punjab **[16]** described Arsenic varying from 3.5 to 688 mg/l. They classified Arsenic status of ground water as low (50 mg/l). From one such study , it was found that geochemical conditions, such as pH, oxidation-reduction or competing ions, and evaporative environments have significant effects on Arsenic concentration in ground water. These values are shows that how much is constrained to the aquifer materials or the solid fragment in water and how much Arsenic is dissolved or accelerate into the water **[22].**

The occupants of society have lost all regard and yielding for Mother Nature and water. The period 2005-2015 annouced as worldwidedecade for activity on "water for life" had demonstrated by United Nations **[2]**. It has not only been used for supplying potable water to both rural and urban areas but also essential for economic, sprinkling, advancement, and protection of environmental and ecological balance **[2, 3]**. Some of the heavy metals which are used as micronutrients become pernicious to human health due to increase in concentration of heavy metal when their concentrations exceeding the permissible or desirable limits of drinking water **[3]**. Solid wastes is main reason for water, epidemic originates from the demolition of solid wastes from different human activities, such as construction, agriculture and industry, and the demolition of domestic things and industrial wastewater is released into rivers through the sewer systems **[3,4].** Quality of drinking water is anessential aspect for humanity. Unfortunately, morethan one billion people all over the world do not get safe drinking water and among,800 million live in rural areas **[5].**

Use of pesticides and other chemical fertilizers are considered to be a foundation tool for the success of agricultural industry in the present planting practices. Pesticides are generated by the expansion of agriculture, which are most dangerous epidemics of our environment. Among various heavy metals present in the environment, high concentrations of arsenic in groundwater in many places is a worldwide well known substantial problem in recent years **[22]**.These heavy metals are notonly harmful and toxic but also have the property to bioaccumulate**[24]**. They can take part in various natural, chemical and biological processes. Many of these pesticides (effects agricultural activities) are characterized by a strong persistence it explains their wide presence in the different area of the environment **[29]**. In this context, these pesticides should be banned by the government and strict regulations for the control of pesticide residues concentration. Permissible concentration for pesticides is 0.1 μgl-^{1} for each single substance (including their adjustability) and 0.5 μgl^{-1} for the sum of pesticides according to the European Union of the Deaf on drinking water quality . Variouspesticides areused in India , out of which around 39% belong toallorganochlorine class ofchemical pesticides **[15]**. Other major category is organophosphate pesticides.Once ground water is contaminated, analyzing the problem and providing alternative water supplies can be quite expensive. Since the discovery in 1979 of aldicarb in Long Island groundwater, for example, more than $3 million has been spent measuring aldicarb concentrations in Long Island wells**[39]**. Carbon filtration units have been installed in more than 2,500 affected households and plans are being made to replace individual wells with expensive community water supply systems. These huge expenses have helped to define and treat the problem, yet have not corrected the underlying groundwater contamination**[41]**.

Keeping of the view from the above discussion, our study was bases on the analysis of ground water samples from Patiala district of Punjab**[25]**. As such very limited studies have been reported for ground water management in Tier-II cities of India. Patiala is one the emerging and top Tier-II city of Northern India. Patiala district along has been declared a potential business hub for agricultural activities which in future will lead to more deterioration of ground water due to influx of population, tourists etc. Hence, if no control measures not provided now, future management may become untenable **[29]**. Results will be submitted to the ground water department as well as municipal corporations so that an effective management and utilization of ground water can be set up for the future**.**

1.3 Sources of Ground water Contamination:

1.3.1Landfill: Landfills are playing an essential part in our day to day life because it helps in collecting and disposing the waste material in condense locations which minimizes the risks associated to public health and safety but on the other hand they are also responsible for the contamination of ground water which is a long term threat to the human life **[29].** This contamination takes place when precipitation and surface runoff occurs the chemicals can leach into the water which leads to the formation leachate.

1.3.2 Improper Disposals of Hazardous Waste: Hazardous waste should always be disposed of properly, that is to say, by a licensed hazardous waste handler or through municipal hazardous waste collection days. Many chemicals should not be disposed of in household septic systems, including oils (e.g., cooking, motor), lawn and garden chemicals, paints and paint thinners, disinfectants, medicines, photographic chemicals, and swimming pool chemicals **[37].**

1.3.3 Natural Sources: Some substances found naturally in rocks or soils, such as iron, manganese, arsenic, chlorides, fluorides, sulfates, or radionuclides, can become dissolved in ground water. Other naturally occurring substances, such as decaying organic matter, can move in ground water as particles **[39]**. Whether any of these substances appears in ground water depends on local conditions. Some substances may pose a health threat if consumed in excessive quantities; others may produce an undesirable odor, taste, or color. Ground water that contains unacceptable concentrations of these substances is not used for drinking water or other domestic water uses unless it is treated to remove these contaminants **[38].**

1.4 Impacts of Contaminated ground water:

Diseases such as hepatitis and dysentery may be caused by contaminated water. Poisoning caused by toxins that have leached into well water supplies, defiled groundwater also effect wildlife. Long term effects such as certain types of cancer may also result from exposure to polluted water **[40]**. The consequences of contaminated ground water or degraded surface water are often serious. For example, estuaries that have been impacted by high nitrogen concentration from ground water sources have lost critical shellfish habitats. In terms of water supply, in some instances, ground water contamination is so severe that the water supply must be abandoned as a source of drinking water. In other cases, the ground water can be cleaned up and used again, if the contamination is not too severe and if the municipality is willing to spend a good deal of money. Follow-up water quality monitoring is often required for many years **[39]**. Because ground water generally moves slowly, contamination often remains undetected for long periods of time. This makes cleanup of a contaminated water supply difficult, if not impossible.

1.5 Groundwater Scenario of Patiala:

1.5.1 Hydrogeology:

Patiala district is occupied by Indo-Gangetic plain of Quadripartite age, andcome down inGhaggar river basin. The groundwater present with fine to rough sand,which formstheprospective artesian basin. In the shallow water level (up to 50m)ground wateroccursunder unconfined/water table conditions, where as in deeper aquifer,semi-confined/confined conditions exist **[18]**.

1.2.2 Water level behavior:

During pre monsoon period the depth to water level ranges from 4.52 to 21.62 m below ground level and 7.10 to 25.28 meter below ground level during post monsoon period. The seasonal movement varies from 0.04 to 3.66 m in the area due to rainfall. Norm rainfall is 0.60 m/year **[57]**.

1.2.3 Ground water flow:

In Patiala district the elevation of the water table varies from 230 m to 300 m abovemean sea level. The highest upgrading is in the north eastern part and the lowest inthe south westbound part. The hydraulic bank, in the south western part, it is gentlewhereas in the northern eastern part is precipitous. Ground water overall flow is fromnortheast to south-west direction **[57]**.

1.5 Need for the Study:

- Our study depends on the assessment of ground water from Patiala district of Punjab. It is observed that very limited studies have been done for ground water management in Tier –II cities of India.
- Patiala is one the emerging and top Tier-II city of Northern India. Patiala district along has been declared a potential business hub for agricultural activities which in future will lead to more deterioration of ground water due to influx of population, tourists etc. Hence, if no control measures not provided now, future management may become untenable.
- Study assesses the present ground water management strategies and helps identifying factors responsible for inefficient ground water management in the city and to suggest suitable remedial measures.
- Results will be submitted to the ground water department as well as municipal corporations so that an effective management and utilization of ground water can be set up for the future.

CHAPTER 2

LITERATURE REVIEW

2.1 General:

This chapter discusses the reviews related to literature both in terms of theoretical and experimental research on heavy metals and pesticides present in groundwater.

2.2 Review of Literature:

The Literature review helps to understanding about effects of heavy metals and pesticides.

2.2.1 International Level Study:

In Baotou, China from study it is evaluated that there are healtheffects caused due to the presence of heavy metals in ground water **[1]**.Even in U.S. to determine the non carcinogenic and carcinogenic effects on residents or people of that region who used ground water for drinking, a health risk assessment model derived from the U.S. Environmental Protection Agency was used **[3]**. In some of region, drinking water sources were evaluated for heavy metals and pesticide pollution. Study was conducted to assess quality of drinking water which is contaminated due to presence of Arsenic and other heavy metals and its impact on health of people present in that area from Mailsi (Punjab), Pakistan **[6]**. Concentrations of Arsenic, 11 to 828 μg/l that interweave limit of WHO permissible limit. Concentration of $SO4^{2-}$ fluctuating from 247 to 1053 mg/l were observed. In Sargana site health risk index was higher, which employed in term Hazard Quotient, and Carcinogenic Risk of arsenic. From results the local differences in amount and frequency of pesticides applied, pesticide pollution was found everywhere **[5]**. Study was carried out to check the groundwater for irrigation purpose. From the results showed that Sodium and Calcium are predominant cations while Chlorine and Sulphate are main anions. Study was conducted to evaluate the pesticide contamination of groundwater in four major area of cotton growing area, Pakistan **[8]**. Four pesticides which were detected in the ground water i.e. bifenthrin, carbofuran, endosulfan and monocrotophos did not exceed the drinking water criteria which is established by United States Para-Equestrian Association **[51]**. Study was carried out to validate and predict heavy metals contamination in seven separate sub-catchments of the Lourens river, South Africa, through with help of geographic information system run off model **[8]**. A Study carried out in Philippines to measure heavy metals and pesticides contamination of GW under rice cropping system. Nitrate concentrations of groundwater varied from 0 to < 2 mg/l and from samples only one sample was above the permissible limit which is set by WHO for drinking water (10 mg/l) **[10]**. Due to large volatilization losses and fast chemical and microbial degradation under anaerobic conditions in the tropics, extract of nitrate and pesticide into shallow ground water under rice may be low. Hydro chemical processes and groundwater hydrodynamics in a multilayer water level system. The chemical and isotopic signatures indicated there are differences in hydrogeological peculiarity of water level. Hydro chemical results establish that ground water mineralization is controlled by natural and anthropogenic processes. Natural processes including water-rock cooperation i.e. dissolution of evaporated; pyrite oxidation and at variance dissolution of dolomite **[7]**. Another assessment of groundwater was done in an industrial city of Sialkot in Pakistan. Contamination of groundwater due to heavy metals have received great amount of attention even at global level due to toxicological collaboration in ecosystems and its impact on public health **[54]**. In this study 25 samples were taken from different places from the city of industries of Sialkot ,Pakistan to determine the ground water quality **[19]**.There were 22 physio-chemical parameters including potiential of hydrogen , EC, TDS,Heavy metal test , etc. And the results of these tests were compared with standard guidelines of WHO and Pakistan Standard Quality Control Authority for ground water quality **[25]** .The results revealed that the ground water of the Sialkot area is highly turbid with very high level of Zinc, Iron and Lead,which were above WHO and Pakistan Standard Quality Control Authority permissible limits **[13]**.Study on assessment of ground water quality in a typical rural settlement in southwest Nigeria. Different physical and chemical parameters were determined upto 200 m from the source of pollution **[16]**.In most cases Lead and Cadmium exceeded the permissible limit of WHO. Different water samples were taken out of which the quality of well water samples were not found suitable for human consumption without some treatment **[17]**.Study on the assessment of ground water quality near a municipal landfilling. Different physical and chemical parameters were determined. These parameters indicated traceable pollution.But these were below WHO limits. The pH ranged from 5.8 to 6.7 which indicated toxic pollution, turbidity values were between 1.6 to 6.5 NTU and temperature ranged from 26.5 to 27.5C .For heavy metals Zinc ranged between 0.3mg/L and Lead ranged from 1.1 to 1.3mg/L is given by WHO **[14]**.

2.2.2 National Level Study:

Studied was carried out on, "Assessment of Water Quality Index for the ground water in Tumkur, Karnataka State (India)". In this study they were calculate WQI for 12 parameters and band WQI for those 259 samples ranges from 89.21 to 661.56 k/sn **[20]**. Quality of many water were poor; the analysis shows that ground water of that area need treatment before using water of area **[53]**. It is considered that level of Arsenic was high by which epidemic and assessed health related problem and other elements in drinking water, vegetables and other food components in two blocks from Samastipur district, Bihar, India **[34]**. Groundwater (79%) samples exceeded WHO limits (10 μg/l) of Arsenic while Manganese also exceeded the previous WHO limit of 400 μg/l in 30% samples. Health Risk Index were > 1 for Arsenic in drinking water, rice and vegetables, for Manganese in drinking water, rice and wheat, vegetables, for Lead in rice and wheat indicated the health risk to local population or society **[55].** Pollution assessment indices and chemometric techniques were applied to determine the intensity and source of pollution in the Sirsa River, Himachal Pradesh, India. From results it shows that EC, Cromium, Iron, Manganese, and Nickel were above the permissible limit set by the Bureau of Indian Standards **[40]**. Principal component analysis at the same time cluster analysis was used to identify the main factors responsible for being deraded of water quality, namely discharge of industrial liquid waste, river bed mining, agricultural runoff, and minor natural or input. A study was carried out on evaluation of seasonal variation in groundwater suitability and its quality for irrigation purpose in selected blocks of Rupnagar District, Punjab, India **[56]**. Analytical results show that in different samples proportion of salt was above the desirable limit which prescribed by Bureau of Indian Standard. In the study area depth to water level ranges from 5 to

40 meter below ground level, whereas, Chamkaur Sahib and Morinda Blocks fall in the over-utilization category with groundwater development being more than 100%**[50]** .Assessment of ground water quality was carried out using WQI Thirumanimuttar sub-basin, Tamil Nadu, India **[28].** Pre-monsoon samples displayed poor quality in greaterpercentage when it compared with post-monsoon due to competent leaching of ions,over ill treatment of ground water, direct discharge of drainage and agricultural impact. Astudy carried out on, 'Analysis of Ground Water Quality parameters.' For calculatingcondtion of water quality of Indore, they were used WQI and statistical evaluation.Twenty seven parameters were considered like potential of hydrogen, Color, chloridecontent, TDS, EC, Total Hardness, Calcium, Total Alkalinity, Acidity etc and resultswhich are obtained compared with IS: 10500-2012. They suggest that the audits ofwater quality should be seasonally done **[35]**. Studied on, 'Ground water quality and itssuitability for drinking and irrigational use in the Southern Tiruchirapalli district, TamilNadu, India.In this study there was 20 ground water samples were taken from dug andbore wells. The following parameters were analyzed: pH, EC, TDS, Calcium,Magnesium, Sodium, Potassium, Bicarbonate, Carbonate, Sulphate, Chloride, Nitrate, andFluoride **[39]**. Chemical analysis indicates that the ground water was slightly alkaline andsome samples were suitable and some of them unsuitable for drinking. According totheirstudy they found that by evaporation dominance and rock water interactiondominance, the water quality of study area has been alternated. Studied on, "Physicochemical analysis of drinking water samples of contrasting places in Kadegaon Tahsil,Maharashtra (India)" Two different scenarios were compared in this study like bore wellwater and well water **[42]**. Assessment of ground water quality was also carried out inBhalswa landfill site in Delhi. It was carried out by using a hydrochemical approach**[47]** . Results were compared to the standard values which indicated that nitrate,fluoride and heavy metal pollution are in an alarming state as it is unsafe to useground water for drinking purposes.Study on assessment of ground water quality and health problems associated with Ranchi city, Jharkhand was done . In this studysampling was done and about 44 samples were taken from different places in monsoonseason.The area was divided into rural , semiurban, urban and commercial zones.Physical and Chemical parameter were calculated and heavy metal testing was alsodone.It was concluded that only 9% out of the 44 sampling locations have good

waterquality**[34]** . It was determined that due to the presence of arsenic and selenium as hevy metals noncarcinogenic effect is one of the health risks in that area.

2.3 Summary of Literature Review:

From Study was conducted to assess quality of drinking water which is contaminateddue to presence of Arsenic and other heavy metals and its impact on health of peoplepresent in that area from Mailsi (Punjab), Pakistan. Concentrations of Arsenic, 11 to 828µg/ l that crossed limit of WHO permissible limit. Concentration of SO_4^{2-} ranging from247 to 1053 mg/l were observed. Pollution assessment indices and chemometrictechniques were applied to determine the intensity and source of pollution in the SirsaRiver, Himachal Pradesh, India. From results it shows that EC, Cromium, Iron,Manganese, and Nickel were above the permissible limit set by the Bureau of IndianStandards . Principal component analysis at the same time cluster analysis was used toidentify the main factors responsible for being deraded of water quality, namelydischarge of industrial liquid waste, river bed mining, agricultural runoff, and minornatural or input. A study was carried out on evaluation of seasonal variation in ground water suitability and its quality for irrigation purpose in selected blocks of RupnagarDistrict, Punjab, India.

2.3 Objectives of the Study:

- To assess the ground water pollution levels in ground water samples in parts of Patiala district .
- To estimate the heavy metal pollution in ground water samples in parts of Patiala district.
- To assess the pesticide pollution in ground water samples in parts of Patiala district.
- To suggest suitable management practices to control further degradation of study area.

2.5 CURRENT PRACTICES:

2.5.1 Manage chemical waste:

Harmful chemicals are everywhere.Unfortunately, they ultimately end up in water bodies or seep into the ground and mix with the ground water **[35]**.The story is same when it comes to effluents dicharged by industries.

2.5.2 Manage household waste:

Be smart while disposing of your household waste. When it comes to biodegradable waste, instead of disposing of it (which could end up contaminating a ground water source), turn into manure and you can use to grow plants **[19]**.

2.5.3 Avoid or reduce pesticide usage:

Everyone knows how toxic pesticides are, and nothing good can come out of pesticidesmixing with ground water.When using any pesticide product, follow label directions to minimize its environmental impact.Mixing areas should be over an impervious surface to prevent a spill from soaking into unprotected soil.Measure concentrated pesticides carefullly **[20]**.

CHAPTER 3

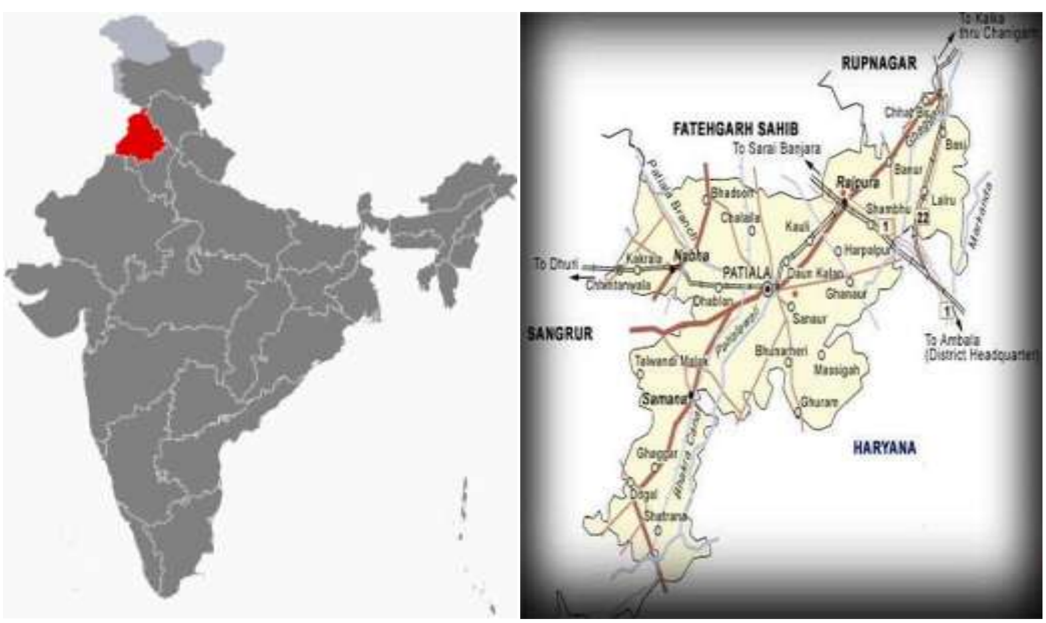
MATERIALS AND METHOD

3.1 General:

This topic describes the heavy metals and pesticides in parts of Patiala city including thestudy of sources ofground water and pesticides.

3.2 Description of Study Area-Patiala:

The district Patiala is lay at south-eastern wedge of the land. District Patiala liesbetween 29°49' and 30°47' north parallel, 75°58' and 76°54' east angular distance. Thearea of Patiala district consists of Indo -Gangetic tidal plain and three types of zone,namely the tableland plain, the manifested FoothillPlain and the delta plain of theGhaggar River **[27]**. In Patiala district, there are five tehsils, eight blocks, one thousand eighty four villages in the district **[28]**. In Patiala, rural areas mostly uses the tube well or bore well forfulfilling drinking andother needs.The study area is determined by the rainyseason occurring during the South West Monsoon (July to September).



(a) (b)

Figure 3.2.1 (a) Location of Punjab in India (b) Location of Patiala city

Population of agricultural area of Patiala district essentially uses bore well as the originof water for drinking and sprinkling purposes. Apart from this, the Patiala district has aconvolute drainage system consisting of canals and rivers. Ghaggar river is the mostimportant channel of the district **[37]**. It is a seasonal stream, so it is dry during most part ofthe year **[37]**. However, during the rainy session, it oftenleads to floodingof the nearbyvillages, causing destruction to crops and at times to houses and human lives. Anumber of supporting stream join the Ghaggar River, the most important ones being thePatiala-Wali-Nadi [**29]**.

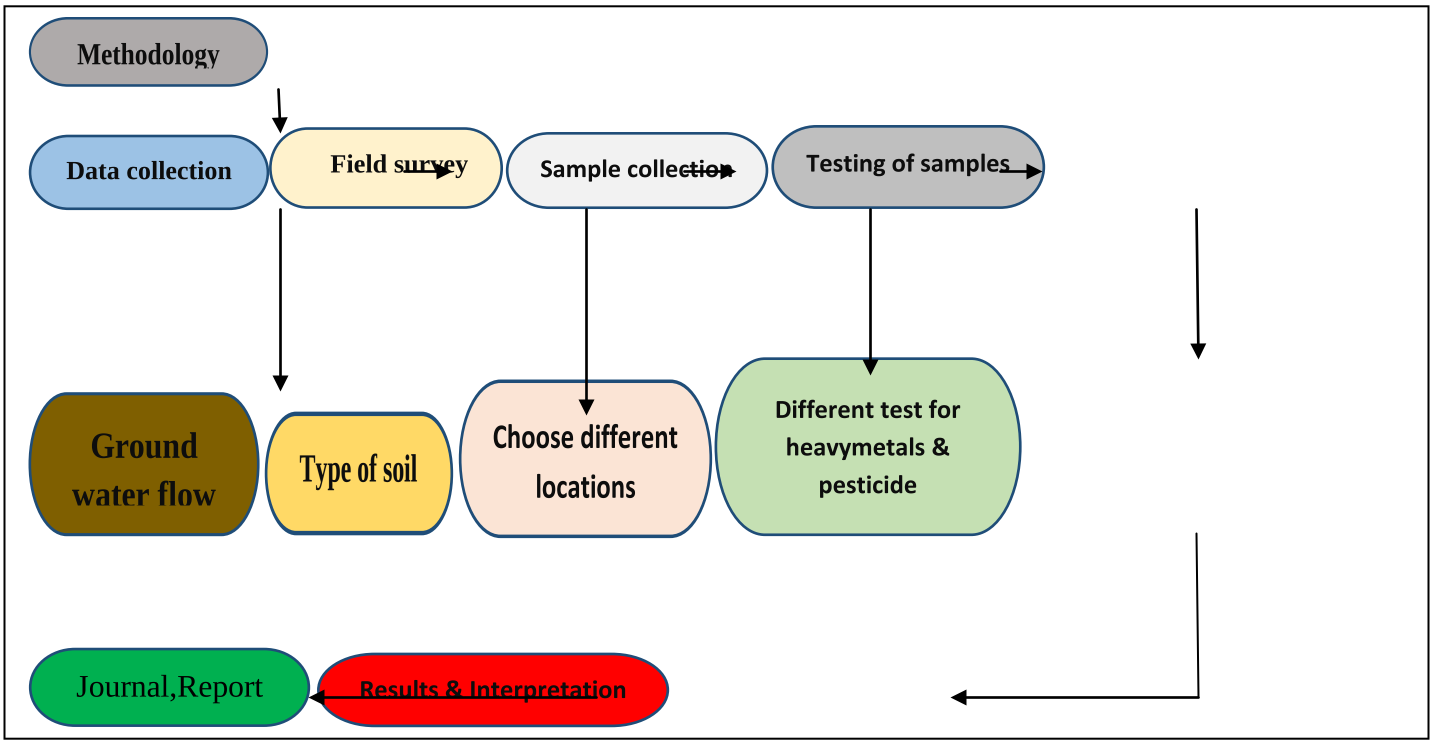


Figure 3.2.2 Step wise flow chart of methodology

3.3 Field Investigation and Sample Collection:

Field survey was carried out to collect preliminary baseline data pertaining to water resources. Basic information regarding sources of water pollution, hand pumps and relevant data were also possessed from different government and non government organizations.

The ground water samples (tube wells) were collected from various sites within region ofPatiala. The source of samples were driven at least 3-4 minutes preceding to sample collection inorder to get fresh ground water. The drinking water sample was assembled in pre-washedglass jar / bottle. The bottle was stored at 4°Ctill the analysis is completed.

(a) **(b)**

FIGURE 3.3.1 (a) and (b) collection of ground water samples

(a) Patiala

(b) Nabha

(c) Rajpura

FIGURE 3.3.2 (a), (b), (c) Groundwater Samples location

CHAPTER 4

RESULTS AND DISSCUSSION

4.1 General: This chapter includes results of groundwater samples of post monsoon and pre monsoon. Results are shown below in form of graph and table.

4.2 Results of Parameters:

Under mentioned parameters are analyzed: pH, Total Dissolved Solids,Electronic Conductivity, Turbidity, Total Alkalinity, Chloride Content etc.

- **pH**: The pH value is the –ve log of hydrogen ion concentration. The hydrogen ion absorption usually ranges from zero to fourteen. pH value is measured by pH meter. The limit of pH value for drinking water is 6.5 to 8.5 **[38]**.

Figure 4.2.1 pH meter

In this table, it consists values of pH (Patiala) which are between 6.5 – 8.5 .It means samples are suitable for drinking purpose.Values of pH (Nabha) region and no value is above the permissible limits.Values of pH (Rajpura), which is less than permissible limits .Water with acidic pH can indirectly affect your health.

Table 4.2.1 Values of pH (Patiala, Nabha, Rajpura)

	Patiala		**Nabha**		**Rajpura**		**Permissible Limits**
pH	**Sampling 1**	**Sampling 2**	**Sampling 1**	**Sampling 2**	**Sampling 1**	**Sampling 2**	
Site 1	8.2	8.0	7.6	7.9	7.7	7.9	6.5 – 8.5
Site2	7.7	7.8	7.2	7.5	6.9	7.4	6.5 – 8.5
Site 3	7.1	8.2	6.8	7.2	7.9	8.0	6.5 – 8.5
Site 4	8.1	8.5	8.1	7.8	8.1	7.9	6.5 – 8.5
Site 5	8.0	7.9	7.0	7.1	7.8	8.1	6.5 – 8.5

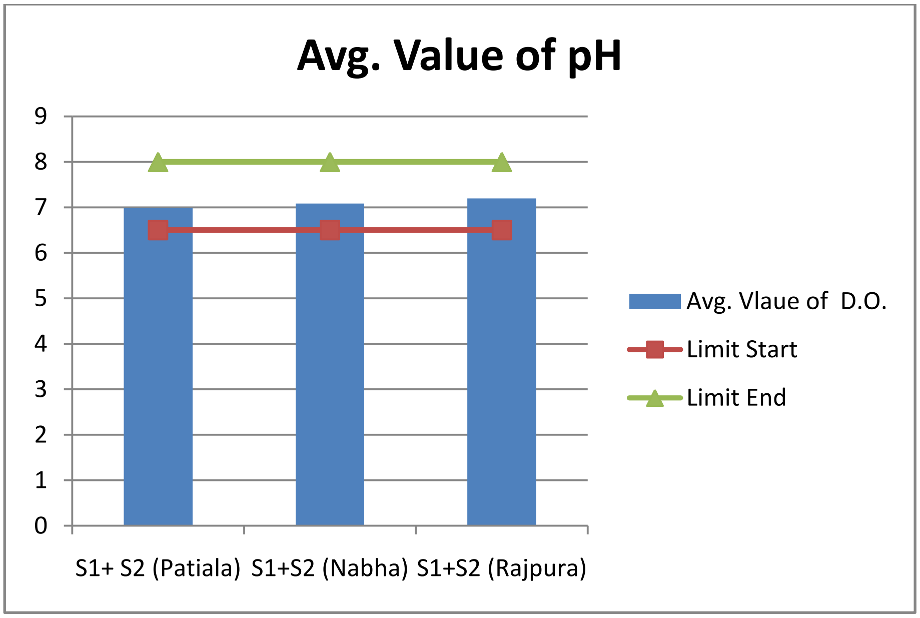
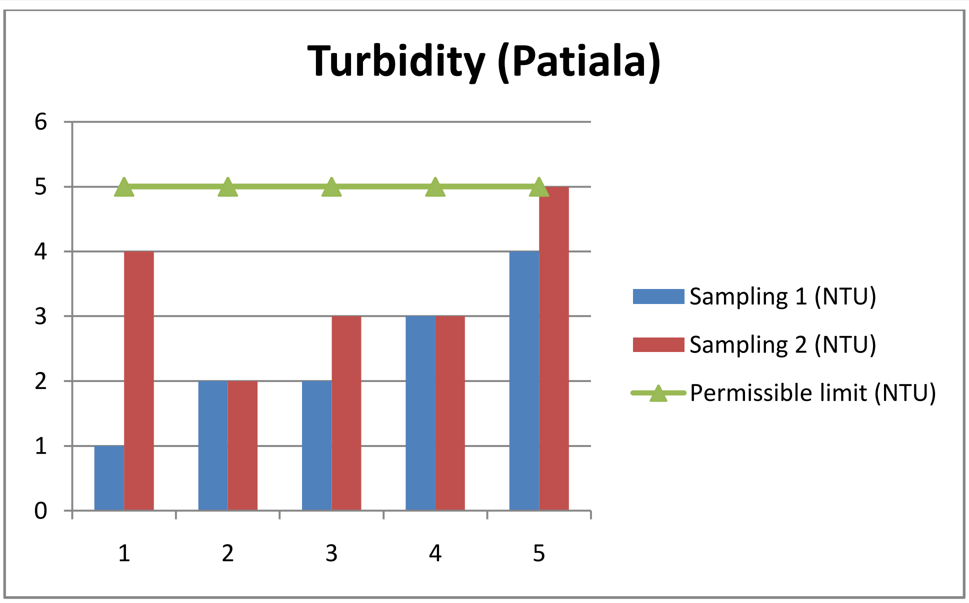


Figure 4.2.2 Avg. Value of pH

- **Turbidity:** Particles which are suspended in water interfering with route of light is known as turbidity. Turbidity is due to the presence of different types of suspended particles. 1 NTU and permissible limit is 5 NTU is acceptable limits **[26]**.



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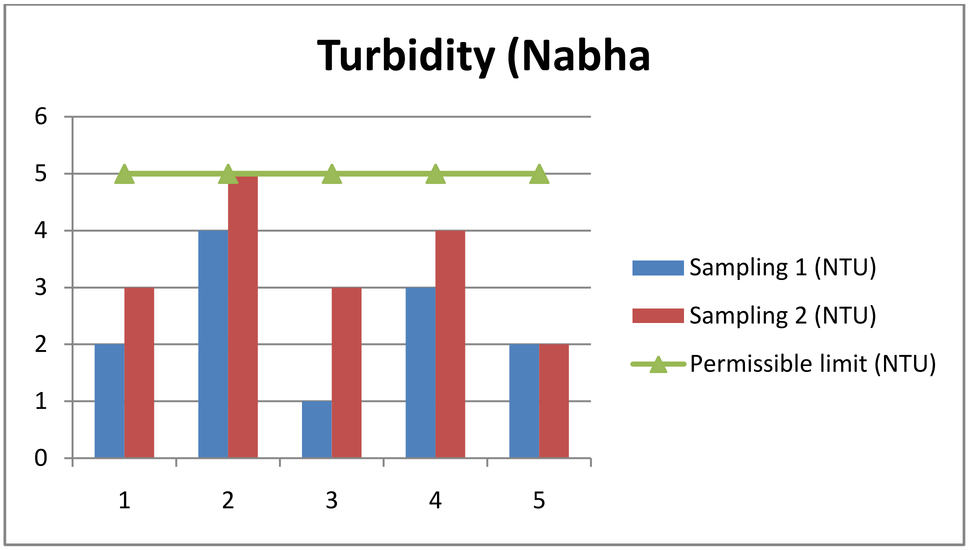

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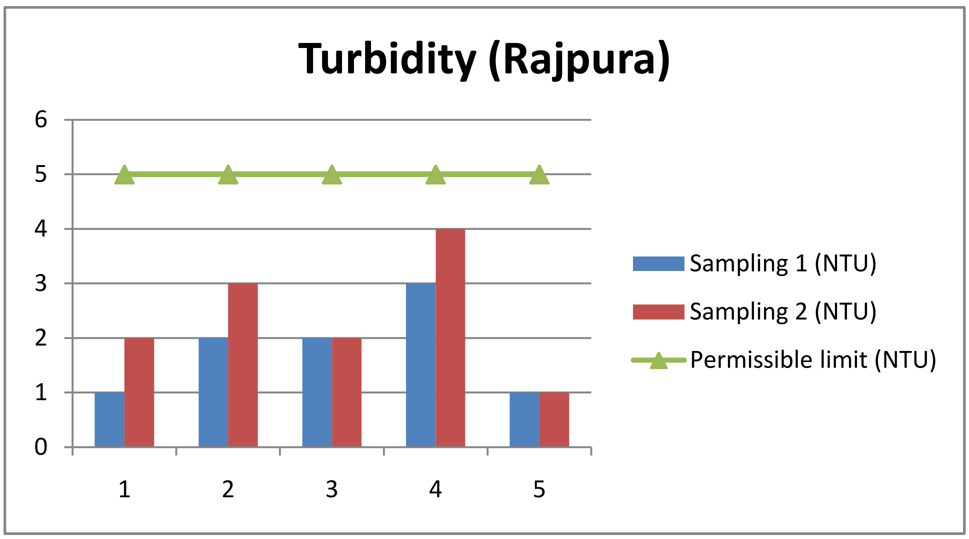
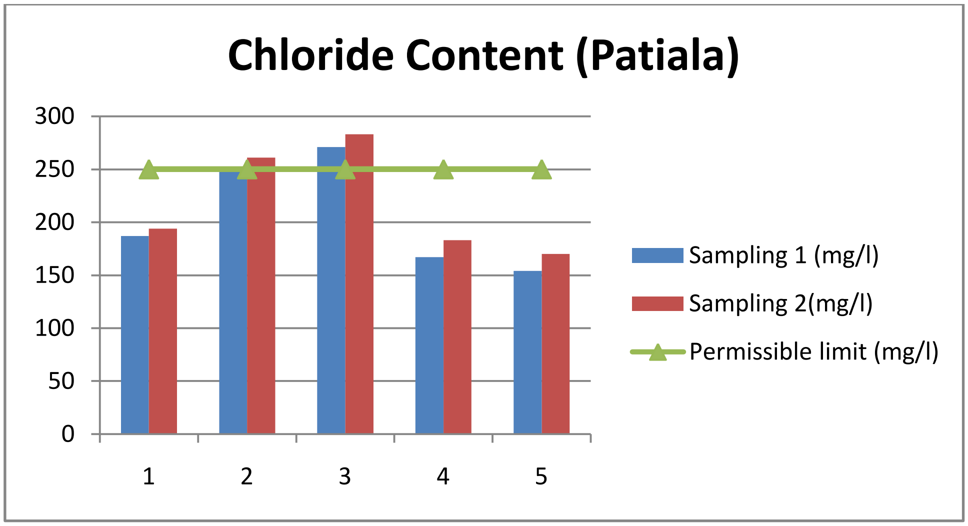


(c)

Figure 4.2.3 Values of Turbidity (a) Patiala, (b) Nabha, (c) Rajpura

- **Chloride Content:** Chloride constitutes approximately 0.05% of earth's crust. Chloride concentration permissible or desirable limit is 250 mg/l. Chloride ions come into solution in water in underground aquifers, contain ground water **[41]**.



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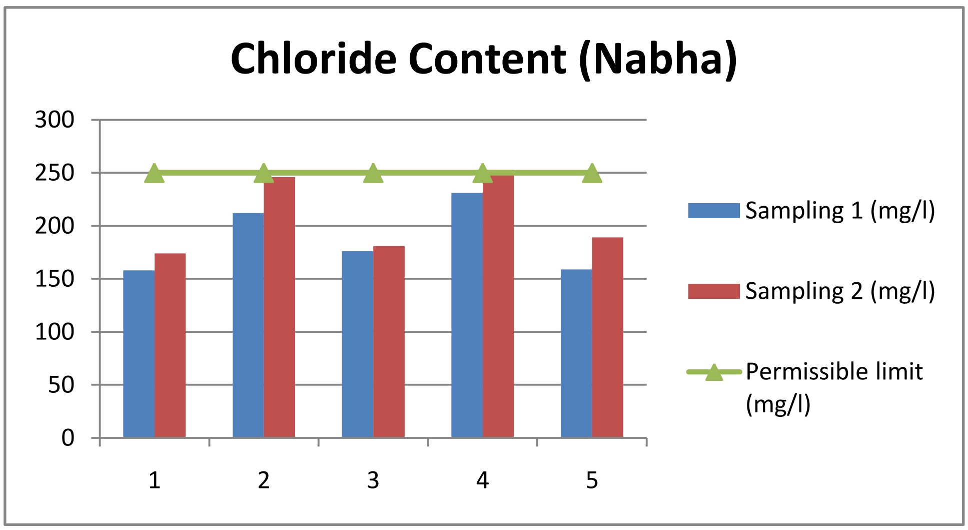

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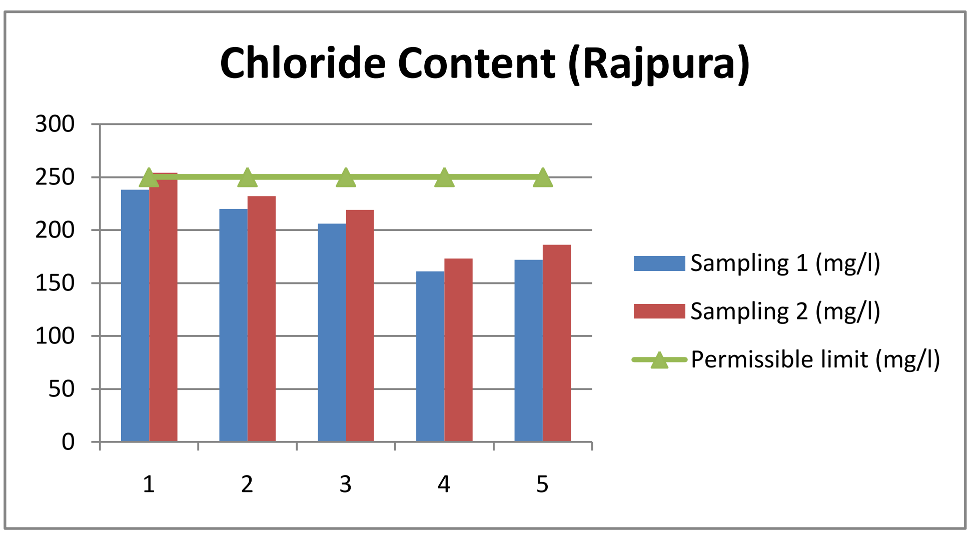
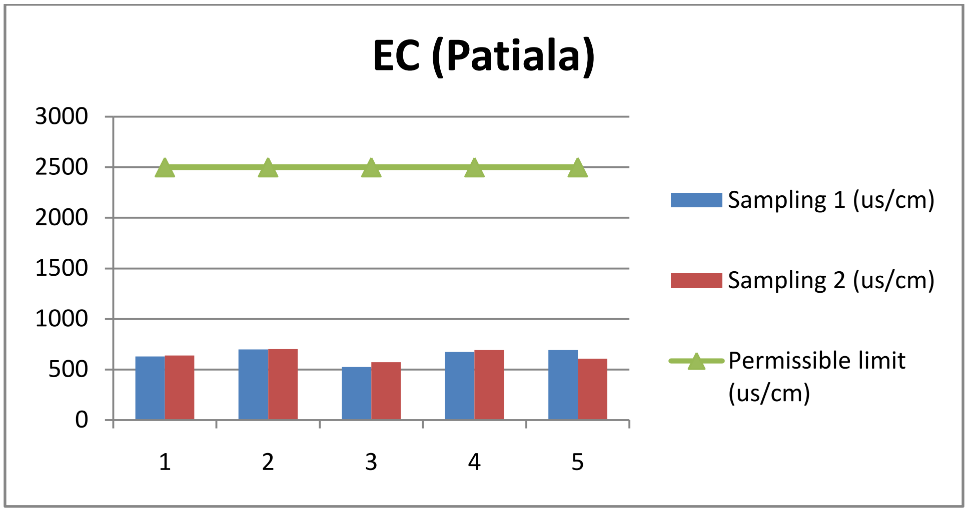


Figure 4.2.4 Values of Chloride Content (a) Patiala, (b) Nabha, (c) Rajpura

Figure 4.2.5 End point of chloride content

- **EC:** EC is a numerical value. It iscapability of an aqueous solution to take away the current. EC is measured by an instrument called electrical conductivity meter. The instrument is standardized with the help of std. Potassium Chloride solution . Salination is an indication of the concentration of dissolved salts in surface water. The level of salinity in surface water is essential to aquatic plants and animals as species can survive only within certain salinity ranges [**39]**. Salinity is measured by comparing the dissolved solids in a water sample with a standardized solution. Evaporation of water from the lake and ponds then leads to the concentration of salt within the system. In dry periods, will lead to increasing the salinity and conductivity value **[40]** .

Figure 4.2.6EC instrument



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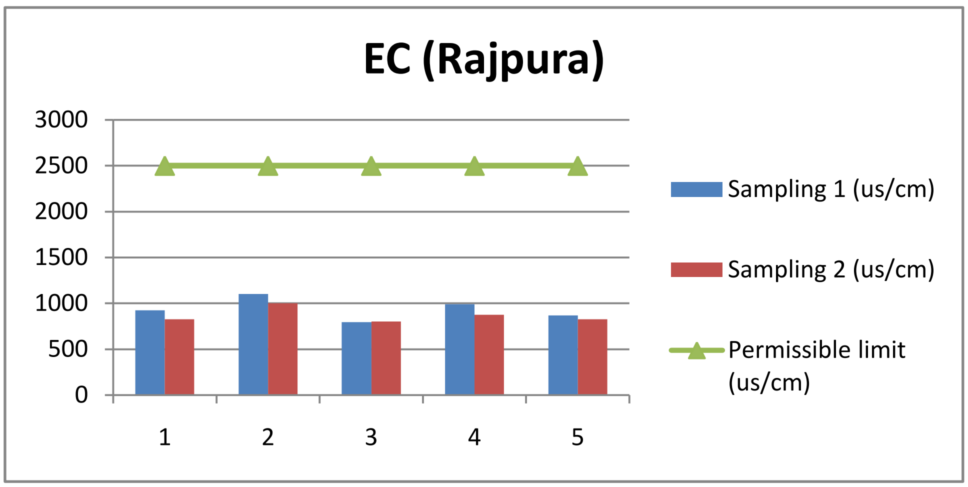

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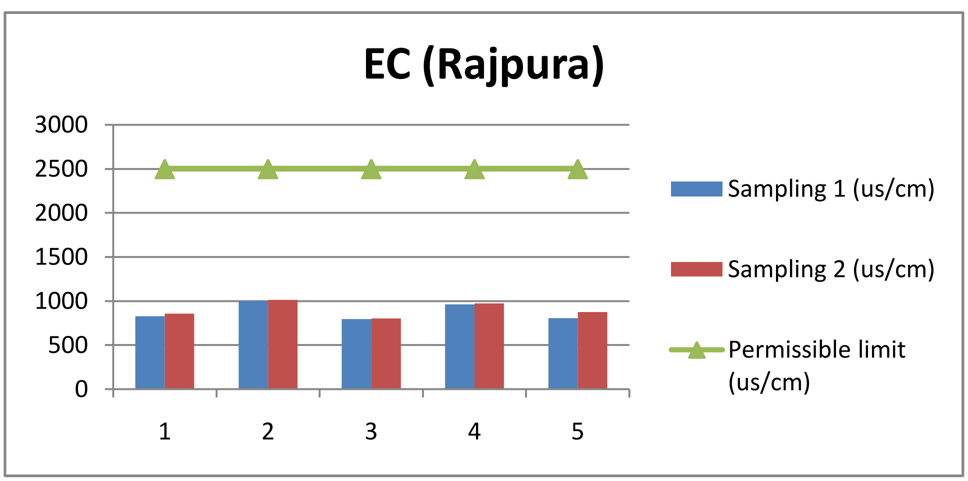

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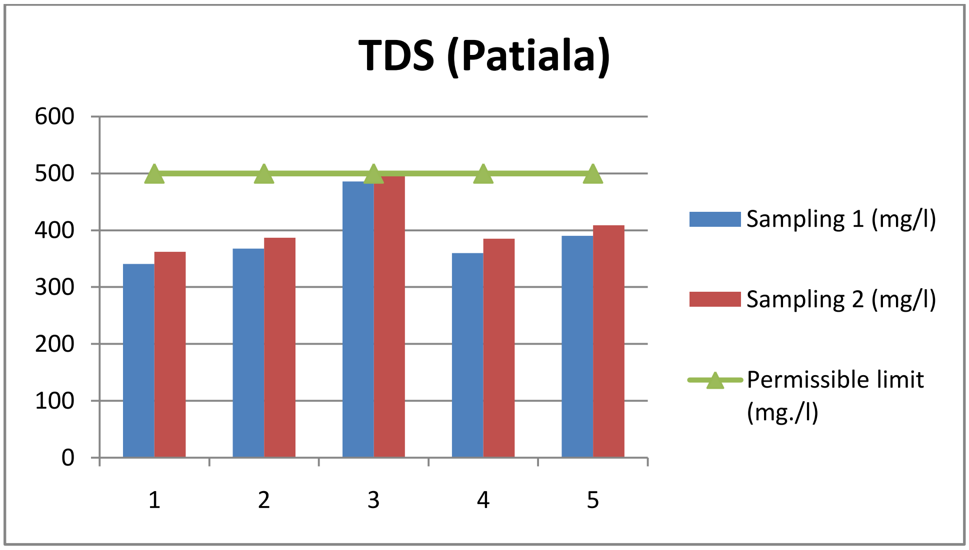
Figure 4.2.7 Values of EC (a) Patiala, (b) Nabha, (c) Rajpura

- **Total Dissolved Solid:** A different kind of minerals which is present in water is denoted by TDS. TDS is directly associated with the purity of water and also the quality of water **[20]**. And we can say the sum of the cations and anions concentration is equal to TDS. Acceptable limit is 500 mg/l and permissible limit is 2000 mg/l as per IS :10500-2012.



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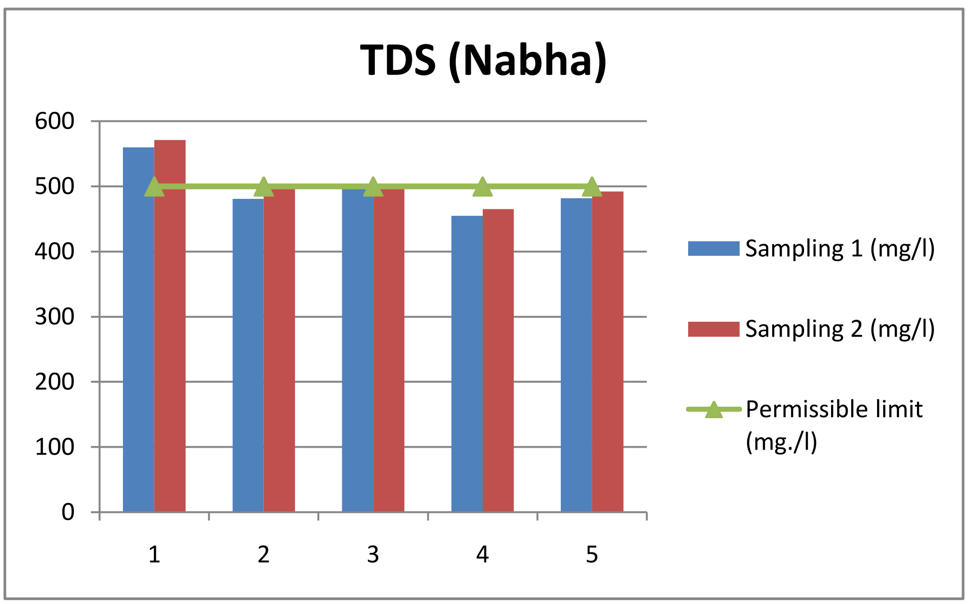

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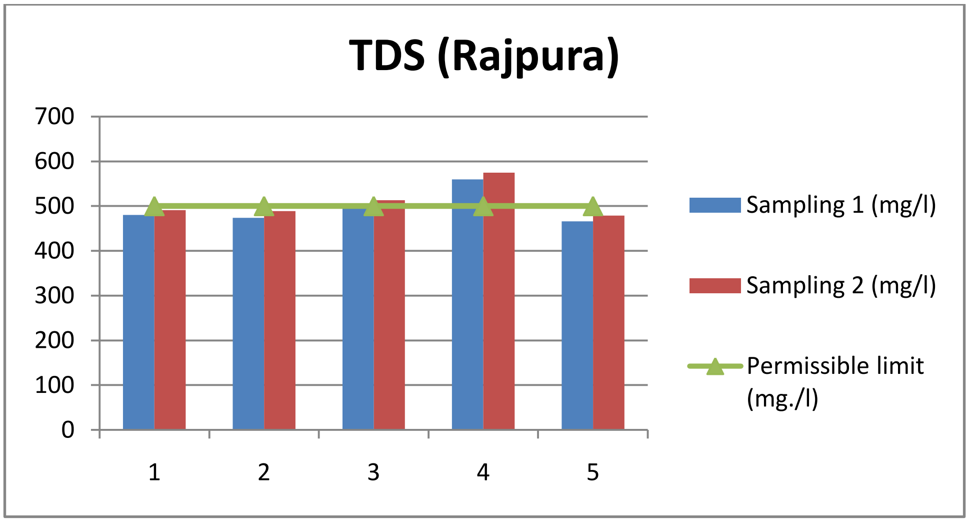

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Figure 4.2.8 Values of TDS (a) Patiala, (b) Nabha, (c) Rajpura

- \ **Total Alkalinity:** Alkalinity could be a chemical activity of water's ability to neutralize acid. Hydroxide, carbonate and bicarbonate are major elements caused the large part of the alkalinity in water. In potable water 120 mg/l is the acceptable limit of alkalinity **[27]**.

Figure 4.2.9 End point of alkalinity

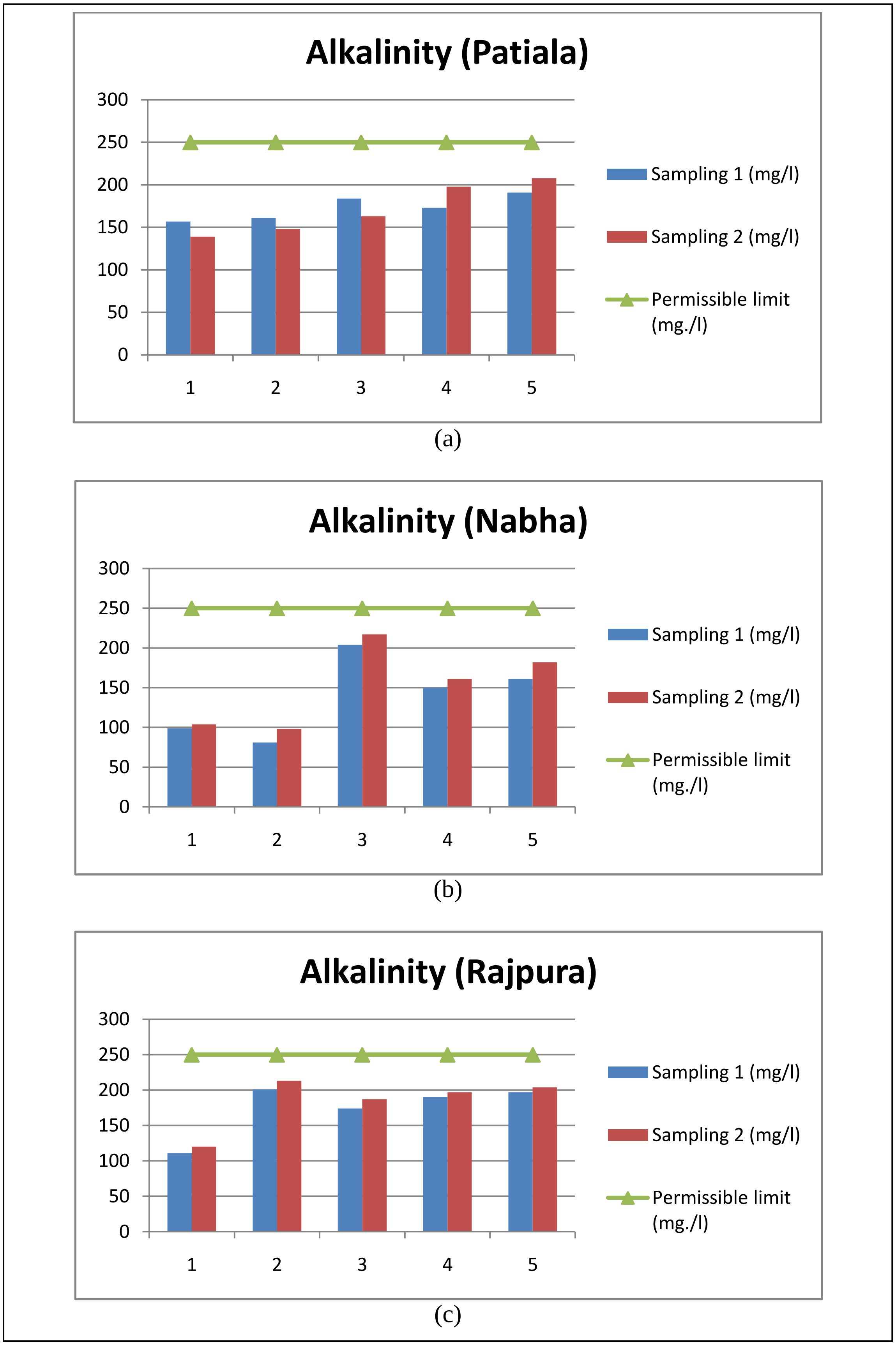


Figure 4.2.10 Values of alkalinity (a) Patiala, (b) Nabha, (c) Rajpura

The table 4.2.2 consists values of D.O. (Patiala) and these values within permissible limits . Adequately D.O. is necessary for good water quality. If value of D.O. drops below 5.0 mg/l aquatic life is put under stress.

Table 4.2.2 Values of D.O. (Patiala, Nabha, Rajpura)

	Patiala		**Nabha**		**Rajpura**		**Permissible Limits**
D.O.	**Sampling 1**	**Sampling 2**	**Sampling 1**	**Sampling 2**	**Sampling 1**	**Sampling 2**	
Site 1	7.60	7.72	6.90	7.01	7.78	7.34	6.5 – 8
Site2	6.86	6.79	7.34	7.19	7.54	7.51	6.5 – 8
Site 3	6.92	6.89	7.77	7.78	6.92	6.86	6.5 – 8
Site 4	6.56	6.60	6.87	6.92	6.77	6.72	6.5 – 8
Site 5	6.93	6.99	6.50	6.54	7.37	7.28	6.5 – 8

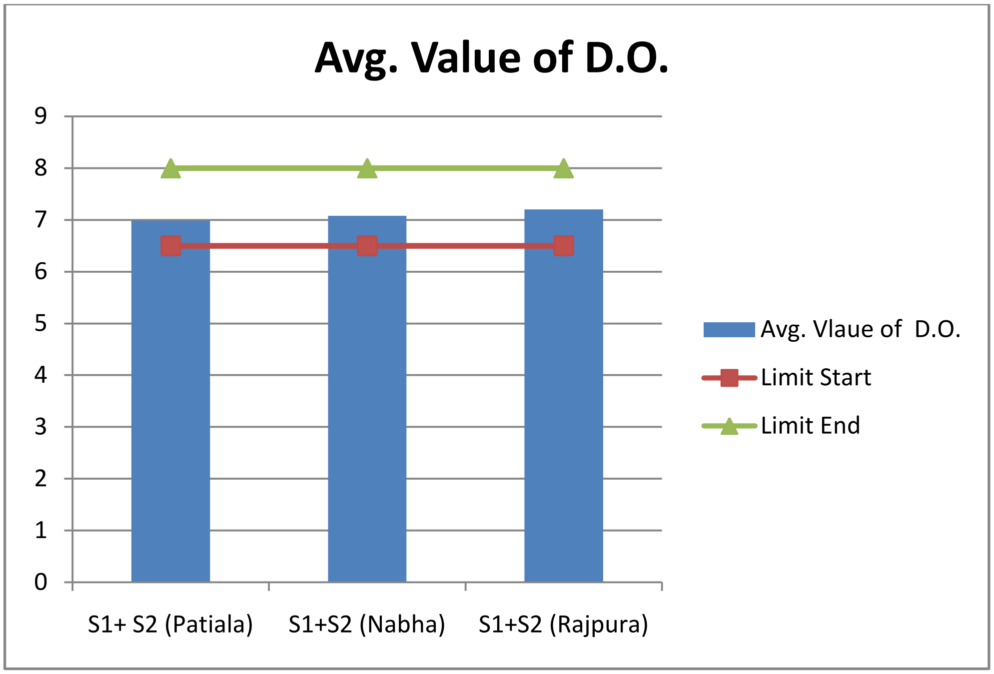
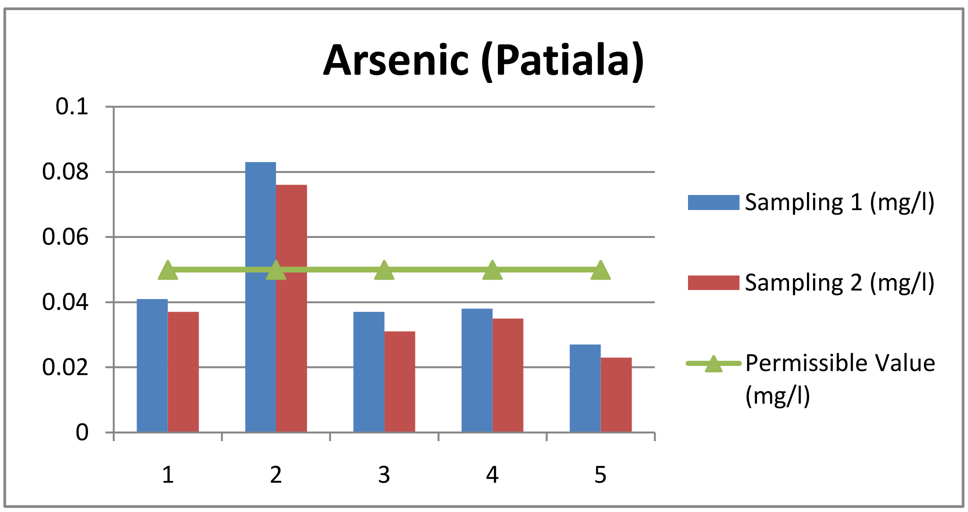


Figure 4.2.11 Avg. Value of D.O.

Figure 4.2.12 D.O. instrument

4.3 Results of Heavy Metals and Pesticides:

Arsenic: Permissible and desirable level as defined by Bureau of Indian Standard (2012)for maximum cocentration of arsenic in safe drinking water is 0.01 mg/l and 0.05 mg/l. In the study area, arsenic concentration in ground water ranged from 0.001 to 0.087 mg/l. One ground water sample having maximum value (0.087 mg/l) was observed from Nabha. Considering the geology of the area, it is possible that arsenic in the ground water owes its origin to the sediments brought down from the Himalayas by the floods in river Sutlej. So another the reasonfor the presence of arsenic in the aquifers could be the use of arsenical pesticides by the farmers. Figure 4.3.1shows the distribution of arsenic in groundwater.



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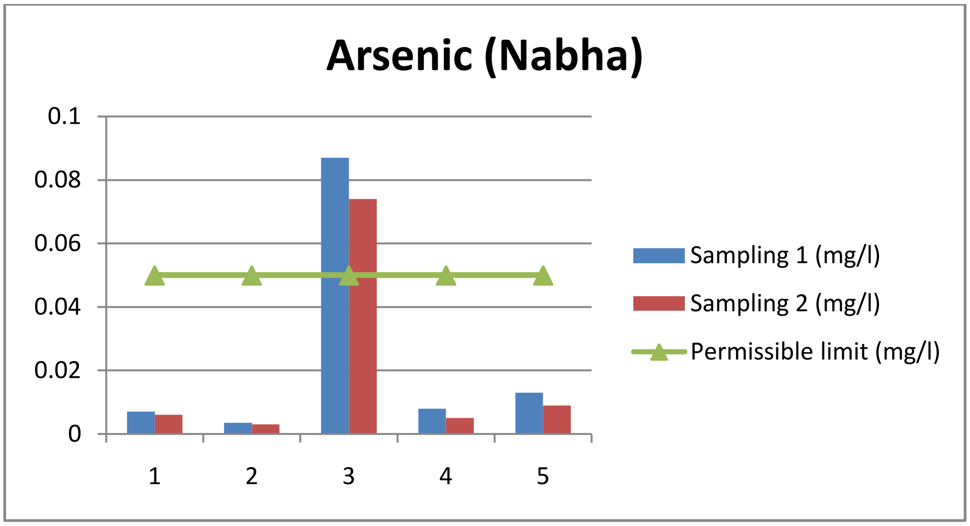

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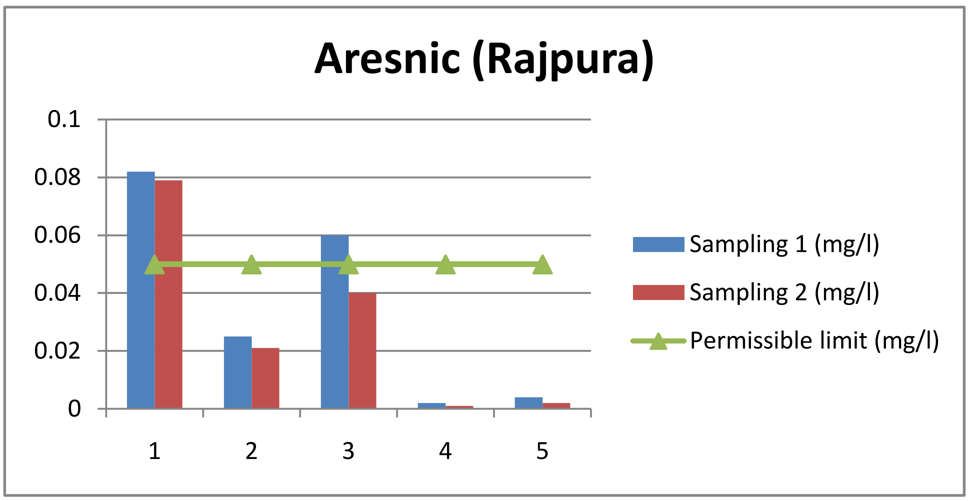

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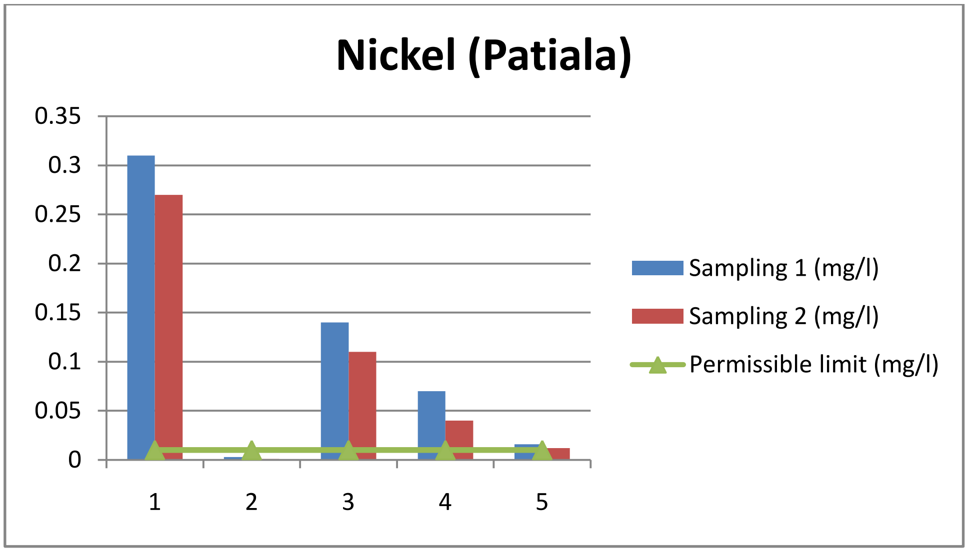
Figure 4.3.1 Arsenic in ground water (a) Patiala, (b) Nabha, (c) Rajpura

Nickel: Nickel content in ground water ranged between 0.01 to 0.359 mg/l with an average value of 0.170 mg/l. The prescribed limit of nickel in drinking water as per Bureau of Indian Standard (2012) is 0.01 mg/l. Maximum concentration of nickel (0.359 mg/l) was obtained. Out of the total 15 samples analyzed, six samples crossed the standard limit of 0.01 mg/l which may be due to weathering of nickel bearing minerals, leaching of untreated industrial effluent and domestic sewage. Figure 4.3.2 shows the distribution of nickel in ground water.



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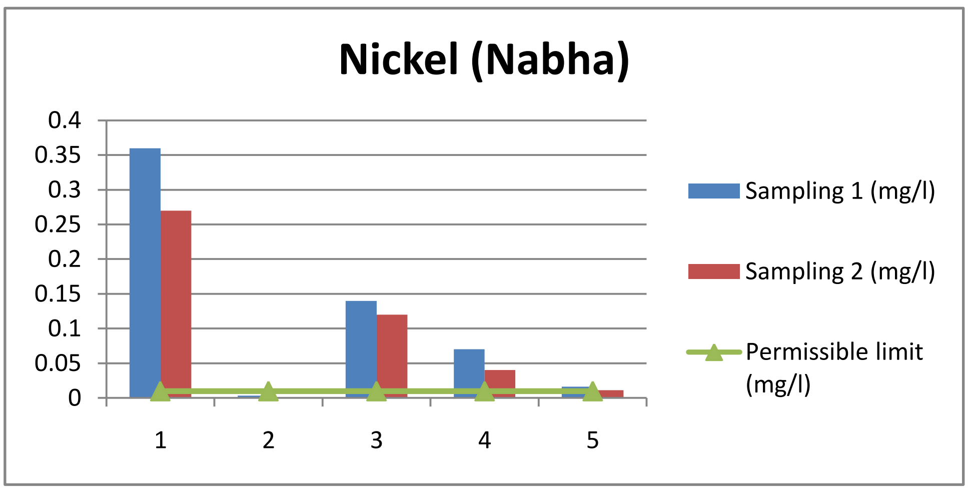

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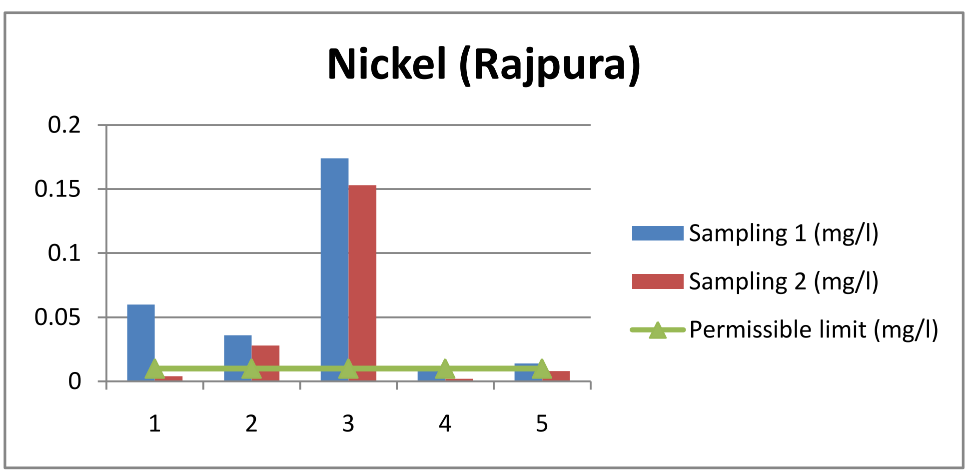

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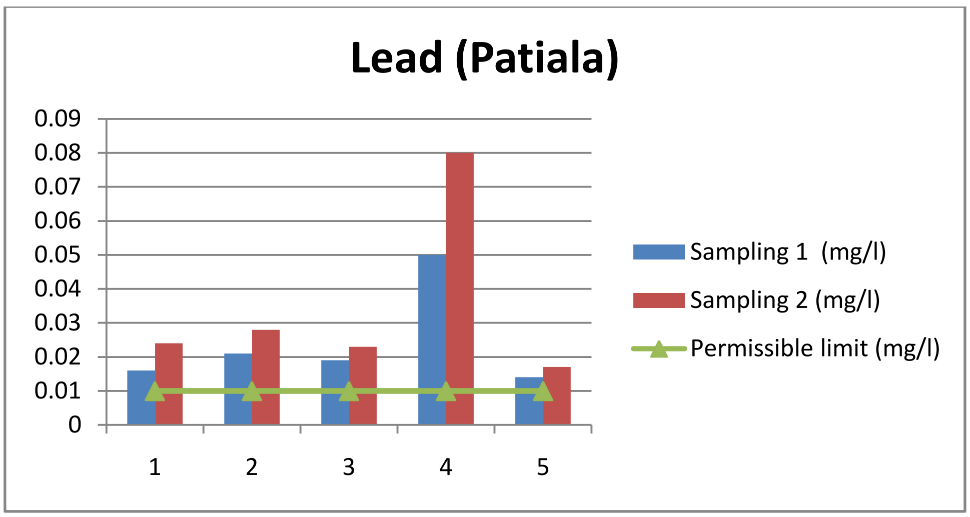
Figure 4.3.2 Nickel in ground water (a) Patiala, (b) Nabha, (c) Rajpura

Lead: Lead concentration in ground water ranged from 0.003 mg/l to 0.12mg/l with an average value 0.028 mg/l (Figure 4.3.3). Permissible limit given byBureau of Indian Standard (2012) for lead in drinking water is 0.01mg/l. There are elevan samples which have exceeded the desirable limit of 0.01 mg/l. It is quite clear from the results that ground water is not suitable for drinking purposes due to the presence of high concentrations of lead. It is toxic in both acute and chronic exposures. Excessive amount of lead in drinking water leads to burning in mouth, severe inflammationof gastro-intestinal tract with vomiting and diarrhoea, chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anaemia.



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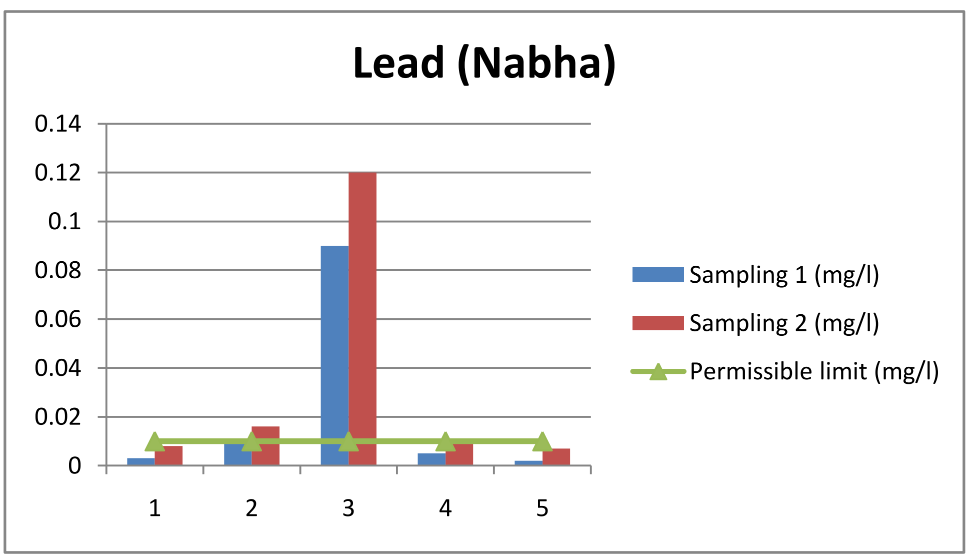

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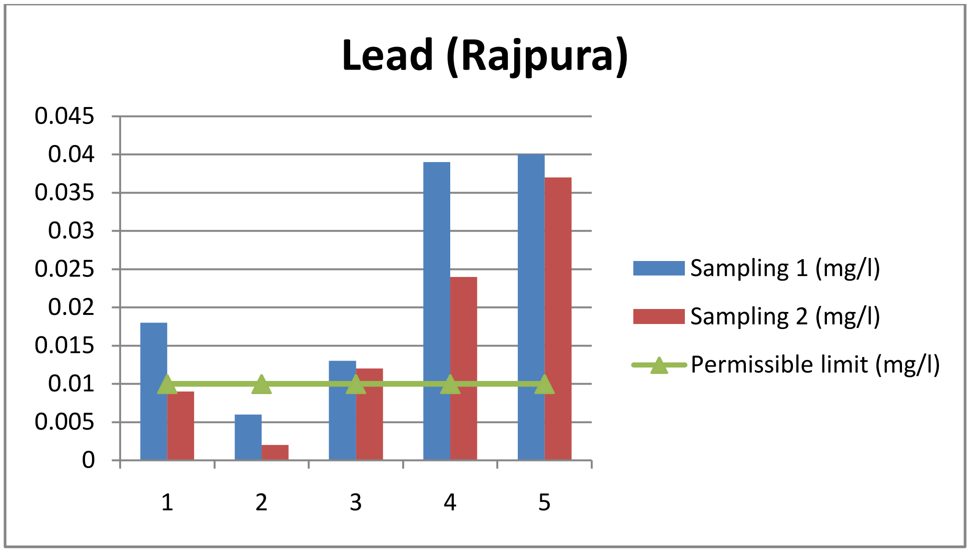

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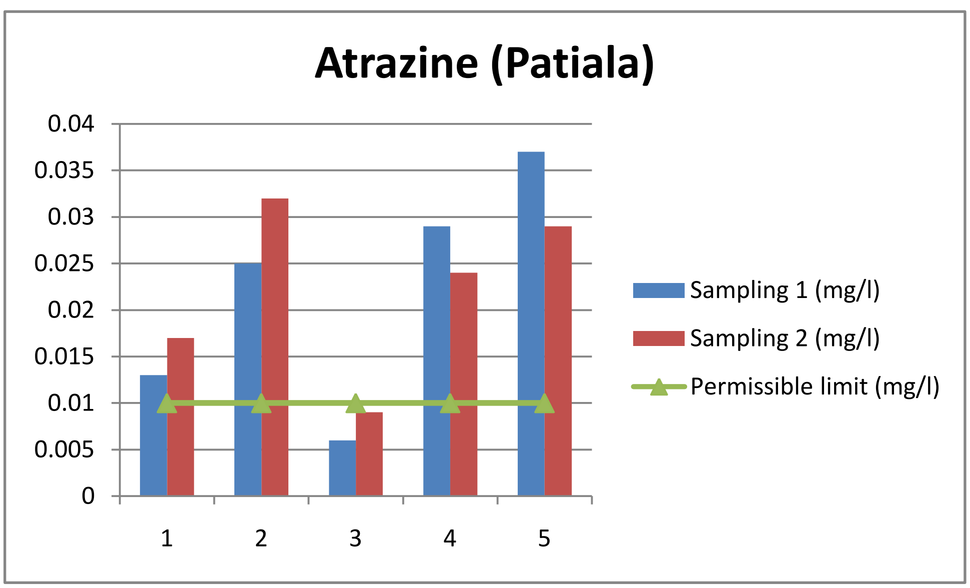
Figure 4.3.3 Lead in ground water (a) Patiala, (b) Nabha, (c) Rajpura

Atrazine: Atrazine is a herbicide of the triazine class. It is used to prevent pre-emergence broadleaf weeds in crops such as maize (corn) and sugarcane and on turf, such as golf courses and residential lawns. Atrazine's primary manufacturer is Syngenta and it is one of the most widely used herbicide in United State. In our study, highest levels of contamination are in Patiala and Rajpura where it is widely used in corn fields. Concentratrions typically spike during spring as rains flush the freshly applied herbicide into ground water.



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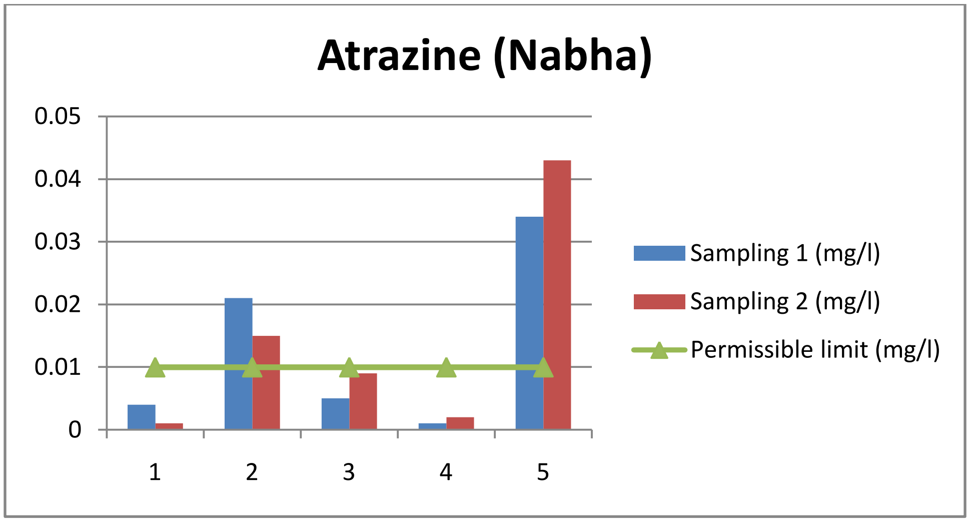

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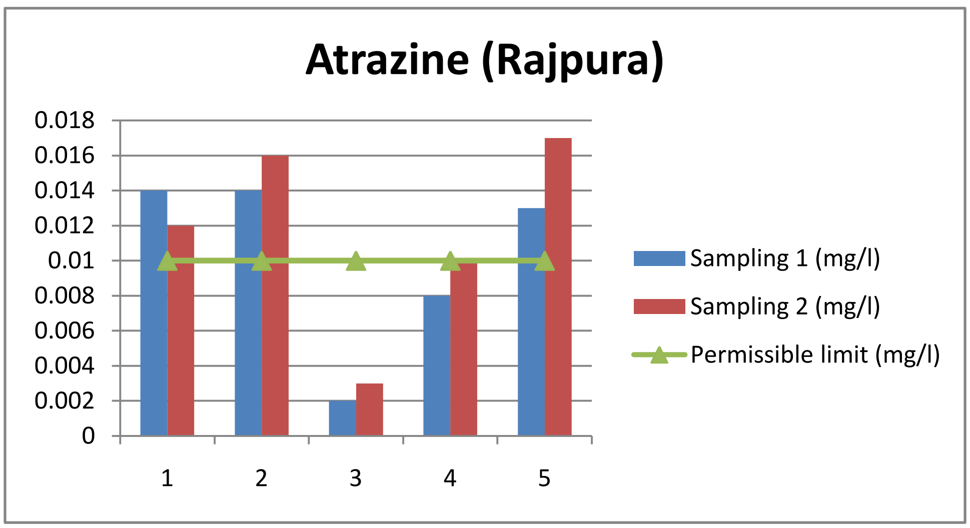

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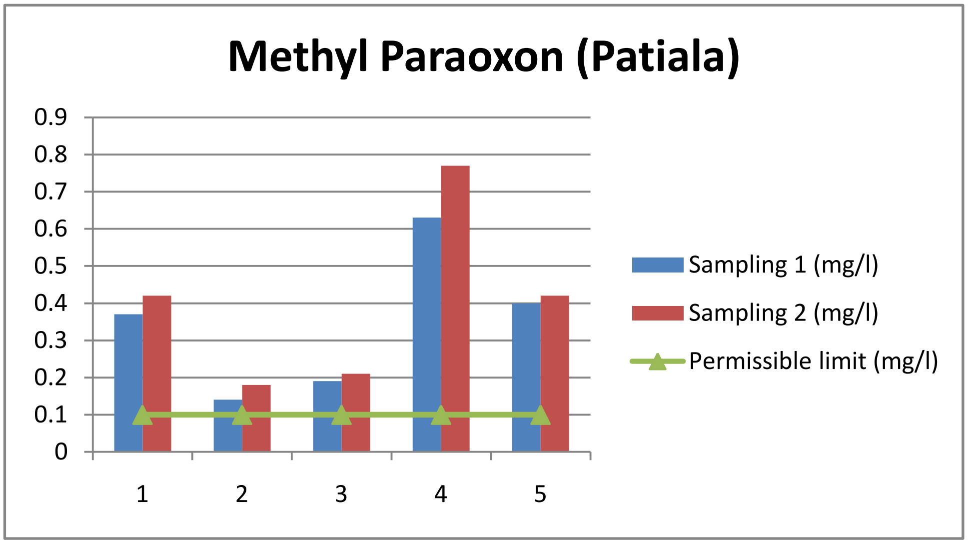
Figure 4.3.4 Atrazine in ground water (a) Patiala, (b) Nabha, (c) Rajpura

Methyl Paraoxon: It is an organophosphate compound. Methyl paraoxon is a metabolite of the widelyused insecticide parathion; paraoxon is highly toxic and poisonous to humans and other animals. The compound acts as an acetylcholinesterase inhibitor, causing accumulation of acetylcholine at nerve endings in the peripheral or central nervous system. In the groundwater samples from the study area, methyl paraoxon ranged from 0.18 to 0.77 mg/l with an average value of 0.40 mg/l. It is found more than the limit in study areas, due to its widespread use in agriculture, occupational exposure in humans often occurs via inhalation.



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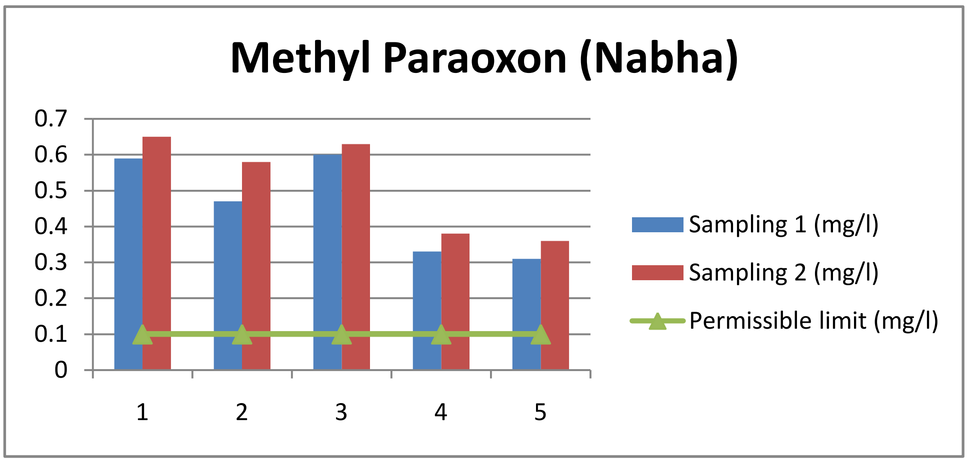

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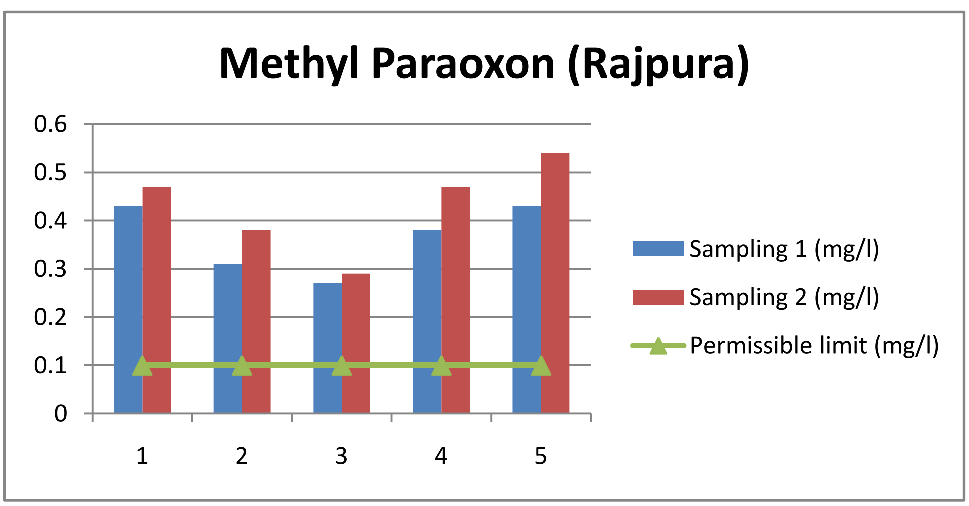

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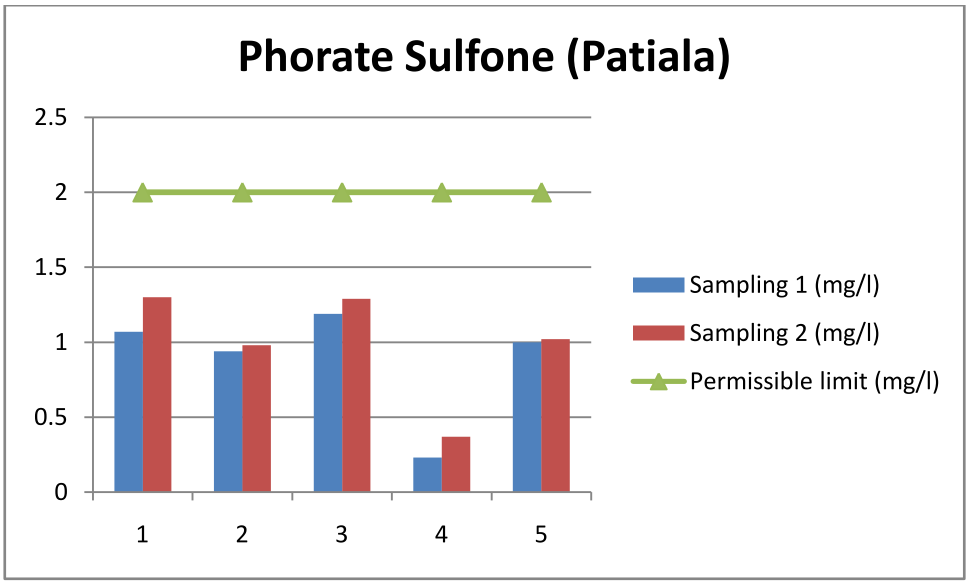
Figure 4.3.5 Methyl Paraoxon in ground water (a) Patiala, (b) Nabha, (c) Rajpura

Phorate Sulfone: It is an organophosphate pesticide. Distribution of phorate sulfone is given in figure 4.6. The acceptable limit for the insecticide is 2 µg/l for drinking water (Bureau of Indian Standard 2012).The concentration of phorate sulfone in groundwater samples ranged from 0.20 to1.80 mg/l with an average value of 0.75 mg/l . Like its otherorganophosphate counterparts this compound also causes cholinesterase inhibition inhumans; that is, it over stimulates the nervous system causing nausea, dizziness and atvery high exposures (e.g., accidents or major spills), respiratory paralysis and death.



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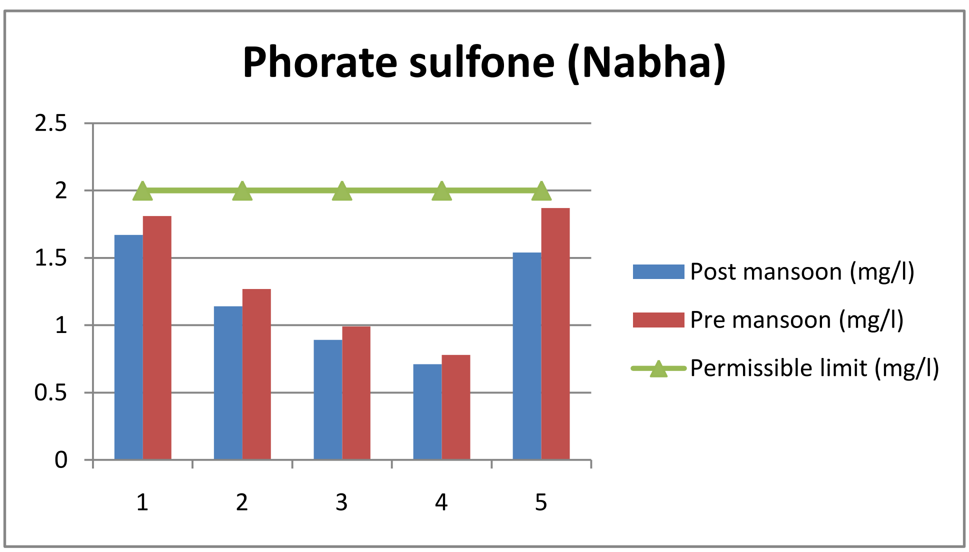

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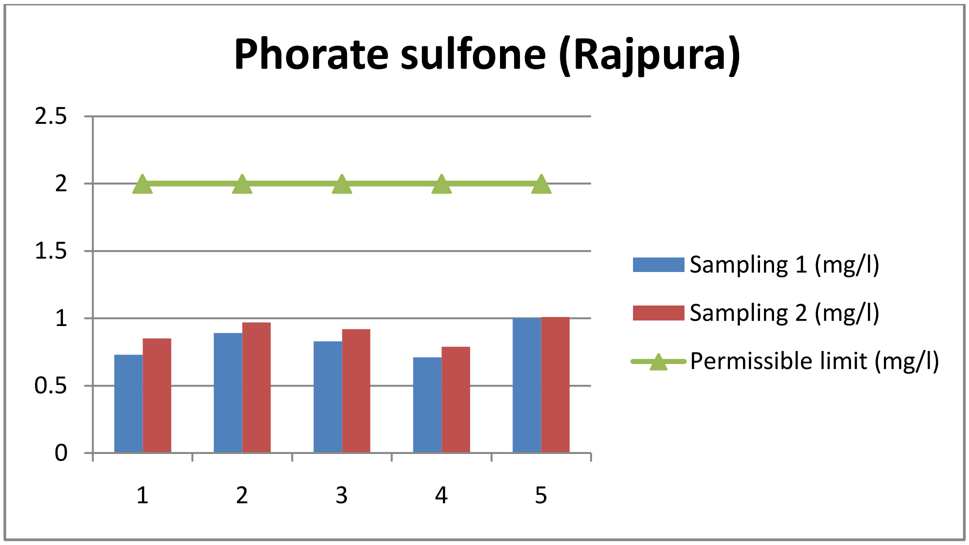

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Figure 4.3.6 Phorate Sulfone in ground water (a) Patiala, (b) Nabha, (c) Rajpura

4.4 DISCUSSION:

Higher concentration of Nickel may cause different diseases like, vomiting, nausea,abdominal discomfort, headache, cough and shortness of breath according to World Health Organization. The mainsource of nickel in drinking-water is 1)leaching frommetals in contact with drinking-water, such as pipes and fittings. Nickel is usedmainly in the production of stainlesssteels, non-ferrous alloys, and super alloys.2)Use of nickel and nickel salts inelectroplating, as catalysts, in nickel–cadmiumbatteries, in coins and in certainpigments.

Many studies identified the nervous system as the most sensitive target of aluminumtoxicity and major research on animals focused on neurotoxicity and neuro-advancedtoxicity. A number of studies have found weak associations between an increased riskof Alzheimer’s disease and people residing in elevated aluminium levels in drinkingwater; other studies have not found significant associations. Aluminium is also knownto affect gene expression by altering the expression of cerebral proteases leading tocell death. There are evidences that Aluminium is neurotoxic, both in humans aswell as in experimental animals .

There is not any major industry found in the district Patiala that may cause anincrease in the concentration of Aluminium and Nickel in groundwater. The greaterpart of the soluble constituents in groundwater comes from soluble minerals in soilsand sedimentary rocks. Solid waste disposal sitesand domestic refuse havethe potential to release large amount of hazardous and deleterious chemicals.Therefore, solid waste and domestic refuse is one of the major causes ofenvironmental problems in Patiala. Cadmium is a non-essential heavy metal present inthe environment at low levels. The metal accumulates in many organs, such as liverand kidneys . This study provides a preliminary data for the development of aframework for sustainable groundwater development and management in the area.Moreover, can be instructional for other districts of Punjab, India, like Ludhiana andJallandhar, where maximum dyeing industry is present, to understand the potentialthreats to groundwater resources. Surface water is very contaminated because allwastes of household, industries, drainage waste merged into river. According to above results atrazine , methyl paraoxon and phorate sulfone are found above the permissible limits due to the excessive use of pesticides in the parts of Patiala district . Atrazine could be responsible for causing various health problems such as endocrine disruption , reproductive effects and cancer . There are many ways for growing food without relying only on atrazine. In many countries such as Germany and Italy use of atrazine is banned . Methyl Paraoxon exposure to very high levels for a short period of time in air or water may cause numberless problems such as loss of consciousness , dizziness , confusion , headaches , difficult breathing , chest tightness , diarrhea . It is also responsible for causing mental related issues as it some times damages nerve system as well. Phorate Sulfone is another type of chemical which is present above the permissible limits. It is used against leafhoppers , leafminers , mites , some nematodes and rootworms. But overuse of this pesticide can cause various health issues such as nausea , dizziness , respiratory paralysis and even death at high exposure.

CHAPTER5

CONCLUSION AND RECOMMENDATIONS

5.1 General:

The chapter discusses the summary and conclusions drawn from the study conducted tofulfill the objectives of the study. The study of objectives is done effectively using theinformation, data and satellite images which is easily and freely accessible with the helpof Google Earth Pro from the internet.

5.2 Conclusions:

The concluding part of this report is that Patiala district has been experiencing rapid industrial development along with urabanization which is leading to unprecedented changes in the land use patterns. These activities are responsible for the deterioration of the ground water quality because of unplanned dumping of wastes and some agricultural activities. This report presents the heavy metals and pesticides concentrations in ground water samples in Patiala district.In few samples, concentrations of Lead and Nickelwere found above the guidelines for drinking waters set by the WHO. Further research on the drinking water is undergoing in other communities in this region as levels of contaminants may vary due to different soil types, water chemistry, and different human activities.No correlations were found between metal concentrations in the drinking water samples. Keeping in view of the unusually high concentrations of Nickel and Lead, it is advisable to test the portability of the groundwater of the area before using it for drinking. Surface water quality is dependent on the type of the pollutant. And it is also depend on the nature of mineral found at specific space of submersible. The present review paper undertaken to fetch an awareness among those who lives close to the substation of waste collection. The individual, the community and Municipal Corporation will facilitate to reduce submersible water pollution by straightforward housework and management practice. From the study it show that ground water as a source of water supply, its qualities, pollutions and sources with a purpose of encouraging research activities more in the use of appropriate technology for the treatment of ground water. The water in a river originates from overland flow, from interflow. Baseflow forms a higher proportion of river water in summer than in winter, and in rivers flowing over good aquifers. The growing uncertainty of surface water availability and increasing levels of water pollution and water diversions threaten to disrupt social and economic development in many areas as well as the health of ecosystem. Surface water of Badi Nadi needs to treated. More attempt should be taken to control the pesticide use in this region, evaluate, and decrease their out-turn on human health. In the future, the appeal of organic cultivation can be a great blend to the ground water contamination problem.

Pesticides are mainly contemporary chemicals. There are many hundreds of these composite, and substantial tests and studies of their consequence on human being have not been finalized. All the results confirm that the groundwater quality in Patiala district is getting deteriorated .This groundwater quality is bad but still it can be improved , if same continues in future the groundwater source will be completely polluted . It is high time to protect our natural resources. For this some major steps should be taken by our government and which should be equally followed by every citizen.

5.3 Recommendations:

The groundwater quality of Patiala district is getting deteriorated at an alarming rate due to increasing human activities. Based on the results and discussion of various physio-chemical parameters tested for the water samples from Patiala district , the following recommendations are made so that further deterioration of groundwater could be avoided.

- Disposal of solid waste (domestic) , agriculture residues and wastes on a land fill should be minimized as it is one of the reason for ground water deterioration . A proper management system should be introduced.
- Health awareness programmes are to be conducted regularly with the help of health agencies or NGO’s with regard to the problems caused due to waterborne diseases.
- Human caused activities like washing of clothes , animals and vehicles in the water bodies should be avoided.
- Chemical fertilizers/Chemical pesticides should be avoided. Instead of them bio fertilizers/bio pesticides should be used in appropriate manner.

- Farmers must be given proper guidance about the use of chemical based products in judicious manner and to use bio based products or IPM practices.
- Entry of agriculture wastes into the water bodies should be avoided.
- Continuous and proper monitoring of the groundwater should be done and environmental regulations should be followed by the government authorities.
- Farmers should be introduced to proper management practices.
- Chemical fertilizers and pesticides even though they remain as a important tool for agricultural activities , but farmers should be provided with proper education for the optimum use of fertilizers and pesticides , and they should be encouraged for organic farming.

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