A REPORT ON

“WATER QUALITY SCENARIO OF SATLUJ RIVER BETWEEN 2012-2016”

Submitted for partial fulfillment of award of

MASTER IN TECHNOLOGY

By

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Under The Supervision of

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Abstract

Water is one of the vital needs of all living beings. Humans need water in many daily activities like drinking, washing, bathing etc. Water is the most important in shaping the land and regulating the climate.If the quality of water is not desirable then it becomes unfit for drinking and other activities. The quality of water is usually described according to its physical, chemical and biological characteristics. Hence it becomes necessary to find the suitability of water for various purposes like drinking, irrigation and Industrial purposes.

Rapid industrialization and use of chemical fertilizers and pesticides in agriculture are causing deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from various water borne diseases.

River pollution has been one of the main topics in the environmental issues of any country or state. Deteriorating water quality of rivers is of major concern in India; this is especially true for rivers being used as drinking water sources. One such river considered in this study is the Satluj. A total of 14 water samples from different point sources of pollution were collected and tested for physico-chemical parameters (pH, temperature, DO, BOD, COD, TSS, TDS), metals (As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) and microbiological parameter using World Health Organization (WHO) and the Bureau of Indian Standards (BIS) standards.

<u>Declaration</u>

I, Bhupinder Singh Channa (Regd. No. 41400146), hereby declare that this dissertation report entitled "**WATER QUALITY SCENARIO OF SATLUJ RIVER BETWEEN 2012-2016**" submitted in the partial fulfillment of the requirements for the award of degree of Master of Technology in Environmental Engineering, in the School of Civil Engineering, Lovely Professional University, Phagwara, is my own work. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

Date: Bhupinder Singh

Place:

Certificate

Certified that this project report entitled **"WATER QUALITY SCENARIO OF SATLUJ RIVER BETWEEN 2012-2016"** submitted by **"Bhupinder Singh,** Reg. no**:41400146"** student of Civil Engineering Department, Lovely Professional University, Phagwara, Punjab who carried out the dissertation work under my supervision.

This report has not been submitted to any other university or institution for the award of any degree.

Date:	**Sign of Supervisor**	**Sign of HOD**
	Name:	**Name:**
	UID:	**UID:**

Acknowledgement

This study is an important step towards the journey of my thesis to obtain M.Tech degree. I have not travelled in a vacuum in this journey. The study has been kept on track and been seen through to completion with the support and encouragement of numerous people including my well-wishers, my friends and colleagues. At the end of this study, I would like to thank all those people who made this study possible and an unforgettable experience for me. It has been a wonderful experience working on this study to make it successful.

At this moment of accomplishment, first of all I would like to express my deepest gratitude to my mentor **Ms. Alka** who had enlightened my knowledge and had showed me the path in every step I took. This work would not have been possible without his guidance, support and encouragement. Under his guidance, I successfully overcame many difficulties and learned a lot. His review on the study progress, and valuable suggestions and corrections has helped me a lot. His unflinching courage and conviction will always inspire me. His expert advices have been phenomenal in compiling this work and especially for his amicable listening and guidance.

However, the deepest gratitude, I owed to my parents for helping me to study in this prestigious college and supporting me whatever the circumstances may be. I owe everything to them.

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Most of all, I thank God for the good health and wisdom that He has blessed me with throughout the study.

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Mrs. DolonchappaPrabhakar

Ms. Pooja Rani Sinha

Signature of Student

Bhupinder Singh

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SATLUJ RIVER

Chapter 1

INTRODUCTION

The Sutlej River is the longest of the five rivers that flow through the historic crossroads region of Punjab in northern India and Pakistan. The Sutlej River is also known as Satadree. It is the easternmost tributary of the Indus River.

Length:	1,450 km
Basin area:	66,317 km²
Source:	Mount Kailash
Basin:	395,000 km^2 (152,510 sq mi) approx
Countries:	India, Pakistan
Mouths:	Arabian Sea, Panjnad River

Pollution in its widest sense includes all changes which curtail natural utility and exert harmful effect on life. The crisis triggered by the industrialization and very fast growing population and with the resultant degradation of the environment causes a grave threat to the quality of life. Deterioration of water quality is the unfavorable alteration of the properties of water (physical, chemical and biological) that prevents domestic, industrial, commercial, recreational, agricultural and other beneficial uses of water.

Water resource development has taken place all over the world. There is a tremendous amount of pressure in protecting and conserving the water resources available in the country. Protecting the surface water resources from domestic wastewater pollution plays a significant role for the improvisation and development. The disposal of domestic wastewater into the surface water body leads to serious health problems that affect the common people. Especially, in the urban areas, the domestic wastewater discharges into the nearby rivers or lake, which is ultimately creating many problems to the public.

There are multiple ways for safely disposing the domestic wastewater. But improper management of domestic wastewater generation in the urban areas ultimately finds its own path of getting into the rivers or lakes. Hence, the effluent discharge affects the surface water bodies. The water quality changes in the surface water bodies created many health problems to the public. That is why there is a need of proper sewage treatment plant in order to treat the domestic wastewater of a particular region and controlling water pollution.

Sewage and sewage effluents are the major sources of water pollution. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes. The growing environmental pollution needs for decontaminating waste water result in the study of characterization of waste water, especially domestic sewage. In the past, domestic waste water treatment was mainly confined to organic carbon removal.

History

The Upper Sutlej Valley, called Langqên Zangbo in Tibet, was once known as the Garuda Valley by the Zhangzhung, the ancient civilization of western Tibet. The Garuda Valley was the centre of their empire, which stretched many miles into the nearby Himalayas. The Zhangzhung built a towering palace in the Upper Sutlej Valley called Kyunglung, the ruins of which still exist today near the village of Moincêr, southwest of Mount Kailash (Mount Ti-se). Eventually, the Zhangzhung were conquered by the Tibetan Empire.

The boundaries of Greater Nepal extended westward to beyond Satluj River until the tide turned in 1809 and Kangra king repulsed Gorkha army eastward with help from Maharaja Ranjit Singh.

Today, the Sutlej Valley is inhabited by nomadic descendants of the Zhangzhung, who live in tiny villages of yak herders.

The Sutlej was the main medium of transportation for the kings of that time. In the early 18th century, it was used to transport devdar woods for Bilaspur district,Hamirpur district, and other places along the Sutlej's banks.

Of four rivers (Indus, Sutlej, Brahmaputra and Karnali/Ganges) mythically flowing out of holy Lake Manasarovar, the Sutlej is actually connected by channels that are dry most of the time

Instrument use

- TDS meter
- Ph meter
- DO detector

TDS Meter indicates the Total Dissolved Solids (TDS) of a solution, i.e. the concentration of dissolved solid particles.

Dissolved ionized solids, such as salts and minerals, increase the electrical conductivity (EC) of a solution. Because it is a volume measure of ionized solids, EC can be used to estimate TDS. Dissolved organic solids, such as sugar, and microscopic solid particles, such as colloids, do not significantly affect the conductivity of a solution.

The most accurate way to measure TDS of water in a laboratory is to evaporate the water leaving behind dissolved solutes as residue and then weighing the residue.

pH Meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as pH.The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution.The pH meter is used in many applications ranging from laboratory experimentation to quality control.

Do detector is an electronic device that is designed to detect the presence of water and provide an alert in time to allow the prevention of water damage. A common design is a small cable or device that lies flat on a floor and relies on the electrical conductivity of water to decrease the resistance across two contacts. The device then sounds an audible alarm together with providing onward signalling in the presence of enough water to bridge the contacts. These are useful in a normally occupied area near any infrastructure that has the potential to leak water, such as HVAC, water pipes, drain pipes, vending machines,dehumidifiers, or water tanks

Recently, increasing pollution in the waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants.

The main function of wastewater treatment plants is to protect human health and the environment from excessive overloading of various pollutants. The typical domestic wastewater treatment system is a decentralized municipal-sized facility that treats wastewater to specified discharge limits, to protect human health and the environment. Treatment of any kind of wastewater to produce treated water of good quality is necessary. Treatment technologies are based on varying levels of mechanization, energy inputs, land requirements, costs, skilled manpower etc.

Due to industrial development and urbanization in near Satluj, domestic effluent and urban run-off

contribute the bulk of wastewater generated in the city. Domestic wastewater usually contains

grey water (sullage), which is wastewater generated from washrooms, bathrooms, laundries,

kitchens etc. It also contains black water made up of urine, excreta and flush water generated from toilets.

Geology

The Sutlej, along with all of the Punjab rivers, is thought to have drained east into the Ganges.

There is substantial geologic evidence to indicate that prior to 1700 BC, and perhaps much earlier, the Sutlej was an important tributary of the Ghaggar-Hakra River (thought to be the legendary Sarasvati River) rather than the Indus, with various authors putting the redirection from 2500 to 2000 BC, from 5000 to 3000 BC, or before 8000 BC.Geologists believe that tectonic activity created elevation changes which redirected the flow of Sutlej from the southeast to the southwest. If the diversion of the river occurred recently (about 4000 years ago), it may have been responsible for the Ghaggar-Hakra (Saraswati) drying up, causing desertification of Cholistan and the eastern part of the modern state of Sindh, and the abandonment of Harappan settlements along the Ghaggar. However, the Sutlej may have already beencaptured by the Indus thousands of years earlier

The waters of the Sutlej are allocated to India under the Indus Waters Treaty between India and Pakistan, and are mostly diverted to irrigation canals in India.There are several major hydroelectric projects on the Sutlej, including the 1,000 MW Bhakra Dam, the 1,000 MW Karcham Wangtoo Hydroelectric Plant, and the 1,530 MW Nathpa Jhakri Dam

Soures

The source of the Sutlej is west of Lake Rakshastal in Tibet, as springs in an ephemeral stream channel descending from this lake. Rakshastal in turn is ephemerally connected by Ganga Chhu to sacred Lake Manasarovar about 4 KM further east. The nascent river flows at first west-northwest for about 260 kilometres (160 mi) under the Tibetan name *Langqên Zangbo* (*Elephant River* or *Elephant Spring*) to the Shipk La pass, entering India in Himachal Pradesh state. It then turns slightly, heading west-southwest for about 360 kilometres (220 mi) to meet the Beas River near Makhu, Firozpur district, Punjab state. North western part of Panchkula district in Haryana state is located in the Sutlej river basin. Thus Haryana is also a riparian state of Indus river basin.

Continuing west-southwest, the Sutlej enters Pakistan about 15 kilometres (9.3 mi) east of Bhedian Kalan, Kasur District, Punjab province, continuing southwest to water the ancient and historical former Bahawalpur princely state.

About 17 kilometres (11 mi) north of Uch Sharif, the Sutlej unites with the Chenab River, forming the Panjnad River, which finally flows into the Indus river about 100 kilometres (62 mi) west of the city of Bahawalpur. The area to the southeast on the Pakistani side of the Indian border is called the Cholistan Desert and, on the Indian side, the Thar Desert.

The Indus then flows through a gorge near Sukkur and the fertile plains region of Sindh, forming a large delta region between the border of Gujarat, India and Pakistan, finally terminating in the Arabian Sea near theport city of Karachi, Pakistan. During floods, Indus river water flows in to Indian part of Great Rann of Kutch. Thus Gujarat state of India is also a riparian state of Indus river as Rann of Kutch area lying west of Kori Creek in the state is part of the Indus River Delta

1.1 The main causes of the deterioration of the water bodies in near satluj cities are as

follows:

- Indiscriminate cutting of surrounding vegetation thus increasing silt and nutrient load in the river and lake bodies.
- Disposal of domestic and sewage wastes directly or partially treated.
- Excessive use of insecticide and pesticide in the catchment.
- Agriculture practices in and around the water bodies using agrochemicals.

Discharge of domestic wastewater

Chapter 2

OBJECTIVE

1. Studying the domestic wastewater generation- A case study of Satluj.
2. To check composition and characteristics of the local water bodies which is used for the water supply purpose.
3. To check composition and characteristic of domestic wastewater which is directly discharged without any treatment in the local river bodies.
4. Designing decentralized treatment units according to the need in accordance with economy.
5. With the help of questionnaires, taking feedback of common people about the domestic wastewater.
6. To introduce the concept of using new feasible materials in sewage treatment plant that will not compromise the strength and duration but economically beneficial.
7. Suggesting methods of recycling the domestic wastewater for the purpose of gardening, flushing toilets, fountains etc.

Chapter 3

SCOPE OF THE PROJECT

1. Management of domestic wastewater reduces or eliminates adverse impact on the environment and human health and supports economic development and improved quality of life.

2. The treated water can be recycled and used for gardening, flushing toilets, laundry etc.

3. The root cause of water pollution is discharge of wastewater into the river bodies. If treatment plants are constructed then water pollution will be reduced up to the maximum level.

4. With the help of survey, up to date and current knowledge of the present scenario of domestic wastewater will be obtained.

Chapter 4

NEED OF THE PROJECT

These lakes are irreplaceable natural water bodies' aboding a rich and diverse gene pool.
If proper wastewater management is not taken into account, Satluj will face many health hazards to human beings as well as the other living organisms.
The irregation department will also be affected, as no one likes to visit a place full of wastewater and epidemics. Hence, economy of the state may suffer to a greater extent. Thus, management of domestic wastewater is very important for the betterment of state and country as a whole.
The most important factors are listed below:

1. Population is increasing vigorously and the graph of generation of wastewater near satluj is increasing every year. Wastewater needs to be managed before its disposal into the river bodies.

2. To reduce the adverse impacts on environment and human health.

3. The wastewater generated can either be recycled or reused after proper treatment for various other purposes.

4. To manage the domestic wastewater and suggest the possible treatment for the domestic wastewater generated.

5. Domestic wastewater if discharged freely causes bad smell, degrades the environment and increases the growth of micro-organisms in the local water bodies which can affect all the living organisms directly or indirectly.

6. Improper disposal of domestic wastewater increases the risk of diseases like malaria, typhoid etc.

6

Chapter 5

PROJECT STUDY

- Satluj'swater, which enters Punjab at bhakhra nangal are rated A class (pure) at nangal headwork at nangal due to effluents from NFL,PNFC and Punjab Alkalies,its toxity level increases.
- At kiratpur sahib the addition of human ashes
- Ropar (due to effiuents from the ropar thermal plant DCM, Swaraj Mazda and United Puip and Paper Mills)

Station 1.

Nangal industrial Area

1st station where impure water and chemical waste enters into satluj

7

Satation 2.

N.F.L nangal

N.F.L. use number of chemical which enters satluj

Station 3.

Wastage of nangal town directly put in satluj

Station 4

Lodhipu (Shri Anadpur Sahib)

Station 5.

Nakiya (kotla powerhouse)

Station 6.

Patal puri kiratpur sahib

Patal puri kiratpur sahib

At kiratpur sahib, the addition of human ashes (crematory)

Station 7

Ropar thermal plant

Wastage of ropar thermal plant

Station 8.

D/S Rishab Paper mill

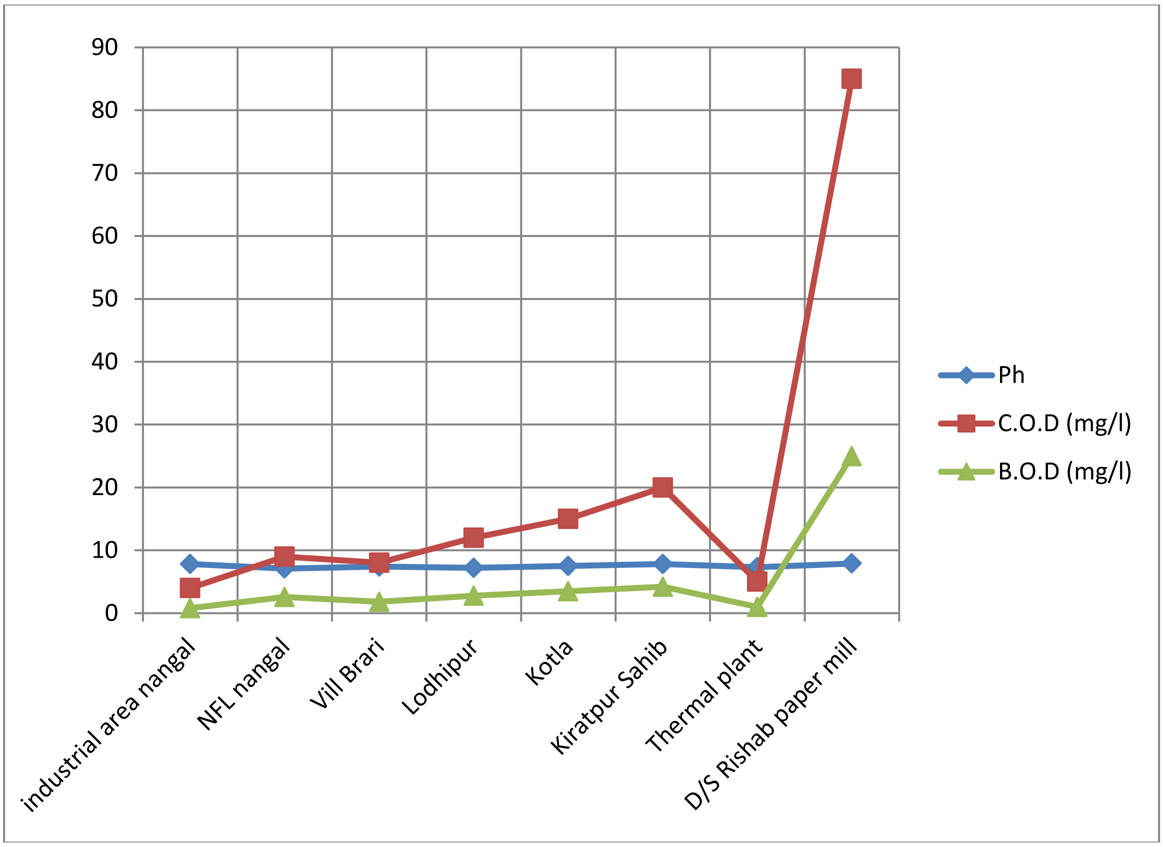
Chapter 6

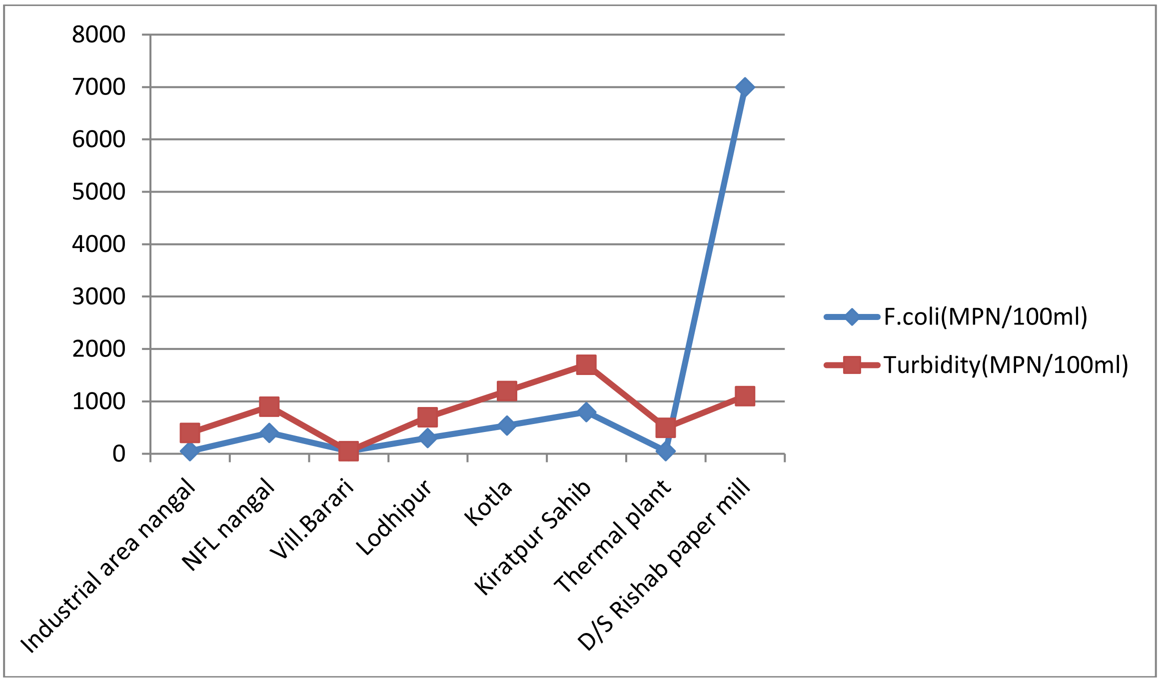
REPORT 2012 to 2016

Report 2012

S.N.	Name of Station	Ph	C.O.D mg/l	B.O.D mg/l	F.coli MPN/100ml	Turbidity MPN/100ml
1	Industrial area nangal	7.8	4	0.8	50	400
2	NFL nangal	7.1	9	2.6	400	900
3	Vill Brari	7.4	8	1.8	50	500
4	Lodhipur	7.2	12	2.8	300	700
5	Kotla (power house)	7.5	15	3.5	540	1200
6	Kiratpur sahib	7.8	20	4.2	800	1700
7	Thermal plant	7.3	5	1.0	50	500
8	D/S Rishab paper mill	7.9	85	25	7000	11000

6.1 Table 1

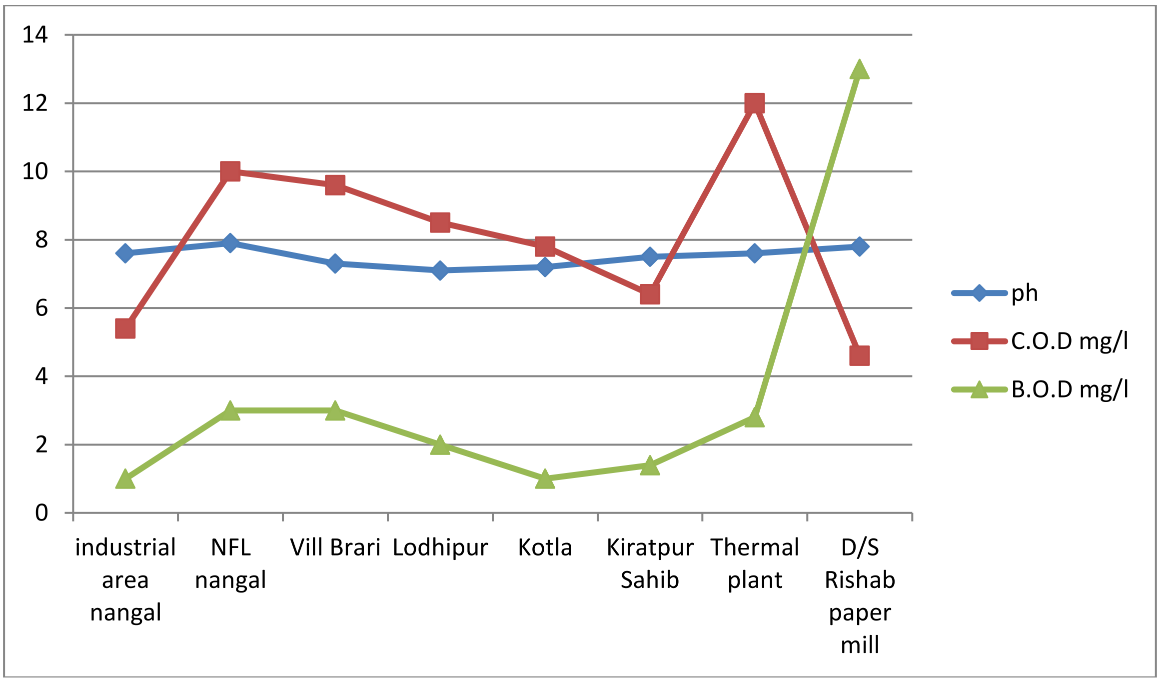

90
80
70
60
50
40
30
20
10
0
industrial area nangal
NFL nangal
Vill Brari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
Ph
C.O.D (mg/l)
B.O.D (mg/l)

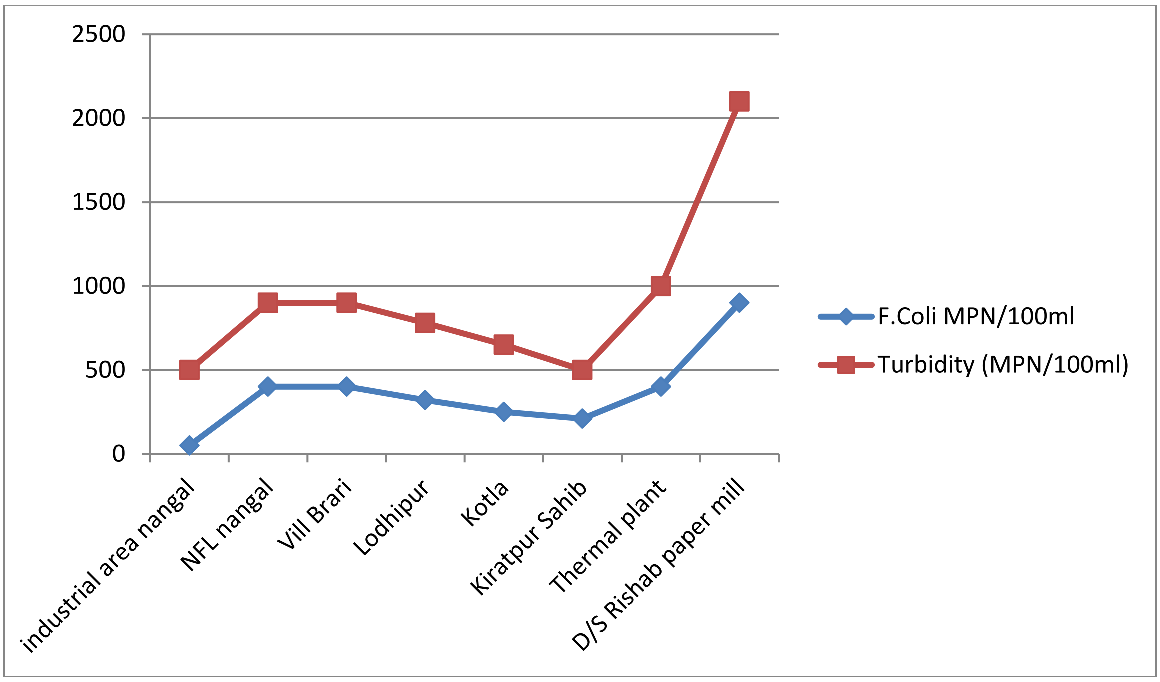

8000
7000
6000
5000
4000
3000
2000
1000
0
Industrial area nangal
NFL nangal
Vill.Barari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
F.coli(MPN/100ml)
Turbidity(MPN/100ml)

Report 2013

S.N.	Name of Station	Ph	C.O.D mg/l	B.O.D mg/l	F.coli MPN/100ml	Turbidity MPN/100ml
1	Industrial area nangal	7.6	5.4	1.0	50	500
2	NFL nangal	7.9	10.0	3.0	400	900
3	Vill Brari	7.3	9.6	3.0	400	900
4	Lodhipur	7.1	8.5	2.0	320	780
5	Kotla (power house)	7.2	7.8	1.0	250	650
6	Kiratpur sahib	7.5	6.4	1.4	210	500
7	Thermal plant	7.6	12	2.8	400	1000
8	D/S Rishab paper mill	7.8	4.6	13	900	2100

6.2 Table 2

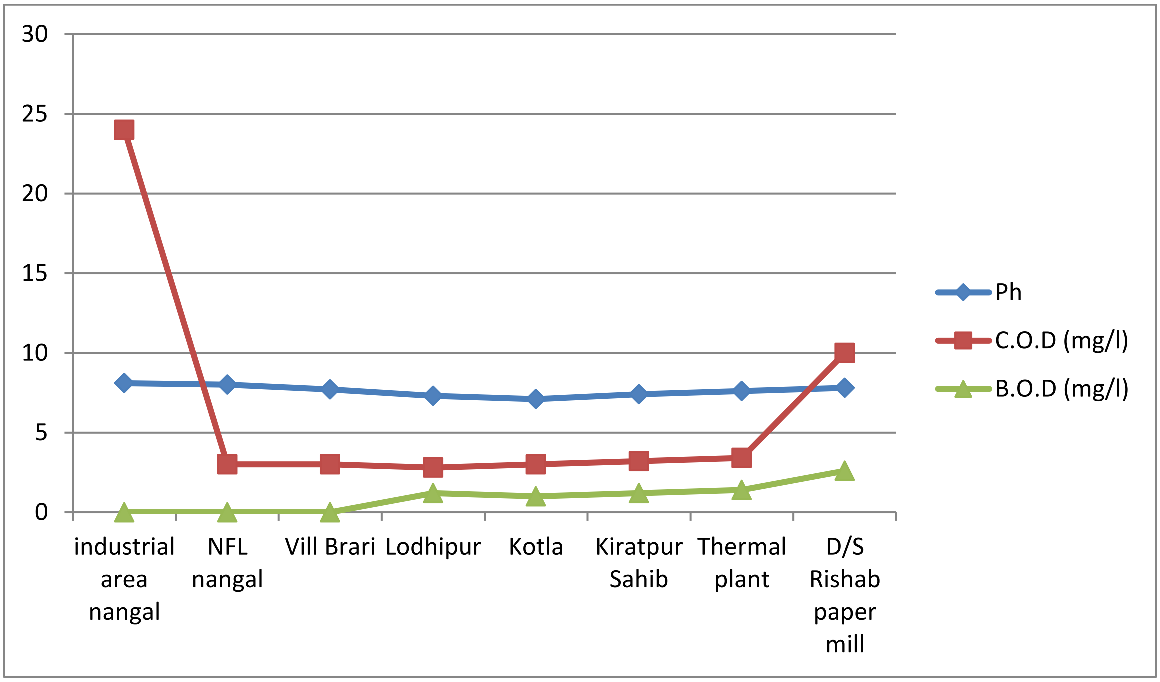




Report 2014

S.N.	Name of Station	Ph	C.O.D mg/l	B.O.D mg/l	F.coli MPN/100ml	Turbidity MPN/100ml
1	Industrial area nangal	8.1	24	ND	40	110
2	NFL nangal	8.0	3.0	ND	110	300
3	Vill Brari	7.7	3.0	ND	700	1100
4	Lodhipur	7.3	2.8	1.2	400	1000
5	Kotla (power house)	7.1	3.0	1.0	220	600
6	Kiratpur sahib	7.4	3.2	1.2	210	500
7	Thermal plant	7.6	3.4	1.4	430	750
8	D/S Rishab paper mill	7.8	10	2.6	1400	2100

6.3 Table 3


30
25
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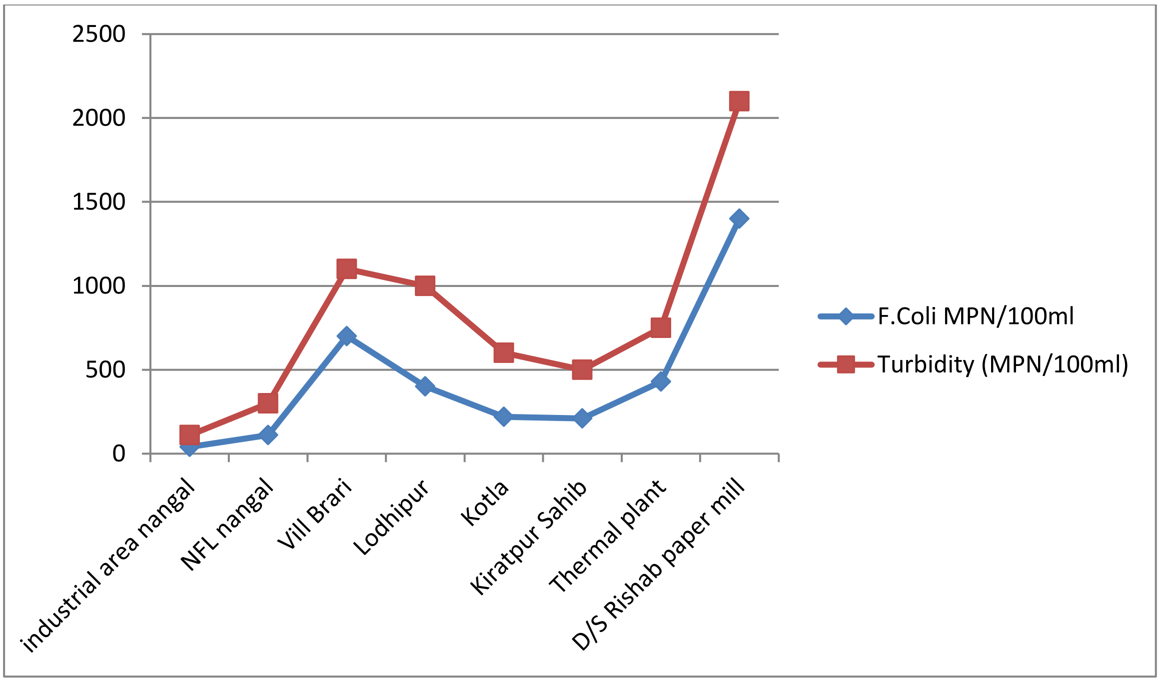
industrial area nangal
NFL nangal
Vill Brari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
Ph
C.O.D (mg/l)
B.O.D (mg/l)


2500
2000
1500
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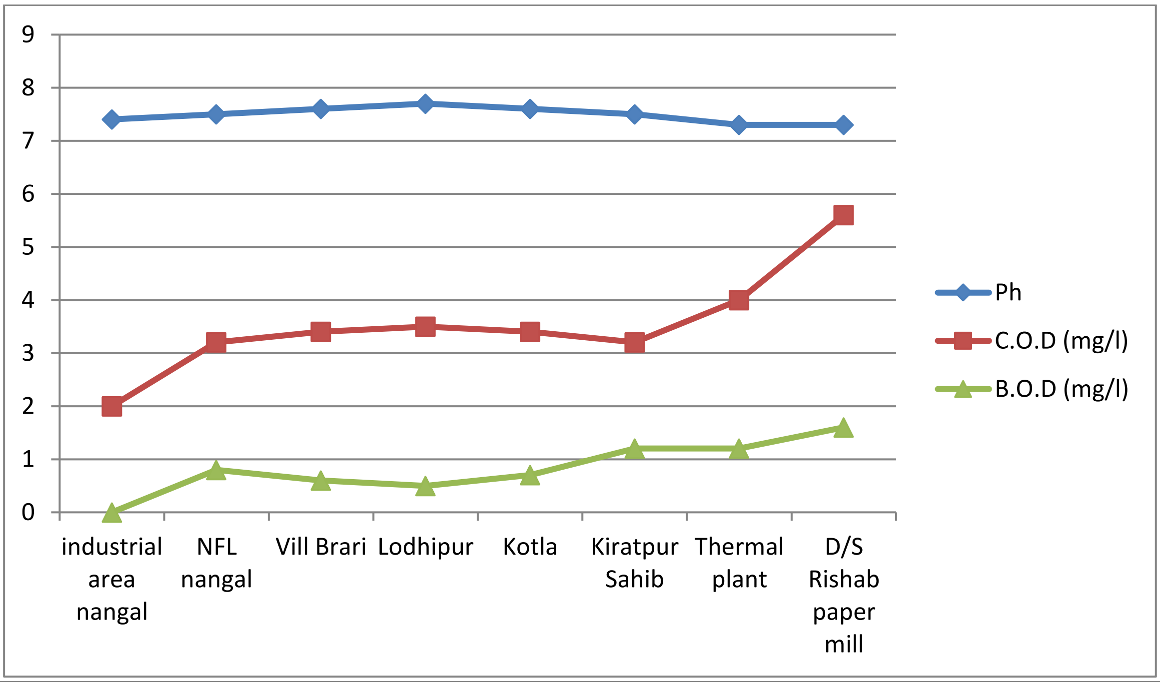
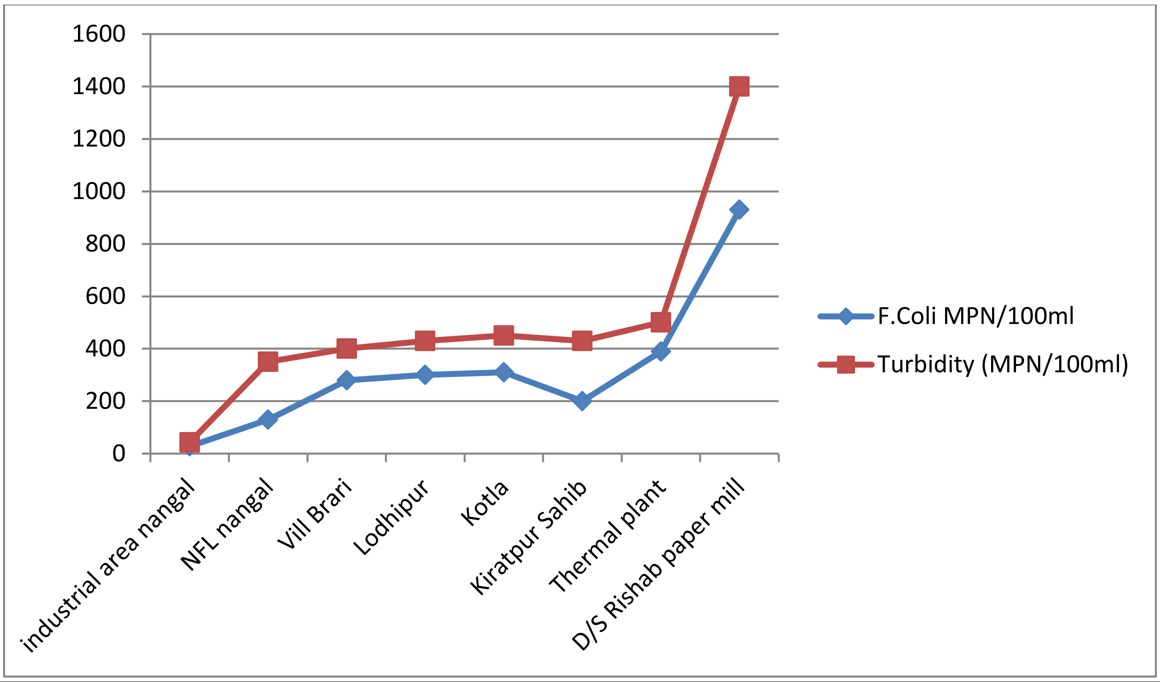
industrial area nangal
NFL nangal
Vill Brari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
F.Coli MPN/100ml
Turbidity (MPN/100ml)

Report 2015

S.N.	Name of Station	Ph	C.O.D mg/l	B.O.D mg/l	F.coli MPN/100ml	Turbidity MPN/100ml
1	Industrial area nangal	7.4	2.0	ND	28	43
2	NFL nangal	7.5	3.2	0.8	130	350
3	Vill Brari	7.6	3.4	0.6	280	400
4	Lodhipur	7.7	3.5	0.5	300	430
5	Kotla (power house)	7.6	3.4	0.7	310	450
6	Kiratpur sahib	7.5	3.2	1.2	200	430
7	Thermal plant	7.3	4.0	1.2	390	500
8	D/S Rishab paper mill	7.3	5.6	1.6	930	1400

6.4 Table 4

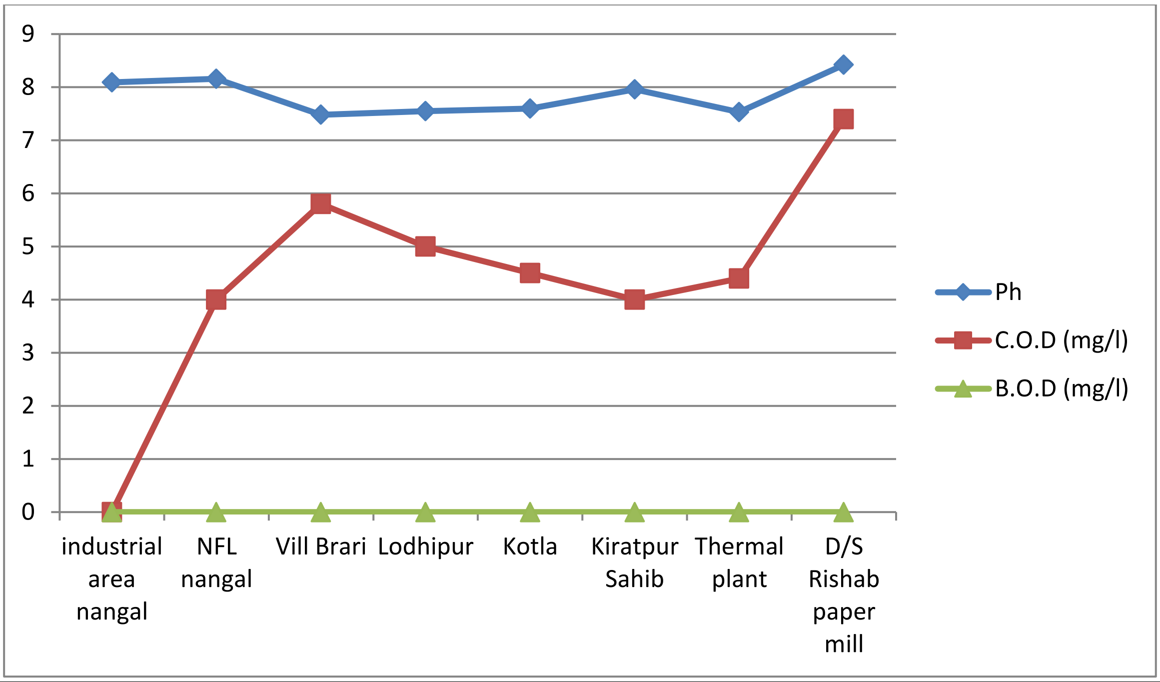




Report 2016

S.N.	Name of Station	Ph	C.O.D mg/l	B.O.D mg/l	F.coli MPN/100ml	Turbidity MPN/100ml
1	Industrial area nangal	8.09	BDL	BDL	40	150
2	NFL nangal	8.16	4	BDL	200	400
3	Vill Brari	7.48	5.8	BDL	200	450
4	Lodhipur	7.55	5	BDL	300	520
5	Kotla (power house)	7.60	4.5	BDL	380	570
6	Kiratpur sahib	7.96	4	BDL	400	680
7	Thermal plant	7.53	4.4	BDL	200	780
8	D/S Rishab paper mill	8.42	7.4	BDL	400	820

6.5 Table 5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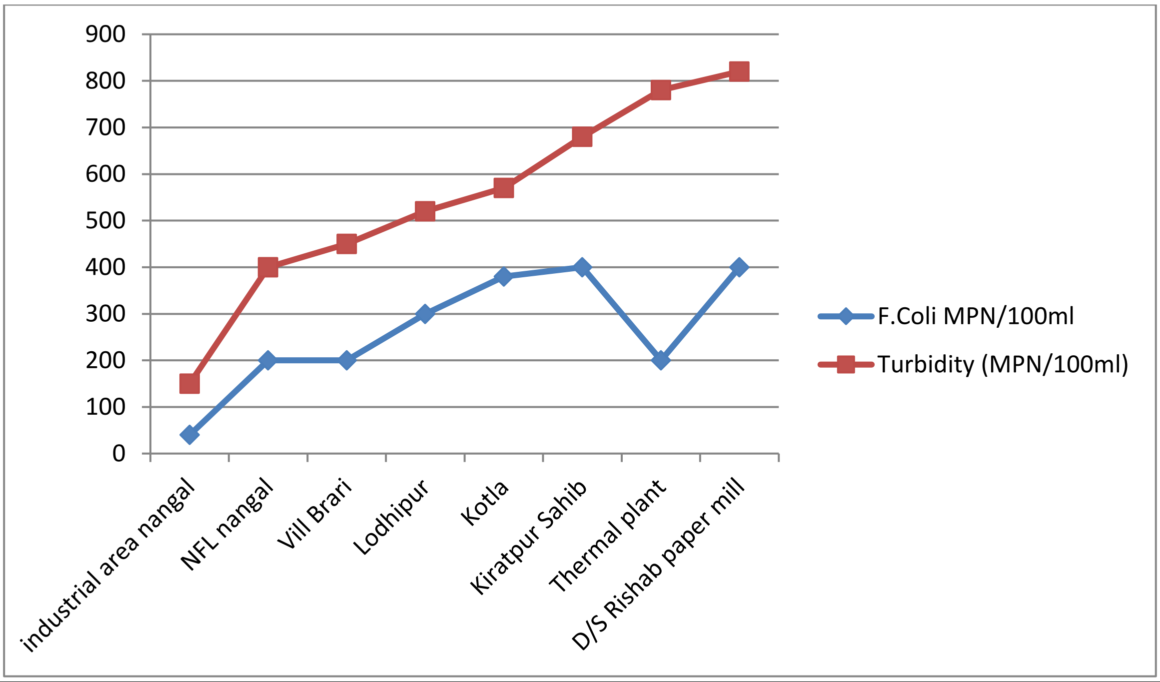
industrial area nangal
NFL nangal
Vill Brari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
Ph
C.O.D (mg/l)
B.O.D (mg/l)


900
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100
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industrial area nangal
NFL nangal
Vill Brari
Lodhipur
Kotla
Kiratpur Sahib
Thermal plant
D/S Rishab paper mill
F.Coli MPN/100ml
Turbidity (MPN/100ml)

Chapter 7

CAUSES

- The specific pollution in water include a wide spectrum of chemical and physical changes such as discoloration naturaly.

- Oxygen substance dispointinted by man made chemical that is couses of turbidity

- Many chemical like toxic can produce waterborne diseases in either human or animals.it is the reson of ph changes

- Detergents, food processing waste, fule oil, volatile organic compounds mixes in water is the reson of COD, BOD.

- Ammonia from food processing waste, chemical waste, fertilizers, silt are reason of physical changes.

Chapter 8

REVIEW OF LITERATURE

Prior to taking up the analysis of the available data pertaining to the main premise of my work, it is essential to scan the conceptual and theoretical structure as also to review the perspective of other researchers briefly. It will make a modest attempt to review few of such efforts taken from time to time by various subject experts to make the problem more simplified and relate such ideas with the present study.

There is no dearth of studies available on Sewage treatment plant. After searching a series of studies available or related to the issue, the review of the parts of the study related to my research topic is put as under:-

8.1 NEED OF THE TREATMENT UNIT:

(N. Muthukumaran and N. K. Ambujam, 2003) There is a tremendous amount of pressure in protecting the water resources available in the country. Protecting the surface water resources from wastewater pollution plays a vital role for the development. The disposal of wastewater into the surface water bodies leads to serious problems and affects the people in health aspects. Especially in the urban areas, the pollution of domestic effluent discharges into the nearby surface water bodies created problems for the public. Improper management of waste water finds its own way of getting into the surface water. The water quality changes in the surface water bodies created many health problems to the public.

The major cities are growing with a daily average addition of 1000 persons. As a result of this tremendous growth, service infrastructure is not able to keep up to provide the city a healthy environment. Ample supplies of clean unused water can no longer be taken for granted due to population growth, increasing urbanization and industrial water demands. Pollution of fresh water streams and ground water by industrial discharges result in depletion of existing water sources. Hence, it is increasingly becoming obvious that reuse of wastewater is a viable solution in many instances.

8.2 PRESENT SCENERIO OF WASTEWATER TREATMENT UNITS IN INDIA:

(R Kaur *et al.*,) Agricultural growth, urbanization and industrialization has brought severe water shortage. That’s why low quality/ waste water is emerging as a potential source for water supply after the proper treatment. India represented 16% of world population but water resources is just 4%. Demand of population is high and water resources are low. Efficiency and recycling of water is highly required. In India 234-Sewage treatment plants are there covering only 5% of cities/towns. Oxidation pond technology and activated sludge process technology is used covering 59.5% of total installed capacity. Followed by Up Flow Anaerobic Sludge Blanket Technology (26%). Stabilization ponds is also used in 28% of the plants, though its combined capacity is only 5.6%. As per the recent world bank report (Shuval *et al*., 1986) favoured stabilization pond for treating waste water in developing countries because of the shortage of skilled labour and availability of the land at reasonable opportunity cost.

(Ajay Tyagi, 2013) 152 STPs are there across 15 states in our country. 9 STPs are under construction out of 152 STPs. Moreover, 30 STPs are not operating and 28 STPs are not performing satisfactory. 49 STPs are exceeding the BOD standards and 7 STPs are violating the general standards of discharge with respect to COD. STPs which are designed on trickling filters and sequential batch reactor technologies are meeting the standards and their efficiency in more than 90% in terms of BOD removal. Ministry of environment and forest were funding 179 STPs under GAP-I, YAP-I and NCRD scheme. 152 STPs with installed capacity of 4716 MLD are being inspected and their actual utilizable capacities are 3126.42 MLD i.e. only 66% of installed capacity.

8.3 INDICATOR FOR WATER QUALITY IN WASTEWATER:

(Ghanizadeh *et.al*., 2001). The temperature of wastewater varies greatly, depending upon the type of operations being conducted. The survey of various treatment processes in wastewater treatment shows that temperature is an important factor affecting efficiency of settling and flocculation. Changes in wastewater temperatures affect the settling rates, dissolved oxygen levels, and biological action. The temperature of wastewater becomes extremely important in certain wastewater unit operations such as sedimentation tanks and re-circulating filters

(D Wani *et al.*, 2013) Microbial pollutants can be served as an indicators for water quality. Like total and faecal coliforms, and the entercocci - faecal streptococci are the indicator organisms currently used in the public health area because they indicate fecal contamination and presence of enteric pathogens in surrounding wastewater/water. Indicator organisms are always used to determine the relative risk of the possible presence of a particular pathogen in wastewater/water. *E. coli* are a particular species of bacteria that may or may not be pathogenic but are widely present in the human intestinal tract. The increased population and urbanization in Srinagar city has resulted in an increase in the discharge of domestic sewage into the water bodies especially Dal Lake, due to which the lake has undergone tremendous changes in its chemical, biological and trophic status. So there is an immediate need for trapping these pollutants before releasing into the lake.

8.4 COMPARISION OF DIFFERENT BIOLOGICAL UNITS:

(Saumyen Guha and C S Harndranath, 2013) An aerobic process is the one in which the organic matter is consumed by bacteria that use oxygen for respiration. An aerobic process is the one in which bacteria use elements or functional groups other than oxygen for respiration (e.g., nitrate, manganese, iron, sulphate, organic matter, carbon dioxide). In case of complex mixtures of recalcitrant organic compounds, both may be required as some compounds may be more efficiently degraded by anaerobic bacteria and some by aerobic. It is also common for a recalcitrant compound to first get partially degraded by anaerobic bacteria and then mineralized (organic carbon to carbon dioxide) by aerobic bacteria.

(A Samie *et al*., 2009) For sewage treatment plants to meet national and international standards, there is a need to improve treatment processes and to adopt stringent policies in terms of monitoring and control of the quality of the final effluent. This includes the use of effective methods for the detoxification and disinfection of the sewage effluent. Depending on the origin of the sewage, different treatment processes should be in place. In a region that cannot afford sewage treatment plants, a lagooning system is the minimal requirement for treatment of wastewater (WHO, 1989). Although the presence of high level of nutrient might be useful for the irrigated plants the presence of pathogenic bacteria may be detrimental for those who might consume the product without prior proper cleaning. Other parameters that might affect the treatment of STP wastewater include the temperature, pH, conductivity, dissolved oxygen and elements such as nitrogen and phosphate.

(Prachi N. Wakode *et al.,* 2014) US EPA report summarized “The SBR is equivalent to activated sludge system which operates in time rather than in space”. In SBR, there is a requirement of only one basin because every process happens there only. So less civil structure is required. Inter-connecting pipework, and process equipment and the consequent savings in capital and operating costs. While as in activated sludge system, requirement of separate tanks for the unit processes of biological reactor and solid-liquid separation. Also returned sludge from the final clarification stage to the aeration tank. SBR is having the capacity of cyclically mixing and aeration to promote anoxic/aerobic and anaerobic environments with less energy consumption.

(Charu Sharma *et al.,* 2013) Advanced aerobic biological filtration and oxygenated reactor process is an emerging advanced waste water treatment technology that’s gaining success around the world.

BIOFOR is one of the patented technologies of M/S Degremont limited. It includes vigorous aerobic treatment. BIOFOR filters are having aerobic biological reactors that use attach growth technology. The biological filtration can be described as a system of three phase with

A solid phase: The filter media with attached biomass.

A liquid phase: the wastewater that passes through filter material.

A gas phase: the oxygen to assure oxidative process or the gaseous nitrogen at denitrification.

Economically if we consider this, space requirement is very less as compared to conventional activated sludge system. 75% space saving can be achieved if complete BIOFOR technology is adopted. BIOFOR requires $500m^2$/MLD. Space saving can be done upto 40% if its installed along with the activated sludge system for which area requirement is $900m^2$/MLD. Operation and maintenance cost should be considered. Capital cost for BIOFOR plant upto tertiary treatment ranges from Rs. 100-105 lac/MLD and capital cost is ranging between Rs. 6-8 lac/MLD of treated water. The cost factor is also affected on the basis of material availability, local conditions and property prices etc.

8.5 NUTRIENT/PATHOGEN REMOVAL FROM WASTEWATER TREATMENT PLANT:

(E O'Reilly *et al.*, 2013) Nutrient removal using on-site wastewater treatment system:

Nitrogen removal: For nitrogen removal, nitrification-denitrification process is suitable especially for temperate climates. Denitrification in soils used for percolation, where possible is a simple and attractive, though effectiveness can vary depending on a number of issues including the presence of organic carbon, the level of soil saturation and the soil texture. Horizontal flow biofilm (HFBR) recently developed and is very good.

Phosphorus removal: Phosphorus can be removed through adsorption and can be directly related to the adsorptive capacity of filter media. Dedicated adsorptive type system can offer effective Phosphorus removal on-sites in sensitive areas where discharge is into or close to a water course.

Pathogen removal: Disinfection becomes mandatory in the cases where discharge can potentially result in pollution of drinking water sources, agriculture farms and bathing waters, where surface water discharge is being considered or where treated water is being reused. Membrane Bioreactors (MBR), can offer a solution where pathogen removal is required. UV is inexpensive and does not produce disinfection by-products and relatively simple to install and operate. Conventional disinfection methods such as UV, ozone and chlorine are not effective against pathogens such as nematode. Gamma radiation could provide an alternative solution, however, it may increase the cost factor. So we can apply this technology where water is in the limited quantity.

(M Suplee, 2007) Biological Nitrogen Removal (BNR) processes are incorporated into wastewater treatment systems to reduce effluent Total Nitrogen (TN) to an average level of 8 to 10 mg/L and Total Phosphorous (TP) to an average of 1 to 3 mg/L before being discharged into a receiving water body (Freed 2007). In many cases, BNR technologies can be retrofitted to existing plant configurations and are adaptable to climate extremes. Nitrogen in wastewater is usually in the form of organic nitrogen and ammonia. Nitrogen in municipal wastewater is generally not removed by conventional secondary treatment. BNR for nitrogen is achieved through a series of biochemical reactions that transform nitrogen from one form to another. The key transformations are nitrification and denitrification (USACE 2001). Phosphorus removal obtained in a conventional biological wastewater treatment is very less (mostly less than 20 percent).

Chapter 9

RESEARCH METHODOLOGY

1. Survey: Survey will be conducted for knowing the present scenario for disposal of domestic wastewater from the common people. It will also benefit in creating awareness of the concept of domestic wastewater and its disposal. It will be done with the help of questionnaires. Few selected questions will be prepared in a particular questionnaire. Those questionnaires will be randomly distributed to the common people near of satluj. Attempts will be taken to cover up the maximum possible wards of Satluj from every zone. Feedback from the survey will be recorded. The mode of questionnaires will be offline as well as online. In offline mode, door to door survey will be conducted and in online mode, questionnaires will be send via mail to the local people. The questions that will be used in questionnaires are given below:

- How can you contribute for the reduction of waste water?
- Are you aware of the wastewater treatment and sewage treatment plants?
- What according to you is the best way for disposal of domestic wastewater?
- What kind of sanitation facility your house and locality have?
- What kind of domestic sewage treatment plant will you prefer for you locality?
- Are you willing to use the treated wastewater (which is fulfilling the standards) for domestic purpose?
- Are you willing to help and contribute in the construction of sewage treatment plant?
- Do you think that the construction of STP would be a solution to the frequent floods that the state is facing?

2. Physical, chemical and biological tests of local water bodies (Satluj River): Various tests of the local water bodies will be conducted in the government laboratory under PHE at HMT. The tests will be conducted so that it becomes evident that water bodies are contaminated because of the direct discharge of wastewater into them. The tests will be conducted are mentioned below along with the procedure:

I. Turbidity: It's the cloudiness or haziness of a water because of the large numbers of individual particles that are generally invisible to the naked eye same as to smoke in air. The measurement of turbidity is an Important test of water quality.

For determination of turbidity we will use naphelometric unit (NTU). It is used to measure turbidity by the principle of scattering of light. In this instrument, the sample scatters the light that impinges on it. The scattered light is then measured by putting the photometer at right angles to the original direction of the light generated by the light source. This instrument is calibrated and digitised.

II. pH: It is defined as the log of reciprocal of hydrogen ions present in the water; i.e.

$$pH = \log_{10} 1/H^{+}$$

It is helpful in determining the acidity or the alkalinity of water. If pH value is found to be less than 7, it will become acidic in nature, and if pH is found more than 7, it will become alkaline in nature. It is an important parameter in water supply systems and sewage treatment processes.

pH meter

For the determination of pH, pH-meter will be used. A beaker or a glass (electrode), in association with calomel electrode, dipped into the water, detects hydrogen ions. The meter is pre-calibrated by using the standard solutions of known pH values, and can be used to directly read the pH value of the given sample of water, kept in the glass or the beaker.

III. Alkalinity: Alkalinity is a measure of the buffering capacity of water, or the capacity of bases to neutralize acids. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. Alkalinity does not refer to pH, but instead refers to the ability of water to resist change in pH. The presence of buffering materials help neutralize acids as they are added to the water. These buffering materials are primarily the bases bicarbonate ($HCO3^-$), and carbonate ($CO3^{2-}$), and occasionally hydroxide (OH^-), borates, silicates, phosphates, ammonium, sulfides, and organic ligands

Titration of water sample

For the determination of alkalinity titration is done. An acid of known strength, known as titrant, is added to a given sample of water. The volume of acid required to bring the sample to a specific pH level reflects the alkalinity of the sample. The pH end point is indicated by a color change. Alkalinity is expressed in units of milligrams per liter (mg/l) of $CaCO_3$ (calcium carbonate).

IV. Total dissolved solids (TDS): This is one of the quality check parameter. High concentration of TDS indicates the poor quality of water. It is the concentration of the dissolved chemicals in the water. These chemicals could have been solids or liquids before dissolving.

TDS/Conductivity meter

We will use electrical conductivity for its determination with the help of TDS meter. This is easy and reliable method for the detection of TDS. We have to dip the TDS probe into the water and the TDS meter will measure how well the water conducts electricity. It then converts that to concentration of total dissolved solids. The instrument should be well calibrated and digitalized.

V. Conductivity: Conductivity is used to measure the concentration of dissolved solids which have been ionized in a polar solution such as water. Since the electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS). Salts dissolve into positively charged ions and negatively charged ions, which conduct electricity.

For determination of electrical conductivity we will again use the TDS/conductivity meter as done for the determination of TDS.

VI. Hardness: The basic definition of harness implies the amount of dissolved magnesium and calcium in the particular water. The water which is hard, is having high concentration of dissolved minerals, including both magnesium as well as calcium. We can say, hardness indicates the ability of water to form foam or lather.

The total hardness of a given sample of water can be determined by titration, by using E.D.T.A. solution as a titrating agent. We have to use a good indicator (like Eriochrome Black T) so that it will easily show when EDTA becomes excess, or when all the ions causing hardness have been used up to form complex compounds of the divalent ions. During the titration with EDTA, all free hardness causing ions are complexes. Finally, the EDTA disrupts the wine red because it's capable of forming a more stable complex with the hardness ions. This action frees the EBT indicator, and the wine red color changes to distinct blue colour, showing the end point of titration.

VII. Iron content: Human bodies require iron to function properly, but if its dosage exceeds the permissible limit then it's harmful for the health. It is considered as secondary contaminant because it acts as a useful surrogate for other heavy metals, whose presence in drinking water is a real danger to public health. It has a high impact on food and property. It imparts a bloody taste in water.

It can be determined with the help of spectrophotometric technique. It involves the complication of Fe2+ with 1,10-phenanthroline (phen) to produce an intensely red-orange colored complex. Since the iron present in the water predominantly exists as Fe3+, it is necessary to first reduce Fe3+ to Fe2+. This is accomplished by the addition of the reducing agent hydroxylamine. An excess of reducing agent is needed to maintain iron in the +2 state (because dissolved oxygen will reoxidize Fe2+ to Fe3+). Fe2+ is quantitatively complexes by 1,10-phenanthroline in the pH range from 3 to 9. Sodium acetate is used as a buffer to maintain a constant pH at 3.5. The determination of the iron-phen complex is performed with a spectrophotometer at a fixed wavelength of 508 nm using external calibration based on iron standard solutions.

Chlorides: The chloride ion is the anion (negatively charged ion) Cl^-. It is formed when the element chlorine (a halogen) gains an electron or when A compound such as hydrogen chloride is dissolved in water or other polar solvents. Chloride salts such as sodium chloride are often very soluble in water. In water it is generally present in the form of sodium chloride and may be due to leaching of marin sedimentary deposits, pollution from sea water, domestic wastewater etc.

Chloride content can be measured by titrating the water with standard silver nitrate solution using potassium chromate as an indicator.

IX. Nitrites/Nitrates: The partially oxidized organic matter present in water in the form of nitrites. It's very dangerous and its value should be nil in potable water. The nitrates represents the fully oxidised organic matter. The presence of excess amount of nitrates in water may adversely affect the health of infants, causing a disease called mathemoglobinemia

Determination of nitrates by color matching method

The amount of nitrites or nitrates, present in the water sample, can be measured by color matching methods. For nitrides, the color is developed by adding sulphonic acid and napthamine; whereas for nitrates, the color is developed by adding phenol-di-sulphonic acid and potassium hydroxide. The colored developed in water is finally compared with the standard colors of known concentration.

Dissolved oxygen: Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing

water quality because of its influence on the organisms living within a body of water. A dissolved oxygen level that is too high or too low can harm aquatic life

and affect water quality

DO detector

The most popular method for dissolved oxygen measurements is with a dissolved oxygen meter and sensor. It is a modern techniques which involve either an electrochemical or optical sensor. The dissolved oxygen sensor is attached to a meter for spot sampling and laboratory applications or to a data logger, process monitor or transmitter for deployed measurements and process control.

XI. Biochemical oxygen demand (BOD): If sufficient oxygen is present in water, the useful aerobic bacteria production will flourish and cause the biological degradation of waste and organic matter, thereby reducing the carbonaceous material from the water. The amount of oxygen required in the process until oxidation gets completed is known as BOD. Polluted water will continue to absorb oxygen for many months, till the oxidation gets completed, and it is not practically possible to determine this ultimate oxygen demand. Hence, the BOD of water during the first five days at 20°C is generally taken as the standard demand. It can be determined by calculating the oxygen demand of the sample at beginning. Then the sample will be incubated for five days at 20°C in an incubator. After five days the oxygen demand will again be calculated. Final dissolved oxygen will be reduced from the initial oxygen demand and that will be the BOD at 5^{th} day

XII. Pathogens: Bacteria are the minute single cell organisms possessing no defined nucleous and having no green material to help them manufacture their own food. They can be harmless, known as non-pathogens or harmful, called as pathogens. They can cause harmful diseases like cholera, typhoid, infectious hepatitis, etc. We use microbiological analytical procedure which uses samples of water and from these samples determine the concentration of bacteria. It is then possible to draw inferences about the suitability of the water for use from these concentrations. This process is used, for example, to routinely confirm that water is safe for human consumption or that bathing and recreational waters are safe to use.

Plate count method can be used for the determination of pathogens in water sample. The plate count method relies on bacteria growing a colony on a nutrient medium so that the colony becomes visible to the naked eye and the number of colonies on a plate can be counted. To be effective, the dilution of the original sample must be arranged so that on average between 30 and 300 colonies of the target bacterium are grown. Fewer than 30 colonies makes the interpretation statistically unsound whilst greater than 300 colonies often results in overlapping colonies and imprecision in the count. To ensure that an appropriate number of colonies will be generated several dilutions are normally cultured.

The laboratory procedure involves making serial dilutions of the sample (1:10, 1:100, 1:1000, etc.) in sterile water and cultivating these on nutrient agar in a dish that is sealed and incubated. Typical media include plate count agar for a general count or MacConkey agar to count Gram-negative bacteria such as E. coli. Typically one set of plates is incubated at 22°C and for 24 hours and a second set at 37°C for 24 hours. The composition of the nutrient usually includes reagents that resist the growth of non-target organisms and make the target organism easily identified, often by a color change in the medium. Some recent methods include a fluorescent agent so that counting of the colonies can be automated. At the end of the incubation period the colonies are counted by eye, a procedure that takes a few moments and does not require a microscope as the colonies are typically a few millimeters across.

3. Physical, chemical and biological tests of domestic wastewater: Various tests of the domestic wastewater will be conducted in the government laboratory under PHE at HMT. These tests will be conducted so as to determine the need and proper design criteria of sewage treatment plants.

All the physical, chemical and biological tests will be done by the same procedure as done for the water sample. Little dilution may be required in some tests. Rest all the procedure and methodology will remain same as above.

4. Population projections: Population projections are one of the primary criteria for estimating the future water demand and domestic wastewater generation of a city. The usual methods of population projections are based on the record of population of previous several decades. Obviously, the reliability of the projection model is dependent on the number of decades of data that is available. Some of the recommended methods of population projection are:

- Arithmetic mean: This method is based on the assumption that the population increases at a constant rate; i.e. $dP/dt=constant=k$; $P_t= P_0+kt$. This method is most applicable to large and established cities.
- Geometric mean: This method is based on the assumption that percentage growth rate is constant i.e. $dP/dt=kP$; $\ln P= \ln P_0+kt$. This method must be used with caution, for when applied it may produce too large results for rapidly grown cities in comparatively short time. This would apply to cities with unlimited scope of expansion. As cities grow large, there is a tendency to decrease in the rate of growth.

Incremental increase: Growth rate is assumed to be progressively increasing or decreasing, depending upon whether the average of the incremental increases in the past is positive or negative. The population for a future decade is worked out by adding the mean arithmetic increase to the last known population as in the arithmetic increase method, and to this is added the average of incremental increases, once for first decade, twice for second and so on

- Yearly variation
- Semi log (analytical): The three factors responsible for changes in population are: (i) Births, (ii) Deaths and (iii) Migrations.

  Logistic curve method is based on the hypothesis that when these varying influences do not produce extraordinary changes, the population would probably follow the growth curve characteristics of living things within limited space and with limited economic opportunity. The curve is *S-shaped* and is known as *logistic curve*.

Using the above methods population estimates for the period of design i.e. 30 years or 3 decades can be made.

Ward wise population densities: the future projections should also take into account the ward wise population densities. This is necessary because wards which have reached high population densities. This is necessary because wards which have reached high population densities, the prospects of growth will be lower than the wards which are thinly populated. Hence the same growth formula cannot be applied to densities and thinly populated wards.

The gist of the above discussion implied that a micro-level population projection technique has to be adopted in order to have a realistic estimate of future population.

Chapter 11

CONCLUSION

Satluj river water

Control on waste of industry treatment of NFL waste not allowing to waste directly in sutluj set reservoir on the way of river after every 2 km with minimum storage 10000k . this water tank below the surface of river this water use for agriculture and other purpose set treatment plant according to requirement with the interblend under the conversation of tables and graphs, it will certain changes (increase or decreases) according to time and place. We will wants to control with the control and purification.

Result

According to this idea we will never face the waste water treatment and obtained a healthy environment with respect. We will never face shortage of water and obtained a better satluj river.

Chapter 12

EXPECTED OUTCOME

The expected outcomes of the research in designing of the sewage treatment plant in Satluj will be:-

- Gathering the results from questionnaires so that it can help in determining the approximate estimation of extend of domestic wastewater generation and its discharge into the local water bodies.
- Testing the domestic wastewater samples and designing the sewage treatment plants accordingly.
- Quality check of raw water so as to determine the health hazard from the particular pollutant.

Chapter 13

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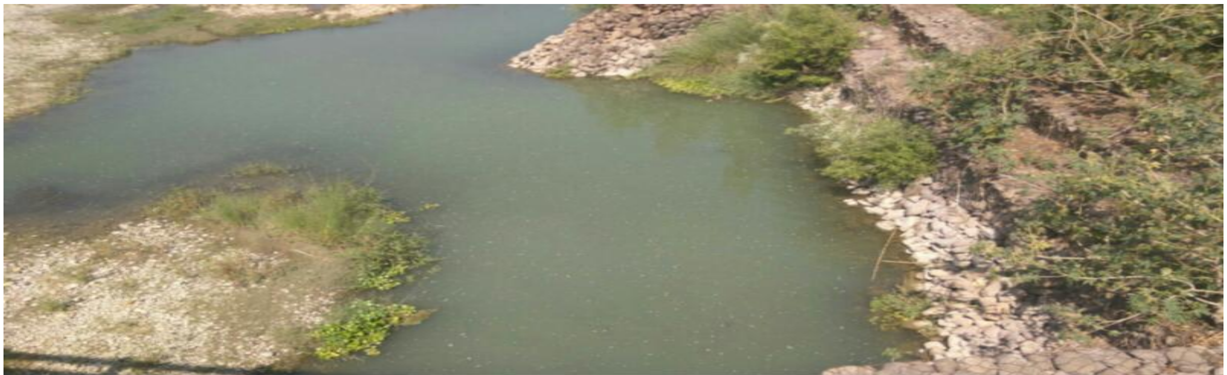
Chapter 14

SATLUJ PICTURE GALLERY



Chapter 15

LAB PICTURE GALLERY