# Environmental Impacts of Industrial Development: A study of Baddi-Barotiwala Industrial Area, Himachal Pradesh

Megha Singla[1] , Gagandeep Singh[1] , Sayena Singla[1]
[1]Department of Urban Planning, Lovely Professional University, Phagwara, Punjab, India

**Abstract**

India being a developing nation has various factors that lead to the development of the country. One of the important factors making India the fifth largest economy in terms of GDP is the manufacturing sector. The Gross Value Added from the industrial sector in India grew at a compound annual growth rate of 4.29% between FY12 and FY19 contributing 16% to the overall GDP of the country. The industrial sector is recognized to improve the economic status of the country because of which many initiatives like "Made in India" are taken by the GoI expecting to increase the GDP contribution of industrial sector by 22% meeting the world standard of 30% and creating around a hundred million jobs for the people. Apart from the economic development that is caused by industrialization, it is also considered as one of the major sources of pollution in the world. The waste produced from the industry impacts the environment adversely causing air, water, and soil pollution. In this research, a study is conducted regarding the environmental impacts that industrial areas in India have on the environment focusing on Baddi-Barotiwala, Himachal Pradesh, an the industrial hub of our nation.

Baddi is notified as to the third-largest industrial hub of Asia and is ranked 22nd in terms of contribution to the GDP. Baddi consists of world-wide famous industries and companies such as Ranbaxy, Colgate, L'Oreal, Cadbury, and many more, which act as an economic source to a large number of people of the nation. The availability of such factories and export of the products is generating a GDP of ₹1.69 lakh crore (US$24 billion) out of which the contribution of Industry is 42%. But this has also led to a rising issue of increasing externalities on the environment. Bringing into consideration, this industrial belt of Baddi-Barotiwala-Nalagarh has various negative impacts on the environment within and in surrounding areas. Some of the negative impacts include depletion in groundwater level due to heavy extraction of the same, depletion of water quality, increasing diseases amongst residents and workers due to the falling Air Quality Index. This research focuses on analyzing the impact of industrial growth on water quality, air quality, soil quality, and noise.

## Introduction

Since ancient times, the main source of income in India has always remained agriculture. But due to the growth in population and to increase the economy of the country as well as to provide employment to the people the focus was shifted from agriculture to industry in 1956 with the establishment of Indian Industrial Policy. But as said, with the good comes the bad, so with the increase in the industries came the positive externalities in terms of modernization, improved lifestyle growth in diverse sectors and negative externalities in terms of pollution, extinction of flora and fauna and depletion of resources.

Due to industrial activities, various levels of pollutants are released into the environment directly or indirectly leading to the degradation of water, soil, and air quality. India is in the hold of an adverse water pollution problem. A report in 2015 by the government of India estimates that the major cause of the increase in the number of polluted waterways in the last five years is the release of untreated sewage from industries resulting in a situation where more than half of the country's rivers are contaminated. World health organization in its recent study has estimated that the air pollution caused by industries results in 2% of the heart and lung diseases globally. It is seen that even after witnessing one of the worst industrial disasters of all times that took place in Bhopal, India, in 1984 which claimed the lives of more than 8,000 people no evident steps are taken in terms of checking the externalities of the industries. So this study is done to evaluate the environmental parameters affected by the industrial set-up, along with the type of impact it has on the same and people around.

Baddi is an industrial hub (with a total of 2,120 factories generating a turnover of Rs 60,000 crore) in the Southwestern Solan district of Himachal Pradesh. The city of Baddi has an area of about 6.99 sq. km. with a

population of 25639 constituting a density of 3668 per sq.km. The town lies on the border of Himachal Pradesh and Haryana in the Shivalik Hills around 35 kilometers west of Solan. The city is connected to Pinjore, Haryana through NH105 and Nalagarh through NH21A.

**Physiographic Characteristics**

The description of the features and phenomenon of nature along with physical geography is called physiography. The geological structures depend upon the tectonic and lithologic characteristics of the region. Major characteristics in physiography include wind direction, elevation, flow direction, soil, rainfall, climatic characteristics, etc.

Wind Direction

The wind direction plays an important role in terms of location of the industry as it should not effect the people residing in the vicinity. The average wind direction in the area is NW having an average speed up to 5.4m/s.

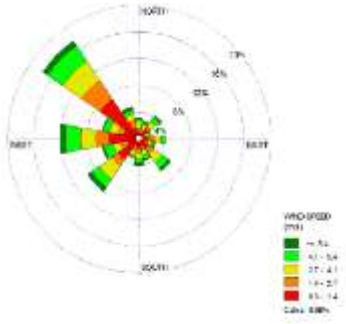


**Figure 1: Wind rose diagram**

Elevation

Baddi-Barotiwala areas is located at foothills of shiwalik range. Area has a vast range of hills and area is surrounded by shiwalik hills, Surajpur-Haripur-Mandhala range and Dharampur Range. Average elevation of the area is 372 metres.

Flow Direction

The topography is cut by khuds and Nallahs. The channels flow from east to west and join Sirsa River. Sirsa is the main perennial river in BBN area. Tributaries of the river are non-perenial and hence, remain dry during non-rainy season.

Soil

The area consists of brackish water sediments and the upper tertiary sediments consisting of shiwalik group fluvial deposits. It also consists of organic inter mountain deposits and alluvium. Most of the area has soils namely black, brown alluvial soils.

Bearing capacity of the soil is 15 tonne/sq.m. that can be used for urban development and construction of super structures.

Groundwater

The groundwater level varies in the areas near water bodies than the areas away from the water bodies. Heavy extraction of groundwater, since groundwater being the only source of water for the area, for residential, commercial and industrial purposes leads to groundwater depletion. The groundwater lever near water bodies is 5.5 m to 6.3 m whereas it is 10-13 m in industrial areas.

Rainfall

Area experiences humid climate characterized by hot summers and mild winters. Rainy season starts from July and continues till September. Average rainfall (yearly) of the area is about 105 cms. The area also has winter rains that generally commence from December and continue till February .

**Evolution in Industrial Development**

Industrial growth in Baddi-Barotiwala industrial area began in year 2003 after the provision of subsidies by GOI. From year 2003 to year 2007, adverse effect on the industrial growth is seen. Further, from year 2007 to 2011, industrial growth in the areas of Jharmajri and Thana is observed due to the growing connectivity and improved transportation facilities.


Further, from year 2011 to 2014, areas of Baddi, Bhatolikalan and Thana became denser due to industrial growth and coming up of industries of various types and categories due to certain topographical and infrastructural facilities. Areas of Haripur-Sandholi and Thana grew by 2017. Overall, areas of Jharmajri and Bhatolikalan-Thana i.e. north-western parts of the industrial areas developed.


**Figure 2: Evolution of Bad**

## Land Use Distribution

Total area of Baddi-Barotiwala industrial area is 49.16 sq.km. Landuse distribution of the Baddi-Barotiwala area shows that maximum area is covered by green and open spaces i.e. 65%. Followed by industrial area i.e. 24%. Industrial area consists of industrial clusters and phases in both Baddi and Barotiwala, namely: EPIP Phase-I at Jharmajri, EPIP Phase-II at Thana-Bhatolikalan, HPSIDC and HIMHUDA. Barotiwala Industrial Area came up in 1962-63 whereas, Baddi industrial area came up in 1982.

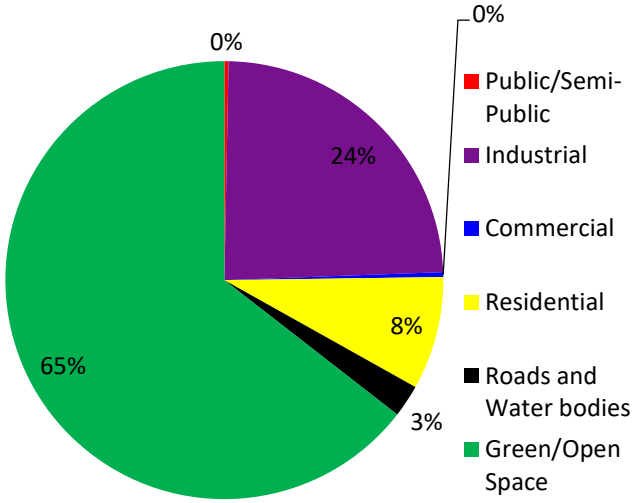



**Figure 3: Land Use distribution of Baddi-Barotiwala Area**

## Industrial Clusters

The study area: Baddi-Barotiwala Industrial Area, Himachal Pradesh is divided into 5 major industrial areas for the study purpose for thesis project, namely: Thana-Bhatolikalan, Baddi, Haripur Sandholi, Jharmajri and Barotiwala. Percentage distribution of industries shows that maximum number of industries are found in Baddi-Haripur Sandholi area followed by Jharmajri and Barotiwala. 58% of total industries found in Baddi-Barotiwala industrial area are found in Baddi.

Industrial area consists of industrial clusters and phases in both Baddi and Barotiwala, namely: EPIP Phase-I at Jharmajri, EPIP Phase-II at Thana-Bhatolikalan, HPSIDC and HIMHUDA. Industrialization in Baddi-Barotiwala area came up due to some of the following reasons:

- Government of himachal came up with friendly industrial policies.
- Good connectivity with neighboring states;
- Entrepreneurs, manufacturing units in the region.
- Area has a virtues of sustainability for development, advantages of flat land, power, water and transport facilities.

Following is the overall industrial distribution (percentage) of Baddi-Barotiwala area.

Distribution of industries is done in areas of Baddi, Barotiwala, Jharmajri, Bhatolikalan, Katha, Thana and Nalagarh. Maximum number of industries are located in Baddi followed by industries in Jharmajri. Industries located in the industrial areas included pharmaceutical industries, plastic, electronic, packaging, cosmetics, chemical, food and beverages, textile industries etc. The industries are further classified into red, green and orange industries as per the standards from MoEF.

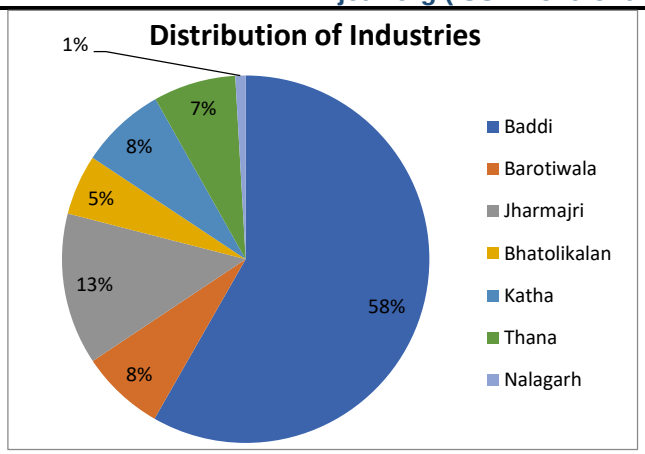



**Figure 4: Types of Industries**

There are more than 2000 industries in Baddi-Barotiwala-Nalagarh Region of various types and categories. Out of these, as per studies conducted by the local help groups along with local people and NGOs, it was found that just 45% of the industries are set up with legal consent, whereas rest 55% are set up without any legal consent. The data isn't published by the government officials or PCB for the benefits they receive for the same.

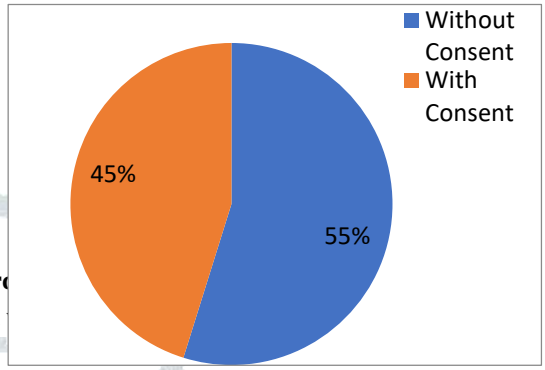



**Figure 5: Perc and**

Figure 6 shows the classification of industries into re green. Maximum number of industries are under g followed by the orange and red. Green industries set up in the area fall under medium or small scale industries, whereas the red and orange industries fall under medium and large scale industries (source: PH report of Baddi-Barotiwala area 2015; Draft EIA report of BBN area industrial set up 2014).

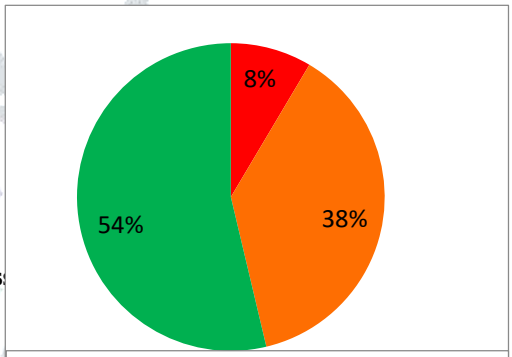



**Figure 6: Class**

Figure 7 shows the classification of industries that are set up without consent in the region. This again shows that maximum number of industries are under green category, followed by the orange and red category industries. Green industries mainly consist of small scale and medium scale industries whereas red industries are mostly of medium and large scale industries which have much adverse effect on environment as compared to the others.

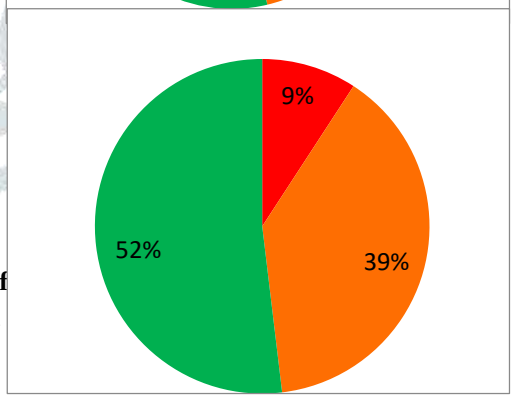
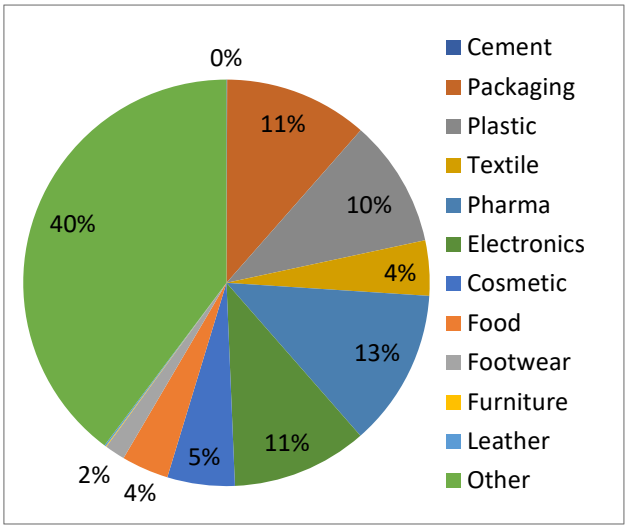



**Figure 7: Classif without consent**



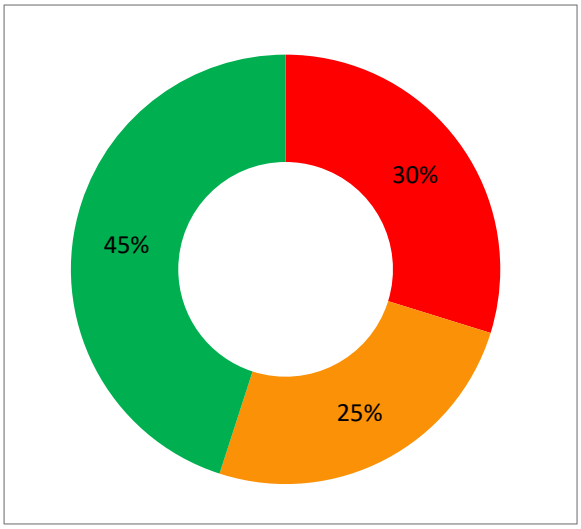




Figure 8 and Figure 9 show classification of types of industries and categories of industries in Baddi-Haripur Sandholi industrial areas. The area mainly consists of electronical, pharmaceutical, packaging and plastic industries. Other industries located in Baddi-Haripur Sandholi area include cement, textile, electronics, food, footwear, furniture, leather and cosmetics industries.

45% of the total industries fall under green category, followed by red industries i.e. 30% and least are the orange industries i.e. 25%. Cement, packaging, pharmaceutical and cosmetics industries are red industries. Plastic, textile, electronics, leather fall under green industries. The rest, including food and other industries that consist of AC, etc are orange industries.

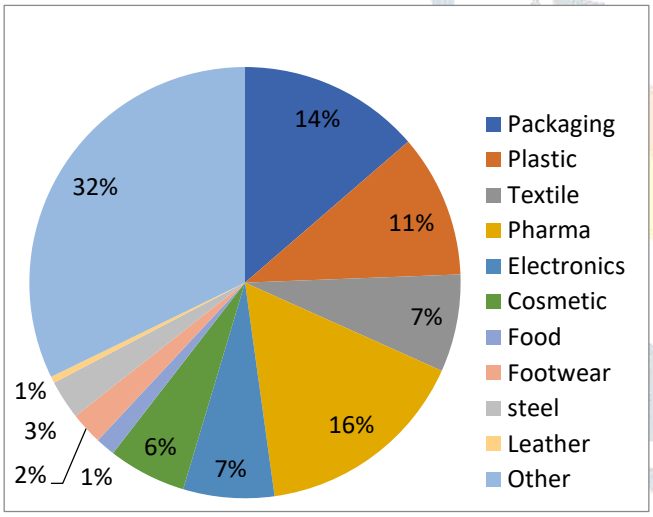



**Figure 10: Types of Industries in Jharmajri**

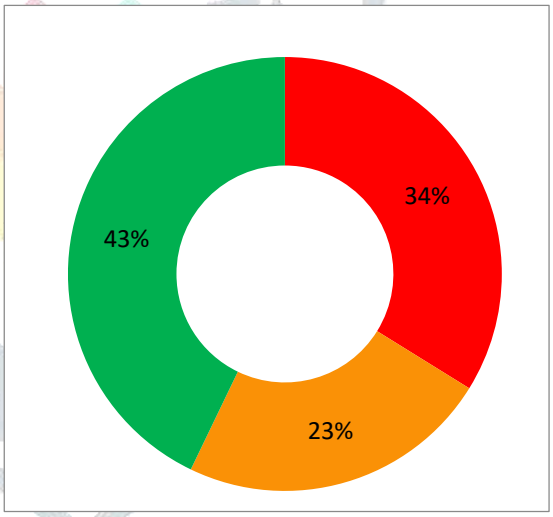



**Figure 11: Classification of Industries in Jharmajri**

Figure 10 and Figure 11 show classification of types of industries and categories of industries in Jharmajri industrial areas. The area mainly consists of electronical, pharmaceutical, packaging and plastic industries. Other industries located in the industrial area include textile, electronics, food, footwear, furniture, leather and cosmetics industries.43% of the total industries fall under green category, followed by red industries i.e. 34% and least are the orange industries i.e. 23%. Cement, packaging, pharmaceutical and cosmetics industries are red industries. Plastic, textile, electronics, leather fall under green industries. The rest, including food and other industries that consist of AC, etc are orange industries.

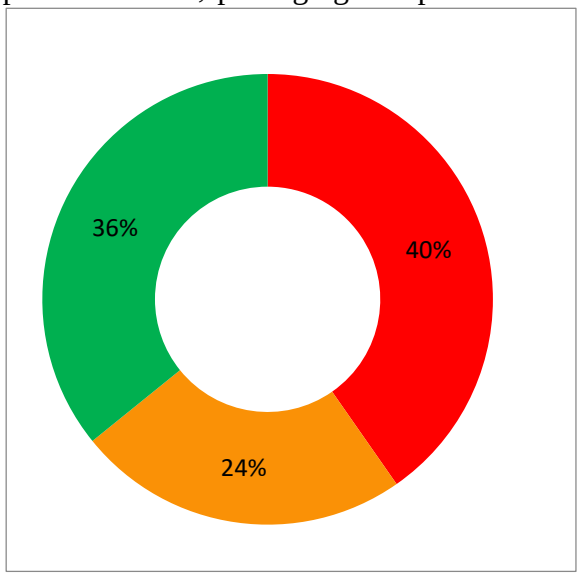



**Figure 13: Classification of Industries in Baroda**

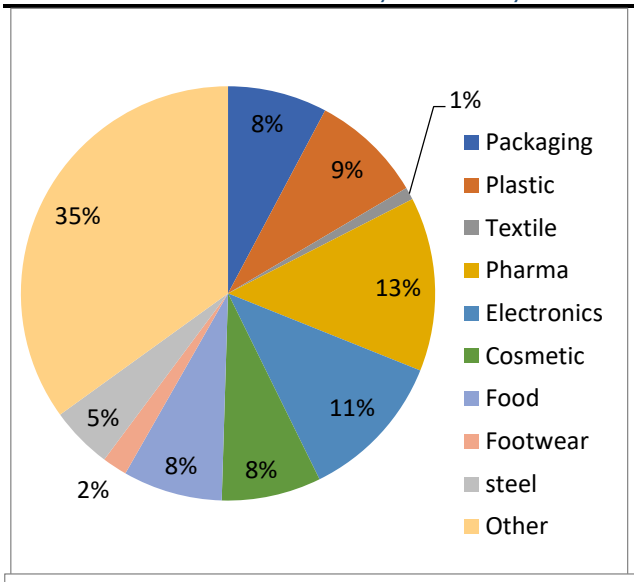



Figure 12 and Figure 13 show classification of types of industries and categories of industries in Barotiwala industrial areas. The area mainly consists of electronical, pharmaceutical, packaging and plastic industries. Other industries located in Barotiwala area include cement, textile, electronics, food, footwear, furniture, leather and cosmetics industries.

36% of the total industries fall under green category, whereas red industries are the highest i.e. 40% and least are the orange industries i.e. 24%. Cement, packaging, pharmaceutical and cosmetics industries are red industries. Plastic, textile, electronics, leather fall under green industries. The rest, including food and other industries that consist of AC, etc are orange industries.

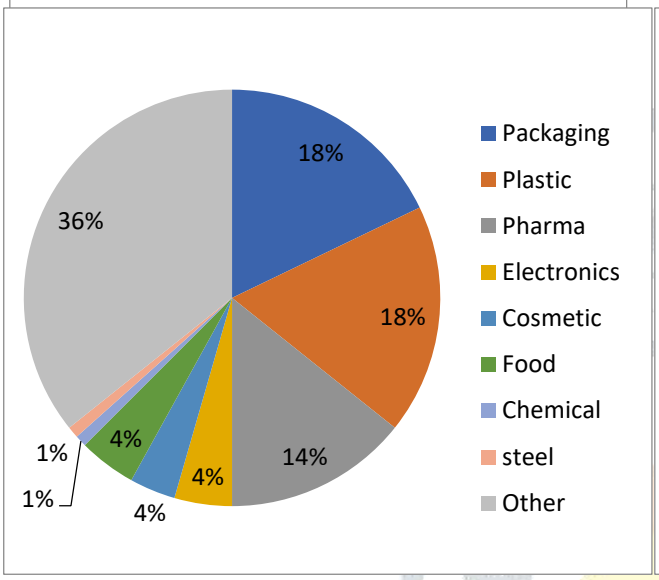



**Figure 14: Types of Industries in Thana**

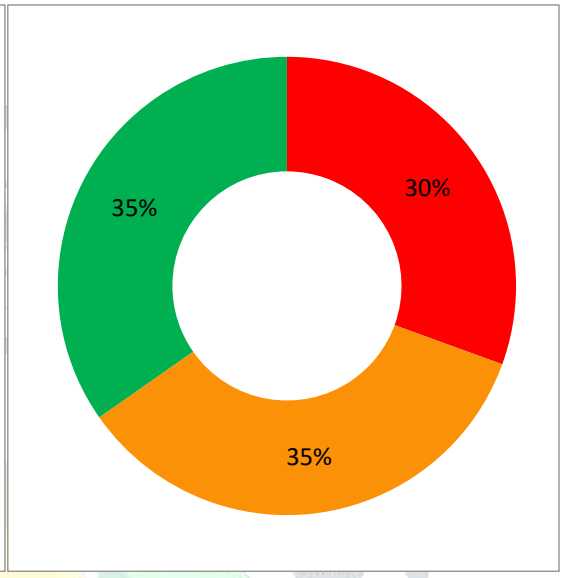



**Figure 15: Classification of Industries in Thana**

Figure 14 and Figure 15 show classification of types of industries and categories of industries in Thana-Bhatolikalan industrial areas. The area mainly consists of pharmaceutical, packaging and plastic industries. Other industries located in Barotiwala area include steel, electronics, food, footwear, furniture, leather and cosmetics industries.

35% of the total industries fall under green and orange category, followed by the red industries i.e. 30%. Cement, packaging, pharmaceutical and cosmetics industries are red industries. Plastic, textile, electronics, leather fall under green industries. The rest, including food and other industries that consist of AC, etc are orange industries.

**Impacts of Industrial Growth**

Impact on Water Quality

Industrial impact on water: both groundwater and surface water can be so adverse that it may affect both environment and ecology in various ways. Surface water gets consumed by the stray animals and people who depend on it for livelihood.

Groundwater, being the only source of water in area is extracted heavily by both common people and industrial sectors for consumption. Thus, polluting the same with industrial effluents has an impact on overall environment and ecology.

1. Groundwater

Groundwater is water present underneath the surface ground that can be extracted for any kind of purpose through different methods and procedures. Ground water level near Sirsa river basin varies from 5m to 10m, whereas, it varies from 13m to 15m in other areas away from the Sirsa River basin. The variation mainly occurred due to heavy extraction of groundwater for industrial purposes. The only source of water in the region is ground water.

Not only is the ground water table depleting or is going down, but also is the ground water getting contaminated due to release of chemical effluents from industries in the form of wastes, both solid and liquids. Groundwater in the study area occurs in porous consolidated alluvial formation comprising sand, silt, gravel, cobbles/pebbles. It occurs both under phreatic and confined conditions. Groundwater level in valley of Sirsa is 5.5 m to 6.3 m near the riverbed. Average elevation is estimated to be 300-3000m above sea level. Contamination of water by trace metals leads to health issues amongst living organisms. Heavy metal toxicity leads to cardio-vascular, neurological problems. High concentration of one or more heavy metals is responsible for the ill health of people residing there. 27% of the samples crossed desirable limits of 0.3 mg/L which makes it unsuitable for drinking purpose. Presence of Iron in ground water and its further consumption leads to gene mutation, heart diseases, liver problems, diabetes etc (Figure 16).

Exceeded permissible limits 0.05 mg/L in 5% samples. Presence of lead in ground water leads to burning in mouth, vomiting, diarrhea, chronic paralysis, anemia etc (Figure 17).

13% of the tested samples are found non-potable due to presence of elements such as copper. Presence of this leads to liver damage and irritation of central nervous system (Figure 18).

Manganese is found above desirable limits in more than 18 samples. Presence of this leads to change in appetite and reduction in metabolism of iron to form hemoglobin (Figure 19).

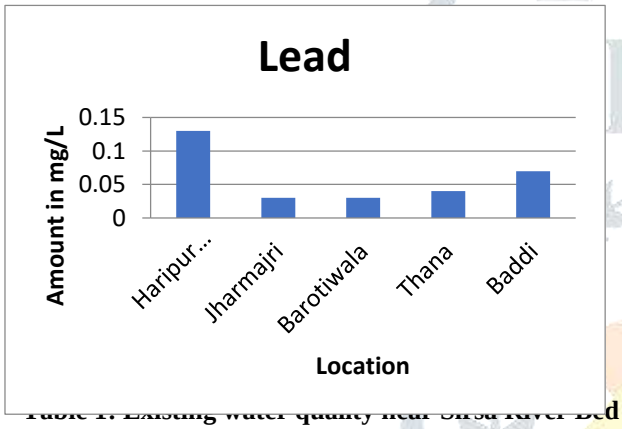



Figure 16: Presence of Iron in Groundwater

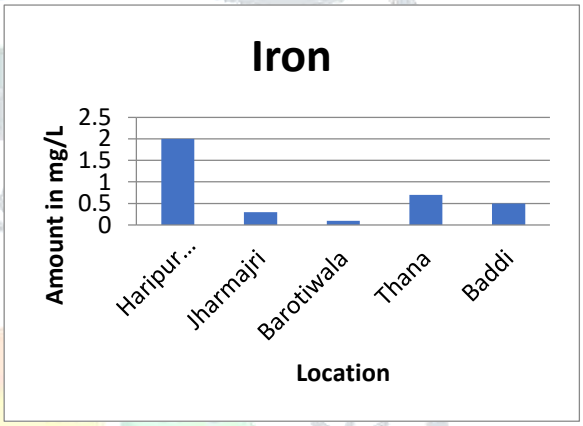



Figure 17: Presence of Lead in Groundwater

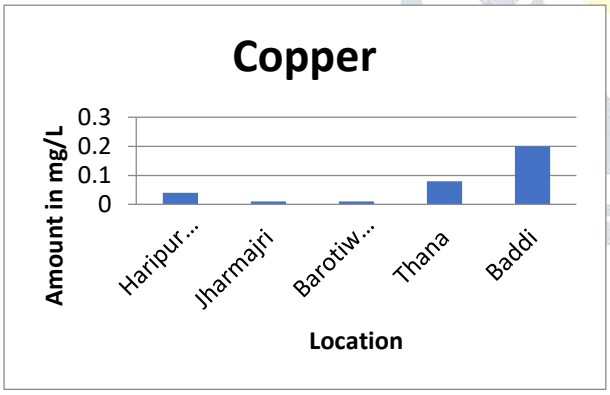



Figure 17: Presence of Copper in Groundwater

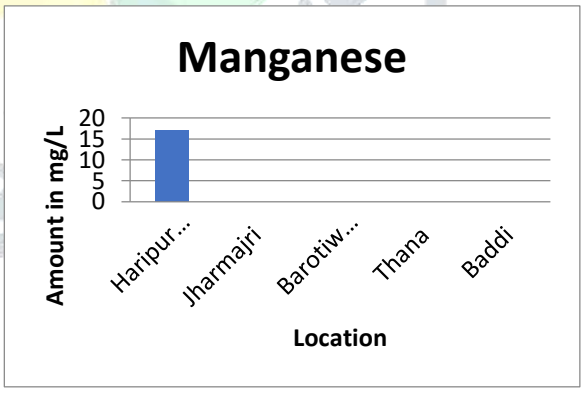



Figure 18: Presence of Manganese in Groundwater

2. Surface Water

The table 1 shows water quality of surface water near the river Sirsa. Ph level of the samples collected showed that the water was acidic in nature. Tests were conducted by NGOs and Public Health groups like HIMDHARA and HIMPARIVESH in 2016 as the government departments failed to showcase the true results to public. Other parameters like TSS, TDS, BOD came out to be in medium range when compared to the national standards.

| Parameters | Existing water quality | Remarks |
|---|---|---|
| pH | 3.6 | |
| DO | 2.6 | Low |

| | | |
|---|---|---|
| BOD | 7 | |
| TSS | 6.1 | |
| TDS | 508 | Medium |
| COD | 86 | |
| Coliform | 233500 | High |

**Source: Primary Survey, February 2018**

Table 2 shows data regarding water quality and the presence of different parameters in different samples collected from different locations in the industrial area. Samples collected from Sito Majra Nallah seem to have crossed permissible limits in a number of parameters. Polluted water affects people and other living organisms residing in the surrounding areas. Measures need to be taken in order to reduce the pollution level and avoid it from increasing in the other locations.

**Table 2 : Existing water quality at different locations in**

| Parameter | Sito Majra Nallah | Sandholi Drain | Permissible Limits by PCB |
|---|---|---|---|
| pH | 7.2 | 7.3 | 6.5-8 |
| DS | 8780 | 670 | 2100 |
| SS | 1 | 2 | 1 |
| COD | 1892 | 484 | 250 |
| BOD | 575 | 155 | 30 |
| Sulphate | 45.2 | 72.5 | 1000 |
| Chlorides | 450 | 200 | 1000 |
| Nitrate | 12 | 33.1 | 20 |
| T-Hardness | 440 | 250 | 100 |

**Source: Primary Survey, February 2018**

Impact on Air Quality

Ambient air quality in impact area is monitored as per MoEF guidelines. The ambient air quality in India is observed and determined through ambient air quality networks in which various monitoring stations are set up in the cities of India. At each sampling station monitoring was done for an interval of 2 days per week for 4 weeks in a month during study period. Particualte matter ($PM_{10}$ & $PM_{2.5}$), sulphur dioxide ($SO_2$) and the oxides of nitrogen ($NO_x$), were sampled on 8/24 hourly.

**Figure 19: An industrial set-up in Jharmajri**

Results were divided into24 hours to meet the requirements of the MoEF and compared with the standards stipulated by CPCB. In addition to the above parameters, $CH_4$and CO is also monitored.

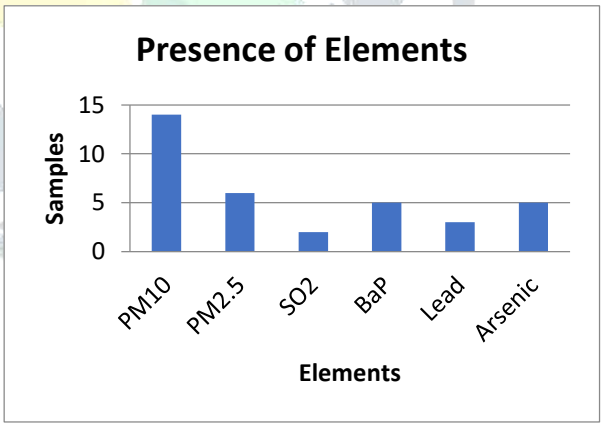
1. Scenario

a) Particulate Matter < 2.5µ & 10µ

Particulate Matter is use to determine the composition and amount of solid particles and liquid droplets suspended in the atmosphere. The main contributor to this is the manufacturing sector leading to an increased amount of health issues in the nearby settlements.

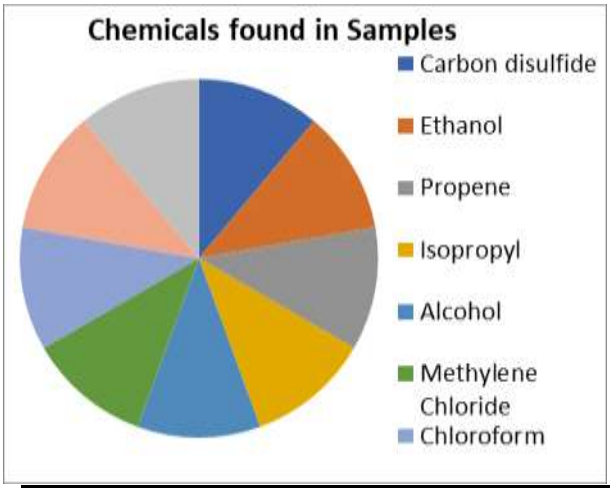
Particles ($PM_{10}$) having diameter between 2.5µ and 10µ is formed by mechanical activities (e.g. crushing, grinding, and abrasion of surfaces), evaporation from sprays and suspension of dust. $PM_{10}$ composed of alumio-silicate and other oxides of crystal elements originated from the dust from roads, agriculture, industry, construction and fly ash from fossil fuel.

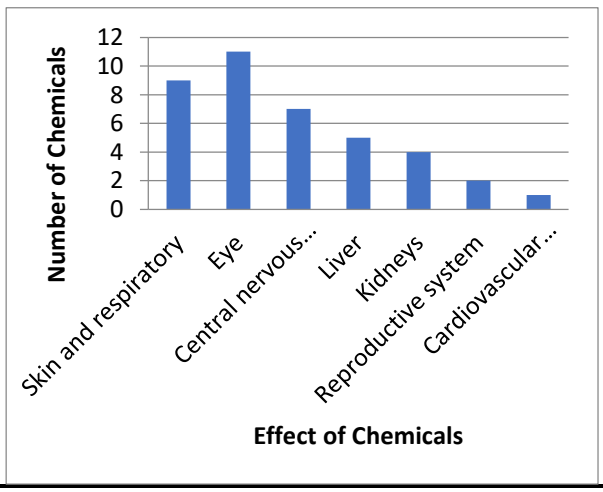
All dust samples revealed excess levels of PM10 and PM2.5 by upto 4 or 7 times of permissible limit respectively. Cadmium, lead, nickel, Manganese and Mercury were found in the samples. Chloroform was detected 321 times and Methylene chloride was detected 6.8 above US environmental Protection Agency Region 6 levels.




Presence of elements like PM10, PM2.5, SO2, BaP, Lead and Arsenic was found in the samples studies from different locations. These elements have different characteristics which lead to different types of impacts on both humans and other living organisms in the environment.

Presence of chemicals was detected in the air samples which included chemicals like carbon disulfide, ethanol, propene, isopropyl, alcohol, methylene chloride and chloroform. The chemicals present in air have an adverse on human body. Maximum number of chemicals have an impact on eyes followed by the skin and respiratory systems. Other types of impacts that these chemicals have include impact on central nervous system, liver, kidneys, reproductive system and cardiovascular system.



24 hours average values of $SO_2$ and oxides of nitrogen were compared with the national ambient air quality standards and found that all sampling stations recorded values were much lower.

**Table 3: Presence of SO2 ad NOx in air samples**

| | $SO_2$ | | $NO_x$ | |
|---|---|---|---|---|
| Location | Min | Max | Min | Max |
| Thana | 8.0 | 12.5 | 15.1 | 22.3 |
| Baddi | 8.3 | 12.8 | 15.7 | 20.6 |
| Barotiwala | 7.3 | 11.5 | 15.2 | 24.7 |
| Jharmajri | 7.6 | 12.0 | 13.9 | 20.1 |
| Haripur Sandholi | 7.3 | 11.3 | 14.2 | 19.7 |
| AAQ std. | 80 | | 80 | |

**Source: Primary Survey, February 2018**

Methane in the study area is formed due to emissions from human activities (energy, landfills, livestock, waste treatment, biomass burning etc.) it is found within the range 0.43 to 0.124.

**Table 4: Presence of CO and $CH_4$ in air samples**

| | CO ($mg/m^3$) | | $CH_4$ (ppm) | |
|---|---|---|---|---|
| Location | Min | Max | Min | Max |
| Thana | 0.052 | 0.072 | 0.4 | 0.7 |
| Baddi | 0.092 | 0.124 | 0.5 | 0.8 |
| Barotiwala | 0.056 | 0.072 | 0.4 | 0.7 |
| Jharmajri | 0.089 | 0.098 | 0.3 | 0.6 |
| Haripur Sandholi | 0.043 | 0.064 | 0.2 | 0.5 |
| AAQ Std. | 2.0 | | - | |

**Source: Primary Survey, February 2018**

The 24 hours average values of particulate matter was compared to national ambient quality standards and found that all sampling stations recorded values within the permissible limits of industrial area limits for all locations in study area. Minimum and maximum level of particulate matter < 2.5µ recorded within the study area was in range of 35.6 to 48.3 $\mu g/m^3$. The minimum and maximum level of particulate matter <10µ recorded within the study area was in the range of 68.3 to 74.5 $\mu g/m^3$.

**Table 5: Presence of particulate matters in air samples**

| | Particulate matter < 2.5µ | | Particulate Matter < 10µ | |
|---|---|---|---|---|
| Location | Min | Max | Min | Max |
| Thana | 37.2 | 46.5 | 60.4 | 75.9 |
| Baddi | 40.4 | 48.0 | 62.3 | 76.5 |
| Barotiwala | 38.3 | 47.3 | 54.5 | 68.4 |
| Jharmajri | 35.6 | 46.1 | 50.8 | 68.3 |
| Haripur Sandholi | 38.7 | 48.3 | 64.1 | 74.3 |
| AAQ Std. | 60 | | 100 | |

**Source: Primary Survey, February 2018**

According to the study, Baddi and Haripur Sandholi are found more prone to crossing the standards for particulate matter in the nearby future. Hence, prevention measures to avoid the same are necessary.

Impact on Noise Quality

Almost all the industrial clusters cross the permissible limits as per National standards for noise in day time. Whereas slight difference could be observed in the night time existing conditions and the national standards. The national standards are taken from the document of ministry of environment. Noise levels are found maximum in Jharmajri followed by Haripur Sandholi.

Precaution measures in order to reduce and avoid the increase in noise that affects the environment and people residing in the areas. Impact on noise quality generally affects the psychological well-being of people and may also sometimes lead to hearing aids if not dealt with the precautions.

**Table 6 : Noise quality data of different locations of Baddi-Barotiwala Industrial**

| Sr. No. | Location | Day time | NS | Night time | NS |
|---|---|---|---|---|---|
| 1. | Baddi | 77 | 65 | 56 | 55 |
| 2. | Jharmajri | 79 | 65 | 54 | 55 |
| 3. | Haripur Sandholi | 78 | 65 | 52 | 55 |
| 4. | Malpur | 58 | 55 | 42 | 45 |
| 5. | Barotiwala | 68 | 75 | 46 | 70 |

**Source: Self Computed**

Impact On Soil Quality

Structure of soil in the area depends upon the tectonic and lithologic condition of region. Lower tertiary sediments are also available. Alluvial deposits, late organic inter mountain deposits are some of the main characteristics. Alluvial soil along with sub-montane soils are present in the hilly side. Other types of soils include shallow-black, brown and alluvial soils.

Waste from industries is dumped illegally in open, hence affecting the soil quality. The waste consists of harmful chemicals used in industries which affect the pH . It becomes difficult to breathe without a mask on due to fowl smell and odor due to the same. As wastes consist of harmful chemicals used in industries, it affects the pH and other main characteristics of soil. Leaching further affects the groundwater quality. Waste water and solid waste remains accumulated due to improper waste management system in industrial areas. Hence, spreading diseases amongst the residents there. Skin diseases amongst stray animals can be commonly seen in the area.

**Figure 23: Solid waste dumped outside industries**

pH in the study area varies from 6.67 to 8.23, which shows that soil falls under normal range. Electrical conductivity in area varies from 69 to 175. Organic matter varies from 0.33 to 0.94. Essential nutrients like nitrogen vary from 257 to 449, Phosphate from 1.9 to 4.5, Potassium from 63-100. The observations show that soil characteristics fall under normal range as compared to the standards. Characteristics such as pH show that soil in areas such as Thana-Bhatolikalan and Jharmajri have maximum amount of nutrients. So it is necessary to either control the level of elements getting mixed up in the soil in order to avoid the growth of plants getting affected.

**Table 7: Soil Quality data of different locations in Baddi-Barotiwala**

| Parameter | Units | S1 | S2 | S3 | S4 | S5 |
|---|---|---|---|---|---|---|
| pH | - | 8.23 | 8.01 | 6.67 | 8.23 | 8.13 |
| EC | Ms | 144 | 175 | 69 | 116 | 122 |
| Organic Matter | % | 0.33 | 0.30 | 0.52 | 0.94 | 0.48 |
| Pb | mg/Kg | 10.12 | 12.45 | 8.56 | 11.20 | 5.62 |
| Cd | mg/Kg | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Cr | mg/Kg | 4.25 | 3.47 | 3.12 | 1.54 | 2.02 |
| Ni | mg/Kg | 0.12 | 0.24 | 0.24 | 0.34 | 0.34 |
| Zn | mg/Kg | 146 | 137 | 186 | 214 | 174 |
| Cu | mg/Kg | 14.50 | 22.80 | 11.40 | 6.58 | 9.85 |
| N | Kg/Ha | 449 | 330 | 282 | 428 | 257 |

| | | | | | | |
|---|---|---|---|---|---|---|
| P | Kg/Ha | 2.1 | 4.5 | 3.2 | 1.9 | 2.1 |
| K | Kg/Ha | 63 | 100 | 73 | 65 | 107 |

**Source: Primary Survey, February 2018**

**Observations and Recommendations**

From the assessment of the water, air, noise and soil quality it is evident that most affected areas of all are Haripur Sandholi and Baddi. People residing in the housing phases adjacent to these areas are worst affected due to industrial activities. The observations made after the assessment is as follows:

- The measuring stations located at different locations seem to be not working according to public hearings and reports of local NGO's and public health groups like HIMDHARA and HIMPARIVESH.
- Departments like Pollution control boards do not present the original data to the media or people for their personal benefits
- It should be made mandatory for the industries to display true data of effluents released on the boards infront of the sites for proper checking.
- Proper filters for chimneys of the industries is not fixed resulting into direct release of harmful effluents into the environment.

To avoid the same proper EIA assessments should be done as per national environmental policy, 2006.

The following recommendations are given to improve/minimize the pollution caused by the industries in the area:

1. Rainwater Harvesting: The water conserved through rainwater harvesting can be used for various purposes in industries and is proven cost-effective as it results in decreased dependency of industry on other sources of water and also leads reduction in water bills.
2. Bio-remediation: It is a technique in which biological interventions like plantation of specific flora etc. is done to reduce the impact of the pollutants on the environment.

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