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## Industrial development and water pollution in Bahadurgarh city (Haryana)

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### Abstract

The present analysis reveals that the industrial effluents generated by industrial units in Bahadurgarh city are the major contributors to the environmental degradation, which pollute severe water and land resources in and around the city. The water pollution load generated by industrial units in the city is increasing day by day at an alarming rate. There are many industrial units in the city, which generate water pollution. The status of water quality in Bahadurgarh city is continuously deteriorating as the effluents of industrial units and local bodies discharging untreated into the Mungespur-West Zua drain. Majority of respondents in primary survey i.e. 67 per cent accepted that industries generated effluent is significant cause for water pollution in the city. The ground water of adjacent areas of this drain is also contaminated. Thus, there is an urgent need for solving industrial pollution problems by adopting a balance approach between industrial development and environmental management in Bahadurgarh city.

**Keywords:** Environmental pollution, Industrialization, industrial effluents, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), concentration of hydrogen ion (pH), etc.

### Introduction

The nature and intensity of water pollution is linked with many factors like waste water disposal and treatment system, hydrological conditions of diluting bodies and self-purification capacity of the streams, characteristics of effluents discharging from an area, socio-economic conditions of the communities generating the wastes and, in cases, types of soil and vegetation (Singh and Singh, 1988) [8]. The water pollution is assessed on the basis of certain parameters e.g. (i) Physical, (ii) Chemical, and (iii) Biological parameters. Physical parameters are used to ascertain the quality of water include temperature, colour, odour, turbidity, conductivity, density, suspended, dissolved and total solids while chemical parameters include nature and amount of soluble salts, hardness of water, acidity and alkalinity of water, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), concentration of hydrogen ion (pH), amount of ammonia, nitrate and nitrites, amount of heavy metals, mercury, lead, chromium, chlorides, pesticides, insecticides, detergents etc. Biological parameters are bacteria, coliform MPN, algae, viruses etc. Generally, BOD, DO and pH value are important indicator of water quality. Increasing urbanization and industrial expansion are responsible for the release of enormous quantities of these pollutants of various kind through sewage effluents into the rivers and lakes and thus contaminating the water beyond permissible safety level. Most of the Indian rivers receiving urban and industrial effluents (wherever large cities and industrial complexes are located at or near the banks of the rivers) are heavily polluted due to point source pollution at least and downstream of the large cities and industrial centers. For example, the Yamuna River at Delhi has, in fact, become a sewage as 323 million gallons of sewage enter the Yamuna per day through 17 open drains, while the capacity of all treatment plants of the Municipal Corporation of Delhi (MCD) is only 184 MGD (Million Gallons per Day). The toxic effluents discharging into the Yamuna carry 1,25,000 kg of BOD, 2,50,000 kg of dissolved solids and 1,25,000 kg of suspended solids per day. Before the Yamuna enters the capital, 100 milliliters of its water contain more than 7,500 disease causing bacteria but after receiving Delhi's share of sewage, carry 24 million bacteria (Central Pollution Control Board, 2007) [1].

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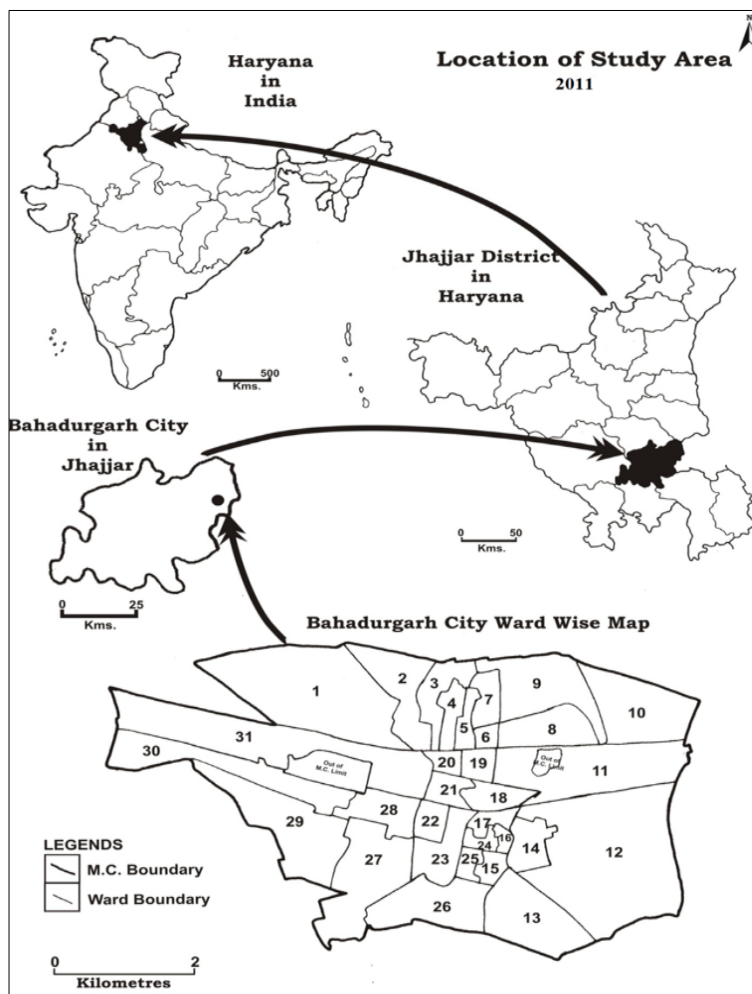
## Study Area

Bahadurgarh city is an important industrial center of Jhajjar district of Haryana state where 1, 70, 426 people inhabited in 31 municipal wards spread over an area of about 29.65 square kilometres (2011). The city lies between  $28^{\circ}41' N$  to  $28^{\circ}68' N$  latitudes and  $76^{\circ}55' E$  to  $76^{\circ}92' E$  longitudes (Figure 1). It is located at distance of 45 kilometers from Rohtak, 35 kilometers from Jhajjar, situated 28 kilometers west of Delhi on the Delhi-Rohtak NH-10. The Industries and Commerce Department Haryana and other Government agencies like Haryana Urban Development Authority (HUDA), Haryana State Industrial and Infrastructure Development Corporation (HSIIDC), have developed six industrial estates in Bahadurgarh, which spreads an area of 1,395 acres, and so far, 3,052 numbers of plots are allotted for establishing industries. In 1966, when Haryana state was formed, the city had 6 large scale and medium scale and 117 small-scale registered industries, which has been

increased by 37 large and medium scale and 1,486 small-scale industries in 2010. In these industries, the capital investment is Rs. 559.28 crores and production capacity is Rs. 3,012.61 crores in 2009-2010. These industries provide employment to 23,627 workers. Most of the industries are located on the National Highway No. 10 and near the railway line. Now a day, many foreign investors have been establishing industries in the Bahadurgarh region. Now a day Bahadurgarh city has been selected by more and more entrepreneurs for establishing industries.

## Objectives

The objectives of this study are to examine the level of water pollutants generated through industrial effluents from industrial units in Bahadurgarh city and to suggest an action plan for the abatement of water pollution load generated by industrial units in the city.



## Data and Methodology

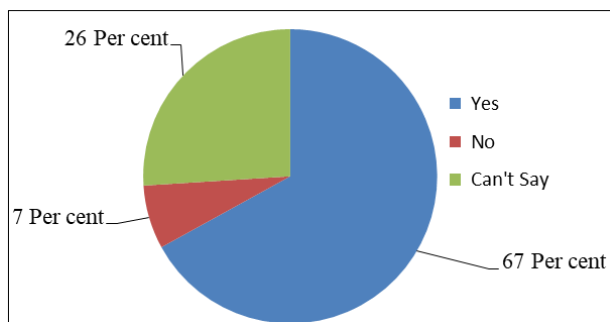
The study is based on the primary as well as secondary sources of data. The primary data have been collected through a well-structured questionnaire survey and the secondary data have been collected from published and unpublished reports, statistics and other materials. The primary data is provided the information about water pollutants generated through industrial effluents from industrial units in the city. Purposive stratified sampling technique is used to draw the samples for the study. Total 100 respondents have been selected for primary survey, in which 90 respondents were selected from three localities of

Bahadurgarh city, which are located adjacent to industrial areas of the city. 30 respondents from each locality have been selected for primary survey, who is permanent residents of these localities. Remaining 10 respondents were selected from, officials of State Pollution Control Board and District Industrial Department and Doctors from various hospitals of the city. The three localities selected for primary survey are Kabir Basti, Chottu Ram Nagar, and Vivekanand Nagar. Kabir Basti is located in central-western part of the city between West-Zua drain and railway line and adjacent to old industrial area of the city. Chottu Ram Nagar is located in north-eastern part of the city, which is elongated

the Mungespur drain and situated in the north of railway line and Modern Industrial Estate-I. Vivekanand Nagar is located on National Highway No. 10 in central-eastern part of the city. This locality is located in west of Modern Industrial Estate- I and between Mungespur-West Zua drain.

**Water Pollution in Bahadurgarh city**

The industrial development of Bahadurgarh city is also generating water pollution by contaminating water resources. In primary survey, the majority of respondents, 67 per cent perceived that industrial effluent discharged from industrial units is major source of water pollution in Bahadurgarh city, while only 7 per cent responsible said that industrial effluent did not affect water quality and 26 per cent respondents were not aware about this (Figure 4).



Source: Primary Survey, 2011

**Fig 2:** Industrial Effluent Discharge and Water Pollution in Bahadurgarh City, 2011

The status of water pollution in Bahadurgarh city is observed by obtaining the data from monitoring the Mungespur-West Zua drain, which passes through the city. As, the effluents discharge by industrial units and local bodies in Bahadurgarh city is carried through this drain which generate water pollution by altering the physio-chemical parameters of this drain. The samples of the ground water adjacent to this drain have been collected, the level of fluoride and nitrate in these samples are very much high on both sides of drain. The industrial effluents are also contaminating the water of river Yamuna as this drain flows in to the Yamuna through Najafgarh drain. Bahadurgarh city's industrial units and local bodies are covered under provisions of Water Act, 1974. The industrial profile of the Bahadurgarh city indicates that there are mostly inorganic chemical manufacturing units, pickling and electroplating industries (manufacturing M.S. Pipes, Turned components, nut and bolt and automobile components), leather tanneries, textile dyeing and washing units, dye-manufacturing units and bulk drug-manufacturing units. There are 31 industrial units and 2 local bodies are generating trade effluent and domestic effluent. These industrial units and local bodies either needs some modification in their existing Effluent Treatment Plants (ETP) or have to install new ETP for treating their effluent. From the perusal of status of pollution

load, it is evident that the most of the organic pollution load in terms of Bio-chemical Oxygen Demand (BOD) are being contributed by the domestic effluent, being discharge by the Bahadurgarh city's local bodies. The BOD load of the local bodies of Bahadurgarh city is 1,616 mg/l daily. Besides this 3,932 mg/l Chemical Oxygen Demand (COD), 1,792 mg/l Suspended Solids (SS) and 223 mg/l Oil and Grease (O and G) are discharged by these local bodies into drain. The total discharge by Bahadurgarh city's local bodies is 11,200 kg/day whereas, industrial units discharging trade effluent are generating inorganic pollution load. The industrial units in Bahadurgarh city daily generate 29.7 mg/l BOD, 75.8 mg/l COD, 34.81 mg/l SS and 2.94 mg/l O and G and the total discharge by industrial units is 326 kg/day in Bahadurgarh city. Table 1 shows the industry wise discharge of water pollution load in Bahadurgarh city in 2010 by recording of BOD, COD, SS and O and G from different industrial units. The major industrial sectors, which generated BOD are Finished Leather, Sanitary Wares and Dyeing and Washing of Fabric, these industrial sectors generated 53.3, 35.4 and 8.8 per cent respectively of total BOD load followed by Drug Manufacturing 1.0 per cent, Electroplating 0.4 per cent, Chemicals 0.4 per cent and others 0.7 per cent. In case of COD the main generating industrial units are Finished Leather 57.52 per cent of total discharge followed by Sanitary Wares 25.46 per cent, Dyeing and Washing of Fabric 13.32 per cent, Electroplating 1.06 per cent, Chemicals 1.06 per cent, Drug Manufacturing 0.01 per cent and others 1.57 per cent. In discharge of SS, the main industrial units are Finished Leather 44.81 per cent of total discharge followed by Sanitary Wares 33.32 per cent, Dyeing and Washing of Fabric 17.81 per cent, Electroplating 1.15 per cent, Chemicals 0.86 per cent, Drug Manufacturing 0.03 per cent and others 2.2 per cent. The O and G is also mainly generated by Finished Leather 51.02 per cent of total discharge followed by Sanitary Wares 23.81 per cent, Dyeing and Washing of Fabric 10.20 per cent, Electroplating 6.81 per cent, Chemicals 3.40 per cent, Drug Manufacturing 1.36 per cent and others 3.40 per cent. Thus, the Finished Leather, Sanitary Wares, Dyeing, and Washing of Fabric manufacturing industrial units alone generated more than 90 per cent of water pollution load in terms of BOD, COD, SS and O and G in Bahadurgarh city in 2010. Besides this various government departments, including the Public Health Department, are also contributing to water pollution in a big way by discharging untreated sewage into the drain. According to Haryana Pollution Control Board, there is no combined treatment plant in the MIE and hardly 10 per cent of the total units have installed their own treatment plants. A large quantity of effluent is being discharge illegally into sewers. HUDA has also set up a disposal plant there without a treatment. The effluent, which is accumulated in the disposal plant, is being flushed out in to drain running across the MIE without treatment (Table 1).

**Table 1:** Water Pollution Load from Industrial Units, 2010

Name of Industrial Sector / Units	Pollution Load (mg/l) per Day							
	BOD	In Per cent	COD	In Per cent	SS	In Per cent	O&G	In Per cent
Finished Leather	15.8	53.3	43.6	57.52	15.6	44.81	1.5	51.02
Sanitary Wares	10.5	35.4	19.3	25.46	11.6	33.32	0.7	23.81
Dyeing & Washing of Fabric	2.6	8.8	10.1	13.32	6.2	17.81	0.3	10.20
Electroplating	0.1	0.4	0.8	1.06	0.4	1.15	0.2	6.81
Chemicals	0.1	0.4	0.8	1.06	0.3	0.86	0.1	3.40

Drug Manufacturing	0.3	1.0	0.01	0.01	0.01	0.03	0.04	1.36
Others	0.2	0.7	1.19	1.57	0.7	2.02	0.1	3.40
Total	29.7	100.0	75.8	100.00	34.81	100.00	2.94	100.00

Source: Haryana State Pollution Control Board, Bahadurgarh, 2010.

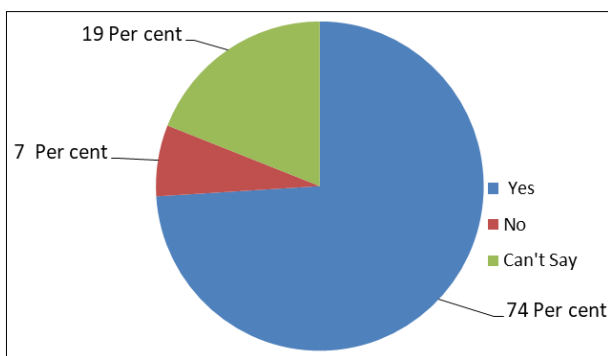
The 67 per cent respondents in primary survey revealed that industrial effluent generating by industrial units in the city is directly discharge in to drain without any treatment (Plate 1), which contaminates drain and adjacent ground water, besides this 17 per cent respondents informed that industries discharge their industrial effluent in to sewers (Plate 2), which also goes to drain, 10 per cent respondents told about other methods like, discharge of industrial effluent on their adjacent land and boring of industrial effluent into ground by pipes, while only 6 per cent respondents said these water polluting units discharge their industrial effluent in disposal treatment plant, after that treated water is used for agriculture purposes (Table 2).

**Table 2:** Response of People about Discharge Methods of Industrial Effluent by Industrial Units

Discharge Methods	Response in Per cent
Drain	67
Sewer	17
Disposal treatment plant	6
Others	10

Source: Primary Survey, 2011.

The pollution load in terms of BOD, COD, SS and O and G is very high, in the Mungeshpur-West Zua drain, than the prescribed ambient water quality described by Central Pollution Control Board (CPCB). The variation in the level of pollution load depends on the seasons. It was noticed less during rainy season and high in summer and winter as volume of water increases due to rain. In primary survey, 74 per cent respondents revealed that water quality of Mungeshpur-West Zua drain declines after meeting of hazardous industrial effluent from industrial areas of Bahadurgarh city, while only 7 per cent respondents said that water quality of drain does not declined in industrial areas and 19 per cent respondents have no knowledge about this (Figure 5).



Source: Primary Survey, 2011

**Fig 5:** Water Quality Deterioration of Mungeshpur- West Drain after Meeting of Industrial Effluent from Industrial Areas

The pollution load in this drain is increasing at alarming rate due to discharge of industrial effluents. Table 3 shows the status of pollution load in Mungeshpur-West Zua Drain in 2000, 2006 and 2010 in Bahadurgarh city. It is noted that the level of pollution load had increasing trend during 2000 to 2010 as Biochemical Oxygen Demand (BOD) has

increased by from 75.0 mg/l to 120.0 mg/l (160 per cent increase); Chemical Oxygen Demand (COD) from 204.0 mg/l to 290.0 mg/l (70 per cent increase); Suspended hazardous (SS) from 156.0 mg/l to 1420.0 mg/l (910 per cent increase) and Oil and Grease (O and G) from 8.4 mg/l to 19.0 mg/l (226 per cent increase) in Bahadurgarh city (Table 3).

**Table 3:** Status of Pollution load in Mungeshpur-West Zua Drain in Industrial Areas of Bahadurgarh City in 2000, 2006 and 2010

Years	Pollution Load (mg/l)			
	BOD	COD	SS	Oil and Grease
2000	75.0	204.0	156.0	8.4
2006	85.0	242.0	590.0	18.0
2010	120.0	290.0	1420.0	19.0

Source: Haryana State Pollution Control Board, Bahadurgarh, 2010.

The Mungeshpur-West Zua drain flows in the middle of the city and it is the main source of water pollution in the city. The industrial areas located in the city mainly Modern Industrial Estates (MIE) I and II discharge their effluent on land and into drain through sewer. The water quality of the Mungeshpur-West Zua drain critically deteriorated and its pollution load increases after the meeting of untreated industrial effluent from these industrial areas. The Haryana State Pollution Control Board, Bahadurgarh assessed the water quality of this drain by taking water samples before and after meeting of industrial effluent from industrial areas. The water quality of drain deteriorated after meeting of industrial effluent from industrial areas in Bahadurgarh city (Plate 3 and Plate 4). The Biochemical Oxygen Demand (BOD) has increased after meeting of industrial effluent from 55.0 mg/l to 75.0 mg/l, 52.0 mg/l to 85.0 mg/l and 100 mg/l to 120 mg/l; Chemical Oxygen Demand (COD) from 138.0 mg/l to 204.0 mg/l, 150.0 mg/l to 242.0 mg/l, and 274 mg/l to 290 mg/l; Suspended Hazardous (SS) from 118.0 mg/l to 156.0 mg/l, 153.0 mg/l to 590.0 mg/l and 830 mg/l to 1420 mg/l and Oil and Grease (O and G) from 4.6 mg/l to 8.4 mg/l, 15.0 mg/l to 18.0 mg/l and 16 mg/l to 19 mg/l in 2000, 2006 and 2010 respectively, which indicates critical declines of water quality as the pollution load increased in the drain (Table 4).

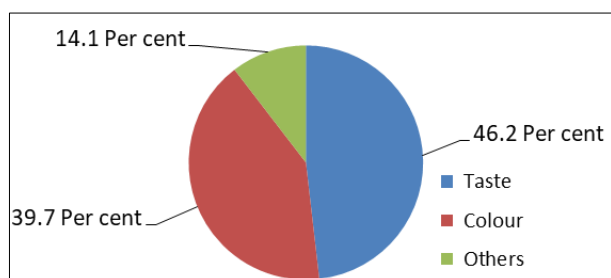
**Table 4:** Status of Mungeshpur-West Zua Drain Before and After Meeting of Industrial Effluent from Industrial Areas in 2000, 2006 and 2010

Year	Point of sample collection	Pollution Load (mg/l)			
		BOD	COD	SS	O&G
2000	Before meeting of industrial effluent	55.0	138.0	118.0	4.6
	After meeting of industrial effluent	75.0	204.0	156.0	8.4
2006	Before meeting of industrial effluent	52.0	150.0	153.0	15.0
	After meeting of industrial effluent	85.0	242.0	590.0	18.0
2010	Before meeting of industrial effluent	100.0	274.0	830.0	16.0
	After meeting of industrial effluent	120.0	290.0	1420.0	19.0

Source: Haryana State Pollution Control Board, Bahadurgarh, 2010.

The quality of water in Bahadurgarh city has been degraded due to contamination of water resources. In primary survey

people revealed that due to water pollution quality of drinking water is declined. The 46.2 per cent respondents said that taste of water is becoming poor, they complained about increasing salinity in water, 39.7 per cent respondents said they received yellow and black water in supply and 14.1 per cent respondents told other water contamination problems like smell, hardness, etc. in the city (Figure 7).



Source: Primary Survey, 2011

Fig 7: Water Quality Degradation

The residential areas and localities locate on both side of the drain, like Chhikara Colony, Kabir Basti, Nai Basti, Nehru Park, Teacher Colony, Aggarwal Colony, Model Town, Ram Nagar, Dharam Vihar and Police Colony are highly prone to water pollution. In these areas water supply has been contaminated as the water pipes are laid very close and in some areas, they cross this drain. The situation has become worse due to old and leaking pipes, which causes serious water borne diseases. The residents of these areas complain about black colour and greasy tap water, which smell like rotten eggs. Thus, people of these areas are using highly contaminated water and living in the danger of life threatening diseases. The industrial units which are located outside Bahadurgarh city discharge effluent on land situated inside and adjacent to their boundary in open. This poisonous industrial effluent contaminates the sub soil water and soil fertility of hundreds of acres of agriculture land around these industrial units. Besides this, some industrial units had bored into the ground to directly percolate chemical-mixed effluent in to the earth, which is contaminating ground water of that area and posed a serious threat to the environment.

#### Action Plan for Water Pollution Generating Industrial Units

The water- polluting industrial units in Bahadurgarh city, which are not complying the provision of Water (Prevention and Control of Pollution) Act, 1974, are require either to modify their existing Effluent Treatment Plant (ETP) or to install Sewerage Treatment Plant (STP) for treating their industrial effluent. The Haryana State Pollution Board issued show cause notice under the Water Act, 1981, to all these water polluting industrial units. The Pollution Control Board is ensuring that all these non-complying units will comply the provisions Water Act, 1981. These water-polluting units, to whom notices have been issued for installation of STP and where the existing ETP required to be modified or upgraded will have to complete the installation and modification work within six months, failing this action deemed fit should be initiated against these units. The action plan for water quality improvement in Bahadurgarh city is being formulated based on the data obtained from the monitoring the Mungespur-West Zua drain, which passes through the city. The data obtained from

this drain since 2000, are being considered for preparing the action plan with regard to reducing the water pollution level in the drain. The discharge of effluent from industrial areas in Bahadurgarh city is the major source of water pollution in the drain. To reduce the water pollution load from industrial areas of the city, the Haryana State Pollution Board is constantly in touch with industrial association and developers of these industrial areas to form a registered society for construction and maintenance of Common Effluent Treatment Plant (CETP), so that the water quality of Mungespur-West Zua drain could be improved. There is a proposal of installation of CETP at MIE Bahadurgarh has been finalized and it will take at least 2-3 years for completion. Besides this other water pollution control measures should be adopted, which are as follows:

1. Soil permeability studies should be made prior to effluents being discharged into holding tanks or impoundments and steps taken to prevent percolation and ground water contamination.
2. Special precautions should be taken regarding flight patterns of birds in the area. Effluents containing toxic compounds, oil and grease have been known to cause extensive death of migratory birds. Location of plants should be prohibited in such type of sensitive areas.
3. Deep well burial of toxic effluents should not be resorted to as it can result in resurfacing and groundwater contamination. Resurfacing has been known to cause extensive damage to crops and live stocks.
4. In all cases, efforts should be made for reuse of water and its conservation.
5. Government should provide adequate funds to the industries for making water pollution control more effective.

#### Concluding Remarks

Bahadurgarh city has emerged as a main industrial hub in Haryana. However, this industrial development has contributed to the environmental pollution related problems in the city. The present analysis reveals that the industrial effluents generated by industrial units in Bahadurgarh city are the major contributors to the environmental degradation, which pollute severe water and land resources in and around the city. The water pollution load generated by industrial units in the city is increasing day by day at an alarming rate. There are many industrial units in the city, which generate water pollution. The status of water quality in Bahadurgarh city is continuously deteriorating as the effluents of industrial units and local bodies discharging untreated into the Mungespur-West Zua drain. Majority of respondents i.e., 67 per cent accepted that industries generated effluent is significant cause for water pollution in the city. The ground water of adjacent areas of this drain is also contaminated. Thus, there is an urgent need for solving industrial pollution problems by adopting a balance approach between industrial development and environmental management in Bahadurgarh city.

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