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Industrialization And Environmental Quality In Mysuru City And Its Environs

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Abstract: *The Environment is under serious threat today and it is no surprise that world rulers are making their sincere efforts at global forum to devise strategies for preserving the bio-diversity and and also to prevent environmental degradation. The present article tries to highlight the existing guide lines for sitting industries and types of pollution like air, water, land, caused by industrial activities in and around Mysuru city. The study tries to highlights water and Air pollution, source of air pollution, problems of air and water pollution, causal relationship of air pollutants. Further, water pollutants that changes the structure and quality of water bodies.*

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I. INTRODUCTION:

Industrialization implies a process of transformation of industrial activities and it is closely linked with structural changes resulting from the interaction of demand and supply factors. In sitting up of an industrial estate, consideration should be given to the determination of the optimum combination of location, size and type of industrial estate and selection of industries. Areas of investigation should include distribution of population and land use pattern of surrounding areas, availability of labour, local resources, existing utilities, transport and communication, physical and social infrastructure and other site characteristics. The industrial activities should be compatible with existing surrounding environment to accommodate changes and to achieve sustainable development with much destruction of surrounding environment. It is therefore, there is a need to integrate the industrial activities, wherever compatible with the surrounding environment to make land use feasible and enjoyable.

Environmental pollution is a serious threat to our country and it has become common phenomenon in most of our cities. The wide spread migration from villages to cities to avail job opportunities in towns and cities that led to cities being overcrowded. Rapid industrialization and urbanization have resulted in increased pollution in metropolitan cities (Pandve, 2008). Rapid industrialization and urbanization put more pressure on natural resources that resulted in degradation of environment in varying degrees and initiatives are required to make the environmental feasible both in terms of taking action to avoid environmental degradation to ensure eco-friendly (Maria Khan and Md. Tarique, 2015).

Abbasi, etal, (2002)stated that Industrialization carried with it the seeds of environmental problems experienced by now industrialized countries and majority of newly industrializing economies are facing it today. Industrial pollution and waste encompass the full range of materials generated by industrial activities that are unwanted by the producers. Certain components of industrial pollution and waste are hazardous to human health and environment.

Khan and Venkatachalappa (1992) suggested that the dispersion of atmospheric contaminant has become a global problem in recent years due to rapid industrialization and urbanization. The toxic gases and small particles could accumulate, under certain meteorological conditions, in large quantities over urban areas. Tobey (1999) says that in developing countries while industrial growth without pollution control measures reduces the environmental quality and degrades natural systems, it may reduce poverty and as such reduce what is termed as poverty related pollution. When there is a severe pressure on economic growth, conservation oriented issues get the lowest priority. Discount rates in less developed countries are often very high (Tisdell, 1995). Costs of environmental conservation are not included mainly to the projects which are having higher rates of return. Provision for effluent disposal after treatment or waste disposal are not specified in original projects proposals. As population increased, technology becomes to dominate the earth. Eco-friendly net work design offers feasible alternatives for moving towards a sustainable environment. However, a supporting

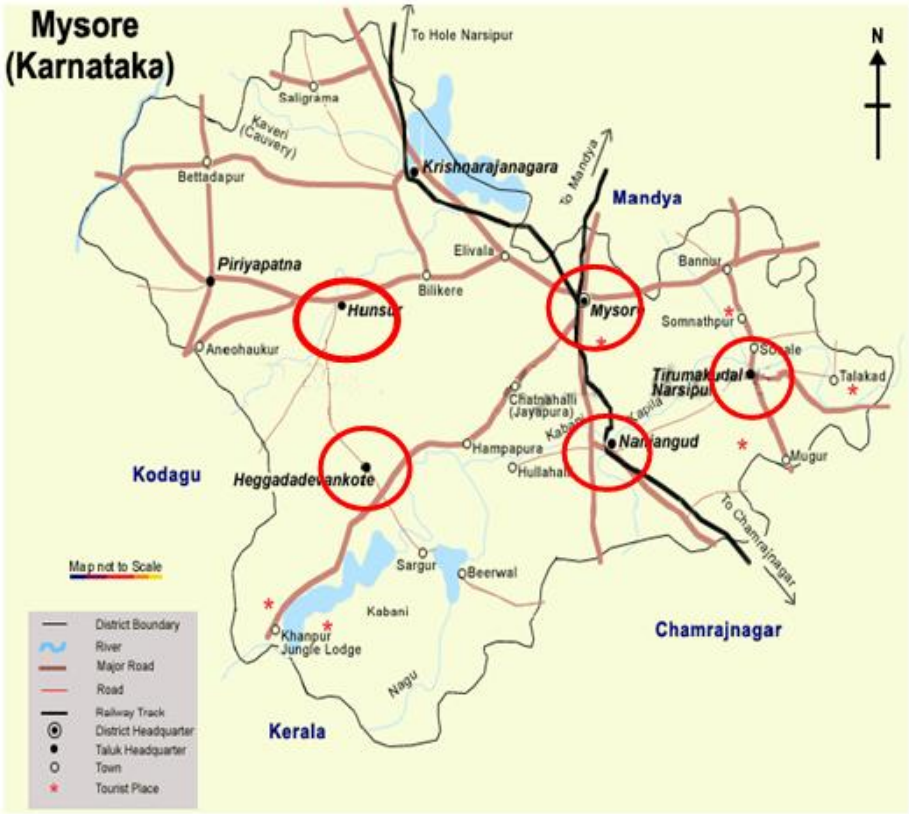
infrastructure base will be needed to provide an environment for industrial symbiosis to flourish the industrial activities (Patnaik, 2015). It is therefore, the conscious organization of the land uses especially industrial land use becomes more important to maintain the ideal urban form and better environment.

It has been a continuous increase of environmental pollution. The obnoxious gases emitted by the ever increasing number of industries get into the air we breathe. The vast amount of effluents discharged from all kinds of industries get into the system of water sources and altering their biota in addition to rendering them most unsuitable for human use (Ravishanker, 1987 20-25). Further, many of the deleterious chemicals of some industrial wastes are likely to make an impact on Hydraulic parameters and also incorporated into the food chain.There are not many studies on different aspects of water and air quality in and around Mysore city. It is therefore; the attempt has been made to highlight the sources, nature of concentrations of pollutants in air and water in Mysore city and its environs. It is earnestly hoped that this attempt may yield some guidelines and warning notes to city planners and urban designers so as to enable them to mitigate or minimize pollutants concentration in water and air, if not provide a remedy to the present alarming situation before it is too late.

1.1 Study area

Mysore city occupies an important location in the larger context of south central part of the Deccan plateau. It is situated in the southern part of the Karnataka state at 12° 18' north latitude and 76° 12' east longitude. Mysore city lies in a saucer shaped basin flaked by Chamundi hills on the south east and raised plat form near Hinkal village on the west. It is in the interfluves between the two rivers Cauvery and Kabini. Mysuru city is situated at an altitude of about 777 meters above mean sea level. Major portion of the city slopes towards the south coming under the Kabini basin. River Cauvery Traverses from west to east at a distance of 16 km. from Mysore city but only the north portion lies in the catchment area of Cauvery River. The major tributaries of river Cauvery are kabini , Lakshmana thirtha, lokapavani and Suvarnavathi which flowing throughout the district. The Cauvery and its tributaries have large number of small and large reservoirs which are the sources of water for cultivation of different crops like sugar cane, paddy, ragi, and jowar. The rapid industrialization and urbanization apparently caused undesirable change in the structure of water bodies in the region. The study reveals that more intense activities in the catchment areas of water bodies have been a major factor for causing deterioration in the structure and quality of water bodies and becomes a threat to diversity of flora and fauna in the region.

Water quality monitoring stations at in river Cauvery and its tributaries



Source: Based on Smitha, P.Shivashankar and Venkataramana, (2013)

The lakes selected for study from an average distance of 8 to 10 Km from Mysuru city and its environs. They are Doorakere and Kuduregundihalli kere (Nanjangud Taluk), Karigaladodda kere, and Paduvakote lake (H.D. Kote taluk), Santhe kere, and karimuddanahalli kere (Hunsur taluk). Devibudhi and Yennehole kere (Mysuru taluk). In addition, water samples from rivers were also collected regularly at an interval of 30 days and from a depth of 2'.5". They were transported to the laboratory in pyrex bottles with well fitted pyrex glass stoppers (Deviprasad and others.2007). The samples were analyzed for the following factors such as (1) PH value (2) conductivity (3) total dissolved solids (4) total suspended solids (5) dissolved oxygen (6) BOD (7) Alkalinity (8) COD (9) chlorides (10) Fluoride (11) Nitrate-nitrogen (12) Sulphates (13) Calcium (14) Magnesium (15) chlorides (16) Bicarbonates (17) Dissolved silica (19) Dissolved iron (20) Phosphate etc.

Mysuru district has undulating river Cauvery on the northen side of the Mysuru city and its tributaries Kabini on south-western side. Lkashmanathirtha,shimsha, Lokapavani and Suvarnavathi are the other tributaries that flow through the district and the slope of the drainage pattern towards east (Deviprasad and others,2007). The flow of Cauvery river and its tributaries form large number of small and bigger lakes which are the source of water for cultivation of different crops like sugarcane, paddy, and other food grains. However, disposal of waste water from various sources to lakes like industrial, agriculture and other sources and also encroachment of lakes have caused undesirable change in the climate and structure of lakes. Further, Deviprsad and others (2007) have observed that more intensive activities in the catchment areas of the lakes causing changes in the structure and quality of water in the lakes posing threat to biodiversity.Many water borne diseases such as dysentery, botulism, hepatite, pliomylits and represent the potential health hazards which owe their origin to polluted waters.The types of water pollution are determined both by the medium (surface water, ground water etc). The habitat in which they occur (rivers, lakes, estuaries, coastal waters and open sea), as also the source or type of contamination (nutrient, bacterial and viral, industrial, pesticide, radioactive wastes etc).In Mysore city and its environs, there are variety of industries like automobile, textile, paper, food, chemical, rubber tyres and fertilizer factories. They generate large amounts of waste waters into the main sewage channels of the city. A few at the outskirts, discharge their effluents directly into the rivers. Effluents of some industries are utilized for irrigation purposes.

1.2 Guidelines for sitting of Industries

At present, industries are being located on the basis of raw material availability, access to the market, transport facilities and such other techno-economic considerations without adequate attention to environmental aspects. It is essential that environmental considerations are recognized as important criteria for sitting of industries.

To prevent air, water and soil pollution arising out of industrial projects, the industrial licensing procedure requires that the entrepreneurs before setting up their industries should obtain clearance from Central/State Air and Water Pollution Control Boards. The Central/ State Pollution Control Boards stipulate that air (gases) and water (effluents) emanating from the industry should adhere to certain quality standards. However, these stipulations do not prevent wrong sitting of industry. Also, the cumulative effect of industries at a particular place is not being studied upon, with the result that an industry or an industrial area over a period of time could significant damage to the surrounding environment and ecological features.

1.3. The State Director of industries confirms that the site of the project has been approved from environmental angle by the competent State Authority.

1.4. The entrepreneurs commit both to the State Government and Central Government that he will install the appropriate pollution control equipment and implement the prescribed measures for the prevention and control of pollution caused due to industrial activities.

1.5. The concerned State Pollution Control Board has to certify that the proposal meets with environmental requirements installed or proposed to be installed are adequate and appropriate to the requirements.

In order to help the concerned authorities and the entrepreneurs, certain broad guidelines have been recommended for sitting of industries. These are in pursuance of the directives that have been issued under the industries (Development and Regulation) Act. The guidelines provided information relating to areas to be avoided for sitting of industries, precautionary measures to be taken for site selection as also the aspects of environmental protection to be incorporated during implementation of the industrial development projects.The basic concept behind urban and environmental designing is to understand the nature of a place by analyzing its bio-physical components such as geology, soil, hydrology, physiographic, climate, vegetation, and wildlife by establishing the interrelationship of these bio-physical components with each other and then ascertaining to manmade demands and finally arriving at a healthy compromise when all the bio-physical components may function properly for satisfying all the planned demands, policy formulation on issues with direct bearing on the environment such as land use zoning, industrial licensing, air and water quality standards, and resource allocation for infrastructure expansion is necessary for the environmental considerations in industrial development.

II. GROWTH OF MICRO, SMALL, AND MEDIUM SCALE OF INDUSTRIES BASED ON RAW MATERIALS

Industrial estates are scattered over in different parts of Mysore city and its environs especially along the transport corridors such as Hebbal, Hootagally, Belgola, Belavadi and also other old industrial estates like Yadavagiri, Industrial suburbs and Bannimantap are situated within the urban fold. However,at present, there are 25447Micro, Small, and Medium scale of industries based on raw materials and 57 Large and Mega Industries in Mysore city (see table no. 2 and 3). The government of Karnataka has realizing the dangers of over industrial growth in Bengaluru Metropolitan area and imposed several restrictions in setting up of industries in this area. Since, Mysore city is closer to Bengaluru; entrepreneurs have started taking interest in establishing industries in Mysore city. Table No. 3 reveals the raw materials based classification of industries as micro, small and medium scale industries. As per the data obtained from the District industries center in the year 2017-18, there are 25447 industries in Mysuru district (Mysuru city and its environs).

Out of 25447 belong to different category of industries such as micro, small and medium scale industries based on different types of raw materials. Out of 25447 industries, the highest numbers of industries are forest based industries with 31.31 per cent. Then, the next comes Textile based industries and food processing with 14.14 and 13.85 per cents respectively. The lowest numbers of industries are based on Ferrous and non-ferrous raw materials with 0.06 percent. It is evident from the table no.3, that next to ferrous and non-ferrous based industries, rubber and plastic, the gas and ceramics based industries are the lowest numbers of industries in the district with 2.23, and 2.62 percent respectively. This may be due to the concerned authorities are not encouraged more polluting industries like rubber, plastic and leather based industries in the interest of air quality of the region. Mysuru district envisages 25,447 registered Micro, small and medium scale of industries manufacturing various types of products. The various small scale industries include mechanical engineering, paper and printing, rubber and plastics, electrical and electronic goods, chemicals and pharmaceuticals, sugar, automobiles, Food and intoxicants, Glass and ceramics, Leather and Food processing industries.

Table No.1: Micro, Small, and Medium scale of industries based on raw materials.

Source: District industries center, Mysuru

Type of Industries	No. of Industries	Percent to total	Investment (Rs. In Lakh)	Per cent to total	No. Of Employees	per cent to total
Food Processing	3524	13.85	6955.0	11.03	10722	8.36
Textiles based	3598	14.14	5320.86	8.44	9423	7.34
Forest based	7968	31.31	6945.28	11.01	11190	8.72
Leatherm based	675	2.65	297.1	0.47	2210	1.72
Rubber and Plastic	568	2.23	1625.28	2.58	1532	1.19
Chemical based	1278	5.02	2005.36	3.18	8088	6.30
Gas and ceramics	664	2.61	1786.3	2.83	2983	2.33
General engineering	1434	5.64	4600.02	7.29	9546	7.44
Electrical	673	2.64	2503.38	3.97	1982	1.54
Job works and repairs	2175	8.55	1498.25	2.38	5422	4.23
Automobiles services	553	2.17	1498.25	2.38	2553	1.99
Ferrous and Nonferrous services	16	0.06	18.95	0.03	89	0.07
Miscellaneous and others	2321	9.12	26677.68	42.30	62555	48.76
Total	25447	100.00	63063.62	100.0	128295	100.00

2.1. Classification of large and mega industries based on raw materials

Table No. 2 shows the large and mega industries in the region, wherein the food processing, textiles, automobiles, rubber and plastics based industries are more prominent. There are 57 large and mega industries, in which there are 10 large and mega industries related to food processing constituting 17.54 per cent. Then, next comes to rubber and plastic, automobiles, textiles based industries with 14.04 per cent for each type of industries respectively. It is evident from the table that the automobiles, food processing, paper industries, textiles, rubber and plastic are more labor intensive industries which created more employment opportunities for the needy people.

However, there is no correlation between employment ratio and size of investment on industries. The district has 57 large and mega industries 7270.97 crores of investment and 37,339 employment status. These large and mega industries contribute significantly to the growth of the Mysuru city and its environs. The industries in Mysuru district are mainly spread around the city of Mysuru and Nanjangud corridor. Karanataka Industrial development Board has established 8 industrial areas in Mysuru district to encourage the industrial development. The industrial areas of Belgola, Belavadi, Hebbal, Hootagally, Koorgally, KadakolaNajangud and thandavapura are located in different places of Mysuru city and its environs. The industrial growth is mainly

due to the intervention of industrial policy, and decentralization of industries from Bengaluru to Mysuru. Since from 1981, the establishments of new large and medium scale of industries are prohibited in Bengaluru city. In 2018-19, there are 25447 Micro, Small, and Medium scale industries registered with an investment of Rs.63063.62 lakh and created employment for 128295 persons in Mysuru city and its environs.

Table No.2: Large and Mega Industries based on Raw materials

Type of Industries	No. of Industries	Per cent to total	Investment (Rs.in crore)	Per cent to total	No. of Employees	Per cent to total
Auto mobile	8	14.04	1010.89	13.9	5350	14.33
Chemical	1	1.75	91.76	1.26	61	0.16
Electronics	7	12.28	504.23	6.93	2435	6.52
Engineering	2	3.51	33.79	0.46	266	0.71
Food Processing	10	17.54	610.76	8.4	4907	13.14
Metal	1	1.75	26.86	0.37	471	1.26
Paper	3	5.26	387.26	5.33	8934	23.93
Pharmaceuticals	4	7.02	1134.49	15.6	1426	3.82
Rubber and plastics	8	14.04	1328.87	18.28	4593	12.3
Software development	2	3.51	269	3.7	1882	5.04
Textiles	8	14.04	493.06	6.78	4494	12.04
Others	3	5.26	1380	18.98	2520	6.75
Total	57	100	7270.97	100	37339	100

Source: District industries center, Mysuru**.**

2.2. Pollution based classification of industries

The Pollution Control Board has classified the existing industries in Mysore city and its environs into three categories namely green, orange and red categories of industries by taking into consideration certain factors like scale of production, nature of products, the amount of gas, liquid and solid wastes are produced in an industry etc.

2.2.1. Green category of industries

In Mysore city, there are 25447Micro, Small, and Medium scale industries, of which nearly 33 per cent of the industries are classified as green category of industries or less polluting industries. The waste from these small scale industries are not harmful except the industries like chemicals, plastic, agro based, automobile based and livestock based industries. These industries must get no objection certificate from the pollution control board before they start functioning.

2.2.2.Orange and Red categories of industries

There are 57 medium and large scale industries, some of the large scale industries are treating their effluents. Almost all large scale industries are treated as highly polluting or red category of industries. About 35 large scale industries are taking much care in treating their effluents, because of the regulations imposed by the pollution control board and effluents from these industries cause health hazards and pollute the environment (mainly water). Therefore effluents are treated in the vicinity of the industries and disposed to the sewerage system. The treated industrial waste is easy to handle in the treatment plants and treatment cost becomes less.
Some of the medium scale industries are not treating the effluents to the standards required by the pollution control board and they are disposing the industrial waste to the open drainages which pollute the environment. The polluted environment would cause various types of health hazards.

III. POLLUTION

Pollution is an introduction of extraneous materials into environment adversely affecting its normal use. This definition holds good for all the three kinds of pollution namely, of air, water, land, and noise pollution resulting in impairment of the human systems and affecting living conditions.

3.1. Water Pollution

Water pollution is caused mainly by discharge of waste waters into natural water courses and water bodies which resulted in depletion of life sustaining oxygen in the water bodies, introduction of all types of materials not normally found in water in its natural state and last but not least, discharge of toxic materials which would affect health and life of the aquatic flora and fauna and also of human beings. There are two major sources of water pollution namely, industries and human habitations. Industrial waste from all types of industries contains polluting substances which can be broadly defined as oxygen depleting substances, chemicals and toxic materials.

The rapid growth of population, Industrialization, urbanization and irrational human interference in the name of developments are caused irrevocable damage to our water resources and ecological system which support the biodiversity. However, developments required, but it should not cause damage to environment but it should take place along rational and sustainable basis. It is necessary to ensure that the use of water resource should within the permissible limits and it should not stress to environment. A.G. Deviprasad and others (2007) have selected some of the lakes in Mysuru city and its environs for study of fish diversity and its conservation in major wet lands (see table No.3 and 4).

Table No 3: Lakes selected for strudy in Mysuru city and its environs

Lakes	Distance from city(Km)	Water spread area(Ha)	Catchment area(Km)	Average depth(m)	Irrigated area(Ha)
Doorakere	23	9.20	3.71	7	120
Kuduregundihalla kere	60	93.0	67.35	6	810
Devibudhi kere	12	66.0	5.49	7	160
Yennehole kere	15	80.94	41.0	10	1200
Kanngaladoddakere	30	26.13	26.80	9	800
Paduvakote kere	42	2.60	2.54	8	741
Santhekere	60	70.31	60.95	8	1102
Karimuddanahallakere	40	125.86	258.27	11	2500

Source: A.G. Deviprasad, G.V. Venkataramana and Mathew Thomas (2007)

3.2. General findings from water the analysis

From the results obtained in the present investigation on the industrial water pollution in and around Mysore city the following conclusions are drawn. The drainage of electroplating waste of an automobile factory near Mysore is responsible for severe heavy metal pollution. Although the electroplating wastes contain higher concentrations of trace metals and cyanides, they harbor a good number of bacteria, algae and fungi.As high concentrations of metals are recorded in the grasses sludge and in the milk of the live stock, it could sludge suggested that live stock be prevented from grazing in areas polluted by heavy metals.

Table No.4:Water quality monitoring stations at Hunasur, T. Narasipur and Nanjangu in river Cauvery and its tributaries

2019-2020												
	Hunsur				T. Narasipur				Nanjangud			
Months	**DO**	**BOD**	**FC**	**TC**	**DO**	**BOD**	**FC**	**TC**	**DO**	**BOD**	**FC**	**TC**
Jan	6	3	940	2800	6.7	1.8	340	1300	6.5	2.5	840	2100
Feb	-	-	-	-	6.5	2.1	340	1300	5	3.6	790	2400

March	-	-	-	-	6.4	2.5	390	1400	5.1	3.5	840	2800
April	-	-	-	-	7.2	1.5	130	790	6.5	2	210	940
May	-	-	-	-	7.1	1.5	140	840	6.4	2.1	210	940
June	6.5	2.5	940	2100	7.2	1.2	170	840	6.9	1.5	490	1100
July	4.5	2.3	790	2400	7.3	1.2	380	1200	7	1.4	460	1400
August	6.8	2	390	1200	7.5	1.2	130	840	7.3	1.2	340	1300
Sept	6.3	2	930	4000	7.5	1.1	93	700	7	1.4	220	1100
Oct	5.2	3.4	630	2100	7.3	1.2	260	1200	6.9	1.5	630	2100
Nov	6.1	2.8	490	200	6.9	1.7	270	1300	7	1.8	380	1500
Dec	6.5	2	630	1700	7	1.5	260	1100	6.5	2.3	700	2200

Source: Based on Smitha, P.Shivashankar and Venkataramana, (2013)

Irrigation coconut plantations or vegetable gardens with electroplating wastes are very undesirable, mainly because the trace metals enter into the food chain by getting into the coconuts. The effluent of the rubber tyre factory and yeast manufacturing industry do not pose serious water pollution problems. Since they contain certain objectionable characteristics as per ISI standards, a pretreatment is necessary before being let out.

In view of the industrial effluents containing heavy metals a high PH value and other objectionable characteristics, it is not advisable to use them for irrigating the paddy fields and dry farm lands. It leads to deleterious effects of industrial effluents on quality of water in and around Mysore city.

It is therefore the urban planning and designing authorities should take the guide lines and the warning notes from the studies on industrial water pollution and Ecology. Due considerations should be given for environmental permissibility and the safe disposal of treated wastes before sitting an industrial estate and also to preserve and maintain livable and lovable urban form and environment.

IV. AIR POLLUTION:

Air quality generally means a mixture of gases where oxygen is present along with nitrogen, hydrogen, and carbon dioxide but the air quality deteriorates with the increase in gases produced by industrial chimneys. Air pollution problems are more pronounced in areas of intense industrial activities. The problems of air pollution are more complex, as they also affect the weather and climate.

Many definitions of air pollution have been proposed. One such definition is as follows;" Air pollution may be defined as the presence in the outdoor atmosphere of one or more contaminants and combinations thereof in such quantities and of such which unreasonable interference with the comfortable enjoyment of life or property or the conduct of business.

4.1. Source of Air Pollution:

Many of the pollutants concern are formed and emitted through natural and artificial process. Naturally pollutants are occurring as particulates include pollen grains, fungus spores, salt spray, and smoke particles from forest fires and dust from volcanic eruptions.

The artificial occurring pollutants near urban areas more than 90 per cent volume of air polluted as the result of human activity. The artificial sources of pollutants may broadly be classified as stationary or mobile sources; stationary sources include solid waste disposal, constructional and demolition, and industrial process. Manufacturing process such as grinding, smelting, crushing, and grain milling and drying also contribute to air pollution.

4.2. Nature of Air Pollution:

One of the common effects of air pollution is the reduction in visibility resulting from the absorption and scattering of light air borne liquid and solid materials. The air pollutants enter the human body mainly via the respiratory system. Damage to the respiratory organs may follow directly, since it has been estimated that over 50 per cent of the particles between 0.01 and 0.1 m which penetrates into the pulmonary compartment and deposit there. Visibility is principally affected by panicles that are formed in the atmosphere from gashouse reactions. Although not visible, carbon dioxide, water vapor and ozone in increased concentrations change the absorption and transmission characteristics of the atmosphere.Generally, in urban atmosphere the following primary pollutants are identified; Suspended Particulate Matter (SPM), Sulphur Oxide (Sox) and Nitrogen Oxide (Nox) (Sigh etal., 1990) These pollutants contribute further to the ambient level when the new industrial

siting; powered by coal or fuel. The components of pollutants monitored are utilized for public authorities and city planners and urban designers into any development or land use process.

4.3. Ambient Air Quality Standards

Topographic, meteorological, and land use characteristics of areas within an air region will vary. The social and economic development of an area will result in different degrees of air pollution and demand for air quality as well. Because of this it is practical and reasonable to establish different level of air quality for certain areas within a jurisdiction.

Air quality standards are expressions of public policy in land use zoning regulation in relation to location of industrial activities and thereby different countries depending on *exposure conditions*, the socio-economic situation and importance of other health related problems. According to Central Pollution Control *Board of India*, the concentration of permissible primary pollutants limits are standardized for different category of area shown in table No.5.

Table No.5: Permissible Concentration mg/m^2 in Ambient Air Quality Standards.

Category	Area	SPM	SO_2	NO_2	Co
A	Industrial mix use	500	120	120	5000
B	Residential and rural	200	80	80	2000
C	Sensitive	100	30	30	1000

Source: Karnataka State Pollution Control Board , Mysuru

Where category A includes industrial activity in an area and is bound to have somewhat inferior quality of air compared to other categories. Category C covers Hill stations, Tourist resorts, Sanctuaries, Health resorts, National parks, National monuments and other such areas where Nation conserves its clean environment even if that implies some curbs on economic activities. Category B include all areas not specifically included in A or C.

4.4Ambient Air Quality Of The Study Area:

As per the report of Indian Meteorological Department, the climate of Mysore city is mild most of the time, during October to March the prevailing wind is from southeast; during the rest of the month it is from west.

Table No.6: Sampling Air Quality Monitoring Stations

Location	Zone
KSRTC Building, (KR Circle), Mysuru	Commercial/ City Bus stand
KSPCB Building, (Hebbal) Mysuru	Industrial area

Source: Karnataka State Pollution Control Board , Mysuru.

The sampling stations situated at K.R. circle is located on second floor of Visweswaraiah Building. There is heavy vehicular traffic, since many commercial and business establishments. The exhaust from automobile is the major cause for the air pollution in this area.

4.5 Air qualityanalysis at different stations

The monitoring stations located at KSPCB and KSRTCBuilding duringJanuary 2019 to December 2019, the concentration levels of concentration So_2,No_2, RSPM, and SPM aremonitored atdifferent air quality monitoring stations more at KIADB. This may be due to large particulate emission from the surrounding industrial operations.

This can be related to more human activities due to Dasara festivities. The values observed at all the three stations are lies well within the ambient air quality standards. The concentration of SO_2 is more; this may be due to high emission from the surrounding industrial operations. Also the monitored SO_2 concentration at three different stations found to be within the specified limit (see table NO. 7).

a) **Nitrogen Oxide** (NO_2):

The monthly mean variation of $N0_2$ concentration in two different study areas shown in tableNo.7. At monitoring station of V.V. building $N0_2$ concentration is found to be maximum compared to other sampling stations.

Table No.7: Air quality Monitoring Stations located at KSRTC and KSPCB Buildings at Mysuru.

Parameters	SO_2	NO_2	RSPM	SPM
Standards	**120**	**120**	**200**	**500**
Jan. 11	11.6	25	61	124
Feb. 11	11.3	24.9	65	131
Mar .11	11.1	22.7	57	112
Apr. 11	10.8	21.1	48	100
May. 11	11.1	21.6	43	86
Jun. 11	10.9	21.3	38	81
Jul. 11	10.7	20.6	43	78
Aug.11	10.6	20.9	30	60
Sept.11	10.9	21	39	73
Oct.11	10.4	21.4	49	92
Nov.11	11.6	21.8	51	100
Dec.11	11.5	21.6	55	109
Annual Average	11	22	48	96

Source:Karnataka State Pollution Control Board, Mysuru, 2019.

This may be due to the heavy vehicular traffic, since the city bus stand market and business establishments are situated around sampling stations.

4.6.Time Series Analysis:

The time series analysis is carried out to evaluate future concentration trends of Mean value of So_2, No_2, SPM, and RSPM at various air quality monitoring stations in Mysore city. The time series was analyzed by moving average point method for the period 2001to 2020. Table No.8: Mean value of So_2, No_2, SPM, and RSPM at various air quality monitoring stations from 2001 to 2020.

Table No.8: Mean values of So_2, No_2, SPM, RSPM at Various air quality monitoring stations

Mean values of So_2, No_2, SPM, RSPM at Various air quality monitoring stations				
Standards(µg/m³)	**80**	**80**	**200**	**100**
Year	**So_2**	**No_2**	**SPM**	**RSPM**
2000-2001	30	30	109	64
2005-2006	22	34	48	93
2010-2011	11	22	48	98
2015-2016	11	28	46	88
2019-2020	11	22	48	98

Source: Karnataka State Pollution Control Board, Mysuru, 2019

Mysore was one of the cities with major green areas and open spaces. Mysore has now been undergoing rapid urbanization and hence it is necessary to understand the air quality within the city. The ambient air quality monitoring is necessary as it is related to the health of the citizens, spread of diseases and other conditions within a city. In Mysuru, the air quality has been within the permissible limits specified by the Pollution Control Board. In Mysuru, the Karnataka State Pollution Control Board (KSPCB) is the authority responsible for the monitoring of air quality. There are three monitoring stations at Mysore one at KSPCB office building in Hebbal Industrial area, second at KSRTC building at Krishnarajendra circle and the third at Government First Grade College building at Kuvempunagar, which is in the midst of a residential locality. The parameters analyzed are Sulphur dioxide (SO_2), Oxides of Nitrogen (NOX), Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM). The table No.8 reveals the air quality in Mysuru city for the last twenty years, which has been monitored by KSPCB.

The time series analysis for SPM at industrial area was also carried out by moving average method and the forecast value for the year of 2000-01 found to be increasing trend of SPM. Similarly the predicted value of

SO_2 for year 2019-20 found to be decreasing trend but the corresponding forecast value of NO_2 shows the increasing trend. This may be due to high concentration of pollutants at monitoring stations.

4.7. Pollutant concentration behavior with respect to wind direction:

The behavior of the pollution roses are constructed by plotting the frequency of concentration along the direction. Pollutant rose for SPM concentration for different months are shown in tableNo.8. These SPM concentrations along wind direction are caused by higher frequency distribution of low wind speed. In Jan, February, March and November, December, 2019. These high SPM concentration observed at prevailing south-east winds. It can be attributed to the low wind speed. Whereas in December 2019, the higher pollution roses occur prevailing of north- east winds. The frequency distribution of pollutant found to south-east during January 2019 and south west during February 2019. This behavior of these pollutant roses is due to the low wind speed.

4.8.General Findings

Based on the investigation of the study the following conclusions are drawn:

- From air quality parameters of SPM assessed during the study period higher concentration of SPM was observed at commercial area than academically sensitive area and industrial zone, however observed SPM concentration at all three stations found to be within permissible limit. However, care must be taken to maintain the air quality. The air quality index value of Mysuru is satisfactory with 61 index value along with prominent pollutant of $o_{3,}$ though, the air quality is moderate, the breathing discomfort to the people with lungs problems, Asthma and heart diseases. In view of this, the air quality should be maintained by taking appropriate measures to be taken by the concerned authorities in the interest of clean city.
- The recorded arithmetic mean value of pollutants sulphur dioxide and nitrogen dioxide for three zones are found to be within the permissible limit and it has been observed that during the entire study period SO_2 and NO_2 concentrations are more near the commercial area compared to other two stations.
- The trend analysis illustrates that SPM concentrations at commercial area is maximum compared to industrial area. The SPM and NO_2 concentration trend showed and increase whereas the SO_2 concentration trend has decreased from 2001 to 2019.
- The study concludes that the air pollutants concentration (SPM, So_2 and No_2) decreases with increase in wind speed, temperature and Solar Radiation, whereas the pollutants concentration increases with increase in air Humidity.

V. LAND POLLUTION

Apart from the emission of the air and liquid affluent the solid waste generated has also to be disposed off safely. These are generally disposed off on land. Unless this is satisfactorily accomplished, with rain water falling, the pollutants find their way to the natural or ground water sources. Apart from this contamination, precious land is lost for agriculture use thereby creating a pressure on available land. The table No.9, shows the hydraulic loading applicable for different types of soils.

Table No.9: Hydraulic loading applicable for different soils.

Types of soil texture	**Permissible industrial effluents (M^3/hect/Day)**
Sandy	225 - 280
Sandy loamy	170 -225
Loamy	110-170
Clay loamy	055-110
Clay	035-055

Source: Karnataka State Pollution Control Board, Mysuru, 2019

VI. NOISE POLLUTION

Noise is a growing environmental problem in industrial societies especially in cities. Noise assaults modern man outdoor, indoor and on the job. Noise may be defined as any sound that is undesired by the recipient. Noise that permeates our environment to the extent that irritates the general public may be termed "Noise Pollution". The noise pollution and soil pollution are almost negligible due to dispersed and low density

development of land use pattern in Mysore city. It is therefore noise and land pollution are not considered in the present study of industry and pollution. Industrial wastes should be retreated before draining into rivers. Keeping modern technology in mind industrial law should be modified, so that man's right to have an environment of quality and his responsibility to protect and improve the environment for future generations should be kept in mind.

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