

A Comparative Analysis of Increasing Air Pollution and Increasing Vehicles in Jaipur Metro City



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Abstract

Jaipur is a developing city of Rajasthan. It is slowly emerging as a substitute of Delhi. With fast developing industries, it has urbanized more in comparison to other cities of the state with better facilities of transport, communication and entertainment. So, it has attracted immigrants from other cities. Therefore, it has led to increase in population of Jaipur. Not only this, Jaipur is one of the favorite destinations of the country, and so attracts huge number of tourists. So, the population has increased all the more. But, with the augmenting population, level of pollution in Jaipur has compounded and it has become one of the most polluted cities of the country. Harmful gases such as Nitrous oxide, sulphur oxide etc, with dangerous proportions are present in the air which has resulted into various kinds of illnesses prevalent among the population. So, it has become imperative to handle this menace of air pollution and steps need to be undertaken at individual as well as at the level of authorities.

Keywords: Jaipur Metro City, Air Pollution.

Introduction

The presence in or introduction into the air of a substance which has harmful or poisonous effects is called air pollution" (as per dictionary of google). In a broader sense, air pollution means the presence of chemicals or compounds in the air which are usually not present and which lower the quality of the air or cause detrimental changes to the quality of life (as defined by Environmental Pollution Centers). The envelope of air surrounding the earth's surface is called atmosphere. It comprises different gases in different proportions, e.g. Nitrogen, (78%), oxygen (21%), argon (0.93%), carbon dioxide (0.04%), traces of neon, helium, hydrogen, etc. There has to be a fine balance of these gases in air for a healthy living of humans and other living beings. If there is imbalance in these gases percentage then it becomes harmful.

The development process of a region begins with industrialization process. As industries are set up, more people throng in the city area from nearby places. This leads to development of these industrialized regions with proper development of amenities such as housing, sanitation and recreational facilities. This process augurs urbanization and thus, industrialization and urbanization go hand-in-hand.

This is a positive sign for a region, but it has its negative impacts side-by-side too. Pollution is a direct consequence of this procession. Air pollution, water pollution, soil pollution, noise pollution are the forms of pollution which has engulfed the whole planet. Out of this air pollution is a disastrous form as it affects directly through inhalation. The industries emit lot of smoke which consists of harmful gases such as carbon dioxide, sulphur oxides, nitrogen oxides, and particulate matter. These are poisonous gases which cause serious diseases in human beings, plants and animals. Besides industries, spurt in number of vehicles is also a mark of development. As urbanization and industrialization advance, so does the number of vehicles plying on the road. These vehicles release harmful gases and aggravate air pollution. Lead, benzene, polycyclic aromatic hydrocarbons are released from the traffic exhaust. Aside from these, home appliances, agricultural inputs, diminishing forest cover, are other sources of air pollution. So, the impact of air pollution in a region is correlated with the development process. Air pollution has become a topic of debate on a global scale as it has led to heightened increase of temperature and has wrecked havoc on local or regional scale. Henceforth,

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this paper studies impact of air pollution on the development process of Jaipur by measuring the pollutants such as Nitrogen dioxide, sulphur dioxide, and particulate matter.

Review of Literature

The study of pollution of environment including air pollution has been done keenly by various environmentalists, scientists, policy planners, NGOs, etc. A brief review of the important works on the air pollution has been done below:

Gupta, Sunit, and Gupta, Mukta, (1998) have highlighted in their book

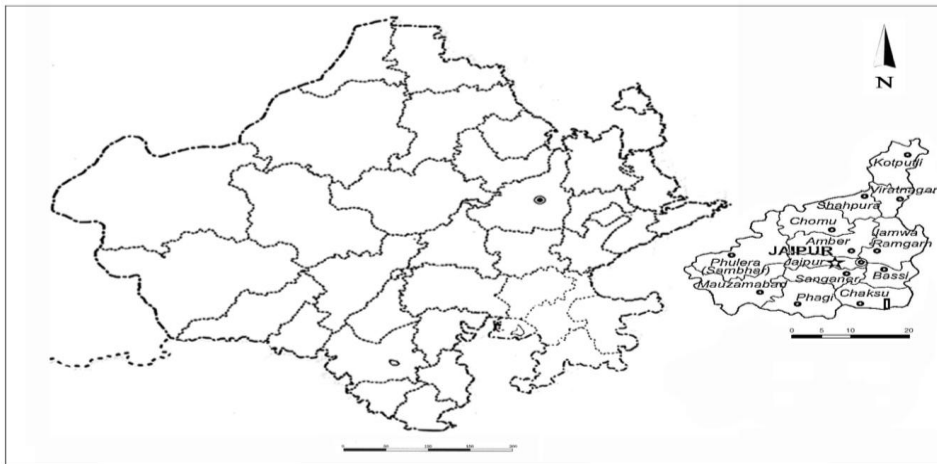
“*Natural Resource Management , Need for 21st century*”, that environmental issues have a great influence for survival for mankind. The advancement of civilisation by technology has caused great threat by causing pollution of air, water and soil.

Bhasin, M.K., and Bhasin, Veena, (1999), in their book, “*Rajasthan Ecology, Culture and Society*”, have focused on the need for a holistic approach for environment, socio-cultural factors and biological factors.

Singh, P.P., and Sharma, Sandhir, (2004) in their book, “*Environment and Pollution Education*”, have focused on environmental education and awareness, effects, other environmental concerns for overpopulation, environmental policies of India, impact of movements, air pollution by mills, atmospheric pollution, etc.

Ghosh, G.K.,(2008), in the book “*Environmental Pollution Scientific Dimension*”, examines the balance between environment and

Map 1. Key map of Rajasthan



Objectives of Study

The objectives of the study denote the aim or overall purpose of our study. It gives the boundaries within which our study should be conducted. For this, our study also has the following objectives:

1. To estimate the growth rate of vehicles classified as L,M,N,O vehicles in Jaipur from 2007-08 to 2016-17.
2. To understand the changing pattern of air pollutants in different areas of Jaipur.

Hypotheses

Hypothesis is defined as a “ proposed explanation made on the basis of limited evidence as

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development. It emphasizes on the need for sustainable development.

Mani, Chandra (2010), book “*Environmental Degradation*” studies the environmental degradation and its impact on the poor and the planet.

Prasad, P.N., and Amarnath, T.R., (2010) in the book “*Environmental Pollution, Causes, Effects and Control*” have studied air pollution, water pollution and noise pollution. They have given detailed study of the causes and effects of these pollution forms and given a critical examination of the issue.

Study Area

Jaipur is the capital city of Rajasthan which is the centre of attraction for tourists with beautiful forts, palaces and havelis. The co-ordinates of this city are 26.9 degree North 75.8 degree East. Jaipur is situated at an altitude of 431 meters or 1417 feet above the sea level. It is surrounded by the aravallis from three sides. These hills also guard Jaipur from the rough and dry climate of the desert region. Sikar district is situated to its north, and Tonk in south direction. Eastern boundary touches Alwar district, while Nagaur, Ajmer cities are located to the western side of Jaipur.

According to census 2011, Jaipur city had a population of 3,073,350. In 2016, the population was 3,548,512 and the density of the city is 598 persons per square kilometer. The literacy rate of Jaipur is 84.34% with 90.61% for males and 77.41% for females. The sex ratio of the city is 898 females per 1000 males.

a starting point for further investigation” as per google definition. The hypotheses for this study are:

1. The pattern of air pollution has remained almost same all over the city.
2. The growth of number of vehicles is directly related to the increase in the level of pollutants in the city.

Methodology

Secondary data has been used from internet, census, magazines, newspapers and various journals. Maps, graphs, and tables have been used to depict comparisons and analyze study area.

Factors Causing Air Pollution

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The alteration in the physical and chemical characteristics of air leads to air pollution. The natural as well as anthropogenic activities are responsible for causing air pollution. The extent of pollution has gone beyond control so much so that international forums are being used to discuss this issue and to discover new ways and means to control it. The Earth summit also known as Rio de Janeiro summit in 1992 was held in Brazil to address various issues concerning climate change.

The natural causes of air pollution include wastes from plants and animals. Carbon dioxide, methane, water vapour, nitrous and sulphur oxides are the major greenhouse gases. Carbon dioxide gas absorbs the terrestrial radiation which results in increase of temperature of the earth which is known as greenhouse effect. Methane released from animal wastes is also a major greenhouse gas. The man-made sources of air pollution include vehicles gushing out harmful gases such as carbon dioxide, carbon monoxide, sulphur dioxide, nitrogen oxide, particulate matter, and hydrocarbons. Industries emit lot of smoke and gases which mingle in the air thereby

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polluting it. Similarly, there are other sources which can be explained as under.

1. Industries are major pollutants of air because their smoke contains various harmful gases such as lead, sulphur, nitrogen oxides and other hydrocarbons. Various printing, powerloom, gems and jewellery cutting industries are located in Jaipur which are responsible for emitting gases and dust in the air.
2. Traffic exhaust from vehicles is one of the major causes of air pollution in Jaipur. Fossil fuels such as coal and petroleum are burnt from automobiles. Poisonous gases such as sulphur oxides, nitrogen oxides, particulate matter 10, 2.5 are released through vehicles. Polycyclic aromatic hydrocarbons is also one of the major air pollutant. According to the Indian standards, the vehicles are classified into light and heavy categorized as L, M, N, O.

The following table gives the total number of vehicles in Jaipur district categorised into light and heavy:

Table 1: Number of Vehicles, Jaipur District, 2007-08 to 2016-17

YEAR	CATEGORY L	CATEGORY M	CATEGORY N	CATEGORY O
2007-08	83,999	22,341	4,611	0
2008-09	74,592	21,154	2,972	0
2009-10	81,555	25,138	6,462	50
2010-11	100,974	28,659	6,859	0
2011-12	122,583	33,268	9,155	0
2012-13	117,221	31,748	8,659	0
2013-14	122,849	35,679	7,285	0
2014-15	96,161	32,856	7,631	0
2015-16	113,938	35,630	8,734	0
2016-17	113,558	38,538	6,692	139

Source : Statistical Abstract 2007-17, Rajasthan Transport Office

Category L- includes vehicles with less than four wheels, two wheelers, auto-rickshaws, tempos.

Category M includes vehicles with at least four wheels ,for carrying passengers, cars, jeeps,taxi cars/jeeps, buses.

Category N includes vehicles with at least four wheels for carrying goods such as trucks.

Category O includes trailers.

As seen from the above table, the number of L category of vehicles is the highest in all the years from 2007-17. This shows that people use vehicles with less than four wheels more than the other vehicles. More of auto-rickshaws, tempos are being used which is a good sign as more of public transport

is preferred than other M and N category of vehicles. M category comprising cars, jeeps, buses occupies second place. The number of M category is continuously increasing with each year as in 2016-17 their number increases to 38,538 from 35,630. This is little disturbing as people with raising standards of living are buying more cars, jeeps and other four wheeler vehicles. The L category occupies the last place. This table shows that number of vehicles for carrying people is increasing more than for goods as population of the city is increasing.

To study the growth of vehicles, the table below gives the percent growth of vehicles categorywise:

Table 2 : Percent growth of vehicles, Jaipur district, 2008-09 to 2016-17

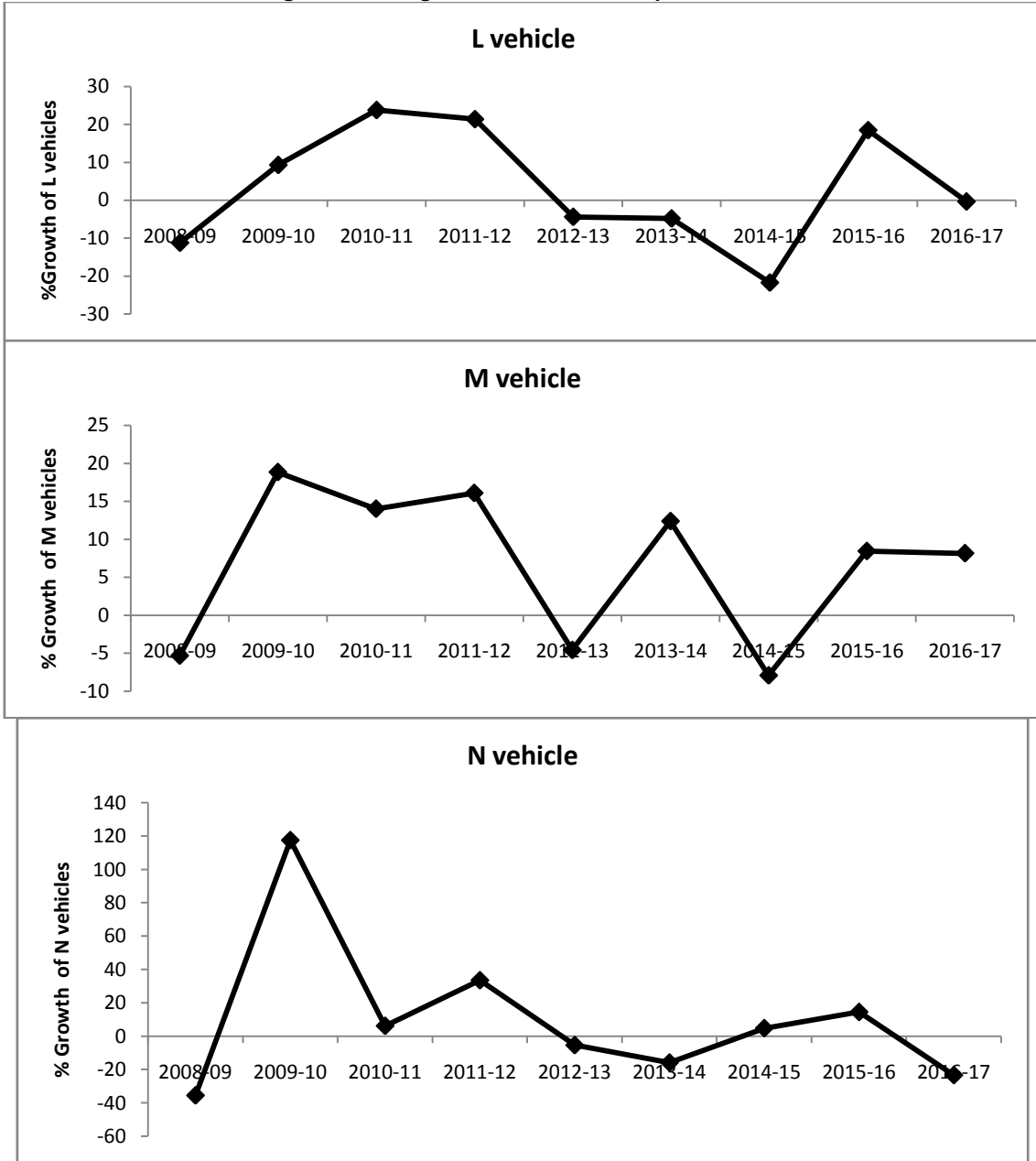
YEAR	CATEGORY L	CATEGORY M	CATEGORY N	CATEGORY O
2008-09	-11.20	-5.31	-35.55	-
2009-10	+9.33	+18.83	+117.43	-
2010-11	+23.81	+14.01	+6.14	-
2011-12	+21.40	+16.08	+33.47	-
2012-13	-4.37	-4.57	-5.42	-
2013-14	-4.80	+12.38	-15.87	-
2014-15	-21.72	-7.91	+4.75	-
2015-16	+18.49	+8.44	+14.45	-
2016-17	-0.33	+8.16	-23.38	-

Source: Statistical Abstract 2007-17, Rajasthan Transport Office

In 2008-09, there was decrease in L category of vehicles from 2007-08. In 2009-10, there was +9.33% increase in these vehicles which increased further whoppingly to +23.81% in 2010-11.

But, in 2012-13, the number of L category of vehicles decreased to -4.37% which regained the increase of +4.80% in 2013-14.

Fig. 1. Percent growth of vehicles, Jaipur, 2007-17



The percentage of L category of vehicles plummeted to -21.72% but, again increased to +18.49%. In the year 2016-17, the percentage of these vehicles decreased to just -0.33%. So, as seen by the above tabular study, the L category of vehicles comprising two wheelers auto-rickshaws, tempos have increased with each year, though, decreasing to nominal percentage in 2008-09, 2012-13, 2014-15 and 2016-17. This is due to the fact, that the standard of living of the people of Jaipur has risen, more number of females, students have taken to driving. The number of auto-rickshaws has increased as

people have now more disposable incomes to use them instead of other four wheeler public transport.

M category includes four-wheeler vehicles like cars, jeeps, buses. Their number too decreased in 2008-09 to - 5.31% but, increased in 2011-12 upto +16% to +18%. After further decrease, their number again increased to +8.44% in 2015-16 and +8.16% in 2016-17.

N category of vehicles include vehicles which carry goods such as trucks. With decrease of -35.55% in 2008-09, the number of these vehicles increased enormously to +117.43% in the year 2009-10,

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increasing further in the following years, but, decreased in 2012-13, 2013-14. Then, their number increased to +14.45% in 2015-16, but, decreased to -23.38%.

(3) Incomplete combustion of fuels produces carbon monoxide which is poisonous and lethal. This is also a major pollutant of the atmosphere.

(4) Mining is also another major source of air pollution. In Jaipur, mining is done which produces various gases and dust. The dust particles released pollute the atmosphere.

(5) Agriculture is another activity which contributes to air pollution. The various chemicals, pesticides, insecticides are used which produce various polluting gases and thus, pollute the atmosphere. Methane is released from the respiration and excretory products of atmosphere that is also a cause of air pollution.

(6) The various home appliances such as air conditioners and refrigerators use chlorofluorocarbons which are hazardous as these are ozone depleting substances. These emit polluting gas which lead to thinning of ozone layer which protects us from harmful ultraviolet radiations which come from outer atmosphere. Not only this, the paints used on the walls, doors, other furnitures produce harmful gases causing pollution.

These are the factors which have caused air pollution in Jaipur. The surrounding areas of Jaipur city are both agricultural and industrial towns and thus, have both agricultural as well as other discussed causes of air pollution. For example : Sanganer sub-division of Jaipur is famous for its printing and dyeing industry. But, the by-products are released in the atmosphere and even in water sources which mixes with the nallahs thus, leading to air and water pollution. Therefore, many industries which do not meet the standards have been closed.

Thus, there is an urgent need to check these factors and to prevent further pollution. Both

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individuals and authorities need to work together to take care for this menace from aggravating.

Air pollution quality

The atmosphere surrounding us contains gases in different proportions. These gases are used in different quantities by living organisms. But, when these gases are present in variations due to natural and man-made factors, these become dangerous for us. Gases such as carbon dioxide, nitrogen oxide, sulphur dioxide, carbon monoxide, particulate matter in the form of dust, pollen, moulds have risen to dangerous levels in most of the places in Jaipur making the air polluted which has caused severe health problems for the people. Jaipur is the most polluted city in Rajasthan mainly because of its vehicles and industries. Everywhere, huge number of vehicles are added on the roads. Rising personal disposable incomes, lavish lifestyles, different vehicles at the disposition of different individuals have led to huge rush on the roads making it cumbersome traffic at nearly every main road. These serpentine lines of vehicles gush out enormous amount of gases to hazardous levels. In addition to these vehicles, industries also emit smoke which contains poisonous gases.

The quality of air is determined by the different gases in it and it is measured in microgram /cubic metre. The quality of air is measured in Jaipur at different monitoring stations such as Ajmeri Gate, Jhalana Doongari, Chandpole, etc. The air quality status in Jaipur has been determined by State Pollution Control Board in the form of National Ambient Air Quality Status depicting the quantity of sulphur dioxide, nitrogen dioxide and particulate matter for this study This has been given in the tabular form below:

Air Quality
Table 3 : Air Quality- Nitrogen Dioxide

Year	Ajm-eri gate	Jhalana Dungri	Chandpole	MIA RIICO office	Nagar Nigam Mansarovar	RIICO Baees Godam industrial area	RIICO Sitapura	RO (North)	VKIA
2010	38.07	31.58	42.71	34.84				40.47	41.89
2011	38.89	34.45	39.41	34.77				38.73	38.98
2012	52.71	46.57	52.32	47.67				54.37	53.53
2013	43.16	37.47	40.62	34.74				41.90	40.28
2014	41.15	39.39	41.77	37.11				42.94	43.34
2015	37.07	34.06	44.09	32.37				40.08	39.02
2016	34.75	32.04	35.22	30.95				36.20	36.41
2017	32.45	30.10	32.64	29.58				33.50	33.29
2018	38.72	27.02	35.63	29.88	25.74	28.63	30.21	31.62	36.86

National Ambient Air Quality Standards as per CPCB notification – 40 microgram / cubic metre

Source : Environment Report, Rajasthan Pollution Control Board

If we compare the data year wise of the different stations, then we find that, in 2010, Chandpole had the maximum concentration of Nitrogen dioxide equal to 42.71 microgram | cubic metre, then Vishwakarma Industrial area had pollution level of 41.89, and Regional Office area of Rajasthan State Pollution Control Board (RO office) with 40.47. In 2011, Chandpole had the maximum pollution with 39.41 microgram| cubic metre, then VKIA with 38.98.

In 2012, RO(North), the level of Nitrogen dioxide was 54.37 followed by VKIA with 53.53 and Ajmeri Gate with 52.71 microgram| cubic metre. In 2013, Ajmeri Gate had the maximum pollutants equal to 43.16 microgram| cubic metre, then 41.90 in RO(North) and Chandpole with 40.62 microgram| cubic metre. In 2014, VKIA had pollution level of 43.34 then, RO (North) with 42.94 and Chandpole with 41.77. In 2015, Chandpole had the highest pollution with 44.09,

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RO with 40.08 and VKIA with 39.02 microgram| cubic metre. In 2016, VKIA had the pollution level of 36.41, RO(North) had 36.20 and Chandpole had 35.22 microgram | cubic metre. In 2017, the level of Nitrogen dioxide in RO was 33.50, followed by VKIA

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with 33.29 and Chandpole with 32.64 microgram| cubic metre. In 2018, the highest level was found in Ajmeri Gate, then VKIA with 36.86 and Chandpole with 35.63 microgram | cubic metre.

Table 4 : Air Quantity – Sulphur Dioxide

Year	Ajmeri gate	Boards office Jhalana Dungri, Jaipur	Chandpole Jaipur	MIA, RIICO office, Jaipur	Nagar Nigam office, Jaipur	RIICO Baees Godam industrial area	RIICO Sitapura	RO(North)	VKIA
2010	6.02	5.32	6.17	5.48				5.91	6.14
2011	6.34	5.85	6.37	5.92				6.79	6.39
2012	9.16	7.8	9.14	7.90				9.61	9.59
2013	7.34	6.66	7.23	6.42				7.96	8.08
2014	7.09	6.69	7.09	6.45				7.63	7.80
2015	7.14	6.79	6.97	6.64				7.49	7.92
2016	8.55	8.17	8.62	7.89				9.34	9.15
2017	8.42	7.81	8.48	9.18				9.33	8.90
2018	8.37	6.52	7.81	7.46	6.95	7.31	7.25	8.68	10.40

National Ambient Air Quality Standard as per CPCB notification – 50 microgram / cubic metre

Source: Environment Report, Rajasthan Pollution Control Board

As per above tabular study, in 2010 chandpole had the maximum pollution level of 6.17 microgram| cubic metre, then VKIA had 6.14 and Ajmeri Gate with 6.02 microgram| cubic metre. In 2011, RO (North) had pollution level of 6.79 followed by VKIA with 6.39 and Chandpole with 6.37 microgram | cubic metre. In 2012, RO (North) had pollution level of 9.61, followed by VKIA with 9.59 and Ajmeri Gate with 9.16 microgram| cubic metre. In 2013, VKIA had maximum pollution with 8.08, then RO (North) with 7.96 and Ajmeri Gate with 7.34 microgram| cubic metre. In 2014, VKIA had the maximum pollution of 7.80 microgram| cubic metre followed by RO (North) with 7.63, then Ajmeri gate and Chandpole areas with 7.09 microgram cubic metre. In

2015, VKIA had pollutants equivalent to 7.92 microgram cubic metre, RO (North) with 7.49 and Ajmeri Gate with 7.14 microgram cubic metre. In 2016, RO (North) had pollution level of 9.34, VKIA with 9.15 and Chandpole with 8.62 microgram| cubic metre. In 2017, RO (North) had pollution level of 9.34, VKIA with 9.15 and Chandpole with 8.62 microgram| cubic metre. In 2017, RO (North) had maximum pollution of 9.33 followed by MIA, RIICO office with 9.18 and VKIA with 8.90 microgram| cubic metre. 2018 had maximum pollutant level in VKIA with 10.4, RO (North) with 8.68 and Ajmeri Gate with 8.37 microgram| cubic metre. Similarly, a study of particulate matter pollutant can be done as follows:

Table 5: Air Quality – Particulate matter less than 10 microgram / Cubic metre

Year	Ajmeri Gate, Jaipur	Boards office, Jhalana Dungri	Chandpole	MIA, RIICO office Jaipur	Nagar Nigam, Mansarovar	RIICO Baees Godam	RIICO Sitapura Industrial Area	RO(North)	VKIA
2010	121	106	198	102				195	252
2011	143	90	164	101				192	216
2012	159	125	209	129				271	238
2013	119	102	143	107				197	258
2014	122	100	148	103				225	236
2015	145	112	179	111				230	249
2016	189	130	256	122				252	281
2017	196	130	213	128				251	272
2018	173	97	172	121	126	136	98	202	284

National Ambient Air Quality Standards as per CPCB notification -60 microgram / cubic metre

Source : Environment Report, Rajasthan Pollution Control Board

In 2010, the maximum concentration of this pollutant was found in VKIA with 252 microgram| cubic metre due to the pollutant emitted from industries, then in Chandpole area due to heavy congestion of traffic with 198 microgram| cubic metre and in the Regional Office area of Rajasthan State Pollution Control Board equal to 195 microgram cubic metre.

Year 2011 witnessed maximum pollution in VKIA with 216 microgram| cubic metre, followed by RO (North) with 192 and, then, Chandpole with 164

microgram| cubic metre. In 2012, VKIA had the maximum pollutants with 238 microgram| cubic metre, then RO (North) with 271, followed by Chandpole with 209 microgram| cubic metre. In 2013, the maximum concentration of the pollutant was found in VKIA with 258 microgram| cubic metre, RO (North) with 197 and, then, Chandpole with 143. In year 2014, VKIA with 236 microgram| cubic metre concentration of particulate matter had the highest concentration of pollutant, followed by RO (North) with 225 and Chandpole with 148 microgram| cubic metre. 2015

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saw VKIA with the maximum concentration of pollutants with 249 microgram| cubic metre, RO (North) with 230 and Chandpole with 179 microgram| cubic metre. In 2016, VKIA had highest pollutant with 281, followed by 256 in Chandpole and 252 micrograms| cubic metre in RO (North). In 2017, the concentration of particulate matter was maximum in VKIA with 272 microgram| cubic metre. Year 2018 saw VKIA with maximum level of pollution with 284 microgram| cubic metre, then RO (North) had 202 and traffic congested area with 173 microgram| cubic metre.

From the above tables, it can be shown that the level of NO₂ and SO₂, has increased from traffic exhausts. The exhaust contains gases such as SO₂, NO₂, hydrocarbons, carbon monoxide, lead exhaust which are used with petrol. So, vehicles older than a definite period have been banned from plying and even lead which was used earlier has now been disallowed to be used. Similarly, particulate matter in the form of dust, pollen and moulds has increased into the atmosphere. The various factors account for this scenario and hence, Jaipur has become one amongst the top polluted cities as per World Health Organisation. Therefore, it is imperative to discuss the effect of air pollution in this region.

Effects of air pollution

Air pollution has become a menace at global level. Countries have grown worried about the alarming rise in global temperatures which is irreversible. At international forums, this disaster has attracted prime importance. The natural causes such as volcanic eruptions, process of respiration by living beings, forest fires release lot of smoke and other harmful gases. Along with these the man-made causes as discussed above also release smoke and other gases. The cumulative effect of this is air pollution which has become lethal for living organisms. The level of these gases has risen to disastrous level and has become havoc for us. The effect of air pollution can be discussed as under:

1. As oxygen is one of the necessities of life, any disturbance in its proportion can be lethal for human beings and animals. Polluting gases such as carbon dioxide, carbon monoxide, sulphur dioxide, nitrogen oxides, hydrochlorofluorocarbons, methane, lead, suspended particulate matter, polycyclic aromatic hydrocarbons smog get infused in air. cause lung cancer. The consequence of air pollution are asthma, pneumonia, lung diseases, cough, chronic obstructive pulmonary disease (COPD). The number of patients with COPD have increased in Jaipur due to increase in pollution level. The deaths from respiratory problems has replaced from that caused by heart diseases.
2. Another major effect of air pollution on environment is global warming. The temperature of earth's atmosphere has increased to an extent which is irreversible which has melted the glaciers raising the sea-levels which may submerge the coastal cities leading to rising concerns worldwide. The impact can also be seen in Jaipur which has registered rise in temperatures with each year passing by. The

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temperatures in summers and winters have increased thereby disturbing rainy seasons as well.

3. The pollutant gases when mix with rain water cause acid rain because they mix with rain water to form different acids which are harmful for human beings as well as animals, plants, soil, buildings, etc.
4. These pollutants when reach the water bodies cause the growth of algae called as eutrophication.
5. Apart from these outdoor sources, the sources of indoor pollution also cause grave impacts. Home appliances such as air conditioners, refrigerators use chlorofluorocarbons which are the causes of ozone hole or thinning of ozone layer causing skin cancer, yellowing of leaves.

These are the major effects of air pollution which have engulfed the people worldwide because of their impact on human population and their environment. The disastrous effect on human health has become a cause of concern, and other related effects have led to the organisations of individuals and communities for finding out solutions to fight this disaster.

Solutions to fight air pollution

After the above study in this paper, it becomes imperative to find solutions to check air pollution. Air pollution has caused irreparable damage to human beings and their surroundings. Human beings, plants, animals and their environment have been affected disturbing their ways of living. The following solutions are suggested to fight the bane of air pollution:

1. It is concluded from the above paragraphs that vehicles are the main reason of pollution in Jaipur. As seen from table 1, the number of vehicles carrying people has been increasing in each year from 2007-17 more than for carrying goods due to increasing population of the city. So, there is a need to control the number of vehicles plying on the roads. In this regard, public transportation is one of the ways so as to curb the vehicular emissions. Car pooling is another way forward. The use of eco-friendly vehicles using compressed natural gas should be encouraged as in the national capital, Delhi.
2. In addition, we should emphasize on conserving energy in using lights, fans and other electrical appliances judiciously, especially in public offices, schools, colleges to use lights, fans, coolers, ACs.
3. A major way forward is to use renewable or non-conventional sources of energy such as solar and wind energy. As Rajasthan is a desert state, there is abundance of solar and wind energy available. So, solar cells, cookers, equipments can be used.
4. Apart from these, other ways can be using the recycled products.
5. Instead of using conventional tube lights and bulbs, chlorofluorescent lights can be used which are energy efficient and eco-friendly. Firecrackers used during festivities should be discouraged or

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at least used within limits and for this youth should play a decisive role.

Cited above are the major steps which can be taken at individual and at the level of authorities to arrest the progress of pollution in Jaipur. But, there should be other ways also to fight this menace. Each one has to contribute to fight it before it engulfs us all into more number of problems.

Conclusion

The above tabular study of pollutants' level in Jaipur city shows that

1. In year 2011-12, there was maximum growth of vehicles in Jaipur city followed by year 2015-16 as shown by table.
2. The other observation shows that of the whole city, Vishwakarma Industrial Area, Chandpole, Ajmeri Gate, and RO (North) are the most polluted centres in the city due to different reasons being the number of industrial units, more number of vehicles plying on the road and, due to this, higher amounts of Nitrogen dioxide, Sulphur dioxide and particulate matter being released into the atmosphere. Though, the other areas of the city also show comparable levels of pollutants which brings out the fact that the pollution level all around the city is high.
3. These two facts can be co-related as, in the year 2011- 2012 and 2015-16, there was maximum growth of the number of vehicles, and concomitantly, the concentration of pollutants was also higher during these years.

These conclusions prove the hypotheses:

1. The level of pollutants has remained the same all over the city.
2. The pattern of the growth of number of vehicles and the level of pollutants are co-related.

The study above underscores the grave necessity of tackling this threat of air pollution. Jaipur is on the track of becoming an industrial city but, this should not take toll on our environment. Jaipur has become a polluted city making the life of inhabitants miserable. Respiratory problems, heart ailments, lung diseases are to name a few of physical problems. This has impacted the lives disturbing the calmness of this city. But, the whole picture is not dismal. Vigilance has risen amongst the civil society and even many organisations have taken steps to check air pollution.

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Jaipur is also no exception to this. Majorly, industries have been shifted to particular sites away from populated areas. People have been curtailed from using fire crackers to a limited time during festivities, trend of usage of common vehicles is being encouraged, more trees and plants are being planted on road pavements, etc. Such steps are although on a nascent stage yet it is satisfying that the people and government have become aware and are endeavouring to control this gruesome phase of air pollution in the city to make it "Our Clean and Green Jaipur".

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