

Impact of Growth of Automobile Industry on Air Pollution in India

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Abstract: *The average growth rate of India's GDP was between 2.5 to 3 % from 1947 to 1991. It was due to protectionism policy of Govt. of India. The Liberalization policy of 1991 boosted industrial sector including automobile industry and India's average growth rate reached to the level of 6 to 8 %. In 2019, India was the seventh largest manufacturer of commercial vehicles. Today, India is the world's fifth largest automobile market in terms of sales, after Germany, selling about 3.49 million units in passenger and commercial categories and total 26.28 million units. India has largest and fastest growing automobile industry with the turnover of 120 billion US \$ which is more than 4 % of India's GDP. Employment wise, more than 1.7 million people are employed in auto sector. Automobile industry also contributes at large extent towards the growth of Indian economy. On the other hand, rise in the number of vehicles leads to increase in air pollution, which creates the environmental problems. Air pollution causes many health issues especially related to respiration. The study is based on secondary data collected from multiple sources. The data of automobile industry in India is collected from Society of Indian Automobile Manufacturers and the data of air pollution level is collected from International Energy Agency. The period of the study is from 2006 to 2020. The graphical presentation explains the growth of automobile industry in India. Descriptive statistics and Linear Correlation Matrix are used to test the relation between growth of automobile industry and air pollution level. Regression technique is used to test the impact of automobile industry growth on air pollution. The empirical analysis inferred that highest production of all vehicles together was 309.1 lakh in 2019, the highest sales was 262.66 lakh in 2019, and the record export was 47.66 lakh in 2020. It is also confirmed that two wheeler segment contributes in majority for production, sales and export. Growth of automobile industry is restricted in 2019- 20, may be due to COVID-19 pandemic. India's maximum air pollution is from Electricity and Heat Producers sector 51.13 % and 3 % from the other energy industry. Air pollution level shows increasing trend every year. The Regression OLS model confirmed that the sales of automobile vehicles have a significant impact on air pollution in India. Hence, it is concluded that the growth of Indian automobile industry contributes to the air pollution.*

Keywords: Air pollution, Automobile Industry, Growth, India

1. Introduction

The average growth rate of GDP in India from 2000 to 2019 was in the range of 3.84 to 4.18%. The emphasis was given to Public Sector Undertakings (PSUs) or Public Sector Enterprises (PSEs) and due to which a number of central PSUs and state PSUs were established in the country. These PSUs helped to create big manufacturing capacities in various fields like: steel manufacturing, cement manufacturing, heavy machine tools manufacturing, ship building, heavy electrical manufacturing, oil refining, telecommunications, automobile including heavy duty, passenger and commercial vehicles, mining industries, etc. In the service sector also, the main stress was on the public-sector institutions. The banks were largely set up under public-sector domain. Electricity supply, water supply, railways, transport sector including passenger and commercial segments, insurance sector and educational sector were largely set up as Government undertakings. These undertakings created lot of employment in the organized sector. Employment created by PSUs helped a sizeable middle class population of India to enjoy much better standard of living. Indian government followed the policy of public sector and protectionism, whereas the other developing countries like China, South Korea, Singapore, Malaysia, etc. opened up their economy to the international competition. They encouraged private investments from

local and foreign companies. The Government of India opened up economy in many fields like Agriculture and Animal husbandry, Mining, Plantation, Transportation, Banking, Insurance, Telecommunication, IT, Education, Defence manufacturing, Broadcasting, Construction, etc. The conditions for FDI were also relaxed and therefore many international companies' setup their manufacturing plants in India. Transportation industry including civil aviation and railway infrastructure also opened up for FDI in India. India was the fourth largest auto market in 2018 with sales of 3.99 million units. India is the second largest bus manufacture and third largest heavy truck manufacturer in the world. Foreign companies like Honda, Suzuki and Toyota of Japan, Hyundai of South Korea, BMW and Volkswagen of Germany, Ford of US, etc. have tie ups in India. The automotive industry comprises of wide range of companies and organizations involved in design, development, manufacturing, marketing and selling of motor vehicles. It is one of the largest industries by revenue. In 2018, India overtook Germany to become 4th largest automobile producer with 5,174,645 units (Production Statistics, OICA). In 2019-20, the automobile production in India was 26,362,282 units whereas the automobile sales were 21,546,390 units (SIAM). Air pollution measured by carbon dioxide (CO₂) emission was 2308 Metric Ton in India in 2018 (International Energy Agency). It is said that air pollution creates out of burning of fuel and maximum fuel is

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burnt during production or use of vehicles. Further, it is assumed that there is significant relationship between the growth of automobile industry and air pollution. Therefore, this project aims at the study of growth of Indian Automobile Industry and its impact on Air pollution.

2. Automobile Industry in India

Indian automobile industry is one of the biggest industry across globe. The growth rate of automobile industry was very high in last 25 years. It was within the range of 10 to 18 % depending on type of vehicles. Earlier, India had a limited number of manufacturers of vehicles. But now, almost all international automobile companies have set up their manufacturing plants in India. The current turnover of automobile sector is Rs. 7.5 Lakh Crores, which is nearly 7 % of India's GDP. Earlier in 2018, it was approximately 8 % of GDP. Employment wise, this sector generates employment for 35 million people (Direct and indirect). It also accounts for 4.3% of India's export. The continuous growth of automobile industry has benefitted the Indian economy by creating a lot of employment opportunities and boosting the export. But, the growth of this sector has also created environment related problems due to rising air pollution in the country. Air pollution causes many health issues especially related to respiration. WHO reported that every year around 5 lakh deaths in India are caused due to air pollution. Report further adds that Delhi is the most polluted city in the world and India is the third most polluted country in the world. Growth in the production of automobile vehicles also increased the emission of hazardous gases which leads to global warming and caused climate change.

3. Objectives of the study

- 1) To study the trend of production, sales and export of automobile industry in India.
- 2) To examine the growth of production, sales and export of automobile industry in India.
- 3) To analyse the status of air pollution in India.
- 4) To study the impact of growth of Indian automobile industry on air pollution.

4. Research methodology

4.1 Review of Literature

This review focuses on empirical studies conducted by various researchers on growth of automobile industry in India and its impact on Air Pollution.

Yadav, et. al (2017) inferred that the growth of automobile industry has impact on air pollution in India. It is growing year by year but increase in number of vehicles also created pressure on air pollution. Linear correlation technique applied on the data for the years 2006 to 2016 also proved that air pollution increases with the growth of production and sales of automobiles.

Roy (2016) also explained that the increase in transport sector has contributed to the climate changes in major cities

across the world. The data from Delhi and Kolkata proved that the increase in the growth of vehicles is correlated with the increase in the average mean temperature in the city.

Kokila et.al (2016) confirmed that the air pollution contamination in a region is result of its own zone's air pollution and also from the nearby regions because of certain factors like wind speed and wind direction. The metrological data is collected and with the help of the Hysplit4 simulation the scattering pattern of the pollutants from the vehicles and its scattering territory is mapped. Whereas **Geetha, et.al (2015)** highlighted that all the major cities in the world due to rapid urbanization and increase in population resulted in rapid growth of number of vehicles which in turns resulted in air pollution and issues related to health & environmental damage. The pollutants are analysed with the simulation software Hysplit4. Path of the pollutants are traced. The trajectory of the pollutants is dependent on the local wind speed, temperature and wind direction.

Krishnaveni, et.al (2015) concluded that production and exports trends of the automobiles in India has been rising year by year. The rise in demand and increase in the FDI inflows has contributed to the production and exports of the automobiles in India. **Singh (2014)** explained that automobile industry in India was restructured after reforms started in 1991. The contribution of automobile industry reached about 8% of India's GDP because of increase in income of the middle class population in India. Easy loan policies of banks for buying two wheelers and cars leads to rapid growth of automobile sector. The growth is also due to heavy FDI inflows i.e. around 48% of total FDI during the periods 2000-2011.

Gaddam (2013) explained that the increase in the trend of production and sales of automobile industry was due to the increase in growth of the Indian economy and also due to increase in income level of the consumers. There is immense future potential for automobile industry as there is still a low penetration of automobiles in India. **Lokhande, et.al (2013)** discussed about the historical trend of the automobile industry in India. They added that the Indian automobile industry has opened up after the liberalization (1990) and now the automobile market has become a highly competitive one. It is suggested that the organizations have to be creative and bring innovations in order to sustain. **Shrivastava et.al (2013)** also explained that rapid urbanization and growth of motor vehicles has serious effect on environment and human life. Most of the cities in South Asia including India are suffering from the high air pollution. The Pollutants like CO, SO₂, NO₂, PM, etc. mainly comes from the emissions of the transport sector.

5. Data Collection, Sampling and Period of study

The data required for the study are drawn from the secondary sources. The data on production, sales and export of automobile sector in India is collected from Society of Indian Automobile Manufacturers (SIAM) and data of air pollution level i.e. carbon dioxide (CO₂) emission is collected from International Energy Agency. The annual data of vehicles is collected for Passenger vehicles,

Commercial vehicles, three wheelers, four wheelers and all vehicles in India. The air pollution level i.e. carbon dioxide (CO₂) emission is considered for country as a whole. The data of 15 years i.e. 2006 to 2020 is used to examine the growth of automobile sector and its impact on air pollution. The data of the year 2018 is used to study the sector wise air pollution in India.

Tools and Techniques

Statistical tools like charts and graphs are used to study the trend and growth of automobile Industry and sector wise air pollution. Descriptive statistics and linear correlation matrix are used to study the relation between growth of automobile

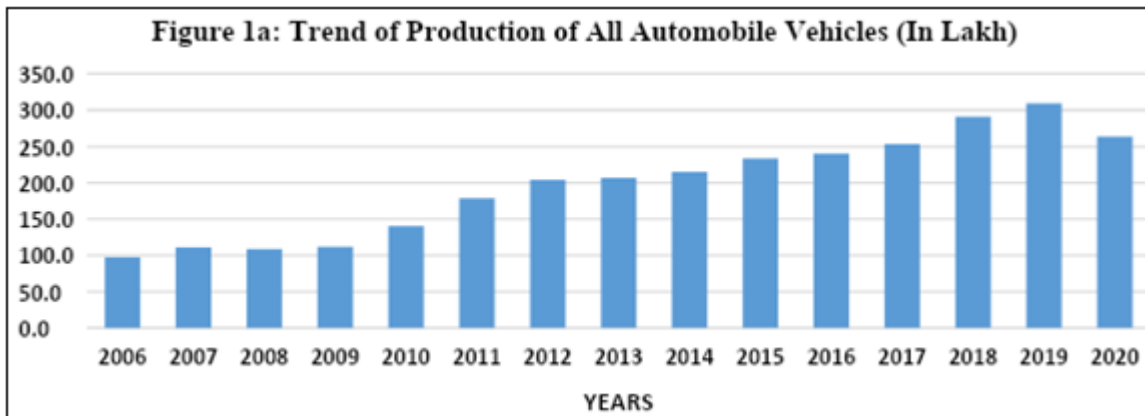
industry and air pollution. Further OLS regression technique is used to examine the impact of growth of automobile sector (Independent variable) on air pollution (Dependent variable).

6. Analysis and Discussion

Trend and Growth of Automobile industry

This sub section presents the trend and growth of production, sales and export of automobile vehicles for the years 2006 to 2020.

A) Trend and Growth of Production of Automobiles



Source: Society of Indian Automobile Manufacturers

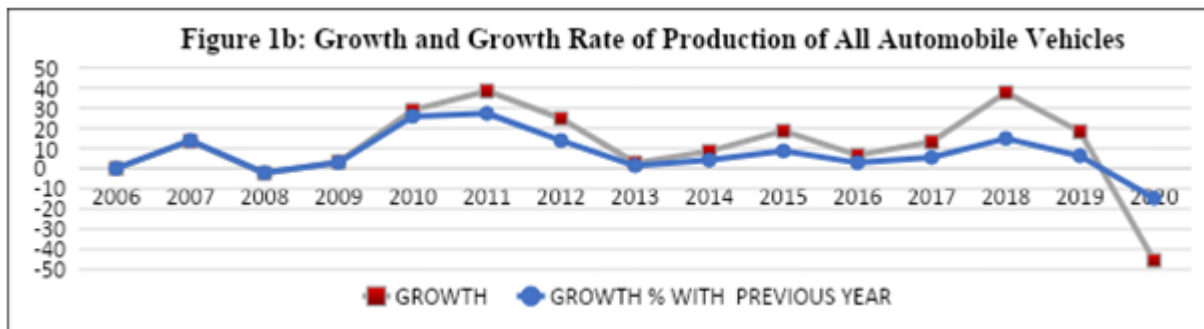


Figure 1a shows the total production of automobile industry for the years 2006 to 2020. The production of all automobile vehicles shows an increasing trend over a period of 15 years. In 2006, production was 97.4 lakh, highest in 2019 i.e. 309.1 lakh but drastically fallen to 263.6 lakh in 2020. It is noted that two wheeler segment is the major contributor to

automobile industry. Figure 1b reflects the growth of production over the previous year, it was highest in 2011 i.e. 38.41 lakh vehicles (Growth rate 27.28 %), whereas lowest in 2020 i.e. - 45.52 lakh vehicles (Growth rate -14.73 %).

B) Trend and Growth of Sales of Automobiles



Source: Society of Indian Automobile Manufacturers

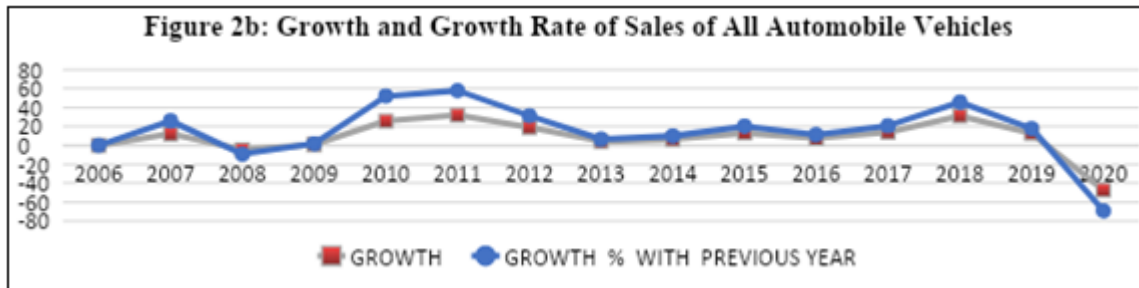


Figure 2a shows the total sales of automobile industry for the years 2006 to 2020. From the data it is proved that the sales of automobiles are in increasing trend except in 2020 and the two wheeler segment is the major contributor. All automobile vehicles together reflect the highest sale in 2019 i.e. 262.66 lakh but decreased to 215.46 lakh in 2020.

Figure 2b reflects the growth of sales over the previous year, it was highest in 2011 i.e. 31.85 lakh vehicles (Growth rate 25.95 %) and lowest in 2020 i.e. – 47.19 lakh vehicles (Growth rate - 21.91 %).

C) Trend and growth of export of automobile vehicles



Source: Society of Indian Automobile Manufacturers



Figure 3a shows the total export of automobile industry for the years 2006 to 2020. From the data it is inferred that all automobile vehicles together have a record export of 46.29 in 2019 and 47.66 lakh vehicles in 2020. Two wheelers were exported in majority. Thus, the trend of export is also upward moving.

2020 seen the record break export of automobiles. Two wheelers were exported in majority.

Figure 3b displays the growth over earlier year of export of automobile vehicles, it was highest in 2015 i.e. 6.4 lakh vehicles but growth rate was highest in 2011 i.e. 28.82 % and lowest in 2013 i.e. – 5.9 lakh vehicles (Growth rate – 20.27 %). Inferred that the export level is increasing continuously over last one and half decade. Years 2019 and

5.2 Air Pollution in India (Carbon dioxide (CO₂) emission)

1) Sector wise Air Pollution in India.

In this sub-section, the status of sector wise air pollution in India is analysed considering the period 2006 to 2018 (13 years). The air pollution is measured in terms of Carbon dioxide emission (CO₂). Table A explains the sector wise air pollution in India.

Table A: Sector wise Air Pollution in India (CO₂ emission) (Measured in Metric Tons)

	EHP	OEI	Industry	Transport	Residential	CPS	Agriculture	FCNES	Total	Number in Thousands
Min.	596	31	260	121	71	11	23	19	1195	1.195
Max.	1183	59	571	305	89	30	72	48	2308	2.308
Mean	897.92	44.46	432.31	216.54	78.69	20.00	32.46	33.62	1756	1.76
%	51.13	2.53	24.62	12.33	4.48	1.14	1.85	1.91	100	

Source: International Energy Agency

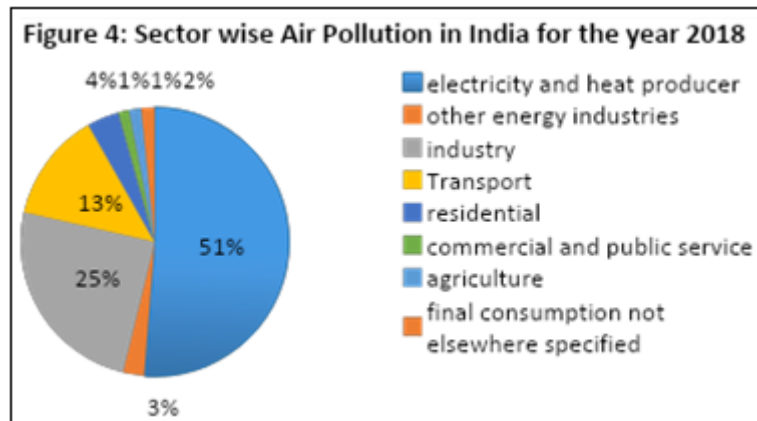
EHP - Electricity & Heat Producer

OEI - Other Energy Industries

CPS - Commercial and Public Services FCNES – Final Consumption Not Elsewhere Specified

Table A depicts the maximum, minimum and average air pollution of last 13 years. It is noted that the maximum air pollution is created from Electricity and Heat Producers sector i.e. 897.92 MT on an average 51.13 % plus other

energy industry 3 %, second is manufacturing Industry Sector i.e. 432.31 MT comprising of 24.62 % of air pollution and third is Transport sector i.e. 216.54 MT covering 12.33 % of air pollution in India. The rest 9 % is from other sectors



Source: International Energy Agency

Figure 4 explains that in the year 2018, the sector wise air pollution raised in India was similar to the average of last 13 years i.e. Electricity and Heat Generation sector 51% and other energy industries 3 %, Manufacturing Industry sector 25% and Transport sector 12%. The highest quantity of

carbon dioxide in India was released in 2018 i.e. 2308.MT. India releases around 2000 MT of CO₂ emissions every year

2) Trend of Air Pollution (CO₂ Emission) in India:

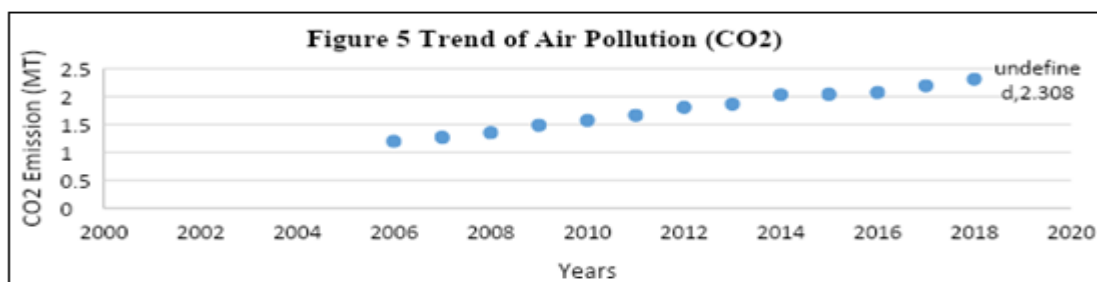


Figure 5 shows an increasing trend of air pollution in India continuously from 2006 to 2018. In 2018 it reflects the highest release of carbon dioxide i.e. 2.308 metric tons. It was started with 1.195 MT in 2006. But continuously for last three years i.e. 2016, 2017 and 2018, it has crossed CO₂ emission of 2000 MT.

2006 and maximum was in 2018 i.e. 2308 metric tons, averaging 1756 MT for last 13 years.

3) Impact of Automobiles Sales on Air Pollution

A) Descriptive Statistics:

Table B: Descriptive Statistics of Automobile sales and Air Pollution

	Automobile Sales of All Vehicles (In Lakh)	Air Pollution (CO ₂) (MT)
Minimum	89.1	1195
Maximum	262.66	2308
Mean	169.76	1756

Source: Authors compilation.

Table B reflects that the minimum number of total automobiles sold in a year were 89.1 lakh vehicles in 2006 where as maximum were 262.66 lakh vehicles in the year 2019 averaging 169.76 lakh vehicles for 15 years. The minimum carbon dioxide released was 1195 metric tons in

B) Correlation analysis

Table C: Correlation Matrix

Correlation coefficients, using the observations 2006 - 2018		
5% critical value (two-tailed) = 0.5529 for n = 13		
Automobile Sales	CO ₂ Emission	
1	0.9794	Automobile Sales
	1	CO ₂ Emission

Source: Authors compilation.

A linear correlation between Automobile Sales and CO₂ emission of India is made and Pearson correlation value is 0.9794, this proves that there is a strong positive correlation between Automobile sales and air pollution in India.

C) Regression Analysis

The impact of automobile sales on air pollution is noted by using the simple regression analysis. The null hypothesis formulated as ‘There is no significant relationship between automobile sales and CO₂ emissions’. The regression result is as follows.

Table D: Regression Analysis

Model : OLS, using observations 2006-2018 (T = 13)					
Dependent variable: CO2 Emission					
	Coefficient	Std. Error	t-ratio	p-value	
constant	685.267	69.831	9.813	<0.0001	***
Automobile Sales (Lakh)	6.72997	0.417969	16.1	<0.0001	***
	R-squared	0.959299	Adjusted R-squared	0.9556	
	F(1, 11)	259.2619			
	S.E. of Regression	76.85165	P-value(F)	5.39E-09	

Source: Authors compilation.

*** Significant at 1% level.

Regression analysis presents the relation between dependent variable i.e. Air pollution (CO₂ used as proxy for Air pollution) and independent variable i.e. Automobile sales in terms of Ordinary Least Square Technique (OLS). The empirical analysis suggest that coefficient of correlation is very high (R= 0.9794), it indicates that there is high degree of correlation between Air Pollution (CO₂ emission) and automobile sales. R Squared (0.9592) implies that about 95.92 % of total variation in air pollution is due to sale of automobile vehicles, whereas remaining 4.08 % is due to other factors. The adjusted R Squared 0.9556 implies that this model offers the best predictor and it explains 96 % of total variation in the dependent variable (Automobile sales). The OLS regression model is fit since R Squared is 0.9592 i.e. 95.92%. The regression coefficient provides that the independent variable i.e. automobile sales is significant at 1 % level. F Ratio (259.26) also turns significant.

The null hypothesis is rejected at 1% level of significance since p value is 5.39E-09 i.e. 0.00. Therefore, the alternate hypothesis 'There is significant relationship between automobile sales and CO₂ emission' is accepted. Finally, it is concluded that this model is a good fit and automobile sales can be used to predict India's air pollution. It also means that the sales of automobile vehicles have a significant impact on air pollution in India. The regression coefficients ($\beta = 6.72997$) implies that an increase in sales of 1 Lakh automobile vehicles results in increase of air pollution (CO₂ emission) by 6.73 metric tons.

6. Findings and Conclusion

The automobile industry production, sales and export trend showed the growth rate and automobile sector is major contributor towards India's GDP. Automobile industry also contributes largely towards manufacturing sector. Reasonable number of people are employed in auto sector. This industry also contributes at large extent towards the overall growth of Indian economy. This rise in the automobile industry leads to increase in air pollution, which creates concern for environmental problems. Therefore, the impact of growth of automobile sector on Air pollution is studied.

A linear correlation between Automobiles sales and air pollution in India (CO₂ emission) is studied, Pearson correlation value is 0.9794, and found that there is strong positive correlation. Air pollution in India is continuously increasing and has crossed CO₂ emission of 2000 metric tons in 2018. OLS regression model also confirms that there is high degree of correlation between Air Pollution (CO₂

emission) and automobile sales. It is also concluded that this model is a good fit (R Squared 0.9592 i.e. 95.92%) and thus, automobile sales can be used to predict India's air pollution. It also means that the sales of automobile vehicles have a significant impact on air pollution in India. The regression coefficients ($\beta = 6.72997$) implies that an increase in sales of 1 Lakh automobile vehicles results in increase of air pollution (CO₂ emission) by 6.73 metric tons. Increase in automobiles sales contributes towards air pollution and therefore it affects the environment. Air pollution causes many health issues especially related to respiration.

It is evident from the study that the maximum air pollution in India is from Electricity and Heat Producers sector 51.13 % plus other energy industry 3 %, and then from Manufacturing Industry Sector and Transport sector. It is also noted that the air pollution is increasing year by year. It is also evident from research of WHO that India is the third most polluted country and Delhi is the most polluted capital city of the world. Out of world's 30 most polluted cities, 20 cities are in India viz. Delhi, Ghaziabad, Bulandshahar, Kanpur, Lucknow, Agra, Meerut, Faridabad, etc. (IQAir Report, 2020). Air quality of these cities doesn't satisfy the WHO's guidelines. Air pollution also results into lakhs of premature deaths in India every year.

7. Limitations and Scope for further research

This study provides overall analysis of Indian automobile industry and impact of its growth on air pollution. The secondary data is collected for the period 2006 to 2020. The analysis is done using average values of carbon emission and number of vehicles for the single country, India. Limited statistical tools like graphs and charts, descriptive, correlation matrix and OLS regression model are applied. More detailed and comparative analysis is possible considering other polluted countries from the world. Also, the present data is taken based on current automotive and fuel technology, there is a big scope for different kind of analysis and research with advancement in technology like electric vehicles, solar powered vehicles or other environment friendly fuels.

References

- [1] Gaddam, J. (2013). Production and Sales Trend of Automobile Industry in India. *Global Journal of Commerce and Management Perspective*, 2(4), 24-33.
- [2] Geetha, P., & Kokila, M. (2015). Estimation of Air Pollution using Remote Sensing Technique in Coimbatore - A Case Study. *International Conference*

- on Communication and Signal Processing, 794-798.
- [3] International Energy Agency. (2018.). Retrieved from <https://www.iea.org/data-and>
- [4] IQAir Report 2020. (2020). Retrieved from <https://www.iqair.com/world-most-polluted-countries>
- [5] Kokila , M., & Geetha, P. (2016). Air Pollution Estimation in Coimbatore District Using Local Meteorological Data in Hypsilt4. *Journal of Chemical and Pharmaceutical Sciences*, 9(1), 515-518.
- [6] Krishnaveni, M., & Vidya, R. (2015). Growth of Indian Automobile Industry. *International Journal of Current Research and Academic Review*, 3(2), 110-118.
- [7] Lokhande, Rana, & Vishal (2013). Marketing Strategies of Indian Automobile Companies: A Case Study of Maruti Suzuki India Ltd. *Prathibha: International Journal of Science, Spirituality, Business and Technology*, 1(2), 40-45.
- [8] Roy, & Alpana. (2014). The Impact of Vehicular Explosion in changing the Annual Mean Temperature of Urban Development - A Case Study of Kolkatta. *IOSR Journal of Humanities and Social Science*, 19(3), 01-10.
- [9] Roy, & Alpana. (2016). The Impact of Vehicular Explosion in changing the Annual Mean Temperature of Urban Environment - A Case Study of Delhi. *Indian Journal of Spatial Science*, 7(2), 30-37.
- [10] Shrivastava, R. , Saxena, N., Gautam, & Geeta. (2013). Air Pollution Due to Road Transportation in India: A Review on Assessment and Reduction Strategies. *Journal of Environmental Research and Development*, 8(1), 69-77.
- [11] Singh , J. (2014). India's Automobile Industry : Growth and Export Potential. *Journal of Applied Economics and Business Research*, 4(4), 246-262.
- [12] Society of Indian Automobile Manufacturers (2020). <https://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=13>
- [13] World Health Organization. (2015). *The Global Burden of Disease Study Report*. World Health Organization.
- [14] Yadav, S., & Sahay , M. (2017). A Study on Automobile Industry Growth in India and Its Impact on Air Pollution. *Journal of Advanced Research in Dynamical and Control Systems* (17), 1901-1909. Retrieved from <https://www.researchgate.net/publication/332539502>.