A quantitative study to know the relation between sales of motors vehicles and pollution: Evidence from the Capital of India (Delhi)

Shivang Sambyal

MBA, Universal Ai University, Karjat, Raigad, Maharashtra, 410201.

Email address: shivangsambyal@gmail.com,

Sindhuja Gupta

MBA, Universal Ai University, Karjat, Raigad, Maharashtra, 410201.

Email address: sindhujagupta818@gmail.com,

Abhishek Sengar

MBA, Universal Ai University, Karjat, Raigad, Maharashtra, 410201.

Email address: abhisheksengar210@gmail.com

Dr. Ansari Sarwar Alam

Assistant Professor, Department of Marketing, Universal Ai University, Karjat, Raigad, Maharashtra, 410201.

Email address: sarwar.ansariamu@gmail.com

Abstract

Environment has become a pivotal point of concern. Various organizations are participating in green initiatives and producing eco-friendly products. No doubt, that these initiatives and green or sustainable products will reduce the percentage of environment degradation, however there are other factors too which are increasing by organizations and their practices. Such factors like pollutions, e-waste, and solid waste. The present research work focuses on one of the harmful factors i.e., pollution. Motor vehicles has become basic need for everyone vis-e-viz pollution has increased. The factor which has been studied in this research paper are sales of motor vehicle and pollution. The present study has used secondary data, which is retrieve from the government of India websites. The capital of India, Delhi is been research to understand

the sales of vehicles, pollution, and the control majors. This study has carried out the comparison between sales of vehicles and pollutants released. A prediction analysis has been made based on the past data to know the future trend. The result and the findings will be helpful to achieve the target of India of becoming Net-Zero by 2070.

Keyword: Air Pollution, Sales of Motor Vehicles, Emissions, Delhi, India.

INTRODUCTION

The fast-growing economy, increasing traffic and rapidly growing cities, with high consumption of fossil fuels have shown a rise in pollution (Central Pollution Control Board, 2010). Pollution from vehicles is a serious environmental problem for the human fitness and it is predicted to cause about 2 million premature deaths every year around the world (WHO, 2005).

These days the air quality in large cities of India is critically polluted which will tremendously affect the fitness of the people. The boom in the automobile industry have increased the numbers of motor vehicles in various cities, which have deteriorated the quality of air. In India, Delhi is having extreme air pollution problems with the common degrees of suspended particulate matter levels more than the set standards. According to a study by the world bank in 1995 which says that air pollution might have accounted for 40,350 premature deaths cases, 19,805 thousand hospitalizations, and around 1201 million minor illnesses cases. The studies of the central pollution control board of India shows that the suspended particulate matter (SPM) measured in city areas exceeds the critical levels designed by the pollution control board in India.

Fig.1: Rashtrapati Bhavan Delhi, Due to Air Pollution

Motor vehicles impact the global as well as the local environment in various ways and the automobile sector is one among the main contributors to environmental pollution. Although the importance of vehicles in economic development can't be denied, the increase in vehicles volume has also raised environmental pollution problems. The rising air pollution levels have been observed with growing numbers of vehicles in cities over the globe. Carbon-dioxide emissions apart from significant quantities of air pollutants are released from the motor vehicles, causing critical health problems. Apart from that the air pollutants released from vehicles are also causing issues such as Global warming, Ozon depletion, Greenhouse effect, Acid rain, etc., which is alarming threat to the mankind.

LITERATURE REVIEW

The Ambient air quality of the atmosphere is determined by the number of air pollutants existing in the environment and the quantity in which air pollutants are coming out from motor vehicles and how rapidly the air pollutants are getting absorbed into the ecosystem. There have been a number of studies and research work done to understand the relationship between the Ambient air quality and their impact on mankind. Previous researches have used various ways to understand air pollutants, its way of absorption in the surroundings and the impact on Ambient air quality of the place to understand overall levels of pollution concentrated in the air. Various models are used to design effective techniques to control the realise of injurious pollutants (Singh et al.,2006). To study the damage of motor vehicle pollutants on ambient air quality, various literatures were reviewed from available sources that are Ministry of Environment and Forest, Central Pollution Control Board, Ministry of Road Transport and Highways, Google Scholars and research papers.

The air pollutants are mainly releasing from sources which are automobiles sector, various industries and day to day fuel usages. The air pollutants are harmful to human health and can cause critical effects if they are present in high concentrations (Stern, 1976; Godish et al., 1985). The rate of increase in air pollution is higher in developing countries like India as compared to the developed once. Therefore, the environment pollution is critical in areas of growing nations all over the globe (Mage et al., 1996). As per an estimate, automobile sector has about 72% contribution in air pollution in Delhi (Goyal et al.,2006).

PROBLEM OF THE STUDY

In current situation the important issues that is ignored by everyone is pollution. The pollutants are noticeable in various forms, which are water pollution, land pollution, and air pollution. The way by which we can control the issue of air pollutants is by elimination or by reducing the usage of fossil fuels by motor vehicles. The growing population, expansion of areas, growth in income, financial boom has created a demand for vehicles and due to which there are air pollution problems world-wide. This study is to analyse and find the relationship between rising pollution and sales of vehicles. This will help us to understand the existing situation of air quality in the cities of Delhi. The worst element about motor vehicle pollution is that it is not easy be prevented as the harmful gages are released near ground levels in which we breathe. This paper relies upon on the information of registered vehicles on Ministry of Road Transport & Highways website and the Central Pollution Control Board reports.

Objectives:

1. To find the number of vehicles in Delhi.

2. To analyse the relation between the sales of vehicle and rise in air pollution.

3. To suggest measures to reduce the air pollution in Delhi.

THE AREA OF STUDY

In India, Delhi is known as one of the most polluted cities around world because of high level of particulate matter and other kind of pollutants in the air. It is a massive metropolitan city with a population of around 1.2 crore as per the census (2011). The rise in businesses that growing on a rapid phase has pushed the transportation demand to a higher extent because of which we are highly dependent on fuels. There are around 134.64 lakhs registered vehicles in Delhi apart from the vehicles of neighbouring cities. The traffic congestions on road of Delhi contribute even more to the degrading air quality of the urban towns. In last some years about 70% of the ambient air quality of Delhi has increased by the motor vehicles.

Based on the report of registered vehicles from the Ministry of Road Transport and Highway and the air quality index from Central Pollution Control Board, we have analysed the

correlation between the sales of motor vehicles and decreasing ambient air quality index of Delhi.
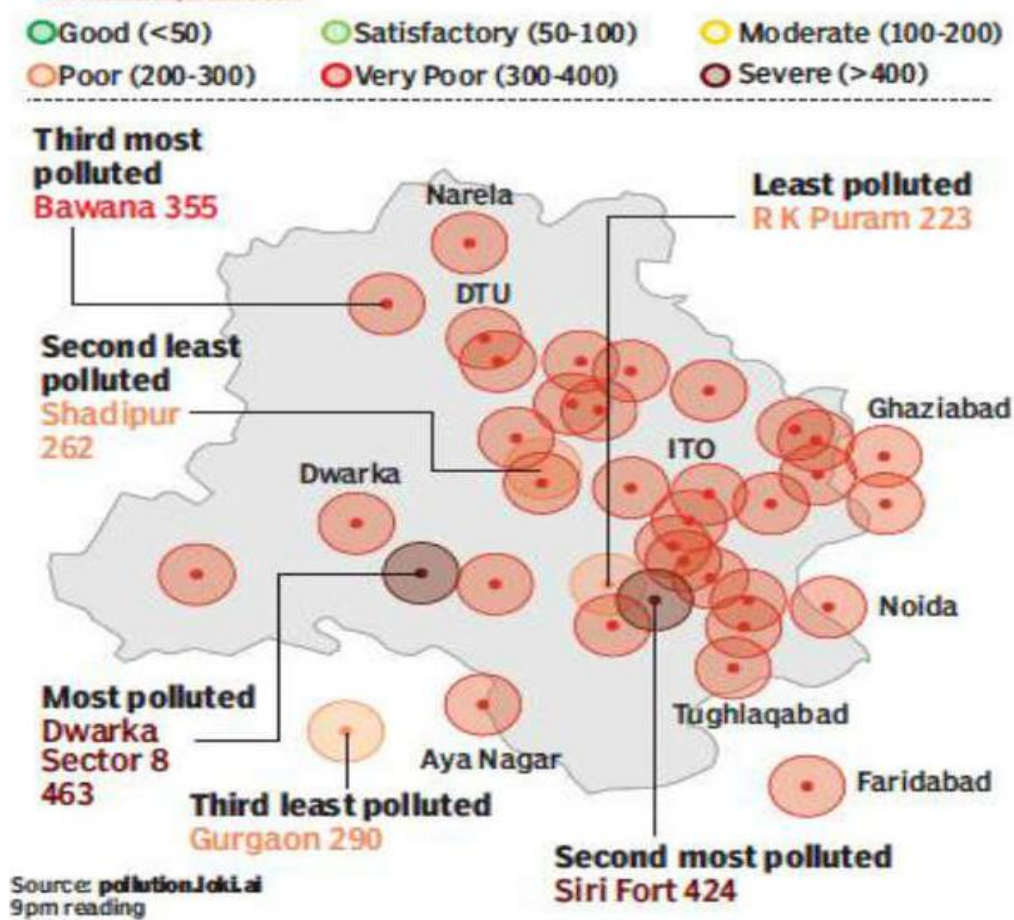

Fig.2: Map of Delhi

AIR POLLUTION FROM MOTOR VEHICLES

Air pollution is addition of harmful gages and particles in the atmosphere from the motor vehicles. These gases and particles are called as pollutants which have severe health effects on the public and the atmosphere. Automobiles are one of the major sources of air pollution around the globe because of the wide variety of automobiles which are available today. As buying power of people increases the sales volume of vehicles will also increase which ultimately is bad for the surroundings. Air quality index has grown to an alarming point because of growing population. The air pollution from motor vehicles in various areas, specifically in vast city's has become a major trouble. The effects of pollution coming out of vehicles have some severe effects like through issues, headache eyes problems, heart issues and critical lung issues.

Fig 3: Air pollution from motor vehicle

Now environmental issue has been one of the critical issues in transportation policies. As the significant portion of NO_2, CO, CO_2, NO, HC, and other air gages and particles that are released from the automobiles into the environment leading to injurious diseases. The continuous growth in sales of motor vehicles means that the steps taken to reduce the emission from each and every automobile is now have been overtaken by the rise in numbers of traffic which is the matter of concern for reduction in the quality of air in cities.

Automobile sector has contributed about 14% world emission of greenhouse gases (CPCB 2010). CO_2 shows a large percentage in the basket of greenhouse gas emissions with fast growing economy CO_2 released in cities are going to spike in near future because of high number of motor vehicle in cities and increase in portion of personal vehicles. From past 3 decades CO_2 emission from motor vehicles have increased on a faster rate as compared to other sectors.

MOTOR VEHICLE POLLUTANTS

The major pollutants that are coming out from motor vehicle exhaust are as follows:

1. **Carbon monoxide (CO):**

   This is invisible gas which is odourless and is released when carbonaceous mixture are incompletely burn and is very dangerous for human health. A normal healthy person can even die if he gets in contact of Carbon monoxide. Haemoglobin in blood has an affinity for CO that is 200 times that of oxygen, and CO interferes with the transport of

oxygen from blood to different part of body. The reaction of CO on humans can be seen even at minimum exposure levels. In people with coronary artery disease, low exposure accelerates angina (chest pain). Healthy people are also affected, but only in high concentrations. High levels of exposure to CO are associated with impaired vision, work ability, performance, reading and writing ability.

2. **Nitrogen Oxides (NO2):** NO2 has been related to a higher vulnerability to respiratory problems, greater airway obstruction in asthmatics, and reduced lung function. Short-term NO2 exposure in children has been related to a variety of breathing difficulties. Chronic cough, a drippy nose, and a dry mouth are the most common side effects. Oxides of nitrogen have the potential to cause acid rain on vegetation and surface rivers, damaging forests and sea species. NOx emissions raise particulate matter levels in the atmosphere by converting to nitric acid and producing particle nitrates.

3. **Photochemical Oxides (Ozone):** Thus, ozone is generated as a result of the chemical interaction of noxious chemicals with NOx there in the near-infrared- infrared spectrum and sunshine, rather than being exhaled by the vehicle. In other words, the discharges of pollutants from automobiles facilitate the creation of ozone via electrochemical reactions. The majority of smoke is constituted of surface ozone, which can trigger respiratory complications like breathlessness and cuffs. Hypertension and other lung conditions Ozone are recognized to harm, not just human health, but also the environment for a lot of reasons, namely diminishing yield of crops, fruits, corporate forestry, and ecosystems. This even plays havoc on urban grassland, wildflowers, bushes, and plants.

4. **Oxides of Sulphur:** Excessive concentrations of sulphur dioxide (SO2) might induce transient dyspnoea in asthmatic youngsters who are engaged outside. Brief exposure of asthmatics to excessive SO2 levels during physical intensity might impair pulmonary health and cause indications such as coughing, tightness of the chest, and breathlessness. Other lengthy impacts of high SO2 levels linked with excessive PM concentrations include breathing problems, lung abnormalities, and worsening of or before the cardiovascular disease.

Table 1: Details of registered vehicles from Delhi RTO 2018 and their fuel type

Vehicle Category (2018)	Total
FOUR-WHEELER (Invalid Carriage)	89
HEAVY GOODS VEHICLE	414
HEAVY PASSENGER VEHICLE	372
LIGHT GOODS VEHICLE	17,426
LIGHT MOTOR VEHICLE	1,68,080
LIGHT PASSENGER VEHICLE	9,769
MEDIUM GOODS VEHICLE	1,828
MEDIUM MOTOR VEHICLE	21
MEDIUM PASSENGER VEHICLE	1
THREE-WHEELER(NT)	3
THREE-WHEELER(T)	35,080
TWO-WHEELER (Invalid Carriage)	35
TWO-WHEELER(NT)	4,94,48

Fuel (2018)	Total
CNG ONLY	19,098
DIESEL	37,429
DIESEL/HYBRID	2,046
ELECTRIC(BOV)	20,978
PETROL	5,93,688
PETROL/CNG	52,113
PETROL/HYBRID	2,249

Table 2: Details of registered vehicles from Delhi RTO 2019 and their fuel type.

Vehicle Category (2019)	Total
FOUR-WHEELER (Invalid Carriage)	59
HEAVY GOODS VEHICLE	357
HEAVY PASSENGER VEHICLE	864
LIGHT GOODS VEHICLE	17,030
LIGHT MOTOR VEHICLE	1,52,973
LIGHT PASSENGER VEHICLE	7,513
MEDIUM GOODS VEHICLE	2,210
MEDIUM MOTOR VEHICLE	2
MEDIUM PASSENGER VEHICLE	1
THREE-WHEELER(NT)	3
THREE-WHEELER(T)	30,426
TWO-WHEELER (Invalid Carriage)	61
TWO-WHEELER(NT)	4,30,298

Fuel (2019)	Total
CNG ONLY	19,923
DIESEL	26,592
DIESEL/HYBRID	805
ELECTRIC(BOV)	23,223
PETROL	5,23,349
PETROL/CNG	39,188
PETROL/HYBRID	8,717

Table 3: Details of registered vehicles from Delhi RTO 2020 and their fuel type.

Vehicle Category (2020)	Total
FOUR-WHEELER (Invalid Carriage)	44
HEAVY GOODS VEHICLE	501
HEAVY PASSENGER VEHICLE	812
LIGHT GOODS VEHICLE	9,656
LIGHT MOTOR VEHICLE	1,17,405
LIGHT PASSENGER VEHICLE	2,252
MEDIUM GOODS VEHICLE	1,524
MEDIUM MOTOR VEHICLE	33
MEDIUM PASSENGER VEHICLE	1
THREE-WHEELER(T)	13,537
TWO-WHEELER (Invalid Carriage)	14
TWO-WHEELER(NT)	2,78,472

Fuel (2020)	Total
CNG ONLY	13,992
DIESEL	10,549
DIESEL/HYBRID	32
ELECTRIC(BOV)	12,381
PETROL	3,60,987
PETROL/CNG	20,995

Table 4: Details of registered vehicles from Delhi RTO 2021 and their fuel type.

Vehicle Category (2021)	Total
FOUR-WHEELER (Invalid Carriage)	87
HEAVY GOODS VEHICLE	1,439
HEAVY PASSENGER VEHICLE	276
LIGHT GOODS VEHICLE	14,515
LIGHT MOTOR VEHICLE	1,40,048
LIGHT PASSENGER VEHICLE	1,264
MEDIUM GOODS VEHICLE	3,109
MEDIUM PASSENGER VEHICLE	28
THREE-WHEELER(T)	22,831
TWO-WHEELER (Invalid Carriage)	1
TWO-WHEELER(NT)	2,75,564

Fuel (2021)	Total
CNG ONLY	25,542
DIESEL	12,122
ELECTRIC(BOV)	25,809
PETROL	3,64,803
PETROL/CNG	24,563
PETROL/HYBRID	6,323

5. **Gaseous Air Toxic:** Automobile concentrations of greenhouse gases also include hazardous air pollutants, which might have serious implications for health.

6. **Particulate Matter:** It refers to a wide variety of biologically and physiologically distinct compounds that persist as separate fine and coarse aggregates (droplets or solids). Particulate matter is either directly discharged into the atmosphere or created as a result of toxic gases such as sulphur dioxide and nitrogen oxides. Premature mortality and worsening heart and cardiac illness are two of the most dangerous consequences of PM. This is shown in an increase in hospitalizations and urgent care visits, as well as absenteeism, vacations, and limited activity days. abnormalities in lung tissue and structure; alterations in airway defence systems; and alterations in lung function and respiratory symptoms Excessive exposure to coarse particles have been linked to the worsening of respiratory diseases including asthma. Fine particles are more directly associated to negative health effects, such as premature death from cardiac sickness.

7. **Suspended Particulate Matter:** Suspended matter includes dust, vapours, mist, and smoke. Lead is the most dangerous chemical element in SPM; which also includes nickel, arsenic, and those prevalent in exhaust fumes. These particles become stuck in our lung tissues as we breathe them in, leading to lung damage and respiratory problems.
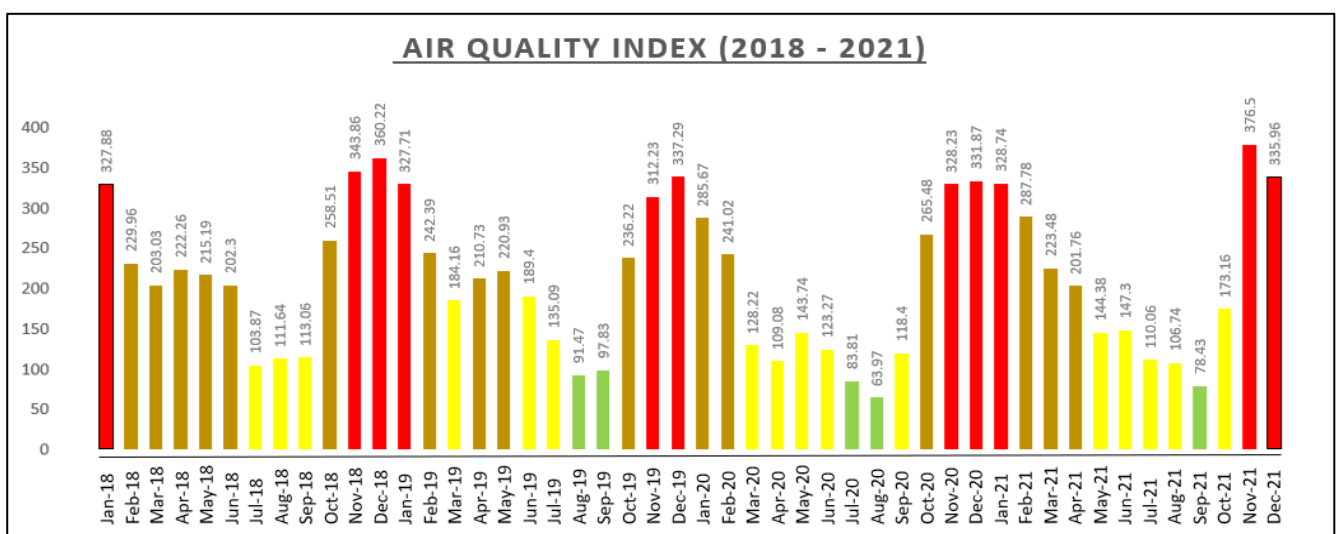

Fig 4: Air Quality Index of Delhi

AQI	Associated health impacts
Good (0 – 50)	Minimal impact
Satisfactory (51 – 100)	Minor breathing discomfort to sensitive people
Moderately polluted (101 – 200)	Breathing discomfort to people with lungs, asthma, and heart diseases
Poor (201 – 300)	Breathing discomfort to most people on prolonged exposure
Very poor (301 – 400)	Respiratory illness on prolonged exposure
Severe (401 – 500)	Affects healthy people, and seriously impacts those with existing diseases

Fig 5: Possible health Impacts of Air pollution

Hypothesis

Null Hypothesis

H0: There is no significant relation between vehicle sales and rise in air pollution.

Alternate Hypotheses

H1: There is a significant relation between vehicle sales and rise in air pollution.

Analysis

To analyse the relationship between sales of motor vehicles and the effect on air quality index. We collected the 4-year data from 2018 to 2021 from the website of Ministry of Road Transport and Highways. Whereas the pollutants emitted during the year 2018 to 2021 is collected from the website of CPCB. Both the data are analysed monthly wise to check the combine relationship between the both.

Months	AIR QUALITY	VEHICLES
Jan-18	327.88	71399
Feb-18	229.96	56806
Mar-18	203.03	59263
Apr-18	222.26	59444
May-18	215.19	59903

Months	AIR QUALITY	VEHICLES
Jun-18	202.3	56542
Jul-18	103.87	60529
Aug-18	111.64	61915
Sep-18	113.06	51516
Oct-18	258.51	60116
Nov-18	343.86	82407
Dec-18	360.22	47715
Jan-19	327.71	61955
Feb-19	242.39	49461
Mar-19	184.16	52999
Apr-19	210.73	57311
May-19	220.93	55108
Jun-19	189.4	48568
Jul-19	135.09	50948
Aug-19	91.47	49072
Sep-19	97.83	42962
Oct-19	236.22	72347
Nov-19	312.23	62282
Dec-19	337.29	38784

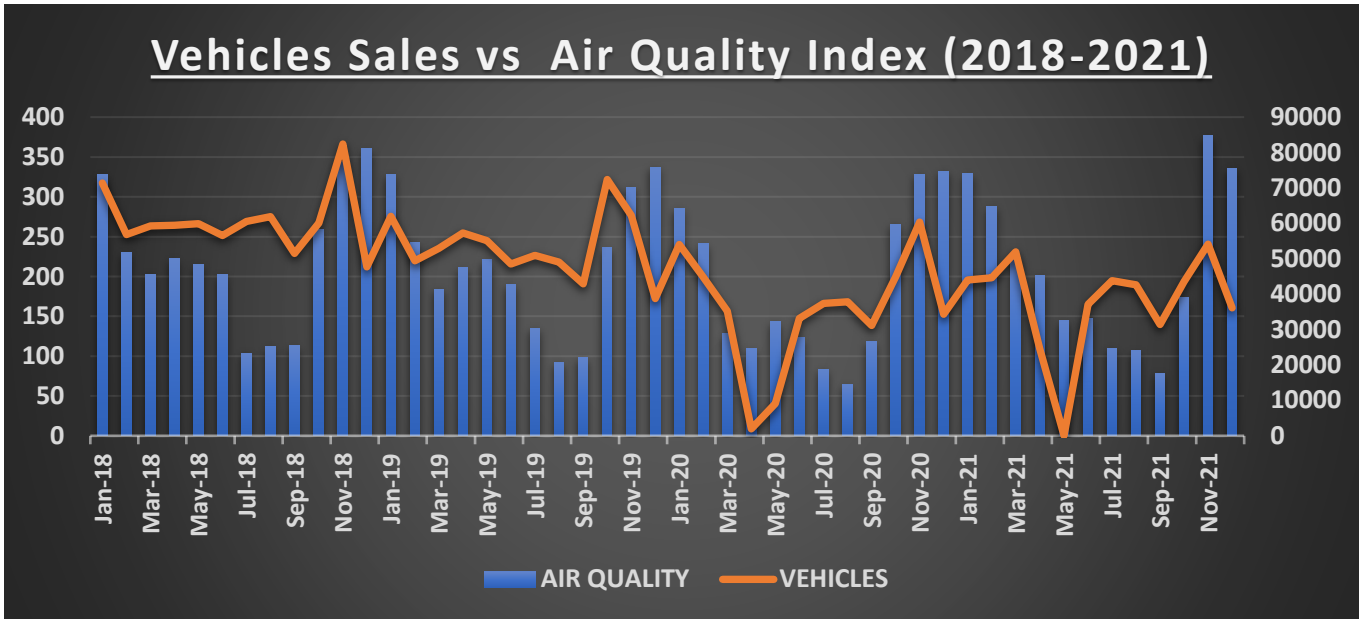| Months	AIR QUALITY	VEHICLES
Jan-20	285.67	53997
Feb-20	241.02	44856
Mar-20	128.22	35200
Apr-20	109.08	1954
May-20	143.74	9071
Jun-20	123.27	33187
Jul-20	83.81	37371
Aug-20	63.97	37868
Sep-20	118.4	31191
Oct-20	265.48	44875
Nov-20	328.23	60344
Dec-20	331.87	34336
Jan-21	328.74	44013
Feb-21	287.78	44595
Mar-21	223.48	52000
Apr-21	201.76	24657
May-21	144.38	55
Jun-21	147.3	37117
Jul-21	110.06	43844
Aug-21	106.74	42674
Sep-21	78.43	31417
Oct-21	173.16	43512
Nov-21	376.5	54123
Dec-21	335.96	36105

Fig 5: Combination Chart of Vehicle Sales vs Air Quality Index

From the fig. 5 we can say that there is a positive correlation between the air quality index (2018-2021) and the overall vehicle sales during the year 2018 to 2021. From here we can see that the sales of vehicle from 2018 to December 2021 have impacted the air quality index during the same time period in Delhi.
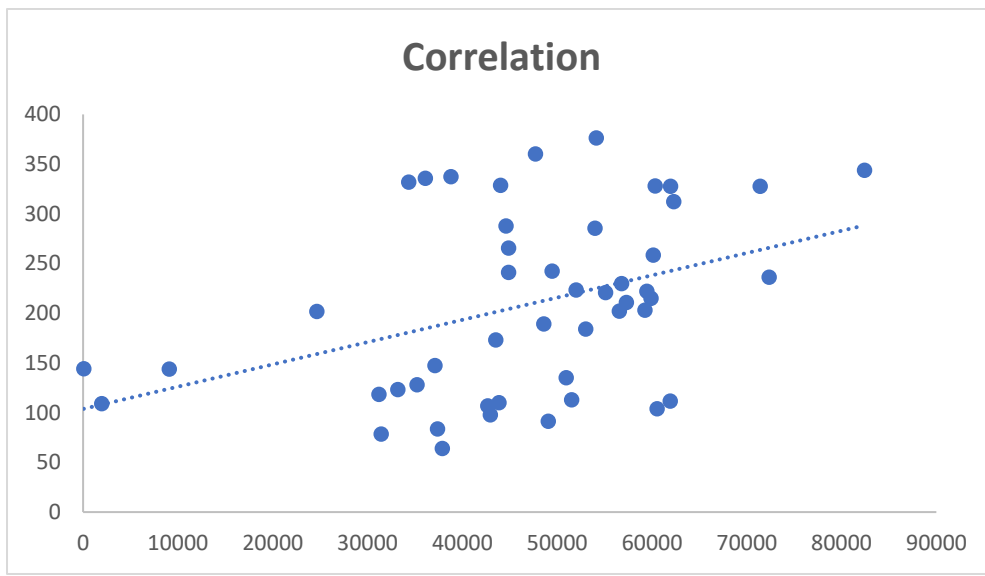

Fig 6: Correlation Graph

Correlation is a statistical term that describes the degree to which two variables are connected linearly (meaning they change together at a constant rate). This is a typical approach to express simple interactions without mentioning a cause-and-effect relationship.

From the above graph we can see that there is a positive correlation between the vehicle sales and the air quality index of Delhi. It's not very strong relation as we can see that the correlation coefficient vale is **0.40** but it is showing that if the sales of the vehicle increase the air quality also get effected.

Table 5: Simple Liner Regression Test

Regression Statistics							
Multiple R	0.401185009						
R Square	0.160949411						
Adjusted R Square	0.142709181						
Standard Error	84.11828714						
Observations	48						

ANOVA							
	df	SS	MS	F	Significance F		
Regression	1	62436.69695	62436.6969	8.82386954	0.004713267		
Residual	46	325490.7666	7075.88623				
Total	47	387927.4636					

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	103.7169796	37.34724586	2.77709848	0.00790913	28.54087272	178.893086	28.5408727	178.8930864
VEHICLES	0.002240438	0.000754229	2.97049988	0.00471327	0.000722253	0.00375862	0.00072225	0.003758624

Regression analysis is a collection of statistical techniques used in estimating the significant connections between a dependent variable and one or more independent variables. It may be used to measure the strength of a variable's link and to forecast the future relationship between the variables.

As the data collected is in numerical form so we applied simple liner regression test to check our hypothesis as we can see the P-value shown in the Table 5, is coming out to be 0.00 which is less than 0.05 (Standard P-value) so we can reject our null hypotheses and say that there is significant relation between overall sales of motor vehicle and the increase of pollutants in the environment.

Measures for emission control

1. Use of remote sensing technology: Remotely sensed technologies are used to calculate the quantity of pollution emitted by a vehicle while it is on the street. Remote smart objects, unlike prior methods, are not physically attached to the vehicle. The document explains how and where to attain approach pollution and avoid car emissions from entering the environment.

2. Cleaner/alternative fuels are being embraced, including LPG, CNG, biodiesel blends, battery-powered autos, hydrogen, and solar energy.

3. Electric/hybrid car promotion through the Nationwide Electromobility Strategic Plan 2020, as well as speedier launch and manufacturing of mixed and hybrid car.

4. Public transportation and underground system promotion, tricycles, pooling promotion, pollution prevention certificate, road rules, maintenance and repair, and so forth.

5. RTO emissions testing: To minimize transportation emissions, tight emission requirements for new automobiles are in place. This attempt, however, would be worthless unless the pollution efficiency of a significant proportion of automobiles on the road improved. As a result, in order to minimize transportation emissions, regional transportation offices with ecological experts must execute an efficient monitoring and repair program for automobiles in circulation.

6. Ban on vehicles over 15 years old: The Supreme Court has barred commercial cars older than 15 years, although all automobiles with the same age shall be considered. Imports of big vehicles (trucks, etc.) more than seven years and light commercial vehicles (cars, vans) more than 5 years should indeed be forbidden. The sale of a car that is more than ten years old should also be prohibited; in other words, the automobile cannot be sold. This leaves the car with two options: trash it or transfer it to a more tolerant country.

CONCLUSION

The worldwide expansion of the number of vehicles is expanding, and environmental degradation from automobile exhaust is reaching dangerous levels. Because the urban population of motor vehicles is significantly bigger than the rural population, car pollution seems to be a more serious concern in the urban environment.

As a result, the use of automobiles is one of the primary contributors to air pollution around the globe. It is everyone's unique obligation to keep our world clean. A lot of good can be done if we alter our ideas and become even more proactive about the environment. Similarly, motor vehicle pollution may be regulated and decreased in order to maintain a healthy environment. A functional and efficient transportation system, such as metro rail, bus, cabs, and waterways (wherever available), can help to dissuade people from driving their own cars, resulting in a large reduction in vehicle pollution emissions.

REFERENCES

1. Alam, M. S., & Khan, A. To minimize Vehicular Emissions of Nagpur, India.

2. Akyurtlu, A., & Akyurtlu, J. (2012). An Investigation on the dispersion of pollutants from major roadways. Transportation (NCIT): Problems, Practices, and Policies, 91.

3. Benson, P., & CALIN, E. (1984). A dispersion model for predicting air pollutant concentrations near roadways. NTIS Report PB, 85-211.

4. Alam, M. S., & Khan, A. The Impact Study of Vehicular Pollution on Environment.

5. Anjaneyulu, M. V. L. R., Harikrishna, M., & Chenchuobulu, S. (2006). Modelling ambient carbon monoxide pollutant due to road traffic. World Academy of Science, Engineering and Technology, 17, 103-106.

6. Humane, M. A., & Khan, A. (2020). A Case Study on Sanitation Conditions in India. International Journal of Engineering Research & Technology (IJERT), 9(11), 657-663.

7. Ahmad, K. (2013). Physical simulation of automobile exhausts dispersion at an urban intersection-part II: traffic induced effects. International Journal of Engineering Research and Applications, 3, 887-890.

8. ARAI, T. (2008). Emission factor development for Indian vehicles. India: The Automotive Research Association of India.

9. Bansal, S. (1996). Ambient air quality of Bhopal city with reference to nitrogen dioxide. Pollution Research, 15, 117-119.

10. Mayer, H. (1999). Air pollution in cities. Atmospheric Environment, 33: 4029-4037.

11. Benson, P. E., Nokes, W. A., Cramer, R. L. (1986). Evolution of the CALINE 4 Line Source Dispersion Model for Complex Terrain Application, Transportation Research Record N1058, 7- 13.

12. Paramesh, H. (2003). Report on State of Environment Action Plan, Karnataka, World Bank Project.

13. Shrivastava, R. K., Neeta, S., & Geeta, G. (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.

14. Sharma, N., Bhandari, K., Rao, P., & Shukla, A. (2003, January). GIS applications in air pollution modelling. In Proceedings of the 6th International Conference 'Map India 2003 (pp. 28-31).

15. Sharma, R.D., Jain, S.A. and Singh, K. (2011). Growth of motor vehicles in India-Impact of demographic and economic development. J. Eco. Soc. Study, 1(2): 137-153.

16. Central Pollution Control Board, Ministry of Environment and Forests, New Delhi, Govt. of India (2000). Air quality status and trends in India. National Ambient Air Quality Monitoring Series, NAAQMS/14/1999-2000

17. CPCB, (2006). "National Air Quality Status 2004. National Ambient Air Quality Monitoring Series NAAQMS/27/2006- 2007". Central Pollution Control Board, Ministry of Environment and Forests, Government of India, New Delhi.

18. CPCB, (2003). "Alternative Transport Fuels- An Overview". Parivesh newsletter, Central Pollution Control Board, Ministry of Environment and Forests, Government of India, New Delhi, April 2003.

19. Goyal, S.K. et al. (2006). Understanding urban vehicular pollution problem vis-à-vis ambient air quality – Case study of a Megacity (Delhi, India), Environmental Monitoring and Assessment, 119: 557-569.

20. A special presentation by centre for science and environment, to the committee on auto fuel policy (Mashelkar Committee) New Delhi, India (2001). (http://www.geospatialworld.net.).

21. Air pollution in megacities of world, UNEP and WHO Publication (1992). Blackwell Publications. Oxford, (UK).

22. Air Quality Guidelines (2005). World Health Organization.

23. Ministry of Road Transport & Highways.