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Air pollution: An initiative of Delhi Government to curb air pollution by implementing odd-even car rationing

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Abstract : Air pollution is increasing day by day. There are various sources of air pollution; some major sources are transportation, industrialization, commercialization, road dust and waste burn. As it is the fifth largest cause of death in India so some serious measures are needed to clean up the air. Due to bad air quality number of patients are increasing and human beings are suffering from disease like heart disease, lung cancer, difficulty in breathing, cough, asthma and death. The paper is focused on pollution due to transportation and what are the various solutions to reduce pollution. It includes a study on air quality in Delhi, the odd-even campaign of Delhi and also provides some solutions and suggestions for the betterment of this campaign. The perception and experiences of respondents regarding odd even campaign are analysed and the initiatives taken by government to reduce pollution are discussed.

Keywords : Policies, Pollution, Sustainability, Air quality, Odd-even campaign.

1. AIR POLLUTION- INTRODUCTION

Environment consists of air, water, and soil. And components of Environment are getting polluted with an excessive speed some of which are air pollution, soil pollution, noise pollution and water pollution etc. From all the above pollutions humans are more sensitive towards air pollution.[1]

Various environmental agencies of developing and developed countries like the US Environmental Protection Agency and the UK Department for Environment is regularly keeping an eye on the alarming pollution. One reason for this upsurge is growing population and urbanization. Transportation, industrialization and commercialization are other major reasons for pollution intensification. The swelling needs of cities are being satisfied at the cost of environment. Air pollution is a main reason for various health problems and Asian brown cloud. As its consequences monsoons are getting delayed from their normal times. Generally, people ignore the indications like cough, headache, nausea, irritation of eyes, various bronchial and visibility problems; however, the main cause behind them is air pollution. The number of vehicles are increasing whereas no one is paying heed to the problems such as poor fuel quality, the age of vehicles, insufficient maintenance, increasing traffic, deprived roads, and timeworn automobile techniques.

World health organization has reported Delhi as one of the major polluted city in India. [2] Main reason for Delhi pollution is its floating population. A large number of People all around the NCR daily go to Delhi. Many surveys have reported that Delhi has more number of vehicles than the other major urban cities like Mumbai, Kolkata, and Chennai. Major pollution share is of two wheeler vehicles followed by cars, jeeps, taxies, trucks and buses in decreasing order. [3] It is estimated and forecasted by WHO that Delhi's vehicular pollution will rise to 10 million by 2020.[2]

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World health organization has given some safety standards for PM2.5 level and India is also having its own standards, but

Delhi's air quality is not satisfying any of this level. Delhi's PM2.5 level is 10times higher than WHO limits and 4times higher than Indian limits [4][5]. Six pollutants have been specified by EPS which are more dangerous for human health and the environment. These pollutants are Ozone, particulate matter, carbon monoxide, nitrogen oxides, sulphur dioxide and lead.[6] All the above pollutants are dangerous but they did not carry the same weightage. [7][8] Worldwide approximately 1.3 million death occur due to outdoor air pollution per year.[9]

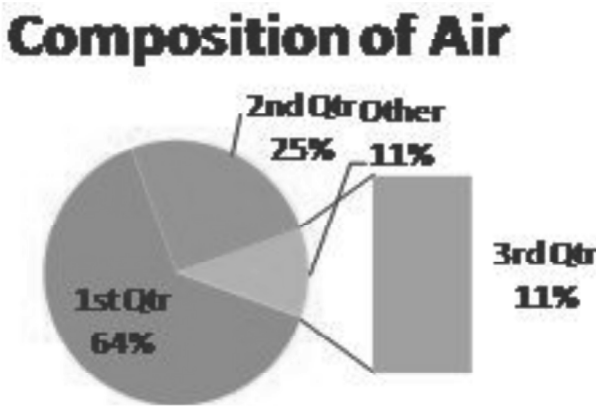

Fig. 1.

2. LIFE IN DANGER DUE TO AIR POLLUTION

Metro cities of developing countries like India are facing traditional as well as modern air pollutants. Air pollution due to traffic is one of the major reasons for cardiorespiratory deaths as polluted air creates problems in breathing and heart.[10] High PM level can create lung cancer. Air pollution has an effect on cardiac death is proven by both short-term and long-term studies. [11]

Transportation one of the major reason for air pollution has the biggest impact on GHG (Green House Gas) emission. Use of diesel engine vehicles pollutes environment most. (UNEP Report) [12]

The impact of anthropogenic activities on the environment is increasing speedily. Efficient management of energy and efficiency is required to make environment pollution free.[6] To measure the impact of these activities air quality monitoring systems are required. Through this real-time monitoring power consumption and cost can be reduced and efficiency can be enhanced. [13][14]

Pollution Cycle

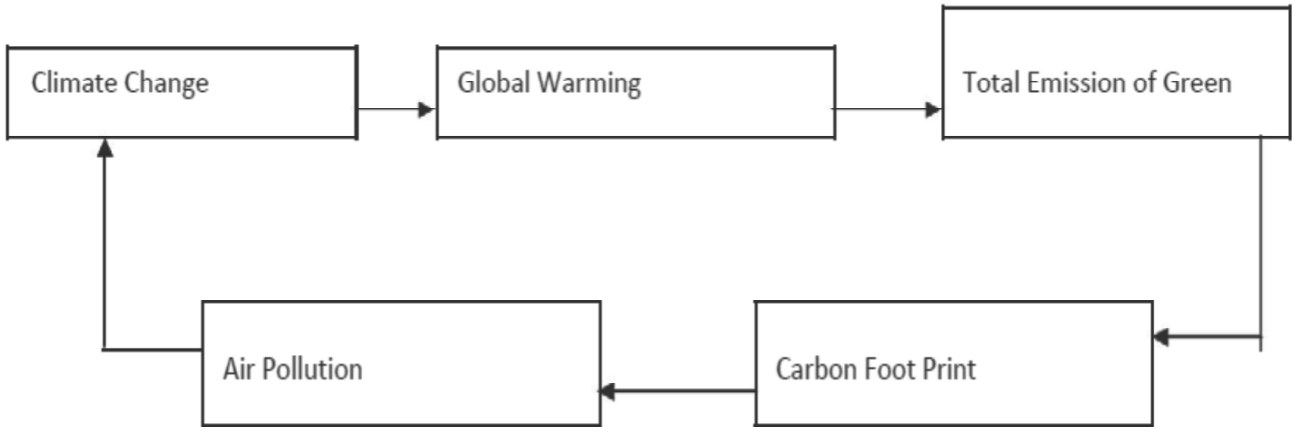

Fig. 2.

Bad air quality is jeopardizing for humankind. The people who work outside a building especially the roadside vendors, they are suffering from many diseases due to air pollution caused by vehicles. Delhi is an over populated city and traffic volume in Delhi is very high. Because it connects cities like Faridabad, Ghaziabad, Palwal, Kundali, Gurgaon, and Noida with each other. People faces traffic jams every day in Delhi. In peak hours when people travel to their schools, offices or homes, the air pollution goes high even more than danger level. [15][16] Chief complication with traffic jam is that we cannot forecast it. It can occur anytime, anywhere and reasons may be Poor road, insufficient road capacity, sudden change in whether, heavy rain fall. [17] In Delhi, approximately 1.6million US$'s fuel get wasted per day due to traffic jams.[2]

Air's quality is measured with the help of air quality monitoring systems and the data is available on air quality portals in all the countries. [18]Sensors are installed to sense the air quality. Dust, weather, power and bugs can manipulate the performance of a sensor. To overcome this problem these sensors are checked time to time, this process is called calibration. [7] Everyone can access these portals any time.

3. MITIGATION MEASURES

Heavy traffic jams lead to unfavourable effects on travel times, fuel consumption, road safety, and pollution. Traffic control policies, can solve this problem if planned and implement properly[3][16]. Despite of all government regulations air pollution is still increasing so some serious actions are required to control the pollution.[19] Delhi government has taken several mitigation measures to reduce or control pollution in Delhi. [3]

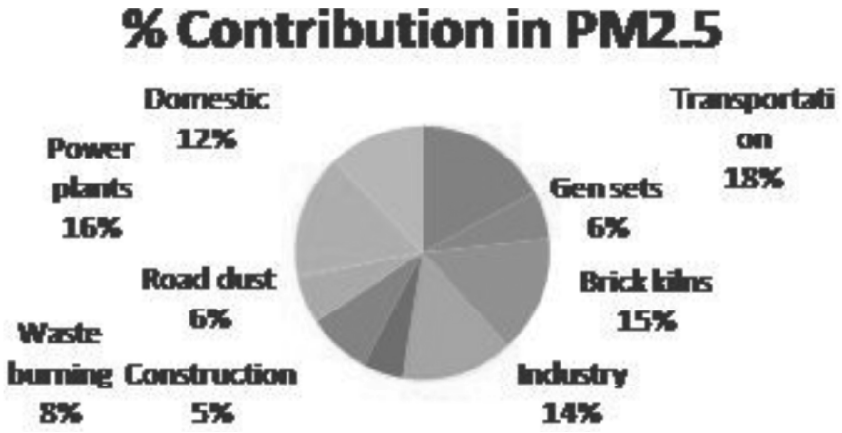

Fig. 3.

1. **Proposed CNG vehicles instead of petrol and diesel[20] :** CNG (Compressed Natural Gas) can be used in place of petrol, diesel and LPG. It is safer to use as it is very light and natural, in the case of leak it spread easily as it is lighter than air. [21] To control air pollution we must have to switch to CNG as it emits low pollution. Delhi High court has also supported CNG to squat pollution. [22] In mid-1993, only three CNG stations were installed in Delhi and till now Delhi has more than 70 CNG filling stations. [23]
2. **Plastic bags banned :** Indian government banned the production of plastic bags in 2002 to protect the environment. Plastic bags of thickness below 20 μm were banned, however, many problems were faced during this enforcement [24]

   India has successfully banned plastic bags in many cities like Delhi, Mumbai, Karwar, Tirumala, Vasco, Rajasthan. [25] Delhi High Court has completely banned the use of plastic bags in 2012. In Delhi, now only biodegradable bags are allowed. [26]
3. **Odd-even formula [27] :** People take time to get adjusted to things; as in the case of the campaign against tinted windows. Delhi police launched this scheme after December 16, 2012, gang rape. Special Commissioner (Traffic) Muktesh Chander said that about 90 percent of car owners in Delhi respected to odd even campaign.

4. AIR POLLUTION IN DELHI

What odd even campaign is

This was implemented for 15 days starting from January 1st 2016. It says to run vehicles with odd and even numbers on alternate days. The odd-even rule was applied from 8AM to 8PM on 6 days a week and Sunday was exempted. Women drivers, commercial vehicles, two wheelers and CNG vehicles were exempted from these restrictions.

Initiatives taken to make it a success

1. High publicity was done
2. Heavy fine of Rs 2000 was announced for violators

Difficulties

1. Increasing the number of busses are not that easy as the road spaces are limited.
2. Exemptions can be miss used
3. Higher the fine greater the bribe rate
4. People, who are addicted to travel by their own car, will not be able to travel by bus or metro and soon they will start buying new cars. So there will be no effect of Odd-Even rule.
5. Odd-Even rule will encourage people to use taxies, and in Delhi, most of the taxies are diesel engine. So it will increase pollution.
6. People start selling their old big cars and start buying new small cars of odd and even numbers.
7. Car owners will oppose to pay full year tax. As they will drive their cars only for six months.

Things to promote

1. Promote electric cars by giving them exemption from odd even, providing free parking to them, providing charging points everywhere, reduce duties on such cars.
2. Separate cycle tracks should be there
3. Separate bike lanes
4. Bikes or cycles on rents allowing you to pick them from one stop and can leave them on some other stop.
5. Increase availability and accessibility of public transport

Loopholes

1. **Socio-economic background :** The socio-economic background of persons supporting this campaign is not considered. As people belonging to different economic classes have different priorities and duties.
2. **Age group:** It should be taken into consideration that people who filled up the questionnaire and supported this campaign belong to which age group.
3. **Accessibility of questionnaire:** Questionnaire was available online and on telephonic call only. So only a fix class was able to access it.
4. **Weather conditions :** As the survey was done in January so weather conditions were in support to air quality. It should be generalized to the weather of whole year.
5. **Economic loss :** This formula will result in a huge economic loss if implemented for long term like people will ask to reduce duty rates on cars, reduce insurance and road tax as they are driving the vehicles only half of the year days.
6. **Fix number of roads :** As the infrastructure is less so it is not feasible to increase number of public transport rapidly.

7. Earlier on December 8, Mail Today had reported that a whopping 55 lakh two-wheelers were the biggest polluters among all categories of vehicles in Delhi. Diesel-run trucks account for nearly 28 percent of vehicular pollution.

   The number of two-wheelers in Delhi is more than double the number of private cars.

Suggestions

1. Senior citizens should also be exempted from Odd-Even car rule in Delhi. As it will not be convenient for them to travel by public transportation modes.
2. Some other amendments in rules can also be planned like if in a car 4 or more than 4 people are travelling then that car can be exempted from this Odd-Even car rule. This will help in encouraging car pulling.
3. Public transportation mediums like buses and metro coaches should be increased and improved.
4. More safety measures should be implemented.

Table 1.

Air pollutants	*Adverse effects on*	*Health issues*
Lead	Young children	Brain, liver, kidney and bones
Carbon monoxide	All people are at risk, but pregnant women are generally more at risk than others	body's organs (like the heart and brain) and tissues (headache, dizziness, vomiting, and nausea)
Nitrogen dioxide	Most serious health effects are in combination with other air pollutants for asthma patients	Lung infection (wheezing, coughing, colds, flu and bronchitis)
Ozone	Children and young adults show greater responses to exposure to ozone than older adults. Asthmatic children appear to be at special risk from ozone exposure.	Eye, nose, throat irritation, chest discomfort, cough and headache
Particles	The elderly and people with pre-existing respiratory problems are most at risk.	Premature deaths, hospital admissions, emergency room visits, and asthma attacks
Sulfur dioxide	temporary breathing difficulty for people with asthma, respiratory illness and aggravate existing heart disease	All ages who exercise or work vigorously outdoors have higher exposure to sulfur dioxide than people who are less active

Main Pollutants of air, their effects and health issues due to these pollutants [28]

5. OBJECTIVES OF STUDY

1. To study the effects of odd even campaign on air quality of Delhi with the help of facts.
2. To know the perceptions & experiences about Delhi's odd even campaign.

6. METHODOLOGY

The study is based on primary as well as secondary data. To collect the primary data questionnaire has been designed and data has been collected after both the campaigns. First data has been collected after the first phase of the campaign which was from 1st January 2016 to 15th January 2016. Second-time data has been collected after the second phase which was from 16th April 2016 to 30th April 2016. 300 respondents from NCR has been taken to collect data. With the use of SPSS paired sample t-test has been applied to the data, to analyze the perception and experiences of the respondents. Many other statistical computations like percentage, frequency, mean and standard deviation have been calculated with the help of SPSS.

7. ANALYSIS AND INTERPRETATION

Table 2. What do you feel about the air quality of Delhi?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
HIGHLY POLLUTED	142	47.3	47.3	47.3
2	82	27.3	27.3	74.7
3	54	18.0	18.0	92.7
Valid				
4	11	3.7	3.7	96.3
LOW POLLUTED	11	3.7	3.7	100.0
Total	300	100.0	100.0	

From the above table it can be easily estimated that 47.3 percent respondents say that Delhi's air quality is highly polluted. 27.3 percent respondents feel that it is lower than highly polluted, 18 percent feel it is moderate, 3.7 percent feel it is low polluted and 3.7 percent feel that it is higher than low polluted.

Table 3. Do you think Delhi is the most polluted city in India?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
YES	177	59.0	59.0	59.0
Valid				
NO	50	16.7	16.7	75.7
CAN'T SAY	73	24.3	24.3	100.0
Total	300	100.0	100.0	

The above table shows that 59 percent respondents think Delhi is the most polluted city of India. While filling up the questionnaire many of them said that it is the most polluted city of the world also. The majority of respondents think Delhi is a most polluted city but 16.7 percent think that it is not the most polluted city and 24.3 percent said nothing about Delhi's pollution in India.

Table 4. How do you commute daily?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
OWN CAR	128	42.7	42.7	42.7
CAB	21	7.0	7.0	49.7
PUBLIC TRANSPORT	98	32.7	32.7	82.3
Valid				
POOLED CAR	49	16.3	16.3	98.7
5	4	1.3	1.3	100.0
Total	300	100.0	100.0	

The above table shows that 42.7 percent respondents commute daily by their own cars. That means a major part is travelling by own cars. 7 percent travel by cab, 32.7 percent travel by public transport, 16.3 percent travel by pooled car and 1.3 by any other which is not mentioned.

Table 5. How many cars do you have?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
ONE	175	58.3	58.3	58.3
TWO	85	28.3	28.3	86.7
Valid				
MORE THAN TWO	40	13.3	13.3	100.0
Total	300	100.0	100.0	

The above table shows that 58.3 percent respondents have one car, 28.3 percent respondents have two cars and 13.3 percent respondents have more than two cars.

Table 6. How many hours you drive your car in one day?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
1-3 HOURS	232	77.3	77.3	77.3
3-6 HOURS	39	13.0	13.0	90.3
Valid				
MORE THAN 6 HOURS	29	9.7	9.7	100.0
Total	300	100.0	100.0	

The above table shows that 77.3 percent respondents drive their car 1-3 hours in a day, 13 percent respondents drive their car 3-6 hours in a day and 9.7 percent respondents drive their car more than 6 hours in a day.

Table 7. What do you think this campaign is beneficial for Delhi?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
STRONGLY AGREE	116	38.7	38.7	38.7
SOMEWHAT AGREE	104	34.7	34.7	73.3
NEITHER AGREE NOR				
Valid	44	14.7	14.7	88.0
DISAGREE				
DISAGREE	20	6.7	6.7	94.7
STRONGLY DISAGREE	16	5.3	5.3	100.0
Total	300	100.0	100.0	

The above table shows that 38.7 percent respondents strongly agree with the statement that Delhi's odd even campaign is beneficial for Delhi. Another 34.7 % of respondents also agree with the statement. Thus, a vast majority of respondents

(73.4%) agree that Delhi's odd even campaign is beneficial for Delhi. However, 12 % of respondents did not agree with the statement and 14.7 percent respondents neither agree nor disagree.

Table 8. For how long it should be implemented?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
PERMANENTLY	129	43.0	43.0	43.0
TILL THE TIME AIR	106	35.3	35.3	78.3
Valid				
QUALITY INMROVES				
NEVER	65	21.7	21.7	100.0
Total	300	100.0	100.0	

The above table shows that 43 percent respondents said that odd even campaign should be implemented permanently. 35.3 percent respondents said that it should be implemented till the time air quality of Delhi improves. However, 21.7 percent respondents don't want odd even campaign to be implemented in Delhi.

Table 9. Should odd-even car formula will also be implemented in NCR (Delhi, Faridabad, Gurgaon, Noida)?

	Frequency	*Percent*	*Valid Percent*	*Cumulative Percent*
YES	224	74.7	74.7	74.7
Valid				
NO	76	25.3	25.3	100.0
Total	300	100.0	100.0	

The above table shows that 74.7 percent respondents agree that odd even campaign should be implemented to NCR (Delhi, Faridabad, Gurgaon, Noida). However, 25.3 percent respondents are not in this favor.

8. HYPOTHESIS

Null Hypothesis : There is no significance difference between the perception and experience during odd even campaign. Alternative Hypothesis- There is significance difference between the perception and experience during odd even campaign.

Below tables show the perception and experiences of respondents regarding Delhi's odd even campaign. To calculate the perceptions and experiences various factors like fuel expenses, car maintenance, travelling cost, travelling time, driving stress and traffic conditions are taken. Respondents are asked to rate these according to their perception about the odd-even campaign and their experience during the campaign.

Table 10. Paired Samples Statistics

		Mean	*N*	*Std. Deviation*	*Std. Error Mean*
	Perception-Fuel Expenses	3.31	300	1.344	.078
Pair 1					
	Experience-Fuel Expenses	3.13	300	1.380	.080
	Perception-Car Maintenance	3.31	300	1.232	.071
Pair 2					
	Experience-Car Maintenance	3.15	300	1.193	.069
	Perception-Travelling Cost	3.30	300	1.271	.073
Pair 3					
	Experience-Travelling Cost	3.08	300	1.231	.071
	Perception-Travelling Time	3.12	300	1.485	.086
Pair 4					
	Experience-Travelling Time	2.99	300	1.388	.080
	Perception-Driving Stress	3.66	300	1.365	.079
Pair 5					
	Experience-Driving Stress	3.47	300	1.345	.078
	Perception-Traffic Conditions	3.65	300	1.486	.086
Pair 6					
	Experience-Traffic Conditions	3.56	300	1.393	.080

The above table shows that the perception mean and experience mean of all pairs are different but this difference is too small. That shows that difference between perceptions and experiences of respondents about the odd-even campaign are not too high.

Table 11. Paired Samples Test

		Paired Differences					*t*	*df*	*sig (2-tailed)*
		Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*				
					Lower	*Upper*			
Pair 1	Perception-Fuel Expenses - Experience-Fuel Expenses	.180	1.329	.077	.029	.331	2.346	299	.020
Pair 2	Perception-Car Maintenance - Experience-Car Maintenance	.163	1.330	.077	.012	.314	2.127	299	.034
Pair 3	Perception-Travelling Cost - Experience-Travelling Cost	.217	1.284	.074	.071	.363	2.923	299	.004
Pair 4	Perception-Travelling Time - Experience-Travelling Time	.127	1.683	.097	-.065	.318	1.303	299	.193
Pair 5	Perception-Driving Stress - Experience-Driving Stress	.187	1.442	.083	.023	.350	2.242	299	.026
Pair 6	Perception-Traffic Conditions - Experience-Traffic Conditions	.087	1.437	.083	-.077	.250	1.044	299	.297

The above table shows that there is no significant difference between perception and experience of pair 1, 2, 3 and 5. Their p-value is less than .05. So we reject the null hypothesis. This shows that the perceptions and experiences of respondents regarding fuel expenses, car maintenance, travelling cost and driving stress are same. However, pair 4 and 6 has p-value greater than .05. In these cases, we accept the null hypothesis. That means the perceptions and experiences regarding travelling time and traffic conditions are not same.

9. CONCLUSION

Maximum respondents are satisfied with this initiative, as their perceptions and experiences regarding most of the factors are almost same. They want odd even to be implemented. 43 percent respondents want odd even to be implemented permanently. However, 35.3 percent respondents want odd even to be implemented till the air quality improves. This is a great initiative taken by the government of Delhi to curb the air pollution.

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