

Traffic Congestion and Environmental Quality: A Case Study of Kolkata City

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ABSTRACT: *Traffic congestion is one of the major problems in the city of Kolkata due to high growth rates of motorized transport. Most of the busy traffic intersection points in Kolkata are badly affected by huge traffic congestion. Park Circus Seven Point Crossing, Behala Chowrasta, Shyambazar Five Point Crossing, M.G Road, Gariahat, Jadavpur Police Station Crossing, Ultadanga, Science City Connector, Esplanade, B.B.D Bag are some of the important intersection points which have been considered as major congested traffic points in Kolkata. Encroachment of the road by pavement dwellers and illegal car parking has reduced the widening space of the road and even improper construction of road divider, unscientific construction of speed breaker, size and weight of the car, problem of traffic signaling system and traffic diversion, more number of on road personalized cars, two wheelers and autos are some of the reasons behind the traffic congestion in the city of Kolkata.*

Due to traffic jam a substantial portion of working hours have to be left on street which directly put adverse impact on economy. Congestion causes tremendous vehicular air pollution within the city of Kolkata. According to the survey conducted by West Bengal Pollution Control Board in the year 2012-2013, it has been observed that concentration of major vehicular air pollutants such as SO_2 , NO_2 , Pb, NO_x , SPM, RPM, Benzene, Volatile Organic Compounds, CO and CO_2 are high in proportion at some of the major traffic points include Esplanade, B.B.D Bag, Shyambazar, Park Circus, Gariahat,, Tollygunge Phanri, M.G Road crossing, Ultadanga, Science City Connector due to maximum congestion during peak hours.

In this paper an attempt has been made to point out the present scenario of traffic congestion and assess the environmental quality at some major intersection points within the city of Kolkata.

KEY WORDS: *Traffic Congestion, Environment, Encroachment, Speed Breakers, Intersection Points.*

I. INTRODUCTION

Traffic congestion is the another root cause in the city for slower vehicular speeds, larger trip times and increased vehicular queuing which is responsible for huge amount of vehicular emissions. Kolkata has registered a growth in terms of total number of motorized transport which has increased exponentially but the road infrastructure is not at par which in turn results to traffic congestion in the city. From the recent observation (Annual Report, WBPCB, 2012-13), it has been pointed out that the road surface condition of Eastern Metropolitan Bypass, M.G.Road, Tollygunge Phanri Crossing, Gariahat, Khidderpore, Garia and Garden Reach because of their poor road condition the traffic speed has reduced at all the traffic intersection points. Traffic congestion cost involves of incremental delay, vehicle operating cost (fuel & wear), pollution emissions and stress that result from interference among vehicles in the traffic stream. (Morphin, 2008). More over traffic congestion leads to emit a large quantity of automobile pollutants in the environ of Kolkata and respondents have been suffering from various chronic diseases which might be the resultants factor because of huge emission in the city of Kolkata. Primary survey on the basis of traffic congestion highlights that people of Kolkata have suffered mentally when they are stucked in the traffic jam during their busy working hours and it means delay to reach their working destination in proper time.

1.1.1 Objectives:

The study has been conducted with a view to fulfill the following objectives:

- To inculcate the present scenario of traffic congestion at various traffic intersection points in the city of Kolkata.
- To find out all the possible causes of traffic jam in Kolkata.
- To assess the status of environmental pollution related to vehicular air pollution at various busy traffic points within the Kolkata Municipal Corporation Boundary.
- To point out the all possible solutions in terms of traffic congestion in the city of Kolkata.

1.1.2 Methodology:

- (I) **THE FIRST PHASE:** The first phase of the study was a preliminary attempt to gather various information and secondary data in registered vehicular population from various sources. The information have been collected from West Bengal Pollution Control Board, various websites of national and international journal's of transport and the Transport Department ,Government of West Bengal.
- (II) **THE INTERMEDIATE PHASE:** The primary survey has been conducted on the basis of various perception in terms of traffic congestion from the traffic policemen, pedestrians and the people of Kolkata at various traffic intersection points with the help of questionnaire survey.
- (III) **THE FINAL PHASE:** After collection of primary and secondary data,computation,tabulation and analysis of the same have been done. In this phase data have been processed to prepare relevant maps and cartographic diagrams.

1.2 Concept of Traffic Congestion:

William Vickrey has explored that Traffic Congestion can be categorized into two type:

- (1) Recurrent
 - (2) Non-current
- (1) Recurrent traffic congestion has been observed in regular, weekly or annual cycle basis at most of the busy traffic intersection points during peak hours (10.00 a.m. to 11.00 a.m.) and (6.00 p.m. to 8.00 p.m.).
- (2) Non-current traffic congestion has not been pointed out regularly but it has occurred due to road accidents and disabled vehicles in the city of Kolkata

Table 1.1 Type of Traffic Congestion in the City of Kolkata

Type	Features	Observation
A. Simple interaction on homogeneous roads	Where two vehicles are travelling close together	This scenario has been observed at M.G.Road Crossing, Shyambazar, Garia, Garden Reach, Picnic Garden & Khidderpore
B. Multiple interactions on homogenous roads	Where several vehicles interact	This scenario has been pointed out at Hazra, Ballygunge Phanri, Tollygunge Phanri, Park Circus Seven Points Corssing, Esplanade, B.B.D. Bag, Rasbehari, Maniktala where four wheelers, private and Government Buses, Tram, Auto Mini Bus, Two wheelers are interacting on the same road space area.
C. Bottle necks	Where several vehicles are trying to pass through narrow lanes	This picture has been observed at Jadavpur, Garia Picnic Garden, Khidderpore, Behala, Chowrasta, Tollygunge Phanri where road space is very narrow as per the increasing number of vehicles.
D. Trigger neck congestion	When an initial narrowing generates a line of vehicles interfering with a flow of vehicles not seeking to follow the Jan itinerary.	This features have been observed at all the traffic points in Kolkata mostly at Gariahat, Jadavpur, M.G.Road Crossing, Shyambazar five points, Behala, Garia, Moulali and Picnic Garden.
E. Network Control Congestion	When traffic controls programmed for peak hour traffic inevitably delay off peak hour traffic	Congestion due to network control that has been observed at Gariahat, Hazra, Park Circus Seven Points Crossing especially in East and West Bound traffic diversion, Behala, Hazra, M.G.Road Crossing, Garden Reach, Khidderpore, Science City Connector, Maniktala & Ultadanga.
F. Congestion due to network morphology	Where traffic congestion reflects the state of traffic an all itineraries and for all nodes.	Congestion due to unscientific planning of network nodes, that has been pointed out at Rashbehari, Gariahat, Garia, Ultadanga, Maniktala, Behala, Picnic Garden, Syambazar Five Points & Park Circus Seven Points Crossing, Moulali etc.

Source: Traffic Congestion scenario of third world by William Vickrey (2004) and the Table computed by the Author

1.3 Major causes of traffic congestion in the city of Kolkata :

There are several reasons which are responsible for traffic congestion in the city of Kolkata.

1.3.1 Erratic traffic behavior leading to congestion and emit huge proportion of automobile pollutants in the city of Kolkata.

1.3.2. Most of the busy traffic intersection points in the Kolkata city are Gariahat, Jadavpur, Garia, M.G.Road Crossing, Maniktala, Picnic Garden which have been encroached by pavement dwellers, street hawkers and illegal car parking which in consequence has reduced the widening space of the road and thereby results to huge traffic congestion.

1.3.3 Improper construction of road divider in between two lane of the road make inadequate road space which prevent better mobility of traffic at same of busy traffic intersection points. mostly in the crossing point at Bhowanipore, College Street, M.G.Road Crossing, Maniktala, Syambazar Five Point Crossing, Behala, Jadavpur even at Garia.

1.3.4 Unscientific construction of speed breaker reducing traffic speed in the city of Kolkata. This type of scenario prevails at Gariahat, Maniktala, Jadavpur, Shyambazar Five Points Crossing, Rashbehari, Ultadanga, Khidderpore, Garden Reach and Garia where speed breakers are located in an uneven manner maintaining a proper distance, which reduces speed of the various mode of transport which include buses, taxis, three and two wheelers as well as personalized vehicles as a result huge emission of vehicular pollutants in the city of Kolkata.

1.3.5 During the survey, it has been noted that improper management of traffic diversion by Kolkata Traffic Police and unscientific mechanism of traffic signaling system at improper time intervals can create traffic congestion which results into emission in the city.

1.3.6 West Bengal Pollution Control Board has pointed out some of the reasons behind the traffic congestion in the city of Kolkata, these are :

(i) Lack of planning of city road, law road space, unplanned stoppage and car parking mostly observed in Gariahat, Hazra, Connector, Garia, M.G.Road and Shyambazar Five Points Crossing.

(ii) Mixed vehicular mode along with the slow moving vehicles such as cycle-rickshaw, hand-pulled rickshaw and more number of personalized and private cars which as been observed in some of the traffic points mostly in Jadavpur, Cornfield road crossing at Gariahat, College Street and M.G.Road crossing, Shyambazar Five Points Crossing, Maniktala, Moulali, Picnic Garden, Garden Reach & Khidderpore.

(iii) Lack of training in driving of the drivers and not enough space for 'U' turn and inadequate road length leads to traffic congestion and responsible for vehicular emission in the city of Kolkata.

(iv) Even lack of awareness campaign, absence of parking policy at all the traffic intersection points leads to reduce traffic speeds. In case of Gariahat, Picnic Garden, Garia & Jadavpur parking of personalized cars in a scattered manner along two sides of the road which obviously has encroached the space of the road might be one of the reason for congestion and hence pollution.

(v) Improper implementation of traffic rules and occurrences of fairs, Festivals, processions and meeting which also create traffic congestion at various busy traffic points within the city of Kolkata. Esplanade, M.G.Road Crossing, B.B.D. Bag, Shyambazar five points crossing, Moulali, Hhazra & Rashbehari are some of the busy traffic crossheads which experience political processions and meetings in several times within a week and thus traffic jam become a regular phenomenon which in turn also responsible for automobile pollutants in the air of Kolkata city.

1.4 Traffic Congestion Scenario in the city of Kolkata:

A traffic congestion trap has been made out to show a cyclic relationship between the traffic congestion and environmental quality in the city of Kolkata. (Fig: 1.1). Most the busy traffic intersection points from North and South Kolkata especially Esplanade, B.B.D Bag, Shyambazar Five Points, M.G.Road Crossing, and Rashbehari, Gariahat, Park Circus Seven Point Crossing, Science city Connector experiences more congestion which has reduced vehicular speed.

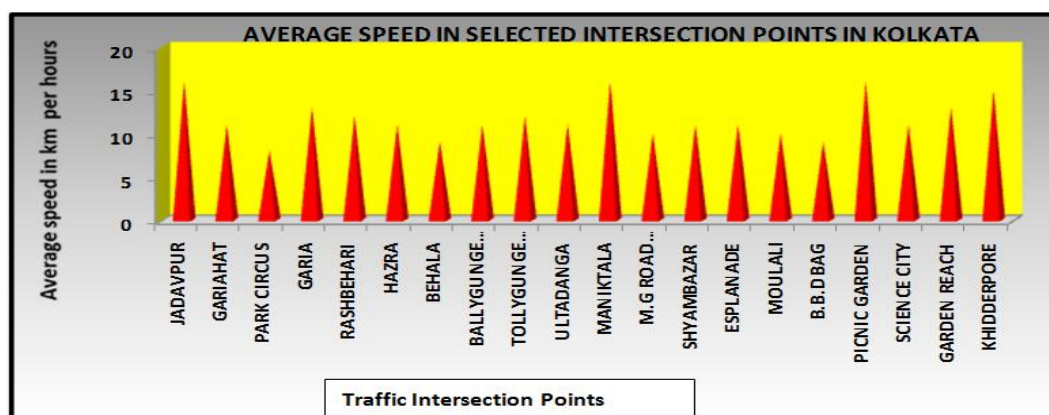


FIG: 1.1

Source: West Bengal Pollution Control Board, 2015

From the diagram (Fig : 1.1) it has been marked out that Park Circus Seven Points, Behala, Ultadanga, M.G.Road Crossing, Esplanade, B.B.D Bag, Moulali and Science City, Shyambazar, Rashbehari, Ballygunge and Tollygunge Phanri experience an average speed less than 11 km/hour where as Jadavpur, Garia, Maniktala, Picnic Garden, Garden Reach and Khidderpore experiences more than 12 km/hours average speed due to less congestion. So far as Kolkata Traffic Police is concerned, again the average speed in Kolkata city is 18 km. per hour and these traffic intersection points exhibit the speed limit less than average. From the perception survey it has been noted that most of the urban people at present opting for personalized modes as it not only symbolizes high urban life style but also comfortable travel with provision of monthly installment from different Governmental as well as Private banks results into traffic congestion as the same road space is used by so many stake holders.

1.4.1 Total stoppage time at various traffic intersection points during peak and lean hours :

During the survey, twenty traffic intersection points have been selected, which are considered to be busy traffic points during Peak hours.

Table 1.2 Average Stoppage Time at Selected Traffic Points

Stoppage time at signals	Intersection points (peak)	Intersection points (lean)	Total
Less than 3 minutes	----	Jaadavpur, Hazra, Maniktala, Picnic Garden, Garden Reach, Khidderpore, Garia	Peak = 00 Lean = 07
3 to 5 minutes	Jadavpur, Hazra, Ballygunge Phanri, Maniktala, Picnic Garden, Garden Reach, Khidderpore, Garia	B.B.D.Bag, Science City, Gariahat, Rashbehari Crossing, Behala Chowrasta, Ballygunge Phanri, Tollygunge Phanri, Ultadanga, M.G.Road, Shyambazar Five points Crossing, Esplanade, Moulali	Peak = 8 Lean = 13
5 to 8 Minutes	B.B.D Bag, M.G.Road, Shyambazar Five Points Crossing, Esplanade, Science City, Moulali, Gariahat, Rashbehari Crossing, Behala, Ballygunge Phanri, Tollygunge Phanri, Ultadanga	Park Circus Seven Point Crossing, Behala Chowrasta, Shyambazar Five Point Crossing, M.G.Road	Peak = 12 Lean = 04
More than 8 Minutes	Park Circus Seven Point crossing, Behala, Ultadanga, M.G.Road, Esplanade, B.B.D.Bag, Science City connector	---	Peak = 07 Lean = 00

Data Source: Primary Data and computed by the Author, 2015

From the given table (Table : 1.2), it has been observed that Park Circus Seven Point Crossing, Behala, Ultadanga, M.G.Road, Esplanade, B.B.D. Bag, Science City Connector has more than 8 minutes stoppage time during peak hours in day and night time (9.30 am to 11.00 am and 5.30 p.m. to 7.30 p.m.) especially during festivals procession time. In an average stoppage time (5 minutes to 7 minutes) has been observed at B.B.D. Bag, M.G. Road, Shyambazar Five Point Crossing, Esplanade, Science City, Moulali, Gariahat, Rashbehari Crossing, Behala, Ballygunge Phanri, Tollygunge Phanri, Ultadanga and even Maniktala, Picnic Garden, Kidderpore and Garden Reach and Garia during peak hours in most of the working days.

During lean our average stoppage time 2 to 4 minutes which has been observed at Jadavpur, Hazra, Garia, Garden Reach, Khidderpore, B.B.D Bag, Science City Connector, Behala Chowrasta, Tollygunge and Ballygunge Phanri, Shyambazar Five Point Crossing, Esplanade, Moulali, Gariahat, Rashbehari Crossing in the city of Kolkata. However from the next observation it has been pointed out that more the signal stoppage time more would be the emission level where at least 50 percent to 70 percentage engines are running one and the vehicles were stucked in the traffic jam or signals. Jadavpur, Hazra, Ballygunge and Tollygunge Phanri, Maniktala, Ultadanga, Esplanade, Moulali, B.B.D. Bag, Science City Connector, Garden Reach and Khidderpore experiences that 70 percent to 90 percent of engines are in hot mode running condition during peak hours traffic congestion and signals which leads to more exhaust emission of CO, VOC, SPM & RPM.

1.4.2 Waiting time of vehicles at various traffic points in Kolkata during peak hours at day time

According to the primary survey at various traffic intersection points within the city of Kolkata, it has been marked out that Park Circus Seven Points Crossing, Rashbehari Ballygunge & Tollygunge Phanri, Ultadanga, Maniktala, M.G.Road Crossing, Shyambazar, Esplanade, B.B.D. Bag, Moulali, Science City Connector Garden Reach and Khidderpore have more waiting time which is in an average 400 – 500 seconds between 9.30 am to 11.00 am during day time peak hours due to more pressure of on-road personalized vehicles, Auto, two wheelers, public and private buses (Fig : 1.2 and 1.3) on the major arterial roads and traffic intersection points in the city of Kolkata.

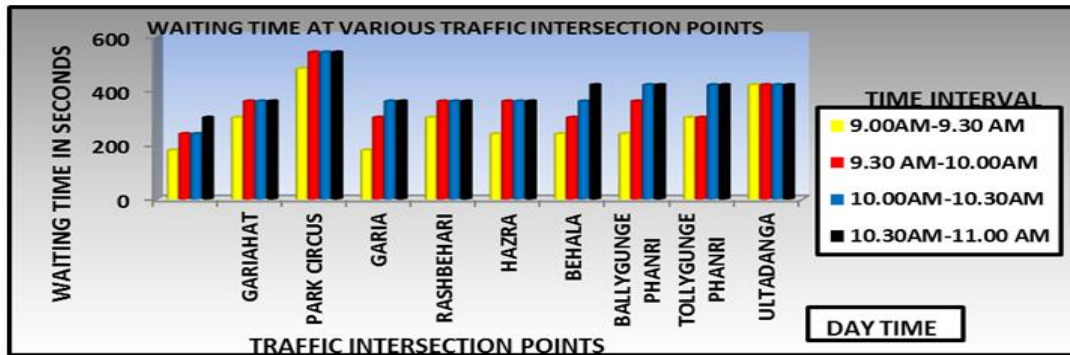


FIG: 1.2

Data Source: Primary Data, 2015

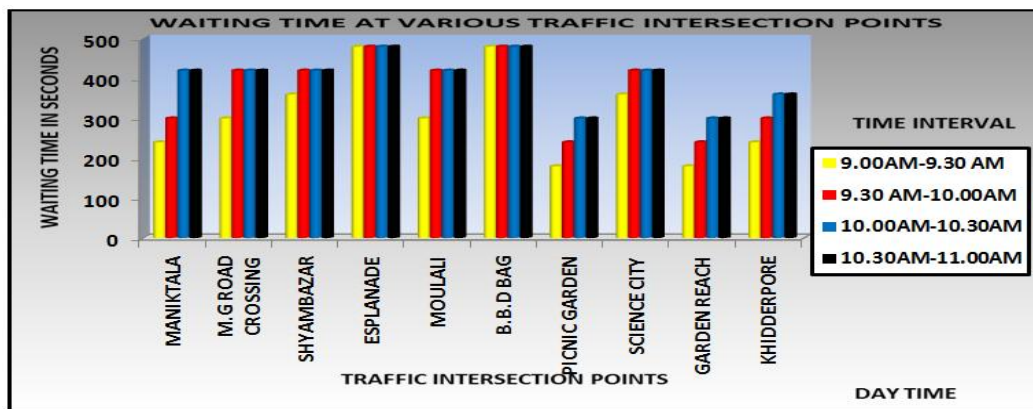


FIG: 1.3

Data Source: Primary Data, 2015

1.4.3. Waiting time of vehicles at various traffic points in Kolkata during peak hours at evening time:

Same scenario has been observed (Fig No: 1.4 and 1.5) during evening time peak hours at Park Circus, Maniktala, M.G.Road Crossing, Shyambazar, Esplanade, B.B.D Bag, Science City Connector, Ballygunge and Tollygunge Phanri, Ultadanga, Gariahat, Behala where more waiting time that is more than 400 seconds between 5.30 pm to 8.00 pm during evening hours peak time due to huge presence of personalized vehicles at all these busy traffic intersection points in the city of Kolkata.

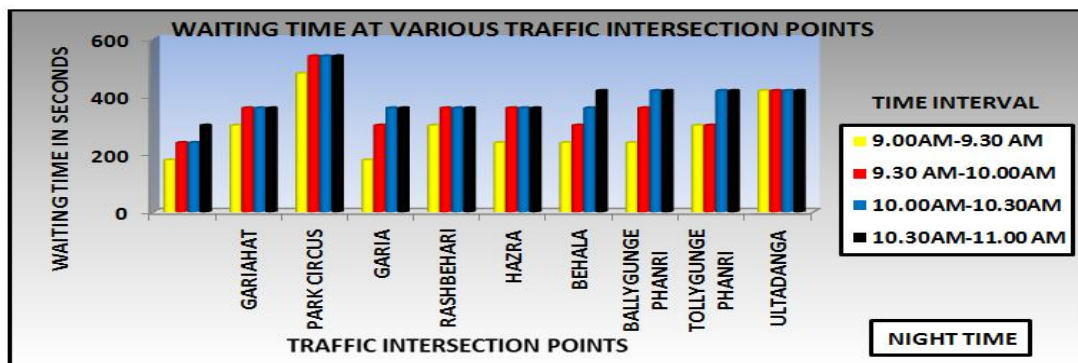


FIG: 1.4

Data Source: Primary Data, 2015

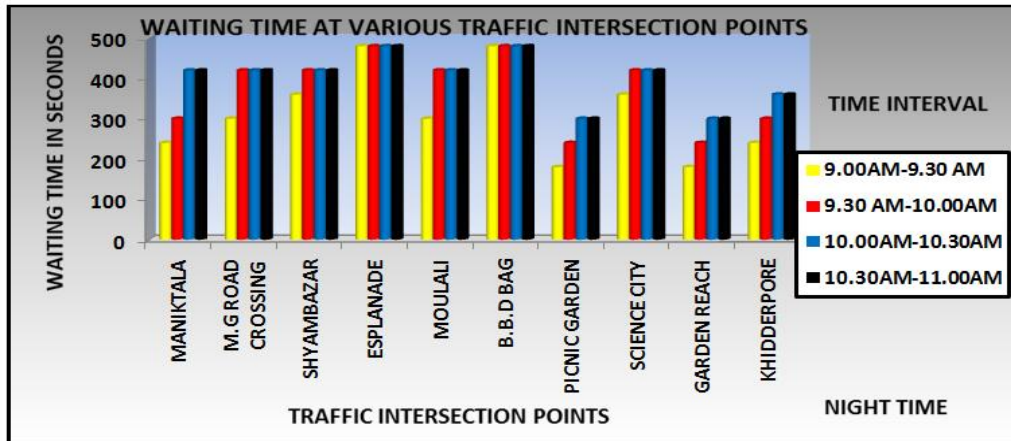


FIG: 1.5 Data Source: Primary Data, 2015

However during peak hours in the evening more waiting time leads to more traffic congestion and as a result more automobile emission exhausted from the tailpipe of the vehicles through combustion of fuel. In that context older fleet public vehicles emit at least 80 percent to 90 percent of exhaust pollutants in the city air which may form chemical fog in and around Kolkata. From the survey conducted by WBPCB (2011-12) it has been recorded that emission of SPM, RPM, CO, NO_x and VOC is more than 60 percent during peak hours both in day and night times in comparison to lean hours traffic time because of less number of vehicles which are plying on the major arterial road within the city of Kolkata.

1.4.4 Relationship between vehicular speed and emission of pollutants :

According to the report published by West Bengal Pollution Control Board, it has been notified that if the vehicles speed has reduced less than 50 km/hour in all the traffic intersection points, emission of CO is more than 800 gm/km in the case of heavy duty gasoline driven passenger cars (Fig : 1.6), even same scenario has been observed in the emission of HC and NO which depicts in the next two diagrams (Fig : 1.7 and 1.8) and from the diagram it has been noted that emission of HC and NO is more than 30 gm/km from heavy duty Gasoline vehicles but it has reduced when the vehicle speed increases which is more than 70 km/hour when the speed level is less than 50 km/hour emission of CO is 124 to 150 gm/km from passenger car (Fig : 1.6) and 250 to 350 gm/km from heavy duty diesel vehicles but the CO emission became less when the speed limit is more than 80 km/hour in both the vehicles under passenger car and heavy duty Diesel vehicles.

Relationship between vehicles speed and emission of automobile pollutants

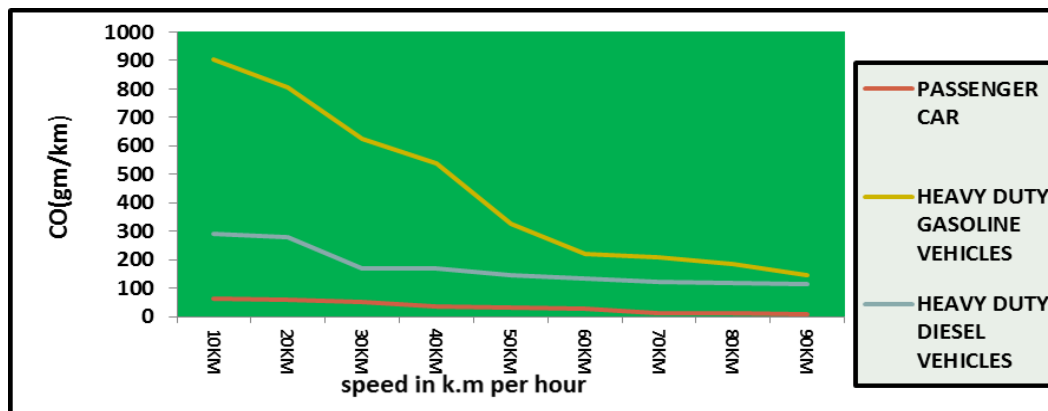


FIG: 1.6 Data Source: West Bengal Pollution Control Board, 2015

In the emission of HC, proportion of Hydrocarbon emits more than 15 gm/km from passenger cars and heavy duty diesel vehicles when the speed limit is less than 40 km/hour but it has

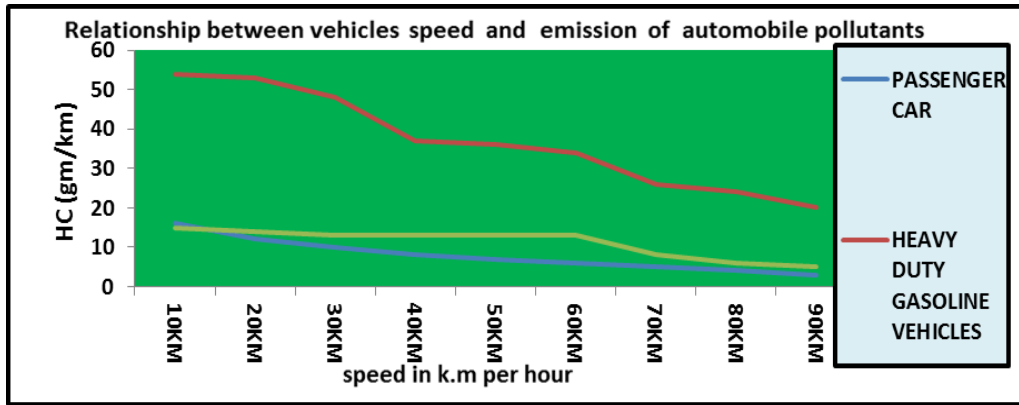


FIG: 1.7 Data Source: West Bengal Pollution Control Board, 2015

reduced when the speed limit is more than 70 km/hour (Fig : 1.7) further No emission is also more than 5 gm/km from passenger cars and heavy duty diesel vehicles when the speed limit is less than 40 km/hour but it has reduced when the speed limit increases more than 70km/hour at all the my traffic points in Kolkata.(Fig : 1.8).However it has been signifiethat

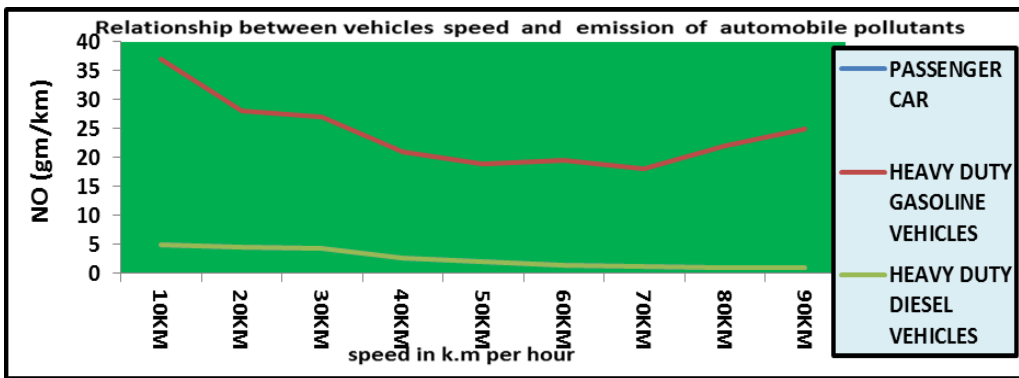


FIG: 1.8 Data Source: West Bengal Pollution Control Board, 2015

reduction of traffic speed leads to increase rate of emission of automobile pollutants at all the traffic intersection points within the city of Kolkata, moreover improper spacing of road divider within 1 K.m road length has also reduced traffic speed which may be responsible for less traffic speed and huge exhaustion of automobile pollutants. Therefore it has been further notified that various transport indices include bus transport index, on street parking index as well as para transit index effects on occurrence of huge traffic congestion as well as high proportionate index value of slow moving vehicles and walkability indices. This fact depicts to point out that more bus transport and on street parking index value which is approximately 10 percent and 18percent reduces walk ability index and increasing slow moving vehicle index which has been observed as a very common features at all the traffic intersection points within the city of Kolkata. However least index value of slow moving vehicles increases high numerical index value of traffic congestion (30 to 35) which is one of the important indices parameter while it has been considered the travel speed and rate of automobile emission.

Table: 1.3 (Relationship between speed of the vehicles and emission levels)

Speed (km/hour)	Auto change in emissions with speed (gm/km)						Buses change in emissions with speed (gm/km)					
	SPM	RPM	CO	HC	NO _x	SO ₂	SPM	RPM	CO	HC	NO _x	SO ₂
10 km/hr	376	242	33.02	4.47	2.53	24	572	372	22.60	5.70	22.30	32
25 km/hr	284	186	21.20	2.60	2.17	18	379	285	14.40	2.30	16.40	26
50 km/hr	156	137	9.80	1.30	2.24	16	282	146	8.20	0.52	11.90	24
75 km/hr	137	112	6.40	0.93	2.97	08	154	137	7.52	0.37	10.21	18
90 km/hr	87	56	2.21	0.15	2.35	04	112	98	5.21	0.19	6.42	11

Source: West Bengal Pollution Control Board, 2015

Table 1.3 shows a trendy relationship between vehicular speed and emission of automobile pollutant between Autos (three wheelers) and Buses in the city of Kolkata when the speed level is less than 25 km/hour, emission of SPM, RPM, CO, HC, NO_x and SO₂ which are the major automobile pollutants emit in huge proportion both in the case of autos and buses at all the traffic intersection points during peak hour time in the city of Kolkata. Moreover increasing traffic speed reduces emission from vehicles which are driven by gasoline as well as diesel fuel. When the speed limit is approximately 10 k.m per hour , emission of SPM and RPM has observed to be high which is approximately more than 300 gm per k.m in both the cases of autos and buses, whereas when the speed limit is more than 50 to 70 k.m per hour , RPM and SPM emission has reduced which is nearly 100 gm per k.m. But this scenario may be happened in the city of Kolkata if the possible solution are taken into consideration to increase the traffic speed which is more than 30 to 40 k.m per hour. In that case emission of all the automobile pollutants will reduce if the proper planning is followed by constructing the sky scrapper flyover from north to south bound and east to west bound movement in the city of Kolkata. While the vehicles will be moving from one part to another part should use the flyovers which might increase the traffic speed and reduce the vehicular emission in the city of Kolkata in near future.

TABLE 1.4 Scenario of speed limit at various traffic intersection points in Kolkata

Speed Limit	Traffic Intersection Points
Less Than 1 Km/Hours	Gariahat, Park Circus Seven Point Crossing, Ultadanga, M.G Road, Shyambazar Five Point Crossing, Esplanade, Tollygunge Phanri, B.B.D Bag, Moulali
1.1km/Hours—1.5 Km/Hours	Garia, Rashbehari Crossing, Maniktala, Science City, Behala, Hazra, Behala Chowrasta, Ballygunge Phanri,
More Than 1.5 Km/Hours	Jadavpur, Picnic Garden, Garden Reach, Khidderpore

Data Source: Primary Data, 2015

Therefore while the speed limit condition has been considered in the city of Kolkata, some of the busy traffic points include Gariahat, Park Circus Seven Points Crossing, Ultadanga, M.G Road Crossing, Shyambazar Five Points Crossing, Esplanade, B.B.D Bag as well as Tollygunge Phanri where (Table : 1.4) the traffic speed is less than 1 k.m per hour because of maximum movement of vehicles in terms of the proper road space area compared to more traffic speed which has observed merely 1.5 k.m per hours at Jadavpur, Picnic Garden, Garden Reach and Khidderpore because of the movement of less number of traffic.

1.5 Emission of Automobile pollutants due to congestion at various traffic intersection points :

As it has been pointed out earlier that most of the traffic intersection points experience more congestion, as a result more emission of automobile pollutants may be observed at all the traffic points. However Gariahat, Park Circus Seven Points Crossing, Rashbehari, Hazra, Ballygunge and Tollygunge Phanri, Ultadanga have reflected huge emission of SPM, RPM, (more than 300 µg/m³) and CO, SO₂ and NO₂ emission has been observed more than 50µg/m³ during peak hour traffic congestion time in comparison to other intersection points.

Same scenario has also been observed in another traffic intersection points in the city of Kolkata. M.G.Road, Esplanade, B.B.D.Bag, Science City Connector has huge emission of SPM & RPM (more than 400 µg/m³) and CO, SO₂ and NO₂ (more than 50 µg/m³) during peak hours in comparison to other traffic intersection points within the city of Kolkata because of its insular location as well as more traffic congestion due to modal shift towards personalized vehicles very low road space area in terms of the increasing number of vehicles. Besides this space factor another domain which is responsible for hike emission in terms of traffic congestion that is illegal car , auto and hand-pulled rickshaw parking beside the city road has also reduced the space which has been noted especially in these specified traffic intersection points. More over NO_x, Pb, Benzene and Volatile organic compound was very low in proportion in all the traffic intersection points in the city of Kolkata.

While it has been notified the measures of automobile pollutants in terms of various traffic intersection points Hazra, Behala, Ballygunge phanri and Tollygunge phanri have experienced large quantity of automobile emission which include SPM and RPM which is more than 300 µg/m³ compared to other automobile pollutants include VOC, Benzene, Pb as well as NO_x which emit least in proportion because of the implementation of vehicular norms as well as regular checking of automobile engine of the vehicles.

CONCLUSION:

At the end part of this chapter it can be concluded that if different measures are taken then the traffic speed would improve in future and in consequence the emission level in the city of Kolkata would have been lowered.

There are some recommendations put forward by West Bengal Pollution Control Board (2012-2013) to reduce the traffic congestion in the city and likewise improvement in the city's air. These are enumerated below:

- (i) Strict order and regulation should be maintained to ban the encroachment on the side of the road and optimization of traffic and improvement in traffic management must be followed to increase the speed of vehicles which would reduce vehicular emission.
- (ii) Traffic management programmes should be initiated including GPS navigation and traffic signaling system.
- (iii) Other measures should be taken to improve the speed limit of the vehicles and reducing emission level.
 - (a) Social awareness campaign should be organized.
 - (b) Construction of more number of flyovers.
 - (c) Implementation of strict traffic law and increasing of pedestrian facilities.
 - (d) A separate lane should be constructed beside the arterial road for the movement of bi-cycle, hand pulled rickshaw and cycle rickshaw.
 - (e) Maximum use of road width and also banning of unauthorized parking beside the main congested intersection points.
 - (f) Implementation of high parking charge at some of the busy traffic points mostly in Gariahat, Garia, M.G.Road Crossing, Shyambazar Five Point Crossing etc.
 - (g) Effective use of underpass and over bridge not only that traffic impact assessment should be implemented before plan of any construction.
 - (h) Finally steps should be taken to stop running engines of the vehicles at various traffic intersection points.

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