

Individual Modes: Efficiency or Illusion - A case of Bangalore city

Modes de transport individuels: efficacité ou illusion – Etude de cas dans la ville de Bangalore

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ABSTRACT: The 'Desire for Movement' is one of the fundamental needs of human being. Transport plays a vital role in the economic development of any country. In India, people had to switch over to Individual Modes due to inadequacy and inefficiency of mass transportation system. Advantages of Individual modes especially 2wheelers, is that they can easily reach any place inside the congested area. The rapid increase in number of vehicles is giving rise to a set of new problems in road safety, congestion, traffic control, noise pollution, air pollution and fuel problems etc. This indicates that individual modes have two faces: Efficiency and Illusion.

In the case of Bangalore city are studied the accident and environmental problems that the city is now facing. Environmental problems due to vehicular emissions and accidents due to personalized modes compared to other modes has been analyzed based on the registered motor vehicles. This will be useful for policy makers while decision-making.

RESUME : le désir de bouger est l'un des besoins fondamentaux de l'être humain. Le transport joue un rôle vital dans le développement économique de tous les pays. En Inde, les gens doivent recourir à des modes de transport individuels en raison de l'inadéquation et de l'inefficacité du système de transport de masse. Les avantages des modes de transport individuels, notamment les deux roues, sont qu'ils peuvent aisément atteindre n'importe quel point à l'intérieur d'une zone à fort trafic. L'accroissement rapide du nombre des véhicules donne lieu à un ensemble de problèmes nouveaux en matière de sécurité routière, de congestion, de contrôle du trafic, de bruit, de pollution de l'air, de carburant, etc.. Cela dévoile les deux faces des transports individuels : Efficacité et Illusion.

A Bangalore, on a étudié les problèmes d'accidents et d'environnement auxquels la ville est aujourd'hui confrontée. A partir des véhicules immatriculés, on a analysé les problèmes d'environnement dus aux émissions des véhicules et comparé les accidents dus aux modes de transport individuels par rapport aux autres modes. Cela sera utile pour les responsables au moment de prendre leurs décisions.

1 INTRODUCTION

The spectacular growth in the Road Transportation Sector in Indian cities has been a key element in its economic development. The increase in investment in the transport sector has resulted a greater movement of men, material and at the same time it spoiled the road traffic and urban environment. Evidently, the two-wheeler has become the most popular mode of personalised transport.

In India, during 1998-99 two-wheeler's production was 75.7 % where as buses only 0.5%. The situation has been worsening due to lack of policy where the personalised modes are getting high prior-

ity than promotion of public transport. The basic problem is not the numbers of these vehicles in the cities but their over concentration.

Bangalore so called Garden City is located in the south of India. Traffic composition in Bangalore is of a mixed nature. There is a variety of about a dozen types of both slow moving and fast moving vehicles plying on the roads. With regard to vehicle population, till 1992, Bangalore stood third among the major metropolitan cities and after 1992 it continued to stand in the second position. One of the reasons for this might be due to liberalisation in the early 1990s which led to a software boom in the city. Thus people have migrated to the city in search

of employment opportunities. Affordability, high purchasing power and cheaper and easy financing schemes have lead to increase in the number of individual modes.

To assess the efficiency and the illusion of individual modes accident data and pollution data of Bangalore city have been analysed. Three principal factors viz., the vehicle, the road and the road user would comprise this study.

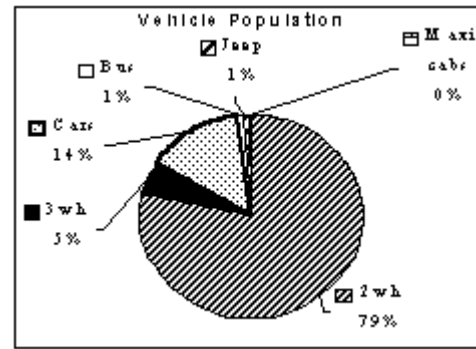


Fig 1: Modal split analysis of passenger transport

2 BANGALORE CITY- AN OVERVIEW

2.1 Physical and demography details

The city has grown from 30 sq. km in the year 1900 to 305 sq. km in the year 1997. It was rated as the fastest growing city in the entire Asia during the period 1971-81 with an increase of 76 percent in its resident population. Topographically, the city has a high altitude and has an undulated terrain with differing road gradients and consequently abrupt changes in vehicle accelerations and decelerations. In India, Bangalore ranks fourth as far as population (Govt. of India, 1991); are considered. In 1991 it was 4.84 million with the decadal growth of 40% during 1981-91. In the year 1998 the city has a population of 6.9 million with a growth rate of 43% (Govt. of India, unpubl.); over the year 1991.

Given the predominance of the low and middle class population in the outskirts of the city and the development in the centre of the city the two wheeler, with its low price and operating cost has emerged as a chosen mode of transport.

2.2 Vehicular Growth

The vehicular population (Govt. of India, 1999); in the city has increased tremendously with just 23,000 registered motor vehicles in 1960 to about 1044481 in 1998. Looking at the per capita vehicle ownership figures in the city showed that in 1971, the per capita vehicle ownership was 0.03 which increased to 0.19 in 1996. The percentage increase has been 84.2% over the past 25 years.

The modal split analysis of Bangalore city in the year 1998 clearly indicates the dominance of two wheelers followed by the cars (Fig 1).

The details of mode wise vehicular growth from the year 1990 till 1998 are given in table no.1 below.

Table 1
No. of Vehicles Registered in Bangalore City as on
31st March 1998

S No	Category	1990-91	1991-92	1992-93	1993-94
1	2 Wheelers	458860	500613	525317	517171
2	3 Wheelers	17379	23096	25478	29755
3	Cars	82205	90929	89879	91690
4	Jeeps	6376	6807	6474	4204
5	Omni Buses	2532	2683	3182	4032
6	Ksrtc Buses*	2483	2663	2892	3796
7	BMTC Buses**	1614	1664	1702	1796
8	Pvt. Buses	419	489	534	323
9	Trucks	19149	21345	21353	26049
10	Tractors	1993	2190	1690	1480
11	Trailers	1723	1903	1595	1360
12	Maxicabs	2511	2773	2862	22847
13	Others	3815	4197	3699	5019
	Total	601059	661352	686657	689522

Table 1 contd.

S No	Category	1994-95	1995-96	1996-97	1997-98
1	2 Wheelers	574578	641298	723626	839072
2	3 Wheelers	33238	37876	46164	54066
3	Cars	105115	117101	133096	152004
4	Jeeps	4690	5650	5790	6497
5	Omni Buses	3853	4376	5487	7669
6	Ksrtc Buses*	3925	4118	4483	921
7	BMTC Buses**	1819	1926	1924	2088
8	Pvt. Buses	710	954	1054	1353
9	Trucks	24455	27469	28775	33853
10	Tractors	2098	2349	2481	5006
11	Trailers	2033	2270	2159	4510
12	Maxicabs	568	3119	3985	2966
13	Others	10352	11201	13351	19871
	Total	767434	859707	972375	1129836

Source : Motor vehicle Department, Government of Karnataka, 1999

* KSRTC - Karnataka state transport Undertakings- Inter city service

** BMTC – Bangalore Municipal transport corporation- city service

As per the table 1 given above, in 1998 there are about 74.2 % two wheelers, 14.0% Cars and jeeps, about 5% auto rickshaws, 3.8 % heavy vehicles, 1% buses and about 1.76 % of other vehicles. There has been a spectacular growth in the individual motorised vehicles viz., two-wheeler over the past years. Frustrating experiences like poor punctuality, inadequacy of services and more breakdowns in bus transport have driven the people towards possessing the two wheelers.

The above factors by themselves and in combination with each other have culminated in a fast deteriorating accident and pollution situation in Bangalore city. The ownership of two wheelers has increased more than one and half times during 1991-98. Personalized vehicles have been rising, as there is no annual ceiling on the registration of number of vehicles.

Table 2

Time series of modal share evolution in numbers

Year	2 wheelers	3 wheelers	Bus	Taxi	Car, Jeep
1979-80	97110	10726	4301	1104	33641
1984-85	189619	11348	5276	1697	52782
1989-90	401811	15591	5608	2218	76901
1990-91	458860	17379	5716	2511	88581
1994-95	574578	33238	6454	2944	109805
1997-98	839072	54066	4362	3327	158501

Table3

Time series of modal share evolution in %

Year	2 wheeler	3 wheeler	Buses	Taxi	Car/Jeep
1979-80	66.1%	7.3%	2.9%	0.8%	22.9%
1984-85	72.7%	4.4%	2.0%	0.7%	20.2%
1989-90	80.0%	3.1%	1.1%	0.4%	15.3%
1990-91	80.1%	3.0%	1.0%	0.4%	15.5%
1994-95	79.0%	4.6%	0.9%	0.4%	15.1%
1997-98	79.2%	5.1%	0.4%	0.3%	15.0%

The above tables 2 & 3 shows that the personalized modes especially two wheelers are always at the top in numbers than any other mode of passenger transport. In the early 1980 their composition was less than 70% and in 90's it stabilized at about 80%. At the same time the growth rate of buses has been decreasing continuously although the human population, demand for travel is increasing. The decreasing

trend is perhaps due to lack of policy framework in promoting bus transport system.

3 INDIVIDUAL MODES – EFFICIENT MODES

Distances between residences and working places are growing in the city and existing of bus transport is not able to meet these acute transport needs. It is thus in the prevailing situation, individual modes are better mode of transportation to reach work place with less travel time.

A two-wheeler is primarily a multi role vehicle. It provides ready conveyance for going to work, alone or with a family member or a friend perched on the pillion. For many it clearly constitutes a workhorse: for visiting sites, making business calls, ferrying helper and tools, and sundry other workday jobs an aid to efficiency like pick-up van.

In leisure time, it often functions as a family car. The family can go for shopping, eating out and other outings at any time they want, and has got options of making stops, load groceries, and travel door-door which otherwise would be difficult with the bus transport system.

Transportation barriers that lead to mobility concerns and made personal vehicles more efficient in Bangalore city are described below.

- Inadequate bus facilities to community centers, seniors' centers and health facilities. Distant bus stops, too many transfer points transfer points required to reach these centers and long waits at these transfer points.
- This substantial time investment can by itself be a deterrent for using buses. In addition, this delay may expose seniors to inclement weather for long periods at transfer points.
- No proper lighting system at these transfer points during night time and perceived as unsafe
- Absence of suitable handholds for Children, women and the aged inside buses poses difficulty for many to travel safely and comfortably
- Only 26 buses per lakh of population and which is not sufficient to meet the travel demands in the city.

Most of the children, aged people with mobility limitations and women are unable to use conventional public transit (BMTC buses) and have started depending on the rides provided by family members and friends to reach schools, medical and shopping facilities.

Inadequate buses, improper bus designs, less accessibility, more waiting times forced the people to

use individual modes of transportation and made the individual modes more efficient.

4 INDIVIDUAL MODES – AN ILLUSION

This can be deduced by considering the accident rates and air pollution problems in the city.

4.1 Road accidents

4.1.1 Accident scenario

As a result of the booming increase in the city's motor vehicle population, the number of road accidents has also shown a drastic increase, from only 564 accidents in 1964 to about 4931 accidents in 1984 and about 8360 accidents in 1998. In the span of past fourteen years, there has been an exponential growth in accidents with an increase of 41%. Total number of accidents and persons killed are shown in the table 4.

1	Two wheelers	1990	34.3%	4.31
2	Three wheelers	1015	17.5%	3.18
3	Cars/jeeps/taxi	1890	32.5%	3.19
4	Buses	915	15.7%	13.58
5	Total	5810	100.0%	24.19

Source : Traffic Police , Bangalore City

The statistics shown in table 5 clearly indicates that the individual modes such as two wheelers constitute maximum of 34.3% of total accidents having a share of only 17.8% of passenger km/yr and cars 32.5% with a share of 13.2% whereas buses account for only 15.7% having a share of 56.1% of total passenger km/yr. The increase in the individual modes has adversely affected the safety of the passengers and highlights the fact that the risk associated with individual modes is considerably higher as compared to bus transport.

Table 6 given below shows that over a period time the rate of accidents are increasing with increase of vehicles, especially the individual modes.

Table 4

Number of Road Accidents and Casualties in Major Cities in India (1998)

Cities	Road Accidents	Persons Killed
Mumbai	26980	370
Calcutta	10999	454
Delhi	10217	2123
Bangalore	8360	726
Chennai	5121	682
Ahmedabad	2949	218
Hyderabad	2208	370

Source : Road Safety cell, Ministry of Surface Transport, 1999.

The data in table 4 shows that the Bangalore city ranks fourth in the country as far as road accidents are concerned. The number of persons killed as result of road accidents is also high in Bangalore and occupies second position in the country.

4.1.2 Mode wise accidents

Mode wise analysis of accidents clearly indicates the illusionary face of the individual modes. The table 5 below shows mode wise accidents in the year 1998.

Table 6

Decadal Growth in Vehicle Population and Road Accidents

Year	Vehicle Population	Road Accidents
1960	23000	564
1970	39454	1761
1980	170877	4214
1990	601059	5047
1998	1129836	8360

Source : Traffic Police , Bangalore City

Table 7

Cause wise accidents- a time series data

Cause	1991	1995	1996	1997	1998
Driver's fault	6855	856	8172	8503	8205
Passenger's fault	7	18	44	4	40
Bad weather	-	-	-	-	-
Bad road	-	-	8	4	12
Mechanical Fault	4	5	5	3	1
Pedestrian fault	5	-	5	2	2
Others	171	88	240	206	100

Source : Road Safety cell, Ministry of Surface Transport, 1999.

The above table 7 analysis the cause wise accidents over a period of time. It can be seen that most of the accidents attributes to faulty driving practices. Correlating the table 5 & 7 it can be concluded that majority of the accidents are caused by the drivers of the personalised modes.

Table 5

Mode wise accidents in Bangalore city (1998)

Sl No	Mode	Total accidents	%	Billion Passenger km/yr
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4.2 Congestion on Roads

The road space occupied by different modes was calculated in passenger car units (pcu's) per road kilometre and was analysed as given in table 8 below.

Table 8
Road Space Occupied by Different Modes

Mode	Actual no. of vehicles 1997-98	PCU'S *	pcu's/ road km *	% age of road space *
2 wheeler	839072	419536	822.6	62.8
3wheelers	54066	54066	106.0	8.1
Cars	152004	152004	298.0	22.8
Jeeps	6497	6497	12.7	1.0
Buses	2088	6264	12.3	0.9
Other buses	9903	29709	58.3	4.4
Total	1063630	1087612	1310.0	100

Source : Transport Department, Government of Karnataka, 1999

* Estimated

It is seen that the two wheelers occupied the maximum (822.6 pcu's/km) space on the roads. Cars occupied as much as 298 pcu's/km whereas the buses occupy road space of only 70.6 pcu's/km. It is seen that the personalised modes ie; two wheelers and cars together occupy 85.6 % of road space whereas the buses occupy only 5.3% of the road space.

Needless to say all the analysis done above states one thing very clearly that the congestion on the urban roads due to increase in number of individual modes of transportation has worsened the environment and road safety situation in the city of Bangalore. One must concede that for safety and stability, comfort and convenience, nothing compares to a vehicle mounted on four wheels.

4.3 Environmental Problems

There is a direct relationship between transport system and health of the society. Emissions from motor vehicles pollute the air which, in turn, affects the health of people and makes cities unsafe for living and working. Large volume of vehicles, mixed nature of traffic composition and less area of road space, inter alia, reduces speed, cause delays, traffic jams and idle fuel consumption. All of these add to air pollution, accidents, physical stress, mental tension, respiratory diseases and a fear psychosis.

4.3.1 Data collection and methodology

The data on registered Motor vehicles for Bangalore has been collected from the Road Transport Authorities from 1971 to 1999. The Vehicular Air Pollution Information System (VAPIS) model originally developed by the World Bank and redesigned by Harvard University is used to analyse vehicular emissions in the city.

4.3.2 Vehicular Emissions

The mode wise emission levels are shown in table 6. In 1998, highest emissions came from two wheelers and cars. Emissions of hydrocarbons and CO are more due to personalised vehicles such as two wheelers and cars.

According to projections it has been found that two wheelers will have the maximum emission levels of 107.03 tonnes/day by 2010 and this domination will continue even in 2020 and 2025 with 187.25 and 254.139 tonnes/day respectively.

Table 9

Estimated daily emissions in Bangalore city (1998) in tons/day

Vehicle Type	CO	NOx	HC	TSP	PM10
Cars/Jeeps	66.40	6.61	12.78	0.80	0.64
2Wh	59.80	0.64	35.79	1.25	1.00
Buses	10.26	13.48	1.87	1.93	1.52
Total	136.46	20.73	50.44	3.98	3.16

From the above table 9, it can be seen that the personalised modes such as 2wheelers and cars are emitting high amount of pollutants. The analysis of CO and HC emissions reveal that two-wheelers are having a share of 43% and 71% respectively and the cars 48% and 25%, whereas Buses are emitting only 7% and 3.7%. However NOx emissions are less from personalised modes than buses.

Table 10

Estimated mode wise emissions per billion passenger km/yr during 1997-98

Mode	Billion Passenger km/yr	% age	Emission/ Billion Passenger-km/yr	% Emission/ Billion Passenger-km/yr
Cars	3.12	15	10211.93	53
2wh	4.31	21	8334.94	43
Bus	13.58	65	780.77	4

It is clearly seen from the table 10 that Cars, which have a share of 15% in passenger kms, emit 53% of total emissions and the two wheelers having

a share of 21% emitting 43%. It is interesting to note that buses have 42.8% share in passenger kms are emitting only 4% of the total emissions. This shows the amount of damage caused by the individual modes to the urban environment.

5.0 SUMMARY

- Due to inefficient and inadequate public transport system people switched to personalised modes.
- The unrestrained growth in personalised vehicles in the city is the major issue which needs to be tackled. Due to increase in the personalised modes created more mobility problems through accidents and occupation of road space.
- Road space Constraint: The city has inadequate road network and as per the city size it should have a bigger Arterial and Sub arterial network. As per the land use distribution the city should have at least 20% of the total city area for transport network which is not the case in Bangalore. The studies reveal that capacities on the roads in the city have already crossed the limits.
- The pedestrian fatalities are high, as much as 40% in the city. Since the roads are congested with vehicles and no separate pavements for the pedestrians and are forced to walk on the roads causing more accidents.
- The vehicular speeds in the city have come down to as low as 11-12 km per hr due to high concentration of individual modes and resulted in more fuel consumption and higher emissions.

6.0 CONCLUSIONS

The growth in the personalised modes has been spectacular particularly from the late seventies onwards. Due to improper planning in promoting the bus transport system and inadequacy in bus services people have become dependent on individual modes. The increase in number of vehicles has rendered the traveling as unsafe. Though Individual modes are more efficient in reaching work places with less travel time etc, they prove to be safety and environmental hazards. Thus the apparent efficiency of the individual modes is nothing more than illusionary. Effective measures are required to reduce the usage of the Individual modes to the maximum extent atleast for those like work and educational purposes. These steps are required to reshape the urban transport environment in the city with a view to minimising the accidents and pollution.

7.0 REFERENCES

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