TRANSPORT ALTERNATIVES FOR MEDIUM SIZED CITIES

Research Study Series Number 56

National Institute of Urban Affairs
New Delhi
July, 1993

TRANSPORT ALTERNATIVES FOR MEDIUM SIZED CITIES

Research Study Series Number 56

National Institute of Urban Affairs
New Delhi
July, 1993

PREFACE

Urban transport related problems of metro cities are frequently highlighted by the media. Although inadequate, the metro cities' residents have a variety of options related to public transport. On the other hand, the rapidly growing medium sized cities in India often do not have any mass public transport system. The residents of these cities face severe hardship in their movements within the city.

Urbanization in India is largely due to the contribution of class-I cities, i.e. cities with population above 100,000. These cities account for about 8 per cent of the total urban centres in India and about 65 per cent of the urban population of the country. While the rate of growth of population of the large cities is declining, the cities with population between 300,000 to 500,000 exhibit an increase in the rate of growth of their population. The problems of urban transportation, associated with the metropolitan cities like - traffic bottlenecks, inadequate mass transportation, overcrowding in buses and trains are well known. The medium sized cities will also experience similar situation if no immediate action is taken to provide adequate mass transport system.

There have been very few comprehensive studies in India related to the demand for urban transport in the medium sized cities. Some of these studies are descriptive in nature and do not provide answers to the basic questions related to economic and environmental feasibility of various options. This study,

conducted in three medium sized cities of India, viz. Ranchi, Cuttack and Rajkot, assesses the travel behaviour of the residents and examines the existing mass and intermediate public transport systems in these cities. The study shows that mass transport systems exists only in two of the three cities studied. Even in the two cities, it caters to a negligible proportion of the travel demand. The intermediate public transport (IPT) like cyclerickshaws and autorickshaws are the predominant public transport modes in these cities.

These three sample cities represent the general situation with regard to urban transport in most medium sized cities. The urban form, particularly in the inner city areas of these cities is not conducive to motirized traffic and mass transport systems. This study proposes standard mini-buses and battery operated mini-buses as the most viable urban public transport options for these cities. These are found to be financially viable as well as suitable to environment criteria. As suggested by the analysis, these urban mass public transport options, coupled with the existing modes of IPTs will be able to meet the demand for urban transport in most medium sized cities of India. There is an urgent need to promote these forms of mass transport systems in the medium sized cities. Concerted efforts on the part of the Central Government, state level agencies and the urban local governments will be necessary to ensure early implementation of the study proposals.

A study that was dependent substantially on field-based information from households, public transport operators and local agencies, required cooperation and coordination from many agencies and individuals in the selected cities. We gratefully acknowledge the cooperation and help of Mr. Amarjeet Singh, Commissioner, Rajkot Municipal Corporation, Mr. M. Mewada, Deputy Town Planner, Rajkot Urban Development Authority, Mr. Santosh Kumar Satpathy, Vice Chairman, Ranchi Regional Development Authority, Mr. Sudhir Prasad, Deputy Commissioner, Ranchi Municipal Corporation, Mr. A.P. Padhi, Vice Chairman, Cuttack Development Authority and Shri B.K. Dhal, Executive Officer, Cuttack Municipality.

The field work in the selected cities was facilitated by Prof. S.M. Pathak, Department of History, Ranchi University, Prof. K.M. Mavani, Principal, College of Commerce, Rajkot and Prof. S.N. Mishra, Department of Economics, Revenshaw College, Cuttack. We gratefully acknowledge their efforts as local resource persons in enabling the project team to conduct a range of surveys in the selected cities.

At the Institute, my colleague, Dr. Pushpa Pathak, has ably coordinated the study since its inception. Dr. Pathak deserves compliments for her efforts in bringing out the study in its present form. The research project team, particularly Dr. Rajesh Chandra, provided excellent support for the study.

We are grateful to the Ministry of Urban Development, Government of India, for their financial support to the study and especially shri K. Dharmarajan, Joint Secretary, for his encouragement and interest in the study. We hope that the suggestions made in the study will be seriously considered by the Government and the residents of the medium sized cities will have a better urban transport system.

Dr. Dinesh Mehta
Director

PROJECT TEAM

Project Coordinator	Pushpa Pathak
Research Staff	Rajesh Chandra Satbir Singh Hundal D.P. Dubey
Special Assistance	Ashwani Luthra Basudha Chattopadhyay Promila Mathur Rajesh Sharma
Secretarial Assistance	Kamlesh Grover
Word Processing	Sangita Vijh Mahender Singh
Cartographic Assistance	Ajoy Kashyap
Local Resource Persons	S.M. Pathak, Ranchi K.M. Mavani, Rajkot S.N. Mishra, Cuttack
Field Supervisors	Mahendra Singh, Ranchi D.F. Mehta, Rajkot Nandita Mohanty, Cuttack

CONTENTS

TRANSPORT ALTERNATIVES FOR MEDIUM SIZED CITIES

EXECUTIVE SUMMARY

This study is aimed at presenting an overview of the transport situation in medium sized cities. The major objectives of the study are : (i) Assessing the overall demand and supply of urban transport; (ii) analysing the economic viability and suitability of various modes for cities having different spatial structures, densities and functions; and (iii) suggesting suitable forms of transport alternatives as well as ways of improving the functioning of the existing modes of transport.

The study was undertaken in three medium sized cities, namely, Ranchi, Rajkot and Cuttack. Ranchi is a new industrial city with a number of public sector industrial townships spread over a large area. Rajkot is an industrial and commercial city with a congested core and expanding peripheral areas. Cuttack is an old congested administrative and commercial city with not much possibility of spatial expansion as it is bound by rivers on the north and south.

The major findings of the study are summarised as follows :

1. The case study cities have three distinct modal mixes. Ranchi does not have any mass transportation facility and cyclerickshaws and autorickshaws are the predominant modes of intermediate public transport. Autorickshaws and buses in Rajkot and cyclerickshaws and buses in Cuttack are the major means of public transport.

2. Two-wheelers like scooter, motorcycle and moped are the most widely used personalised mode of transport.

3. The public transport systems prevailing in these medium cities is inadequate for meeting the existing demand for intra-city travel. The actual boarding on public transport is much higher than the available seating capacity indicating the gap between the supply and demand.

4. The demand for urban transport in these cities is projected to be almost double by the year 2011.

5. Mass transport meets only a small fraction of the total demand for urban transport in the selected cities. The share of Mass Transport System (MTS) in daily trips is zero in Ranchi, and it is 6.7 per cent in Rajkot and 1.6 per cent in Cuttack. IPT accounts for 10-20 per cent of the daily trips. Personalised modes of transport satisfy 40-60 per cent of the demand while walking and use of other modes, such as factory and school buses, take care of another 20-40 per cent of the demand for within the city travel.

6. Work and education trips account for over 60 per cent of the total daily trips while rest of the trips are made for shopping, recreation, social and medical purpose.

7. The household income determines the use of motorised and non-motorised mode as well as public and private means of urban transport irrespective of the city form and structure.

Majority of the low income group persons in the selected cities either walk, use cycles, or travel by bus. Two-wheelers and cars as well as cycle and auto rickshaws are popular modes of transport among the middle and high income groups.

8. Although high income households spend more money on transport in absolute terms, it is the low and lower middle income households who spend a larger proportion of their income on city transport. This suggests that urban transport is quite expensive for meeting the requirements of a large majority of the urban poor.

9. More than half of the respondents in Ranchi and Cuttack and over two-thirds of the respondents in Rajkot find public transport inadequate for meeting their requirements. The main reasons for their dissatisfaction with the existing supply and quality of public transport are : high cost, poor service, discomfort due to overboarding and slow speed.

10. According to the officials of the local government and traffic police department, the present state of urban transport and traffic flows in the medium cities is far from satisfactory. The major constraints in managing the transport situation efficiently are : too many vehicles on the roads, narrow streets, encroachment on streets and inadequate resources at the disposal of these authorities

for road works and repairs as well as for regulating traffic flows within the city.

Considering the current modal split and expressed demand for better public transport service in the case study cities, the study recommends that a mass transport system, which is compatible with the city's urban form and is environment friendly needs to be introduced in small cities. Accordingly, it recommends that a public bus service should be initiated in Ranchi and the existing bus services should be augmented in Rajkot and Cuttack. The initial target for the public bus service in these cities should be to meet the access demand for public transport. A total of 196 mini buses in Ranchi, 52 mini buses and 34 battery buses in Rajkot, and 36 mini buses and 36 battery buses in Cuttack will be required to meet the excess demand. The capital cost requirement of providing a bus service of this scale will be very high. Yet, the financial analysis suggests that this capital investment and spent costs can be fully recovered in eight years, with the present fares. With higher fares, the pay back period will be shorter. Therefore, private operators should be encouraged to provide the public bus service. A city level Urban Transport Authority should be set up to coordinate and regulate the operation of the public buses.

In addition, the supply of IPTs should be permitted to rise and match the increasing demand for public transport

Providing facilities for pedestrian and cycle travel is a must for all medium cities. These modes of travel are cost effective, do not require fuel and do not lead to air or noise pollution.

Finally, the study recommends adoption of other measures for improving the traffic and transportation systems in all medium cities, such as, road space management, enforcement of traffic regulations, and frequent pollution control checks.

CHAPTER I

INTRODUCTION

Urbanisation and the Demand for Urban Transport

Increased mobility of people and goods is a distinct characteristic of urban life. As cities grow, certain activities tend to concentrate at specific locations. Most city development plans strengthen these processes of concentration of activities over space, by specific zoning of industrial and commercial areas. Residential location behaviour in urban areas is influenced by location of work places as well as availability of affordable housing.

The net result of these processes is increasing segregation of activities in the urban space. Expansion of economic activities and corresponding residential developments further exacerbate the demand for urban transport.

At 25.72 per cent level of urbanisation in 1991, India is less urbanised than some of the developing countries of Asia and Africa such as Pakistan (32%), China (53%), Nigeria (35%) and Zambia (59%). However, in absolute terms India's urban population ranks second after that of China. India's urban population has increased rapidly after the Independence. According to the 1991 census, the urban population of India was 217 million. By the year 2001, India's urban population is expected to cross the 300 million mark.

The size-class distribution of urban population suggests high concentration of urban population, particularly in large

cities. Cities with population of 100,000 and above account for about 8 per cent of the total urban centres and about 65 per cent of the urban population of the country (Table 1.1).

The demand for urban transport is expected to grow in proportion to the increase in population size. This hypothesis comes true in the case of many cities of developing countries like, Lagos, Tunis, Abidjan, Singapore, Cararaces, Punson, Bogota, Hongkong, Bangkok, Buenos Aires, and Sao Paulo, where the demand for urban transport has increased more or less in the same proportion as increase in population[1] . In the context of the Indian cities, the experience of metropolitan cities indicates that the demand for transport is more than the growth of population. Such a trend suggests that there has been a general increase in intra-city mobility of people in Urban India. In addition, trip lengths have also increased as cities have expanded in area. Analysis has shown that trip length increases roughly in proportion to the square root of the radius of the city. If the population density remains the same, the growth in city population from 1 million to 2, 4 or 8 million leads to an increase of 20, 45 or 65 per cent respectively in the average trip length.[2]

---

1. The World Bank (1986) : A World Bank Policy Study on Urban Transport, Washington D.C., pp 4-5.

2. Government of India (1988): Report of the National Commission on Urbanisation, Vol.II, p. 273.

Table 1.1

Number and Population of Urban Centres by Size Class, 1981 and 1991

Class/Population		1981		1991	
		Number	Population	Number	Population
I	1,000,000+	12 (0.36)	42121700 (26.71)	23 (0.62)	70661259 (32.81)
I	500,000-1,000,000	30 (0.91)	19832474 (12.58)	30 (0.81)	20936734 (9.72
I	100,000-500,000	176 (5.33)	33378934 (21.17)	247 (6.68)	48132057 (22.35)
II	50,000-100,000	270 (8.18)	18189728 (11.54)	345 (9.33)	23597111 (10.96)
III	20,000-50,000	743 (22.51)	22557147 (14.31)	947 (25.62)	28711989 (13.33)
IV	10,000-20,000	1059 (32.08)	15006860 (9.52)	1167 (31.57)	16997876 (7.89)
V	5,000-10,000	758 (22.96)	5740603 (3.64)	740 (20.02)	5643807 (2.62)
VI	BELOW 5,000	253 (7.66)	852725 (0.54)	197 (5.33)	657392 (0.31)
Total		3301 (100.00)	157680171 (100.00)	3696 (100.00)	215338225 (100.00)

Source: 1. NIUA (1988):State of India's Urbanisation, New Delhi.
2. Census of India (1991): Provisional Population Tables: Rural Urban Distribution, Paper 2 of 1991.

Note : 1. 1991 figures exclude Jammu & Kashmir State, and 1981 figures exclude Assam.
2. Each urban agglomeration has been counted as one urban centre.
3. Percentages are given in the parentheses.

Unprecedented growth of urban centres, in population as well as in geographical area accompanied by higher levels of industrial and commercial activities in India has led to a substantial increase in the demand for urban transport. In the absence of proper transport planning most of the public transport systems even in the metropolitan cities, fail to meet the increasing demand for urban transport. Consequently, the number of private vehicles increases manifold leading to congestion on roads. The spreading congestion on roads not only makes the movement of people and goods very difficult but also results in :

(i) Low speed and consequent wastage of time, fuel and other scarce resources;

(ii) decline in productivity and efficiency of cities;

(iii) road accidents; and

(iv) high levels of noise and air pollution.

Urban Transport Scenario

In India, the availability of motorised vehicles has increased sharply in the last three decades. The number of vehicles per 1000 urban population was 6 in 1960-61 and by 1989-90 it increased ten times, i.e. 68 per 1000 urban population. Two-wheelers are fast becoming the most popular motorised mode of transport. As may be seen from table 1.2, the proportion of two wheelers increased from about 18 per cent in 1960-61 to as much as 69.40 per cent in 1989-90. The proportion of cars, jeeps, taxis and buses has recorded a sharp decline during the aforesaid period.

Table 1.2

Composition of Motor Vehicles in India

(in '000 number)

Year	Two-wheelers		Cars, Jeeps & Taxies		Buses		Others		Total	Number of vehicles per 1000 population
	No.	% share	No.	% share	No.	% share	No.	% share		
1960-61	88	17.71	310	62.37	57	11.47	42	8.45	497	6
1970-71	576	37.84	682	44.81	94	6.18	170	11.17	1522	14
1980-81	2528	54.41	1117	24.04	154	3.31	847	18.23	4646	29
1989-90*	10823	69.40	2391	15.33	293	1.88	2086	13.38	15593	68

Source: Derived from Central Institute of Road Transport (1991): Performance Statistics of STUs 1988-89 and 1989-90 & Review of Performance 1989-90, Pune, p.153.

Note : * Provisional Figures.

Another interesting feature regarding transport in India is wide ranging regional variations in accessibility to transport services. Considering a few key mobility parameters for different states, Chandigarh and Delhi appear on the top while states like Assam, Bihar and Orissa are placed at the lowest level of passenger mobility. As is seen in Table 1.3, the road length per lakh population is the highest in Arunachal Pradesh (915.59), and the lowest in West Bengal (93.14). The maximum number of auto-vehicles per lakh population was recorded in Chandigarh (24175) followed by Delhi (12878). In comparison, Bihar registered very few auto-vehicles per lakh population (503). The maximum number of buses per lakh population was registered in Delhi (182) and Chandigarh (108) while Orissa recorded only 9 buses per lakh population.

Table 1.3

State Level Mobility Parameters

Name of the State/U.T.	Area in sq.kms.	Population in lakhs (1987)	Road length (in kms.) as on 31.3.87	Auto vehicles (Nos.) as on 31.3.87	Passenger buses (Nos.)as on 31.3.87	Road length per lakh of pop.	Auto vehicles per lakh population	Buses per lakh of pop.
Andhra Pradesh	276814	606.60	135218	732705	16496	222.91	1208	27
Assam	78523	239.37	63510	141171	3864	265.32	590	16
Bihar	173876	795.72	84536	400131	11941	106.24	503	15
Gujarat	195984	394.68	74348	1061599	20875	188.38	2690	53
Haryana	44222	150.67	25397	278378	3977	168.56	1848	26
Himachal Pradesh	55673	48.64	22192	46301	3495	456.25	952	72
Jammu & Kashmir	222236	69.97	13091	64388	5091	187.09	920	73
Karnataka	191773	428.12	126371	789791	19997	295.18	1845	47
Kerala	38864	282.88	120558	296988	16733	426.18	1050	59
Madhya Pradesh	442841	597.31	122568	577247	16716	205.20	966	28
Manipur	22356	16.82	6474	25817	1627	384.90	1535	97
Maharashtra	307762	716.21	203712	1698222	25579	284.33	2371	36
Meghalaya	22489	15.78	6183	16727	802	391.83	1060	51
Nagaland	16527	9.89	7716	NA	NA	780.18	NA	NA
Orissa	155782	294.43	173362	149320	2518	588.81	507	9
Punjab	50362	190.92	49798	748913	5961	260.83	3923	31
Rajasthan	342214	406.51	96901	417813	10436	238.37	1028	26
Sikkim	7299	4.04	1514	NA	NA	374.75	NA	NA
Tamil Nadu	130069	533.26	160115	671817	22452	300.26	1260	42
Tripura	10477	24.24	11008	(Included in Manipur)		454.13	--	--
Uttar Pradesh	294413	1270.44	177797	1022523	22659	139.95	805	18
West Bengal	87853	618.52	57606	580941	17311	93.14	939	28
Andaman & Nicobar Island	8293	2.55	681	3075	111	267.06	1206	44
Arunachal Pradesh	3578	7.57	6931	NA	NA	915.59	NA	NA
Chandigarh	114	6.34	1374	153268	687	216.72	24175	108
Dadra & Nagar Haveli	491	1.28	315	NA	NA	238.28	NA	NA
Delhi	1485	80.27	19033	1033678	14582	237.11	12878	182
Goa Daman & Diu	3813	12.53	6307	83382	1408	503.35	6655	112
Mizoram	21087	6.27	3258	NA	NA	519.62	NA	NA
Pondicherry	480	7.00	2643	47844	800	377.57	6835	114

Source: Central Institute of Road Transport (1991): Performance Statistics of STUs 1988-89 and 1989-90 & Review of Performance 1989-90, Pune, p.155.

Public transport in India, as in many developing countries, comprises more than the conventional buses and trains, popularly known as mass transit system (MTS). It consists of various forms of intermediate public transport (IPT), such as mini buses, shared taxis, auto rickshaws and cycle rickshaws. Intermediate public transport can be classified into two types: (1) modes operating on fixed routes providing bus like service at low fares, and (ii) modes providing door to door taxi like service at relatively high fares.

Irrespective of the bias against IPT, it has been growing in importance as it performs three crucial functions:

i. Provides mobility in areas where narrow streets make it impossible to operate conventional bus service;

ii. acts as a feeder service to the conventional bus service; and

iii. adds to the service in area where low demand does not warrant any kind of MTS.

Given the international standards, the provision of conventional stage carriage buses is very low in India, i.e. between 0.17-0.35 buses per 1000 population. It is surprising to note that the provision of buses, even in the largest cities of India is less than half that recorded in U.K. (0.77 bus per 1000 population)[3]. In medium sized cities mass public transport system plays a less important role, serving 20-33 per cent of total trips required.[4] The users of these growing cities have to

---

3. Maunder, David. et al, (1987): "Matching Supply and Demand in India's Public Transport," Transport, December 1987, pp.241-243.

4. Maunder, Ibid.

depend on intermediate public transport as well as on private motorised and non-motorised vehicles.

The importance of the role of IPT has often been underestimated and they are regarded as the main cause of congestion, pollution and accidents. However, since the revenues of most of the public bus transport bodies are far below even the operating costs, buses cannot be maintained properly nor can fleets be expanded fast enough to meet the increasing demand for urban transport. These transport bodies have to mainly depend on government loans and subsidies. It is becoming increasing clear that the limited revenue base of the Government cannot support a continuously losing transport system. This calls for an indepth analysis of the economic viability of various modes of urban transport and their suitability for cities of varying sizes, forms and functions.

It is quite obvious that the cities in the developing countries require an integrated policy perspective which could suggest a correct mix of transport modes to ensure efficiency and cost effectiveness.[5] Both MTS and IPT, therefore, need to be examined carefully in order to determine the correct mix of modes for cities in question. This is also imperative as the inadequacy, or non-existence, of conventional public transport system has led to the proliferation of personalised private modes, which is adding to the congestion, accidents and other traffic problems.

---

5. The World Bank (1986): Op.cit.

Review of Literature

The available literature on the transport situation in medium-sized cities can be put in four broad groups, namely, public transport systems, travel demand and characteristics, traffic and transportation flow studies and energy and environmental considerations associated with urban transport. The following review of selected studies in each of these categories reveals that these studies cover a range of issues.

Public Transportation System

Studies falling in this category largely focus on the supply and management of public transport. Srinivasan and Chand have attempted to develop a rational routing and scheduling pattern for increasing economic returns to bus transportation.[6] Attempts are also being made to explore alternative systems of transport to meet the requirements of cities of different types.[7] Several studies of the TRRL analyse the supply of different types of public transport in terms of operational costs, quality of service, energy consumption and employment implications.[8] Baboo Balgobind and others have looked at the urban transport system

---

6. Srinivasan, N.S., and Mahesh Chand (n.a.) : Optimisation of Bus Transport in Medium Sized Cities, NATPAC, Trivandrum.

7. Government of India (1987) : Report of the Study Group on Alternative Systems of Urban Transport, New Delhi.

8. Patankar, P.G. and P.R. Fouracre (1986) : "Public Transport in Second Order Cities in India," Urban India, Vol. VI, Nos. 1 & 2; Fouracre, P.R. (1984) : Public Transport Survey in Vadodara : Supply Characteristics, Working Paper No. 172, TRRL; and Fouracre, P.R. and D.A.C. Maunder (1981) : Public Transport Supply in Indian Cities, Laboratory Report 1058, TRRL.

from the point of view of drivers in a sociological study of drivers of the urban informal transit system.9

Travel Demand and Characteristics

Studies of this type attempt to assess the total transportation demand of urban areas at macro-level and analyse the demand side of urban transport by looking at the prevailing patterns of trip-rate, trip-length and the modal-split at the household-level. Maunder and Fouracre have analysed the demand for public transport in Indian cities by looking at the travel patterns and socio-economic characteristics of the passengers.10 Srinivasan focuses on the factors influencing the performance of trip-makers and travel demand by different socio-economic groups.11 Kundu examines the travel patterns of the urban poor in selected cities in India.12 Maunder analyses the trip-rate and travel patterns in relation to the socio-economic conditions of the households.13 Another study by the CRRI examines the

---

9. Baboo Balgovind, Anil Singha and Suresh Ahuja (1986): "The Urban Informal Transit System : A Comparative Sociological Study", Urban India, Vol. VI, Nos. 1 & 2.

10. Maunder, D.A.C. and P.R. Fouracre (1981) : Characteristics of Public Transport Demand in Indian Cities, Supplementary Report 709, TRRL.

11. Srinivasan, N.S. (n.a.) : Socio-economic and Travel Characteristics in Medium-sized cities, NATPAC, Trivandrum.

12. Kundu, A. (1986) : "Urban Poverty, Transport and Inter-modal Choice", Urban India, Vol. VI, Nos. 1 & 2.

13. Maunder, D.A.C. (1985) : Household and Travel Characteristics in Patna, Working Paper No. 199, TRRL; and Maunder, D.A.C. (1984) : Household and Travel Characteristics in Vadodara, Working Paper No. 171, TRRL.

travel characteristics of different groups in the context of traffic problems in cities of various sizes.[14]

Traffic and Transportation Flow Studies

The central theme of the studies falling in this category is to study traffic and transportation flows from the point of view of suggesting appropriate measures for traffic management. The CRRI has carried out traffic flow studies on selected corridors in fourteen cities of India.[15]

A study undertaken in four cities of Tamil Nadu assesses the transportation and traffic problems in the light of physical planning and developmental perspective of the city.[16] The National Transportation Planning and Research Centre has prepared a structural plan for traffic engineering in the selected areas of Rajkot city.[17] Srinivasan and others have prepared a traffic management plan including parking, road network, route plan exclusively for the central area of Trivandrum city.[18] Similar

---

14. CRRI (1988) : Mobility Levels and Transport Problems of Various Population Groups, New Delhi.

15. CRRI (1986)) : Traffic and Transportation Flows for Selected Cities in India, New Delhi.

16. Kirloskar Consultants Ltd. (1986): Report on the Traffic and Transportation Study for Coimbatore, Madurai, Trichy and Salam, Pune.

17. National Transportation Planning and Research Centre (1985): Road Network and Traffic Management Proposals for Rajkot, Trivandrum.

18. Srinivasan, N.S. and Arun Herur (1982) : Traffic Management Plan for the Central Area of Trivandrum, NATPAC, Trivandrum.

studies of the NATPAC have suggested scientific traffic circulation and management plans for other cities in India.19

Energy and Environment Related Considerations

This is one aspect of urban transport which has not been explored widely. A study by CIRT tries to find optimum transport mix keeping in view both energy consumption and congestion caused by rapid increase in the number of private vehicles.20 The study by TERI also analyses the energy requirement of various modes in the context of inadequacy of public transport and increase in personalised vehicles.21 The NATPAC study focuses on environmental issues associated with urban traffic and transportation flows and also suggests schemes for improvement.22

As is evident from the above review of literature, the existing database on various modes of urban transport is limited. Although some surveys have been carried out in metropolitan cities, there have been very few comprehensive surveys of cities in the size group 100,000 to 1,000,000. The coverage of such surveys focusing on selected aspects of transport in medium sized cities include the Central Road Research Institute's traffic flow

---

19. Sanyal, D. and Jaidev (n.a.) : Planning of Traffic System and Mass Transport System for Faridabad City, NATPAC, Trivandrum; and Sanyal, D. Jaidev and Imtiyaz Ahmed (n.a.) : Traffic Management Schemes for a Few Important Areas in Jammu, NATPAC, Trivandrum.

20. CIRT (1988) : Report on Energy Implications in Urban Transport, Pune.

21. TERI (1989) : Urbanisation and Energy in the Third World : A Study of India, New Delhi.

22. Srinivasan, N.S., T. Elangovan and K. Srinath (n.a.) : Environmental Planning of Traffic Problem Areas in Cities, NATPAC, Trivandrum.

surveys in nine medium sized cities, namely Chandigarh, Coimbatore, Cuttack, Guwahati, Indore, Ludhiana, Mangalore, Moradabad and Varanasi and comprehensive surveys in two medium sized cities, namely, Madurai and Cochin; comprehensive transport study of Patna and Vadodara undertaken by the Transport and Road Research Laboratory (TRRL) in collaboration with the Association of State Road Transport Undertakings (ASRTU); and studies on intermediate public transport carried out by the School of Planning and Architecture, New Delhi, in three cities, namely Faridabad, Meerut and Agra.

There is, therefore, only a scant database for planners and policymakers to make detailed recommendations for medium sized cities. The need for more comprehensive studies on the transport situation in these cities is imminent if an attempt has to be made for preventing the urban system from reaching a state of total chaos. The existing transport situation in metropolitan cities- traffic jams, accidents, long queues, overcrowding, high levels of noise and air pollution- presents a lesson to be learned. Safe, convenient and efficient transport system is essential for growing medium sized cities if we want these cities to be livable and economically efficient.

The Objective and Scope of the Study

The study is aimed at presenting an overview of the transport situation in medium sized cities including demand, supply, organisation, management and coordination between public and private agencies.

The main thrust of the present study is to suggest an optimum transport mix for medium sized cities keeping in view the congestion and energy consumption caused by a substantial increase in the number of private vehicles. The major objectives of the study undertaken in three medium sized cities are as follows :

i) Assessing the overall demand and supply of urban transport;

ii) analysing the economic viability of various modes of transport prevalent in the sample cities and their suitability for cities having different spatial structures, densities and functions; and

iii) suggesting viable and efficient forms of transport alternatives, as well as ways of improving the functioning of the existing modes of transport.

Methodology

The first step in undertaking this study was identification of case-study cities with different physical and economic structures. A number of cities in the population range of 300,000 to 700,000 were examined to select Ranchi, Rajkot and Cuttack. Rajkot is an industrial and commercial city with a congested core and expanding peripheral areas. Ranchi is a new industrial city with a number of public sector industrial townships spread over a large area. Cuttack is an old congested administrative and commercial city with not much possibility of spatial expansion as it is bound by rivers on the north and south.

The study is based on primary as well as secondary data. The secondary data were collected from Census Publications, Master Plans of the respective cities, and from various

government offices. The primary data used in this study were collected by canvassing three types of questionnaires, namely, Passenger Travel Survey, Drivers' Survey and Transporter's Associations/Unions Survey. All the three surveys were conducted in the selected cities in 1991.

Passenger Travel Survey

This survey was aimed at collecting information on demand side of urban transport. This includes the socio-economic characteristics of households, travel behaviour, cost of travel, assessment of the quality of public transport and potential of shifting to mass public transport in case people are currently using intermediate modes of transport. The size of the sample for this survey was 300 households (1250 sample population) in Cuttack, 400 households (1641 sample population) in Rajkot and 500 households (2334 sample population) in Ranchi, which is roughly 100 households per lakh of 1981 population of the respective cities. We are well aware of the popular methodology of traffic zones used for conducting traffic flow studies. Such traffic zones are useful particularly to estimate the origin-destination trip matrix, which are required to design a mass system. Given the focus of the study on assessing overall demand for urban transport, it was deemed sufficient to identify the sample households according to the income and location in the city. An attempt was made to cover high, middle and low income groups, both in the core city as well as in the peripheral areas. This method of distributing the sample households was considered

more suitable for assessing the pattern of demand and travel behaviour of people belonging to different income groups and residing in different sections of the selected cities.

Drivers' Survey

This survey focused on various aspects pertaining to the supply of intermediate modes of transport such as autorickshaws, and cyclerickshaws. This survey was designed to collect data on the operational aspects like vehicle ownership, source of financing of the vehicle, running cost, fare structure and net monetary returns.

A total of 50 drivers of motorised modes of transport and 50 drivers of non-motorised modes of transport were supposed to be covered by this survey in all the three case study cities. However, eventually the distribution of the total sample across three cities was determined according to the modes predominant in each city. Accordingly, a total of 43 autorickshaw drivers and 48 cyclerickshaw drivers were interviewed in the three case study cities (Table 1.4).

Table 1.4

Sample for the Survey of IPT Drivers

Cities	Auto-Rickshaw	Cycle-Rickshaw	Total sample
Ranchi	18	26	44
Rajkot	20	N.A.	20
Cuttack	5	22	27
Total	43	48	91

Transporters' Associations/Unions Survey

This survey was also aimed at understanding the supply side of urban transport. It focused on the institutional arrangements and organisational structure of various intermediate modes of transport, the nature of relationship between the transport operators and the city transit authority and the local government, and ways by which these associations/unions can be called upon to participate more effectively in improving the transport situation in the medium sized cities. One office bearer of each association/union of intermediate modes of transport in each city was interviewed for this purpose.

City Profiles

Ranchi

Ranchi Urban Agglomeration (614,454 population in 1991) is the district as well as divisional headquarter situated in the Chhotanagpur region of Bihar State. The city experienced very high population growth rate (88.6%) during the decade 1971-81 as compared to the decade 1981-91 when the population growth rate was as low as 22.2 per cent. In 1981, Ranchi had an area of 182.09 square kilometres and population density of 2761 persons per square kilometre.

Ranchi is a rectangular city with development extending along the roads in all directions. Planned developments have also taken place in the north and the south of the city with large townships of public sector industries.

The character of the city in 1981 was multi-functional and service, industry and trade and commerce were the predominant economic activities. Owing to its close proximity to coal and iron mines and establishment of many public sector heavy industries has facilitated the course of city's growth (Tables-1.5 to 1.7).

Main modes of public transport within the city are cycle-rickshaw and auto-rickshaw.

Table 1.5

Area and Population

Cities	Population			Population Growth Rate (Decadal)		Area (sq.km.)		Density/sq.km.	
	1971	1981	1991	1971-81	1981-91	1971	1981	1971	1981
Ranchi (Bihar)	255,551	502,771	614,454	88.6	22.2	89.98	182.09	2840	2761
Rajkot (Gujarat)	300,612	445,076	651,007	48.1	46.3	60.15	69.00	4998	6450
Cuttack (Orissa)	205,759	327,412	439,273	42.3	34.2	73.32	109.95	2806	2978

Source : Census of India, 1971, 1981 and Provisional Results of 1991.

Table 1.6

Work Participation Rate

Cities	Percentage of Workers to Total Population					
	1981			1991		
	Main	Marginal	Main + marginal	Main	Marginal	Main + marginal
Ranchi	26.1 (131,063)	0.3 (1,644)	26.4 (132,707)	24.7 (151,879)	0.4 (2,255)	25.1 (154,134)
Rajkot	27.2 (121,442)	0.3 (1,452)	27.5 (122,894)	29.7 (193,317)	0.6 (4,004)	30.3 (197,321)
Cuttack	30.4 (99,520)	0.4 (1,437)	30.8 (100,957)	30.1 (132,113)	0.4 (1,791)	30.5 (133,904)

Source : Census of India, 1971, 1981 and Provisional Results of 1991.
Note : Number of Workers is given in parentheses.

Table 1.7

Functional Characteristics

Cities	Predominant Economic Activity 1971	Economic Activity 1981
Ranchi	Industry and Service	Industry, Service and Trade & Commerce
Rajkot	Service and Industry	Industry, Service and Trade & Commerce
Cuttack	Service and Trade & Commerce	Service and Industry

Source : Census of India, 1971 and 1981.

Note : Monofunctional - If any one sector employs more than 40% workers.
Bifunctional - If any two sector together employ more than 60% workers.
Multifunctional - If any two sectors together do not account for 60% or more workers.

Rajkot

Rajkot Urban Agglomeration (651,007 population in 1991) is situated in the south western part of Gujarat state. Presently, it is the district headquarter. It became an urban agglomeration in 1991 Census. The city is growing at a consistently high growth rate. During 1971-81 and 1981-91, its population growth rates were 48.1 per cent and 46.3 per cent, respectively. In 1981, Rajkot had an area of 69.0 square kilometres and a density of 6450 persons per square kilometre.

Rajkot city has the traditional urban form with walled area in the centre and rest of the city growing around it with the passage of time. The Walled area in Rajkot is the business centre. In the rest of the city, residential, recreational, educational and industrial areas are clearly marked out. The city does not have much of mixed landuse as is observed in the case of Ranchi and Cuttack cities.

The character of the city in 1981 was bifunctional, transport and industry being the predominant functions. However, it is becoming increasingly more industrialised.

Within the city only two types of public transport modes operate, namely, buses run by the state government and auto-rickshaws. In the walled area autorickshaws are the only means of public transport. Cyclerickshaw has never existed in the Rajkot city.

Cuttack

Cuttack Urban Agglomeration (population of 439,273 in 1991) is a thousand years old city. It was the capital of Orissa until first half of the century. The capital was shifted to Bhubaneswar in 1951-52.

In 1981, area of Cuttack was 109.95 sq. km. and population density of 2978 persons per sq. km. It experienced population growth rate of 42.3 per cent and 34.2 per cent during the decades 1971-81 and 1981-91, respectively.

The growth of the city has been restricted on the three sides by the two rivers. The city is like a delta with water on its three sides. In can expand only in the south-east direction. Like Ranchi, this city also has mixed land use but unlike Ranchi and Rajkot, it has restrictions on physical expansion with the growth in population due to its geographical setting. Economic character of Cuttack in 1981 was bifunctional with service and industry being the predominant activities. Main modes of public transport are cyclerickshaw and bus. The city also has a few autorickshaws.

Organisation of the Report

The second chapter deals with the status of urban transport in the case study cities in terms of the supply and demand and institutional arrangement for provision and management of the city transport. The third chapter focuses on the household characteristics and passenger travel pattern of the sample population. The fourth chapter analyses the viability of various

modes from the point of view of the users, transport suppliers and the regulating and managing authorities. The last chapter suggests various measures for dealing with the transport problems specific to three different types of medium sized cities.

CHAPTER - II

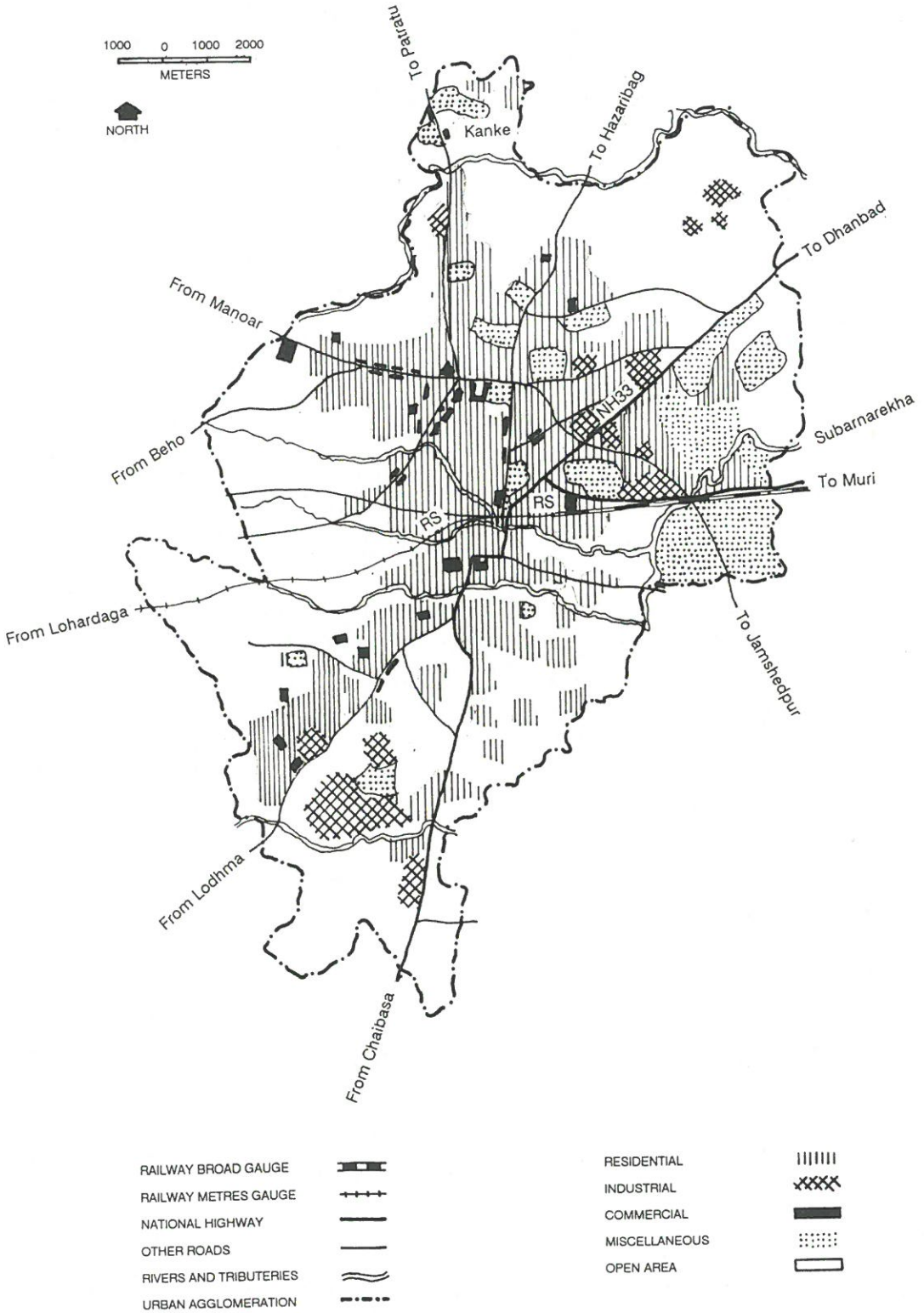
THE STATUS OF URBAN TRANSPORT IN THE CASE STUDY CITIES

Urban Form and Road Network

Ranchi is a rectangular polycentric city with a busy Central Business District (CBD) and commercial development along all major roads and townships like Doranda, Jagannathnagar, Kanke and other nearly self-sufficient industrial complexes such as Heavy Engineering Corporation and Hindustan Steels Limited. The main road in the middle of the city forms the major north-south communication artery. In the southern half of the city, this road becomes the Ranchi-Chaibasa state highway and in the northern side it joins the Ranchi - Hazaribagh national highway. All the highways and major roads of the city touch the main road at some point, which takes the bulk of the load of the city and regional traffic. Consequently, the traffic flow on this road is very slow particularly during the peak hours (map 2.1). The width of the main road and roads in other planned areas of the city is 10 to 25 metres and the width of other major roads is 5 to 10 metres. The condition of roads in Ranchi is very poor, except the roads within the industrial complexes with are better maintained. Some of the newly developing areas do not even have pucca roads.

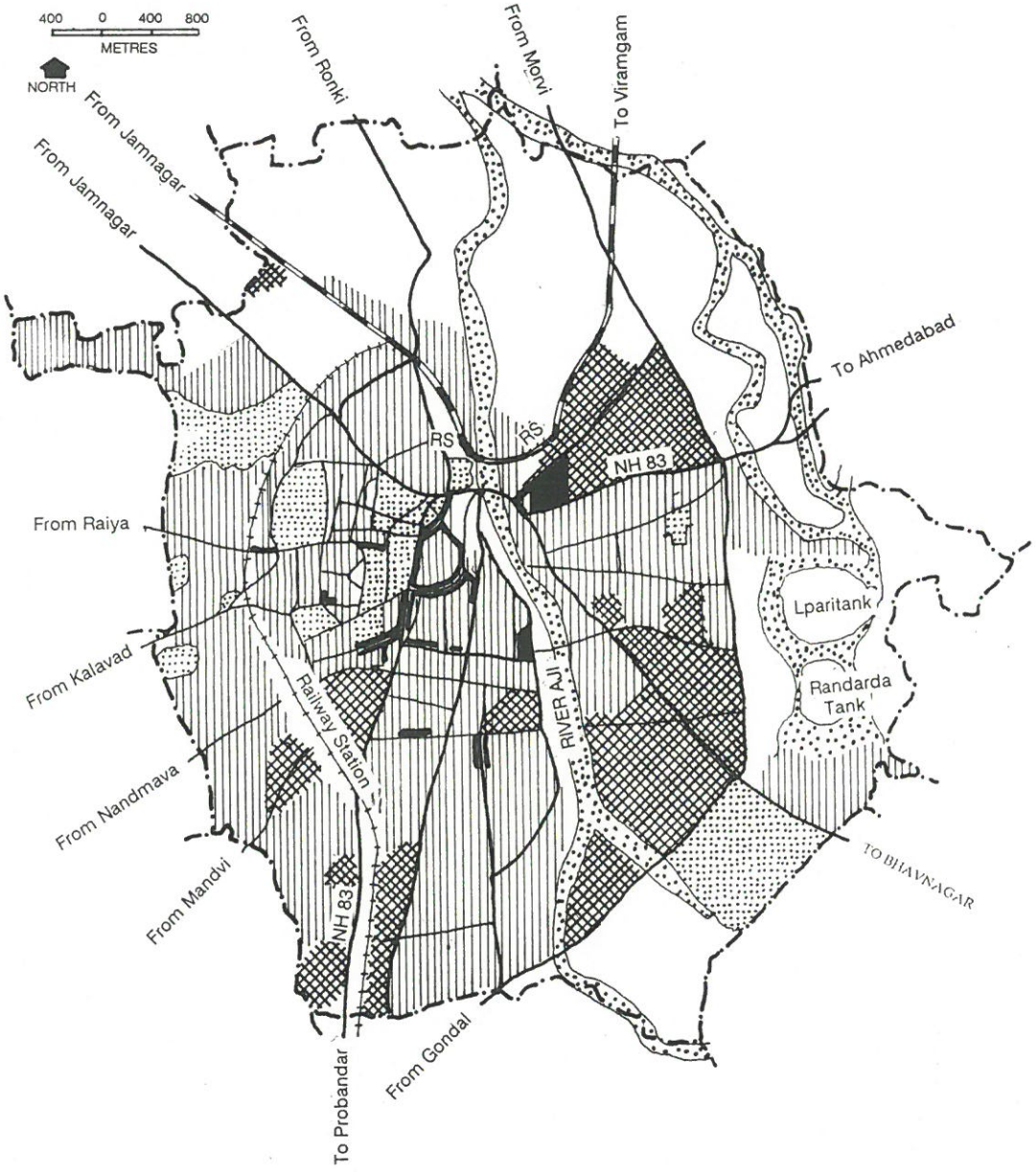
Rajkot is a circular mono-nuclear city with newly developing areas all around the Walled inner city. Major concentration of commercial activity is in the CBD while industrial activity is located in the peripheral areas of the city, particularly in the eastern side of River Aji. The national highway connecting Rajkot

RANCHI U.A.
LAND USE



MAP NO. 2.1

RAJKOT
LAND USE

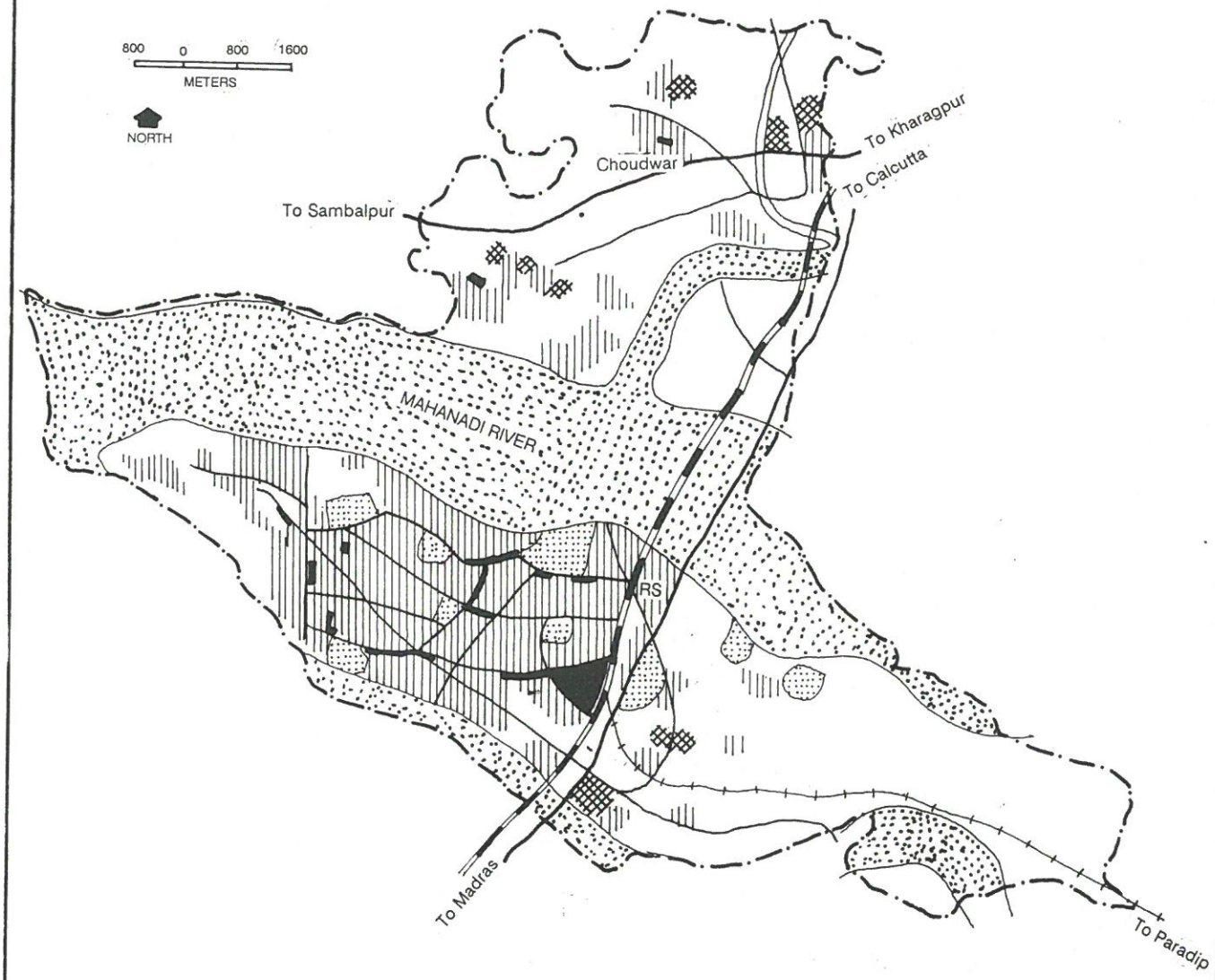


RAILWAY BROAD GAUGE
RAILWAY METRES GAUGE
NATIONAL HIGHWAY
OTHER ROADS
RIVERS AND TRIBUTERIES
URBAN AGGLOMERATION

RESIDENTIAL
INDUSTRIAL
COMMERCIAL
MISCELLANEOUS
OPEN AREA

MAP NO. 2.2

CUTTACK U.A.
LAND USE



RAILWAY BROAD GAUGE
RAILWAY METRES GAUGE
NATIONAL HIGHWAY
OTHER ROADS
RIVERS AND TRIBUTERIES
URBAN AGGLOMERATION

RESIDENTIAL
INDUSTRIAL
COMMERCIAL
MISCELLANEOUS
OPEN AREA

MAP NO. 2.3

with Ahmedabad in the north-east and Porbundur in the south-west passes through the city. State highways connect Rajkot with Morvi, Jamnagar, Kalavad and Bhavnagar. All the highways form the main arterial network and divide the city into various sectors. There are only two bridges on river Aji which connect the more developed western part with the newly developing eastern part of the city. All the highways converge at the bridge located in the centre of the city (Map 2.2). The width of the roads in the walled inner city is 4 to 6 metres and in the rest of the city it is 10 to 20 metres. Although the roads in the inner city are narrow, they are in good condition.

Cuttack is a linear city with one satellite town of Choudwar across the river Mahanadi. Cuttack is like an island between Mahanadi river in the north and Katjuri river in the south. There are only two bridges, one on each river, which connect the city with the mainland. Because of the physical restriction the city has the possibility of further expanding only in the south - east where there is still a sizeable part of undeveloped land. There is only one highway which passes through the city and connects it to Calcutta in the north-east and Bhubaneswar-Madras in the south-west (Map 2.3). There is a ring road which has been built along the two rivers and width of this road is 12 to 15 meters. The rest of the city is unplanned, congested with narrow streets of 5 to 12 metre width. At places, the drains appear to be wider than the roads. It is interesting to note that at the time of the survey in 1991 Cuttack had open sunface drains measuring 521 km. as against paved streets measuring 321 kms. Of the drains, 15 km. long main

storm water channel is 30 feet wide and 29.5 km. long branch storm water channels are 10-15 feet wide while considerable proportion of roads in the city are 10-14 feet wide. Except the ring road and the national highway, all the city roads are in bad condition.

All the three cities with the different form and layout have varying road length in relation to the population and area. Rajkot with the highest population density has the best road network amongst the three case study cities. On the other hand, Ranchi with the largest urban area does not seem to be well provided for as far as the length of the city roads is concerned. The road length per 1000 population in Rajkot is 0.80 km., in Cuttack 0.60 km. and in Ranchi it is 0.26 km. The road length per 100 sq.km. of area is 517.39 km. in Rajkot, 180 km. in Cuttack and 72.53 km. in Ranchi (Table - 2.1).

Table 2.1

Mobility Indicators for Road Traffic in Case Study Cities

Cities	Population 1981	Area (sq. km.) 1981	Pucca roads (km.)	Road length in km per	
				1000 population	100 sq.km. area
Ranchi	502771	182.09	132	0.26	72.53
Rajkot	445076	69.00	357	0.80	517.39
Cuttack	327412	109.95	198	0.60	180.00

Source: Census of India, 1981.

Supply of Public Transport

The two modes of public transport prevalent in Ranchi are auto-rickshaws and cycle-rickshaws. This city with the largest urban spread does not have a fast moving mass transit service like bus, run by public or private agencies. However, some passengers use the inter-city bus service for traveling between the city bus stand and the peripheral areas within the city. According to estimates provided by the auto-rickshaw association and the Municipal Corporation of Ranchi, there were 7000 auto-rickshaws and 9000 cycle-rickshaws plying in the city in 1990-91. The auto-rickshaws, however, also provide a bus like service on fixed routes, particularly on the main road. On an average six passengers share an auto-rickshaw and pay a fixed rate per seat. The fare goes up if the number of passengers is reduced on demand. Cycle-rickshaws provide personalised service, particularly between the auto-rickshaw stand and residential areas. Beside providing the feeder service, cycle-rickshaws are also available for door to door taxi like service for relatively short distance journeys (Table 2.2).

The major modes of public transport in Rajkot are auto-rickshaws and buses. In 1990-91, there were about 9000 auto-rickshaws, 57 buses and 131 taxis in the city. Auto-rickshaws are largely used as personalised door to door service, and a few of them also operate as shared mode if passengers are willing. Auto-rickshaw is the only means of public transport available within the Walled City. Taxis provide services to passengers at selected spots like the railway station and airport.

Table 2.2

Estimated Supply of Public Transport, 1990-91

Sl. no.	Cities	Number of public transport vehicles			
		Auto-rickshaw (a)	Cycle-rickshaw (b)	Taxi (c)	Bus (d)
1.	Ranchi	7000	9000	N.A.	-
2.	Rajkot	9000	-	131	57
3.	Cuttack	31	8000	N.A.	35

Note: N.A. means data not available.
- means zero

Source: 1(a) - Auto-rickshaw Association.
1(b) - Licence Officer, Ranchi Municipal Corporation.
2(a) & 2(c) - RTO, Rajkot
2(d) - Deputy Manager, State Transport City Depot.
3(a) - Union leader, Cuttack Auto-rickshaw Association.
3(b) - Additional Executive Officer, Cuttack Municipality.
3(d) - Planning Member, Cuttack Development Authority.

The predominant mode of public transport in Cuttack is cycle-rickshaw. A part of the demand is also met by buses and auto-rickshaws. The estimated number of cycle-rickshaws in 1990-91 was 8000. In addition, 35 buses and 31 auto-rickshaws were also plying in the city. The buses are available on selected routes, particularly on the ring road and on the main arterial streets within the city. The cycle-rickshaws ply everywhere in the city. In fact, the narrow streets of Cuttack with hardly any right of way along the streets are not suited for any form of mass public transport. The city bus was planned as ring-bus service and rickshaws as feeder service in order to reduce the through traffic and congestion within the city. This plan has not met with a great deal of success as the longer journey time and transfer from one mode to another is not found to be convenient by many people. They

prefer to take a cycle-rickshaw from the origin to destination even if it costs more than traveling a part of the distance by bus.

It is not easy to assess the level of public transport supply in the three case study cities as different modes are operating in each city which are not strictly comparable in terms of seating capacity, travel time and cost incurred by the operators and the users. Considering the supply of public transport per 1000 population, Ranchi appears to have the lowest supply of public transport. The number of auto-rickshaws per 1000 population recorded in Ranchi is 11.4 which is lower than 13.8 auto-rickshaws per 1000 population in Rajkot. The number of cycle-rickshaws per thousand population in Ranchi is 14.6 which is comparatively lower than 18.2 prevailing in Cuttack. The provision of buses at 0.1 per thousand population is comparable in Rajkot and Cuttack (Table 2.3).

Table 2.3

Indicators of Supply of Public Transport, 1990-91

Cities	No. of auto rickshaws per 1000 population	No.of cycle rickshaws per 1000 population	No.of taxi per 1000 population	No.of buses per 1000 population
Ranchi	11.4	14.6	N.A.	-
Rajkot	13.8	-	0.2	0.1
Cuttack	0.1	18.2	N.A.	0.1

The exact data on increase in the number of various modes of public transport is not available for the selected cities. However, the registration records of the three Regional Transport Authorities concerned indicate that the registration of motorised

vehicles, both public and private has increased by 224.4 per cent in Ranchi and by 239.4 per cent in Rajkot while it went up by only 47.8 per cent in Cuttack between 1980-81 and 1990-91 (Table 2.4). Two-wheelers like scooter, motor cycle and moped have recorded the highest growth rate in Ranchi as well as in Rajkot, while buses have the highest growth rate in the case of Cuttack. In terms of sheer number of motorised vehicles, Rajkot ranks first (148,264) followed by Ranchi (117,214) and Cuttack (33,339).

Table 2.4

Growth in the Number of Motorised Vehicles Registered with the Regional Transport Authorities in Ranchi, Rajkot and Cuttack

Type of vehicles	Ranchi		% growth rate	Rajkot		% growth rate	Cuttack		% growth rate
	No. of vehicles			No. of vehicles			No. of vehicles		
	1980-81	1990-91		1980-81	1990-91		1980-81	1990-91	
Auto-rickshaw	8180	13738	68.0	1720	2095	21.8	279	745	167.0
Two wheelers	22272	92276	314.3	34025	133746	293.1	21513	30563	42.1
Motor car	4598	9095	97.8	6284	9868	57.0	535	1169	118.5
Taxi	77	254	229.9	1007	1633	62.2	*	61	-
Bus/Mini bus	1005	1851	84.2	673	922	37.0	223	801	259.2
All vehicles	36132	117214	224.4	43709	148264	239.2	22550	33339	47.8

Notes:1. * included in motor car
2. Buses in Ranchi include corporation buses 212 in 1980-81, 493 in 1990-91.
3. Buses in Cuttack include minibuses 28 in 1980-81, 129 in 1990-91.

Source: Tax Deptt. R.T.O., Ranchi.
R.T.O., Rajkot.
Office of the Town Traffic Squad, Cuttack.

Institutional Arrangement for the Provision and Management of Public Transport

Public Private Partnership

Provision of public transport in urban areas falls within the jurisdiction of State Transport Authorities or City Transport Corporations. In addition, a large number of private operators provide city transport who are expected to follow the norms prescribed by the authorities concerned. The state authorities and city corporations are responsible for regulating the public transport provided by private operators through a number of measures, such as licensing, contracting, determining the routes and prescribing the optimum boarding and fares. The management of traffic flows within the urban areas, however, falls solely within the jurisdiction of the local traffic police department. The urban local bodies are responsible for issuing licenses for cycle-rickshaws. Road construction and maintenance within the city, excluding the national and state highways, is also one of the obligatory functions of the urban local bodies in India.

Bulk of the transport in the three case study cities is provided by the private sector. Ranchi has only intermediate modes of transport consisting of auto-rickshaws and cycle-rickshaws falling in the private sector. Rajkot has both publicly run bus transport and privately operated auto rickshaw and taxi service. In Cuttack four of the 35 buses are operated by the municipality, while 31 buses are privately owned. The city also has intermediate public transport, provided by the private sector and the

predominant mode of this type is cycle rickshaw. How much of the demand for city transport is met by public sector will be discussed in the following chapter.

Registration and Licensing

All motorised vehicles used as various forms of public and private transport are supposed to be registered with the Regional Transport Authority. The registration fees for different types of vehicles is determined by the state transport authorities. Privately owned vehicles used for public transport have to also meet certain requirements for registration. For example, auto-rickshaws must provide (a) insurance, (b) road tax receipt, (c) fitness certificate for the vehicle provided by the motor vehicle inspector, and (d) paint the auto rickshaw black and yellow. The privately owned buses have to also acquire a permit for operating at specified routes in the city for a given period of time.

Cycle-rickshaws have to acquire a license from the urban local body. The license fee in Ranchi is Rs.14 and in Cuttack Rs.20 per annum. Cycle-rickshaws also have to undergo physical verification of fitness. An attempt is also made to check the increase in the number of cycle-rickshaws by fixing an upper limit of licenses to be issued every year. Such a limit in Cuttack was 8000 at the time of the survey. In Ranchi, all the rickshaws were unlicensed, as a case was going on to determine whether the licence fee should be taken from the owner or the driver. The Government of Bihar intends to introduce a new legislation which will ensure that rickshaw owner should also be the driver. The aim of this legislation is to discourage large number of rickshaws being owned

by a few people who rent out the rickshaws to poor rickshaw pullers at high rates. The rickshaw owners have obviously opposed implementation of such a legislation.

Boarding Capacity and Fares

Boarding capacity restriction and fares determination are two important measures of regulating the operation of urban transport, particularly in the private sector. The fares are normally fixed on the basis of the cost of operations and the seating capacity of each mode of transport by the state transport authorities.

Buses have a seating capacity of 55 in Rajkot and 30 in Cuttack. But the number of passengers carried by buses in both the cities is far greater because there is no prohibition on standing passengers although the prescribed crush capacity for standard bus is 80 and mini bus 40. The prescribed maximum boarding for auto rickshaws is 4 adults in Ranchi and 3 adults in Rajkot. The average boarding on auto-rickshaws as observed during the survey is 6 in Ranchi and 4 in Cuttack. Taxis in Rajkot are supposed to take a maximum of 4 or 5 passengers depending on the size of the taxi cab. Similar regulations for boarding and fares for cycle-rickshaws have not been introduced either in Ranchi or cuttack. The cycle-rickshaws are, however, designed to accommodate two adult passengers.

The buses run by the State Government in Rajkot charge Re.0.50 per passenger for the first stage of one km. and Re.0.10 for the successive stages of one km. or a part thereof. The fare of

privately owned, and municipality buses in cuttack has also been fixed by the state Commerce and Transport Department at Re.1.00 for the first stage of 3 km. (Table 2.5).

The fare structure of auto-rickshaws fixed on the basis of the distance traveled is also quite comparable in Ranchi and Rajkot, that is approximately Rs. 2.50 per km. There are, special provisions in Ranchi for shared auto-rickshaws which amounts to Re.0.50 per passenger per km. as well as fixed rates for specified routes ranging between Rs.1.50 and Rs. 4.50 per passenger (Table 2.5). In addition, there are provisions for charging fixed rates for traveling outside the municipal limits, detention, night time and baggage. For example, in Rajkot for traveling outside the municipal and contiguous cantonment limits the fare is one and a half times more, the detention charges are Re.0.30 for every five minutes given the maximum waiting time of one hour within the city and two hours outside the city and there is a surcharge of 50 per cent for journeys between 11 p.m. and 5 a.m. The auto-rickshaws in these cities do not follow the meter system for determining fares according to the distance traveled. The drivers fix the fares arbitrarily which are invariably a little higher than the prescribed fare. How successfully such elaborate measures of regulating public transport are implemented needs to be examined in order to assess their effectiveness.

Table 2.5
Prescribed Boarding and Fares for Public Transport

Cities	Bus	Taxi	Auto rickshaw
Ranchi Seating capacity	-	-	4 adults, 3 in the back and one in the front on the left side of the drive.
Fare	-	-	Re.0.50 per passenger/km. for shared auto Rs.2.50 per km.for reserved auto Fixed route fares ranging between Rs.1.50 and 4.50 per passenger for shared auto rickshaws.
Rajkot Seating capacity	55	a.4 in case of small taxis b.5 in big taxis	3 adults
Fare	Re.0.50 per passenger for the first stage of one km. and Re.0.10 for the successive stage of one km. or a part thereof	a.Re.0.33 for every 1/5 km or a part there of subject to a minimum of Rs.2.50 b.Rs.0.40 for every 1/5 km. or a part thereof subject to a minimum of Rs.3.00.	Rs.2.50 for the first 1.2 km or a part there of & Re.0.40 for subsequent 1/5 km. or a part there of
Cuttack Seating capacity	30	-	Not prescribed
Fare	Re.1.00 for the first stage of 3 km., Re.0.20 for the next stage of 3 km. and Re.0.30 for the next stage of 4 km. or a part thereof.	-	Rs.1.50 for the first km. and Rs.1.15 for every subsequent km.

Source:1. District Transport Office, Ranchi.
2. Notification of the Home Department, Govt. of Gujarat, Gandhinagar.
3. R.T.O. Cuttack

Assessment of Demand

The demand for urban transport usually contingent on the situation of each city is determined by a number of factors, such as : population size and age structure ; urban area, and form; employment pattern; and locational pattern of residences, economic activities and services. Broadly speaking, the demand for urban transport is expected to grow at more or less the same rate as growth in urban population suggesting strong positive correlation between the two.

Various models for estimating and projecting total demand for urban transport for cities of different sizes have been developed. These models can be used for estimating trip volumes in relation to the population of cities at a given point of time. All these models use trip rate per person and total population along with other variables like employment and urban form. However, the trip rate is defined at times as bus trips, trips made by public transport, all trips but excluding walk trips and so on, resulting in a considerable degree of variation in the extent of estimated demand for urban transport. For example, Report of the Study Group on Alternative systems of Urban Transport presents two estimates of total volume of trips, one is based on all trips as well as bus based trips while the other has taken traffic volume in four maximum density corridors into consideration.[1] This report also presents a statistically significant model developed on the basis of data on 14 cities listed in Annex 1. This model, however, is

---

1. Govt. of India (1987): Report of the Study Group on Alternative System of urban transport. Appendices, New Delhi, See page 5. Annexes 1 and 2 for the results.

based on approximate data as generated from state-wise urban statistics.2

Model A : TV = -395.1118+1.2914 P

Where TV = Trip volume in thousands per day
P = Population in thousands per day

The following model based on traffic studies of eleven cities (Annex-3) has also found significant linear relationship between total trips and total population.3

Model B : T = -2.39+1.11 P

Where T = Total trips
P = Population

The estimated volume of trips in the case study cities at the time of the survey by using these two models is presented in Table 2.6. The model A has yielded a slightly higher number of trips, that is 793,111 trips in Ranchi, 840,315 in Rajkot and 566,882 trips in Cuttack. According to model B the number of trips in Ranchi is 682,042, in Rajkot 722,615 and in Cuttack it is 487,591.

Table 2.6

Estimated Volume of Trips in Case Study Cities, 1991

Cities	Population 1991	Volume of trip using Model A	Model B
Ranchi	614454	793111	682042
Rajkot	651007	840315	722615
Cuttack	439273	566882	487591

Note : Model A is based on GOI (1987) op. cit
Model B is based on TERI (1989) op. cit.

2. Ibid, p.5.
3. Tata Energy Research Institute (1989): Urbanisation and Energy in the Third World : A Study of India, New Delhi, p.73.

However, the models developed using very small samples have limited validity in the case of cities of all sizes and economic structure. Therefore, we estimated the existing demand for urban transport or total volume of trips using the trip rate per person per day of the respective case study cities.

The survey results were analysed to generate two trip rates, one takes into account walk trips while the other excludes walk trips (table 2.7). The trip rate excluding walk trips is however, more suited for estimating demand for public transport. Accordingly, the total trips in Ranchi are 737,345, in Rajkot 976,511 and in Cuttack trips number 720,408. As is evident, these estimates are more or less comparable with the volume of trips yielded by models A and B in the case of Ranchi and are considerably higher in the case of Rajkot and Cuttack. It is, however, difficult to say which set of estimated volume of trips is closest to the reality of the selected cities.

Table 2.7

Estimated Demand for Urban Transport in Case Study Cities, 1991

Cities	Population	Including walk trips		Excluding walk trips	
		Trip Rate (person per day)	Total Trips	Trip Rate (person per day)	Total Trips
Ranchi	614454	1.72	1058581	1.20	737345
Rajkot	651007	2.04	1328054	1.50	976511
Cuttack	439273	1.99	878546	1.64	720408

Note : Trips rates are based on the surveys of the sample households in the three cities conducted by NIUA in 1991.

We have also attempted to get an idea of the existing gap between supply of and demand for public transport in these cities. The supply of passenger seat capacity per day of public as well as IPT was estimated by multiplying number of vehicles by average number of trips made and seating capacity as designed or prescribed by the transport authorities. For estimating the demand, seating capacity was substituted by the actual boarding as observed in each of the case study cities (Table 2.8). The results of this exercise indicate that the demand is more than the supply of public transport. The gap between supply and demand is widest in Ranchi (304,000) where there is no system of mass transit. The gap in Rajkot is 146,166 and in Cuttack it is 100,173.

Table 2.8

The Gap Between Supply and Demand, 1991

Cities	The supply of Public transport (Based on the seating capacity per day)	The Demand for Public transport (Based on the actual boarding per day)	The gap
Ranchi	608000	912000	-304000
Rajkot	491565	637731	-146166
Cuttack	202473	302646	-100173

Projection of Demand

The models of estimating trip volumes discussed in the earlier sections can also be used for projecting demand for urban transport for any point of time in the future. The underlying assumption in Models A and B is that similar conditions will prevail in all types of cities at all times while Model C assumes that the trip rate will remain constant in the future.

Table 2.9

Projected Population of the Case Study Cities

Cities	Population	
	2001	2011
Ranchi	848500	1171693
Rajkot	843152	1092008
Cuttack	589201	790301

Table 2.10

Projected Trip Volumes for the Case Study Cities

Cities	Trip Volumes (in lakhs)					
	Model A		Model B		Based on trip rates	
	2001	2011	2001	2011	2001	2011
Ranchi	10.95	15.13	9.42	13.01	10.18	14.06
Rajkot	10.88	14.10	9.36	12.12	12.65	16.38
Cuttack	7.60	10.20	6.54	8.77	9.66	12.96

The three models yield different projected trip volumes for 2001 and 2011 (Table 10). The total trips in Ranchi will be between 9.42 lakhs and 10.45 lakhs in 2001 and between 13.01 lakhs and 15.13 lakhs in 2001. Rajkot may have trip volumes ranging between 9.36 and 12.65 lakhs in 2001 and between 12.12 and 16.38 lakhs in 2011. The trip in smallest of the three cities Cuttack may be between 6.54 and 9.66 lakhs in 2001 and between 8.77 and

12.96 lakhs in 2011. The purpose of presenting a range of projections is to emphasise the fact that it is not easy to arrive at one neat estimate of trip volumes. The planners can either use lower or upper or a median projection for setting the goal for transport planning for the medium sized cities under consideration.

CHAPTER-III

PASSENGER TRAVEL PATTERNS

The assessment of the transport situation presented in the previous chapter was based on the city level secondary data. In this chapter, the demand side of urban transport has been analysed using primary data on passenger travel pattern collected through a sample survey of households. The sample households represent different income groups as well as different residential locations in the case study cities. For most of the trip analysis one way home - based trips have been taken into consideration.

Characteristics of the Sample Households

The total population in the sampled households at the time of the passenger travel survey in 1991 was 2,334 in Ranchi, 1,641 in Rajkot and 1,250 in Cuttack. The average household size in all cities is between 4.1 and 4.7 which is much smaller than recorded by the census in 1981. The average household size for Ranchi and Rajkot in 1981 was 5.9 and for Cuttack it was 6.0. The smaller household size amongst the sample population may be partly a result of reduction in the family size during the ten year period and partly due to certain bias in sampling. In terms of the economic status of the sample population, Rajkot appears to be better off with the highest work participation rate of 32.17 per cent and the lowest dependency ratio of 2.11 (Table 3.1).

The distribution of the sample population in various income groups is representative of the income characteristics of the total population in the case study cities. In all the three cities, the

largest proportion of the sample population falls in the lower-middle income group having monthly income of Rs. 1001-3000. The middle-income group with monthly income of Rs.3001-5000 ranks second, followed by high-income group having more than Rs. 5000 monthly income and low-income group with monthly income of Rs. 1000 or less (Table 3.2). Rajkot has the smallest proportion of low income households while cuttack has relatively larger proportion of both low and high income households.

Table 3.1

The Sample Households and Population

Cities	Sample house-holds	Total population	House-hold size	No. of workers	% of workers to total population	Dependency ratio
Ranchi	500	2334	4.7	659	28.23	2.54
Rajkot	400	1641	4.1	528	32.17	2.11
Cuttack	300	1250	4.2	379	30.32	2.30
Total	1200	5225	4.4	1566	29.97	2.68

Table 3.2

Distribution of the Sample Households by Monthly Household Income

Income Group (Rs.)	Ranchi		Rajkot		Cuttack		All cities	
	No.	%	No.	%	No.	%	No.	%
Upto 1000 Low income	46	9.2	30	7.5	38	12.7	114	9.5
1001-3000 Lower Middle Income	266	53.2	230	57.5	160	53.3	656	54.7
3001-5000 Middle income	130	26.0	94	23.5	57	19.0	281	23.4
More than 5000 High Income	51	10.2	46	11.5	44	14.7	141	11.7
Income not stated	7	1.4	-	-	1	0.3	8	0.7
Total	500	100.0	400	100.0	300	100.0	1200	100.0

The data on private vehicle ownership reveal a number of combinations (Table 3.3). Considering the highest order vehicle in each group, one finds that 6 to 10 per cent of the households in the three cities have cars, some of these households also have two-wheelers and cycles. Comparatively larger variation is observed in the ownership of two-wheelers like motor cycle, scooter and moped. In Rajkot as many as 62.3 per cent of the households have two-wheelers, where as in Ranchi 50.6 per cent and in cuttack 48.3 per cent of the sample households have two-wheelers. Cycles are the second most popular vehicle in these cities with 35.3 per cent households in Cuttack, 24.0 per cent households in Rajkot and 21.2 per cent households in Ranchi having bicycles as the only

private mode of transport. It is interesting to note that Ranchi has the highest proportion of households (19%) not having any private vehicle, a city which does not have a conventional bus service. The other two cities with a mix of public and IPT modes have less than 8 per cent households not owning private vehicles.

Table 3.3

Distribution of Households by Vehicle Ownership

Cities	Car+Scooter/ Motor cycle/ Moped+Cycle	Car+Scooter/ Motor cycle/ Moped	Car+ Cycle	Car	Scooter/ Motor cycle/ Moped+Cycle	Scooter/ Motor cycle/ Moped	Cycle	No vehicle	% House-holds having private vehicles	Total
Ranchi	2 (0.4)	19 (3.8)	4 (0.8)	21 (4.2)	32 (6.4)	221 (44.2)	106 (21.2)	95 (19.0)	81.0	500 (100.0)
Rajkot	6 (1.5)	11 (2.8)	1 (0.3)	7 (1.8)	79 (19.8)	170 (42.5)	96 (24.0)	30 (7.5)	92.5	400 (100.0)
Cuttack	6 (2.0)	11 (3.7)	3 (1.0)	11 (3.7)	73 (24.3)	72 (24.0)	106 (35.3)	18 (6.0)	94.0	300 (100.0)

Note : Percentages are given in the parentheses.

As expected, almost all the car-owning households fall in the middle and high income groups, while a majority of low-income and lower-middle income households possess cycles and motorised two-wheelers. The largest concentration of no vehicle owing households is found in the lower-middle and in low income groups. The city wise distribution of sample households by income and vehicle ownership clearly shows that vehicle ownership increases with ascending household income (Annexes 4-6). It can be inferred, therefore, that if people can afford it they will prefer high quality private transport which can maintain speed and provide comfort and privacy.

Daily Trips, Purpose and Income

For the purpose of this study, a trip has been defined as one way journey within the city for any purpose using any mode of transport, including trips undertaken by walking. Considering the total trips generated in the three medium cities it can be stated that roughly two trips per person are made daily, that is one round trip. At the city level, the daily trip rate per household in Rajkot was 8.38, in Cuttack 8.30 and in Ranchi 8.00 (Table 3.5). This shows that cities like Rajkot and Cuttack having conventional bus transport as well as high percentage of households owning private vehicles generate relatively larger number of daily trips per person and per household. These cities also have higher trip rate in the "others" category which includes shopping, recreation, social and medical trips than trip rate for essential activities namely, work and education. (Tables 3.4 and 3.5)

Table 3.4

Average Daily Trip Rate per Person

Cities	Work	Education	Others	Total
Ranchi	0.56	0.70	0.46	1.72
Rajkot	0.64	0.58	0.82	2.04
Cuttack	0.60	0.60	0.79	1.99

Note : Includes trips undertaken by walking.

Table 3.5

Average Daily Trip Rate per Household

Cities	Work	Education	Others	Total
Ranchi	2.64	3.22	2.14	8.00
Rajkot	2.64	2.38	3.36	8.38
Cuttack	2.52	2.52	3.26	8.30

Note : Includes trips undertaken by walking.

Work and education trips together account for over 60 per cent of the total daily trips while the rest of the trips are made for shopping, recreation, social and medical purpose (Table 3.6). In all the three case study cities, work trips have a share of approximately 30 per cent in the total daily trips. In Ranchi a larger proportion of trips fall in the education category than observed in the other case study cities. The distribution of trips by purpose is closely linked with the employment status and age structure of the population. The sample households in Ranchi are quite likely to have more children in the school going age which can explain why such a large number and proportion of trips are educational in the city.

Table 3.6

Distribution of Daily Trips by Purpose

Cities	Daily trips by purpose						Total one way trips
	Work	Education	Shopping	Recreational	Social	Medical	
Ranchi	659 (32.9)	808 (40.4)	250 (12.5)	182 (9.1)	65 (3.2)	37 (1.8)	2001 (100.0)
Rajkot	528 (31.5)	475 (28.4)	295 (17.6)	213 (12.7)	130 (7.8)	34 (2.0)	1675 (100.0)
Cuttack	379 (30.4)	379 (30.4)	218 (17.5)	150 (12.0)	47 (3.8)	75 (6.0)	1248 (100.0)
Total	1566 (31.80)	1662 (33.75)	763 (15.50)	545 (11.07)	242 (4.91)	146 (2.97)	4924 (100.00)

Note : Percentages are given in the parentheses.
Walk trips are included

The distribution of daily trips by households shows that about half of the total trips are generated in the households which have monthly income between Rs.1001 and 3000 alone (Table 3.7). The middle income group with household income of Rs. 3001-5000 accounts for another quarter of the total trips while other income groups together account for rest of the daily trips. One of the reasons for such an uneven distribution of trips by household income is the proportion of sample households in each income group itself (Table 3.2). A comparison of these two table suggests that income level of a household does not determine how many trips are made by the members of each type of household. However, household income does appear to have some impact on the share of trips by purpose at the city level. (Annexes 7-9).

Table 3.7

Distribution of Daily Trips by Household Income

Cities	Household income per month (Rs.)					
	Upto 1000	1001-3000	3001-5000	More than 5000	Income not stated	Total one-way trips
Ranchi	136 (6.8)	1009 (50.4)	572 (28.6)	273 (13.6)	11 (0.5)	2001 (100.00)
Rajkot	104 (6.2)	882 (52.7)	431 (25.7)	258 (15.4)	- (0.0)	1675 (100.00)
Cuttack	165 (13.2)	603 (48.3)	291 (23.3)	189 (15.1)	0.01 (0.0)	1248 (100.00)
Total	405 (8.23)	2494 (50.65)	1294 (26.28)	720 (14.62)	11 (0.22)	4924 (100.00)

Note : Percentages are given in the parentheses.

Modal Split

The use of various modes of transport for meeting the total demand for city transport, popularly known as modal split, has been examined in relation to purpose as well as household income. Primary mode of transport has been defined as the mode used most of the time (75% or more).

Two-wheelers like scooter and motor cycles are the most predominant modes of transport in Rajkot and Cuttack whereas travel on foot ranks first in Ranchi (Table 3.8). In Ranchi 30.4 per cent of the total demand is met by travel on foot, 23.8 per cent by two-wheelers, 12.1 per cent by cycles and office/factory/school buses also play an important role by carrying 11.5 per cent of the daily passengers. This mode of transport is not so popular in the other

two cities. In Rajkot, 35.0 per cent of the demand is met by two-wheelers, 26.3 per cent by travel on foot and 18.6 per cent by cycles. In Cuttack, 29.2 per cent of the demand is met by two-wheelers, 26.0 per cent by cycles, 19.4 per cent by cycle-rickshaws and 17.5 per cent by travel on foot. Only in Rajkot buses appear to have a significant share of about 7 per cent in total daily trips.

Table 3.8

Distribution of Daily Trips by Primary Mode

Cities		Bus	Auto rick-shaw	Cycle rick-shaw	Office/ School/ Factory bus	Cycle	Walk	Scooter Motor cycle/ Moped	Car	Any other	Total one way trips
Ranchi	Daily Trips	13	178	147	230	243	608	477	90	15	2001
	Ranking	8	5	6	4	3	1	2	7	9	-
	% Trips	0.7	8.9	7.3	11.5	12.1	30.4	23.8	4.5	0.7	100.0
Rajkot	Daily Trips	113	142	-	12	311	441	586	67	3	1675
	Ranking	5	4	-	7	3	2	1	6	8	-
	% Trips	6.7	8.5	-	0.7	18.6	26.3	35.0	4.0	0.2	100.0
Cuttack	Daily Trips	16	2	242	8	324	218	365	69	-	1248
	Ranking	6	8	3	7	2	4	1	5	-	-
	% Trips	1.6	0.2	19.4	0.6	26.0	17.5	29.2	5.5	-	100.0

Note : 'Any other' includes use of multiple modes.

The most predominant modes for work trips in all the three cities are two-wheelers, walking, and cycles, their relative importance, however, varies in each city (Table 3.9). The most popular modes of transport for education trips in Ranchi are walking, school bus and cycles. In Rajkot walking, cycles and auto rickshaws predominant while in cuttack walking, cycles and cycle rickshaws account for bulk of the education purpose trips (Table 3.10). The top modal choice for other purpose trips in all the three cities is two-wheelers, walking ranks second in Ranchi and Rajkot while cycle-rickshaws rank second in Cuttack (Table 3.11).

Table 3.9

Modal Choice for Daily Work Trips

City	Bus	Auto-rick-shaw	Cycle-rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor cycle/ Moped	Car	Any other	Total one way trips
Ranchi	7 (1.1)	48 (7.3)	15 (2.2)	13 (2.0)	102 (15.5)	173 (26.3)	250 (37.9)	40 (6.1)	11 (1.7)	659 (100.0)
Rajkot	23 (4.4)	12 (2.3)	- -	5 (0.9)	122 (23.1)	71 (13.4)	275 (52.1)	18 (3.4)	2 (0.4)	528 (100.0)
Cuttack	8 (2.1)	- -	7 (1.8)	2 (0.5)	104 (27.4)	68 (17.9)	167 (44.1)	23 (6.2)	- -	379 (100.0)

Note : Percentages are given in the parentheses.
'Any other' includes use of multiple modes.

Table 3.10

Modal Choice for Daily Education Trips

City	Bus	Auto-rick-shaw	Cycle-rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor cycle/ Moped	Car	Any other	Total one way trips
Ranchi	4 (0.5)	35 (4.3)	56 (6.9)	217 (26.9)	112 (13.9)	325 (40.2)	46 (5.7)	10 (1.2)	3 (0.4)	808 (100.0)
Rajkot	34 (7.2)	63 (13.3)	- -	7 (1.5)	126 (26.5)	180 (37.9)	61 (12.8)	4 (0.8)	- -	475 (100.0)
Cuttack	8 (2.1)	2 (0.5)	89 (23.5)	6 (1.6)	132 (34.8)	98 (25.9)	31 (8.2)	13 (3.4)	- -	379 (100.0)

Note : Percentages are given in the parentheses.
'Any other' includes use of multiple modes.

Table 3.11

Modal Choice for Daily Other Trips

Cities	Bus	Auto-rick-shaw	Cycle-rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor cycle Moped	Car	Any other	Total one way trips
Ranchi	2 (0.4)	95 (17.8)	76 (14.2)	- -	29 (5.4)	110 (20.6)	181 (33.9)	40 (7.5)	1 (0.2)	534 (100.0)
Rajkot	56 (8.3)	67 (10.0)	- -	- -	63 (9.4)	190 (28.3)	250 (37.2)	45 (6.7)	1 (0.1)	672 (100.0)
Cuttack	4 (0.8)	- -	146 (29.8)	- -	88 (18.0)	52 (10.6)	167 (34.1)	33 (6.7)	- -	490 (100.0)

Note : Percentages are given in the parentheses.
'Any other' includes use of multiple modes.

Motorised and non-motorised modes play an equally important role in Ranchi while in Rajkot motorised transport meets a little over half of the demand and in Cuttack non-motorised transport is predominant (Table 3.12).

Table 3.12

Share of Motorised and Non-Motorised Modes of Transport

Cities	Motorised	Non-motorised	Total
Ranchi	995 (49.73)	1006 (50.27)	2001 (100.00)
Rajkot	920 (54.93)	755 (45.07)	1675 (100.00)
Cuttack	464 (37.18)	784 (62.82)	1248 (100.00)
Total	2379 (48.31)	2545 (51.69)	4924 (100.00)

Note : Percentages are given in the parentheses.

The household income determines the use of motorised and non-motorised mode of urban transport irrespective of the city form and structure. Majority of the low income group persons in all the three case study cities either walk or use cycles, for which they do not have to pay (Annexes 10-12). A considerable number of low income people in Rajkot also use public bus. Two-wheelers appear to be the most widely used mode of transport amongst the middle and high income groups. It is only in the high-income group in Cuttack where car emerges as the second most important mode of travel within the city.

The Role of Private, Intermediate and Mass Public Transport

Private transport meets bulk of the demand for city transport in Cuttack and Rajkot, IPT ranks second and MTS third. In Ranchi the share of private transport is comparatively low at 40.5 per cent, but the relative position of the three categories of transport is the same as observed in the other two cities (Table 3.13). It is important to note that Ranchi has a large number of factory and school buses which meet a significant proportion of the demand for work and education trips, which allows the use of private transport to remain low. The factory buses are either subsidised or are not meant for making profit, therefore, charge low fares, which makes them attractive to the commuters. These buses fill in a gap created by the absence of a mass transit system like bus. A few trips which appear in the MTS category are made on inter-city buses.

Table 3.13

Share of IPT, MTS and Private Transport in Daily Trips

Cities	Private	IPT	MTS	Other modes	Total one way trips
Ranchi	810 (40.5)	332 (16.6)	13 (0.6)	846 (42.3)	2001 (100.0)
Rajkot	964 (57.6)	142 (8.5)	113 (6.7)	456 (27.2)	1675 (100.0)
Cuttack	758 (60.7)	244 (19.6)	20 (1.6)	226 (18.1)	1248 (100.0)

Note : 1. Percentages are given in the parentheses.
2. 'Other modes' includes office/school/factory bus, walk or use of multiple modes.
3. IPTs means Intermediate Public Transport.
4. MTS means Mass Transit System.

Looking at the travelling pattern of the sample population in relation to household income, purpose and the type of transport used reveals city-wise variations (Annexes 13-15) . For example, in Ranchi 50-75 per cent of the work trips and 60-80 per cent of the other purpose trips in the middle and high income groups are made by private vehicles. In Rajkot, 65-80 per cent of the work trips in all income groups and 50-70 per cent of other purpose trips in lower middle, middle and high income groups are made by private vehicles. In Cuttack, the demand for 81-83 per cent of the work trips in lower middle, middle and high income groups and 50-72 per cent of other purpose trips in all the income groups is met by privately owned vehicles. The highest proportion of private vehicles used for education trips in all the income groups is observed in Cuttack.

Classification of the sample households by travel behaviour shows that a combination of IPT and private transport caters to the needs of 30 to 40 per cent of the households. Another 25 to 30 per cent of the households use all three types of urban transport namely MTS, IPT and private vehicles. In comparison, fewer households depend on only private transport, MTS or IPT (Table 3.14). This means that even private vehicle owning households have a demand for public transport. The non-vehicle owning households, however, are more likely to have greater demand for public transport.

Table 3.14

Number and Percentage of Households Using IPT, MTS and Private Transport

Cities	Private	Private and IPT	IPT	MTS	Private, MTS and IPT	Do not use any mode	Total sample households
Ranchi	98 (19.6)	201 (40.2)	67 (13.4)	3 (0.6)	125 (25.0)	6 (1.2)	500 (100.0)
Rajkot	60 (15.0)	148 (37.0)	33 (8.3)	26 (6.5)	127 (31.8)	6 (1.5)	400 (100.0)
Cuttack	43 (14.3)	104 (34.7)	59 (19.7)	5 (1.7)	84 (28.0)	5 (1.7)	300 (100.0)
Total	201 (16.8)	453 (37.8)	459 (13.3)	34 (2.8)	336 (28.0)	17 (1.4)	1200 (100.0)

Note : 1. Percentages are given in the parentheses.
2. IPT means Intermediate Public Transport.
3. MTS means Mass Transit System.

Another interesting feature regarding travel behaviour at the household level is the pattern of private vehicle ownership and choice of public transport(Annexes 16-18). In Ranchi, only car or car along with other vehicle owning households prefer to use auto-rickshaws and factory/school/office buses while two-wheeler and cycle owning households use all the three modes available in the city, namely auto-rickshaws, cycle-rickshaws and factory/ school/ office buses. In Rajkot, for all the car owning households, auto-rickshaws act as the supplementary means of transport while all the two-wheeler and cycle owning households depend on buses as well as autorickshaws. In Cuttack cycle rickshaw is used by all types of households while a fewer car owning households opt for buses in comparison to the two wheeler and cycle owning households. Such a pattern suggests that car owning households prefer IPT to

supplement their privately owned means of transport. On the other hand, the two-wheeler and cycle-owning households which form the majority amongst the sample households seek both IPT and MTS in order to meet their city travel requirement.

Trip Length and Time

The trip length depends on a number of factors such as city structure, location of work and residence, and road layout while trip time is largely determined by the speed of the mode used and traffic conditions. In the case study cities of different types, the trip length for work is more or less the same, that is between 2.6 and 2.7 km. Both Cuttack and Ranchi have average trip length for education of about 2 km and other trips of about 3 km, whereas Rajkot has average trip length of 1.7 km for education and 2.5 km for other purpose trips (3.15). As mentioned in Chapter 1 (Table 1.4), Ranchi is the most spread out city with the largest area and Rajkot has the smallest area which determines the trip length in these cities to some extent.

Table 3.15

Average Daily Trip Length by Purpose

Cities	Average daily trip length (kms.)		
	Work	Education	Others
Ranchi	2.9	2.2	3.3
Rajkot	2.6	1.7	2.5
Cuttack	2.7	2.3	3.1

Table 3.16 shows that average trip time spent on travelling about the same distance varies by a few minutes in the cities under consideration. Rajkot which has the minimum trip length for work of 2.6 km. has the maximum trip time of 18.6 minutes, which can be explained by high population and vehicle density resulting in slow speed of the traffic (Table 1.4 for area and population density and Table 2.2 for the number of vehicles). The time taken by work trips in Ranchi is 16.8 minutes and in Cuttack it is 12.9 minutes. The education trips indicate less variation in terms of trip time between the three cities inspite of the difference in trip length. Other purpose trips take 16 to 20 minutes in these cities and seem to have some association with the trip length.

Table 3.16

Average Time Spent on Daily Trips by Purpose

Cities	Average time spent (in minutes)		
	Work	Education	Others
Ranchi	16.8	13.7	20.5
Rajkot	18.6	12.2	16.1
Cuttack	12.9	14.2	18.0

Further disaggregation of trip length and time by the mode used reveals an expected pattern, that motorised modes are used for long distance travel and non-motorised modes are used for short trips. For instance, for work trip distance travelled by bus in all the cities is over 5 km. but time taken to cover this distance

in Ranchi is 25.7 minutes, in Rajkot 30.9 minutes and in Cuttack it is 47.5 minutes (Table 3.17 and 3.18). The trip length of commuting by cycle rickshaws in Ranchi is 2.6 km. and in Cuttack it is 2.2 km., and the trip time is 26.5 minutes and 18.4 minutes in these cities respectively. The trips made by walking are of about 1 km in length and take 10-12 minutes in all the case study cities.

Table 3.17

Average Daily Work Trip Length by Mode

Cities	Average trip length of work trips by mode (in km.)									Overall average of total work trips by all modes
	Bus	Auto rick-shaw	Cycle rick-shaw	Office/School Factory bus	Cycle	Foot	Scooter/ Motor cycle/ Moped	Car	Any other	
Ranchi	5.6	4.1	2.6	4.7	3.1	1.2	3.4	3.3	5	2.9
Rajkot	5.3	4.8	-	3.7	2.1	0.7	2.7	4.9	4.5	2.6
Cuttack	5.7	-	2.2	5.5	2.2	0.9	3.2	5.3	-	2.7

Note : Any other includes multiple modes.

Table 3.18

Average Time Spent on Work Trips by Mode

Cities	Average time spent on work trips by mode (in minutes)									Overall average of total work trips by all modes
	Bus	Auto rick-shaw	Cycle rick-shaw	Office/School Factory bus	Cycle	Foot	Scooter/ Motor cycle/ Moped	Car	Any other	
Ranchi	25.7	20.6	26.5	28.5	20.8	11.1	17.2	16.2	12.5	16.8
Rajkot	30.9	17.8	-	18.0	29.3	9.8	14.8	16.2	50.0	18.6
Cuttack	47.5	-	18.4	29.0	14.5	12.2	12.0	13.1	-	12.9

Note : 'Any other' includes use of multiple modes.

The peak travel time as estimated on the basis of secondary information available for different traffic corridors in the three cities, is 10-11 a.m. and 5-6 p.m. in Ranchi and Cuttack. The traffic volume is at its peak between 11 a.m. and 12 noon and between 6-7 p.m. in Rajkot (Table 3.19).

Table 3.19

Peak Travel Time

Cities	Morning	Evening
Ranchi	10-11	5-6
Rajkot	11-12	6-7
Cuttack	10-11	5-6

Expenditure on Transport

Considering very rough estimates regarding expenditure on transport, both public and private, obtained through the household surveys we find that most of the households spend upto Rs. 300 per month on city travel in the three case study cities. The distribution of the sample households across various expenditure slabs is however different in each city (Table 3.20). For instance, in Ranchi about 30 per cent of the households spend Rs.101-150 and 9.4 households only use cycles and walk and incur no expenditure on transport. In Rajkot, the maximum number of households amounting to 23.3 per cent spend Rs. 151-200 per month and 13.7 per cent of the households spend nothing at all on local transport. In Cuttack, the largest proportion of households (25.7%) also record an expenditure of Rs. 151-200 per month while 5.7 per cent of the sample households do not use any mode of

conveyance which requires recurring expenditure. The expenditure on transport is also different across various income groups. Middle and high income households have relatively higher expenditure on transport in all the three cities (Annexes 19-21).

Table 3.20

Distribution of Households by Monthly Expenditure on Transport

Cities	Monthly transport expenditure (Rs.)										
	0	1-25	26-50	51-100	101-150	151-200	201-251	251-300	More than 300	Median Expenditure	Total households
Ranchi	47 (9.4)	6 (1.2)	39 (7.8)	85 (17.0)	148 (29.6)	80 (16.0)	30 (6.0)	33 (6.6)	32 (6.4)	135.1	500 (100.0)
Rajkot	55 (13.7)	2 (0.5)	34 (8.5)	49 (12.3)	79 (19.7)	93 (23.3)	34 (8.5)	26 (6.5)	28 (7.0)	149.8	400 (100.0)
Cuttack	17 (5.7)	7 (2.3)	38 (12.7)	36 (12.0)	48 (16.0)	77 (25.70	37 (12.3)	19 (6.3)	21 (7.0)	154.5	300 (100.0)

Note : Percentage are given in the parentheses.

Table 3.21

Percentage of Household Income Spent on Transport

Cities	Percent of household income spent on transport				Median Expenditure (as percentage of income)	Total households
	No expenditure on transport	Upto 5	5 - 10	More than 10		
Ranchi	47 (9.5)	213 (43.1)	207 (41.9)	27 (5.5)	5.00	494 (100.0)
Rajkot	55 (13.7)	140 (35.0)	187 (46.8)	18 (4.5)	5.34	400 (100.0)
Cuttack	17 (5.7)	109 (36.3)	164 (54.7)	10 (3.3)	6.43	300 (100.0)
Total	119 (10.0)	462 (38.7)	558 (46.7)	55 (4.6)		1194 (100.0)

Note : i) Percentages are given in the parentheses.
ii) Income not stated for 6 households in Ranchi

Looking at the expenditure on transport in relation to the household income in proportionate terms, we find that a majority of the households spend up to 10 per cent of their income on urban transport. There are only marginal differences in the distribution of households in the three broad expenditure groups in the case study cities (Table 3.21). It is interesting to note that although high-income households spend more money on transport in absolute terms, it is the low and lower-middle income households which spend more than 10 per cent of their income on city transport in all the three case study cities (Annexes 22-24).

Elasticities of Transport Expenditure

Transportation demand is generally assumed to rise with increasing income. The elasticity of transport demand with respect to incomes in the sample cities were estimated with the conventional double log regressions. The results are presented in Table 3.22. It is seen that in all the three cities, the demand for transport is highly elastic with respect to income, and ranges from 1.36 in Cuttack to 2.06 in Rajkot.

Table 3.22

Estimation of Income Elasticity of Transport Expenditure
(Dependent Variable : Log of Monthly Transport Expenditure)

Variables	Cuttack	Rajkot	Ranchi
Constant	-5.948	-11.992	-8.67
Log monthly income	1.367 (17.28)	2.065 (17.39)	1.682 (21.34)
R-square	0.5014	0.4381	0.4811
No. of observations	299	400	493

These results suggest that with increase in population in these cities, and increase in the household incomes, there will be a disproportionate increase in demand for transport services. If this demand is not met by increased mass public transport or intermediate public transport, there will be a considerable increase in personalised transport modes. Given the nature of transport demands and high elasticities, it is imperative to provide more efficient public transport, for which there is an expressed willingness to pay.

CHAPTER-IV

VIABILITY OF URBAN TRANSPORT

Viability of the state of urban transport in any city can be examined from the points of view of the three major partners, namely the users, the suppliers and the regulating and managing authorities concerned at the city level. The users will find that transport service viable which offers high degree of comfort and convenience at low cost. The major viability criteria for the suppliers are likely to be smooth functioning and profitability. The government authorities are more likely to be concerned with manageable traffic flows, low accident rate and low levels of vehicular congestion on roads. An attempt has been made in this chapter to assess the state of transport in the selected cities from the points of all the three partners.

Users' Perspective

Adequacy of transport services can be assessed at two levels. First, the difference between the total demand and supply of transport at the city level, which has been discussed in chapter-II. Second, the perception of adequacy in terms of cost and convenience at the users' level, which is being examined in this section.

More than half of the respondents in Ranchi and Cuttack and over two-thirds of the respondents in Rajkot find transport services inadequate in the respective cities (Table 4.1).[1] It is

---

1. The person interviewed in each of the sample household, in most cases the head of the household, is the respondent. All the perception and opinion questions were answered by the respondents.

important to note here that respondents who feel that the transport is adequate are mostly those who do not use public transport at all or have private vehicles to supplement the supply of public transport.

Table 4.1

Users' Perception of Adequacy of Public Transport

Cities	Number of respondents		
	Adequate	Inadequate	Total
Ranchi	240 (48.0)	260 (52.0)	500 (100.0)
Rajkot	116 (29.0)	284 (71.0)	400 (100.0)
Cuttack	132 (44.0)	168 (56.0)	300 (100.0)

Note : Percentages are given in the parentheses.

Of the respondent who feel that the transport service is not adequate, 44.6 per cent in Ranchi, 59.8 per cent in Rajkot, and 19.6 per cent in Cuttack indicated that the public transport is too expensive, and hence not affordable. Another 33.3 per cent respondents in Cuttack, 25.7 per cent in Rajkot and 17.3 per cent in Ranchi stated poor services as the prime reason for their dissatisfaction. Poor service includes low frequency, unpunctuality and poor connections to all areas in the city in the case of bus service and non - availability at all times of the day for all destinations in the case of auto-rickshaws and cycle-rickshaws. Other major reasons for dissatisfaction with the public transport services are discomfort due to overboarding of passengers and slow speed resulting from too much traffic on the roads (Table 4.2).

Table 4.2

Reasons for Dissatisfaction with the Public Transport

Cities	Poor service	Costly	Not comfor-table	Slow speed	Others	Total respondents
Ranchi	45 (17.3)	116 (44.6)	13 (5.0)	19 (7.3)	67 (25.8)	260 (100.0)
Rajkot	73 (25.7)	170 (59.8)	7 (2.5)	10 (3.5)	24 (8.5)	284 (100.0)
Cuttack	56 (33.3)	33 (19.6)	30 (17.9)	21 (12.5)	28 (16.7)	168 (100.0)

Note : (i) Percentages are given in the parentheses.
(ii) 'Others' includes multiple response.

All the respondents of the three cities were asked to rank various IPT and MTS modes plying in their cities from the point of view of convenience, comfort, safety and fares charged and so on. Majority of the respondents in Ranchi ranked both auto-rickshaw and cycle-rickshaws average or poor. Poor ranking assigned to fare charged by any mode implies that it is expensive (Table 4.3). In Rajkot, bus service is also considered average or poor while some of the respondents find auto-rickshaws good as far as no waiting time, comfort and convenience and getting direct connection is concerned. Both these modes are thought to be unreasonably priced by a majority of the respondents (Table 4.4) In Cuttack, the quality of bus service is considered to be average or poor, though not very highly priced. Most of the respondents have ranked cycle-rickshaws and auto-rickshaws also as average or poor and also think that fares charged by these modes are on the higher side (Table 4.5). In fact, it is cheaper to travel 28 km. between

Cuttack and Bhubaneswar by bus than to traverse a distance of 3 km. within the city by cycle-rickshaw.

Table 4.3

Users Ranking of the Quality of MTS and IPT

RANCHI

Ranking	Availability within reasonable waiting time	Comfort & convenience	Getting direct connection to destination	Behaviour of drivers and conductors	Safety	Fare charged
IPT						
Auto Rickshaw						
Good	145 (29.0)	100 (20.0)	72 (14.4)	71 (14.2)	50 (10.0)	47 (9.4)
Average	184 (36.8)	153 (36.6)	153 (30.6)	111 (22.2)	119 (23.8)	139 (27.8)
Poor	155 (31.0)	225 (45.0)	256 (51.2)	300 (60.0)	314 (62.8)	297 (59.4)
No response	16 (3.2)	22 (4.4)	19 (3.8)	18 (3.6)	17 (3.4)	17 (3.4)
Total	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)
Cycle Rickshaw						
Good	159 (31.8)	192 (38.4)	169 (33.8)	182 (36.4)	133 (26.6)	30 (6.0)
Average	220 (44.0)	175 (35.0)	188 (37.6)	137 (27.4)	200 (40.0)	135 (27.0)
Poor	93 (18.6)	103 (20.6)	121 (24.2)	154 (30.8)	145 (29.0	307 (61.4)
No response	28 (5.6)	30 (6.0)	22 (4.4)	27 (5.4)	22 (4.4)	28 (5.6)
Total	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)	500 (100.0)

Note: Percentage are given in the parentheses.

Table 4.4

Users Ranking of the Quality of MTS and IPT

RAJKOT

Ranking	Availability within reasonable waiting time	Comfort & convenience	Getting direct connection to destination	Behaviour of drivers and conductors	Safety	Fare charged
MTS						
Bus						
Good	80 (20.0)	77 (19.3)	97 (24.8)	75 (18.8)	117 (29.3)	88 (22.0)
Average	139 (34.8)	102 (25.5)	147 (36.8)	192 (48.0)	141 (35.3)	128 (32.0)
Poor	181 (45.3)	221 (55.3)	156 (39.0)	133 (33.3)	142 (35.5)	184 (46.0)
Total	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)
IPT						
Auto Rickshaw						
Good	195 (48.8)	216 (54.0)	214 (53.5)	130 (32.5)	150 (37.5)	123 (30.8)
Average	91 (22.8)	79 (19.8)	116 (29.0)	118 (29.5)	165 (41.3)	102 (25.5)
Poor	114 (28.5)	105 (26.3)	68 (17.0)	152 (38.0)	85 (21.25)	175 (43.8)
Total	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)	400 (100.0)

Note: Percentage are given in the parentheses.

Table 4.5

Users Ranking of the Quality of MTS and IPT

CUTTACK

Ranking	Availability within reasonable waiting time	Comfort & convenience	Getting direct connection to destination	Behaviour of drivers and conductors	Safety	Fare charged
MTS						
Bus						
Good	87 (29.0)	73 (24.3)	57 (19.0)	80 (26.7)	114 (38.0)	105 (35.0)
Average	58 (19.3)	80 (26.7)	77 (25.7)	143 (47.7)	112 (37.3)	96 (32.0)
Poor	155 (51.7)	147 (49.0)	166 (55.3)	77 (25.7)	74 (24.7)	99 (33.0)
All	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)
IPTS						
Cycle Rickshaw						
Good	81 (27.0)	64 (21.3)	76 (25.4)	69 (23.0)	85 (28.3)	95 (31.7)
Average	52 (17.3)	73 (24.3)	94 (31.3)	148 (49.3)	79 (26.4)	83 (27.7)
Poor	167 (55.7)	163 (54.4)	130 (43.3)	83 (27.7)	136 (45.3)	122 (40.6)
All	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)
Cycle Rickshaw						
Good	93 (31.0)	87 (29.0)	61 (20.3)	53 (17.7)	109 (36.3)	103 (34.3)
Average	67 (22.3)	93 (31.0)	87 (29.0)	167 (55.7)	98 (32.7)	70 (23.3)
Poor	140 (46.7)	120 (40.0)	152 (50.7)	80 (26.6)	93 (31.0)	127 (42.4)
All	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)	300 (100.0)

Note: Percentage are given in the parentheses.

With apparently low satisfaction level regarding public transport, it is imperative to know the alternatives considered by the people in these cities. For this purpose, the respondents were asked what alternative modes were used by them if the normal or primary mode was not available. IPT is considered to be expensive in most cities while MTS is thought to be relatively cheaper, it meets only a fraction of the total demand in Rajkot and Cuttack while it does not exist in Ranchi. The respondents were also directly asked if they would like to shift from IPT to MTS and what would be the preconditions for doing so.

In Ranchi, the most sought after alternative modes of transport are auto-rickshaw, cycle-rickshaw and walking. A substantial proportion of respondents would also like to use public bus if such a service is provided in the city (Table 4.6). In Rajkot auto-rickshaw is preferred as an alternative mode for work trips by more than half of the respondents while about 12 per cent do not mind travelling by public bus (Table 4.7). In Cuttack, a little less than half of the respondents stated that they would travel to work by cycle-rickshaws and about 20 per cent selected public bus as an alternative mode if the normal mode was not available (Table 4.8). Given the present transport situation, various IPT modes of transport appear to be the most popular alternative in all the case study cities.

Table 4.6
Preference for Alternative Modes
if Primary Mode is not Available for Work Trips

RANCHI

Existing mode	Preference for alternative mode										Total households
	Bus	Auto Rickshaw	Cycle Rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor-Cycle/ Moped	Car	Any other	Avoid travelling	
Bus	-	1 (20.0)	-	-	-	-	-	1 (20.0)	2 (40.0)	1 (20.0)	5 (100.0)
Auto Rickshaw	5 (14.7)	-	10 (29.4)	-	1 (2.9)	9 (26.4)	1 (2.9)	-	3 (8.8)	5 (14.7)	34 (100.0)
Cycle Rickshaw	1 (11.1)	3 (33.3)	-	-	-	2 (22.2)	1 (11.1)	-	-	2 (22.2)	9 (100.0)
Office/School/ Factory bus	-	-	1 (25.0)	-	-	1 (25.0)	-	-	2 (50.0)	-	4 (100.0)
Cycle	16 (21.6)	12 (16.2)	15 (20.3)	2 (2.7)	-	24 (32.4)	-	-	2 (2.7)	3 (4.1)	74 (100.0)
Walk	9 (10.1)	32 (36.0)	20 (22.5)	1 (1.1)	3 (3.4)	- -	3 (3.4)	1 (1.1)	3 (3.4)	17 (19.1)	90 (100.0)
Scooter/Motor cycle/ Moped	20 (10.8)	50 (27.0)	41 (22.1)	12 (6.5)	6 (3.2)	18 (9.7)	-	8 (4.3)	19 (10.3)	11 (5.9)	185 (100.0)
Car	-	6 (30.0)	4 (20.0)	-	-	4 (28.0)	5 (25.0)	-	-	1 (5.0)	20 (100.0)
Other	-	2 (20.0)	3 (30.0)	-	1 (10.0)	3 (30.0)	1 (10.0)	-	-	-	10 (100.0)
Total	51 (11.9)	106 (24.7)	94 (21.9)	15 (3.4)	11 (2.6)	61 (14.2)	11 (2.6)	10 (2.3)	31 (7.2)	40 (9.2)	430 (100.0)

Note: Percentage are given in the parentheses.
This question was not applicable in the case of 53 non-working respondents and 17 gave no response.
'Other' includes use of multiple mode.

Table 4.7

Preference for Alternative Modes
if Primary Mode is not Available for Work Trips

RAJKOT

Existing mode	Preference for alternative mode										Total households
	Bus	Auto Rickshaw	Cycle Rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor-Cycle Moped	Car	Any other	Avoid travelling	
Bus	-	7 (70.0)	-	-	-	-	-	-	2 (20.0)	1 (12.0)	10 (100.0)
Mini bus	-	-	-	-	-	-	-	-	-	-	-
Taxi	-	-	-	-	-	-	-	-	-	-	-
Auto Rickshaw	2 (20.0)	-	-	-	1 (10.0)	1 (10.0)	2 (20.0)	-	-	4 (40.0)	10 (100.0)
Cycle Rickshaw	-	-	-	-	-	-	-	-	-	-	-
Office/School/ Factory bus	-	2 (100.0)	-	-	-	-	-	-	-	-	2 (100.0)
Cycle	26 (32.9)	20 (25.3)	-	-	-	21 (26.6)	5 (6.3)	-	3 (3.8)	4 (5.1)	79 (100.0)
Walk	6 (14.3)	23 (54.7)	-	-	-	-	2 (4.8)	-	3 (7.2)	8 (19.0)	42 (100.0)
Scooter/Motor Cycle/ Moped	10 (5.1)	141 (71.9)	-	-	4 (2.0)	12 (6.1)	-	1 (0.5)	1 (0.5)	27 (13.8)	196 (100.0)
Car	-	9 (52.9)	-	-	-	-	7 (41.2)	-	-	1 (5.9)	17 (100.0)
Total	44 (12.4)	202 (56.6)	-	-	5 (1.4)	34 (9.6)	16 (4.5)	1 (0.3)	9 (2.6)	45 (12.6)	356 (100.0)

Note: Percentage are given in the parentheses.
'Any other' includes use of multiple modes.
Not applicable in the case of 38 non-working respondents and 6 gave no response.

Table 4.8

Preference for Alternative Modes
if Primary Mode is not Available for Work Trips

CUTTACK

Existing mode	Preference for alternative mode									Total households
	Bus	Auto Rickshaw	Cycle Rickshaw	Office/ School/ Factory bus	Cycle	Walk	Scooter/ Motor-Cycle/ Moped	Car	Taxi	
Bus	-	-	2 (50.0)	-	2 (25.0)	1 (25.0)	-	-	-	4 (100.0)
Auto rickshaw	-	-	-	-	-	-	-	-	-	-
Cycle rickshaw	-	-	-	-	1 (100.0)	-	-	-	-	1 (100.0)
Office/School Factory bus	-	-	-	-	-	-	1 (100.0)	-	-	1 (100.0)
Cycle	17 (21.5)	1 (1.3)	34 (43.0)	2 (2.6)	-	18 (22.8)	6 (7.6)	-	1 (1.3)	79 (100.0)
Walk	7 (23.3)	1 (3.3)	13 (43.3)	-	6 (20.0)	-	2 (6.7)	-	1 (3.3)	30 (100.0)
Scooter/Motor Cycle/Moped	21 (21.2)	9 (9.1)	47 (47.5)	-	11 (11.1)	3 (3.0)	-	1 (1.0)	7 (7.1)	99 (100.0)
Car	-	4 (26.7)	8 (53.3)	-	-	-	1 (6.7)	-	2 (13.3)	15 (100.0)
Total	45 (19.7)	15 (6.6)	104 (45.4)	2 (0.9)	19 (8.3)	22 (9.6)	10 (4.4)	1 (0.4)	11 (4.8)	229 (100.0)

Note: Percentages are given in the parentheses.
Not Applicable in the case of 54 non-working respondents and 17 gave no response.

Of those respondents who presently use IPT, 62.8 per cent in Ranchi stated that they would shift to MTS if the bus service was provided at lower cost and congestion and with high level of reliability. In Rajkot the proportion of respondents willing to definitely shift to MTS is 28.9 per cent and in Cuttack it is 43.9 per cent (Table 4.9). People's willingness to shift to MTS is highest in Ranchi which does not have a city bus service and is the lowest in Rajkot which has a fairly good bus service, while in Cuttack buses are not able to ply on all routes owing to the narrowness of the streets in major part of the city.

Table 4.9

Willingness of People to Shift from IPT Modes to MTS Modes if Cost and Congestion is Reduced and Reliability Increased

Cities	definitely shift	Probably shift	Definitely not shift	Number of house-holds presently using IPT modes
Ranchi	182 (62.8)	73 (25.2)	35 (12.0)	290 (100.0)
Rajkot	22 (28.9)	28 (36.9)	26 (34.2)	76 (100.0)
Cuttack	47 (43.9)	45 (42.1)	15 (14.0)	107 (100.0)

Note: Percentages are given in the parentheses.

Perspective of the Suppliers of Public Transport

Viability of urban transport from the point of view of the suppliers and operators has been examined in terms of costs and monetary returns as well as in terms of overall functioning of their modes of transport in the selected cities. For this purpose we interviewed drivers/owners of various modes and office-bearers

of the transporters associations/unions in each city. Although state is also one of the suppliers of city transport in Rajkot and Cuttack, attention has been focussed on the suppliers of IPT as they meet relatively larger proportion of the total demand for urban transport.

The survey of the drivers of IPT in the case study cities reveals that most operators of auto-rickshaws are owner-drivers while majority of the rickshaw-pullers are re-entiers who hire the rickshaws on daily basis (Table 4.10). This shows that majority of the rickshaw-pullers are relatively poorer who can not afford to purchase their own vehicle. Moreover, hiring out of rickshaws is normally controlled by a few wealthy businessmen in each city. Of the owners of these modes in all the three cities, about one-third of the auto-rickshaw owners and over half of the cycle-rickshaw owners have taken loans from commercial banks for purchasing new vehicles. The remaining owners of both the modes have acquired finances from informal sources or have invested their own savings.

Table 4.10

Status of the Drivers of IPT

Cities	Mode	Number of drivers		
		Owner	Rentier	Total
Ranchi	Auto-rickshaw	14	4	18
	Cycle-rickshaw	6	20	26
Rajkot	Auto-rickshaw	15	5	20
	Cycle-rickshaw	-	-	-
Cuttack	Auto-rickshaw	4	1	5
	Cycle-rickshaw	6	16	22

The normal plying time of almost all the drivers of the two modes is throughout the day, starting very early in the morning and working until late in the evening. Only two of the sample auto-rickshaw drivers in Rajkot and one cycle rickshaw driver in Cuttack do the night shift, starting late in the afternoon and working well past mid-night. The drivers of these modes put in long hours of work ranging between 9 and 14 hours per day (Table 4.11). On an average, during these hours each driver of IPT modes makes 11 to 16 trips while each city bus in Rajkot makes 19 trips and in Cuttack each bus makes 9 trips per day (Table 4.12).

Table 4.11

Working Hours of the Drivers of IPT

Cities	Modes	Working hours per day					Total
		6-8	9-11	12-14	More than 14 hrs.	Not fixed	
Ranchi	Auto-rickshaw	-	13 (72.2)	5 (27.8)	-	-	18 (100.0)
	Cycle-rickshaw	4 (15.4)	10 (38.5)	11 (42.3)	1 (3.8)	-	26 (100.0)
Rajkot	Auto-rickshaw	1 (5.0)	4 (20.0)	14 (70.0)	1 (5.0)	-	20 (100.0)
	Cycle-rickshaw	-	-	-	-	-	-
Cuttack	Auto-rickshaw	-	3 (60.0)	2 (40.0)	-	-	5 (100.0)
	Cycle-rickshaw	1 (4.5)	7 (31.8)	10 (45.5)	2 (9.1)	2 (9.1)	22 (100.0)
Total		6 (6.6)	37 (40.6)	42 (46.2)	4 (4.4)	2 (2.2)	91 (100.0)

Table 4.12

Average Number of Trips Made Per Day

Cities	Modes	Average number of trips per day
Ranchi	Auto-rickshaw	14
	Cycle-rickshaw	12
Rajkot	Auto-rickshaw	16
	City bus	19
Cuttack	Auto-rickshaw	11
	Cycle-rickshaw	12
	City bus	9

The average fare per seat/km. for auto-rickshaw is Rs. 2.63 in Ranchi, Rs. 1.96 in Rajkot and Rs. 2.20 in Cuttack. The per seat/km. fare charged by cycle-rickshaw is Rs. 2.27 in Ranchi and Rs.1.94 in Cuttack. The average fare charged by public buses is Re.0.33 per passenger/km. in Rajkot and Re.0.23 per passenger/km. in Cuttack (Table 4.13). The state transport run bus service in Rajkot is relatively more expensive than predominantly private bus service in Cuttack. One of the reasons for this is the relatively higher operating cost of buses in Rajkot. Average operating cost (including fuel, spares, repairs and salary of the drivers and conductors and excluding local taxes, welfare, interest on debt charges and administration cost) in Rajkot is Rs. 3.90 per km. and in Cuttack, it is only Rs. 1.42 per km.[2]. We do not, however, have adequate information to ascertain whether bus revenues are also proportionately higher in Rajkot. A comparison of prescribed fares and actual fare charged (Table 2.5 in Chapter-II) indicates that

2. Divisional Office of the Gujarat State Road Transport Corporation, Rajkot; and interview with the drivers of the privately run city buses, Cuttack.

auto-rickshaws charge two to three times more than the prescribed fares. Although no fare is fixed for cycle-rickshaws, they are equally expensive.

Table 4.13

Fares Charged by Various Modes of Transport

Cities	Modes	Average fare per seat/km. (Rs.)
Ranchi	Auto-rickshaw	2.63
	Cycle-rickshaw	2.27
Rajkot	Auto-rickshaw	1.96
	City bus	0.33
Cuttack	Auto-rickshaw	2.20
	Cycle-rickshaw	1.94
	City bus	0.23

Significant difference has been observed in the operating cost and earnings of owner-drivers and rentier-drivers of the two major IPT modes. The operating cost of auto-rickshaws for owner-drivers involves fuel and maintenance, while for rentiers it means daily rent of about Rs.50 and fuel charges. The operating cost of cycle rickshaw for owner-drivers involves maintenance and repairs and for rentier-drivers, it involves daily rent of Rs.10-15. The operating cost of auto-rickshaw ranges between Rs. 1,297 and Rs. 2,375 while net earnings vary between Rs. 1,000 and Rs. 3,057 per month. The owner-drivers of auto-rickshaws appear to have higher returns than the rentier-drivers. Operating cost of cycle-rickshaws in less than Rs. 60 per month for the owner drivers and between 200 and 300 for the rentier-drivers. The net earnings of the owner-drivers is

about Rs. 700 and of the rentier-drivers about Rs.1,000 (Table 4.14). The inter-city variation in the running cost of auto-rickshaws is largely the result of difference in the cost of fuel.

Table 4.14

Average Operating Cost and Average Income for IPT

Cities	Type of operators	Av. Monthly operating cost (Rs.)		Av. Monthly net earning (Rs.)	
		Auto-rickshaw	Cycle-rickshaw	Auto-rickshaw	Cycle-rickshaw
Ranchi	Owner	2375	25	3057	650
	Rentier	1575	203	1600	1070
Rajkot	Owner	1297	-	1370	-
	Rentier	1406	-	1800	-
Cuttack	Owner	1413	52	2350	783
	Rentier	1300	293	1000	1059

Responding to questions pertaining to the operation of their vehicles, the IPT drivers stated following major problems faced by them :

- Roads are in very bad condition which lead to high degree of wear and tear of their vehicles.
- Authorised parking places provided by the city authorities are not sufficient, particularly at high demand points, such as, bus stand and railway stations.
- The police harass the drivers, at times for false traffic offenses, for extorting money from them.

- Criminals and anti-social elements, especially in Ranchi, also demand illegal commission for plying on particular routes or for parking at specified stands.

- Keeping in view the petrol and diesel price hikes the prescribed fares to be charged by auto-rickshaws are not revised promptly.

- Adequate financing facilities for the purchase of the vehicles on easy terms is not available, especially for cycle-rickshaw operators who are relatively a poorer lot.

The representatives of the unions and associations of the operators of IPT modes feel that main problems in the expansion of the modes are the licensing procedure, legal disputes and court cases, inadequate financing for purchase of vehicles, narrow streets and traffic jams and high operating cost. The cycle-rickshaw associations, although dominated by the owners, suggested that some basic amenities and night shelter should be provided for the rickshaw-pullers who are largely daily or seasonal migrants from rural areas. These associations are also against mass public transport and motorised IPT as it displaces a large number of poor cycle-rickshaw pullers. According to them, one cycle- rickshaw can keep up to three persons gainfully employed. Most of the unions and associations are, however, not registered and therefore, are not able to play a very active role in improving and expanding the operation of various IPT modes in the case study cities.

Perspective of the Regulating and Managing Authorities

The regulating and managing authorities at the city level are responsible for licensing, enforcing regulations regarding fares and boarding, maintaining roads and footpaths, allocating parking spaces and managing traffic flows. The main criterion for the viability of city transport from the perspective of authorities is its manageability.

According to the officials of the local government and traffic police department of the three cities concerned, the present state of city transport and traffic flow is far from satisfactory. The major constraints in managing the transport situation efficiently are as follows:

- There are too many vehicles on the roads, private vehicles as well as IPT vehicles, leading to immense vehicular congestion, slow speed and accidents. In fact, Rajkot with the highest population and vehicle density has also recorded the largest number of fatal and non-fatal accidents (Table 4.15). The government's effort at checking the increasing number of IPT vehicles by fixing an upper limit has not met with much success. There are considerable number of unlicensed vehicles on the roads of these cities, particularly cycle-rickshaws.

- In many parts of these cities, especially in the central non-planned areas, there is no possibility of widening the streets for accommodating the burgeoning flow of traffic.

Table 4.15

Fatal and non-fatal Facilities, 1986 and 1989

Cities	Number of accidents						
	Fatal accidents		Non-fatal accidents		Total accidents		Total accidents per km. of pucca roads
	1986	1989	1986	1989	1986	1989	1989
Ranchi	18	20	147	141	165	161	1.2
Rajkot	59	77	315	529	374	606	1.7
Cuttack	20	14	146	134	166	148	0.7

Source: Records of the Traffic Police of the respective cities.

- Encroachment on the footpaths by hawkers and by illegal parking on the roads further narrows down the width of the city streets.

- The regional traffic on the national and state highways passing through the cities in the absence of by-passes adds to the congestion in these cities.

- The number of police personnel with equipment like motor cycles, jeeps and wireless provided for is not enough for regulating the traffic, enforcing traffic regulations and catching the offenders. The traffic police also do not have judicial powers which will enable them to levy fines on the spot for traffic offenses.

- These cities also lack qualified personnel like traffic engineers. Currently, civil engineers of the local body are responsible for suggesting suitable measures for traffic management.

- Finally, funds provided for road works and repairs in the budget of the local governments are inadequate.

CHAPTER-V

EFFICIENT TRANSPORT ALTERNATIVES FOR MEDIUM SIZED CITIES

This study presents an overview of the transport situation in the selected medium sized cities including the demand and supply of urban transport, institutional arrangement for the provision and maintenance of public transport, modal split, travel patterns and viability of various forms of public transport prevalent. The case study cities have different spatial structure, population density and economic functions. For instance, Rajkot is an industrial and commercial city with a congested core and expanding peripheral areas. Ranchi is a new industrial city with a number of public sector industrial townships spread over a large area. Cuttack is an old congested administrative and commercial city with not much possibility of spatial expansion as it is bound by rivers on the north and south.

Major Findings

The major findings of the study are summarised as follows :

1. The case study cities have three distinct modal mixes. Ranchi does not have any mass transport facility and cycle-rickshaws and auto-rickshaws are the predominant modes of public transport. Auto-rickshaws and buses in Rajkot and cycle-rickshaws and buses in Cuttack are the major means of public transport.

2. Two-wheelers like scooter, motorcycle and moped are the most widely used personalised mode of transport.

3. The public transport systems prevailing in these medium sized cities is inadequate for meeting the existing demand for intra-city travel. The actual boarding on public transport is much higher than the available seating capacity, indicating the gap between the supply and demand.

4. The demand for urban transport in these cities is projected to be almost double by the year 2011.

5. Public transport meets only a small fraction of the total demand for urban transport. The share of MTS in daily trips is zero in Ranchi, and it is 6.7 per cent in Rajkot and 1.6 per cent in Cuttack while IPT accounts for 10-20 per cent of the daily trips. Personalised modes of transport satisfy 40-60 per cent of the demand while walking and use of other modes, such as factory and school buses, take care of another 20-40 per cent of the demand for within the city travel.

6. Work and education trips account for over 60 per cent of the total daily trips while rest of the trips are made for shopping, recreation, social and medical purposes.

7. The household income determines the use of motorised and non-motorised mode as well as public and private means of urban transport irrespective of the city form and structure. Majority of the low-income group persons in the selected cities either walk, use cycles, or travel by bus which is the only affordable means of public transport available to them. Two-wheelers and cars as well as cycle-rickshaws and auto-

rickshaws are popular modes of transport amongst the middle and high-income groups.

8. The city-wise distribution of sample households by income and private vehicle ownership clearly shows that vehicle ownership increases with ascending household income. It can be inferred therefore, that if people can afford, they will prefer high quality private transport which can maintain speed and provide comfort and privacy.

9. Although high-income households spend more money on transport, in absolute terms it is the low and lower-middle-income households who spend a larger proportion of their income on city transport suggesting that urban transport is quite expensive for meeting the requirements of a large majority of the urban poor.

10. More than half of the respondents in Ranchi and Cuttack and over two-thirds of the respondents in Rajkot find public transport inadequate for meeting their requirements. The main reasons for their dissatisfaction with the existing supply and quality of public transport are high cost, poor service, discomfort due to overboarding and slow speed.

11. According to the officials of the local government and traffic police department, the present state of urban transport and traffic flows in the medium cities is far from satisfactory. The major constraints in managing the transport situation efficiently are : too many vehicles on the roads, narrow streets, encroachment on footpaths and streets, and inadequate

personnel, equipment and funds at the disposal of these authorities for road works and repairs as well as for regulating traffic flows within the city.

Efficient Transport Alternatives

The results of this study indicate that the present supply of public transport in the selected medium sized cities is inadequate for meeting the existing demand for travel within the city. The prevailing public transport system also provides poor service at relatively high cost to the users. This leads to proliferation of low occupancy private vehicles resulting in congestion on roads, slow traffic speed, high energy consumption per passenger and high levels of air pollution. Therefore, it is imperative to identify efficient transport alternatives which can facilitate easy movement of people with more comfort and convenience at relatively lower personal and social cost.

The following three policy options are available to the planners for improving the transport situation in cities of any size :

1. Encouraging shift towards a mass transit system and minimising the use of personalised vehicles.
2. Introducing new modes of IPT which may be more suitable for cities of certain types.
3. Making optimum use of the existing system with better management and marginal increase in the fixed and operational cost and improvement in the quality of the service.

The first option of increasing the share of some kind of a mass transit system has been considered the best solution for

dealing with the transport-related problems of even medium sized cities. For instance, as per the modal split levels recommended by the Central Institute of Road Research, 70 per cent of the passengers trips should be carried by mass transit (bus), 15 per cent by IPT (taxi and auto-rickshaw) and another 15 per cent by personalised modes (car and scooter) in medium size cities having population between 0.5 and 1 million. It is estimated that 30 buses per lakh of population would be required to carry the volume of passengers trips generated by the recommended modal split (Table 5.1). Such a modal split appears to be highly unrealistic wishful thinking via-a-vis the present modal split and supply of public transport in medium sized cities.

Table 5.1

Recommended Level of Modal Split for Medium Sized Cities (0.5 to 1 million)

Mass Transit (Bus)	IPT Modes (Taxi & auto-rickshaw)	Personalised modes (Car+two wheeler)	Total	No.of buses per lakh of population
70	15	15	100	30

Source: CIRT (1988) : Report on Energy Implications in Urban Transport, Pune, P.49.

As indicated in Table 5.2, mass transport carries 12 per cent of the passenger trips in Rajkot and 3 per cent of the passenger trips in Cuttack while no mass transport service is available in Ranchi. The number of buses per lakh of population is 9 in Rajkot and 8 in Cuttack which falls much below the recommended number. Given the norm of buses per lakh of population, the number of

additional buses required to meet the present demand is 138 in Rajkot, 97 in Cuttack and a new bus service will have to be started in Ranchi with a fleet of 184 buses. This will require capital investments of the magnitude which are certainly well beyond the resources available for most medium sized cities. Such a recommendation of modal split assumes that (i) adequate funds will be available to invest in mass transit, (ii) the road network of medium cities will be suitable for the movement of heavy vehicles in all parts of the city, and (iii) people currently using personalised and IPT modes would be willing to shift to the mass transit system.

Table 5.2

The Present Modal Split in the Case Study Cities

Cities	Mass Transit (Bus)	IPT Modes (Taxi+Auto-rickshaw+ cycle-rickshaw)	Personalised Modes (Car+Two wheelers)	Total	No.of buses per lakh of population
Ranchi	0	36	64	100	0
Rajkot	12	16	72	100	9
Cuttack	3	35	62	100	8

Note: Excluding Walk, cycle and office/school/factory bus trips.

However, the positive aspects of a mass transit mode like bus cannot be overlooked even if we do not agree with the above mentioned recommended level of modal split. Buses can play an important role in reducing road congestion and energy consumption per passenger km., though at relatively high fixed cost. Buses are also the only affordable means of public transport for the urban poor and economically weaker sections.

The operation of buses is much more advantageous on the following counts :

i. The operating cost per passenger kilometer for two-wheelers and three-wheelers is 3 times the cost of a bus. This in the case of cars is as high as ten times the cost incurred in operating a bus.

ii. The fuel cost for a car and two-wheeler is 13 times and 7 times respectively as compared to that for a bus.

iii. The average occupancy for a bus is the highest in comparison to other modes.

iv. For meeting the same travel demand, a car consumes around 5 times, a two wheeler consumes 2.5 times and three wheeler 3 times more energy than consumed by a bus.

v. For meeting the same travel demand, a bus contributes to nearly one sixth of the pollution as compared to other modes.

Table 5.3

Operational Parameters of Different Transport Modes

Indicators	Operation of Different Modes			
	Bus	Two-Wheeler	Three-Wheeler	Car
Average occupancy	40.0	1.4	1.7	2.6
Energy efficiency Kms/litre	3.5	35.0	25.0	10.0
Cost/PKM (paise)	16.5	51.4	56.5	157.3
Index(Bus=1)	1.0	3.1	3.4	9.5
Fuel cost/PKM (paise)	2.5	18.5	21.1	32.7
Index (Bus=1)	1.0	7.4	8.4	13.1
Emissions in grams/kms	76.1	13.5	19.9	29.2
gms/PKM	1.9	9.6	11.7	10.8
Index (Bus=1)	1.0	5.1	6.2	5.7

Source : Derived from Tata Energy Research Institute (1989) : Urbanisation and Energy in the Third World - A Study of India, New Delhi.

According to the report of the Study Group on Alternative Systems of Urban Transport, urban public transport development should be started when a city reaches a population threshold of 0.25 million and a modal split of 30 per cent for bus service should be the target for cities of over 0.5 million[1]. Upgradation of bus service up to 30 per cent seems more realistic provided the cities in question have all the prerequisites for sustaining a bus service at this level. As per this suggestion, all the three case study cities qualify for having a bus service and the modal share of bus service needs to be upgraded in Rajkot and Cuttack where buses are already operating.

For a medium sized city, there is a range of options for road based mass transport system. The modes which can provide bus service, or bus-like service, on fixed routes with higher occupancy than personalised modes are standard bus, urban bus, mini bus, battery bus and tempo. The design and operational specifications of these modes need to be examined for assessing their suitability for medium sized cities.

Standard Bus

The conventional standard bus is fitted on a truck chassis having dimension of 9.7x2.5 metre (Table 5.4). These buses are specially designed for inter-city travel. However, in many cities, these buses are used for intra-city travel after being modified to

---

1. Government of India (1987): Report of the Study Group on Alternative Systems of Urban Transport, New Delhi, p.6

accommodate larger number of passengers. For instance, shutters of the doors are removed and bars are fitted inside the roof to provide support for standing passengers.

The operation of these buses has been found more successful in such areas of the cities which are not congested and have broad roads without sharp curves, particularly in large cities. The major disadvantages of these buses are as follows:

i. These buses cannot operate on narrow and spiral roads due to their large size and wide turning radius.

ii. The floor height is high which makes boarding and alighting of passengers very difficult.

iii. These are designed for higher cruising speeds which result in high energy costs and pollution.

iv. The body of the conventional bus is comparatively heavier which again results in high energy costs on frequent start and stop operations.

v. It provides poor driver ergonomics.

Urban Bus

The Study Group on Alternative Systems of Urban Transport has suggested an improvement over the conventional standard bus. The 10x2.5 metre "Urban Bus" has 40 seats and crush loading capacity of 90, low floor height (approximately 15-18"), two wider doors (1.25m width), an efficient diesel engine developing its maximum torque at lower r.p.m. with economic fuel consumption at lower speeds (40 k ph), and emitting less pollution. Taking into consideration the price of Rs.4.5 lakhs, the study group pointed out that this bus is 10 per cent faster in speed than the standard bus because of better acceleration and lower stop time, the cost/vehicle km. is 25 per cent less than the standard bus, 10 per cent lower fuel consumption

and 50 per cent less pollution due to efficient engine and higher speed.[2]

The major disadvantage of the "Urban Bus" is that it can also not operate on narrow and spiral roads due to its even larger size than the standard bus and equally wide turning radius.

Mini Bus

Mini buses are yet another mode which could be more suitable for the medium size cities which are compact in nature, having narrow, spiral and overcrowded roads. These buses could be fitted with an efficient diesel engine for reducing costs, oil consumption and pollution. These buses should have wider doors and low height floors so that the commuters could board and get down easily.

The National Commission on Urbanisation has also recommended the introduction of mini bus services which can be stopped any where along the street. The main advantage of introducing mini bus is that "almost every passenger in the mini-bus would represent one less car on the road"[3]. The other advantages of operating mini buses are as follows:

i. The turning radius for mini-bus is only 7 metre while it is 11 metre for standard and urban buses. As a result, mini bus can be operated on narrow and spiral roads having sharp turns where the operation of standard bus is not possible.

ii. The cost/vehicle-km. for mini bus is the lowest (Re.0.55) in comparison to standard bus (Re.1.00)and urban bus (Re.0.75).

---

2. Government of India (1987) : Report of the study Group on Alternative Systems of Urban Transport, New Delhi, p.33.

3. Government of India (1988) : Report of the National Commission on Urbanisation, New Delhi, vol.1, p.18.

Table 5.4
Systems' Parameters

	Mini Bus	Standard Bus	Urban(1) Bus	Battery Bus(4) (Commuter Model)
LxW(m)	6.6x2.3	9.7x2.5	10x2.5	5.43x1.80
Turning radius(m)	7	11	11	-
Vehicle capacity Design (seats)	30 (20)	55 (35)	60 (35)	25(18)
Crush capacity	40	80	90	-
P C U	2	3	3	-
Acceleration (m/s/s)	0.8	0.5	0.8	0.097
Cruising speed[2]	60	60	35-45	40
Average speed (kph)	20	17	20	-
Life (yrs)	8	8	8	-
Energy source	D/P	D	D	96 v.batteries
Cost/vehicle km. (Rs.)	0.55/1.1	1.0	0.75	1.00
Pollution(kg/'000 veh.kms at average speed)	35.0	38.05	19.025	nil
Max.capacity[3] ('000 pphpd on 6 lane road)	15	30	35	-
Vehicle cost[5] (Rs.lakh) Current prices	4.41	4.86	4.5	5.32

Source : Government of India (1987): Report of the Study Group on Alternative Systems of Urban Transport, New Delhi, p.32.

1. Figures are estimated 2. At average congestion
3. At high congestion, and a L/F of 1.0 Capacity is for the public transport system only and excludes other vehicles.
4. Office of the Bharat Heavy Electricals Limited, BHEL House, Siri Fort, New Delhi.
5. Current Prices.*
   Standard Bus : Rs.4.86 lakhs(Rs.3.56 lakhs for chassis with engine and Rs.1,30,000 for Body)
   Mini Bus : Rs. 4.41 lakhs (Rs.3.46 lakhs for chassis with engine and Rs. 95,000 for Body)

iii. Mini bus is faster than standard bus due to better acceleration.

iv. A mini bus causes less pollution (35.0 kg/,000 veh.kms. at average speed) than that of standard bus (38.05 kg/,000 veh.kms. at average speed).

Battery Bus

Keeping in view the oil crisis and increasing pollution, it is advisable to introduce battery powered, smokeless, noiseless and oil free vehicle. The Bharat Heavy Electricals Limited (BHEL) has manufactured Electravan, a battery powered van, propelled by a robust D.C. traction motor, its speed is controlled by an electronic chopper controller and is fuelled by a set of 16 rechargeable lead acid traction betteries.

The main parameters of the Electravan are :

Range per charge	-	70 km
Maximum speed	-	45 km ph
Cruising speed	-	40 km ph
Gradability	-	Over 10%
Specific energy Consumption	-	0.5 KWH/Km.
Seating capacity	-	18

The price of Electravan is Rs. 5.32 lakhs with excise duty and sales tax. The Government gives Rs.1 lakh as subsidy on purchasing one van. Moreover, it is being considered by the government of India that the state governments may exempt such vehicles from the payment of passenger tax and road tax for a period of five years.[4]

---

4. Minutes of the meeting on Electronic Automotive System, held on 19.1.1993, Ministry of Surface Transport, Govt. of India, New Delhi.

Its prescribed seating capacity is 18, excluding the driver and conductor seats. The energy consumption cost is 100 paise per km. The energy cost per passenger kilometer at full load comes around 6 paise.[5]

The Electravans are of two types - commuter van and delux van. In Delhi, these vans are operated by the Delhi Administration and provide free of cost service to government officials. BHEL has already developed a 20 seater battery powered bus which could be seen running in many cities, including Delhi. The Bhopal unit of BHEL has also developed a 40 passenger capacity battery powered bus, designed and manufactured for the Department of Non-conventional Energy Sources. This bus is driven by 38 HP/DC motor and does not have combustion engine and is totally pollution free. It can run at a speed of 40 km. per hour and cover 70 km. in a single charge. The advantages of using Electric Vehicles or battery powered bus are as follows :

i. Conservation of petrol/diesel with consequent saving of precious foreign exchange.

ii. As electravan is energy efficient, it does not use energy when standing on red signals or getting loaded or unloaded, and offers better drive efficiency.

iii. It has low maintenance cost due to the absence of a large number of moving parts like piston and cylinder etc.

iv. It causes no pollution, unpleasant smell or toxic emissions. It therefore helps to keep the living and working environment clean, noise free and hygienic.

v. Because of the absence of engine vibrations, and electrical equipment being used in it has longer life.

vi. Jerk free and smooth ride offers higher passenger comfort.

---

5. BHEL (1992) : Corporate Digest, Vol.No. XII May 1, 1992; and Office of the Bharat Heavy electricals Limited, BHEL House, Siri Fort, New Delhi.

Tempo

Amongst the various IPT modes, i.e. three-wheeler, cycle-rickshaw and tempo, Vikram tempo is a very popular mode in many cities, such as Lucknow, Dehradoon and Agra. Vikram tempos are manufactured by the Scooters India Limited, Lucknow. The operational and other specifications of this tempo are as follows :

Dimensions	:	1.5x3.5m
Seating capacity	:	6 seats (excluding driver's seat)
Engine power	:	10 horse power
Energy source	:	Diesel
Energy efficiency	:	22 kms/litre of fuel
Fuel cost/passenger kilometer	:	11.00 paise
Vehicle price	:	Rs.101,000

In a few medium sized cities, another make of tempos manufactured by Bajaj Auto Ltd. are in operation. The Bajaj Tempos are prices at Rs. 95,000. The operation of this tempo is not very successful as it is a triangular vehicle and is prone to accidents due to rear wheel alignment. Secondly, it is considered to be unfit for operation because of high levels of noise and air pollution. In 1986, the operation of this tempo was banned in Lucknow, keeping in view the safety considerations.6

---

6. Singh, Deepak (1990-91); Alternative Strategy for Mass Transportation (Focus on IPT's): Case Study of Lucknow, Unpublished Dissertation for the Post Graduate Diploma in Planning, School of Planning, C.E.P.T., Ahmedabad.

Tempos provide bus-like service on fixed routes with fixed stops but these can also be stopped anywhere on the request of the passengers. They are allowed to operate within 25 km. radius of the city centre.

Fares charged by these tempos are not kilometer-wise but are charged according to the origin and destination. For the same travel distance, fares are higher in peripheral areas and lower in city centre. They usually charge Re.1 as fare for a distance of first 6 km., Rs. 1.50 for 9 kms. and Rs.2.25 or 2.50 for more than 9 kms.

The operational aspects in favour of tempos are :

i. Tempos can provide service in densely populated areas where the roads are very narrow and spiral and the operation of mini buses is not possible.

ii. Its prescribed seating capacity (7 seats including driver's seat) is more than that of a three-wheeler (3 seats), two wheeler (2 seats) and cycle rickshaw (2 seats).

iii. Its fuel cost per passenger kilometer at full load is less (11 paise), than two wheeler (18.5 paise) three-wheeler (21.1 paise) and cars (32.7 paise).

iv. Fares charged by the tempo operators for the same travel distance are very low in comparison to the fares of three-wheelers and taxis.

v. Increasing use of this mode may lead to reduction in personalised vehicles especially the two-wheelers, and hence, would optimise the use of road space.

Recommended Alternatives for Medium Sized Cities

A review of the operational parameters of various modes of public transport in the context of the reality of the three medium sized cities under consideration suggests that these cities require a judicious combination of bus service and IPT service for

minimising the use of personalised modes. Such a shift towards mass transit has to be supported by the third policy option of making full use of the existing transport system without incurring much additional expenditure.

In general, target for bus service can be fixed at 20-30 per cent of the total passenger trips depending on the condition of each medium city falling in the population size group of 0.25 and 1 million. The choice of the type of bus which can provide a mass transit service will also depend on the road network, the volume of traffic, and people's preference and willingness to pay for the quality of service to be provided. It is certainly not necessary to select standard urban bus for all the medium cities. Smaller buses, either diesel or battery operated, are more suitable for cities with narrow streets. These buses could be operated at higher frequencies to meet the existing demand. Equally important are IPT modes like tempos and shared auto-rickshaws which can provide bus like service and can also operate in areas where plying of even mini buses is not feasible due to the road width or low demand level.

At the city level, considering the current modal split and expressed demand for better public transport service in the three case study cities, it is recommended that a public bus service should be initiated in Ranchi and the existing public bus service should be augmented in Rajkot and Cuttack. As mentioned earlier, at present a mass transit system does not operate in Ranchi while in Rajkot and Cuttack it meets only 6.7 per cent and 1.6 per cent of the total demand for city transport respectively. The following

city specific modal alternatives are recommended for supplementing the existing supply of public transport :

Ranchi : Mini buses should be introduced to provide cheaper public transport on major thoroughfares in Ranchi. The respondents in this city have shown the highest level of willingness to shift from IPT to MTS. The residents of this city are also less inclined to pay more for transport even if their incomes increase.

Rajkot The public buses operate on major streets in Rajkot. This could be supplemented by mini buses and smaller battery buses which can provide bus like service in the central congested part of the city as well as on those routes where low demand level does not justify operation of the standard bus. These modes may also offer more frequent service on the routes where buses are plying less frequently. The residents of this city are likely to be willing to pay more for better quality of the service as incomes increase.

Cuttack The most suitable options for augmenting the existing bus service in Cuttack are also mini and battery buses. Battery buses can operate on narrow city streets and can also act as a

feeder service between the ring road and major points within the city, while mini buses can ply on relatively broader major roads in the city.

The initial target for the public bus service in these cities should be to meet the excess demand for public transport. The excess demand has been defined as the gap between the supply of and demand for public transport, both mass as well as intermediate public transport (see Table 2.8). In Ranchi a fleet of 196 mini buses will be required to meet this gap. In Rajkot 70 per cent of the excess demand can be met by 52 mini buses and the remaining 30 per cent of the demand can be met by 34 battery buses. In Cuttack a total of 36 mini buses and 36 battery buses will be required to meet the 60 per cent and 40 per cent of the additional demand, respectively. The recommended bus service in these cities can be made operational at a cost of Re. 0.30 PKM in the case of mini buses and Re. 0.37 PKM in the case of battery buses (Table 5.5).

The cost estimates presented in table 5.5 clearly indicate that the capital cost of providing for the recommended initial level of public bus service in these cities will be very high. For example, a sum of Rs. 864 lakhs would be required to operate 196 mini buses in Ranchi. Similarly, Rajkot and Cuttack would require an investment of Rs. 400 lakhs and Rs. 340 lakhs, respectively. The concerned state transport undertakings and the local governments are not likely to have the prerequisite funds for investing in public transport systems in medium sized cities.

Therefore, private provision of mass transport service in medium cities appears to be a viable option. The private operators should be permitted to operate on specified routes and they should be allowed to choose the quality of service to be provided. Different quality of bus services can be provided, such as, low-fare ordinary bus service and high-fare delux bus service. A city-level Urban Transport Authority should be set-up to co-ordinate and regulate the operation of these buses through a set of norms for route allocation, boarding, fare charged, safety and pollution control.

Table 5.5.

Viability of Recommended Transport Alternatives for Medium Sized Cities

Cities	Excess demand (Passenger trips per day)	Recommended modes and number of vehicles	Average length of operation of each vehicle per day (kms.)	Average occupancy of each vehicle per trip	Capital cost (in Rs.)	Operating cost/month (in Rs.)	Cost of operation per km. (in Rs.)	Cost/PKM (in Rs.)
Ranchi	304,000	196 Mini buses	150	30	864,36,000	78,16,571	8.86	0.30
Rajkot	146,166	52 Mini buses (70% of the excess demand)	150	30	229,32,000	20,73,784	8.86	0.30
		34 battery buses (30% of the excess demand	120	25	170,91,800	11,26,991	9.21	0.37
Cuttack	100,173	36 Mini buses (60% of the excess demand)	150	30	158,76,000	14,35,697	8.86	0.30
		36 battery buses (40% of the excess demand)	120	25	180,97,200	11,93,285	9.21	0.37

Note : For details of capital cost and operating cost estimates see Annexes 25 and 26.

While recommending increase in the modal share of mass transit in later stages, one has to bear in mind that peoples' natural tendency is to acquire private modes of transport as incomes increase. This may not be a cost-effective option but it certainly offers more comfort and convenience as well as higher social status. Therefore, to lure people away from increasing use of personalised modes of transport may be more difficult than enhancing the supply of public transport for reducing the existing access boarding on public transport. For encouraging people to shift from private and IPT modes to MTS, the public transport has to be made very attractive in terms of cost and convenience. It also requires rigorous campaigning for increasing awareness of people regarding personal and social costs and benefits associated with the use of public transport.

The present regulations regarding licensing of IPTs also needs a serious review. In the medium sized cities, IPTs perform a useful function and its supply may be permitted to rise and match the increasing demand for public transport.

Providing facilities for pedestrian and cycle travel is a must for all medium cities. These modes of travel are cost-effective, do not require fuel and do not lead to air or noise pollution.

It is also necessary to adopt other measures for improving the traffic and transportation systems in all medium cities. These measures include :

- Improvement in the condition of roads and widening of streets and footpaths.

- Road space management by restricting use of road space by heavy vehicles and private motor cars in congested central areas during rush hours.

- Providing authorised parking spaces at high demand areas in order to reduce encroachment on roads by unauthorised parking.

- Facilitating smooth flow of traffic through measures such as traffic signals and signs, one-way streets and speed control with emphasis on enforcement of traffic regulations.

- Road safety and pollution control checks including the inspection of fitness of vehicles as well as training and testing of the IPT drivers.

ANNEXES

Annex - 1

Cities	Population ('000)	Consumption expenditure Rs./Cpta/Mth	Average trip length (km.)	Population aged 16-54 ('000)	Area under roads/unit city area	Employment (number of workers ('000)	Trips/per son/day (NSS 32nd)	Trip/per son/day (Bus based)	Total trips ('000 person per day)
Hyderabad	2272.0	65.3	7.6	1273.5	0.067	643.6	1.12	0.72	1618.2
Gauhati	261.6	72.8	6.4	157.4	0.053	89.6	0.26	0.91	288.3
Ahmedabad	2244.6	66.8	7.3	1298.7	0.089	649.6	1.63	1.3	2909.8
Bangalore	2472.6	65.5	10.6	1431.1	0.038	681.4	1.01	1.31	3240.16
Mangalore	273.9	65.5	6.2	156.4	0.046	104.2	1.01	-	-
Indore	733.9	65.5	14.3	395.1	0.057	213.7	1.11	-	-
Bombay	7237.5	118.1	10.8	4741.4	0.140	2628.4	1.03	1.61	11974.7
Pune	1492.7	79.8	7.9	985.9	0.089	450.7	2.12	1.18	1756.7
Cuttack	284.3	70.1	17.8	161.3	0.007	86.3	0.32	-	-
Ludhiana	534.5	82.5	6.8	307.4	0.094	169.9	0.84	-	-
Jaipur	875.9	68.8	6.5	475.1	0.141	240.9	0.88	0.34	300.0
Coimbatore	853.9	64.8	9.8	508.4	0.076	280.7	1.52	1.51	1290.9
Madras	3889.3	74.7	6.9	2312.1	0.160	1028.6	1.72	1.18	4606.6
Kanpur	1543.6	60.8	5.7	881.7	0.039	424.9	0.67	0.89	1384.2
Lucknow	939.1	60.8	5.8	524.7	0.089	260.8	0.67	0.65	614.0
Moradabad	321.7	60.8	7.9	170.3	0.093	87.3	0.67	-	-
Varanasi	728.1	60.8	4.5	387.4	0.076	195.4	0.67	1.32	960.0
Calcutta	8418.7	108.9	5.8	5237.7	0.060	2620.0	0.86	1.11	9289.7
Chandigarh	355.4	125.7	6.6	220.8	0.186	122.2	2.74	-	-
Delhi	4990.3	88.1	11.2	2886.5	0.180	1590.6	0.97	0.78	3895.5

Source : Govt. of India (1987): Report of the Study Group on Alternative Systems of Urban Transport, Appendices, New Delhi.

Annex - 2

Cities	Population ('000)				No. of trips per person perday				Total trips in thousand persons per day			
	1981	1991	2001	2011	1981	1991	2001	2011	1981	1991	2001	2011
Calcutta	9194	11828	14932	18036	1.249	1.258	1.265	1.269	11478.0	14879.5	18888.0	22896.6
G.Bombay	8243	11161	14965	18769	1.243	1.256	1.256	1.270	1025.0	14018.2	18930.7	23843.2
Delhi	5729	8883	13400	17917	1.222	1.247	1.262	1.269	7003.67	11076.4	16909.6	22742.89
Madras	4289	5776	7433	9090	1.199	1.223	1.238	1.248	5144.14	7064.0	9203.86	11343.71
Bangalore city	2922	5063	8640	12217	1.156	1.213	1.246	1.259	3378.03	6143.2	10762.6	15381.92
Ahmedabad	2548	3682	5216	6750	1.136	1.184	1.216	1.233	2895.44	4359.8	6340.82	8321.8
Hyderabad	2546	3521	4760	5999	1.136	1.179	1.208	1.226	2892.57	4151.9	5751.9	7351.99
Pune	1686	3485	2673	2861	1.057	1.132	1.143	1.153	1782.32	2814.0	3056.79	3299.58
Kanpur	1639	2048	2445	2842	1.050	1.098	1.129	1.152	1721.57	2249.67	2762.35	3275.04
Jaipur	1015	1611	2478	3345	0.902	1.046	1.131	1.173	915.86	1685.33	1804.97	3924.6
Lucknow	1008	1174	1272	1370	0.899	0.955	0.980	1.003	906.1	1120.98	1247.5	1374.1
Coimbatore	920	1128	1304	1480	0.862	0.941	0.988	1.024	793.43	1061.58	1288.86	1516.15
Indore	829	1243	1826	2409	0.815	0.973	1.054	1.142	675.87	1210.09	1962.98	2715.86
Varanasi	797	1013	1239	1465	0.796	0.901	0.972	1.023	634.34	913.07	1204.93	1496.78
Ludhiana	607	921	1369	1817	0.640	0.862	1.002	1.074	388.83	794.26	1372.81	1951.35
Chandigarh	423	713	1174	1635	0.357	0.737	0.819	1.049	150.87	525.65	1120.98	1716.34
Moradabad	345	437	522	607	0.147	0.387	0.353	0.640	50.87	169.22	278.99	388.78
Cuttack	327	483	171	951	0.085	0.473	0.740	0.876	27.7	228.62	530.8	833.0
Mangalore	306	414	554	694	-	0.337	0.578	0.722	-	139.52	320.32	501.11
Gauhati	222	437	654	867	-	0.387	0.685	0.836	-	169.22	446.87	724.82

Source : Govt. of India (1987): Report of the Study Group on Alternative Systems of Urban Transport, Appendices, New Delhi.

Annex - 3

Cities	Year of Study	Population in 1981 (lakhs)	Projected population for year of Study (Lakhs)	Passenger trips (Lakhs)	% of share of Public	
					Public Transport	Cycles
Calcutta	1984	91.9	98.1	86.1	na	na
Bombay	1986	82.4	96.9	113.4	67.3	na
Delhi	1981	57.3	57.3	39.1	59.7	17.3
Madras	1984	42.9	47.0	45.9	75.7	14.9
Hyderabad	1986	25.5	30.3	23.9	43.8	25.8
Pune	1986	16.9	20.6	20.4	31.5	28.0
Kanpur	1987	16.4	19.0	8.0	4.8	51.5
Jaipur	1983	10.2	11.2	9.8	25.5	43.9
Patna	1985	9.2	11.3	10.5	23.1	28.2
Coimbatore	1985	9.2	10.1	8.3	61.4	24.0
Vadodara	1985	7.4	8.9	11.6	43.1	25.2

Source : TERI, (1989): Urbanisation and Energy in the Third World : A Study of India, New Delhi.

Annex 4

Distribution of Households by Income and Vehicle Ownership

RANCHI

Monthly household income (Rs.)	Number and percentage of households owning vehicles								
	Car, Scooter/ Motor-cycle/ Moped & Cycle	Car & Scooter/ Motor-cycle/ Moped	Car & Cycle	Car	Scooter/ Motor-cycle/ Moped& Cycle	Scooter/ Motor-cycle/ Moped	Cycle	No Vehicle	Total
Upto 1000	-	-	-	-	1 (2.2)	-	15 (32.6)	30 (65.2)	46 (100.0)
1001-3000	-	2 (0.8)	-	-	15 (5.7)	102 (39.1)	87 (33.3)	55 (21.1)	261 (100.0)
3001-5000	1 (0.8)	7 (5.3)	1 (0.8)	9 (6.8)	12 (9.1)	91 (68.9)	4 (3.0)	7 (5.3)	132 (100.0)
More than 5000	1 (1.9)	10 (18.5)	3 (5.6)	12 (22.2)	4 (7.4)	22 (40.7)	-	2 (3.7)	54 (100.0)
Income not stated	-	-	-	-	-	6 (85.7)	-	1 (14.3)	7 (100.0)
Total	2 (0.40)	19 (3.80)	4 (0.80)	21 (4.20)	32 (6.40)	221 (44.20)	106 (21.20)	95 (19.0)	500 (100.0)

Note: Percentage are given in the parentheses.

Annex 5

Distribution of Households by Income and Vehicle Ownership

RAJKOT

Monthly household income (Rs.)	Number and percentage of households owning vehicles								
	Car, Scooter Motor-Cycle Moped & Cycle	Car & Scooter Motor-Cycle/ Moped	Car & Cycle	Car	Scooter/ Motor-Cycle/ Moped & Cycle	Scooter/ Motor-Cycle/ Moped	Cycle	No Vehicle	Total
Upto 1000	-	-	-	-	4	3	15	8	30
					(13.3)	(10.0)	(50.0)	(26.7)	(100.0)
1001-3000	2	3	1	2	37	105	65	15	230
	(0.9)	(1.3)	(0.4)	(0.9)	(16.1)	(45.7)	(28.3)	(6.5)	(100.0)
3001-5000	3	2	-	4	31	43	5	6	94
	(3.2)	(2.1)		(4.3)	(33.0)	(45.7)	(5.3)	(6.4)	(100.0)
More than 5000	1	6	-	1	7	19	11	1	46
	(2.2)	(13.0)		(2.2)	(15.2)	(41.3)	(23.9)	(2.2)	(100.0)
Income not stated	-	-	-	-	-	-	-	-	-
Total	6	11	1	7	79	170	96	30	400
	(1.5)	(2.8)	(0.4)	(1.8)	(19.8)	(42.5)	(24.0)	(7.5)	(100.0)

Note: Percentage are given in the parentheses.

Annex 6

Distribution of Households by Income and Vehicle Ownership

CUTTACK

Monthly household income (Rs.)	Number and percentage of households owning vehicles								
	Car, Scooter Motor-Cycle Moped & Cycle	Car & Scooter Motor-Cycle/ Moped	Car & Cycle	Car	Scooter/ Motor-Cycle/ Moped & Cycle	Scooter/ Motor-Cycle/ Moped	Cycle	No Vehicle	Total
Upto 1000	-	-	-	-	3 (7.9)	5 (13.2)	22 (57.9)	8 (21.0)	38 (100.0)
1001-3000	1 (0.6)	-	-	1 (0.6)	40 (25.0)	39 (24.4)	70 (43.8)	9 (5.6)	160 (100.0)
3001-5000	4 (7.0)	3 (5.3)	1 (1.8)	2 (3.5)	23 (40.4)	18 (31.6)	6 (10.5)	-	57 (100.0)
More than 5000	1 (2.3)	8 (18.2)	2 (4.5)	8 (18.2)	7 (15.9)	10 (22.7)	8 (18.2)	-	44 (100.0)
Income not stated	-	-	-	-	-	-	-	1 (100.0)	1 (100.0)
Total	6 (2.0)	11 (3.7)	3 (1.0)	11 (3.7)	73 (24.3)	72 (24.0)	106 (35.3)	18 (6.0)	300 (100.0)

Note: Percentage are given in the parentheses.

Annex 7

Distribution of Daily Trips by Income and Purpose

RANCHI

Monthly household income(Rs.)	Daily trips			
	Work	Education	Others	Total one way trips
Upto 1000	58 (42.6)	42 (30.9)	36 (26.5)	136 (100.0)
1001-3000	306 (30.3)	435 (43.1)	268 (26.6)	1009 (100.0)
3001-5000	162 (28.3)	252 (44.1)	158 (27.6)	572 (100.0)
More than 5000	133 (48.7)	72 (26.4)	68 (24.9)	273 (100.0)
Income not stated	- (0.0)	7 (63.6)	4 (36.4)	11 (100.0)
Total	659 (32.9)	808 (40.4)	534 (26.7)	2001 (100.0)

Note : Percentage are given in the parentheses.

Annex 8

Distribution of Daily Trips by Income and Purpose

RAJKOT

Monthly household income(Rs.)	Daily trips			
	Work	Education	Others	Total one way trips
Upto 1000	23 (22.1)	41 (39.4)	40 (38.5)	104 (100.0)
1001-3000	262 (29.7)	256 (29.0)	364 (41.3)	882 (100.0)
3001-5000	137 (31.8)	121 (28.1)	173 (40.1)	431 (100.0)
More than 5000	106 (41.1)	57 (22.1)	95 (36.8)	258 (100.0)
Income not stated	-	-	-	-
Total	528 (31.5)	475 (28.4)	672 (40.1)	1675 (100.0)

Note : Percentage are given in the parentheses.

Annex 9

Distribution of Daily Trips by Income and Purpose

CUTTACK

Monthly household income(Rs.)	Daily trips			
	Work	Education	Others	Total one way trips
Upto 1000	40 (24.2)	44 (26.7)	81 (49.1)	165 (100.0)
1001-3000	167 (27.7)	237 (39.3)	199 (33.0)	603 (100.0)
3001-5000	84 (28.9)	72 (24.7)	135 (46.4)	291 (100.0)
More than 5000	88 (46.6)	26 (13.7)	75 (39.7)	189 (100.0)
Income not stated	-	-	0.01 (0.0)	-
Total	379 (30.4)	379 (30.4)	490 (39.2)	1248 (100.0)

Note : Percentage are given in the parentheses.

Annex 10

Daily Trips by Motorised and Non-motorised Modes and Household Income

RANCHI

Monthly household income (Rs.)	Motorised trips					Non-Motorisd Trips				Total
	Bus	Auto rick-shaw	Office/ School/ Factory Bus	Scooter/ Motor Cycle/ Moped	Car	Walk	Cycle	Cycle rickshaw	Any other	
Upto 1000	-	9 (6.6)	3 (2.2)	-	-	87 (64.0)	23 (16.9)	13 (9.6)	1 (0.7)	136 (100.0)
1001-3000	6 (0.6)	116 (11.5)	94 (9.3)	167 (16.6)	5 (0.5)	359 (35.6)	164 (16.3)	93 (9.2)	5 (0.5)	1009 (100.0)
3001-5000	3 (0.5)	36 (6.3)	94 (16.4)	198 (34.6)	40 (7.0)	112 (19.6)	48 (8.4)	34 (5.9)	7 (1.2)	572 (100.0)
More than 5000	4 (1.5)	17 (6.2)	39 (14.3)	106 (38.8)	45 (16.5)	46 (16.8)	8 (2.9)	6 (2.2)	2 (0.8)	273 (100.0)
Not stated	-	-	-	6 (54.5)	-	4 (36.4)	-	1 (9.1)	-	11 (100.0)
Total	13 (0.6)	178 (8.9)	230 (11.5)	477 (23.8)	90 (4.5)	608 (30.4)	243 (12.1)	147 (7.3)	15 (0.7)	2001 (100.0)

Note : Percentage are given in the parentheses.
'Any other' includes use of multiple modes.

Annex 11

Daily Trips by Motorised and Non-Motorised Modes and Household Income

RAJKOT

Monthly Household income (Rs.)	Motorised trips							Non-motorisd trips		
	Bus	Auto rick-shaw	Office/ School/ Factor bus	Scooter/ Motor cycle/ Moped	Car	Walk	Cycle	Cycle rickshaw	Any other	Total
Upto 1000	15	9	-	1	-	42	37	-	-	104
	(14.4)	(8.7)	-	(1.0)	-	(40.4)	(35.6)	-	-	(100.0)
1001-3000	67	60	4	310	4	284	150	-	3	882
	(7.6)	(6.8)	(0.5)	(35.1)	(0.5)	(32.2)	(17.0)	-	(0.3)	(100.0)
3001-5000	26	51	4	159	26	94	71	-	-	431
	(6.0)	(11.8)	(0.9)	(36.9)	(6.0)	(21.8)	(16.5)	-	-	(100.0)
More than 5000	5	22	4	116	37	21	53	-	-	258
	(1.9)	(8.5)	(1.6)	(45.0)	(14.3)	(8.1)	(20.5)	-	-	(100.0)
Not stated	-	-	-	-	-	-	-	-	-	-
Total	113	142	12	586	67	441	311	-	3	1675
	(6.7)	(8.5)	(0.7)	(35.0)	(4.0)	(26.3)	(18.6)	-	(0.2)	(100.0)

Note : Percentages are given in the parentheses.
'Any other' includes use of multiple modes.

Annex 12

Daily Trips by Motorised and Non-Motorised Modes and Household Income

CUTTACK

Monthly Household income (Rs.)	Motorised trips: Bus	Auto rick-shaw	Office/ School/ Factory bus	Scooter/ Motor cycle/ Moped	Car	Non-Motorisd Trips: Walk	Cycle	Cycle rickshaw	Any other	Total
Upto 1000	4	-	-	3	-	66	80	12	-	165
	(2.4)	-	-	(1.8)	-	(40.0)	(48.5)	(7.3)	-	(100.0)
1001-3000	10	1	6	161	6	112	179	128	-	603
	(1.6)	(0.2)	(1.0)	(26.7)	(1.0)	(18.6)	(29.7)	(21.2)	-	(100.0)
3001-5000	3	1	-	115	20	24	53	75	-	291
	(1.0)	(0.3)	-	(39.5)	(6.9)	(8.2)	(18.2)	(25.8)	-	(100.0)
More than 5000	2	-	2	86	43	16	12	27	-	189
	(1.6)	-	(1.1)	(45.5)	(22.8)	(8.5)	(6.3)	(14.3)	-	(100.0)
Not stated	-	-	-	-	-	-	-	-	-	-
Total	20	2	8	365	69	218	324	242	-	1248
	(1.6)	(0.2)	(0.6)	(29.2)	(5.5)	(17.5)	(26.0)	(19.4)	-	(100.0)

Note : Percentages are given in the parentheses

'Any other' includes use of multiple modes.

Annex 13

Distribution of Daily Trips by Monthly Household Income, Purpose and Mode

RANCHI

Purpose	Household income	Private vehicle	Mass public transport	Intermediate public transport	Other modes	Total oneway trips
Work	Upto 1000	10	-	4	44	58
		(17.2)		(6.9)	(75.9)	(100.0)
	1001-3000	171	2	32	101	306
		(55.9)	(0.7)	(10.5)	(33.0)	(100.0)
	3001-5000	116	1	19	26	162
		(71.6)	(0.6)	(11.7)	(16.0)	(100.0)
	Above 5000	95	4	12	22	133
		(7.4)	(3.0)	(9.0)	(16.5)	(100.0)
	Income not stated	-	-	-	-	-
	Total	392	7	67	193	659
		(59.5)	(1.1)	(10.2)	(29.3)	(100.0)
Education	Upto 1000	5	-	-	37	42
		(11.9)			(88.1)	(100.0)
	1001-3000	94	-	46	295	435
		(21.6)		(10.6)	(67.8)	(100.0)
	3001-5000	48	2	38	164	252
		(19.0)	(0.8)	(15.1)	(65.1)	(100.0)
	Above 5000	14	2	9	47	72
		(19.4)	(2.8)	(12.5)	(65.3)	(100.0)
	Income not stated	7	-	-	-	7
		(100.0)				(100.0)
	Total	168	4	93	543	808
		(20.8)	(0.5)	(11.5)	(67.2)	(100.0)
Others	Upto 1000	4	-	13	19	36
		(11.1)		(36.1)	(52.8)	(100.0)
	1001-3000	88	-	118	61	268
		(32.8)		(44.0)	(22.8)	(100.0)
	3001-5000	101	1	36	20	158
		(63.9)	(0.6)	(22.8)	(12.7)	(100.0)
	Above 5000	54	1	5	9	68
		(79.4)	(1.5)	(7.4)	(13.2)	(100.0)
	Income not stated	3	-	-	1	4
		(75.0)			(25.0)	(100.0)
	Total	250	2	172	110	534
		(46.8)	(0.4)	(32.2)	(20.6)	(100.0)
All purpose		810	13	332	846	2001
		(40.5)	(0.6)	(16.6)	(42.3)	(100.0)

Notes : Percentages are given in the parentheses.

Annex 14

Distribution of Daily Trips by Monthly Household Income, Purpose and Mode

RAJKOT

Purpose	Household income (Rs.)	Private vehicle	Mass public transport	Intermediate public transport	Other modes	Total oneway trips
Work	Upto 1000	15	1	1	6	23
		(65.2)	(4.3)	(4.3)	(26.1)	(100.0)
	1001-3000	210	3	7	42	262
		(80.2)	(1.1)	(2.7)	(16.0)	(100.0)
	3001-5000	105	5	8	19	137
		(76.6)	(3.6)	(5.8)	(13.9)	(100.0)
	Above 5000	85	3	7	11	106
		(80.2)	(2.8)	(6.6)	(10.4)	(100.0)
	Income not stated	-	-	-	-	-
	Total	415	12	23	78	528
		(73.6)	(2.3)	(4.4)	(14.8)	(100.0)
Education	Upto 1000	14	-	2	25	41
		(34.1)		(4.9)	(61.0)	(100.0)
	1001-3000	87	33	25	111	256
		(34.0)	(12.9)	(9.8)	(43.4)	(100.0)
	3001-5000	46	24	5	46	121
		(38.0)	(19.8)	(4.1)	(38.0)	(100.0)
	Above 5000	44	6	2	5	57
		(77.2)	(10.5)	(3.5)	(8.8)	(100.0)
	Income not stated	-	-	-	-	-
	Total	191	63	34	187	475
		(40.2)	(13.3)	(7.2)	(39.4)	(100.0)
Others	Upto 1000	14	4	7	15	40
		(35.0)	(10.0)	(17.5)	(37.5)	(100.0)
	1001-3000	184	27	34	119	364
		(50.5)	(7.4)	(9.3)	(32.7)	(100.0)
	3001-5000	93	26	11	43	173
		(53.0)	(15.0)	(6.4)	(24.9)	(100.0)
	Above 5000	67	10	4	14	95
		(70.5)	(10.5)	(4.2)	(14.7)	(100.0)
	Income not stated	-	-	-	-	-
	Total	358	67	56	191	672
		(53.3)	(10.0)	(8.3)	(28.4)	(100.0)
All purposes		964	142	113	456	1675
		(57.6)	(8.5)	(6.7)	(27.2)	(100.0)

Note : Percentages are given the parentheses.
'Other modes' includes office/school/factory bus, foot or use of multiple modes.

Annex 15

Distribution of Daily Trips by Monthly Household Income, Purpose and Mode

CUTTACK

Purpose	Household income (Rs.)	Private vehicle	Mass public transport	Intermediate public transport	Other modes	Total oneway trips
Work	Upto 1000	16	-	1	23	40
		(40.0)		(2.5)	(57.5)	(100.0)
	1001-3000	137	3	2	25	167
		(82.0)	(1.8)	(1.2)	(15.0)	(100.0)
	3001-5000	68	2	2	12	84
		(81.0)	(2.4)	(2.4)	(14.2)	(100.0)
	Above 5000	73	2	3	10	88
		(83.0)	(2.3)	(3.4)	(11.4)	(100.0)
	Income not stated	-	-	-	-	-
	Total	294	7	8	70	379
		(77.5)	(1.8)	(2.1)	(18.5)	(100.0)
Education	Upto 1000	20	4	-	20	44
		(45.5)	(9.1)		(45.5)	(100.0)
	1001-3000	103	62	2	70	237
		(43.5)	(26.2)	(0.8)	(29.5)	(100.0)
	3001-5000	40	15	4	13	72
		(55.6)	(20.8)	(5.6)	(18.0)	(100.0)
	Above 5000	13	10	2	1	26
		(50.0)	(38.5)	(7.7)	(3.8)	(100.0)
	Income not stated	-	-	-	-	-
	Total	176	91	8	104	379
		(46.4)	(24.0)	(2.1)	(27.4)	(100.0)
Others	Upto 1000	42	31	1	7	81
		(51.9)	(38.3)	(1.2)	(8.6)	(100.0)
	1001-3000	113	62	3	21	199
		(56.8)	(31.2)	(1.5)	(10.6)	(100.0)
	3001-5000	79	37	-	19	135
		(58.5)	(27.4)		(14.1)	(100.0)
	Above 5000	54	16	-	5	75
		(72.0)	(21.3)		(6.7)	(100.0)
	Income not stated	-	-	-	-	-
	Total	288	146	4	52	490
		(58.8)	(29.8)	(0.8)	(10.6)	(100.0)
All purposes		758	244	20	226	1248
		(60.7)	(19.6)	(1.6)	(18.1)	(100.0)

Note : Percentages are given in the parentheses.
'Other modes' includes office/school/factory bus, foot or use of multiple modes.

Annex 16

Distribution of Households Having Private Modes and Using Public Transport

RANCHI

Private vehicle ownership of households	Public modes				
	Bus	Auto-rickshaw	Cycle-rickshaw	Any other	Total house-holds
Car+Scooter/ Motor-Cycle/ Moped+Cycle	-	1	-	-	1
Car+Scooter/ Motor-Cycle/ Moped	-	5	2	5	12
Car+Cycle	-	1	-	3	4
Car	-	8	-	8	16
Scooter/Motor-Cycle/Moped+ Cycle	1	8	8	13	30
Scooter/Motor-Cycle/Moped	1	40	49	59	149
Cycle	1	40	15	39	95
Total households	3	103	74	124	307

Note:-

(i) There are 92 households, which use private mode of transport only. Similarly, there are 6 households which do not use any mode of conveyance and they commute by walking.

(ii) There are 95 households which have no vehicles.

(iii) 'Any other' includes school/office/factory buses and multiple modes.

Annex 17

Distribution of Households Having Private Modes and Using Public Transport

RAJKOT

Private vehicle ownership of households	Public modes				
	Bus	Auto-rickshaw	Cycle-rickshaw	Any other	Total house-holds
Car+Scooter/ Motor-Cycle/ Moped+Cycle	-	4	-	-	4
Car+Scooter/ Motor-Cycle/ Moped	-	5	-	-	5
Car+Cycle	-	1	-	-	1
Car	-	6	-	-	6
Scooter/Motor-Cycle/Moped+ Cycle	9	60	-	1	70
Scooter/Motor-Cycle/Moped	42	103	-	1	146
Cycle	22	55	-	1	78
Total households	73	234	-	3	310

Note:-

(i) There are 60 households, which use private mode of transport only.

(ii) There are 30 households which have no vehicles.

(iii) 'Any other' includes school/office/factory buses and multiple modes.

Annex 18

Distribution of Households Having Private Modes and Using Public Transport

CUTTACK

Private vehicle ownership of households	Public modes				
	Bus	Auto-rickshaw	Cycle-rickshaw	Any other	Total house-holds
Car+Scooter/ Motor-Cycle/ Moped+Cycle	1	-	4	-	5
Car+Scooter/ Motor-Cycle/ Moped	-	-	4	-	4
Car+Cycle	-	-	3	-	3
Car	2	-	5	-	7
Scooter/Motor-Cycle/Moped+ Cycle	3	3	59	2	67
Scooter/Motor-Cycle/Moped	5	1	45	3	54
Cycle	9	1	89	-	99
Total households	20	5	209	5	239

Note:- (i) There are 43 households, which use private mode of transport only.

(ii) There are 18 households which have no vehicles.

(iii) 'Any other' includes school/office/factory buses and multiple modes.

Annex 19

Distribution of Households by Monthly Expenditure on Transport

RANCHI

Monthly household income (Rs.)	Monthly expenditure (Rs.)									
	0	1-25	26-50	51-100	101-150	151-200	201-250	251-300	More than 300	Total house-holds
Upto 1000	18	3	7	15	3	-	-	-	-	46
	(39.1)	(6.5)	(15.1)	(32.6)	(6.5)	(0.0)	(0.0)	(0.0)	(0.0)	(100.00)
1001-3000	27	1	32	56	75	61	6	3	-	261
	(10.3)	(0.4)	(12.3)	(21.5)	(28.7)	(23.4)	(2.3)	(1.1)	(0.0)	(100.00)
3001-5000	1	-	-	10	68	12	10	22	9	132
	(0.8)	(0.0)	(0.0)	(7.0)	(51.5)	(9.0)	(7.0)	(16.7)	(6.8)	(100.00)
More than 5000	-	-	-	-	2	7	14	8	23	54
	(0.0)	(0.0)	(0.0)	(0.0)	(3.6)	(13.0)	(26.0)	(14.8)	(42.6)	(100.00)
Income not stated	1	2	-	4	-	-	-	-	-	7
	(14.3)	(28.6)	(0.0)	(57.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.00)
Total	47	6	39	85	148	80	30	33	32	500
	(9.4)	(1.2)	(7.8)	(17.0)	(29.6)	(16.0)	(6.0)	(6.6)	(6.4)	(100.00)

Note : In 47 household, only walk and cycles are used as mode of conveyance.

Annex 20

Distribution of Households by Monthly Income and Monthly Expenditure on Transport

RAJKOT

Monthly household income (Rs.)	Monthly expenditure (Rs.)									
	0	1-25	26-50	51-100	101-150	151-200	201-250	251-300	More than 300	Total house-holds
Upto 1000	15	2	6	7	-	-	-	-	-	30
	(50.0)	(6.7)	(20.0)	(23.3)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)
1001-3000	37	-	28	36	57	61	7	4	-	230
	(16.1)	(0.0)	(12.2)	(15.7)	(24.8)	(26.5)	(3.0)	(1.7)	(0.0)	(100.0)
3001-5000	2	-	-	6	15	27	18	17	9	94
	(2.1)	(0.0)	(0.0)	(6.4)	(16.0)	(28.7)	(19.1)	(18.1)	(9.6)	(100.0)
More than 5000	1	-	-	-	7	5	9	5	19	46
	(2.2)	(0.0)	(0.0)	(0.0)	(15.2)	(10.9)	(9.6)	(10.9)	(41.2)	(100.0)
Income not stated	-	-	-	-	-	-	-	-	-	-
Total	55	2	34	49	79	93	34	26	28	400
	(13.8)	(0.5)	(8.6)	(12.3)	(19.8)	(23.3)	(8.5)	(6.5)	(7.0)	(100.0)

Note : In 55 households, only walk & cycles are used as mode of conveyance.

Annex 21

Distribution of Households by Monthly Income and Expenditure on Transport

CUTTACK

Monthly household income (Rs.)	Monthly expenditure (Rs.)									
	0	1-25	26-50	51-100	101-150	151-200	201-250	251-300	More than 300	Total
Upto 1000	7	7	16	6	2	-	-	-	-	38
	(18.4)	(18.4)	(42.1)	(15.8)	(5.3)	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)
1001-3000	9	-	22	26	35	57	11	-	-	160
	(5.6)	(0.0)	(13.8)	(16.3)	(21.9)	(35.6)	(6.9)	(0.0)	(0.0)	(100.0)
3001-5000	-	-	-	4	9	15	19	7	3	57
	(0.0)	(0.0)	(0.0)	(7.0)	(15.8)	(26.3)	(33.3)	(12.3)	(5.2)	(100.0)
More than 5000	-	-	-	-	2	5	7	12	18	44
	(0.0)	(0.0)	(0.0)	(0.0)	(4.5)	(11.4)	(15.9)	(26.3)	(40.9)	(100.0)
Income not stated	1	-	-	-	-	-	-	-	-	1
	(100.0)									(100.0)
Total	17	7	38	36	48	77	37	19	21	300
	(5.7)	(2.3)	(12.7)	(12.0)	(16.0)	(25.7)	(12.3)	(6.3)	(7.0)	(100.0)

Note : In 17 households, only walk & cycles are used as mode of conveyance.

Annex 22

Destribution of Households According to the Monthly Income and Percentage of Household Income Spent on Transport

RANCHI

Monthly household income (Rs.)	Percentage of household income spent on transport				Total house-holds
	Upto 5	5 - 10	More than 10	No expenditure on transport	
Upto 1000	3 (6.6)	7 (15.2)	18 (39.1)	18 (39.1)	46 (100.00)
1000-3000	89 (34.1)	136 (52.1)	9 (3.4)	27 (10.4)	261 (100.00)
3001-5000	90 (68.2)	41 (31.1)	-	1 (0.7)	132 (100.00)
5001-7000	31 (57.4)	23 (42.6)	-	-	54 (100.00)
Income not stated	-	-	-	1 (100.0)	1 (100.00)
Total	213 (43.1)	207 (41.9)	27 (5.5)	47 (9.5)	494 (100.00)

Note : (i) Percentages are given in the parentheses.
(ii) Income not stated = 6 households.

Annex 23

Distribution of Households According to the Monthly Income and Percentage of Household Income Spent on Transport

RAJKOT

Monthly household income (Rs.)	Percentage of household income spent on transport				Total house-holds
	Upto 5	5 - 10	More than 10	No expenditure on transport	
Upto 1000	2 (6.7)	6 (20.0)	7 (23.3)	15 (50.0)	30 (100.00)
1000-3000	64 (27.8)	118 (51.3)	11 (4.8)	37 (16.1)	230 (100.00)
3001-5000	48 (51.1)	44 (46.8)	-	2 (2.1)	94 (100.00)
5001-7000	26 (56.5)	19 (41.3)	-	1 (2.2)	46 (100.00)
Income not stated	-	-	-	-	-
Total	140 (35.0)	187 (46.8)	18 (4.5)	55 (13.7)	400 (100.00)

Note : Percentages are given in the parentheses.

Annex 24

Distribution of Households According to the Monthly Income and Perentage of Household Income Spent on Transport

CUTTACK

Monthly household income (Rs.)	Percentage of household income spent on transport				Total house-holds
	Upto 5	5 - 10	More than 10	No expenditure on transport	
Upto 1000	7 (18.4)	16 (42.1)	8 (21.1)	7 (18.4)	38 (100.0)
1000-3000	48 (30.0)	101 (63.1)	2 (1.3)	9 (5.6)	160 (100.0)
3001-5000	28 (49.1)	29 (50.9)	-	-	57 (100.0)
5001-7000	26 (59.1)	18 (40.9)	-	-	44 (100.0)
Income not stated	-	-	-	1 (100.0)	1 (100.0)
Total	109 (36.3)	164 (54.7)	10 (3.3)	17 (5.7)	300 (100.0)

Note : Percentages are given in the parentheses.

Annex 25

Costing for a Fleet of 15 Mini Buses

Fleet Strength	:	15 Mini buses
Average operation	:	150 kms/bus/day
Seating Capacity	:	20 persons
Average occupancy	:	30 pass./bus

Costs

A. Capital Cost:

Cost of 15 Mini buses (@Rs.4.41 lakhs per bus)	:	Rs.66,15,000

B. Operating Cost:

		Amount (per month)
(i) Personnel cost -		
- Salary of 30 drivers @ Rs.3,000/- per month	:	Rs. 90,000
- Salary of 30 conductors @Rs.3,500/- per month	:	Rs. 3,500
- Salary of one account @Rs. 3,500/- per month	:	Rs. 20,000
- Salary of one Asst. accountant @Rs. 2,500/- per month	:	Rs. 2,500
- Salary of one Head Mechanic and his 5 Assistants	:	Rs. 20,000
(ii) Material Cost -		
(a) Diesel (Rs.222/- per bus/day) for 15 mini buses @Rs.5.17 litre	:	Rs. 99,900.00
(b) Servicing with enginw oil and other lubricants @Rs.1500/bus/month	:	Rs. 22,500.00

(c) Tyres/Tubes/Batteries (After one year) etc. for 15 buses Rs.315,000/ Annum, @ Rs. 21,000/ Mini bus/Annum	:	Rs. 26,250.00
(iii) Comprehensive insurance (Apprx. @Rs.11,000/ Mini bus/month)	:	Rs. 13,750.00
(iv) Motor vehicle tax *, on an average Rs.500/ minibus/month	:	Rs. 7,500.00
(v) Monthly installment on capital cost (Rs. 66,15,000) @17% interest, for a repayment period of 8 years	:	Rs.1,31,032.00
(vi) Monthly installment for establishing depot. (@12% of the capital cost)	:	Rs. 66,150.00
(vii) Contingency	:	Rs. 55.125.00
Total operating cost (i to vii)	:	Rs.5,98,207.00

- Cost of operation per km.

$$\frac{\text{Rs. } 5,98,207}{67,500 \text{ kms}} = \text{Rs. } 8.86$$

- Cost/PKM = Rs. 0.30

  Fare/PKM = 0.40 to 0.50

---

* Motor vehicle tax varies from state to state.

Annex 26

Costing for a Fleet of 15 Battery Buses

Fleet Strength	:	15 Battery buses
Average operation	:	60 kms/bus/day
Average operation with one set of extra batteries	:	120 kms/bus/day
Seating Capacity	:	18 persons
Average occupancy	:	25 pass./bus

Costs

A. Capital Cost:

Cost of 15 Battery buses (@Rs.4,87,500 (ex-works cost)	:	Rs.73,12,500.00
- Total cost with exise duty & sales tax @ Rs.5.31,600	:	Rs.79,74,000.00
- Cash subsidy from govt. Rs.100,000 per bus	:	Rs.15,00,000.00
- Net cost of 15 Battery buses	:	Rs.64,74,000.00
- Net cost of 15 Battery buses with 15 extra sets of batteries (The cost of one battery set is approx. Rs.71,100.00)	:	Rs.75,40,500.00
Total capital cost	:	Rs.75,40,500.00

B. Operating Cost:

(i) Personnel cost -		Amount (per month)
- Salary of 30 drivers @ Rs.3,000/- per month	:	Rs. 90,000.00
- Salary of 30 conductors @Rs.2,000/- per month	:	Rs. 60,000.00
- Salary of one Accountant	:	Rs. 3,500.00

-	Salary of one Asst. Accountant	:	Rs. 2,500.00
-	Salary of 5 maintenance crew (mechanics/electricians)	:	Rs. 12,500.00
(ii)	Energy cost of 15 battery buses batteries, @Rs.39,600/- per bus per annum	:	Rs. 49,500.00
(iii)	Battery replacement cost for 30 sets of batteries (@Rs.23,700/- per set of batteries per annum, assuming 3 years battery life)	:	Rs. 59,250.00
(iv)	Maintenance cost, 15 Battery buses (@Rs.11,000/ bus/annum)	:	Rs. 9,875.00
(v)	Motor vehicle tax* on an average Rs.500/bus/month	:	Rs. 7,500.00
(vi)	Comprehensive insurance approx. @Rs.11,000/ bus/annum	:	Rs. 13,750.00
(vii)	Monthly instalment on capital cost (Rs.75,40,500) @17% interest, for a repayment period of 12 years	:	Rs.1,25,989.00
(viii)	Contingency	:	Rs. 62,838.00
(ix)	Total operating cost (i to viii)	:	Rs.4,97,202.00

$$\frac{\text{Rs. } 4,97,202}{54,000 \text{ kms}} = \text{Rs. } 9.21$$

- Cost/PKM = Rs. 0.37

  Fare/PKM = 0.40 to 0.50

---

* Motor vehicle tax varies from state to state.