Development of Bus Rapid Transit System in Nashik City

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Abstract: *The rapid pace of urbanization and unprecedented economic growth has put majority of the million plus cities in India under serious pressure of traffic congestion, pollution and other related problems. Specially, large cities are facing a rapid growth of personal vehicles (two wheelers and cars) and in medium and small cities different forms of intermediate public transport provided by the informal sector are struggling to meet the mobility demands of city residents. In the era of sustainable development and limited space available in cities, urban planners are designing mass rapid transit systems as a solution to these problems, which can ensure safe and clean mobility to all citizens. In view of Nashik becoming a smart city and increasing number of private vehicles, it is necessary to examine the steps to be taken to make people to opt public transport. BRTS will be most suitable mode of mass transit system. Hence it is necessary to find mode share of BRTS for Nashik.*

Keywords: Compound Annual Growth Rate, Bus Rapid Transit, Transit Oriented Development.

1. INTRODUCTION

1.1 General

The rapid pace of urbanization and unprecedented economic growth has put majority of the million plus cities in India under serious pressure of traffic congestion, pollution and other related problems. Specially, large cities are facing a rapid growth of personal vehicles (two wheelers and cars) and in medium and small cities different forms of intermediate public transport provided by the informal sector are struggling to meet the mobility demands of city residents. While the population of India's six major metro cities went up by 1.9 times during the period 1981 to 2019, the number of vehicles multiplied by over 10.5 times during the same period. The total number of registered motor vehicles increased from about 0.3 million as on March 1951 to about 28.86 million as on 31 March 2018. The total registered vehicles in the country grew at a Compound Annual Growth Rate (CAGR) of 10.5 per cent between 2001 and 2019. In the last decade the growth rate of registered motor vehicles was almost three times the growth rate of the road network in India (Mahadevia et al., 2019).

The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) was introduced by the Government of India in 2005. The Mission, through project funding, gives an impetus to sustainable service improvements in urban agglomerations (UAs) with a population of one million-plus, and aims to encourage reforms, improve infrastructure, and rollout fast-paced urban transport initiatives including Bus Rapid Transit (BRT) System. The mission is led by the Prime Minister's Office, the Ministry of Finance and the Ministry of Urban Development (MoUD, 2006). It interfaces with state and local governments that are eligible for project funding. JnNURM draws mainly from the National Urban Transport Policy (NUTP, 2006), which promotes investments in infrastructure and reformation of Road Transport Corporations (RTCs). The ministry wants to build rapid transit networks in all of India's major cities, and has identified BRT as the core rapid transit mode for

cities with populations under a million. For cities with populations over five million, rail-based technologies are earmarked. In the cities where rail-based rapid transit is planned, BRT will play a supporting role, enhancing the coverage of the rail networks (NUTP, 2006).

1.2 Need of Study

Nashik is the forth largest city in the state of Maharashtra, with a population of 7.82 lakhs as per 2011 census. The number of vehicles registered with Road Transport Authority, Nashik is growing with an average rate of 9.0% every year. When one has a look on the present mode share of the city, there is huge gap between public and private mode shares. This is not a good sign for any growing city such as Nashik, because if the private modes are allowed to grow at such rate, the entire system will get choked up as it is not feasible to construct roads to accommodate every vehicle.

As per the recommendations of the working group of Urban Transport for 11th five year plan (2020-2031), cities with million+ population, low to medium mass transit system along high density corridors should be implemented, the preference being BRTS, Light Rail Transit (LRT) and Mass Rapid Transit (MRT) with increase in population. Similar recommendations were given by the working group of Urban Transport for 12th five year plan (2020-2027). It recommended that for million+ cities at least 20 kilometers of BRTS should be present for every 1 million population. Further if motorized trip length is greater than 5 kilometers, population by 2011 is 1 million, demand by 2031 is between 8000-15000 pphpd then BRTS is preferred mode of public transport.

In view of Nashik becoming a smart city and increasing number of private vehicles, it is necessary to examine the steps to be taken to make people to opt public transport and if a mass transit is provided, what will be its mode share. Taking into account the population and the recommendations listed above, BRTS will be most suitable mode of mass transit system. Hence it is necessary to find mode share of BRTS for Nashik.

2. LITERATURE REVIEW

Heddebaut et al. (2010) discussed the respective American Bus Rapid Transit (BRT) and European Bus with High Level of Service (BHLS) concepts comparing their approaches and implementation conditions. Significant differences between the two are high stop spacing in BRTS while BHLS has lesser stop spacing. More number of seats are present in BRTS as commute time is longer. In BHLS as stop spacing is less, lesser number of seats is provided so that more standing space is available. They describe the gains in ridership findings for several case studies among European countries and concluded that BHLS seems to have a highly promising market in Europe in towns, medium-sized conurbations as well as in the outlying zones of the biggest metropolitan areas.

Jaiswal (2012) examined the impact of BRT System on Ahmadabad's transport sector and the changes that can be brought about by introduction of BRT System in other cities. The author concluded that BRTS Ahmadabad has improved access for local riders by providing advanced public transportation systems. While reducing the environmental impacts of transportation, greenhouse gases and air pollutants can be reduced. This helps cities grappling with rapid growth, congestion and environmental concerns to overcome them.

Satiennam et al. (2013) assessed potentials of BRT for shifting travellers from private vehicles. The study developed modal split models for predicting the choices of private vehicle users on BRT systems. The models were developed based on a Stated Preference (SP) survey. The target group was private vehicle users; which were classified into two groups namely, a group of motorcycle users and a group of private car users. Totally 600 samples were collected, with 300 samples belonging to each group. The attributes used in design of SP survey were access time between residential location and BRT station,

waiting time at station, in vehicle travel time, egress time between BRT station and destination and ticket fare.

Nkurunziza et al. (2008) analyzed individual commuter preferences towards the proposed BRT system in Dar-es-Salaam, Tanzania. Stated Preference survey was conducted to identify how commuters perceive and value the proposed BRT service quality attributes. Opinions were obtained from 684 commuters who travel on regular basis to central business district. The BRT attributes considered for study were travel time, travel fare, and comfort. The stated choice data were analyzed using a binary logit model.

Jawalkote (2011) developed a travel demand model for entire Nashik urban area by considering all transportation systems which were available. Highway network was developed using Q-GIS, and VISUM PLANNING software. Then the four steps of travel demand modeling were implemented using the VISUM software. Stated preference survey was carried out to find out the modal shift towards the BRTS, using questionnaire as a tool. The attributes used in the design of the questionnaire were travel time, travel cost, waiting cost, number of transfers and discomfort. A total of 316 people were interviewed and the data obtained was analysed using ULOGIT package. From results obtained, it was found that the shift to BRTS was 36.2%. Based on travel demand modelingfor2031,two demand oriented corridors were identified.

3. METHODOLOGY

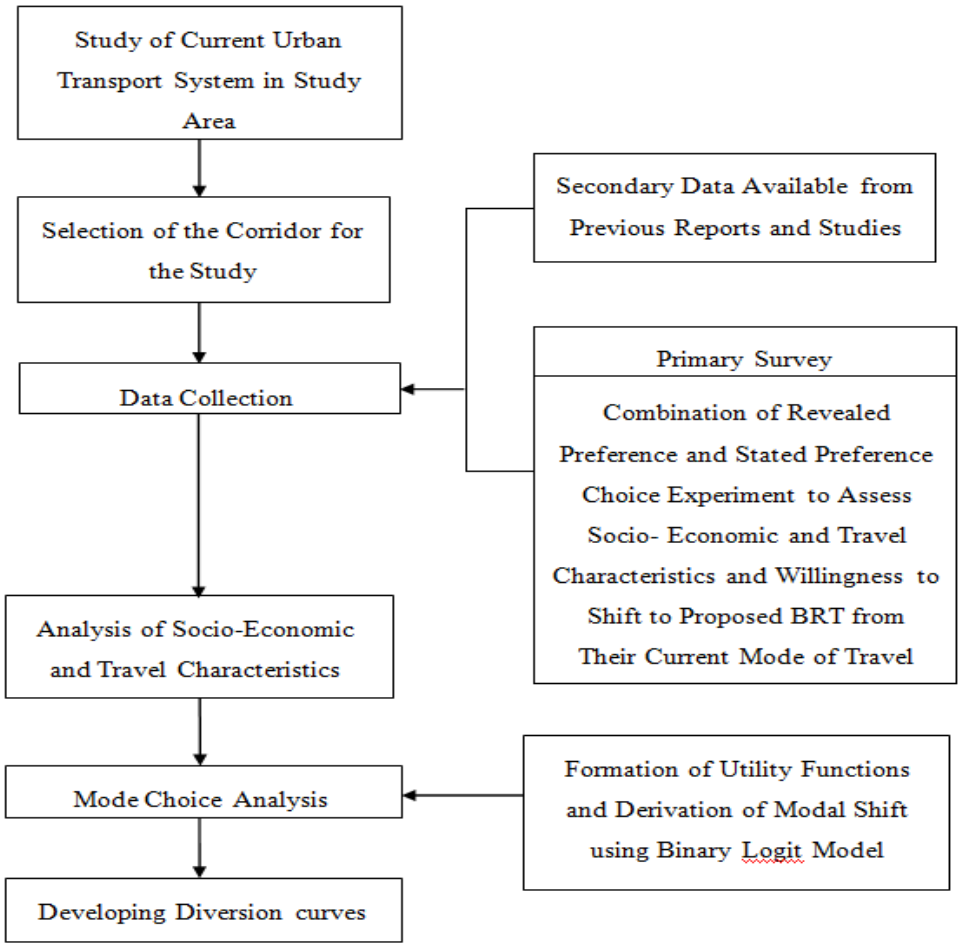

Figure Number 1. Flow chart of Methodology

4. Study Area and Data Collection

The city is included in Metro project and smart city project by central government. The city is known for Nasik is well known for being one of the Hindu pilgrimage sites, that of Kumbh Mela which is held every 12 years. After taking control of 1373 gram panchayats, its population has exceeded 1.4 million and this growth, plus its historical significance, caused the government to authorise the prefix Greater to the name of Nashik Municipal Corporation in early 2015. Presently, the 4-NMC covers over 407.71 square kilometers. City planning is governed by the Nashik Urban Development Authority, which was constituted in 1982. The body oversees development of infrastructure and other projects in the city.

Figure Number 2. Demographic picture

4.1 Study Corridor

ITDP observed shared autorickshaw and MSRTC routes, and also completed traffic counts, Frequency-occupancy counts, and parking surveys across the city to get a better understanding of the existing traffic conditions. Interviews with key agencies, including NMC, MSRTC, the Regional Transport Office, and the Traffic Police, were completed as was exhaustive analysis of agency data sets.

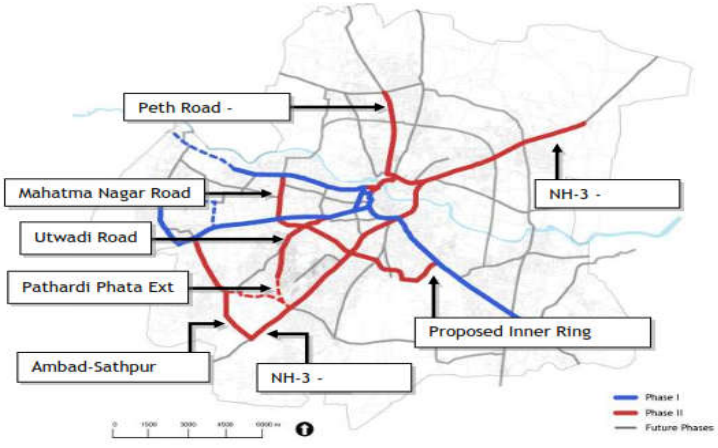

Figure Number 3. Study Corridor

4.2 Analysis of shift at different aggregation levels

Table Number 1. Percent of cases willing to shift to BRT with respect to income levels

Income Ranges in Rs	Total No of Samples	Cases Willing to shift to BRT	
		No of Cases	%age
No Income (student)	90	46	51.11
> 60,000	39	6	15.38
40,000-60,000	34	5	14.74
20,000-40,000	335	83	24.77
10,000-20,000	695	242	34.82
5,000-10,000	627	266	42.42
< 5,000	180	57	31.66
Total	2000	705	35.25

The percentage of shift with respect to gender as presented in table 2 shows that males are more likely to shift to BRT than females. The willingness to shift as per the current mode category is presented in table 3 and presented graphically in figure 4. 23.73% of the motorcycle and 13.14% of the car users said that they will use BRTS for their trips. Some shift is shown from bicycle as well, around 7.69%. The highest shift is from the bus as these are considered mostly captive travelers and is about 70.87%. It is assumed that all the users of bus will be shifted to BRT by default as the BRTS system will be completely replacing the existing City Bus service along the route 1 and also the fare of BRT is more or less comparable to that of City bus. This is followed by auto with a shift of about 58.15%.

Table Number 2. Percent of cases willing to shift to BRT with respect to gender

Gender	Total No of Samples	Cases willing to shift to BRTS	
		No of Cases	Percentage
Female	497	165	33.19
Male	1503	540	35.76
Total	2000	705	35.25

Table Number 3. Percent of cases willing to shift to BRT with respect to current mode

Mode	Total No of Samples	Cases willing to shift to BRT	
		No of Cases	Percentage
Car	175	23	13.14
Two Wheeler	1083	257	23.73
Auto	595	346	58.15
Bicycle	26	2	7.69
Bus	103	73	70.87
Walk	18	4	22.22
Overall	2000	705	35.25

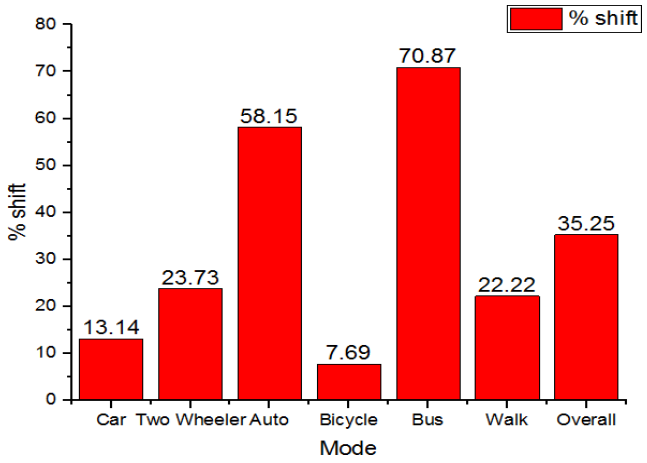

Figure Number 4. Percent of cases willing to shift to brt from current mode

4.3 Developing Diversion Curves from Binary Logit Models

The model used to obtain the following diversion curves is, UBRT –UMC = -2.618 - 0.043(DTT) - 0.156(DTC)+1.318(comfort). Figure 5 shows the shift of motorcycle to Non AC BRTS. Each curve corresponds to varying, difference in travel time values and a constant, difference in travel cost values

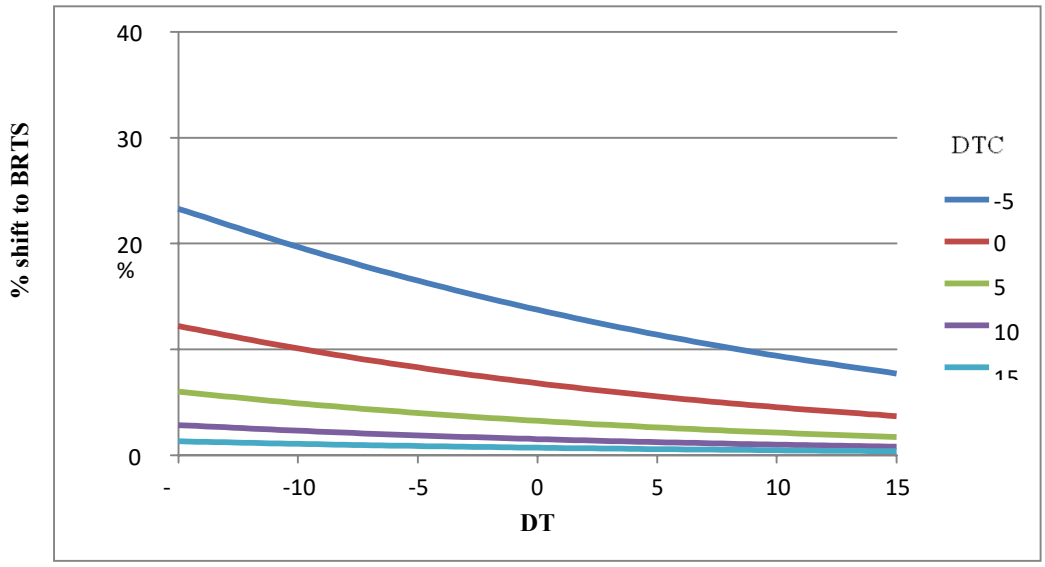

Figure Number 5. Diversion curves for Motorcycle and Non AC BRTS

of the two modes, as indicated in the legend of the graph. For Non AC environment comfort is given value of 0 and for AC environment it is 1. As these curves are forNonAC BRTS, comfort is assigned a value of 0.

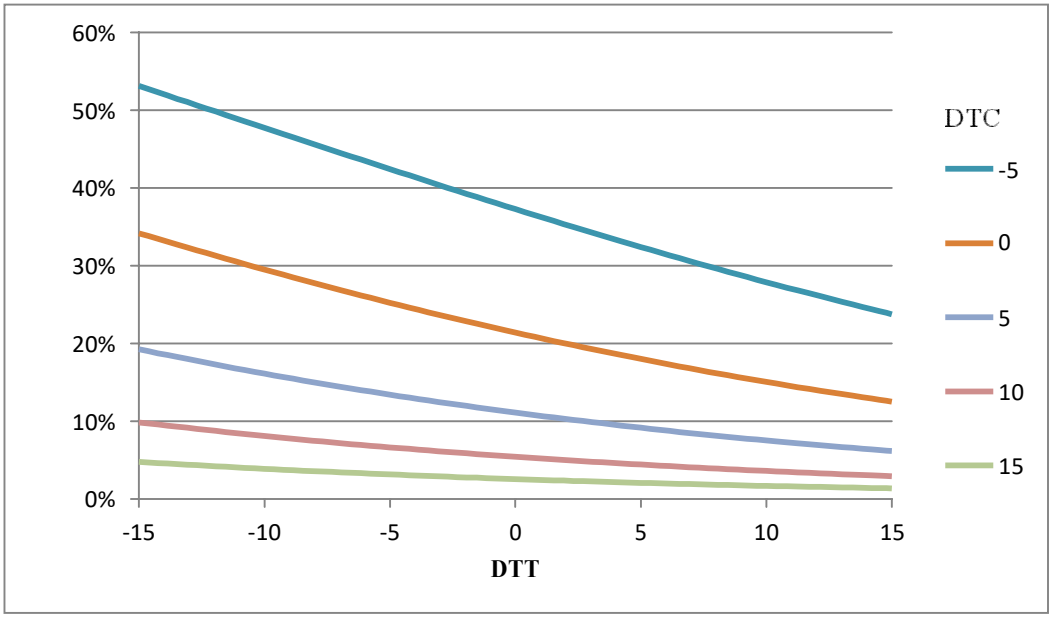

Figure Number 6. Diversion curves for Motorcycle and AC BRTS

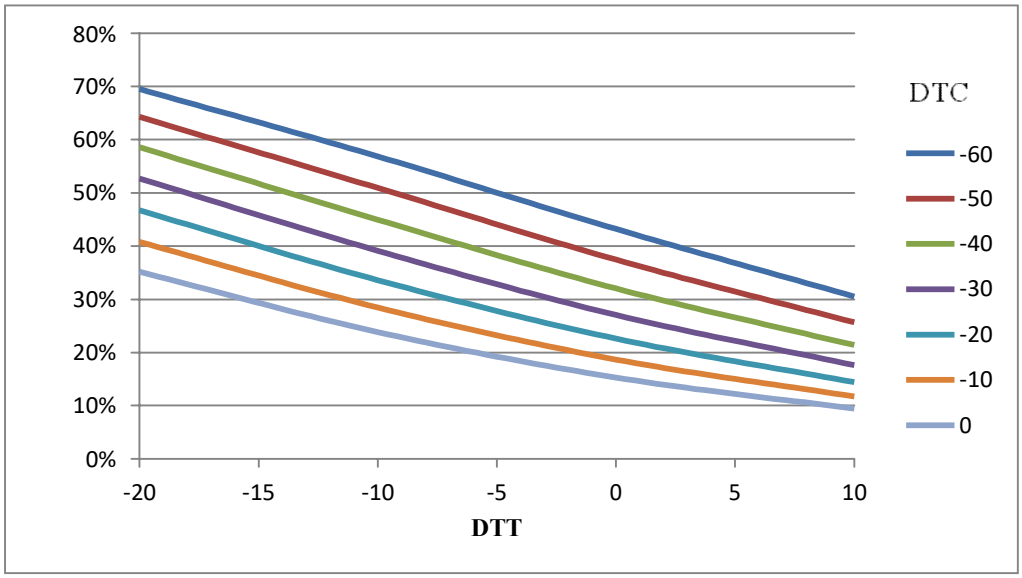

Figure Number 7. Diversion curves for Car and BRTS

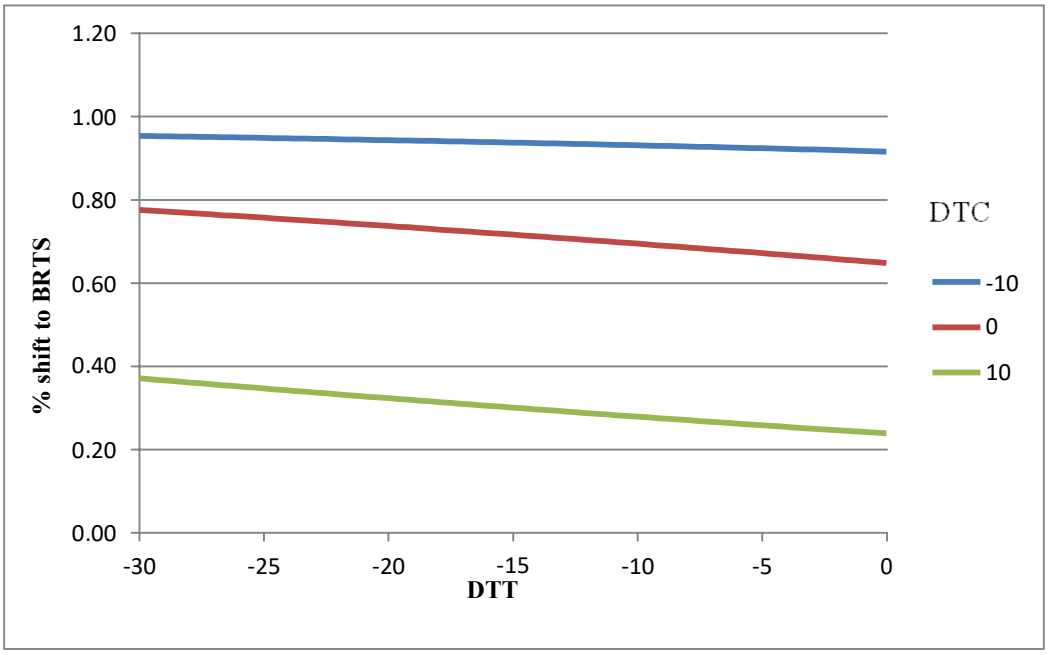

Figure Number 8. Diversion curves for Bus and BRTS

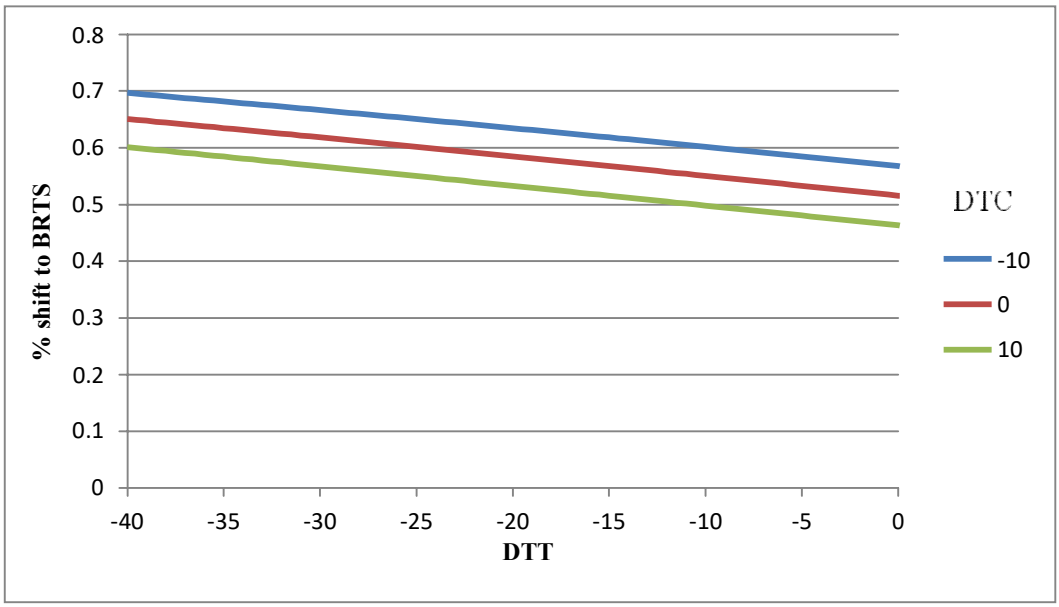

Figure Number 9. Diversion curves for Auto and BRTS

The study has helped to establish the relationship between the socio-economic characteristics of the people and their travel characteristics. The study indicates that the majority of the people in the sample population belong to the middle income group. Motorcycle has a highest share in the modal split which is an indication that people are more attracted to this mode than any other modes. Public transport is predominantly in use by students. Highest average trip length is for bus followed by car and motorcycle. When analysing trip length by purpose, shopping trips are longer than work trips,

followed by educational trips. People are concerned about the low cost, safety and reliable and punctual services of the public transport. Mode choice experiments help in understanding travel behaviour of commuters in choosing a particular mode for their trips. Overall 35.25 % of the commuters are willing to shift to BRTS. When analyzing the shift at different aggregation levels such as income, gender and current mode, it reveals that low income group, males, students and bus users are more likely to use the BRTS. The model for Motorcycle and BRT and Bus and BRT can be considered as good fit model with R square values of 0.312 and 0.316 respectively. The model for Car and BRT and Auto and BRT are having R square values of 0.128 and 0.017 respectively. Diversion curves were developed from binary logit models between all the existing modes and BRTS, to understand the possible shift to BRTS. It can be clearly seen that as travel time saved (difference in travel time) and travel cost saved (difference in travel cost) increases from the existing mode, more percentage of people are willing to shift to BRTS across all existing modes. BRTS having AC environment is likely to have more shift of people when compared to BRTS, not having AC environment.

5. CONCLUSION

The highest shift to BRTS is from bus users followed by auto users and motorcycle users. The least shift is from bicycle and car users. Low income group, males and students are more likely to use BRTS. People are concerned about the low cost, safety and reliable and punctual services of the public transport. Providing feeder bus services is found to be most sort of policy change for private vehicles to shift to BRTS. The policy change for which motorcycle users are more sensitive is enforcement of traffic rules and car users for provision of feeder bus services.

There is a immediate need of providing a effective mass transit system for the city of Nashik as it is growing very fast both in terms of human population and vehicles. Due to the lack of good public transport system, most of the residents use private vehicles, which is quite evident through the vehicular mode share. This needs to be changed or else the entire system will get choked sooner or later. Keeping in view of the recommendations for mass transit systems, BRTS becomes the most suitable option for Nashik. At present there are four routes on which city buses are running. The BRTS is proposed on the route number 1 Gangapur Road from CBS to Serene Meadows, including loop MG Road and Shalimar (7.5 km). Trimbak Road from CBS to Shramiknagar / Mahindra & Mahindra via Mico Circle and Satpur (9 km). Nashik Road Railway Station to CBS via Dwarka Circle and Tilak Path (9.5km).

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