SCENARIO BASED ANALYSIS OF CHANGE IN FARES FOR PUBLIC TRANSPORT, RIDERSHIP, CONGESTION AND EMISSIONS IN BANGALORE

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TABLE OF CONTENTS

1. INTRODUCTION 2

2. DATA AND METHODOLOGY 4

2.1. PARAMETERS IN THE STUDY 6
2.1.1. DEMAND ELASTICITY 6
2.1.2. SCENARIO BASED CALCULATION OF PROFIT & LOSS FOR BMTC 7
2.1.3. MODAL SHARE: 8
2.1.4. ENVIRONMENT 8
2.1.5. EASE OF MOVEMENT: 9

3. SCENARIOS 10

4. RESULTS 11

4.1. REVENUE 11
4.2. MODAL SHARE AND RIDERSHIP: 11
4.3. ENVIRONMENT 11
4.4. EASE OF MOVEMENT 12

5. CONCLUSION 13

1. INTRODUCTION

Transportation is seen as an economic enabler in a city, but there is another critical role played by transportation in social mobility that is mostly ignored. Transportation connects communities to employment, education, and vital services which promote social mobility[1]. As linkages between transportation and economic growth was given more prominence historically, traditional transport planning and evaluation are concerned with efficiency and speed improvement, thus social mobility remains neglected. Moreover, focus on speed improvement led to greater promotion of car-based transport leading to adverse environmental impact[2], and greater speeds has resulted in greater fatality rates[3]. Thus, new paradigms of sustainable transport planning focus on bringing social mobility and environmental impact to the forefront, alongside economic factors. In other words, new paradigm of sustainable urban transportation focuses on evaluation of transport from the lens of transport equity and environment impacts along with efficiency-based parameters[4,5]. Sustainable transport systems thus deal with three aspects: social, economic and environment. Promoting greater modal share for public mass transit like buses, metro and suburban trains is one of the effective strategies towards sustainability[6].

In this report, we focus on the city of Bangalore. Owing to limited ridership of metro, Bangalore Metropolitan Transport Corporation (BMTC) buses are the main means of public transport in Bangalore[7]. Over the years there has been a steady drop in BMTC's ridership[8]. BMTC is also among the costliest public bus service in India, leading to the issue of unaffordability to a large section of the population[9]. In order for transportation to be more sustainable in Bangalore, as described earlier, promoting a greater modal share for BMTC becomes a critical strategy.

Demands for reduction of fare from various quarters[10] has been proposed to increase ridership, but on the other hand, the other the annual losses of BMTC are a cause of concern[11]. Given the various complexities involved, what are the trade-offs and consequences of reduction in fares in building towards sustainable transportation for Bangalore? Scenario-based analysis allows us to examine different what-if questions or future scenarios, and explore consequences and trade-offs of these options. In this report, we present a scenario-based analysis of change in BMTC's fare to understand possible strategies towards a sustainable

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[1] https://www.brookings.edu/events/pathways-to-opportunity-housing-transportation-and-social-mobility/ (Last accessed:07/03/2020)
[2] Martens, K. (2016). Transport justice: Designing fair transportation systems. Routledge.
[3] https://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/speed_en.pdf (Last accessed:07/03/2020)
[4] https://www.tandfonline.com/doi/pdf/10.1080/01441647.2017.1278647?needAccess=true (Last accessed:07/03/2020)
[5] https://www.uncclearn.org/sites/default/files/inventory/unescap20_0.pdf (Last accessed:07/03/2020)
[6] https://www.uncclearn.org/sites/default/files/inventory/unescap20_0.pdf (Last accessed:07/03/2020)
[7] https://www.thehindu.com/news/cities/bangalore/namma-metro-ridership-hits-an-all-time-high-on-deepavali-eve/article29808669.ece (Last accessed:07/03/2020)
[8] https://timesofindia.indiatimes.com/city/bengaluru/as-commuters-shift-gears-bmtcs-daily-ridership-drops-to-36-lakh/articleshow/71238762.cms (Last accessed:07/03/2020)
[9] https://timesofindia.indiatimes.com/city/bengaluru/Bangalore-Metropolitan-Transport-Corporation-ride-costliest-in-India/articleshow/34399312.cms; (Last accessed:07/03/2020)
https://timesofindia.indiatimes.com/city/bengaluru/bmtc-fare-for-first-5km-highest-in-india-study/articleshow/65788161.cms (Last accessed:07/03/2020)
[10] https://indianexpress.com/article/cities/bangalore/bengaluru-80-of-bmtc-commuters-find-fares-too-high-says-survey-6275982/ (Last accessed:07/03/2020)
[11] https://economictimes.indiatimes.com/news/politics-and-nation/record-loss-in-fy19-raises-doubts-about-bmtcs-future/articleshow/69572872.cms?from=mdr (Last accessed:07/03/2020)

transportation for Bangalore. The scenario-based analysis is presented in light of the following three parameters:

a. Financial implication for the bus service provider, i.e. BMTC: We examine the change in revenue generated through ticket-sales when there is a change in ticket prices.
b. Environmental effect due to possible mode shifts: Here we present various scenarios with a shift from private vehicles (cars and motorcycles) to BMTC buses and present the environmental effects.
c. Change in ease of movement due to possible mode shift: We examine the change in road space caused by the change in percentage composition of vehicles, which is caused by the modal shift.

Organisation of the report:

In order to build these different scenarios relating to change in fares of public transport, we first look at different cases in the past from India at the outset in Section 2. Using these cases as a base, we construct different possible scenarios that could result from changing the fares in BMTC in Section 3. In Section 4, we present in detail all the scenarios. In the final section, we present our conclusions.

2. DATA AND METHODOLOGY

As our intent is to build different future scenarios that could result in changing fares at BMTC, we first need to understand what are the effects of change in fare in a public transport ecosystem. In order to do that, we look at past examples in India as exemplars. There have been three well documented cases of fare change in public transport in India in the last five years. We have shortlisted the cases of Brihanmumbai Electricity Supply and Transport (BEST) undertaking of Mumbai, Delhi Metro Rail corporation (DMRC) of Delhi and the Delhi metro Rail corporation – Airport express line based on the availability of data for public transport in the public domain. In each of these cases, the effect of fare hike or fare cut on the ridership of the public transport has been assessed.

The Brihanmumbai Electricity Supply and Transport (BEST)

The Brihanmumbai Electricity Supply and Transport (BEST) is an undertaking of the Municipal Corporation of Greater Mumbai (MCGM). Over the years due to congestion in the city, the efficiency of the BEST's bus fleet began to decline thus leading to operational difficulties. With the mounting financial losses, the MCGM released a revised fare structure in July 2019 in an attempt to increase the ridership[12]. The fare structure with old and revised fares are shown in Table 1 below. The average of both the fares is considered for the purpose of calculating demand elasticity.

	Distance (km)				
	0-5	5-10	10-15	Above 15	Average
Old Non-Ac bus fares (Rs.)	8	13	19	25	16.25
New Non-Ac bus fares (Rs.)	5	10	15	20	12.50

Table 1: Change in BEST's fares based on services provided and distance travelled[13]

The observed change in ridership before and after the fare cut is shown in Table 2 below.

Time Period	8 July 2019	8 August 2019
Ridership (In lakh passengers)	17.15[14]	27.57[15]

Table 2: Observed change in BEST's ridership

[12] Dhaval, D. (2019). BEST's road to financial recovery may face potholes of populism | ORF. Retrieved 25 February 2020, from https://www.orfonline.org/expert-speak/bests-road-to-financial-recovery-may-face-potholes-of-populism-55727/ (Last accessed:25/02/2020)
[13] Ibid.
[14] https://indianexpress.com/article/cities/mumbai/first-day-of-new-fares-in-mumbai-29-rise-in-ridership-31-dip-in-revenue-for-best-5824278/ (Last accessed:09/03/2020)
[15] https://www.hindustantimes.com/mumbai-news/best-s-revised-fares-ridership-up-by-10l-revenue-dips-by-rs38l/story-rDg6lZ0V6F6cTIKyHL8gNJ.html (Last accessed:09/03/2020)

Delhi Metro Rail Corporation (DMRC)

The Delhi Metro Rail Corporation is the service provider for metro services in the National Capital Region in Delhi. Aiming to recover debt, servicing expenses from a loan through Japan International Cooperation Agency (JICA) and in order to maintain a surplus after the expenses and debt liabilities, the fare fixation committee hiked the fares in 2017[16]. The change in DMRC's fare structure for a trip length of 12.9km is shown below in Table 3.

Time period	2015-2016	2016-2017	2017-2018	
			1st fare hike (May 2017)	2nd fare hike (October 2017)
Fares (Rs.)	18	18	30	40

Table 3: Change in DMRC's fare (For a trip length of 12.9km)[17]

The observed change in average daily ridership DMRC is shown below in Table 4.

Time period	2015-2016	2016-2017	2017-2018	2018-2019
Average daily ridership (In lakh passengers)	25.9	27.61	25.38	22.85

Table 4: Observed change in DMRC's ridership[18]

Airport Express line - DMRC

With an aim to improve the efficiency of the airport express line, DMRC took measures to increase its ridership and optimise their expenditure. One step taken in this effort was to rationalise the existing fare structure[19]. The change in DMRC's fare structure is shown below in Table 5.

Time period	July 2014	September 2015
Fare cuts (%)	40	50

Table 5: Change in DMRC's fare for the airport line[20]

16 Roychowdhury, A., Patel, G., Parashar, L., Dubey, G., Joshi, N., & Das, A. (2019). The Cost of Urban Commute: Balancing Affordability and Sustainability of Public Transport.

17 Ibid.

18 https://indianexpress.com/article/cities/delhi/rti-metro-lost-3-lakh-commuters-to-fare-hike-new-lines-helped-but-not-much-5640755/ (Last accessed:09/03/2020)

19 DMRC Sustainability Report. (2019)

20 https://timesofindia.indiatimes.com/city/delhi/only-corridor-not-to-see-a-fare-hike-55000-took-airport-line-daily-in-nov / articleshow/62090329.cms (Last accessed:09/03/2020)

The observed change in ridership before and after the fare reduction is shown below in Table 6.

Time period	July 2014	March 2015	August 2016
Average daily ridership	14197[21]	19796[22]	50000[23]

Table 6: Observed change in the ridership on DMRC's airport line

2.1. PARAMETERS UNDER CONSIDERATION

In order to examine the effects of change in fare on ridership and revenue, we consider demand elasticity, revenue generated through ridership and the profit and loss for BMTC. The details of these calculations are presented below.

2.1.1. DEMAND ELASTICITY

Demand elasticity is a measure that calculates the response of one variable due to the change in the other[24]. The two variables in consideration are fare and ridership. Thus, the demand elasticity calculated is the ratio of change in ridership to the change in fare.

$$Demand\ Elasticity = \frac{\frac{\Delta\ Change\ in\ ridership}{Old\ ridership}}{\frac{\Delta\ Change\ in\ fare}{Old\ fare}}$$

Equation 1: Demand Elasticity

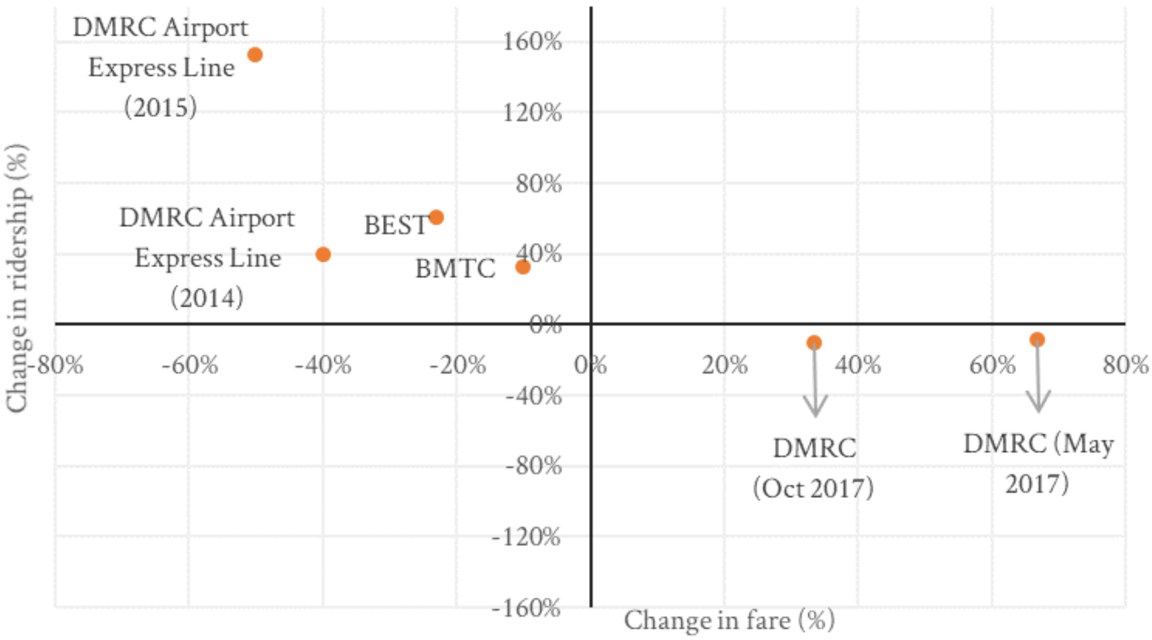

Figure 1: Change in ridership due to change in fare of the data sets considered in the study

21 DMRC Sustainability Report. (2019)
22 Ibid.
23 https://timesofindia.indiatimes.com/city/delhi/ridership-grew-steadily-on-igi-metro/articleshow/58635179.cms (Last accessed:09/03/2020)
24 Dhok, D., & Gadepalli, R. (n.d.). Demand elasticities of Bus ridership in India Case study of Bangalore.

Figure 1 above is a diagrammatic summary showing the change in ridership due to change in fare of all the literature studies considered above in comparison to BMTC. The demand elasticity for BMTC considered is -3.3[25]. Table 7 below shows demand elasticities observed in different cases.

	BEST	BMTC (Vajra)	DMRC		DMRC (Airport express line)	
Demand Elasticities	-2.63	-3.3	-0.12	-0.3	-0.99	-3.05
Average	-2.63	-3.3	-0.21		-2.02	

Table 7: Demand elasticities for the chosen datasets

Therefore, the values for demand elasticity that was considered for the development of the scenarios was 0, -2, -3.3.

2.1.2. SCENARIO BASED CALCULATION OF PROFIT & LOSS FOR BMTC

The steps considered for this calculation is divided into three main sections representing the order followed: Daily ridership, Traffic revenue calculation and Profit/loss incurred.

Daily ridership: The daily ridership data for different years for BMTC is shown below in Table 8.

	2014-15	2015-16	2016-17	2017-18	2018-19
Daily Ridership (In lakh passengers)	51.3	50.7	45.3	44.4	35.8

Table 8: Daily ridership data for BMTC

The change in ridership is based demand elasticities considered for different scenarios.

Traffic revenue calculation: The traffic revenue can be represented by the equation below,

$$Traffic\ Revenue_{Scenario} = Average\ fare\ per\ passenger_{Scenario} * Daily\ ridership_{Scenario} * 365$$

Equation 2: Revenue through ticket sales

In the year 2018-19, BMTC's revenue from ticket sales is Rs.1838.8 crore. In 2018-19, the average fare per passenger translates to Rs. 14.07. Finally, for the different scenarios the change in average fare per passenger is calculated accordingly.

Profit/Loss incurred:

The traffic revenue for 2018-19 is considered for business-as-usual scenario. For other scenarios, the change in traffic revenue is due to change in fare and ridership. The profit/loss is then the difference between the traffic revenue in the given scenario to that of business-as-usual.

[25] Ibid.

2.1.3. MODAL SHARE:

The average modal share for different travel modes used in this study for Bangalore is shown in Table 9.

	PC	MC	PT	IPT	NMT
Modal Share (2005) [26]	4.76%	20.16%	38.70%	7.38%	29.00%
Modal Share (2008) [27]	8.00%	17.00%	35.00%	7.00%	33.00%
Modal Share (2011) [28]	6.00%	25.00%	27.00%	7.00%	35.00%
Modal Share (2013) [29]	2.00%	28.00%	35.00%	4.00%	31.00%
Modal Share (2015) [30]	10.00%	23.00%	29.00%	4.00%	34.00%
Modal Share (2018) [31]	10.00%	23.00%	29.00%	4.00%	34.00%
Average	6.79%	22.69%	32.28%	5.56%	32.67%

Table 9: Modal share for different modes in Bangalore

PC=Passenger Car, MC=Motorcycle, PT=Public Transport, IPT=Intermediate Public Transport, NMT=Non-motorised transport

In this study we explore the implication of change of ridership of bus based on change of fare, and its corresponding effect on the modal share if the change in ridership of bus is compensated by change in ridership of car and motorcycles in different scenarios.

2.1.4. ENVIRONMENT

This study considers the tailpipe greenhouse gases (GHG) emissions for estimating the effect on environment. The GHG's considered are CO_2, CH_4 and N_2O, the relative global warming potentials[32] of these gases considered are 1, 27 and 298 eq. CO_2 units. The emission factors for Passenger Car, Motorcycle and Public bus were derived from the COPERT[33] emission database. The emission factor for different modes used in this study is shown in Table 10 below.

PC (Petrol) kg eg.CO_2/km	PC (Diesel) kg eg.CO_2/km	Bus (Diesel) kg eg.CO_2/km	MC (Petrol) kg eg.CO_2/km
0.257	0.204	1.159	0.064

Table 10: Emission for different modes per km

PC=Passenger Car, MC=Motorcycle

[26] Comprehensive Traffic and Transportation Plan for Bangalore, 2011
[27] Wilbur Smith Associates – Government of India (2008)
[28] Bangalore Mobility Indicators, http://www.urbantransport.kar.gov.in/Bangalore%20Mobility%20Indicators_(22-12-2011).pdf, (Last accessed:02/03/2020)
[29] WRI India Household Survey (2013)
[30] D. Baindur and P. Rao, "Equity in public transport — a case of Bangalore's city bus transport," J Sustain Urbaniz Plan Prog, vol. 1, no. 1, 2016, doi:10.18063/JSUPP.2016.01.002.
[31] https://www2.deloitte.com/content/dam/insights/us/articles/4331_Deloitte-City-Mobility-Index/Bangalore_GlobalCityMobility_WEB.pdf (Last accessed:02/03/2020)
[32] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (Last accessed:02/03/2020)
[33] https://www.emisia.com/utilities/copert/ (Last accessed:02/03/2020)

The fuel split between petrol and diesel passenger cars was assumed to be 60%:40% based on past passenger car sales data[34]. The average distance of daily travelled for a person in Bangalore is 12 km[35], the distribution of average distance across different trips is assumed to follow a normalized distribution with the average of 12km. 100% occupancy of all modes is considered. The annual emission for different modes is then calculated using the equation below.

$$Annual\ GHG\ Emission_{mode} = Emission\ Factor_{mode} * Modal\ Share * Annual\ distance\ travelled_{mode}$$

Equation 3: Annual emission based on modal share

2.1.5. EASE OF MOVEMENT:

For ease of movement the lane kilometers occupied by different vehicles is considered. The average lane width[36] considered in this study is 3m. The vehicle dimensions considered is given in Table 11.

	PC	MC	Bus
No. of Vehicles side by side in a lane	1	3	1
Length of vehicle (m)	3.84	2.05	11
Capacity (No. of passengers)	5	2	60

Table 11: Vehicle dimensions

Vehicle occupancy for all modes is assumed to be 100% and distance between vehicles in queue is assumed to be 0.5m. For the calculating the lane kilometres occupied by different modes following equation is used.

$$Lane\ Kilometers_{mode} = \frac{Total\ Vehicles_{mode}}{Vehicles\ in\ lane_{mode}} * (Length\ of\ vehicle_{mode} + 0.5)$$

Equation 4: Length of lane occupied by a specific mode

[34] http://www.autopunditz.com/autopedia/fuel-split-sales-passenger-vehicles/ (Last accessed:02/03/2020)

[35] D. Baindur and P. Rao, "Equity in public transport — a case of Bangalore's city bus transport," J Sustain Urbaniz Plan Prog, vol. 1, no. 1, 2016, doi:10.18063/JSUPP.2016.01.002.

[36] http://smartcities.gov.in/upload/uploadfiles/files/IUT-1.pdf (Last accessed:02/03/2020)

3. SCENARIOS

As described earlier, we wish to explore the effects of change in fare on BMTC's finances, environment and ease of movement. In the previous section, we looked at different examples from India, and have listed a set of parameters that will help us build different future scenarios. In this section, we outline four scenarios based on the analysis done earlier.

BMTC's revenue earned from ticket sales accounts for 80.2% of the gross revenue[37]. In order to ensure consistency across scenarios and calculates, we have ensured that operational costs for BMTC does not change due to increase/decrease in fleet size. Please note that we are not recommending that the fleet size for BMTC remains constant, we only wish to analyse effects of fare change on ridership and traffic congestion considering all other parameters remain constant. This would indicate that the load factor for BMTC does not exceed 100%, therefore we consider 10% change (increase/decrease) infares of BMTC for our scenario-based analysis. Based on the demand elasticity observed for different cases in India, which has been explained in section 2.1.1,we have considered following 4 scenarios:

- Scenario 1: In this we consider 10% reduction to BMTC's average fare prices, which leads to possible a 33% increase in ridership for BMTC.
- Scenario 2: In this we consider 10% reduction to BMTC's average fare prices, which leads to a possible 20% increase in ridership for BMTC.
- Scenario 3: In this we consider 10% reduction to BMTC's average fare prices, which leads to no change in ridership for BMTC.
- Scenario 4: In this we consider 10% increase to BMTC's average fare prices, which leads to a possible 20% reduction in ridership for BMTC.

All the above 4 scenarios are compared to the business-as-usual (BAU) scenario for Bangalore and BMTC. Due to availability of the data, we have chosen 2018-19 as the year of analysis.

The total capacity of buses for BAU (2018-2019) is calculated with reference to the daily ridership and load factor of the previous years (2015-2016, 2016-2017). An average of the load factors in 2015-2016 and 2016-2017 is used due to unavailability of data for other years. This data is used to calculate the total capacity of the bus. The total capacity is assumed to be similar for business-as-usual (2018-2019) as the variation in fleet size and schedules operated is small. Based on the change in ridership considered, load factor for the all the scenarios are calculated.

As discussed previously, in order to keep the cost of operations constant, we considered a fare change of 10% which leads to the load factor varying between 55.9% and 74.4%. Therefore, the fleet size does not change across the scenarios.

[37] https://www.mybmtc.karnataka.gov.in/info-1/Perfomance+Indicator/en (Last accessed:02/03/2020)

4. RESULTS

In this section, we present the results of the analysis for the various scenarios and the shortlisted cases of fare change in public transport in India.

4.1. REVENUE

The results for change in traffic revenue of BMTC for different scenarios is shown in Table 12 below.

	BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Fare change (%)	-	-10%	-10%	-10%	10%
Change in ridership (%)	-	33%	20%	0	-20%
Load Factor (%)	55.9%	74.4%	67.2%	55.9%	44.8%
Daily Ridership (In lakh passengers)	35.8	47.61	42.96	35.8	28.64
Average fare per passenger (Rs.)	14.07	12.66	12.66	12.66	15.47
Traffic revenue (In crore Rs.)	1838.8	2201.1	1985.9	1654.9	1618.2
Profit/(Loss) from BAU (In crore Rs.)	-	362.2	147.1	(-183.9)	(-220.7)

Table 12: Results for change in revenue for different scenarios

4.2. MODAL SHARE AND RIDERSHIP:

The ridership and number of vehicles for different modes and for the different scenarios is shown in Table 13 below.

		BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Ridership (In lakh passengers)	PC	7.5	1.6	4.0	7.5	11.1
	MC	25.2	19.3	21.6	25.2	28.7
	Bus	35.8	47.6	43.0	35.8	28.6
Number of Vehicles (In lakhs)	PC	1.5	0.3	0.8	1.5	2.2
	MC	12.6	9.6	10.8	12.6	14.4
	Bus	0.6	0.8	0.7	0.6	0.5

Table 13: Ridership and number of vehicles in different scenarios

4.3. ENVIRONMENT

Based on the change in ridership and number of vehicles across different scenarios, the total GHG emission for different scenarios is shown in the Table 14 below.

		BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Annual GHG emission	Mt CO2eq	0.827	0.711	0.756	0.827	0.897
Change from BAU	Mt CO2eq	-	-0.116	-0.070	0.000	0.070

Table 14: GHG emission for different scenarios

4.4. EASE OF MOVEMENT

The result for change in ease of movement for different scenarios is shown in Table 15 below.

Lane Kilometres	BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Bus	686.2	912.6	823.4	686.2	548.9
PC	653.9	141.1	343.1	653.9	964.6
MC	1069.6	818.5	917.4	1069.6	1221.7
Total	2409.6	1872.3	2084.0	2409.6	2735.3

Table 15: Lane kilometres occupied in different scenarios

4.5. OVERALL

The overall results in terms of change in traffic revenue for BMTC, change in GHG emission and Lane kilometres occupied possible for Bangalore for different scenarios is shown in Table 16 below.

	BAU	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Traffic Revenue (Rs. Crore)	1838.8	362.2	147.1	-183.9	-220.7
GHG Emission (Mt CO_2eq.)	0.827	-0.116	-0.070	0.000	0.070
Lane Kilometres (km)	2409.6	-537.3	-325.7	0.0	325.7

Table 16: Overall results for different scenarios

The present gross losses of BMTC for 2018-2019 is 538.2 crores. As can be seen from Table 16, for 10% reduction in price, the implication on revenue for BMTC ranges from reduction of this loss by Rs. 362.2 crores to an increase of loss by Rs. 183.0 crore. On the other hand increase in fares by 10% can likely lead to increase of loses by Rs. 220.7 crores. The reduction of fare by 10% can likely lead to reduction of emission ranging from marginal decrease to a decrease of 0.117 Mt of CO_2eq and a reduction of lane kilometres occupied ranging from n change to reduction by 537.3km. This can lead to substantial reduction in congestion and impact on environment. However, a fare increase of 10% is likely to increase both congestion and emission.

5. CONCLUSION

In this study we presented a scenario-based analysis of possible implication of change of fares of BMTC by 10% on the finances of BMTC, effect on environment and ease of movement. In three of the scenarios, we see that reduction of fare can lead not only to the increase in ridership which is in line with BMTC's vision, but can also lead to reduction of losses for BMTC, and can improve the environment and ease of movement, by reduction of GHG emission and private vehicles on road. In Scenario 3, where it is assumed that the decrease in fare does not change ridership, do we notice an increase in losses. In Scenario 4, where we consider a 10% increase in fare, and we factor a drop in the ridership, we notice an increase in losses, greater emission and congestion on roads due to modal shift which result in a higher number of private vehicles on the road. As indicated earlier, this study does not recommend maintaining the fleet size, but examines the effects of fare change considering all other factor remain constant. As the population of the city of Bangalore has increased, it therefore is important to increase the capacity and fleet size of BMTC proportionally. In 2018-19, BMTC had a fleet size of 0.5 buses per 1000 population, which is lower than the India's average of 1.2 buses per 1000 population. For Bangalore, BMTC would require a fleet size of 14952 buses in order for it to reach India's average of 1.2 buses per 1000 population. According to Transforming India's Mobility report by NITI Aayog[38], India lags in terms of bus fleet per population as compared to other countries, and in order to increase modal share towards public transport, the fleet size needs to be significantly improved.

While this study focuses on the city and provides an indication towards possible implication of reduction in fares, a further in-depth analysis can help in developing strategies that can help increase modal share of BMTC buses, which can help us move towards a sustainable transport for the city of Bangalore. In order to ensure that public transport options such as buses in urban India continue to remain effective and there is a greater adoption and use public transport, various strategies can be employed such as a viability gap funding, allocation of funding for infrastructure cost and cost of operations, subsidising fares through state and central schemes, employee bus passes sponsored by the employers, etc.[39] These strategies have to be employed in conjunction with promotion of non-motorised transport, improving walkability in cities and improving last-mile connectivity.

[38] https://niti.gov.in/writereaddata/files/document_publication/BCG.pdf (Last accessed:08/03/2020)

[39] https://www.uncclearn.org/sites/default/files/inventory/unescap20_0.pdf (Last accessed:08/03/2020)
https://wricitieshub.org/online-publications/83-public-transport-subsidies (Last accessed:08/03/2020)
https://www.pwc.in/assets/pdfs/urban-transportation-financing.pdf (Last accessed:08/03/2020)