Original Article **ISSN: 2788-8517 (online), 2788-9963 (Print)**

Journal of Urban Development Studies
Vol. 2, Issue 2 (2022)

Economic and Environmental Impacts of Road Traffic Congestion in Addis Ababa; the case of Ayat-Mexico Corridor

Yibeltal D. Tazzie

[1]Lecturer of Transport Planning and Management, College of Urban Development and Engineering, Ethiopian Civil Service University, Email: yibe988@gmail.com

Received: 01 July 2022, revised:12 October 2022, accepted: 10 November 2022

Abstract

This research aimed to analyze the economic and environmental impacts of traffic congestion in Addis Ababa, the case of Ayat-Mexico road corridor, one of the city's busiest road corridors. To this end, a survey research design was employed, and 384 sample passengers were taken using convenient sampling. The data were collected primarily using a questionnaire and substantiated by interviews and document review. Then the data were analyzed using descriptive statistics such as frequency, mean and standard deviation. Based on the findings of the vstudy, the study corridor is highly congested, mainly in the morning and afternoon peak hours. The most significant causes of road traffic congestion in this study corridor are intersection bottlenecks, job centralization, poor traffic management, inadequate public transport, a large volume of private cars, and the presence of on-street parking. The result also showed that the congestion situation in the study area resulted in adverse economic and environmental impacts such as reduced productivity, increased fuel consumption, increased vehicle operation cost, discomfort, and health and traffic accident-related problems. The study thus suggests the provision of adequate mass transport, on-street parking restrictions, priority schemes for walking and cycling, and discouraging private car use during rush hours as alternative solutions.

Keywords: Traffic Congestion, Socio-economic, Causes, Impacts

1. Introduction

Traffic congestion is defined as the condition of traffic delay as the number of vehicles using the road nears or surpasses the road network's capacity (Weisbrod et al., 2001). According to Kombs (1988), unplanned and haphazard land-use distribution, poor structural road design, and rapid motorization growth without commensurate road network improvements and related services are the primary causes of traffic congestion.

Due to the widespread use of private automobiles, which affects how people move and shapes the design of cities themselves, the global urban transport sector is currently at a critical crossroads. Whether a country is developed or not, traffic congestion has been on

This work is licensed under a Creative Commons Attribution-Noncommercial 4.0 International License

the rise and will only worsen, endangering the quality of urban life (Jain, Sharma & Subramanian, 2012). Between 2005 and 2050, 2.3 billion new cars are anticipated globally at the current rate of motorization, with more than 80% of those cars likely to wind up on the roads of emerging nations (Chamon, Mauro & Okawa, 2008). With rising income levels that result in increasing automobile ownership, many cities in developing countries have begun to follow the trajectory of motorization that developed countries once experienced, though at a much faster rate. Due to the middle class's tendency to switch from public or non-motorized transport to private vehicles, major city blocks are becoming increasingly congested (Suzuki, Cervero & Iuchi, 2013).

Traffic congestion directly impacts commuters by increasing travel time, delaying key appointments and jobs, and reducing productive hours; it also indirectly impacts the living standard and the environment (Taddese, 2011).

Congestion on the roads has become a major and significant issue in many cities in developed and developing countries. Traffic congestion has occurred in Addis Ababa due to the city's economic and demographic expansion. The city saw fast growth in the number of private automobiles but slight road network improvement to accommodate the increased vehicle traffic. In the city, although the congestion situation is very high at peak hours, it prevails almost throughout the day almost on all days of the week. Despite some recent attempts to improve the congestion situation, the problem of traffic congestion is overgrowing. Most of the measures taken to improve congestion in the city are short-term, implemented on an ad-hoc basis and in isolated ways, without adequate study. Therefore, the researcher conducted this research to come up with possible solutions. In this regard, the main objective of this study was to analyze the economic and environmental impacts of traffic congestion in Addis Ababa, with particular emphasis on the Ayat - Mexico corridor. Specifically, this study aims to achieve the following objectives: i) to assess the existing traffic congestion situation; ii) to identify the major causes of traffic congestion; iii) to assess the economic and environmental impacts of traffic congestion in the study corridor.

The paper is organized into four main sections. The first is an introduction, as already mentioned, used to introduce the study's conceptual and theoretical background and the study's rationale and objectives. The second part describes the materials and methods justifying the research design, the population of the study and the sampling procedures, the data sources, the method of data collection, and the method of data analysis. The third part is the result and discussion, whereas the fourth part is the conclusion.

2. Materials and Methods

2.1. Research Design

This research used both qualitative and quantitative research approaches. As part of the quantitative research approach, a questionnaire was used. The quantitative approach was used to describe the numerical aspects. On the other hand, the qualitative approach was used to construct a theoretical description that can substantiate the quantitative data. It involves the use of interviews and secondary document review. By linking qualitative and quantitative research approaches, both advantages can be gained. Thus, the researcher used these two approaches in combination, which helps offset each approach's shortcomings. The research types employed were both descriptive research. The descriptive research method was used to analyze existing traffic congestion situations, the causes of congestion, and its economic and environmental impacts. Moreover, the time dimension of the research was a cross-sectional survey used to generalize the findings for a large population at a point in time.

2.2. Target Population

The study's target population was passengers of different public transport modes. Additionally, professionals and officials from Addis Ababa City Transport Bureau (AACTB), Addis Ababa City Traffic Management Agency (AACTMA), and Addis Ababa City Road Authority (AACRA) were considered for an interview.

2.3. Sampling Technique

For this research, a non-probability sampling technique was employed. This involves convenient sampling. Accordingly, the questionnaires were distributed to passengers of different modes (LRT, Anbesa, Sheger, Public service bus, Higer & Kitkit, midibuses minibusses, and private car) users to make the study representative. Furthermore, key informants were selected using purposive sampling to select officials and professionals from relevant institutions to get detailed and sufficient data on the issue.

2.4. Sample Size

The sample size needs to be determined based on the nature and characteristics of the target population. For this study, the sample size was determined using scientific sample size determination formula designed by Kothari (2004) for an unknown population:

$$\mathbf{n = \frac{z2pq}{e2}}$$

Where N= population size (unknown)

n = desired sample size,

Z = 1.96 at 95% confidence level;

p = estimated population;

q = 1- p (maximum variation)

e = margin of error (5%)

$$n = \frac{z^2pq}{e^2} = \frac{(1.96)^2*(0.5)*(0.5)}{(0.05)^2} = 384$$

2.5. Data Sources

For this research, both primary and secondary data were used. The primary data were collected from drivers and passengers through questionnaires and from concerned organizations through interviews. On the other hand, secondary data were gathered from relevant institutions such as Addis Ababa City Traffic Management Agency (AACTMA), Addis Ababa City Road Authority (AACRA), and Addis Ababa City Transport Bureau (AACTB).

2.6. Method of Data Collection

This research's primary data collection instruments were questionnaires, interviews, and document reviews. A structured questionnaire was designed and distributed to the sample population to gather data on the perception of passengers about the existing traffic congestion situation, the causes of congestion, and the economic and environmental impacts of congestion. Furthermore, a key informant interview was used to substantiate the analysis which was done with professionals and officials from concerned institutions face-to-face. Additionally, telephone calls and email were used for additional information.

2.7. Method of Data Analysis

The quantitative data collected through questionnaires were analyzed using descriptive statistics such as frequency, percentage, mean and standard deviation with the help of SPSS version 26 and Microsoft Excel 10. In this study, the respondents' perceptions of the causes of traffic congestion and the economic and environmental impacts of congestion were measured on a five-point Likert Scale. On the other hand, the qualitative data collected through interviews and document review were analyzed through narrative analysis to substantiate the questionnaire. Finally, the findings were presented using tables, graphs, charts, and text form.

2.8. Ethical Considerations

Ethical issues are very critical in research work. Therefore, the researcher considered voluntary participation, confidentiality, and anonymity. The researcher assured the respondents' confidentiality of the information given. Moreover, all the sources of materials

used for this research have been duly acknowledged.

3. Results and Discussion

3.1.Demographic Profile of Respondents

The respondents were passengers of different vehicle categories and from 384 questionnaires distributed, 363 were returned, making the response rate 93.9%, sufficient for the analysis. Table 1 sumemrised the demographic characteristics of the respondents. Accordingly, the result revealed that 57.6% of the respondents were male and the majority of the respondents (35%) belong to the age group 25-36 years. The survey also shows that most of the respondents (76%) were workers, while the remaining 24% represent non-working people, mainly students. From this, we can understand that the large majority of the people travel for work trips significantly impact the daily traffic congestion.

Table 1: Demographic Profile of Respondents

No.	Item	Category	Frequency	Percentage
1.	**Sex**	Male	209	57.6
		Female	154	42.4
2.	**Age**	18-25 Year	31	8.5
		26-35 Year	127	35.0
		36-45 Year	76	20.9
		46-55 Year	64	17.6
		Above 55 Year	42	11.6
		No Response	23	6.3
3.	**Level of Education**	Illiterate	0	0.0
		Read and Write	43	11.8
		Primary Education	39	10.7
		Secondary Education	57	15.7
		Diploma	48	13.2
		Degree and Above	162	44.6
		No Response	14	3.9
4.	**Occupation**	Government Employed	74	20.4
		Private Employed	102	28.1
		NGO Employed	22	6.1
		Self-Employed	78	21.5
		Unemployed	30	8.3
		Students	57	15.7

Source: Field Survey (2021)

3.2. Mode of Travel

Based on the survey, most of the respondents frequently use minibusses which represent 32.2%, followed by LRT (28.3%) and bus (24.2%) users, whereas 11.5% and 3.8% of the respondents frequently use midi-bus and private automobile.

This implies that most respondents use minibusses followed by LRT and buses. Therefore, there is considerable interest in the use of mass transport. Thus, the improvement in the mass transport service will further encourage the use of such modes of transportation that positively impact traffic congestion reduction.

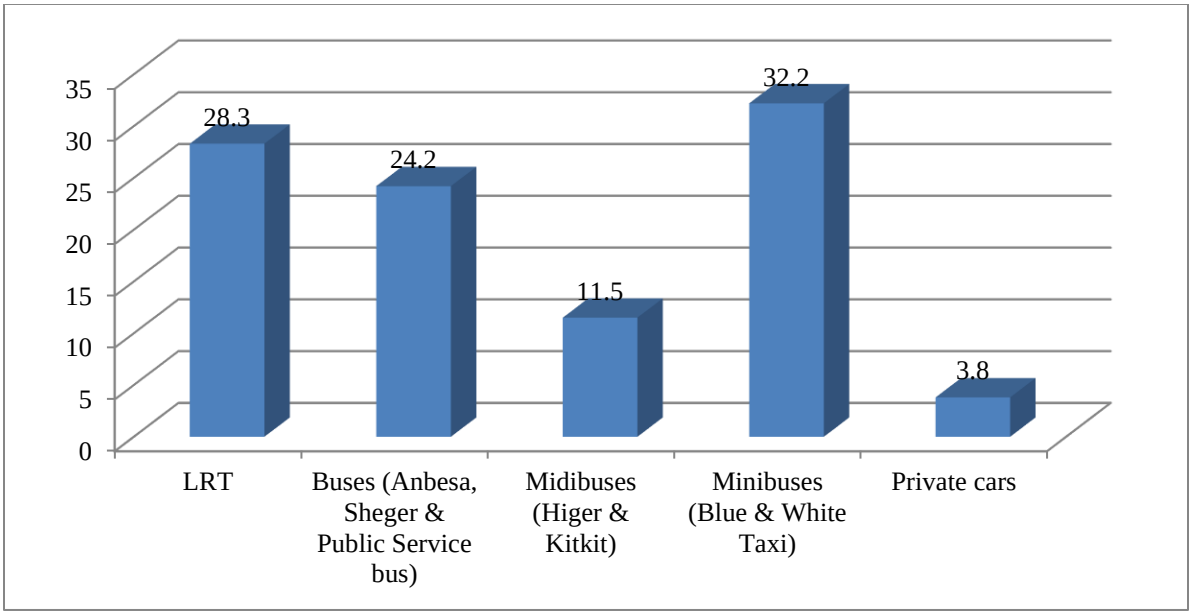


Figure 1: Frequently Used Mode of Travel
Source: Field Survey, 2021

3.3. Purpose of Travel

Figure 2 revealed that 66.3% of the respondents travel daily for work purposes, while 19.4% travel for school, 7.5% commute for shopping, 2.1% for recreation, and 4.5% for other reasons.

This implies that most trips are for working purposes, and congestion may be evident during the morning and afternoon rush hours. The implication is that there is a need to divert some public transport vehicles to the area during the peak period. Flexible working time can also be adopted whereby workers are free to choose a convenient working period.

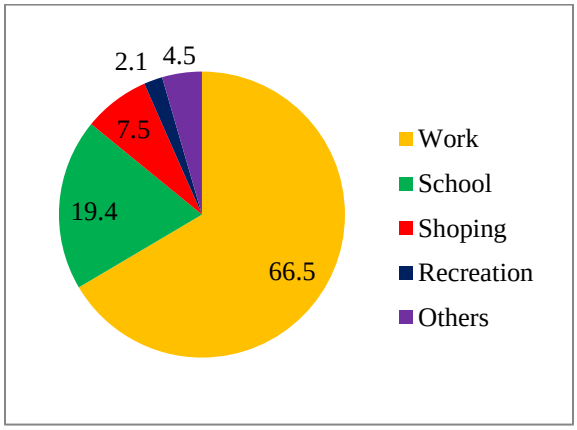


Figure 2: Trip Purpose; Source: Field Survey, 2021

3.4.Travel Frequency

The survey result presented in Table 2 revealed that 47.4 % of commuters' journeys are five days, 22.3% are for six days, 15.4% are

every day, 7.2 % are once a week, and 4.1% journeys to the area once a week, while 2.2% and 1.4% journey are three times and four times a week respectively. This implies that more people commute more than five times weekly (85.1%). This may be one of the contributing factors to traffic congestion almost all days of the week.

Table 2: Travel Frequency of Respondents

Travel frequency of travel in a Week	Frequency	Percent	Valid Percent	Cumulative Percent
Once a week	26	7.2	7.2	7.2
Twice a week	15	4.1	4.1	11.3
Three times a week	8	2.2	2.2	13.5
Four times a week	5	1.4	1.4	14.9
Five times a week	172	47.4	47.4	62.3
Six times a week	81	22.3	22.3	84.6
Everyday	56	15.4	15.4	100.0
Total	363	100.0	100	

Source: Field Survey, 2021

3.5. Traffic Congestion Situation

3.5.1. Level of Congestion

The survey also shows that the city is congested 69.1%, and 18.5% of the respondents evaluated the city as congested and highly congested, respectively. Only 1.9% stated that the area is not overcrowded, and 4.1% responded that it is slightly overloaded. This shows that the city is very congested and demands possible solutions.

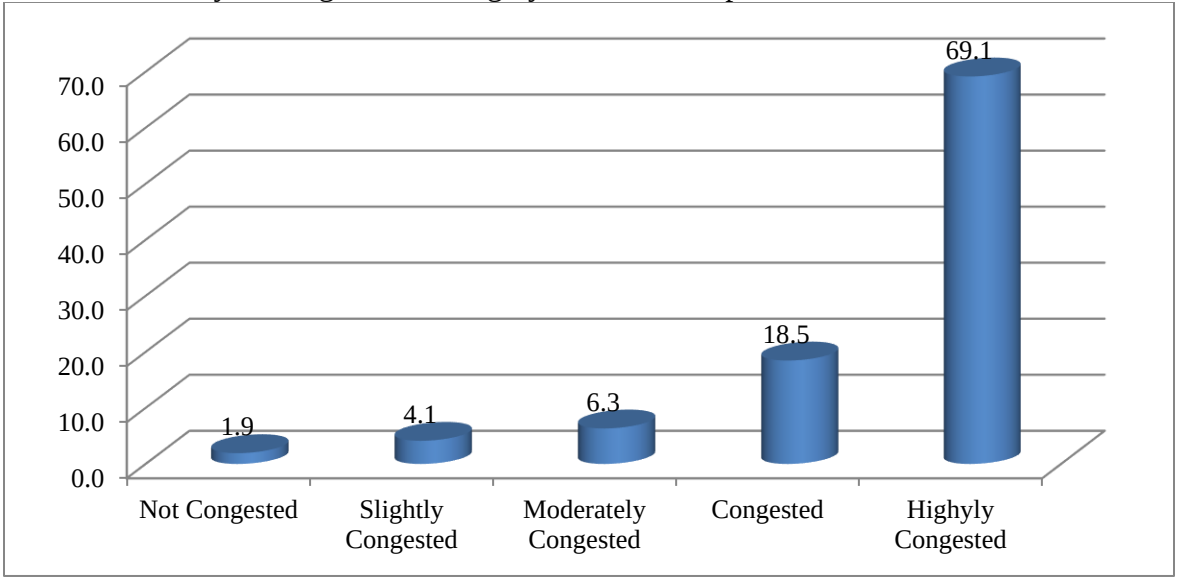


Figure 3: Level of Traffic Congestion; Source: Field Survey, 2021

The interview with concerned institutions also showed that traffic congestion had become a severe problem in Addis Ababa. In this regard, Hargewon (2010) also confirmed that despite the lower car ownership levels, traffic congestion is becoming a severe problem in a day to day activity in Addis Ababa city, specifically in morning and evening peak hours.

3.5.2. Congestion Occurrence in a Week

The survey result in Table 3 revealed that 71.1% and 19.6% of the respondents often experience traffic congestion in their daily travel every week and 3-5 days per week. Only 7.2% and 2.2% of the respondents experienced

traffic congestion twice and once a week. This implies that traffic congestion occurrence occurs almost every day in all weeks.

Table 3: Traffic Congestion in a Week

Response on the occurrence of traffic congestion in a week	Frequency	Percent	Valid Percent	Cumulative Percent
Everyday	258	71.1	71.1	71.1
3-5 days a week	71	19.6	19.6	90.7
Twice a week	26	7.2	7.2	97.8
Once a week	8	2.2	2.2	100.0
Total	363	100.0	100	

Source: Field Survey, 2021

3.5.3. Congestion Prominent Time of Day

The survey revealed that traffic congestion occurs at different times of the day. Accordingly, based on the respondent's responses, most of the congestion happens at peak hours in the morning, from 6 am – 8 am, representing 39.1% of the respondents, and afternoon peak from 4 pm –6 pm, about 25.6% of the respondents. The survey also shows that the morning peak hour congestion even prevails until 10 am starting at 6 am. Thus, commuters traveling to work in the morning and returning from work home in the evening cause severe traffic jams in the city (see Table 4).

Table 4: Time of the Day Congestion is More Prominent

Which time of the day is with more prominent traffic congestion?	Frequency	Percent	Valid Percent	Cumulative Percent
6 am- 8 am	142	39.1	39.1	39.1
8 am- 10 am	78	21.5	21.5	60.6
10 am- 12 am	16	4.4	4.4	65.0
12 am- 2 pm	9	2.5	2.5	67.5
2 pm- 4 pm	12	3.3	3.3	70.8
4 pm- 6 pm	93	25.6	25.6	96.4
6 pm- 8 pm	13	3.6	3.6	100.0
Total	363	100.0	100.0	

Source: Field Survey, 2021

The interview result also indicates that in the city, the traffic congestion situation is almost throughout the day on nearly all days. Although the congestion situation prevails throughout the day, it is severe, especially in the morning from 7 am-10 am and in the afternoon from 5 pm-7 pm.

3.5.4. Congestion Prominent Day of Week

The survey revealed that traffic congestion is most prominent on Monday (51.2%) and Friday (25.3%). It is very high on Monday since it is the first day of the new week where traffic comes towards the city center on Monday morning and goes back to the home of residence on Friday afternoon.

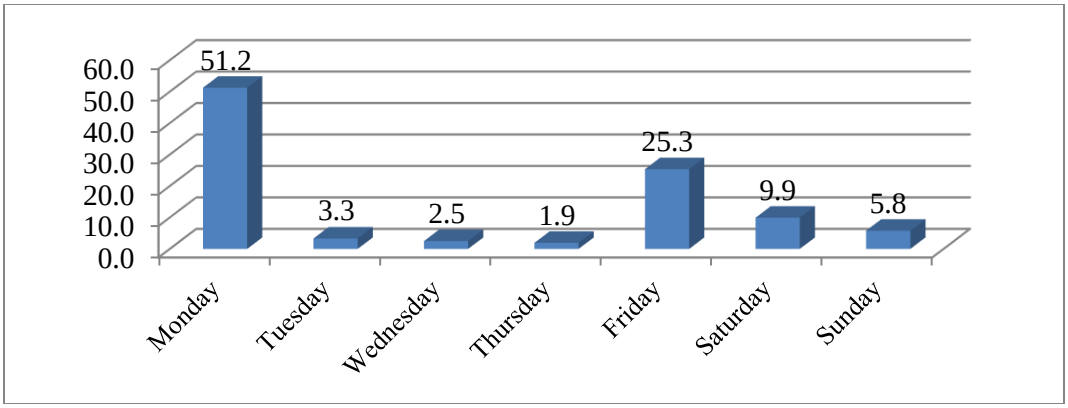


Figure 4: Day of the Week Congestion is Prominent; Source: Field Survey, 2021

3.6. Major Causes of Congestion

Based on the survey, Table 5 revealed that 58.7%, 55.6%, 52.3%, 50.1 and 47.1% of the respondents strongly agreed that poor traffic management, job centralization, intersection bottlenecks, the inadequacy of the public transport service, and on-street parking are the five primary cause of congestion in the study corridor.

Moreover, respondents identified that imbalance of traffic volume with roadway capacity, presence of street vendors, and others contributed to the existing traffic congestion situation in the study area. However, these causes of congestion are not exhaustive but only indicate some of the observed causes of traffic congestion in the city.

Table 5: Major Causes of Traffic Congestion

No.	Causes of traffic congestion		SA	A	N	DA	SDA	Total
1.	Imbalance of vehicle volume and roadway capacity	Count	118	105	42	53	45	363
		%	32.5	28.9	11.6	14.6	12.4	100.0
2.	Intersection bottlenecks	Count	190	83	38	29	23	363
		%	52.3	22.9	10.5	8.0	6.3	100.0
		%	30.6	23.1	15.4	16.5	14.3	100.0
3.	Inadequacy of the public transport services	Count	182	91	29	34	27	363
		%	50.1	25.1	8.0	9.4	7.4	100.0
		%	40.5	24.5	13.2	15.4	6.3	100.0
4.	On-Street Parking	Count	171	87	24	46	35	363
		%	47.1	24.0	6.6	12.7	9.6	100.0
5.	On-Street vending	Count	125	86	49	55	48	363
		%	34.4	23.7	13.5	15.2	13.2	100.0
6.	Loading and off-loading of goods	Count	98	93	63	58	51	363
		%	27.0	25.6	17.4	16.0	14.0	100.0
7.	Inefficient traffic management sys-	Count	213	95	16	22	17	363
		%	58.7	26.2	4.4	6.1	4.7	100.0
8.	Job centralization	Count	202	82	25	31	23	363
		%	55.6	22.6	6.9	8.5	6.3	100.0
		%	38.3	24.2	9.1	15.2	13.2	100.0
9.	Unforeseen circumstances	Count	88	97	59	65	54	363
		%	24.2	26.7	16.3	17.9	14.9	100.0

Source: Field Survey, 2021

Similarly, the mean values for the causes of traffic congestion also indicated the mean rank of each of the causes of traffic congestion, as presented in Table 4.8. By looking at the mean values, we can deduce that respondents agreed on these causes of traffic congestion on average.

Table 6: Mean Analysis of Causes of Traffic Congestion

Causes of traffic congestion	N	Mean	Std. Deviation	Std. Error Mean
Imbalance of traffic volume & roadway capacity	363	4.50	.921	.048
Intersection bottlenecks	363	4.23	1.098	.058
Inefficient public transport services	363	4.48	.929	.049
On-Street Parking	363	3.55	1.406	.074
On-Street Trading	363	4.24	1.178	.062
Loading and off-loading of goods	363	3.49	1.224	.064
Job centralization	363	4.54	.895	.047
Poor traffic management system	363	4.70	.683	.036
Pedestrian interference with vehicles	363	4.08	1.158	.061
Unforeseen circumstances	363	3.44	1.312	.069

Source: Field Survey, 2021

The previous studies on the cause of traffic congestion in developed and developing countries also mentioned that there are various causes. For instance, Aworemi et al. (2009) identified the major traffic congestion causes in the United States are bottlenecks (40%), traffic incidents (25%), work zone (10%), bad weather (15%), poor signal timing (5%) and special events contribute 5% of the traffic congestion. Moreover, Haregewoin (2010) identified the leading causes of traffic congestion in Addis Ababa along the Total-Ayer Tena road segment as; limited road capacity, road parking, un-integrated urban planning, and lack of mass transit, accident, poor vehicle condition, and roadside illegal trade. Thus, the results of this study align somehow with the previous research.

3.7. Economic Impacts of Congestion

Nowadays, traffic congestion has been one of the most severe problems in many large cities of both developed and developing countries, with a significant impact on economic development. Likewise, in Addis Ababa city with an increasing traffic congestion situation, the city's economic growth has been hampered due to delays through congestion.

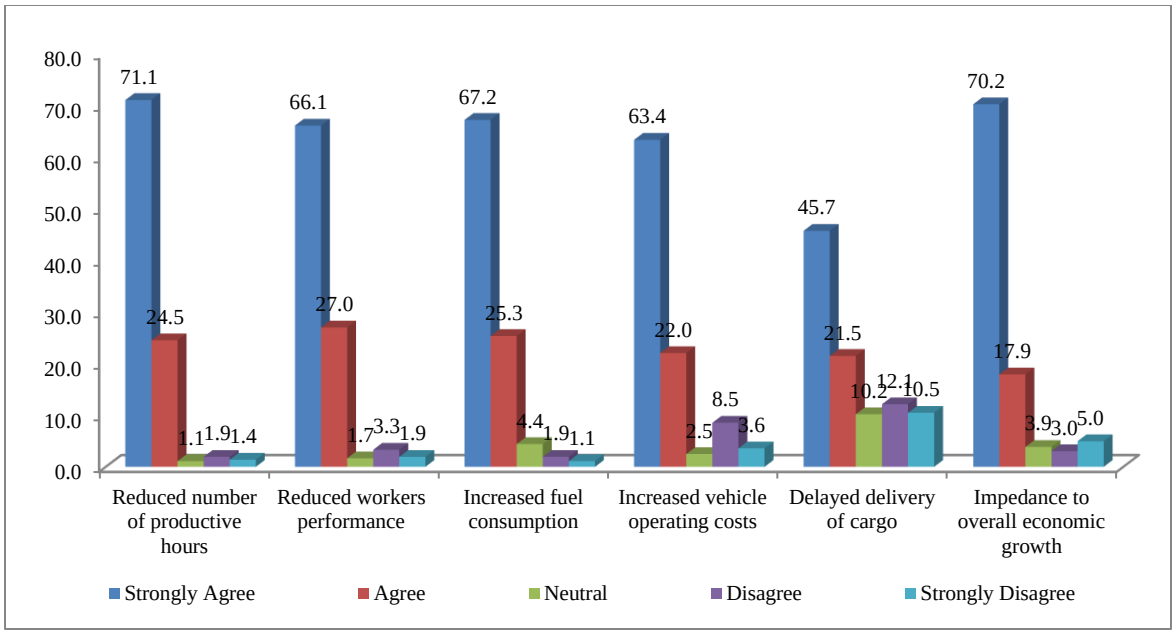


Figure 5: Economic Impacts of Traffic Congestion
Source: Field Survey, 2021

Figure 5 revealed that reduced number of productive work hours, impedance to overall economic growth, increased fuel consumption, reduced work performance, increased vehicle operation cost, and delayed delivery of cargo are observed economic impacts of congestion in the study area, respectively, with percentage response of 71.1%, 70.2%, 67.2%, 66.1%, 63.4%, and 45.7%.

Table 7: Mean Analysis of Economic Impacts of Traffic Congestion

Economic Impacts of Traffic Congestion	N	Mean	Std. Deviation	Std. Error Mean
Late arrival and exit to and from the workplace result in a reduced number of productive hours	363	4.77	.695	.037
Reduced workers' performance due to congestion-related stress and discomfort	363	4.52	.752	.038
Increased fuel consumption	363	4.55	.779	.041
Increased vehicle operating costs	363	4.33	1.103	.058
Delayed delivery of cargo	363	3.80	1.397	.073
Impedance to overall economic growth	363	4.45	1.051	.055

Source: Field Survey, 2021

The mean value in Table 7 above indicates that, on average, respondents agreed on these economic impacts of congestion as the mean value of all these economic impacts of road traffic congestion have mean values greater than 3. This implies that traffic congestion has a significant effect on economic productivity. The analysis of the time spent due to traffic congestion also revealed that 46.3% of the respondents usually spend 2-3 hours, 20.4% spend 1- 2 hours, 14.6% spend more than 3 hours, 12.7% spend 30 minutes – 1 hour, and 1.4% spends less than 30 minutes in traffic jam daily (Table 8).

Table 8: Time Spent in Traffic Congestion

How much time is spent on traffic congestion?	Frequency	Percent	Valid Percent	Cumulative Percent
Less than 30mins	5	1.4	1.4	1.4
30mins-1hr	46	12.7	12.7	14.0
1hr-2hr	74	20.4	20.4	34.4
2hr-3hr	168	46.3	46.3	80.7
Greater than 3hr	53	14.6	14.6	95.3
No Response	17	4.7	4.7	100.0
Total	363	100.0	100.0	

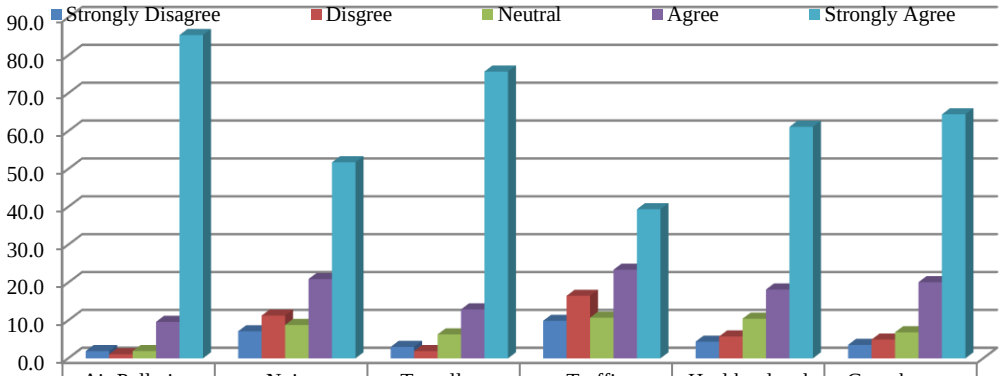
Source: Field Survey, 2021

Furthermore, the interview made with concerned institutions also substantiated the result of the questionnaires as the traffic congestion impacts the economy because of increased travel delays. It was indicated that the city faces severe traffic congestion during peak hours due to the massive number of vehicles coming into the city in the morning and returning home in the evening. This costs a lot in terms of loss of working hours, increasing fuel consumption, and vehicle operating costs due to the start-stop type of vehicle movement.

Andargie (2017), in his study on traffic congestion and its economic cost in Addis Ababa; a case study of Meskel Square to Kality interchange, also found that total congestion costs, including delay, wasted fuel, and operating cost of passenger vehicles and truck vehicles at each road segments on average is about Birr 53.2 million per year. This is similar to the findings of the current study.

3.8. Environmental Effects of Congestion

Based on the survey indicated in Figure 4.6 below, traffic congestion impacts the environment and the survey result revealed that air pollution, discomfort to the travelers, greenhouse gas emissions causing increasing surface temperature, health-related problems, noise pollution, and traffic accidents are the major environmental problems of traffic congestion observed in the city with 85.4%, 75.8%, 64.5%, 61.2%, 51.8% and 39.4 of the respondents strongly agreed respectively.



	Air Pollution	Noise Pollution	Travellers discomfort	Traffic accident	Health related problems	Greenhouse gas emission
Strongly Disagree	1.9	7.2	3.0	9.9	4.4	3.6
Disgree	1.1	11.3	1.9	16.5	5.8	5.0
Neutral	1.9	8.8	6.3	10.7	10.5	6.9
Agree	9.6	20.9	12.9	23.4	18.2	20.1
Strongly Agree	85.4	51.8	75.8	39.4	61.2	64.5

Figure 6: Environmental Impacts of Congestion; Source: Field Survey, 2021

Table 9: Mean Analysis of Environmental Impacts of Traffic Congestion

Environmental impacts of traffic congestion	N	Mean	Std. Deviation	Std. Error Mean
Air Pollution	363	4.75	.723	.038
Noise Pollution	363	3.99	1.307	.069
Travelers discomfort	363	4.56	0.924	.049
Traffic accident	363	3.66	1.394	.073
Health problem	363	4.26	1.132	.059
Greenhouse gas emissions causing for surface temperature change	363	4.12	1.089	.053

Source: Field Survey, 2021

The environmental impact analysis in the above table indicates that, on average, respondents agreed on all environmental impacts of traffic congestion as the mean value of all these lists of environmental effects of traffic congestion have mean values greater than 3. This implies that traffic congestion has an impact on environmental pollution. Furthermore, the interview made with concerned institutions also substantiated the results of the questionnaires where congestion impacts environmental degradation in terms of air and noise pollution, greenhouse gas emissions, and others causing increasing earth's surface temperature.

Similarly, Mahmud et al. (2012) stated that traffic congestion impacts the environment through sound and air pollution. The effects of sound pollution affect students in the nearby school as they are disrupted in their study by noise and the nearby society causes headaches, difficulty concentrating and sleeping, bad tempers, and hearing problems. The congestion situation resulted in air pollution through CO_2, CO, NO_2, N_2O, and NO, which also endangered the community's health. In addition, congestion has costs on the environment and results show that when traffic congestion increases, fuel consumption and emission of pollutants increase. In addition, Andargie (2017) also found that congestion has environmental costs, resulting in increased fuel consumption and emission of pollutants.

4. Conclusions

Traffic congestion is one of the most significant urban transport problems in developed and developing countries. Traffic congestion in Addis Ababa city is becoming a serious challenge. The study assessed the socio-economic impacts of traffic congestion in the study area. Based on the study's findings, the study area is highly congested and the congestion situation is very serious at peak hours. The major causes of traffic congestion in the study area identified are inefficient traffic management, job centralization, intersection bottlenecks, inefficient public transport and on-street parking, imbalance of traffic volume with roadway capacity, on-street trading, and others respectively. The survey also revealed that this congestion situation resulted in reduced productive work hours, increased fuel consumption, reduced work performance, increased vehicle operation cost, and overall economic growth. It also impacted the environment regarding air pollution, discomfort to the travelers, greenhouse gas emissions, noise pollution, and traffic accident-related risks, respectively. Thus, the researcher suggests promoting mass transport and discouraging private automobiles, restrictions on street parking and enforcement of parking rules, priority schemes for walking and cycling, and effective use of traffic management measures as alternative solutions to minimize the

congestion situation and its adverse economic and environmental impacts.

Author Contribution

The sole contribution of the author produces this research, and all the sources of materials used for this research have been duly acknowledged.

Competing interest

There is no competing interest regarding this original research article.

Acknowledgment

The author wants to thank the Ethiopian Civil Service University for funding and supporting this research work.

5. References

Andargie, K.T. (2017). *Analysis of Traffic Congestion and its Economic Cost in Addis Ababa; a Case Study of Meskel Square to Kality Interchange*, Unpublished MSc Thesis, Addis Ababa University.

Anthony, D. (2004). Still Stuck in Traffic: Coping with Peak-Hour Traffic Congestion. Washington DC.

Aworemi, J.R., Abdul-Azeez, I.A., Oyedokun, A.J., & Adewoye, J.O. (2009). A study of the causes, effects, and ameliorative measures of road traffic congestion in Lagos Metropolis. European Journal of Social Sciences, 11(1), 119-128.

Chamon, M., Mauro, P., & Okawa, Y. (2008). Mass car ownership in the emerging market giants. Economic Policy, 23(54), 244-296.

European Conference of Ministers of Transport (ECMT). (2007). Managing urban traffic congestion. Joint Transport Research Centre.

Haregewoin, Y. (2010). Impact of vehicle traffic congestion in Addis Ababa; A case study of Kolfe sub-city: Total-Ayer Tena Road. Unpublished MSc Thesis, Ethiopian Civil Service University.

Jain, V., Sharma, A., & Subramanian, L. (2012). Road traffic congestion in the developing world. In Proceedings of the 2nd ACM Symposium on Computing for Development, pp. 1-10.

Kombs, T. (1988). Consultancy Report: Traffic Management Schemes in Metropolitan Lagos. Federal Urban Mass Transit Programme (FUMTP).

Kothari, C.R. (2004). Research methodology: Methods and techniques. New Age International.

Mahmud, K., Gope, K., & Chowdhury, S. M. R. (2012). Possible causes & solutions of traffic jam and their impact on the economy of Dhaka City. Journal of Management and Sustainability, 2, 112.

Suzuki, H., Cervero, R., & Iuchi, K. (2013). Transforming cities with transit: Transit and land-use integration for sustainable urban development. World Bank.

Taddesse, W. (2011). Assessing & Quantifying the Level of Traffic Congestion at Major Intersections in Addis Ababa, Unpublished MSc Thesis, Addis Ababa University.

Weisbrod, G., Vary, D., & Treyz, G. (2001). Economic Implications of Congestion, National Cooperative Highway Research Program. Transportation Research Board. Washington, DC.