

Original Article

One-Way Traffic Flow Vs Two-Way Traffic Flow: A GIS-Based Time Analysis In Colombo City

GRVM Gamage¹, PGRNI Pussella¹

¹Department of Remote Sensing and GIS, Sabaragamuwa University, Belihuloya, Sri Lanka.

¹Corresponding Author : pgrnip@geo.sab.ac.lk

Received: 17 October 2025

Revised: 25 November 2025

Accepted: 10 December 2025

Published: 31 December 2025

Abstract - A Considerable amount of time, money, and efforts are spent all over the world to automate daily tasks at home and office in order to save time. Although much progress has been made in this aspect, people almost everywhere waste multiple times the amount. The time saved through automation, as well as the time spent traveling between home and office daily, is due to road traffic. Therefore, the effect of automation on time-saving seems almost useless unless the issue of road traffic is addressed properly. Geographical Information Systems (GIS) has been one of the expensive options for those who are trying to solve this issue. It is the belief of the author of this paper that a developing country like Sri Lanka, however, should look for low-cost solutions, such as one-way traffic flow arrangements. As one-way traffic flow has been “on the table” for a while in solving the road traffic issue, especially in the areas of Colombo and its suburbs, it is worth analyzing the efficiency and effectiveness of the solutions that have already been rolled out in these areas. It is the very objective of this case study. It focuses on evaluating and contrasting the variances of time consumption between one-way and two-way traffic flow arrangements in the heart of Colombo, the executive and judicial capital of Sri Lanka. Conventional maps and GIS were used to extract data for the evaluation. Road maps were generated through digitization of conventional base maps, and road traffic data was extracted using GIS, particularly from the Google Maps Application Programming Interface (API). The evaluation was performed using data from seven different time frames between preselected five locations along the traffic uniflow circle that covers Colombo 3, 4, and 6 along the A2 highway, both under the current one-way traffic flow and the preceding two-way traffic flow. Depending on the time differences in travelling between the preselected locations under different traffic flow arrangements, one-way and two-way, the feasibility of each traffic flow arrangement was ascertained, and recommendations for further improvements to minimize travel time were made. However, it was evident that having a system where the traffic flow can be switched between one-way and two-way, or that can change the number of lanes open to either direction, depending on the time of the day (peak and off-peak), could significantly improve the traffic flow, thus reducing travel time.

Keywords - One-Way, Two-Way, Traffic, GIS, Network.

1. Introduction

Traffic congestion can be considered a universal issue. Not only does it waste the valuable time of individuals, especially commuters, but it also slows down the economy of a country remarkably. The negative impact on the economy by disrupting daily productive tasks, time wastage, and fuel wastage is substantial, especially for developing and underdeveloped countries (Sweet, 2011). Traffic congestion has been proven to be an environmental pollutant. Urban air quality is seriously affected in cities where traffic congestion is a regular occurrence (Shefer, 1994). In addition to traffic congestion, it causes distress. Emo et al. (2016) suggested that spending an increased amount of time in slow-moving traffic elevates the anger and stress of the drivers, passengers, and pedestrians.

Traffic congestion has been converted into a pressing issue in Sri Lanka, currently, with the increase in the inflow

of vehicles to Colombo and its suburbs daily, due to the concentration of the majority of government and private organizations, factories, and schools in Colombo. Although some of the government institutes were shifted to the suburbs, a considerable number of them are still located in the city centre. As a result, a large number of employees, students, and visitors are compelled to enter Colombo city daily, which increases traffic congestion in Colombo.

Remote work and education are certainly attainable solutions for many issues, including this, in a developing country such as Sri Lanka. Implementing remote work successfully requires changes in attitudes and policies. The feasibility of these solutions was rigorously tested during the COVID-19 pandemic, as mobility almost came to a standstill. However, as the pandemic has ended, Sri Lankans are getting back to their usual travel patterns; as a result, the habit of working and learning remotely cannot be retained.



Commuters' preference to use their own Transportation over public Transportation is one of the factors contributing to higher traffic congestion in Sri Lanka. The low quality of public Transportation and the hot weather conditions of the city are the main reasons for the same. As there is no proper regulation, undue delays, unfriendly services, poorly maintained, uncomfortable vehicles, and unavailability of services during specific time periods are the common issues in public Transportation in Sri Lanka. Additionally, getting from bus stops and train stations to destinations under the hot sun is not easy either. Taxi services offer very little help in providing a reasonable solution to this issue. These services also have many issues, such as upregulation, non-uniformity, high pricing, and unfriendly services.

Different countries are addressing the issue of traffic congestion in urban areas in various ways. The vision, weather patterns, and capacities influence these solutions. Some countries utilize capital investments to develop public Transportation, while other countries try out strategies to best utilize the existing infrastructure. The one-way traffic flow arrangement on the A4 highway in Sri Lanka is a classic example of the second option. Certain developed countries are looking at high-tech innovative solutions that use technologies such as Artificial Intelligence (AI). These include self-driven vehicles and intelligent remote monitoring systems that are expected to reduce traffic congestion in the near future. It is also worth mentioning that there are some innovative solutions to the problem that do not necessarily involve roads at all; in fact, they eliminate the need to use roads, such as encouraging companies to promote remote work and clearing boundaries to allow drone-assisted deliveries. Countries with temperate climates often promote cycling to reduce traffic congestion and pollution, as well as to improve the physical and mental health of their citizens. Electric cycles have been introduced in some areas as a value addition.

With the purpose of minimizing vehicle traffic-related problems in Sri Lanka, authorities have introduced several solutions, such as widening roads, introducing flyover bridges, constructing inner/ outer circle toll roads, and converting traffic flow from two-way to one-way. It can be observed that less priority has been given to improving the country's public transportation systems. Although a boat service was introduced with the support of the Sri Lanka Navy between Colombo and its suburbs, it did not gain any popularity due to public unawareness. Two-way to one-way traffic flow conversion was the most cost-effective and quick solution among the above solutions, which has been implemented in the recent past in many urban areas in Sri Lanka.

There are many advantages and disadvantages of both one-way and two-way traffic flow systems. One-way roads allow uninterrupted traffic flow due to the absence of

crossovers, enabling faster movement within a shorter time period, while crossovers are inevitable in two-way roads as vehicles are compelled to cut across the opposite traffic when taking right-hand side turns and "U" turns. One-way traffic flow permits more road surface as there are no islands dividing the road in half, while two-way traffic flow requires an unproductive island to safely divide the road into two parts, which consumes an area that could be used as another road surface. This allows one-way traffic flows to have more lanes in one direction compared to the total number of lanes within a two-way traffic flow. As a result, a greater number of lanes can be accommodated for buses, bicycles, and other vehicles. One-way road systems allow motorists to make use of parking space on both sides of the road without taking a "U" turn, while two-way roads allow motorists to utilize parking space on the left edge of the road only.

The probability of head-on accidents is nearly zero on one-way roads, as all the vehicles are moving in one direction, while it is very high on two-way roads unless there is an island dividing the two directions of the road. However, the probability of side accidents is relatively higher on one-way roads compared to two-way roads, as more lanes are vulnerable on one-way roads compared to two-way roads with a clear division, such as an island. Rapid movement of traffic on one-way roads not only increases side accident probability further but also poses an increased risk to tailgaters and pedestrians crossing the road. On the other hand, this risk is relatively low on two-way roads, as the movement of traffic is slower. As there are no islands on one-way roads, pedestrians are compelled to cross a number of lanes in one go to get to the other side of the road, unlike on two-way roads with an island dividing the two directions, where pedestrians can cross one-half of the road and wait on the island until the other half of the road is clear of vehicles to be crossed. Therefore, all crosswalks on one-way roads naturally require either the police or traffic light assistance. One-way traffic flows can make routes relatively longer compared to two-way traffic flows, as destinations along one-way roads can be reached only from one direction. On the other hand, two-way traffic flows allow destinations to be reached from either direction, making routes relatively shorter. Additionally, one-way traffic flows restrict motorists from taking the shortest way out when exiting them unless the direction of the traffic flow on the shortest way out is in their favor, thus making destinations outside the one-way roads also longer.

Sri Lanka tested a one-way traffic flow scheme on the A2 highway covering Colombo 3, 4, and 6 in 2006 and launched it in 2007, which is still in operation for 15 years (Jalaldeen, 2006). Subsequently, some other roads were also converted from two-way to one-way. It is therefore evident that authorities consider one-way roads as a practical solution, and it is safe to assume that these roads will prevail to remain "one-way" in the years to come. However, it needs

further scientific evidence to establish the effectiveness of one-way roads over two-way roads. Furthermore, urban traffic should be minimized to reduce fuel wastage.

There are many bottlenecks in the implemented one-way roads. As an example, having a fixed number of lanes in either direction does not seem to serve the purpose during peak hours, as the load of traffic flow in either direction increases depending on the time of day. Certain narrow connecting roads become congested at times, as they have not been built to serve the purpose of connecting roads. Parts of the road in question are congested near schools during opening and closing times of the schools within proximity, since a number of lanes are occupied by motorists dropping off and picking up students from the schools. In the case of a two-way road system, motorists are compelled to leave at least two lanes (one lane in each direction) for the traffic flow when dropping off and picking up students. However, in the case of a one-way road, motorists tend to utilize all the lanes to drop off and pick up students. This situation not only increases the traffic congestion but also poses an increased risk for accidents, as students walk across lanes.

Therefore, it needs to identify the areas and time durations where these issues would occur and provide a guideline to suggest recommendations to solve them. Hence, this case study was conducted in order to compare the effectiveness of one-way roads and two-way roads in urban transportation networks in Sri Lanka by taking time as the factor. As well, the study aims to evaluate the impact of road network configurations on travel time and traffic flow and assess the efficiency of one-way and two-way roads in terms of urban mobility.

2. Literature Review

Traffic congestion presents a significant challenge that impacts numerous daily human activities due to transportation delays and ecological harm (Jayaweera et al., 2017). This is due to delays in driving time and damages to the environment, resulting in slowing of vehicle speeds, longer travel times, and increasing the traffic congestion (Zhang et al., 2020). Traffic flow slows down, especially when the traffic demand exceeds the capacity (Bunn et al., 2003). This issue is related to a variety of causes and factors, especially in urban areas of developing countries. These include the lack of city transportation plans, road closures due to safety concerns, bad driving habits, traffic violations by drivers, lower parking regulations, inadequate traffic police personnel, and the use of mobile phones while driving (Singh, 2017; Zhang et al., 2020). As a result, accidents due to vehicle traffic are common in cities.

Several approaches can be introduced to address these pressing issues and find sustainable solutions. These strategies include strengthening road infrastructure,

increasing road capacity, reducing the number of intersections, implementing tunnels and overpasses, using signaling systems, using AI technology to predict traffic conditions, implementing one-way traffic systems, creating interconnectable roads, changing road geometries and network topologies, allocating separate routes for specific groups of users (eg. bus lanes), and restricting vehicular access to the city (Mattioli et al., 2018; Lucas, 2019). In addition, experts advocate for the implementation of car-free city plans, especially in Western countries, to reduce reliance on private cars and encourage public transport, cycling, and walking for daily travel (Oguzoglu, 2020). However, the introduction of such measures, especially in urban areas of developing and underdeveloped countries, faces significant challenges.

In terms of road network planning, advocates argue that composite road network geometry is more efficient in providing traffic flow than a tree-like network topology. This approach has several objections from road users and highway managers due to the high overall mobility and the lack of connectivity within the limited road network. An innovative solution to these challenges is the implementation of an intelligent transportation system. These systems include real-time navigation technologies, Global Navigation Satellite System (GNSS)-based traffic monitoring, and mobile applications to guide drivers in real-time route choices.

Researchers have made significant contributions to the study of traffic congestion and its management. For example, Thathsarani & Lanel (2019) attempted to develop a model using graph theory to analyze traffic congestion in Colombo city limits. They used PTV Vissim software developed by PTV Group to optimize traffic flow and effective traffic control. Similarly, Paul (2016) conducted a comparative study comparing travel time obtained from Google Maps with the results of road network analysis based on NZOGPS. The study concluded that travel time is more appropriate than travel distance.

Thivisha (2011) evaluated the benefits and costs of implementing a unidirectional traffic system along the Galle Road corridor in Colombo. The study found that Galle Road saw a significant decrease in traffic congestion, travel time, and emissions, while RA de Mel Road in Colombo showed an increase. The introduction of unidirectional roads can increase road capacity and ease traffic flow in urban areas, resulting in smoother vehicle movement. At the same time, these streets reduce the occurrence of traffic collisions and contribute to a decrease in traffic accidents (Zhang et al., 2020).

A Geographic Information System (GIS) is invaluable in the context of decision making and management (Nagne & Gawali, 2013). GIS helps to solve network-related problems by using connections between different features, including

edges, intersections, and turns. Notable attributes of networks include cost, descriptors, constraints, and hierarchy, which provide the viability of network components required to regulate mobility. These attributes include basic elements such as name, usage type, the cost, descriptor, constraint, and hierarchy, units such as time, distance, and fuzzy, data type such as boolean, integer, float, and double, and usage, thereby contributing to a comprehensive understanding of network behaviour and facilitating effective management strategies.

3. Study Area

The Colombo Municipal Council area was selected as the study area for this case study (Figure 2). It consists of five main areas: Colombo North, Colombo East, Colombo West, Colombo Central, and Borella (Figure 3). Most of the roads in the Colombo Municipal Council area are usually busy during the daytime and nighttime until around 8 pm. Some of the roads often get congested during the peak hours. Traffic movement of a one-way stretch of the A2 highway that covers Colombo 3, Colombo 4, and Colombo 6 areas was analyzed in this study (Figure 4). The stretch is made up of two parallel roads, which were used as separate two-way roads: the A2 highway (Galle Road) and R de Mel Road, also known as Duplication Road previously.

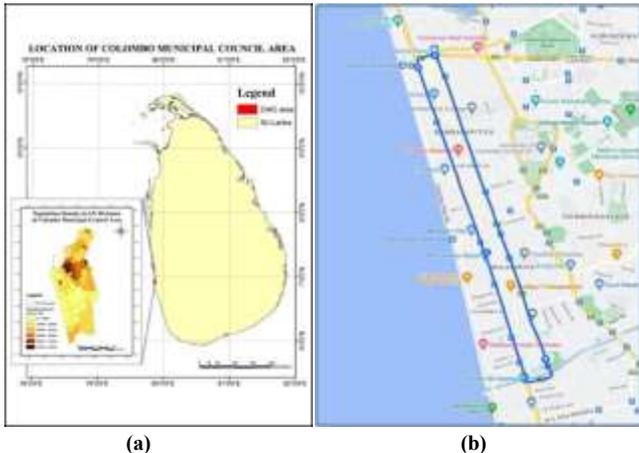


Fig. 1 (a) Colombo Municipal Council Area (source: Senanayake et al., 2013), (b) The One-Way Stretch of the A2 Highway That Covers Colombo 3, 4, and 6 (source: <https://www.google.com/maps>)

4. Methodology

For the successful execution of this study, a range of datasets was required, including maps or shape files depicting the primary and secondary roads within the research area, road geometries encompassing length and width, speed limits, permissions for one-way directions, traffic data, and significant locations. Maps showing major roads, minor roads, and important places were obtained from the maps produced by the Survey Department of Sri Lanka. These maps were then updated with high-resolution images taken from Google Earth Software. The road shape file was

generated through the process of digitization of features in the study area based on a comprehensive ArcGIS map (Open Street Map) using a GIS software package. As this research initiative was being conducted as a pilot project, it was deemed appropriate to move on to the next phase based on the accuracy of the baseline map. Lengths of road segments were calculated using the Calculate Geometry tool in the software.

The permissible speed limits for various road segments were fixed in accordance with the provisions of the Motor Traffic Act (Chapter 203), an official gazette document issued by the government of Sri Lanka, and the maximum speed limit was set as 50 kilometers per hour. The hierarchical ordering of road segments played a key role in the study, which was divided into two types: AA roads and AC roads, according to the classification proposed by the Road Development Authority of Sri Lanka. A value of 1 was assigned for the pathways in the AA category, and a value of 2 was assigned for the pathways in the AC category.

The information about the road directions and traffic conditions was obtained from public sources such as Google Maps and the Sri Lanka Motor Transport Department. The existing traffic system included two types of traffic directions: From To (FT) and To From (TF). These road directions were included in the attribute table, where FT or F was associated with one-way roads, allowing movement in the digital direction only, whereas TF or T was assigned to one-way roads, facilitating movement opposite the digital direction. In addition, the letter N was used to indicate roads where movement in either direction was strictly prohibited. The time calculations were performed using a local calculator, taking into account the speed limits and corresponding lengths assigned to the roads, which is a critical parameter within the road network analysis. The resulting time values, measured in minutes, were obtained by dividing the length of the path by the speed.

To build a comprehensive network dataset, it was deemed necessary to use two tables: the Streets Daily Profile Table and the Street Profile Table. A daily profile table of roads was developed, incorporating speed factors applicable to 24-hour equivalent time intervals and road segments. The time interval was set as 5 minutes. It is very important to note that the “object ID” was the primary key to maintain the relationship between the behavioral data set. In terms of speed factors, the historical traffic layer derived from Google was used, with numerical values of 1, 0.5, 0.3, and 0.1 assigned to the colors of blue, green, orange, and red.

In the context of the study, it was necessary to introduce specific time intervals representing equal traffic volumes within the study area. Therefore, time durations: 0600h to 0800h, 0800h to 1000h, 1200h to 1400h, 1400h to 1600h, 1600h to 1800h, and 1800h to 2000h, were identified as

similar traffic conditions. This strategic approach was adopted due to data limitations within the Google traffic layer, which only includes traffic data from 0600h to 2000h. The selection of sites for network analysis was based on a well-prepared base map provided by the Survey Department of Sri Lanka. Daytime high-traffic areas located on both sides of the existing traffic management system within the study area were carefully considered. In addition, five important areas of community engagement were taken into account in the study.



Fig. 2 Locations of destinations (source: <https://www.google.com/maps>)

Within the framework of the study, a thorough evaluation was carried out to compare the results of the one-way traffic system and the two-way traffic system during the periods. Several factors were considered in order to develop a comprehensive attribute table for the spatial databases. These factors included a variety of elements such as road surfaces, number of lanes, locations of bridges, traffic signs, signals, road conditions, hierarchical structure of the road network, road height, and permissible speed limits.

The road gradient, the effects on the overall safety and efficiency of the road system were duly acknowledged. Furthermore, the assessment included an examination of the number of roads, as this has a significant impact on road capacity and traffic flow. Accurate geolocation of bridges was very important considering their critical role in road networks at intersections and bottlenecks.

Accurate measurement and recording of road lengths played a key role in the study, providing valuable information about the area of each road. These data have been instrumental in determining travel times and distances within the network by providing synonyms and alternative vocabulary to enrich the attribute table further. Furthermore, the maximum permissible speed for each route was carefully incorporated, recognizing that these constraints have a significant impact on travel time and operational efficiency.

By carefully considering and integrating these different factors into the spatial database attribute table, a comprehensive and nuanced understanding of the road network was obtained. This allowed for the analysis and comparison of the one-way traffic system and the two-way traffic system at different times, and the analysis of the traffic dynamics within the study area strongly supported the research results.

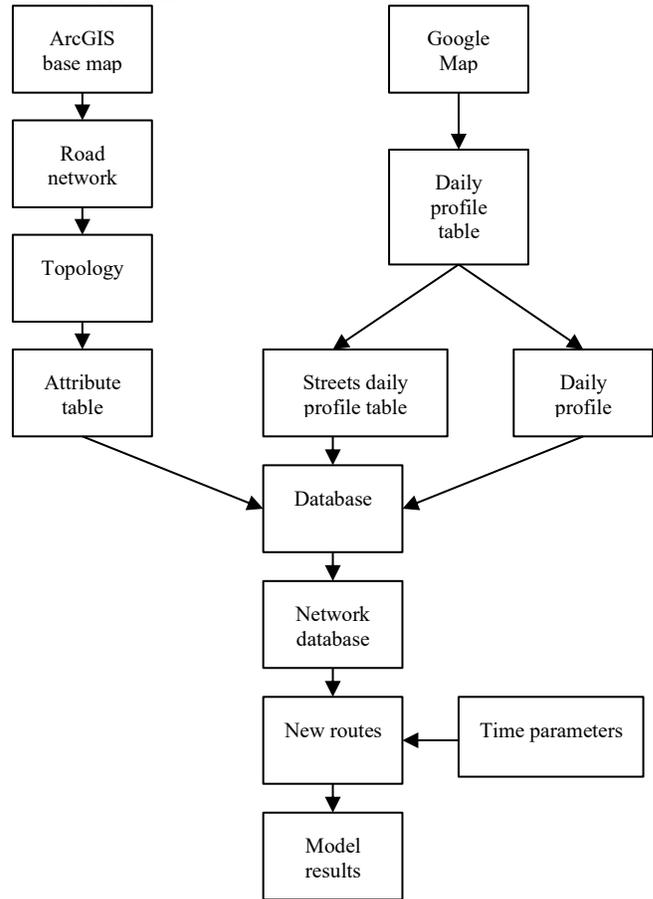


Fig. 3 Data processing (Data Sources and Preparation) Flowchart

5. Results and Discussion

The findings are summarized in Tables 1-2 and illustrated in a line chart in Figures 6-13. All the data presented in the tables and maps indicate that drivers take longer to reach their destinations on two-way streets than on one-way streets. This discrepancy suggests that traffic conditions or road constraints may be responsible for the slight increase in travel time when using the one-way option. These observations also suggest the implementation of a more efficient traffic management strategy to reduce congestion and delays. These findings suggest that changes and optimization of traffic flow supported by the two-way traffic system can increase total trip efficiency. These insights provide an important contribution for transportation authorities and urban planners in developing strategies to optimize road networks and improve commuter experiences.

Table 1. Time Difference Between One-Way Travel Time and Two-Way Travel Time on the Weekend

Time slot	Time Difference Between One-Way Travel Time and Two-Way Travel Time in Minutes on the Weekend									
	A-B	A-C	A-D	A-E	C-B	B-D	B-E	C-D	E-C	D-E
0800h	6.07	1.71	0.87	0.62	0.21	0.82	0.49	1.26	0.55	0.46
1000h	4.65	1.57	0.87	0.62	0.31	0.82	0.40	1.26	0.78	0.70
1200h	5.82	1.39	0.26	0.45	0.31	0.65	0.13	1.18	0.55	0.09
1400h	1.67	2.63	0.57	2.06	0.31	0.65	0.13	1.18	0.55	0.09
1600h	0.94	1.57	0.87	0.62	0.31	0.93	0.55	1.29	0.55	0.60
1800h	0.94	1.57	0.87	0.62	0.31	0.93	0.00	1.18	0.55	0.09
20:00	2.02	2.63	0.87	2.00	0.31	0.93	0.07	1.18	0.55	0.09

Table 2. Time Difference Between One-Way Travel Time and Two-Way Travel Time on Weekdays

Time slot	Time Difference Between One-Way Travel Time and Two-Way Travel Time in Minutes on Weekdays									
	A-B	A-C	A-D	A-E	C-B	B-D	B-E	C-D	E-C	D-E
0800h	0.96	1.81	0.87	0.65	0.31	0.65	0.28	1.50	0.55	0.23
1000h	0.96	1.81	0.87	0.65	0.31	0.81	0.18	1.50	0.55	0.23
1200h	1.54	2.28	0.09	1.52	0.18	0.65	0.00	1.38	0.55	0.00
1400h	1.52	2.28	0.19	1.52	0.00	0.00	0.00	1.26	1.17	0.00
1600h	1.71	2.41	0.09	1.62	0.18	0.57	0.00	1.50	0.00	0.23
1800h	1.71	2.59	0.87	1.80	0.00	0.57	0.32	1.50	0.00	0.23
2000h	1.36	2.81	0.09	1.65	0.21	0.57	0.07	1.50	1.17	0.43

(A- NSB, B- St Anthony’s Church, C- Durdans Hospital, D- University of Colombo, E- Dinermore restaurant)

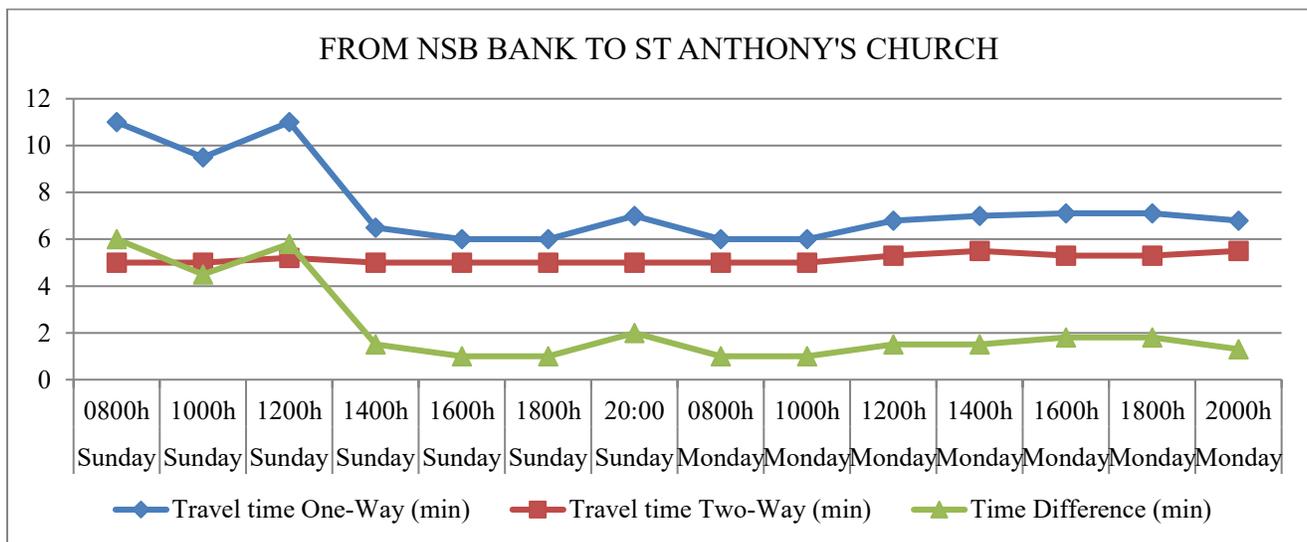


Fig. 4 Route Details From NSB Bank to St Anthony’s Church

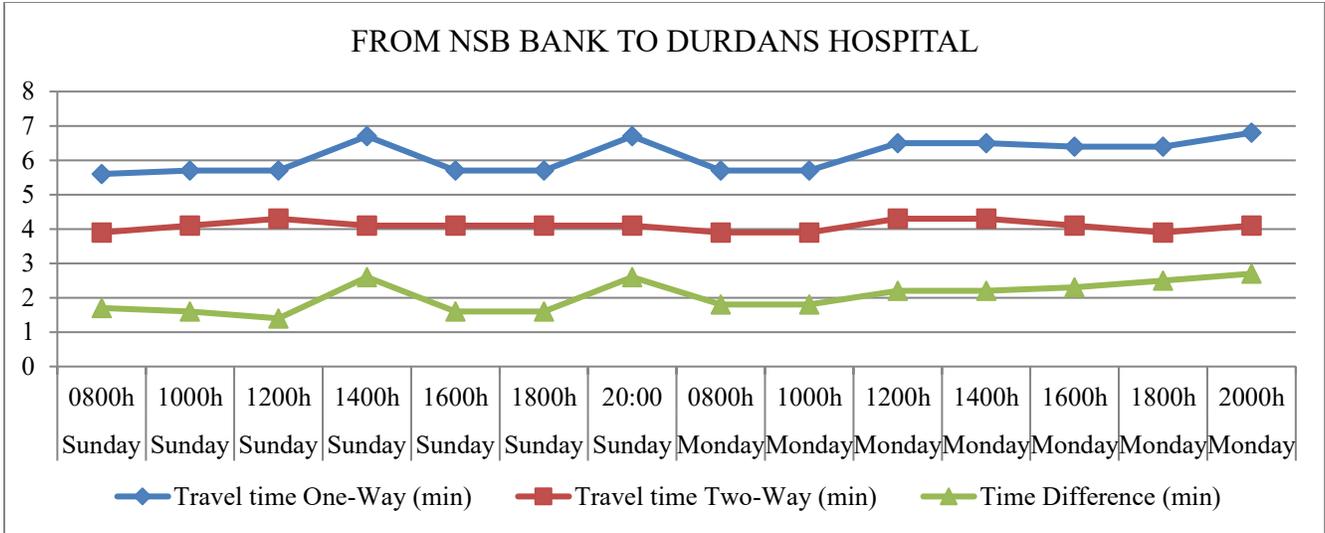


Fig. 5 Route Details From NSB Bank to Durdans Hospital

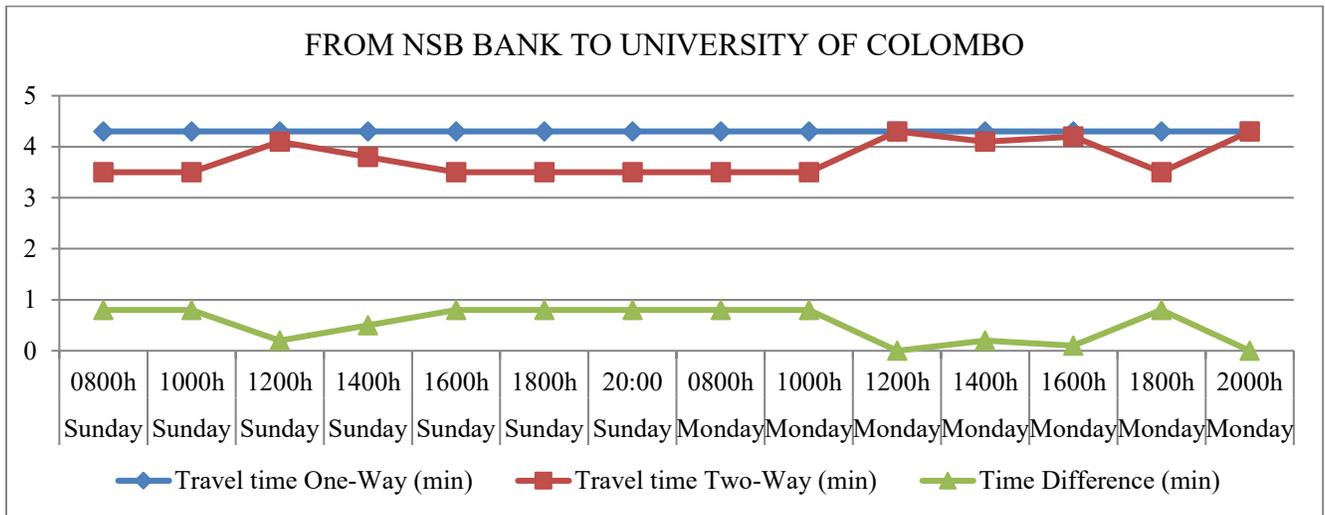


Fig. 6 Route Details From NSB Bank to the University of Colombo

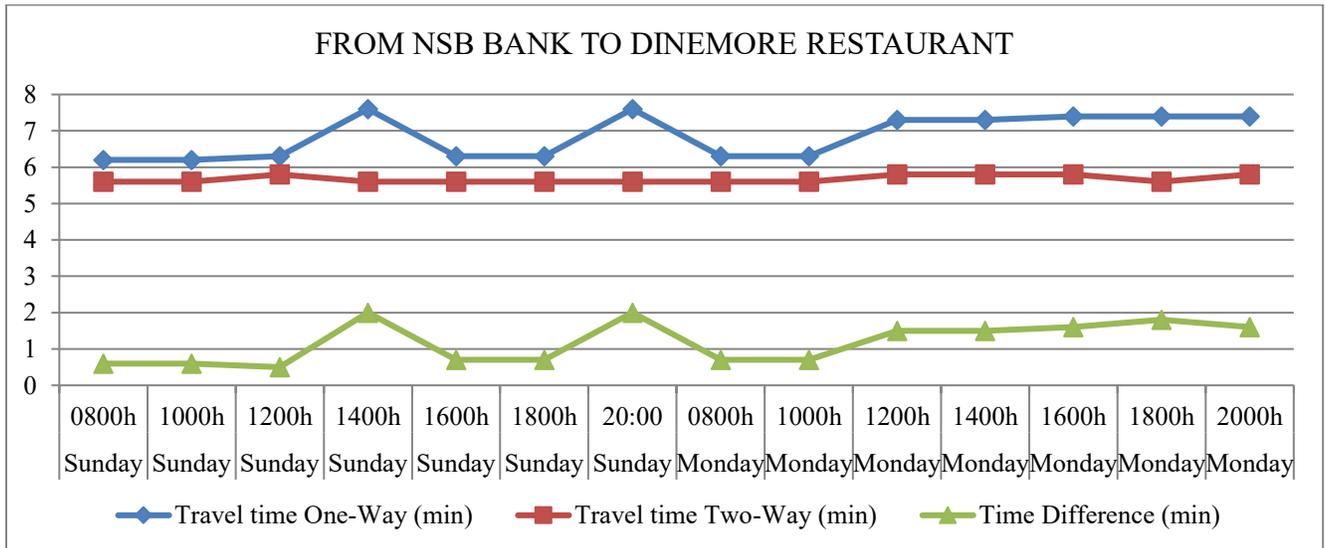


Fig. 7 Route details from NSB Bank to Dinemore Restaurant

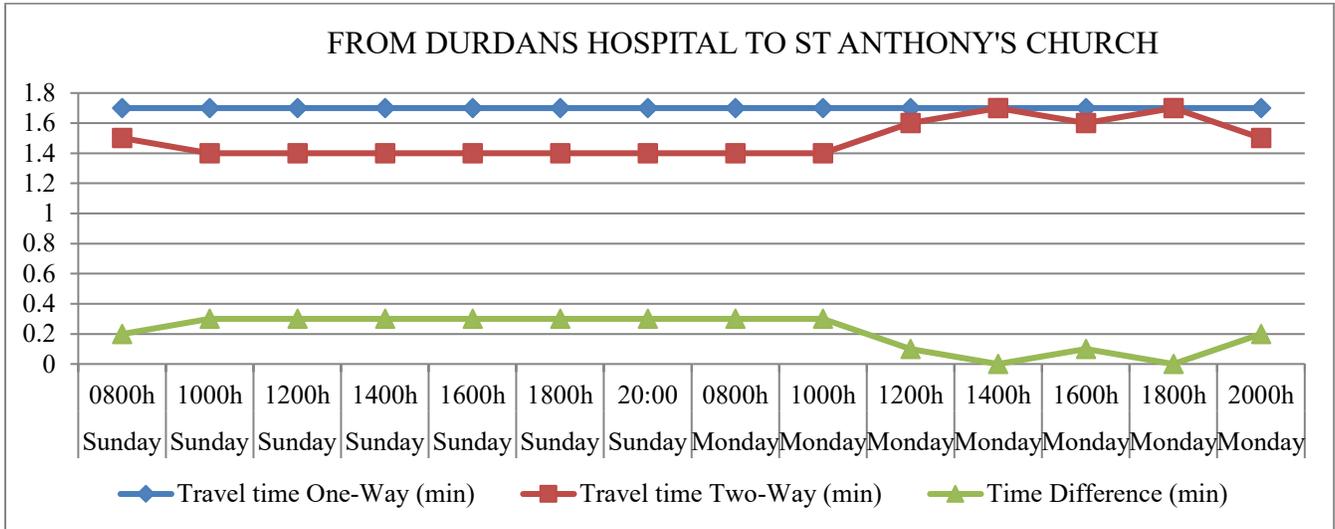


Fig. 8 Route Details From Durdans Hospital to St Anthony's Church

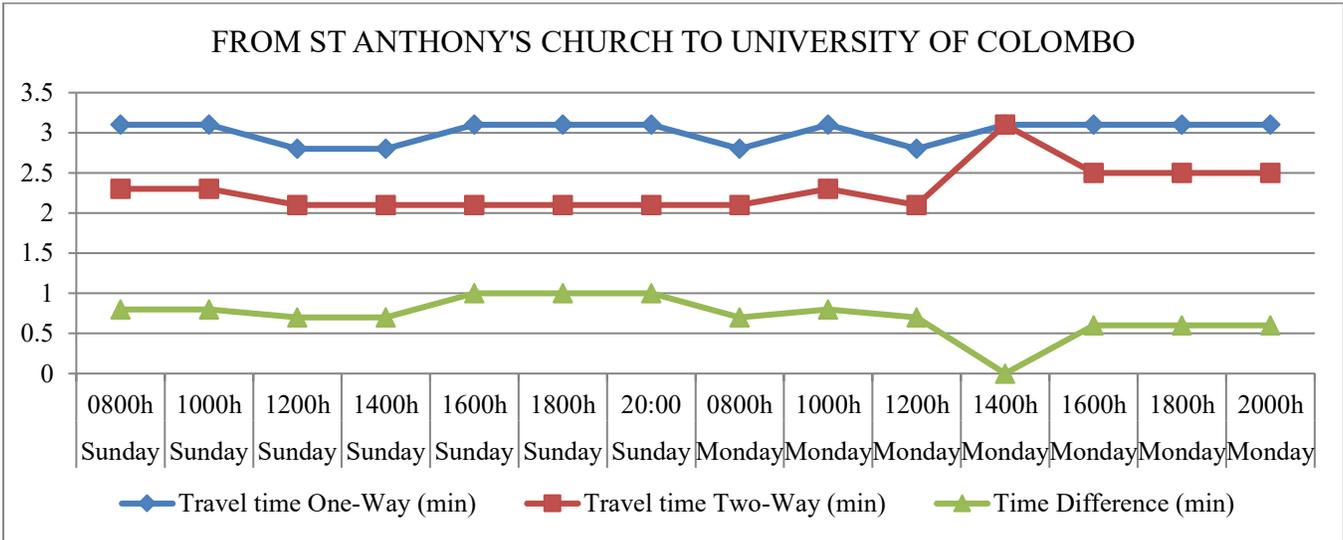


Fig. 9 Route Details From St Anthony's Church to the University of Colombo

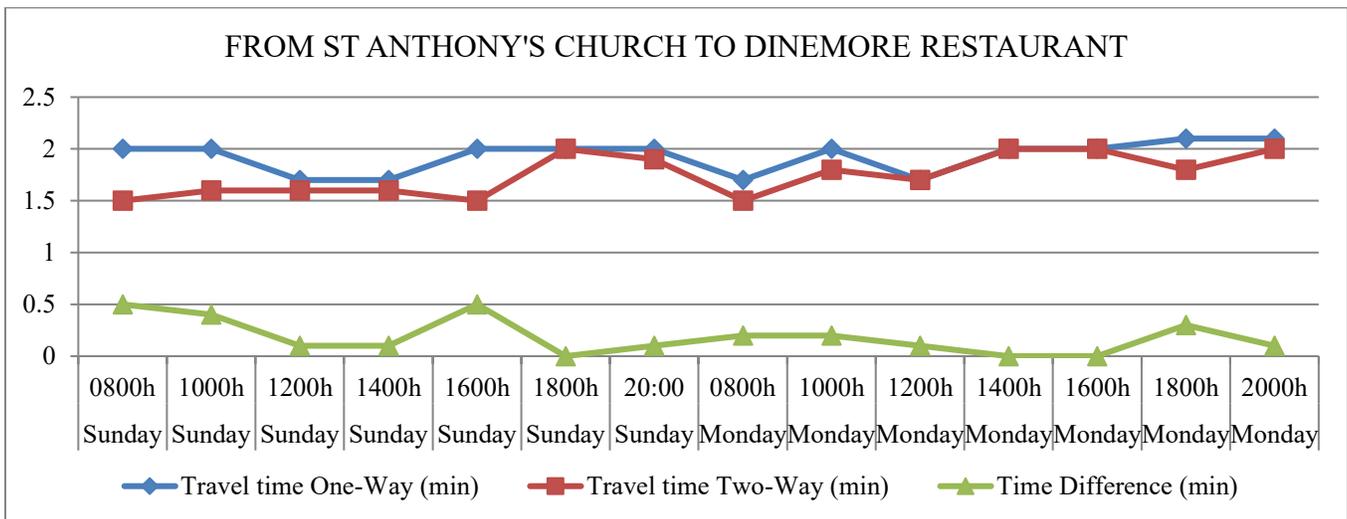


Fig. 10 Route Details From St Anthony's Church to Dinemore Restaurant

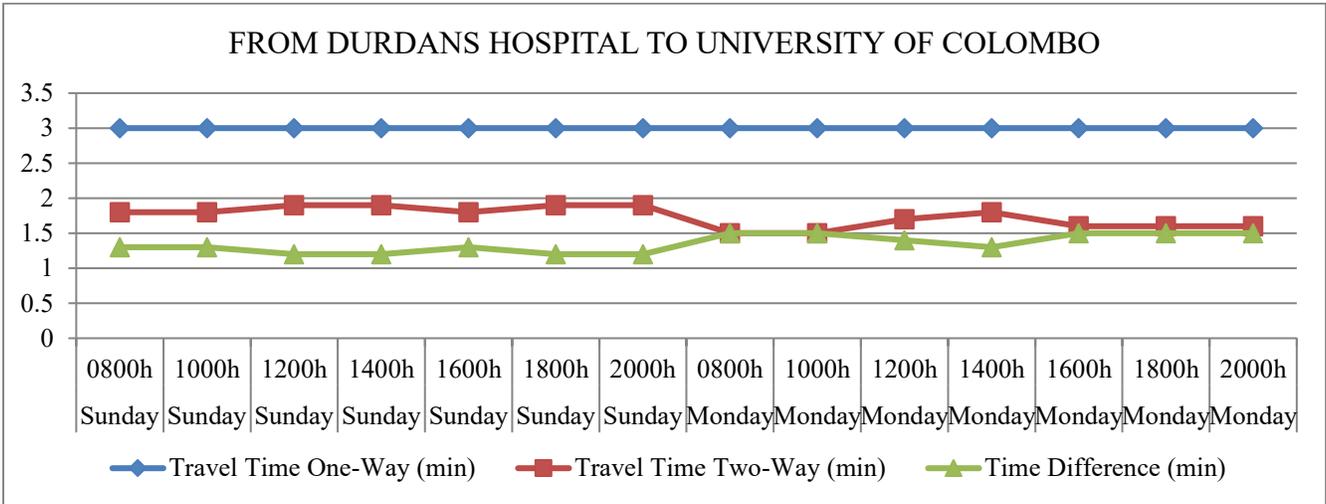


Fig. 11 Route Details From Durdans Hospital to the University of Colombo

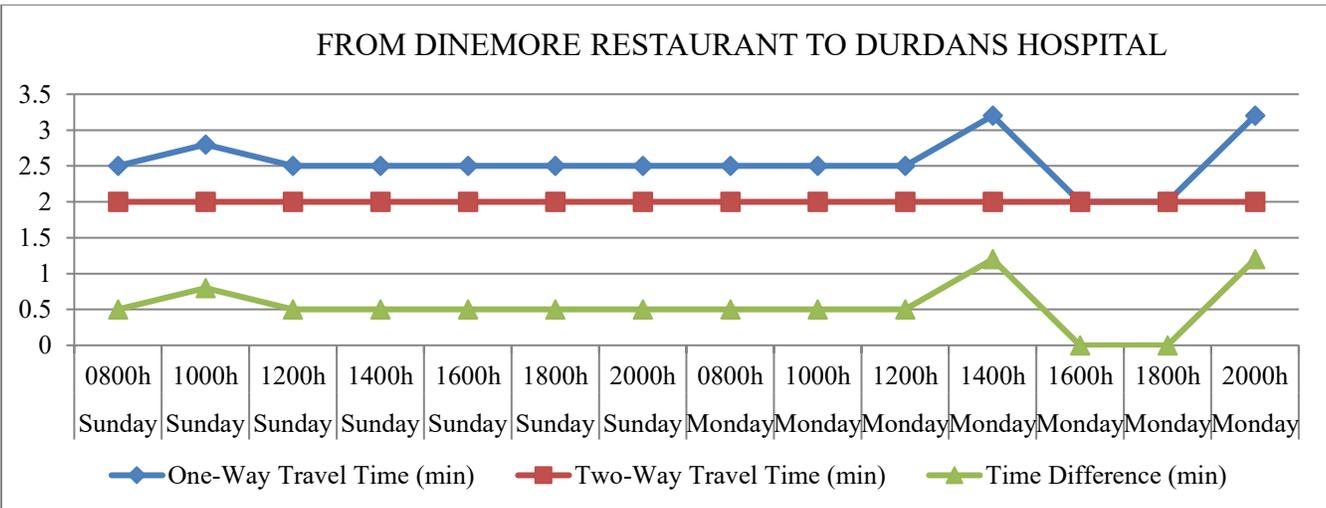


Fig. 12 Route Details From Dinemore Restaurant to Durdans Hospital

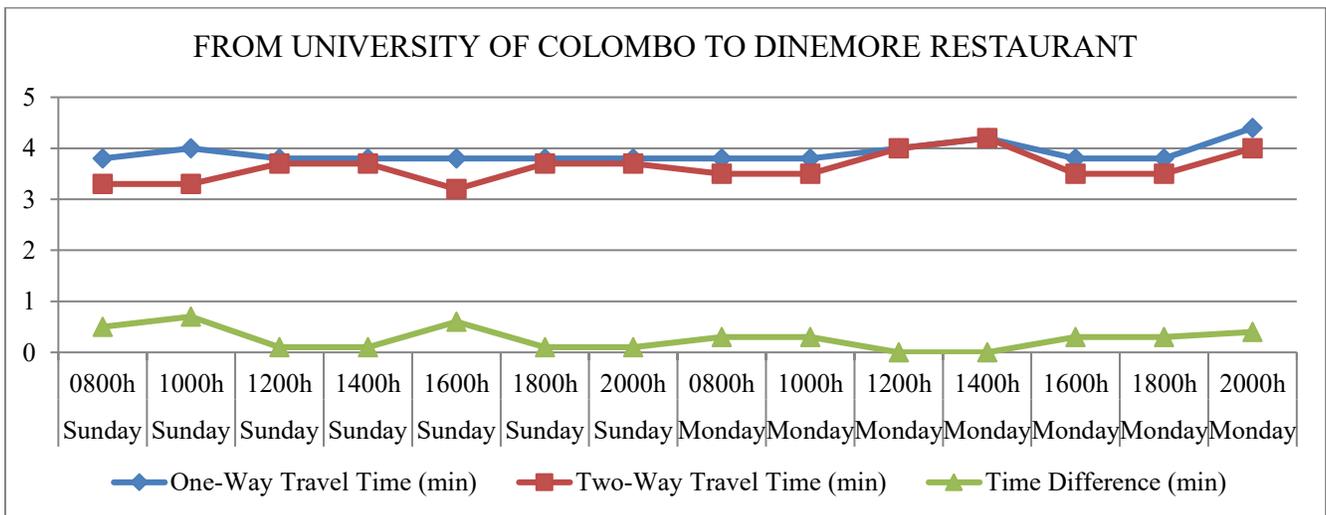


Fig. 13 Route Details From the University of Colombo to Dinemore Restaurant

6. Conclusion

Traffic congestion represents the most precious commodity in human life, time. As a result, many individuals, governments, and other institutions are eagerly trying to solve this problem. Several approaches have been proposed and implemented so far. Among them, the one-way road network system has gained considerable popularity. However, it is worth noting that this system has both advantages and disadvantages, making it less than ideal. Data analysis shows that although the goal is to reduce traffic congestion, it takes longer than using a two-way system.

The findings show that the travel time on two-way roads is reduced compared to the travel time on one-way roads. For example, on the road from NSB to St. Anthony's Church, the highest traffic congestion is between 2 am and 8 pm, and there are intermediate conditions in the one-way mode. Therefore, the travel time is much longer these days. To mitigate this issue, a solution could be to create a new traffic plan specifically designated for 8 pm, or convert a portion of the road to a two-way highway. Similar traffic conditions are observed on the road from NSB to Durdans Hospital, which is reflected in the conditions between NSB and St. Anthony's Church.

Considering the route from NSB to the University of Colombo, the travel time between different time points within the existing dual carriageway system will be the same. However, under the one-way traffic system, the travel time shows fluctuations. Between 10 and 6 pm, the travel time is equivalent to that of a one-way traffic system. Therefore, the current dual-track system is considered suitable for this route. Regarding the route from NSB to Dinermore, the one-way traffic system takes longer, usually at 2 pm and 8 pm. Therefore, changes to the road system are necessary during these periods.

In the case of the road from Durdans Hospital to the University of Colombo, the one-way road system gives the exact times at all times. Therefore, the introduction of a new system based on a two-way traffic configuration can be considered. Similarly, for the route from Dinermore to Doordans, travel times have been extended to 2 p.m. if it is part of a one-sided system. Therefore, the implementation of a two-lane road system during this period will reduce road congestion.

In summary, the study area shows that it is more efficient to convert a road system to a two-lane configuration when there is a significant travel time difference between one-way and two-way systems. Conversely, if the time difference is small or insignificant, maintaining the current road system may be more effective, regardless of whether it is based on a unilateral or bilateral agreement. Therefore, a section of road can be used as a one-way and a two-way road

at different times, but this will confuse drivers. Therefore, it is essential to implement a well-designed notification system.

Based on the results, it can be concluded that the integrated road network system is the most effective method to reduce travel time when traveling from one point to another. Considering these findings, an efficient road network system can be designed for the Colombo District that can effectively reduce traffic congestion and travel time. This research is primarily concerned with investigating which roads can be converted to two-way roads and which roads can be kept unchanged.

To enhance future research, it is suggested that the results of the analysis determine whether each road segment is suitable for remaining unidirectional or switching to two directions. By doing so, travel times can be reduced, and a more efficient traffic network can be identified that will improve traffic flow within the Colombo District.

The results of this study provide valuable information for the road authority, providing a clear understanding of the suitability of the current road network compared to a potential two-lane road network. This information can be used to reduce traffic congestion in the area. However, it is important to establish an effective communication system to keep drivers informed about changes in the roads. Introducing an alert system that notifies drivers of any changes to the road, especially at peak times, can help avoid confusion and keep traffic moving smoothly.

In addition, it is important to note that the data set for this study includes traffic data for the existing road system. Considering the two-way traffic network, it is desirable to obtain specific traffic data for such a system. This is because a two-way traffic network generally increases the number of vehicles, which seriously affects traffic behavior and traffic congestion.

An efficient road network system should not only focus on saving time, but also on improving efficiency. Cost, in this context, refers to the degree of travel. Therefore, analyses should be conducted considering travel time and distance. This comprehensive approach will produce more accurate results and introduce a better road network system for the Colombo region.

However, it is worth noting that the primary focus of this study is the two-way movement of roads across seasons. When such changes occur, they can cause problems for drivers. Therefore, it is imperative to implement a notification system that keeps drivers informed about the overall road conditions and allows them to change their routes accordingly. This will ensure a smooth transition and minimize disruptions for drivers navigating the modified road network.

The study has a number of limitations in the data on the traffic in the Colombo urban area. The data used in the study were collected by the Motor Traffic Department of Sri Lanka. And also, general speed limits were used, although the real speeds of the vehicles differed from the maximum speed limits. Further, weather patterns and other special situations were not taken into account in the present study. The study will be expanded by introducing a number of destinations, considering distance as another factor in the future.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Funding Statement

The authors confirmed that there is no funding for the study.

References

- [1] Colombo Municipal Council. [Online]. Available: <https://www.colombo.mc.gov.lk/>
- [2] Sayed Ahmed, Romani Farid Ibrahim, and Hesham A. Hefny, "GIS-based Network Analysis for the Roads Network of the Greater Cairo Area," *Proceedings of the International Conference on Applied Research in Computer Science and Engineering*, 2017. [[Google Scholar](#)] [[Publisher Link](#)]
- [3] Ozgur Başkan, and Cenk Ozan, "Determining Optimum Configuration of One-Way and Two-Way Streets Using Shortest Path Travel Costs Based on Results of Traffic Assignment," *Pamukkale University Journal of Engineering Sciences*, vol. 24, no. 6, pp. 1087–1092, 2018. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [4] Frances Bunn et al., "Area-wide Traffic Calming for Preventing Traffic Related Injuries," *Cochrane Database of Systematic Reviews*, 2003. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [5] Amanda K. Emo, Gerald Matthews, and Gregory J. Funke, "The Slow and The Furious: Anger, Stress and Risky Passing in Simulated Traffic Congestion," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 42, no. 1, pp. 1-14, 2016. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [6] ESRI, Important Information about ArcMap. [Online]. Available: <https://www.esri.com/en-us/arcgis/products/arcgis-desktop/resources>
- [7] Carmen Gheorghe, "Comparative Analysis of the Performance of One-Way and Two-Way Urban Road Networks," *IOP Conference Series: Materials Science and Engineering*, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [8] DailyNews Archives. [Online]. Available: <http://archives.dailynews.lk>
- [9] Reuters. [Online]. Available: <https://www.reuters.com/>
- [10] I.M.L.N. Jayaweera, K.K.K.R. Perera, and J. Munasinghe, "Centrality Measures to Identify Traffic Congestion on Road Networks: A Case Study of Sri Lanka," *IOSR Journal of Mathematics*, vol. 13, no. 2, pp. 13–19, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [11] Hadi Karimi et al., "Reducing Traffic Congestion and Increasing Sustainability in Special Urban Areas Through One-way Traffic Reconfiguration," *Transportation*, vol. 49, pp. 37-60, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [12] Karen Lucas, "A New Evolution for Transport-related Social Exclusion Research?," *Journal of Transport Geography*, vol. 81, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [13] Giulio Mattioli, Karen Lucas, and Greg Marsden, "Transport Poverty and Fuel Poverty in the UK: From Analogy to Comparison," *Transport Policy*, vol. 59, pp. 93-105, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [14] Ajay D. Nagne, and Bharti W. Gawali, "Transportation Network Analysis by Using Remote Sensing and GIS a Review," *International Journal of Engineering Research and Applications*, vol. 3, no. 3, pp. 70-76, 2013. [[Google Scholar](#)] [[Publisher Link](#)]
- [15] Umut Oguzoglu, "Covid-19 Lockdowns and Decline in Traffic Related Deaths and Injuries," *IZA Discussion Paper No. 13278*, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [16] World Bank Blogs, Martin Raiser, Sri Lanka's Crisis Offers and Opportunity to Reset Its Development Model, 2023. [Online]. Available: <https://blogs.worldbank.org/en/endpovertyinsouthasia/sri-lankas-crisis-offers-opportunity-reset-its-development-model>
- [17] World Economic Forum. [Online]. Available: <https://www.weforum.org/>
- [18] Manjula Ranagalage et al., "Spatial Changes of Urban Heat Island Formation in the Colombo District, Sri Lanka: Implications for Sustainability Planning," *Sustainability*, vol. 10, no. 5, 2018. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [19] Road Development Authority. [Online]. Available: <https://rda.gov.lk/index.php?lang=en>
- [20] I.P. Senanayake, W.D.D.P. Welivitiya, and P.M. Nadeeka, "Urban Green Spaces Analysis for Development Planning in Colombo, Sri Lanka, Utilizing THEOS Satellite Imagery – A Remote Sensing and GIS Approach," *Urban Forestry & Urban Greening*, vol. 12, no. 3, pp. 307-314, 2013. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [21] Daniel Shefer, "Congestion, Air Pollution, and Road Fatalities in Urban Areas," *Accident Analysis & Prevention*, vol. 26, no. 4, pp. 501-509, 1994. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]

- [22] Sanjay Kumar Singh, "Road Traffic Accidents in India: Issues and Challenges," *Transportation Research Procedia*, vol. 25, pp. 4708–4719, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [23] Matthias Sweet, "Does Traffic Congestion Slow the Economy?," *Journal of Planning Literature*, vol. 26, no. 4, pp. 391-404, 2011. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [24] A.A.T. Thathsarani, and G.H.J. Lanel, "A Model to Reduce Traffic Congestion in Colombo City," *International Journal of Scientific and Research Publications*, vol. 9, no. 6, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [25] T. Sivam, "Evaluation of the One-way Traffic System along the Galle Road Corridor," University of Moratuwa Sri Lanka, 2011. [[Google Scholar](#)] [[Publisher Link](#)]
- [26] World Bank Open Data. [Online]. Available: <https://data.worldbank.org/>
- [27] Jun Zhang et al., "Study on the Influence of One-way Street Optimization Design on Traffic Operation System," *Measurement and Control*, vol. 53, no. 7-8, pp. 1107-1115, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]