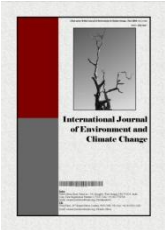

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Traffic Impact Assessment for New Industrial installation at Dhamrai Area along the Dhaka-Aricha Highway, Bangladesh

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Industrialization can benefit individuals, communities or states as it opens new opportunities for economic, social and human development. The stream of globalization is impelling Bangladesh to adopt the technologies of the Fourth Industrial Revolution. Bangladesh has pursued export-oriented industrialization, with its key export sectors include textiles, shipbuilding, fish and seafood, jute and leather goods etc. Communication system plays a very important role in accelerating the place of industrialization of a country. Along with the industrialization, communication system of Bangladesh has also been greatly improved. Various major projects have already been implemented and many more new projects have been under taken. Even then various unplanned developments are creating traffic congestion on our highways which become a big problem for us. Factories are being setup on both side along the highways in an unplanned manner to accelerate the pace of industrialization. As a result, roadways cause a slew of issues, including reduced capacity, increased travel time delays, queue length, increased fuel consumption, and roadway accidents, all of which result in unrecorded economic losses. So, it is vital to investigate and measure the traffic impact of industrial installations along highways in order to achieve long-term sustainability. Traffic Impact Assessment (TIA) is a technical examination of traffic problems and

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safety concerns associated with a particular development. In this study, we have assessed the traffic impact due to setting up a new industry along the Dhaka-Aricha Highway(N-5). It is mainly focused on the impact of the new generated traffic will have on the Dhaka -Aricha highway's traffic system after the installation of an industry. Furthermore, the findings may be used to take the anticipatory role in the future for becoming a beneficiary to set up a sustainable industry along the highways.

Keywords: Industrialization; Fourth Industrial Revolution; Communication System; Traffic Impact Assessment (TIA).

1. INTRODUCTION

Rapid and long-term economic growth, as well as social progress, require industrialization. Bangladesh's industrialization is essential for the country's long-term economic prosperity and social improvement. Textiles, shipbuilding, fish and shellfish, jute, and leather goods are among the most important export sectors of the country [1,2,3]. Pharmaceuticals, steel, and food manufacturing are just a few of the industries that have become self-sufficient. The garment and textile sectors have grown rapidly over the last two decades. The textile and apparel business employs tens of millions of people worldwide. This industry is the main source of foreign exchange revenues for Bangladesh. The ceramic, cement, and fertilizer industries have all seen considerable expansion. With the Industrial Revolution, business, the economy, and society all underwent significant changes. These changes reshaped the planet and continue to do so even now. Before industrialization, Bangladesh's economy was based primarily on agriculture and handicrafts like woven fabrics. Industrial mechanization was made possible because of the usage of water and steam during the First Industrial Revolution [4-6]. The Second made extensive use of electric power to bring its products to mass production. The Third used electronic and computer technologies to streamline production. There are several examples of the fourth industrial revolution in today's world: nuclear power, the internet, and renewable energy sources like coal and gas. Fourth Industrial Revolution because it offers new opportunities for personal, societal, and economic growth. Someone has to start a new industry to participate in the industrial revolution [7,8]. Bangladesh is being compelled by the current globalization to embrace the technologies of the Fourth Industrial Revolution.

The transportation and communication network of a country is a crucial part of its overall physical infrastructure. Bangladesh's transportation infrastructure includes roads, railroads, interior waterways, two seaports, maritime shipping, and civil aviation. It supports both local and international traffic. Bangladesh's communication system has improved dramatically along with the country's development. Several large highway development projects have already been completed, and many more are currently in the works. This industry contributed 11.26% of GDP in FY2016-17, growing at a 6.76% annual pace, according to the latest estimates from the Bangladesh Bureau of Statistics (BBS). The transportation sector in Bangladesh is diverse and includes many different kinds of transportation. Because much of the country is a flat plain, all three modes of surface transportation—road, rail, and water—are frequently used to carry people and goods. In addition, the airline industry has a broad and efficient network. Several large highway development projects have already been completed, and many more are currently in the works [9,10]. Even still, unforeseen events lead to severe traffic congestion on our routes, making getting around a major issue. Unplanned factories are springing up on both sides of highways as the pace of industrialization quickens. As a result, roads create a plethora of problems, such as decreased capacity, longer travel times, longer queues, higher fuel consumption, and more road accidents, all of which result in unrecorded economic losses. So, to ensure long-term viability, industrial sites located along highways must be thoroughly studied and measured for their traffic impact.

A traffic impact assessment, often known as a TIA, is a study that looks at the influence that a development's traffic may have on the local transportation system. When conducting a Traffic Impact Assessment (TIA), we're looking for ways to reduce the negative effects of a proposed development on the transportation network while also identifying workable alternatives. Whenever a new construction project is built near an arterial route, it has the potential to degrade safety and

efficiency by disrupting traffic flow. TIA Watchdog is a service that members can use to provide information about difficulties they've encountered so that others can make well-informed hiring decisions. Engineers and planners can use traffic impact assessment (TIA) to analyze the influence of a project on the transportation and traffic system. The traffic impact assessment can also determine if certain land use is compatible with a nearby road. It's a technical assessment of traffic and safety issues about a given project. The primary goal of a TIA analysis is to determine whether a certain development project will influence the safety and efficiency of nearby roadways in the vicinity [11-13]. This study's primary goal is to determine any additional highway and intersection geometry requirements or enhancements necessitated by the development's expected increased traffic. TIA is becoming increasingly important. Nowadays, city planners and developers are working to reduce traffic congestion in expanding cities, if not eliminate it. One cannot emphasize enough the need of identifying and planning for the traffic implications of new urban development. New commercial developments in Bangladesh's major metropolises, such as Dhaka and Chittagong, closely track changes in the city's transportation infrastructure. As a result, future developments must be planned and monitored more closely. Otherwise, even if additional facilities are built, traffic bottlenecks or critical areas will persist.

2. METHODOLOGY

The research methodology includes the given steps: Identify the Problem Statement, Objective, Literature Review, Visit Study Area, Data Collection, Data Analysis, Result Discussion, Conclusion & Recommendations.

2.1 Study Area

The study was conducted at a place called Kalampur in Dhamrai on the 35th KM of Dhaka-Aricha Highway. Dhamrai Upazila is one of the six Upazilas under the Dhaka district. The Upazila Head Quarter is located approximately 40 KM northwest of Dhaka City. Dhamrai is around by the Mirzapur, Kaliakair, Nagarpur, Singair, Savar and Saturia Upazilas. It is located in the 90.02 - 90.14E and 23.50 - 24.02E coordinates.

Dhaka Aricha Highway is the part of Dhaka (Mirpur)-Utholi-Paturia- Natakhola-Kashinathpur-Bogra-Rangpur-Beldanga-Banglabandh Highway Road, commonly known as N5. The N5 is connecting the capital Dhaka and the town of Bangla bandha on the Bangladesh-India border.

It is one of the main transportation arteries in Bangladesh , approximately 527.00 KM in length. The total road length of N5 is 527 KM while the length of the Dhaka Aricha Highway is 62 KM.

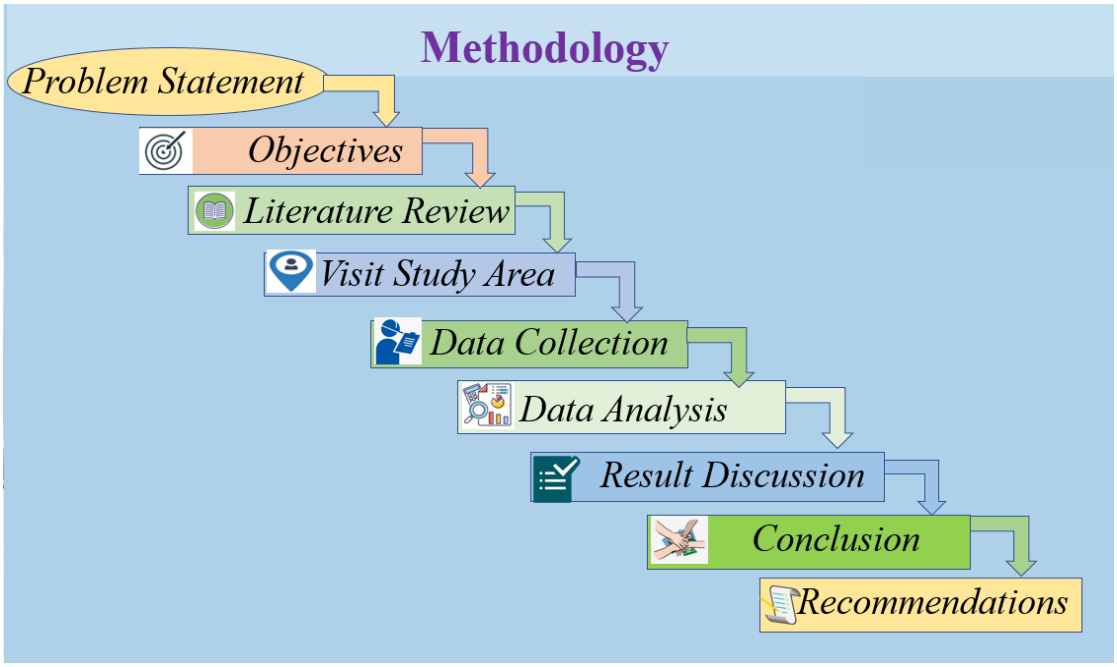

Fig. 1. Methodology Steps

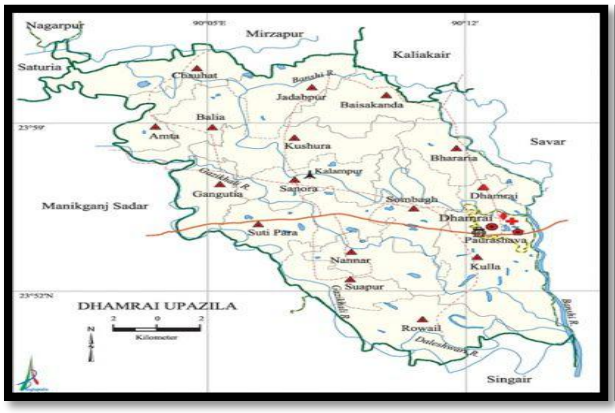

Fig. 2. Dhamrai Upazila Map

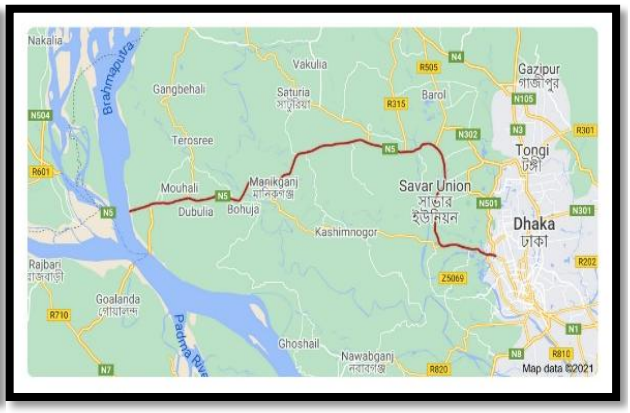

Fig. 3. Dhaka-Aricha Highway

Fig. 4. Project Location

2.2 Data Collection

To accomplish this study, data collections are done in two ways namely primary and secondary data collection. Primary data are collected from field observation and Secondary data are collected from different organizations, book data, published research papers and expert Suggestions which are explained in next. For Primary Data collection, a field survey was conducted from, 16 March'2021, Tuesday, and 19 March'2021, Friday. Survey time was selected from 07:00 AM to 08:00 AM, 08.00AM to 09.00AM, 05:00 PM to 06:00 PM, 06:00 PM to 07:00 PM in order to collect various trip purposes. The data has been collected in accordance with the ITE data collection rules. Weekly open day and closed day were selected for traffic counting. Two sides vehicles are counted separately, one is towards Dhaka and another is towards Aricha.

2.3 Data Analyses

The rigorous analyses in the data analysis chapter were carried out in Microsoft Excel Analysis. Measuring the accessibility index was done in a methodical, step-by-step manner using sensible and prudent data. To find a connection, we examined traffic data that was entered into an excel spreadsheet. To help Division smart, we made summaries of the data and visual charts.

3. RESULTS AND DISCUSSION

The most common method of collecting traffic volume data is the manual method of traffic volume count, which involves a group of people

recording number of vehicles passing, on a predetermined location, using tally marks in inventories. A weekday or workday is any day of the working week. When people traditionally do not work but instead relax or pursue leisure activities is called weekend day. In traffic engineering, for counting traditionally week day weekend day are chosen for average daily traffic measure. So, we it was chosen week day and weekend day data. For hour selection it was chosen two Peak and Off-Peak hours. Peak hour is the time of day when traffic congestion on roads and crowding on public transportation are at their worst. A morning (a.m.) and an evening (p.m.) peak hour analysis should be included in the TIA. The data collection time was divided into four segments 8.00 am to 9.00 am, 5.00 pm to 6.00 pm, 7.00 am to 8.00 am and 6.00 pm to 7.00 pm at on weekday and weekend day. The lane was also divided in to two, Lane-1 called Towards Dhaka and Lane-2 called Towards Aricha.

Table 1. Week Day Total Traffic Volume(24 Hr)

Vehicle Type	Lane-1 Traffic Volume (24 Hr)	Lane-2 Traffic Volume (24 Hr)	Total Traffic Volume (24 Hr)
Heavy Truck	672	600	1272
Med. Truck	696	504	1200
Light truck	648	504	1152
Large bus	576	360	936
Minibus	552	672	1224
Microbus	744	696	1440
Utility car	744	408	1152
Car	768	432	1200
CNG/Auto Ricksha	264	144	408
Motor Cycle	432	288	720
Ricksha	480	264	744
Bicycle	72	72	144
Others	312	216	528
Total =	6960	5160	12120

The volume obtained from the Table 4, Heading Average Traffic Volume (24 Hr) has been consider as Highway Traffic Volume for next calculation.

Bangladesh's main employer is agriculture rather than textiles, despite textiles being the country's largest source of export revenue. Agriculture employs around 60% of the workforce and generates 30% of the country's GDP. Bangladesh's development is aided by the country's readymade garment sector. Bangladesh has also benefited from the "Made in Bangladesh" label, which has elevated the country's brand recognition across the globe. In 2019, Bangladesh has over 4,62 thousand clothing manufacturers. Although the previous year saw a growth, this decreased from 2013, with around 5,88 thousand textile factories in Bangladesh. The RMG business, which is now Bangladesh's single largest export earner, has played a critical role in the country's economic recovery. About 83% of the country's entire export revenue comes from this sector. Major industries along the Dhaka Aricha highway include jute processing and chemical and pharmaceutical manufacturing as well as textile and leather items, ceramics and electronics. There are more readymade garments factories along the Dhaka-Aricha highway than other industries.

Since, we had assumed to set up a RMG factory on a 15-acre land at the highway side. We also assumed that on about 300,000 SFT of floor space, 3000 workers work in and about 1.2 million pieces of premium quality woven shirts will be produced in every month. For new trip calculation, the survey was conducted for sampling on AKH ECO Apparels Ltd situated at Dhamrai, the side of Dhaka-Aricha highway, on a 15-acre land. So, hypothetically we used the surveyed traffic volume for assuming new set up RMG factory on a 15-acre land at the highway side. So, the new generated traffic volume is as Table 5.

Now, Calculation of Percentage of Increase of Traffic Volume (24 Hr) for Table 7, we use the mathematical formula.

For Heavy Truck- Percentage of Increase of Traffic Volume (24 Hr) = ((1170-1164)/1170) x 100

= 0.52 %

The same calculation has been done for others vehicles for Table 7.

And, Finally the Calculation of Highway Traffic Flow for Table 8, we use the mathematical formula.

Highway Traffic Flow = 10818/24

= 451

And Calculation of Highway Traffic Flow New for Table 8, we use the mathematical formula.

Highway Traffic Flow New = 11153/24

= 465

Now the Percentage of Increase of Traffic Flow = ((465-451)/451) x 100

= 3.10 %

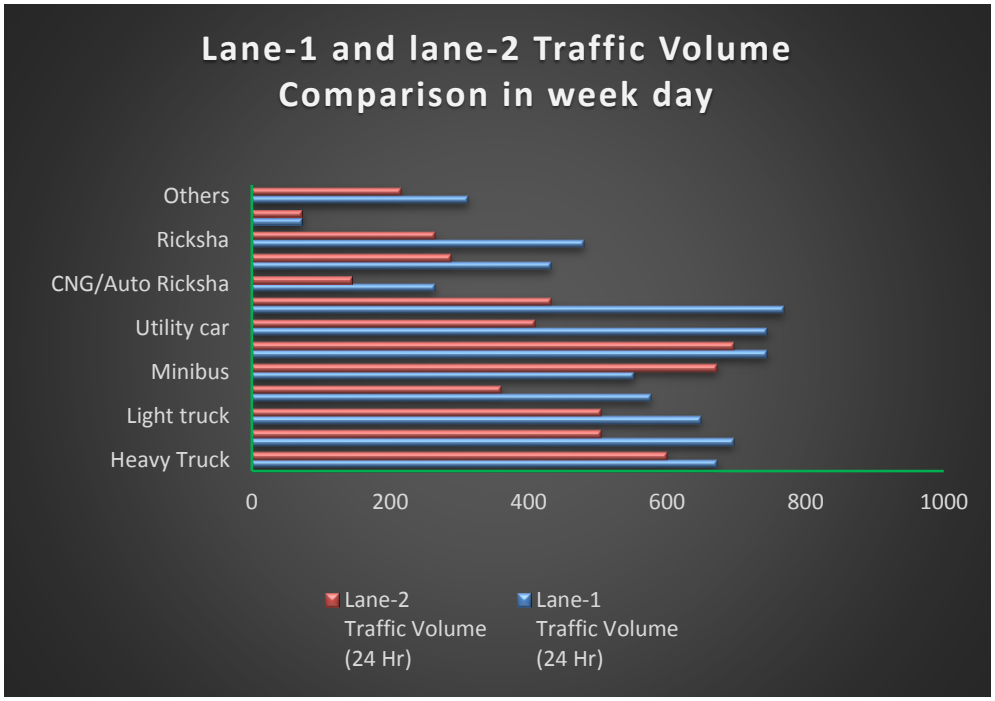

Fig. 5. Lane-1 and lane-2 Traffic Volume Comparison

Table 2. Weekend Day Total Traffic Volume(24 Hr)

Vehicle Type	Lane-1 Traffic Volume (24 Hr)	Lane-2 Traffic Volume (24 Hr)	Total Traffic Volume (24 Hr)
Heavy Truck	504	600	1104
Med. Truck	456	432	888
Light truck	576	480	1056
Large bus	336	240	576
Minibus	360	408	768
Microbus	504	480	984
Utility car	456	360	816
Car	600	528	1128
CNG/Auto Ricksha	240	144	384
Motor Cycle	312	360	672
Ricksha	384	312	696
Bicycle	96	96	192
Others	216	240	456
Total =	5040	4680	9720

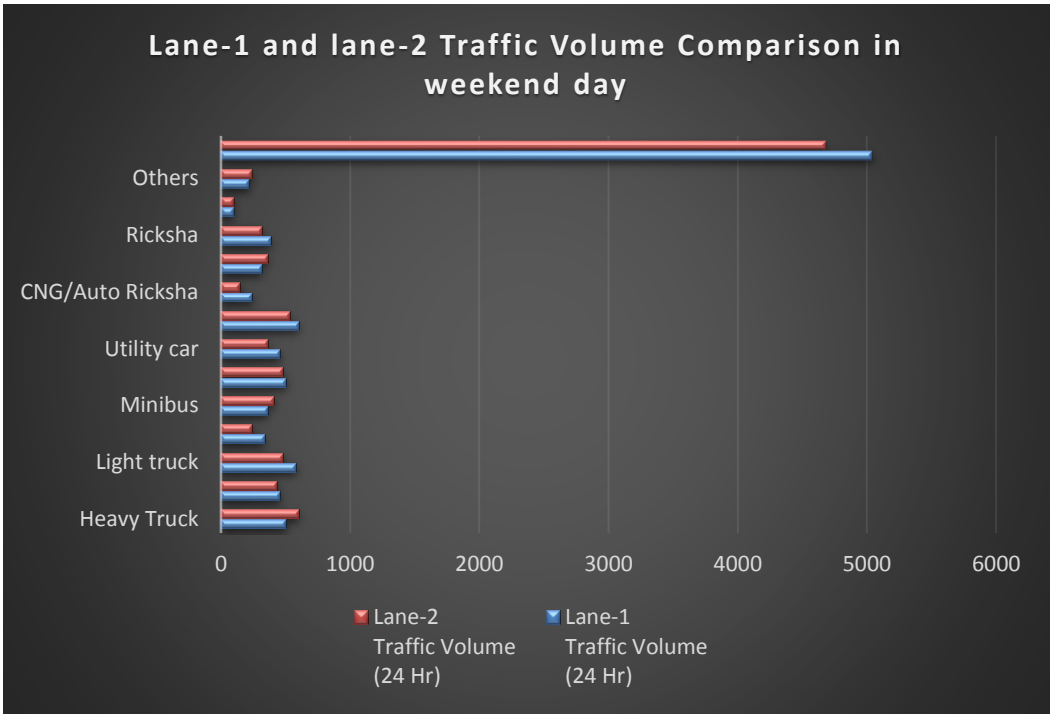

Fig. 6. Lane-1 and lane-2 Traffic Volume Comparison in weekend day

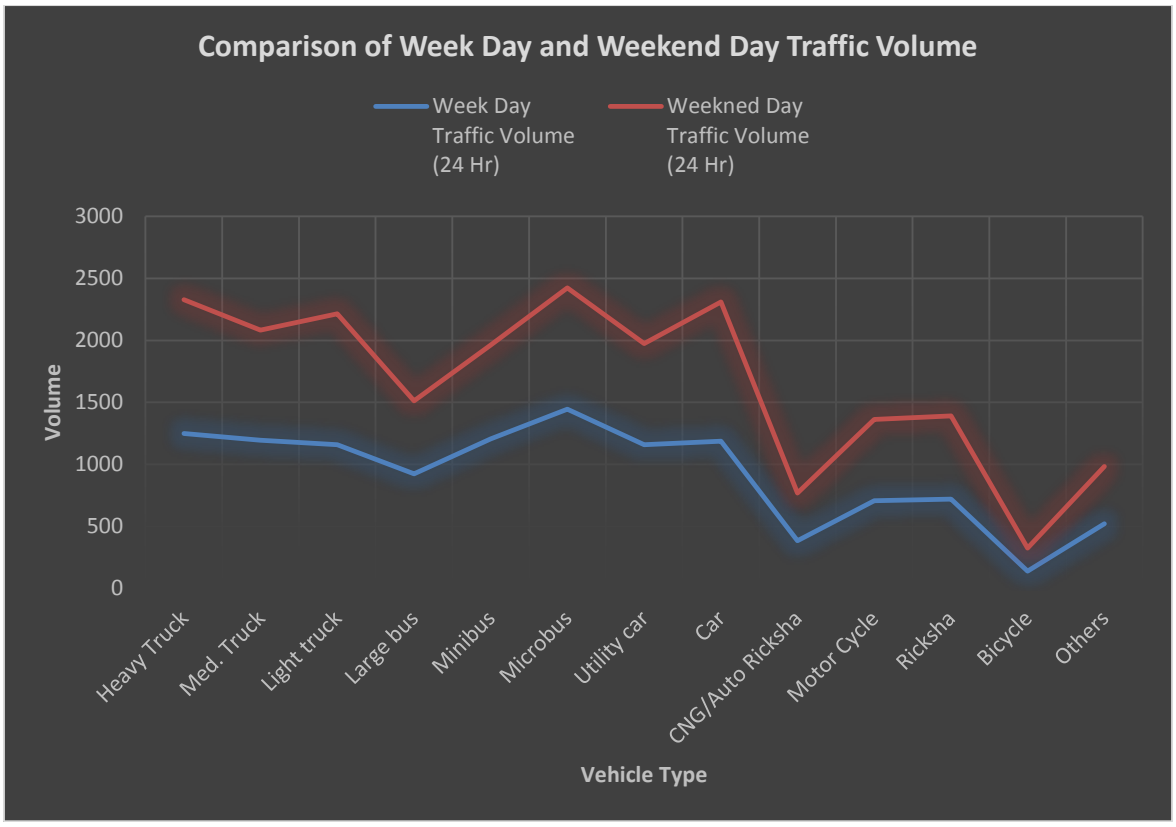

Fig. 7. Comparison of Week Day and Weekend Day Traffic Volume

Table 3. Rate of the Traffic Difference from Week to Weekend Day (24 Hr)

Vehicle Type	Week Day Traffic Volume (24 Hr)	Weekend Day Traffic Volume (24 Hr)	Rate of the Traffic Difference from Week to Weekend Day (24 Hr)
Heavy Truck	1248	1080	13%
Med. Truck	1194	888	26%
Light truck	1158	1056	9%
Large bus	924	588	36%
Minibus	1206	756	37%
Microbus	1446	978	32%
Utility car	1158	816	30%
Car	1188	1122	6%
CNG/Auto Ricksha	384	384	0%
Motor Cycle	708	654	8%
Ricksha	720	672	7%
Bicycle	138	186	-35%
Others	522	462	11%
Total =	11994	9642	20%

Table 4. Average Traffic Volume (24 Hr)

Vehicle Type	Week Day Traffic Volume (24 Hr)	Weekend Day Traffic Volume (24 Hr)	Average Traffic Volume (24 Hr)
Heavy Truck	1248	1080	1164
Med. Truck	1194	888	1041
Light truck	1158	1056	1107
Large bus	924	588	756
Minibus	1206	756	981
Microbus	1446	978	1212
Utility car	1158	816	987
Car	1188	1122	1155
CNG/Auto Ricksha	384	384	384
Motor Cycle	708	654	681
Ricksha	720	672	696
Bicycle	138	186	162
Others	522	462	492
Total =	11994	9642	10818

Table 5. New Generated Traffic Volume

Vehicle Type	New generated Traffic Volume (24 Hr) (Surveyed)
Heavy Truck	6
Med. Truck	10
Light truck	5
Large bus	2
Minibus	30
Microbus	8
Utility car	4
Car	15
CNG/Auto Ricksha	25
Motor Cycle	50
Ricksha	45
Bicycle	115
Others	20
Total =	335

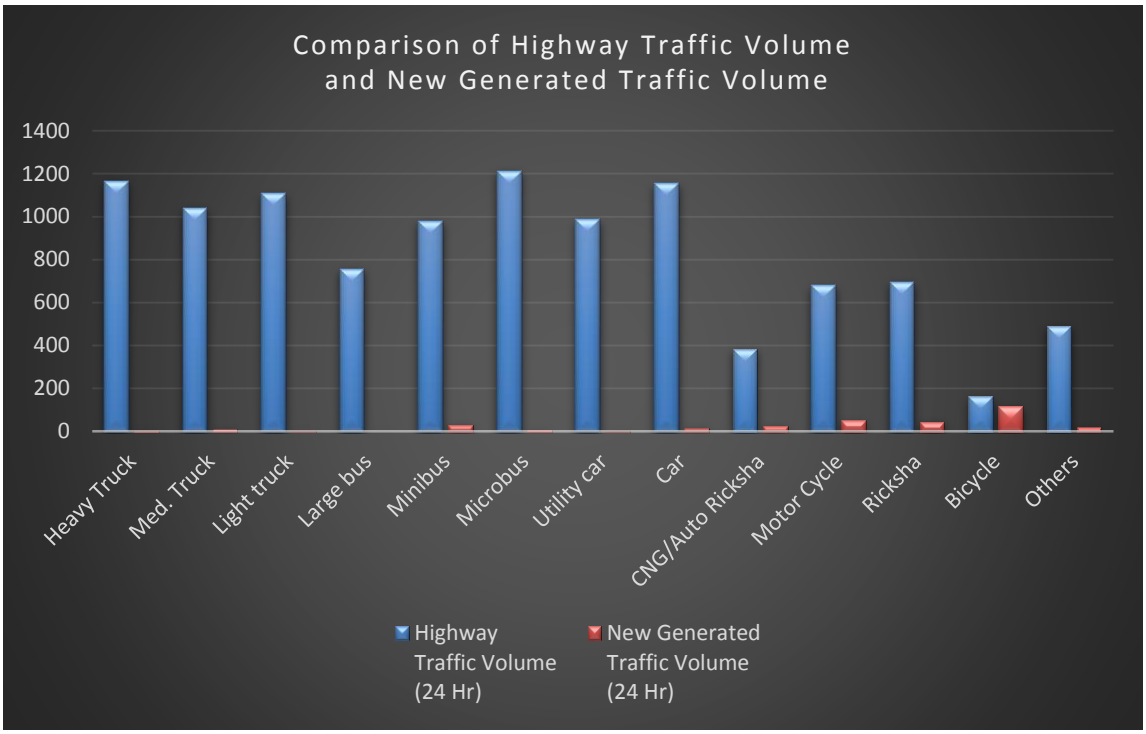

Fig. 8. Comparison of Highway Traffic and New Generated Traffic Volume

Table 6. Highway Traffic Volume New (24 Hr)

Vehicle Type	Highway Traffic Volume (24 Hr)	New Generated Traffic Volume (24 Hr)	Highway Traffic Volume New (24 Hr)
Heavy Truck	1164	6	1170
Med. Truck	1041	10	1051
Light truck	1107	5	1112
Large bus	756	2	758
Minibus	981	30	1011
Microbus	1212	8	1220
Utility car	987	4	991
Car	1155	15	1170
CNG/Auto Ricksha	384	25	409
Motor Cycle	681	50	731
Ricksha	696	45	741
Bicycle	162	115	277
Others	492	20	512
Total =	10818	335	11153

From the above data analysis, it can be seen that the traffic flow will increase in the road by 3.10% if the proposed industry is established. Due to the new development, its increasing vehicle traffic is certainly affecting the neighboring development and the surrounding transport network.

So here is an impact on traffic for newly created trips if the industry is set up here. New development which generates new traffic that can lead to congestion and safety issues hence requires the need to update infrastructure, such as new signs, turning lanes or crossroads and makes a hues impact. The impacts include traffic problems and safety issues for road users that can been created by the development.

3.1 Traffic Impact

The new infrastructures generate high traffic demand and may cause serious traffic problems

on the surrounding transport network. The traffic problems and safety issues are including:

- Reduced the capacity of the road
- Increased travel time delays
- Creating traffic bottlenecks on the highway
- Causing traffic congestion at intersections
- Queue length can grow.
- Increased fuel consumption
- Transportation crisis during peak hour
- Increased roadway accidents
- And all of which result in unrecorded economic losses.

Table 7. Percentage (%) of Increase

Vehicle Type	Highway Traffic Volume (24 Hr)	Highway Traffic Volume New (24 Hr)	Percentage (%) of Increase (24 Hr)
Heavy Truck	1164	1170	0.52%
Med. Truck	1041	1051	0.96%
Light truck	1107	1112	0.45%
Large bus	756	758	0.26%
Minibus	981	1011	3.06%
Microbus	1212	1220	0.66%
Utility car	987	991	0.41%
Car	1155	1170	1.30%
CNG/Auto Ricksha	384	409	6.51%
Motor Cycle	681	731	7.34%
Ricksha	696	741	6.47%
Bicycle	162	277	70.99%
Others	492	512	4.07%
Total =	10818	11153	3.10%

Table 8. Traffic Flow Calculation

Vehicle Type	Highway Traffic Volume (24 Hr)	Highway Traffic Flow	Highway Traffic Volume New (24 Hr)	Highway Traffic Flow New	Percentage (%) of Increase
Heavy Truck	1164	451	1170	465	3.10%
Med. Truck	1041		1051		
Light truck	1107		1112		
Large bus	756		758		
Minibus	981		1011		
Microbus	1212		1220		
Utility car	987		991		
Car	1155		1170		
CNG/Auto Ricksha	384		409		
Motor Cycle	681		731		
Ricksha	696		741		
Bicycle	162		277		
Others	492		512		
Total =	10818		11153		

4. CONCLUSION

All kind of development beside national highway should be done so carefully and in planned way so that development cannot create adverse impact both national and local level. Commercial use along the national highway reducing the journey speed and creating traffic jam which degrading the basic characteristics of National Highway. This study will help the respective authority to visualize and get clear idea about the impacts of such land use beside a national highway. It will also help in enhancing the performance of a national highway.

5. RECOMENDATION

From the above discussion it is clear to us that the new proposed industry has an impact on the surrounding road. After all, more develop can give safer environment if the rules and regulations are maintained. To mitigate the above problems the following measure can be taken.

To reduce the problem, authorities have to arrange the own initiative traffic system by conducting the concerned traffic office arrival and departure of the industry.

Traffic congestion on the road will be less if the arrival and departure times are not kept at the same time for every sector employee. It can be divided two or more segments.

In case of construction of industry connecting roads, proper design and approval of legal authority has to be taken.

A foot over bridge can be constructed in front of industry on its own initiative or conducting the concerned office.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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