# Parking Problem Analysis at the Town Center of Rangamati Municipality

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## Abstract

Last four decades' the population in Rangamati increased considerably. This enormous population created pressure on land and natural resources for house and others infrastructure construction. But the topographical nature of the area limits the flat land required for housing, shops, schools, roads, vehicles parking and other facilities. The purpose of this paper is to assess the parking facilities for the increasing numbers of vehicle at the tourist destination town of Rangamati municipality. Parking demand survey, parking space inventory survey, patrol survey, physical feature survey, and questionnaire type parking usage survey were conducted to justify parking condition in the study area through different parking terminologies (parking volume, parking accumulation, parking duration and parking load). Four major activity centers were analyzed and it was found that insufficient land is allocated for vehicles parking in the study area. Parking demand were increased from afternoon to evening it was due to the increases in number of person's trips for different purposes especially recreation and shopping purposes. In the evening, traffic congestions have been appeared at Banarupa, Tabalchari and Asambosti intersection due to on street parking. However, increases in number of person's trips, illegal use of road, Limited parking facility and poor traffic management are the primary causes of traffic congestion at the major road intersection. Proper operation, management and maintenance of both on-street and off-street parking facilities could be solved the parking problems in the study area.

***Keywords:*** *Increases of person's trips, Limited parking facility, Geographical location, illegal use of road*.

## 1 Introduction

Rangamati is the capital as well as the largest and most densely populated town of Chittagong Hill Tracts (CHT) in Bangladesh. Due to the development of commercial, educational, health and tourism sectors, people from every corner of the country are coming to Rangamati for their livelihood and recreation purpose. So the population of Rangamati is increasing largely day by day. This increasing number of population increases the demand for travel as like as other basic needs. On the other hand the geographical location is an obstacle to develop a new road and infrastructure. Resulting competition for space has one of its consequences that insufficient land is allocated for vehicles parking in the major activity centers (Chakma, 2018). Parking facilities are an integral part of the transport system. Traffic is not usually generated for the sake of movement. It travels towards a destination and, having arrived there, the vehicle must be parked whilst some business, whether private, public, recreation, or service, is transacted. Failure to supply sufficient parking facilities can result in congestion and frustration (Hobbs, 1984). Kadiyali, (2013) on his book "Traffic Engineering and Transport Planning" said that every car owner would wish to park the car as closely as possible to the destination. This result indicates a great demand for parking space in the CBD and other commercial areas where the activities are gathered. Chowdhury et al, (2014) analyzed the parking demand and supply condition in greater Chittagong city, This study has investigated the evidence about the impact of different types of parking measures and policies on road traffic congestion and transport safety, car parking, on the level of parking survey of transports through the activity of commercial area in "Agrabad". Rahaman et al, (2017) analyzed the parking demand and supply condition in Pabna municipality, they found that the deficiency of parking supply and illegal occupancy of the traffic lane in the study area, and recommended for the multistoried parking facility system so that they can shift the existing on-street parking. The parking space inventory survey was needed to identification of the parking space where the parking is done and was also needed to measure the parking demand, where patrol survey was

helpful (Zannat, 2013). From this literature review it is clear that increases the number of vehicle than supply of sufficient parking facilities are the main causes of creating parking problem of an urban area.

Therefore the aim of this paper is to assess the parking characteristics (Demand and Supply) around the major road intersection, shopping center and business areas. Measurements such as parking accumulation, volume, load and duration are used to assess the parking characteristics of vehicles, such as where they are parked and for how long, the effect of trip purpose and walking distance on parking duration. These measurements would help to determine the facts that can clarify the problem and indicate a solution.

## 2 Methodologies

For fulfilling the research work it was necessary to conduct systematic parking study. Therefore the study area was visited at several times and data was collected carefully in a systematic way. Parking demand survey, Parking space inventory survey, Patrol survey, Physical feature survey, and Questionnaire type parking usage survey were conducted to justify parking condition in the study area through different parking terminologies (Parking Volume, Parking Accumulation, Parking Duration, Parking Load, Expected number of Vehicle).
After the primary survey, total parked vehicle converted into PCU for calculating parking, volume, parking accumulation. Passenger Car Unit (PCU) Calculation process are- CNG, motorcycle, Bus/Truck and car are in a single and same unit as a car. For this conversion there are, CNG=0.5, motorcycle=0.4, Bus/Truck= 2.2 and the car =1 as a unit for taking actual measurement (Kadiyali, 2013).
Parking accumulation is the total number of vehicles parked in an area at a specific moment. Normally it is expressed by accumulation curve. Accumulation curve is obtained by plotting the number of bays occupied with respect to time (Tom, Mathew & Rao 2006; Banu & Rahman, 2016)
Parking volume is the number of vehicles parking in a particular area over a given period of time. This does not account for repetition of vehicles (Tom, Mathew & Rao 2006).
Parking load gives the area under the parking accumulation curve during a specific period. It is expressed as vehicle hours. It can also be obtained by multiplying the number of vehicles parked at each time interval and the time interval (Tom, Mathew & Rao 2006; Banu & Rahman, 2016).
According to Tom, Mathew & Rao 2006, Average duration is the average time for which the parking lot was used by the vehicles. So, Average Duration= Parking Load/Total Parking Volume (Hassan & Azmain, 2016).

## 3 Results and Discussion

### 3.1. Parking Condition at Banarupa Bazar

#### 3.1.1. Supply Scenario

Space inventory survey was conducted to find out the available parking apace in Banarupa Bazar. About 80 square meters off street parking space was initiated in Banarupa Bazar which contains about 19 CNG. There is no designated off-street parking provision for the bus. However, there is a patrol pump where external buses stop and load/unload passengers on the road. Although on-street parking is not allowed directly on highway but the CNG drivers in the study area are very familiar about on-street parking.

#### 3.1.2. Demand Scenario

To reflect the demand scenario of Banarupa Bazar, parking volume, vehicle hourly occupation and parking accumulation are discussed below.

##### *3.1.2.1. Parking volume*

Total parking volume over a period of 18 readings is 427 (Table 1). But the total amount of vehicle passed in the area in study hour is even more. As the time spent for a vehicle is less than 15 minutes, many vehicles had passed the stop without being accounted.

Table 1: Parking Volume at Banarupa Bazar

| Time | CNG | Car | Motor cycle | Bus/Track | Other | Total |
|---|---|---|---|---|---|---|
| 8am- 8.30am | 5 | | 5 | 3 | 1 | 14 |
| 8.30am-9am | 8 | | 2 | 2 | | 12 |
| 9am-9.30am | 12 | 1 | 4 | 1 | 3 | 21 |
| 9.30am-10pm | 17 | 2 | 9 | 1 | 2 | 31 |
| 10pm-10.30am | 9 | | 3 | 2 | | 14 |
| 10.30am-11am | 11 | | 7 | | 2 | 20 |
| 11am-11.30am | 10 | | 8 | 1 | 1 | 20 |
| 11.30am-12pm | 8 | 1 | 1 | | 3 | 11 |
| 12pm-12.30pm | 9 | | 4 | | 4 | 17 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12.30pm-1pm | 7 | | 4 | 1 | | 12 |
| 1pm-1.30pm | 6 | | 5 | 1 | | 12 |
| 1.30pm-2pm | 4 | 1 | 5 | | 1 | 11 |
| 3pm-3.30pm | 13 | 3 | 9 | 2 | | 27 |
| 3.30pm-4pm | 15 | | 8 | | 1 | 24 |
| 4pm-4.30pm | 19 | 2 | 12 | 3 | | 36 |
| 4.30pm-5pm | 27 | | 14 | 1 | 2 | 44 |
| 5pm-5.30pm | 25 | | 19 | 3 | | 47 |
| 5.30pm-6pm | 21 | 1 | 29 | | 3 | 54 |

*Source: Field Survey, 2018

***3.1.2.2. Parking accumulation***

From the Table 1, we can see that the number of CNG is higher around 4.30 pm to 5 pm (Figure 1). The reason for becoming the greater number of CNG at that time is that the people in Rangamati come to the Banarupa market for different purposes especially for shopping and recreation. Banarupa is famous for fresh vegetable.

In case of motorcycle accumulation is highest 29 vehicles during evening 5.30pm to 6pm. In the evening, the young generation people come out with the motorcycle and ultimately the numbers of motorcycle accumulation are become higher in that time. Accumulation, in case of Car, Bus and Truck are very low compare to CNG and motorcycle. The top accumulation number of Bus is 3 in different times of the day including 8am- 8.30am, 4pm-4.30pm and 5pm-5.30pm. From the above data, we can say the maximum number of accumulated vehicle in Banarupa Bazar is CNG (226) and then Motorcycle (145). Both the number can increase by 2020.

***3.1.2.3. Vehicle-Hour occupation***

Table 2 shows the number of vehicle hourly occupation. The analysis assumed that about 22.54% vehicle leaves parking place in less than 15 minutes, 33.12% vehicle parked for more than 15 minutes, 20.25% vehicle parked for more than 45 minutes, 13.24% vehicle parked for more than 1 hours and 10.82% vehicle parked for more than 1.25 hours in study area.

Table 2: Hourly vehicle occupation at Banarupa Bazar

| **Vehicle Occupancy Time at Banarupa Bazar** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Duration (Hour) | CNG | Car | Motor Cycle | Bus/ Track | Total Vehicle Parked | Percentage (%) | Hourly Occupation | Percentage (%) |
| 0.25 | 112 | 2 | 51 | 12 | 177 | 43.92 | 44.25 | 22.54 |
| 0.5 | 74 | 4 | 43 | 9 | 130 | 32.25 | 65 | 33.12 |
| 0.75 | 21 | 5 | 27 | | 53 | 13.15 | 39.75 | 20.25 |
| 1 | 11 | | 15 | | 26 | 6.46 | 26 | 13.24 |
| 1.25 | 8 | | 9 | | 17 | 4.21 | 21.25 | 10.82 |

*Source: Field Survey, 2018

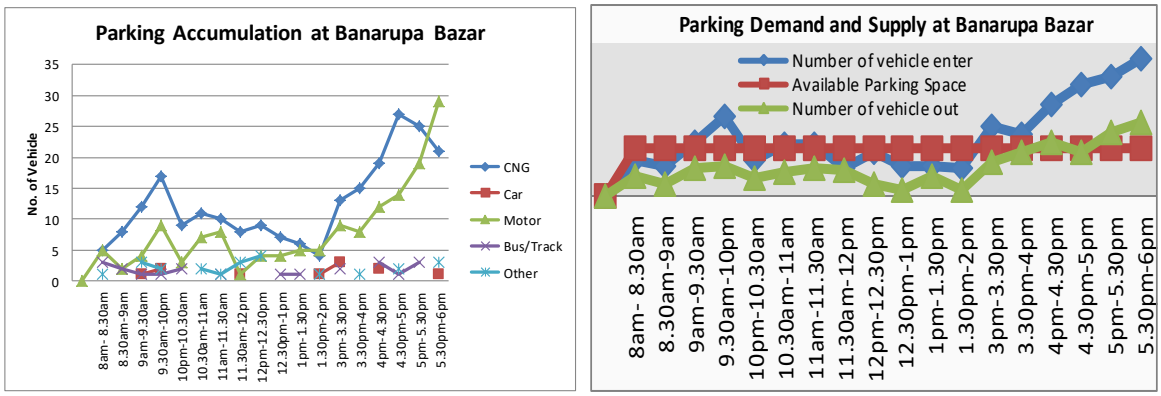


Figure 1: Parking accumulation curve (left side); Parking demand and supply Curve (right side) at Banarupa Bazar

From the above analysis we can summarize that the parking demand become higher from 3pm to 6pm in the evening and 9.30 am to 10am in the morning. It is due to, 3-6pm is shopping and recreation time and on the other hand 9.30-10am is office and educational time. Figure 1 show that parking demand and supply relationship at different time period. Parking demand curve remains above Parking supply curve from afternoon to evening. Since the parking supply is fixed and there is no way to increase the parking supply, so some spillover parking is created at this pick hour.

### 3.2. Parking Condition at Vedvedi Intersection:

#### 3.2.1. Supply Scenario

Vedvedi is the cordon point of Rangamati municipality where has off street parking facility for only 12 CNG. This parking space designed for only use of external trips making CNG. There is no parking space for Bus and Truck. There are some extra spaces in front of CNG parking area which is not organized and use parking space for Bus. The Bus load and unload passengers as their wish without following any parking instruction.

#### 3.2.2. Demand Scenario

To illustrate the demand scenario of Vedvedi Intersection, parking volume, vehicle hourly occupation and parking accumulation are discussed below.

##### *3.2.2.1. Parking volume*

Table 3 shows the hourly parking volume at Vedvedi intersection. Total parking volume over a period of 7 readings is 178. But the total volume of vehicle passed in the area in study hour is even more. As the time spent for a vehicle is less than 15 minutes, many vehicles had passed the stop without being accounted.

Table 3: Parking Volume at Vedvedi intersection

| Time | CNG | Car | Motor Cycle | Bus/Track | Other | Total |
|---|---|---|---|---|---|---|
| 8am- 9am | 13 | 1 | 5 | 3 | 3 | 25 |
| 9am-10am | 14 | | 3 | 2 | | 19 |
| 10pm-11am | 19 | 3 | 5 | 5 | | 32 |
| 11am-12pm | 15 | 2 | 3 | 2 | 4 | 26 |
| 12pm-1pm | 12 | | 2 | | | 14 |
| 3pm-4pm | 21 | 4 | 6 | 7 | | 38 |
| 4pm-5pm | 9 | 1 | 9 | 3 | 2 | 24 |

*Source: Field Survey, 2018

##### *3.2.2.2. Parking accumulation*

Figure 2 shows that CNG is the higher number of accumulated vehicle at the Vedvedi intersection and the uppermost number is 21 around 3pm to 4pm. The CNGs which are come from outside of town accumulated here before going back. After that time the number gradually decrease. In case of motorcycle accumulation just opposite event was happened. The number of motorcycle accumulation is increased with over time it was due to returning back of external trips making motorcycle. Total accumulated numbers of Buses are 22 over a period of 7 readings. The highest accumulated number is 7 around 3pm-4pm and the number is lower with respect CNG and motorcycle, because every one hour after one bus leaves from Rangamati town to the other town.

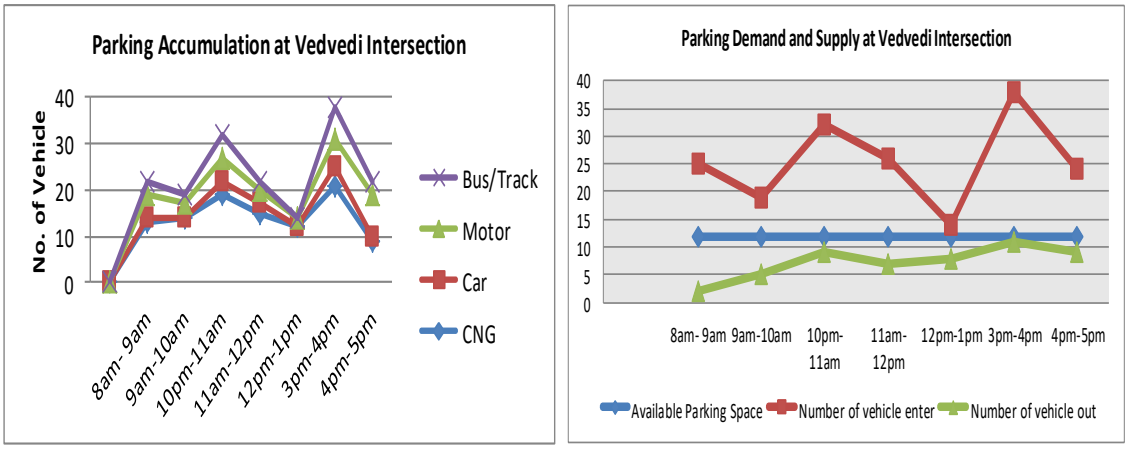


Figure 2: Parking accumulation curve (left side); Parking demand and supply curve (right side) at Vedvedi intersection

##### *3.2.2.3. Vehicle-Hour occupation*

According to physical survey, average vehicle hour occupations at Vedvedi intersection are shown in table 4.

Table 4: Hourly vehicle occupation at Vedvedi intersection

| Vehicle | Occupancy Time at Vedvedi intersection |
|---|---|

| Duration (Hour) | CNG | Car | Motor Cycle | Bus/ Track | Total Vehicle Parked | Percentage | Hourly Occupation | Percentage |
|---|---|---|---|---|---|---|---|---|
| 0.25 | 45 | 4 | 15 | 11 | 75 | 44.37 | 18.75 | 21.42 |
| 0.5 | 21 | 5 | 11 | 4 | 41 | 24.26 | 20.5 | 23.42 |
| 0.75 | 17 | 2 | 5 | 5 | 29 | 17.15 | 21.75 | 24.85 |
| 1 | 12 | | 2 | | 14 | 8.28 | 14 | 16 |
| 1.25 | 8 | | | 2 | 10 | 5.91 | 12.5 | 14.28 |

*Source: Field Survey, 2018

Table 4 illustrate that the average minutes a vehicle stays are less than 30 minutes. Just few vehicles stay in a place longer than 45 minutes. This is the passenger waiting time. About 21.42% vehicle leaves parking place in less than 15 minutes and 16% vehicles parked for more than 1 hour. Figure 2 illustrate that demand curve is remaining above the supply curve at different readings. That's indicating that spillover parking is created at the pick hour time period of Vedvedi intersection.

### 3.3. Parking condition at Asambosti:

#### 3.3.1. Supply Scenario

Asambasti is another one cordon point of Rangamati town. There is no designated on-street or off-street parking provision for the CNG and others vehicles. Vehicles are parked in a very congested and scattered way on the street of Rangamati-Kaptai road. Passengers load/unload activity occurred on the road.

#### 3.3.2. Demand Scenario

To illustrate the demand scenario of Asambasti intersection, parking volume, vehicle hourly occupation and parking accumulation are discussed below.

##### *3.3.2.1. Parking volume*

Table 5 shows the hourly parking volume at Asambasti intersection. Total parking volume over a period of 16 readings is 285. But the total amount of vehicle passed in the area in study hour is even more. As the time spent for a vehicle is less than 15 minutes, many vehicles had passed the stop without being accounted. From the total parked vehicles 158 is CNG, 77 is motorcycle, 30 is car and 20 is mini truck. The maximum numbers of vehicle about 56 are parked at around 4pm-4.30pm time period.

Table 5: Parking Volume at Asambasti intersection

| Time | CNG | Car | Motor Cycle | Mini truck | Total |
|---|---|---|---|---|---|
| 8am- 8.30am | 9 | | | 2 | 11 |
| 8.30am-9am | 11 | | | | 11 |
| 9am-9.30am | 11 | | 3 | 3 | 17 |
| 9.30am-10pm | 8 | | 5 | 1 | 14 |
| 10pm-10.30am | 4 | 3 | | | 7 |
| 10.30am-11am | 5 | | 3 | 2 | 10 |
| 11am-11.30am | 6 | 3 | | | 9 |
| 11.30am-12pm | 5 | 2 | 1 | | 8 |
| 12pm-12.30pm | 6 | | 5 | 3 | 14 |
| 12.30pm-1pm | 2 | | 5 | 2 | 9 |
| 1pm-1.30pm | 4 | 2 | | | 6 |
| 1.30pm-2pm | 7 | | 2 | 3 | 12 |
| 3pm-3.30pm | 11 | 6 | 6 | 1 | 24 |
| 3.30pm-4pm | 16 | 3 | 10 | | 29 |
| 4pm-4.30pm | 28 | 6 | 19 | 3 | 56 |
| 4.30pm-5pm | 25 | 5 | 18 | | 48 |
| Total | 158 | 30 | 77 | 20 | 285 |

*Source: Field Survey, 2018

##### *3.3.2.2. Parking accumulation*

From the analysis it was found that CNG is the highest number of accumulated vehicle at 4pm-4.30pm pick time period (figure 3). Motorcycle is the second highest accumulated vehicle with the same pick hour of CNG. Heavy vehicle are forbidden in Rangamati-Kaptai road but the mini truck are allowed. These company owned vehicles are basically travel for supply goods into the grocery shop. Significant numbers of Car are seen to park in this intersection. It was due to Asambasti is well known tourist spot, people come here for relaxation.

##### *3.3.2.3. Vehicle-Hour occupation*

Table 6 shows that about 26.33% vehicle leaves parking space less than 15 minutes time. About 32.06% vehicles are parked for more than 30 minutes, 21.18% vehicles are parked for more than 45 minutes, 15.26% vehicles are parked for more than 1 hour and 4.77% vehicles are parked for more than 1.25 hours. The vehicle which are parked for more than 1 hour and 1.25 hours are privately hired vehicle, and which are parked for less than 15 minutes are local public vehicles. Figure 3 show the parking demand and supply curve at Asambasti. It is shows that supply and demand curve are almost similar from 8am to 2pm, which means there have enough parking spaces with demand, but after 3pm demand for parking space constantly becomes higher than the supply.

Table 6: Hourly vehicle occupation at Asambasti

| **Vehicle Occupancy Time at Asambosti** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Duration (Hour) | CNG | Car | Motor Cycle | Mini Track | Total Vehicle Parked | Percentage | Hourly Occupation | Percentage |
| 0.25 | 73 | 25 | 30 | 10 | 138 | 48.42 | 34.5 | 26.33 |
| 0.5 | 51 | 5 | 21 | 8 | 85 | 29.82 | 42.5 | 32.06 |
| 0.75 | 26 | | 9 | 2 | 37 | 12.98 | 27.75 | 21.18 |
| 1 | 8 | | 12 | | 20 | 7.01 | 20 | 15.26 |
| 1.25 | | | 5 | | 5 | 1.75 | 6.25 | 4.77 |

*Source: Field Survey, 2018

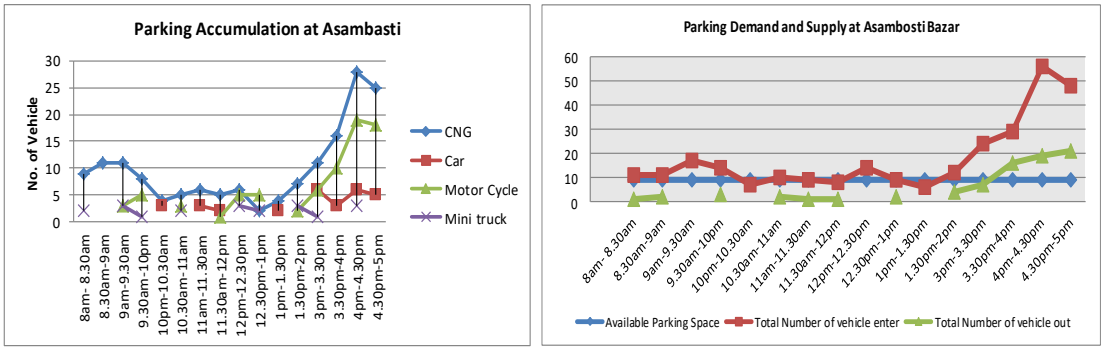


Figure 3: Parking accumulation curve (left side); Parking demand and supply curve (right side) at Asambasti

### 3.4. Parking Condition at Tabalchari Bazar:

#### 3.4.1. Supply Scenario

Tabalchari Bazar is the second largest market in Rangamati, where most attractive tourist spot "hanging bridge" was located. Although it is a well-known tourism site but there is lack of enough parking space. There is no designated off-street parking spaces for car, CNG and other vehicles, as a result tourist vehicle were parked on the street reducing road width and capacity. The condition becomes severe at tourism season.

#### 3.4.2. Demand Scenario

To illustrate the demand scenario of Tabalchari Bazar, parking volume, vehicle hourly occupation and parking accumulation are discussed below.

***3.4.2.1. Parking volume***

Total parking volume over a period of 8 readings in 4 hour is 252 from which 133 is CNG, 103 is Motorcycle, 8 is Bus, 5 is Car and 4 is others vehicles (table 7). That's means on an average in every hour 63 new vehicle were parked on the road. But the total amount of vehicle passed in the area in study hour is even more. As the time spent for a vehicle is less than 15 minutes, many vehicles had passed the stop without being accounted. 6.30pm-7pm is the pick hours.

Table 7: Parking Volume at Tabalchari Bazar

| Time | CNG | Car | Motor Cycle | Bus/Track | Other | Total |
|---|---|---|---|---|---|---|
| 3pm-3.30pm | 11 | 1 | 8 | 1 | | 21 |
| 3.30pm-4pm | 13 | | 5 | | | 18 |
| 4pm-4.30pm | 13 | 1 | 12 | | | 25 |
| 4.30pm-5pm | 14 | | 15 | | | 29 |
| 5pm-5.30pm | 17 | | 8 | 2 | | 27 |
| 5.30pm-6pm | 19 | 2 | 13 | | | 34 |
| 6pm-6.30pm | 21 | 1 | 17 | 3 | 3 | 45 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6.30pm-7pm | 25 | | 25 | 2 | 1 | 53 |
| Total | 133 | 5 | 103 | 8 | 4 | 252 |

*Source: Field Survey, 2018

***3.4.2.2. Parking accumulation***

From the table 7 we can see the hourly basis vehicle accumulation scenario. Figure 4 shows the CNG is the highest numbers of accumulated vehicle at Tabalchari. Figure also shows that the CNG accumulation curve is almost linear with the time. In case of Motorcycle, figure shows that motorcycle accumulation curve has become linear with some up and downward movement. The motorcycle accumulation curve becomes constantly upward from 5pm.

***3.4.2.3. Vehicle-Hour occupation***

Table 8 show the average vehicle hourly occupation according to physical survey. It is shows that 19.77% vehicle leaves parking space less than 15 minutes time, 26.11% vehicles are parked for more than 30 minutes, 15.11% vehicles are parked for more than 45 minutes, 15.67% vehicles are parked for more than 1 hour and 23.32% vehicles are parked for more than 1.25 hours. The vehicles which are parked for more than 1 hour to 1.25 hours are privately hired vehicle and which are parked for less than 15 to 45 minutes are local public transport. The numbers of motorcycle are higher among the privately hired or privately own vehicle and have a significant impact on-street parking.

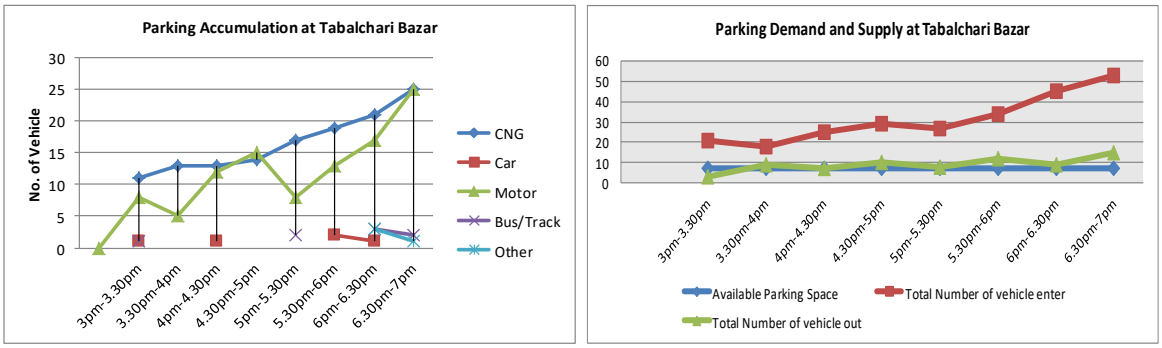


Figure 4: Parking accumulation curvet (left side); Parking demand and supply curve (right side) at Tabalchari Bazar

Figure 4 show the parking demand and supply curve relationship for Tabalchari Bazar. Figure shows that parking demand curve remains above the parking supply curve which means available parking space is not enough to cope with parking demand. As there is no off street parking facility therefor the vehicles load/unload the passengers, good and services on the road.

Table 8: Vehicle hourly occupation at Tabalchari Bazar

| Duration (Hour) | CNG | Car | Motor Cycle | Bus/ Track | Total Vehicle Parked | Percentage | Hourly Occupation | Percentage |
|---|---|---|---|---|---|---|---|---|
| 0.25 | 63 | 3 | 35 | 5 | 106 | 42.57 | 26.5 | 19.77 |
| 0.5 | 45 | 2 | 21 | 2 | 70 | 28.11 | 35 | 26.11 |
| 0.75 | 15 | | 11 | 1 | 27 | 10.84 | 20.25 | 15.11 |
| 1 | 7 | | 14 | | 21 | 8.43 | 21 | 15.67 |
| 1.25 | 3 | | 22 | | 25 | 10.04 | 31.25 | 23.32 |

*Source: Field Survey, 2018

## 4 Conclusions

For development, parking is a basic type of requirement. However, major activity area of Rangamati is suffering in the shortage of available parking space. Due to the lack of adequate parking facility, unauthorized on-street parking was practiced which affects the roadway capacity greatly and creates some relevant problems. So, it is necessary to adopt policies for the allotment of adequate off-street parking facilities, proper operation, management and maintenance of both on-street and off-street parking facilities for the better performance of the road and a balanced transportation growth.

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