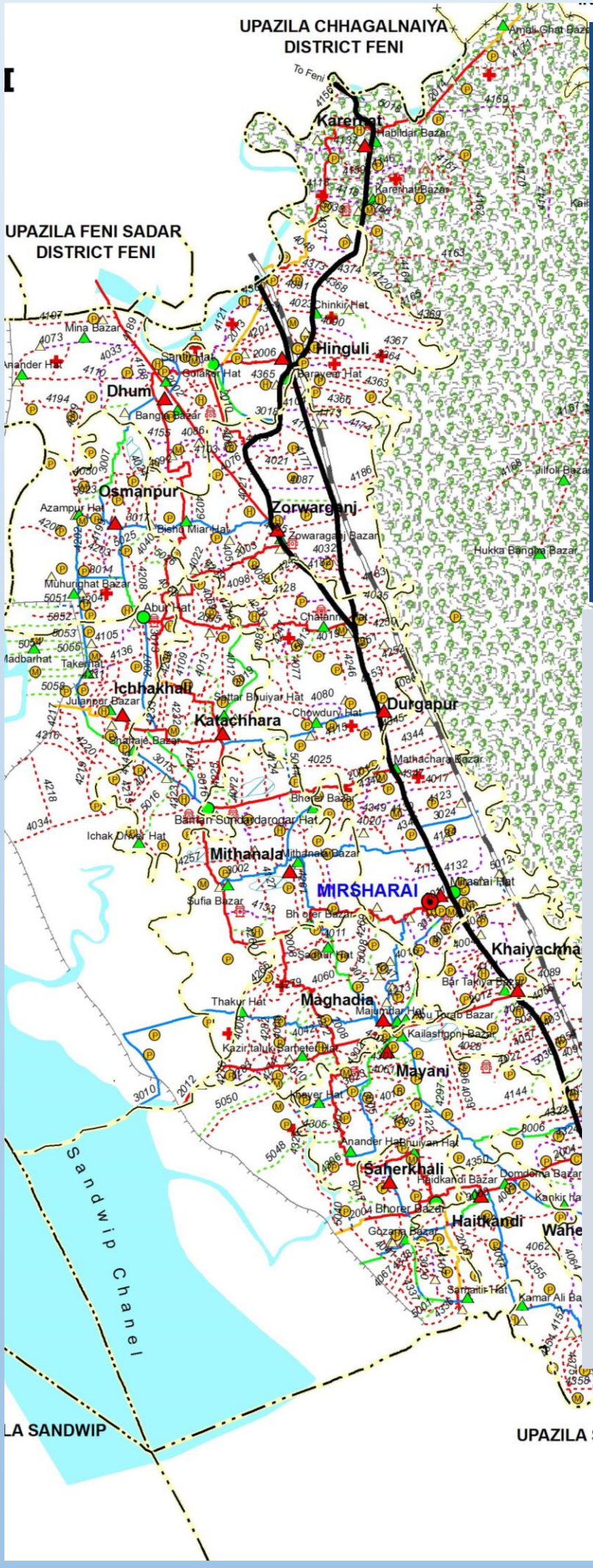

Preparation of Development Plan for Mirsharai Upazila, Chittagong Distrit: Risk Sensitive Land Use Plan

under

Urban Development Directorate (UDD)

Interim Report

Traffic and Transport Surveys and Studies (Package-04)

February 2018

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EXECUTIVE SUMMARY

A thorough traffic study on the existing road network is imperative to shed light on the recent state of transportation as well as to provide information about its pros and cons and possibilities for future development. Through this transportation survey and studies, an improved transport system will be proposed which will be efficient, affordable and sustainable for the growth of Mirsharai Upazila. To fulfill this purpose the consultant team conducted a four day comprehensive traffic survey between January 8, 2018 and January 11, 2018. Mainly five kinds of surveys were conducted: (i) Production (Household Survey)-Attraction (commercial space) survey, (ii) Traffic Count survey, (iii) Origin-Destination survey, (iv) Travel time survey and (v) Stakeholder interview survey. Before conducting the survey consultant team trained surveyors and conduct pilot survey to get the optimum qualified data. Detail survey design and methodology are described in Chapter- 2 and Chapter- 3. For household survey, 16 zones were selected and attraction survey were conducted on six major growth centers and two paurashavas. Traffic count and OD surveys were conducted on 10 locations and travel time survey was conducted on seven routes. However, a second phase of the household survey is planned with sampling from the socio-economic survey data; and the survey will start shortly. Also, as per the remarks from BEPZA a traffic count will be conducted in the Dhaka EPZ which is one-third the size of Mirsharai EPZ. This survey will let us find out the peak hour factor and forecast traffic for Mirsharai EZ in the next 25 years.

From the household survey, it was found that on an average 7 trips are generated within the study area per day per household. Maximum (average 9 trips/ day) trips are generated from zone 11 (Shaherkhali) and zone 16 (Haitkandi), on the other hand minimum (average 3 trips/ day) trips generated from zone 9 (Mirsharai). Among all trips, educational (39%) and work (35%) trips are highest. The main mode of travel are Walking (29%), Auto rickshaw/ CNG (26%) for short distance travel and for long distance travel main mode is Jeep which along with walking (21%). Average cost for short distance is lower than the long distance travelling. Again trip attraction rate is high in Baraiyarhat and Mirsharai paurashavas which are respectively 67 and 90 trips per hour. These two areas are the heart of business and all commercial activities of Mirsharai Upazila.

The traffic count survey was conducted to find out the peak flow on the roads and for this the consultant team decided to survey the external locations for 8 hours and for internal locations 2 hours. From the survey it is found that the peak flow of traffic is between 9:00 am to 12:00 pm and once more again after 3:00 pm to 5:00-6:00 pm for internal locations. In addition, for external locations morning flow and evening flows are high exhibiting the typical nature of a highway. The peak flows on national and regional highways and for Zila roads in both directions are:

	For UP direction	For DOWN direction
Site- 01	Peak 1: 10:00 am to 11:00 am (632)	Peak 1: 12:00 pm to 01:00 pm (523)
	Peak 2: 2:00 pm to 3:00 pm (607)	Peak 2: 5:00 pm to 6:00 pm (717)
Site- 10	Peak 1: 01:00 pm to 02:00 pm (460)	Peak 1: 11:00 am to 12:00 pm (633)
	Peak 2: 04:00 pm to 05:00 pm (577)	Peak 2: 03:00 pm to 04:00 pm (556)
Site- 02	Peak 1: 03:00 pm to 04:00 pm (370)	Peak 1: 02:00 pm to 03:00 pm (362)
	Peak 2: 05:00 pm to 06:00 pm (344)	Peak 2: 05:00 pm to 06:00 pm (345)
Site- 06	Peak 1: 09:00 am to 10:00 am (103) Peak 2: 03:00 pm to 04:00 pm (102)	Peak 1: 12:00 pm to 01:00 pm (104) Peak 2: 11:00 am to 12:00 pm (89)

In national highway (Sites 01 and 10) the share of motorized vehicles are high because the locations are on Dhaka-Chittagong highway. Among the vehicles modal share of medium trucks and large buses are high in both directions for both sites. In site 10 considerable amount of pickups and jeeps are observed.

Site 01	Site 10
Medium truck (45%, 36%)	Medium truck (32%, 48%)
Large bus (11% for both directions)	Large bus (14%, 11%)

In the regional highway (Site 02) share of auto rickshaw/ CNG, motor cycle, bi-cycle and rickshaw are high. In case of Zila road (Site 06), the scenario is same as the scenario of Site 02.

Site 02	Site 06
Auto Rickshaw/ CNG (37%, 33%)	Auto Rickshaw/ CNG (42% for both directions)
Motor-cycle (13%, 16%)	Motor-cycle (20%, 17%)
	Bi-cycle (20% for both directions)

For internal sites (03, 04, 05, 07, 08 and 09) shares of CNG, motor-cycle, rickshaw and bi-cycle are higher than rest of the modes. Shares of CNG varies from 40% to 60% (highest in Site 05), motor-cycle 9% to 20% (highest in Site 03), rickshaw 3% to 22% (highest in Site 03) and bi-cycle 11% to 26% (highest in Site 09).

From the travel time survey, the following findings were found:

Route No.	*Total travel time (hour)*	*Total distance (km) (from GIS map)*	*Average Speed (km/ hr)*
Route 1	2.20	43.39	20
Route 2	Inaccessible via passenger car due to bad road condition		
Route 3	0.28	4.54	16
Route 4	Inaccessible via passenger car due to bad road condition		
Route 5	1.23	14.39	12
Route 6	0.43	9.46	22
Route 7	0.38	7.42	19

From the OD analyses of the household and roadside surveys, it is found that presently the movement is mostly within the zone due to availability of most of the facilities nearby. And Walking and Other MUCM especially CNG are popular modes for commuting within the zone. Whereas for longer distance, Bus and shared MUCM such as Jeep/ Leguna/ Microbus etc. are used. The three major purposes for trip generation are Educational, Shopping and Work.

The stakeholder interviews carried out so far have brought about a number of important findings those may be useful for the holistic transportation planning of Mirsharai Upazila. Most important such remarks are listed out in the Chapter 4 (Section 4.6).

Dr. Moinul Hossain
Team Leader

1 INTRODUCTION

The objectives of the traffic survey are two folds. *Firstly*, it provides idea about the existing traffic demand available supply in the form of infrastructure and services. *Secondly*, it acts as the input for the travel demand forecasting model that is to be constructed as the output of the project which will enable UDD to analyze various traffic scenarios with respect to changed network as well as land use scenarios.

According to the TOR, the consultant team will be responsible to construct a 20-year prediction model for transportation of the project area. A classical four-step travel demand-forecasting model will be constructed with the survey data that will determine the travel demand on the future road network of Mirsharai Upazila.

To estimate the future traffic demand on the future road network of Mirsharai the following surveys will be conducted:

Production-Attraction Survey will comprise production from the households' daily trips survey and attraction to the commercial land use and will contribute to the trip generation of different zones within the project area.

Traffic Count Survey reflects the base year demand in terms of categorized traffic volume.

Origin-Destination Survey facilitates identifying final Traffic Assessment Zones (TAZ), demand for different external and internal zones, as well as directional distribution at different intersections.

Travel Time Survey produces the generalized travel cost matrix and assists in determining the optimized routes for different OD pairs, which is used as an input in the assignment step of modelling.

Stakeholder Interview involves stakeholders from different concerned entities, the community truck, bus and unconventional modes (UCM), assisting in identifying the transportation modes and the users of the proposed road network. This will enable in designing future transportation network as well as services around this network which can be constructed, operated and maintained sustainably.

This report includes the final survey design and detailed methodology for the assignment. It also discusses the result analyses from the data obtained from the surveys/ studies which are already completed so far.

2 DETAIL SURVEY DESIGN

For execution of survey Consultant team prepared survey plan which includes questionnaire preparation, general guidelines for survey activities and for surveyors, equipment and surveyor procurement, training of surveyors, logistic support arrangement, preparation of survey schedule etc. This section will provide a detail overview of traffic survey design.

2.1 Questionnaire Preparation

Questionnaires were prepared by the consultant team except for the traffic count survey and stakeholder interview. Traffic count survey was conducted by video recording process and stakeholder interview was conducted during the project time to time as new questions arose needing answers. The questionnaire of OD survey, Production-Attraction survey and Travel time survey has been included in **Appendix A.**

2.2 Variable Selection

A number of variables were selected mainly for the production-attraction and OD survey. For production survey, it is necessary to understand daily trip behavior of households including their social status and demographic information. The Consultant team identified some important variable for production and attraction survey which reflects the daily trip behavior of households, characteristics of individual trips as well as the characteristics of trips attracted to the commercial areas. These variables are as follows:

Production survey	**Attraction survey**
Number of members	Type of facility
Gender	Mode
Age	Occupancy
Income level	Arrival time
Educational institution	
Vehicle ownership	**Students' information**
Origin	Origin
Destination	Destination
Start time	Mode
End time	Start time
Purpose	End time
Mode	Cost
Cost	

For OD survey origin, destination, mode type, purpose of the travel and occupancy of the vehicle were considered.

2.3 Reconnaissance survey for site selection

A thorough reconnaissance survey was conducted to select the location from which data will be collected. The criteria for Count and OD site selection included:

- Proper visibility during day and night time,
- Secured and comfortable facility for enumerators (shed, seating and toilet facility) and
- Proper OD site section with no road diversions nearby.

Whenever possible, **elevated vantage points** were selected for data collection to ensure excellent visibility and ease of identification of vehicles. For Household survey administrative boundaries and for attraction survey major growth center and two municipalities were considered.

Consultation with local people at Baraiyarhat


Consultation with local people at Sarkarhat


Consultant team visiting Thakur Dighi Bazar


Consultation with lineman in Boro Darogarhat

2.4 Survey Stations/ Locations

Production-Attraction Survey

Production Survey (First Phase) - for this, the study area was divided into 16 internal zones based on political boundaries. Other than these sixteen zones the rest of the zones were considered as external zones. The zones are as follows:

Zone 1: Karerhat
Zone 2: Hinguli
Zone 3: Dhum
Zone 4: Zorawargonj
Zone 5: Osmanpur
Zone 6: Durgapur
Zone 7: Katachhara
Zone 8: Ichhakhali
Zone 9: Mirsharai
Zone 10: Mithanala
Zone 11: Shaherkhali
Zone 12:Maghadia
Zone 13: Khaiyachhara
Zone 14: Mayani
Zone 15: Wahedpur
Zone 16: Haitkandi

Second Phase Household Survey Design is in Progress. Consultant Team will include the design in the Next Report.

Attraction Survey - For this survey, six major growth centers and two Paurashavas were taken into consideration because most of the facilities are located in these places. The objective of the attraction survey was to deduce the attraction rates of different types of commercial/non-residential areas with respect to their floor space. The locations are:

Growth centers

Shantir Hat

Abur Hat

Baman Sundardarogar Hat

Mirsharai Hat

Hadi fakir Market

Shaherkhali Bhorer Bazar

Paurashava

Mirsharai

Baraiyarhat

Traffic Count and OD Surveys

Ten (10) locations were selected among which four were external where traffic enters and exists the Mirsharai study area from different locations of the country and other six locations were internal where traffic moves within the Mirsharai Upazila reflecting intra zonal trips.

Table 2.1: External and Internal OD and Vehicle Count Survey Locations

External Survey Locations	Internal Survey Locations
Baraiyarhat Foot overbridge (Dhk-Ctg Highway)	Shantir Hat Road (Near Janata Super Market)
Baraiyarhat Rail Crossing (Karerhat Road)	Muhuri Project Road
Mirsharai Stadium (Fatikchhari Road)	Thakur Dighi Bazar
Boro Darogar Hat (Dhk-Ctg Highway)	Mirsharai Paurashava (Upazila Road)
	Bara Takiya Bazar (EZ/ Abu Torab Bazar Road)
	Sarkar Hat (near Nizampur College)

Some pictures of vantage points that were selected to set up video recording camera for Vehicle Count (VC) survey are given below:

Camera location for VC at Baraiyarhat Rail Crossing

Camera location for VC at Shantir Hat

Camera location for VC at Muhuri Project Road

Camera location for VC at Thakur Dighi Bazar

Camera location for VC at Mirsharai Paurashava (Upazila Road)

Camera location for VC at Sarkar Hat (near Nizampur College)

Camera location for VC at Boro Darogar Hat (Dhk-Ctg Highway) Foot Over Bridge

Travel Time Survey

Furthermore, seven routes were selected for travel time survey. The detail has been given in the **Section 3.4 and Section 4.5**

2.5 Considerations for site selection

- The site was selected in such a way that the traffic can be counted easily without any interruption.
- Those counting spot was selected which was clear view of vehicles travelling in both directions of the road.
- A vantage point (e.g. an elevated space, Market place, Foot-over Bridge, a suitable veranda of a residential building etc.) for counting was given preferable.
- Safety and security of the surveyors was ensured.
- For OD and Traffic Count Survey site was selected where there were proper facilities such as: toilet and wash room, hotel, restaurant, tea stall etc.
- Contact with the police station was ensured by consultant team to avoid any uncertain situations.

Figure 2.1 shows the survey sites, zone boundaries and travel time survey routes:

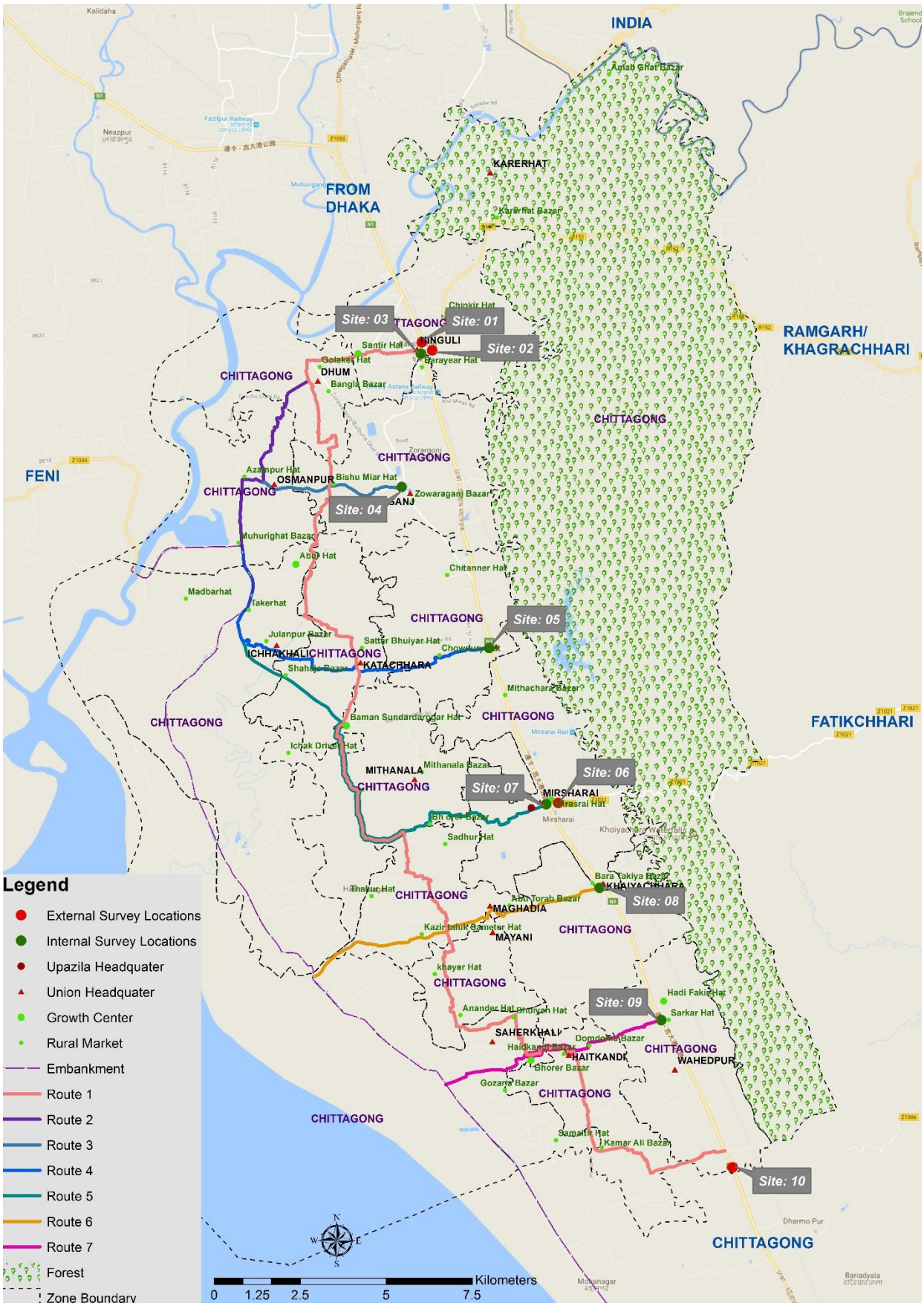


Figure 2.1: Survey locations, Zones and Travel time routes

2.6 Survey Work Schedule

Survey was scheduled for one week due to time constrained. The following Figure represents the survey schedule of the project.

No.	Activity	Days						
		D1	D2	D3	D4	D5	D6	D7
TASK: SURVEY ACTIVITY								
TASK 1	Arrive at Mirsharai							
TASK 2	Survey Preparatory activities							
TASK 3	Training of Surveyors							
TASK 4	Pilot Survey							
TASK 5	Origin-Destination Survey							
TASK 6	Vehicle Count Survey							
TASK 7	Production-Attraction Survey							
TASK 8	Travel Time Survey							
TASK 9	Stakeholder Interview							
TASK 10	Data Review and Return to Dhaka							

2.7 Manpower Arrangement

The consultant team gave preference to arrange surveyors from among the local people. So the consultant team recruited surveyors from USAM (University Students Association of Mirsarai) as they are well known in the area.

USAM (University Students Association of Mirsarai)

Surveyors from USAM during Traffic Survey

Sixteen (16) students were recruited from the organization including one coordinator. For vehicle count and OD surveys six persons was recruited and for household survey 8 (eight) persons and for attraction survey two (2) persons were recruited by the consultant team. The following Table 2.2 to Table 2.4 shows the detail of manpower arrangement of the survey.

Table 2.2: Manpower Arrangement for OD and Count Survey

Day	Location of Survey	Survey Station Type	Duration	Team	Persons
Day 1	Mirsharai Stadium (Fatikchhari Road)	External	11 hrs	Team-1	2
	Mirsharai Paurashava (Upazila Road)	Internal	2 hrs	Team-2	2
	Bara Takiya Bazar (EZ/ Abu Torab Bazar Road)	Internal	2 hrs	Team-3	2
Total for Day 1					**6**
Day 2	Boro Darogar Hat (Dhk-Ctg Highway)	External	9 hrs	Team-1	3

Day	Location of Survey	Survey Station Type	Duration	Team	Persons
	Sarkar Hat (near Nizampur College)	Internal	2 hrs	Team-2	3
				Total for Day 2	**6**
Day 3	Muhuri Project Road	Internal	6 hrs	Team-1	3
	Thakur Dighi Bazar	Internal	2 hrs	Team-2	3
				Total for Day 3	**6**
Day 4	Baraiyarhat Foot overbridge (Dhk-Ctg Highway)	External	10 hrs	Team-1	2
	Baraiyarhat Rail Crossing (Karerhat Road)	External	11 hrs & 20 min.	Team-2	2
	Shantir Hat Road (Near Janata Super Market)	Internal	6 hrs	Team-3	2
				Total for Day 4	**6**

Table 2.3: Manpower Arrangement for Household Interview Survey

Team	Union	Duration	Persons
Team-1	1. Karerhat 2. Hinguli 3. Dhum 4. Osmanpur	4 days	2
Team-2	1. Zorawargonj 2. Durgapur 3. Katachhara 4. Ichhakhali	4 days	2
Team-3	1. Mirsharai 2. Mithanala 3. Khaiyachhara 4. Maghadia	4 days	2
Team-4	1. Wahedpur 2. Haitkandi 3. Shaherkhali 4. Mayani	4 days	2
Total Persons in Four Days			**8**

Table 2.4: Manpower Arrangement for Attraction Survey

Team		Locations	Duration	Persons
Team-1		Abur Hat	4 days	2
		Shantir Hat		
		Baman Sundardarogar Hat		
		Shaherkhali		
		Hadi Fakir Hat		
		Mirsharai GC		
		Mirsharai Paurashava		
		Baraiyarhat Paurashava		
			Total Persons in Four Days	**2**

2.8 Survey Equipment

The consultant team arranged all necessary survey equipment: wristwatch, sufficient pen, notepad, boards, cap, safety vests, transport costs, umbrella, banner and all these provided to surveyors.

2.9 Approval from PD

After the all necessary arrangement and detail survey plans the consultant team discussed with Project Director, Ahmed Akhtaruzzaman, UDD for approval before mobilizing the survey activities. With the approval of PD the team moved to Mirsharai Upazila for conducting the survey at January 06, 2018.

2.10 Logistics Support Arrangement

Official letter from UDD: Official letter from UDD was provided to different departments of Mirsharai Upazila: Police authority of two Thanas, Mayors of two Paurashavas, UNO and other local authorities mentioning the purpose of the project and the survey activities.

Police support: As the surveyors collected data from the highways and it is very difficult to collect data from the Dhaka-Chittagong Highway, therefore, police support was needed. Also, for the video data collection, expensive equipments were left on roads, which needed police protection. With the help of the UDD and Local Authority of Mirsharai, permission was taken from Police of Mirsharai Thana and Zorawargonj Thana to facilitate the data collection.

Figure 2.2: Consultant team with local police and survey team

Support from local people: To conduct any survey properly local support is very important. Local people were quite supportive during the entire survey duration. Linemen of CNG stands, bus stands assisted the survey team which facilitated smooth operation of the survey. Local people were cordial in allowing the survey team to placed video recording camera in their infrastructures as well as provide utility support (electricity).

Support from local authority: Local authority of Mirsharai Upazila, especially Honorable Mayor of Mirsharai helped the consultant team to arrange the logistics, particularly in arranging police support and convincing the local to be supportive.

Support from local UDD officials: UDD's local officials coordinated with the consultant team in arranging training of surveyors, meeting with Honorable Mayors of both Mirsharai and Baraiyarhat paurashava, conducting travel time survey etc. At least one UDD local official was always present in all types of survey to ensure quality as well as to support the consulting team whenever help/suggestion was needed.

Transport Arrangement: A sedan car was arranged by the consultant team for 24 hours so that they could move easily in different survey stations and supervise the survey activities. The vehicle also used in travel time survey as well.

2.11 Training of Surveyors

The consultant team arranged a training program with the help of the local UDD officials in the UDD local office. Proper instructions about the survey was given to surveyors so that they can understand the procedure of the surveys especially how to collect data for respective jobs they had been assigned and how to coordinate with the field coordinators. All necessary equipment was provided with all survey forms after completion of the training. Some pictures of training have been given in below.




Images from the training session at UDD Mirsharai Local Office

2.12 Pilot survey

The consultant team conducted a pilot survey with the surveyors in different traffic count and OD survey sites so that the surveyors can understand the real procedure of survey and get an idea about the real-life challenges that they may face during the survey. The consultant team also supervised the household survey and attraction survey to ensure the quality of data. The pictures below represent some pilot survey scenarios at Mir.


Pilot survey at Mirsharai Paurashava Upazila Road

Pilot survey at Mirsharai Paurashava Upazila Road

Pilot survey at Mirsharai Stadium Road

Surveyors and consultant team doing pilot survey at Mirsharai Stadium Road

2.13 General Requirement

The following requirements were taken into consideration during the entire survey period.

- Chairs or other seating arrangement was provided
- Lightening arrangement was ensured with backup power for uninterrupted work at night
- Cap, safety vests, working shoes was provided to surveyors.
- A Banner of the project was provided and placed beside surveyors
- For O-D Local Police assistance was ensured.
- Photos was taken regularly of work progress in the presence of survey supervisor
- Survey activities should not be done on weekends by all means. So all survey was conducted on weekdays.
- Raw data was collected from each survey team of each location in the presence of supervisor and consultant team
- Data forging or malpractice was checked.

3 METHODOLOGY

The methodology adopted for the traffic surveys are as follows.

3.1 Production-Attraction Survey

The consultant team conducted production-attraction survey to find out the trip making characteristics of the different zones of the Upazila. From the carried out survey an overall observation has been made regarding the trip making behavior of people of each zone. The Consultant team also decided to conduct more detail **Production Survey at Second Phase** to find out more detail information on mode choice, route choice, origin, destination, catchment area of each zone, travelling distance, purpose etc.

3.1.1 Production/ Household Survey- 1st Phase

Production Survey was done by the interview on households. The interviews concentrated on the daily trip behavior- average travel time, mode choice behavior, cost of travel, time of travel including the basic socio-economic information such as no. of family members, age, gender, income level etc.

For production survey the Mirsharai Upazila was divided into sixteen (16) zones based on administrative boundaries (Union Boundary). Figure 3.2 represents the Zone boundary of Mirsharai Upazila. Eight (8) surveyors were assigned in Four (4) teams (2 persons in each team) to collect data. The targeted sample size for each zone was maximum 30 households. In this study an aggregated modelling approach will be adopted where data for each zone will be compiled for each variable and then one record for each zone will be used as input to the model. *Hence, 30 samples per zone were considered to be sufficient. These households were chosen randomly in each zone to comply with the modelling methodological requirements. The data will be particularly important for developing trip generation models using* ***regression method*** *where the 30 samples of each zone will be aggregated into one data point, i.e., in total 16 data point for the 16 internal zones, to develop the regression model. Due to this aggregation, following the central limit theorem of statistics, 30 random samples per zone is expected to be sufficient*. These Thirty (30) samples were divided based on three income criteria: *(i) Income criteria- 1 (0-15000 tk.), (ii) Income criteria- 2 (15000-30000 tk.) and (iii) Income criteria- 3 (more than 30000 tk.).* Surveyors were instructed to collect data from these three income categories households. The variables that were *selected: Number of members, Gender, Age, Income level, Educational institution, Vehicle ownership, Origin, Destination, Start time, End time, Purpose, Mode, Cost.* The zones are as following

- Zone 1: Karerhat
- Zone 2: Hinguli
- Zone 3: Dhum
- Zone 4: Zorawargonj
- Zone 5: Osmanpur
- Zone 6: Durgapur
- Zone 7: Katachhara
- Zone 8: Ichhakhali
- Zone 9: Mirsharai
- Zone 10: Mithanala
- Zone 11: Shaherkhali
- Zone 12: Maghadia
- Zone 13: Khaiyachhara
- Zone 14: Mayani
- Zone 15: Wahedpur
- Zone 16: Haitkandi

3.1.2 Production/ Household Survey- 2nd Phase

For more detail information of trip-making behavior of people the consultant team decided to carry out another Household survey based on the collected data from **"Package- 03 (Socio Economic Survey)" being conducted by Geomark Ltd. & Tiller JVC**. The survey is still ongoing and so far only 7 (seven) Zones' data are at hand.

Observing the data the team decided to categorize the data into three income categories and three household size categories. After collecting all the data from the Geomark Ltd. & Tiller JVC consultants firm the sample size will be defined and random method will be used to collect the data. The Figure 3.1 shows the data that the Consultant team has collected till yet for 7 zones. The criteria lists are:

Income category

- 15000 or less than 15000
- more than 15000 to 30000
- more than 30000

Household size category

- 3 or below 3
- 4 to 5
- above 5

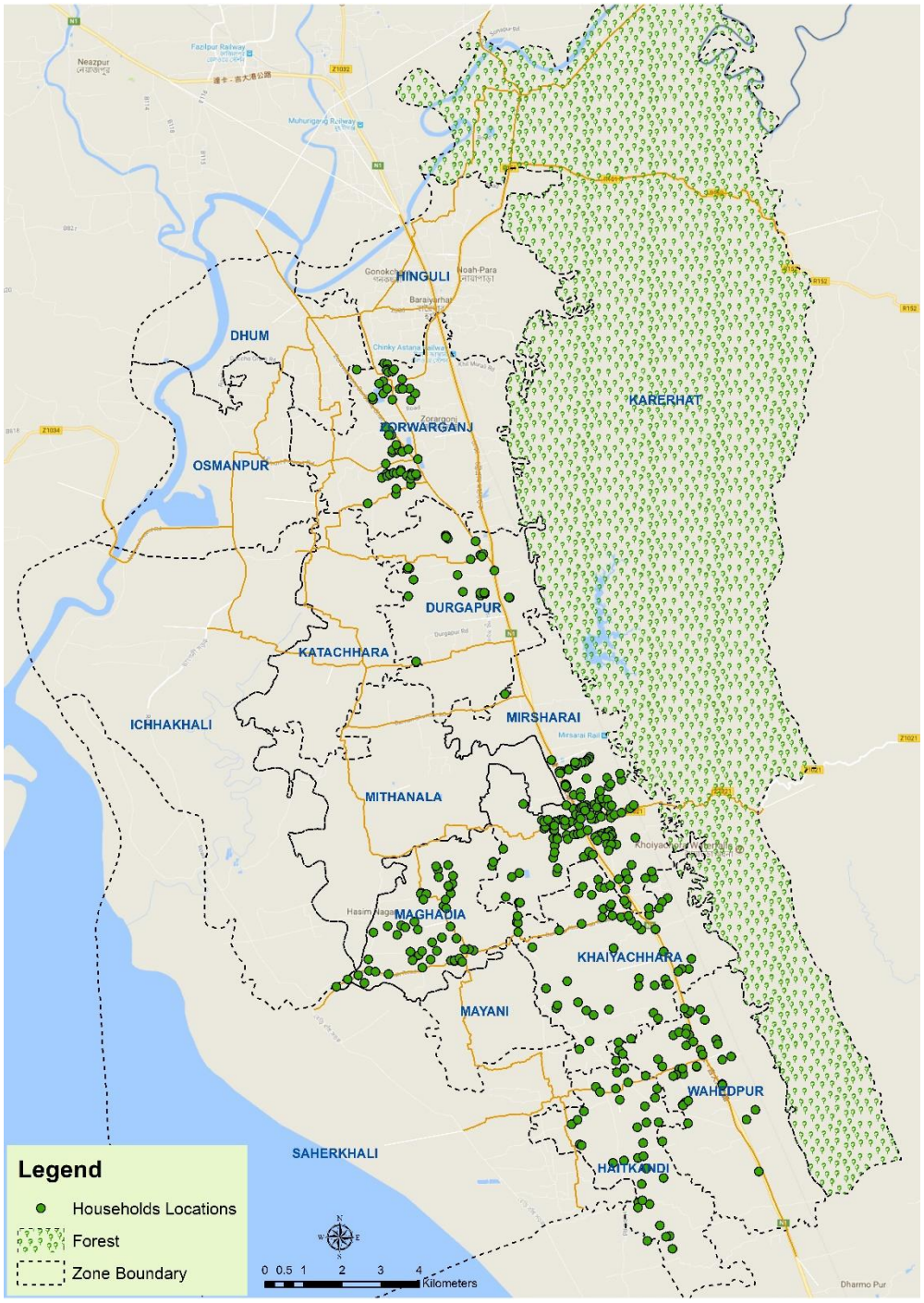


Figure 3.1: Distribution of Households' Location in seven Zones

3.1.3 Attraction Survey

Attraction Survey was carried out focusing on the commercial activities within the Mirsharai Upazila. For this survey six major growth centers and two Paurashavas were taken into consideration because most of the facilities are located in these places. Figure 3.2 shows the location of growth centers. The locations are:

Growth centers	**Paurashava**
Shantir Hat	Mirsharai
Abur Hat	Baraiyarhat
Baman Sundardarogar Hat	
Mirsharai Hat	
Hadi fakir Market	
Shaherkhali Bhorer Bazar	

Growth Centers (GC) are those areas where maximum economic growth in a certain region is expected. For Mirsharai, it is also assumed that most economic activities in present scenario take place in the major growth centers. In addition, it can be considered that the other markets will also develop to be of the same attributes as those of the existing GCs with overall development of the study area. From the reconnaissance, it was seen, on the other hand, that the two municipalities have the largest urbanized area. *The fundamental of transportation planning is based on the idea to provide enough facilities to address the worst possible traffic scenario.* The reconnaissance survey confirmed that highest traffic are attracted by these two locations (Mirsharai and Baraiyarhat Pourashavas). Hence, assuming that other bazars do not attract more traffic than the major GCs and the Municipalities, only the above-listed sites were surveyed for attraction of traffic.

The tourist spots were not surveyed for attraction of trips because most locations except the Mohamaya Lake site, are not yet developed and has limited facilities. Moreover, from the reconnaissance survey in the parking area and discussion with the representatives of the lake authority, it was found that 70-80 tourist vehicles (especially buses) on an average come to Mohamaya during the tourist season. Therefore, the facilities will have to be designed based on this.

Seven type of facilities were considered to be surveyed: i) Bazar, ii) Government Office, iii) Private Office, iv) Shopping Center, v) Shops, vi) Hospital and vii) Educational Institutions. In case of facilities except the educational institutions the following variable were considered: Type of facility, Mode, Occupancy, and Arrival time. Surveyors were instructed to collect data from these facilities by spending at least an hour at each facilities and covered as much as facilities they can. For educational institutions information was collected from students on: *Origin (when they are coming to school), Destination (when they are going back), Mode, Start time from home, End time, and, Cost of travelling*. Surveyors were instructed to take maximum ten (10) students in each institution randomly to collect information about their travel behavior. Total Two (2) surveyors were assigned for Four (4) days for the survey.

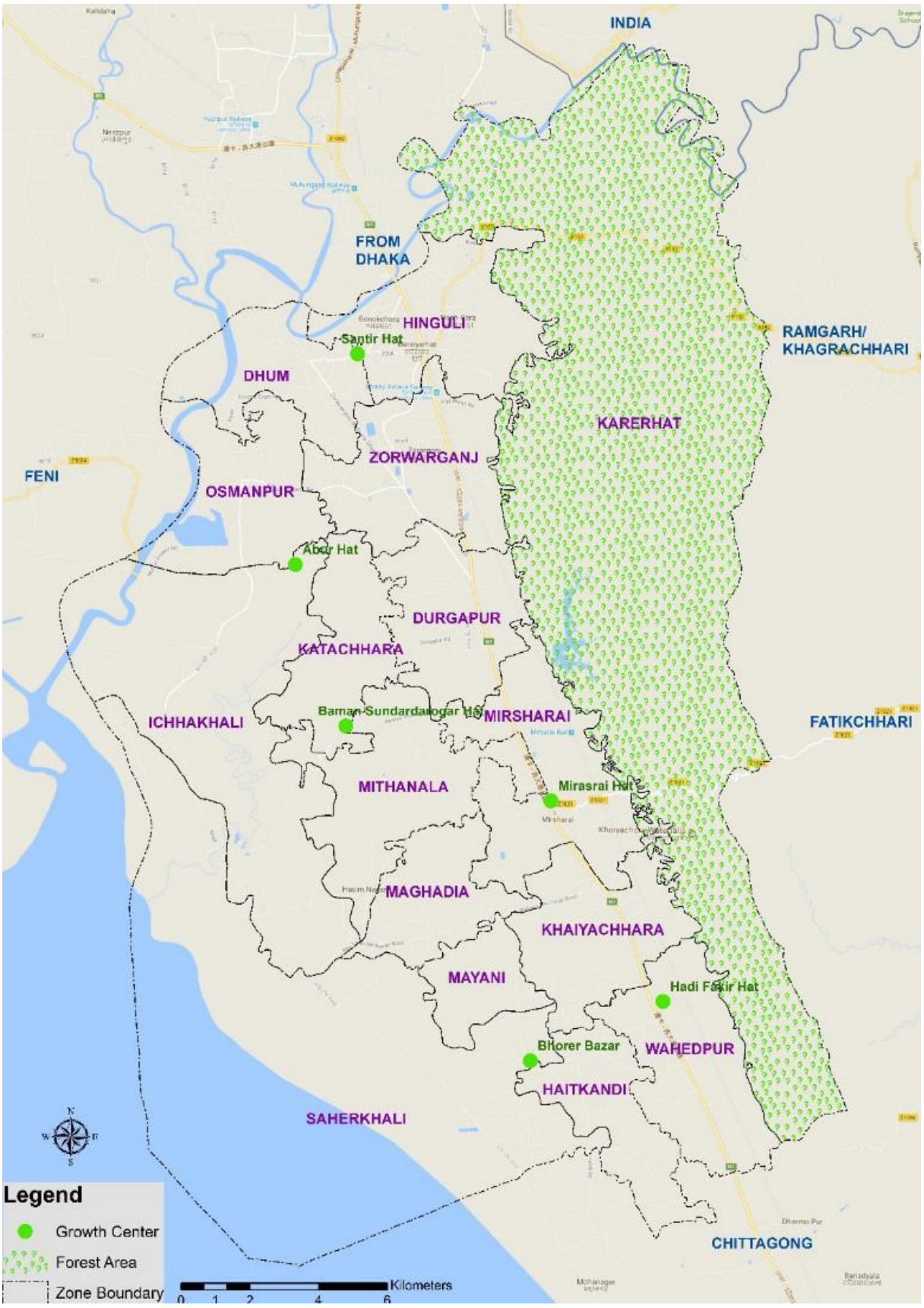


Figure 3.2: Zone boundary and location of growth centre at Mirsharai Upazila

The following pictures shows conduction of household survey at different locations of Mirsharai Upazila:

Household survey in Dhum

Household survey in Mayani

Household survey in Wahedpur

Household survey in Osmanpur

Household survey in Shaherkhali

3.2 Traffic Count Survey

To understand the base year traffic volume of the study area it is necessary to execute traffic count surveys. However, the traffic from the proposed Economic Zones cannot be found from site until it starts operation. Again, no traffic data is available yet from the EZ authorities because of the incomplete Master Plan. In interviews with BEZA and BEPZA, the concerned officials suggested that the Mirsharai EZ traffic could be predicted from the traffic of a similar EZ/ EPZ, which is fully operational at present. Also, it is their presumption that the Mirsharai EPZ (BEPZA industrial zone) will have 3 times the traffic of Dhaka EPZ in the next 25 years' period. Moreover, that of the entire EZ in this period will be 7 to 8 times the DEPZ traffic. Therefore, the traffic volume to be generated from Mirsharai including the present traffic, survey has to be conducted at the DEPZ area in Ashulia.

This led us to divide the count survey into two parts; (i) Traffic Count (Video Filming) in Mirsharai; and (ii) Traffic Count in Dhaka EPZ.

3.2.1 Traffic Count in Mirsharai

Ten (10) locations were selected among which four were external where traffic enters and exists the Mirsharai from different locations of the country and other six locations were internal where traffic moves within the Mirsharai Upazila. The below table shows the Survey Locations within the study area.

List of Survey Stations	Co-Ordinate (Latitude, Longitude)
Station- 01: Baraiyarhat Foot overbridge (Dhk-Ctg Highway)	22.894548°, 91.534453°
Station- 02: Baraiyarhat Rail Crossing (Karerhat Road)	22.894581°, 91.535435°
Station- 03: Shantir Hat Road (Near Janata Super Market)	22.895097°, 91.534000°
Station- 04: Muhuri Project Road	22.860102°, 91.529442°
Station- 05: Thakur Dighi Bazar	22.817682°, 91.553414°
Station- 06: Mirsharai Stadium (Fatikchhari Road)	22.777299°, 91.573601°
Station- 07: Mirsharai Paurashava (Upazila Road)	22.775977°, 91.568448°
Station- 08: Bara Takiya Bazar (EZ/ Abu Torab Bazar Road)	22.755171°, 91.586168°
Station- 09: Sarkar Hat (near Nizampur College)	22.720135°, 91.602477°
Station- 10: Boro Darogar Hat (Dhk-Ctg Highway)	22.681730°, 91.624558°

External traffic count was executed at the entry-exit points of Mirsharai Upazila and was located on the roads providing national/ regional connectivity. On the other hand internal traffic count was done near major intersections within the study area. The Consultant team conducted the count survey by ***"Video Recording Method"*** using ***"EKEN 4K H9R"*** camera and for power back up used ***"Apollo 650VA" UPS***. The following pictures show the equipment used in Count Survey.

UPS for continuous battery backup

4K ultra HD wide angle camera

Camera setup on tripod with battery backup at Shantir Hat

The consultant conducted count survey for more than 8 hours in external locations and more than 2 hours in some internal locations capturing the evolution of the peaks. The peak hours were defined from the reconnaissance survey and by consulting the local people. The model to be developed is to be sufficient to handle the peak hour traffic. Hence, any other time of the day when the traffic demand will be lower will not be of much concern.

Vehicles were categorized based on RHD standard and the consultant's observation. The Table 3.1 represents the vehicle categories. The list of vehicle category with picture has been attached to **Appendix B**. It is to be noted that the internal routes lack private vehicles and large vehicles such as Bus, Trucks, Lorries and had mainly unconventional modes/ para transit vehicles, NMVs etc. populating the roads.

Table 3.1: Vehicle Categories Used for Traffic Counts

Major category	Category No.	Sub category
Motorized Vehicles	1	Trailer (6-axle or 3S-2 tractor-trailer combo, 15-25 tons)
	2	Large/Heavy Truck (single unit straight truck, 2-3 axles, GVW 7+ tons)
	3	Medium Truck with at least 2 axles (2 axles, 5>7 tons, single unit vehicle)
	4	Small Truck (4-wheels)
	5	Large Bus (>31 seat capacity including driver)
	6	Minibus, Coaster (up to 31 passenger capacity)
	7	Microbus (up to 10 passenger capacity)
	8	Pick Up, Jeep, Converted Jeep, SUV
	9	Sedan Car (2 axles, for carrying passengers)
	10	Auto Rickshaw (Maxi/Tempo/Easy Bike/Leguna)/ CNG
	11	Motorcycle
Non-Motorized Vehicles (NMV)	12	Bicycle
	13	Cycle Rickshaw
	14	Animal/Push Cart/ Van

Traffic Count Survey was conducted through the 4 days. Table 3.2 presents survey locations and survey dates.

Table 3.2: Traffic count survey locations and survey dates

Date & Day	Location of Survey	Survey Station Type	Duration	Time
08.01.2018 (Monday)	1. Mirsharai Stadium (Fatikchhari Road)	External	11 hrs	9:00 am- 4:00 pm and 6:00 pm- 9:00 pm
	2. Mirsharai Paurashava (Upazila Road)	Internal	2 hrs	9:00 am- 11:00 am

Date & Day	Location of Survey	Survey Station Type	Duration	Time
	3. Boro Takiya Bazar (EZ/ Abu Torab Bazar Road)	Internal	2 hrs	3:00 pm- 5:00 pm
09.01.2018 (Tuesday)	1. Boro Darogar Hat (Dhk-Ctg Highway)	External	9 hrs	9:00 am- 6:00 pm
	2. Sarkar Hat (near Nizampur College)	Internal	2 hrs	9:00 am- 11:00 am
10.01.2018 (Wednesday)	1. Muhuri Project Road	Internal	6 hrs	3:00 pm- 9:00 pm
	2. Thakur Dighi Bazar	Internal	2 hrs	9:00 am- 11:00 am
11.01.2018 (Thrusday)	1. Baraiyarhat Foot overbridge (Dhk-Ctg Highway)	External	10 hrs	10:00 am- 8:00 pm
	2. Baraiyarhat Rail Crossing (Karerhat Road)	External	11 hrs & 20 min	10:00 am- 9:20 pm
	3. Shantir Hat Road (Near Janata Super Market)	Internal	6 hrs	3:00 pm- 9:00 pm

Consultant team showing UDD official how Video Filming is done, in Mirsharai Stadium Site

Surveyor Operating Camera at Baraiyarhat

Surveyor Operating Camera at Baraiyarhat

3.2.2 Traffic Count in Dhaka EPZ

To predict the traffic generated from the proposed economic zone, this vehicle count survey will be conducted at the Dhaka EPZ entrance and exit points. The count will be done manually for 24 hours unless it is found that there are specific hours for the incoming and exiting DEPZ traffic. The survey will be initiated followed by discussion and necessary approval from UDD & BEPZA.

Figure 3.3: Tentative Survey Location for the Dhaka EPZ

3.3 Origin-Destination Survey

In a transportation model development it is necessary to know the exact origin and destination of the trips and group these trips with reference to the zones of their origin and destination. Origin is the place where trip begins and destination is the place where trip ends.

Text books recommend that in case of the External OD Survey, the data is to be collected stopping every 10th vehicle of each category which will enable the modeler to have access to information on 10% of the flow data. However, considering the large volume and speed of traffic on national and regional highways, the consulting team understands that it may not be possible to stop more than 5% of the traffic on busy Dhaka-Chittagong highway. However, 10% sample size may be achieved for the regional highways, such as, R151 (Baraiyerhat-Karerhat-Heako-Narayanhat-Fatikchhari (Haidchokia) Road) and Z1021 (Mirsarai-Fatikchhari (Narayanhat) Road). So consulted team was tried to achieve information on at least 5% of the flow data at external locations. On the other hand, it was noticed during the reconnaissance survey that the internal count sites mostly have CNGs and other unconventional modes of transport along with NMVs and motorcycles. So consultant team tried to interview 10% of the passing traffic at internal locations

*For the purpose of the project, External and Internal OD Surveys were undertaken at the same survey stations as that of the External and Internal Traffic Count Surveys (*Figure 3.5*)***.** The information that was collected from the OD survey were: origin and destination, time of the day when the journeys are made, trip purpose and mode of travel and occupancy of the vehicle. Vehicle categories for the surveys were matching with the count study and the study duration was exactly the same as the count data collection study. Total six (6) number of enumerators were involved in conducting the survey for 4 days.

The enumerators asked the driver of the vehicle to mention where they were coming from and their destination. The enumerators ensured that the locations are well-known. If not, then the enumerators asked further questions to identify the district and sub-district name. In case of ***external OD survey,*** the surveyors themselves did not stop any vehicles. The police officers were requested to stop every 10th vehicle of each class and request them to park at the road side so that the enumerators can collect data. Finally, another police officer guided the vehicles to merge into the mainline vehicle stream safely after the data collection was over. Buses were excluded from the interview as their OD could easily be

identified by taking pictures of their windshields containing information about their trip ends. For ***internal OD survey*** surveyors stopped as many as vehicles possible to collect data with the help of police or lineman. The below diagram shows the OD survey setup.

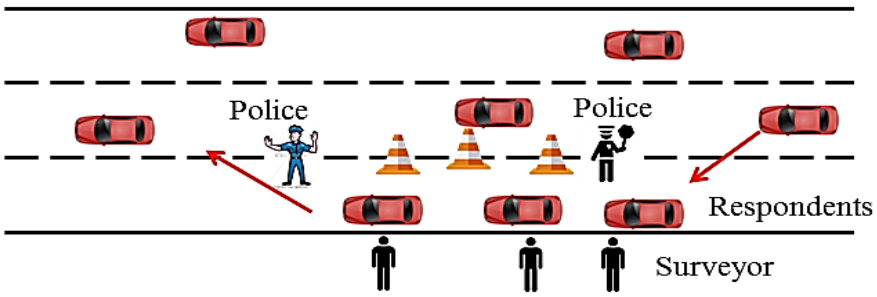


Figure 3.4: O-D Survey Setup

The following pictures represents ongoing OD survey at different survey locations

OD survey at Baraiyarhat Rail Crossing Site

OD survey at Bara Darogar Hat

OD survey at Thakur Dighi Bazar

OD survey at Boro Takiya Bazar

OD survey at Shantir Hat

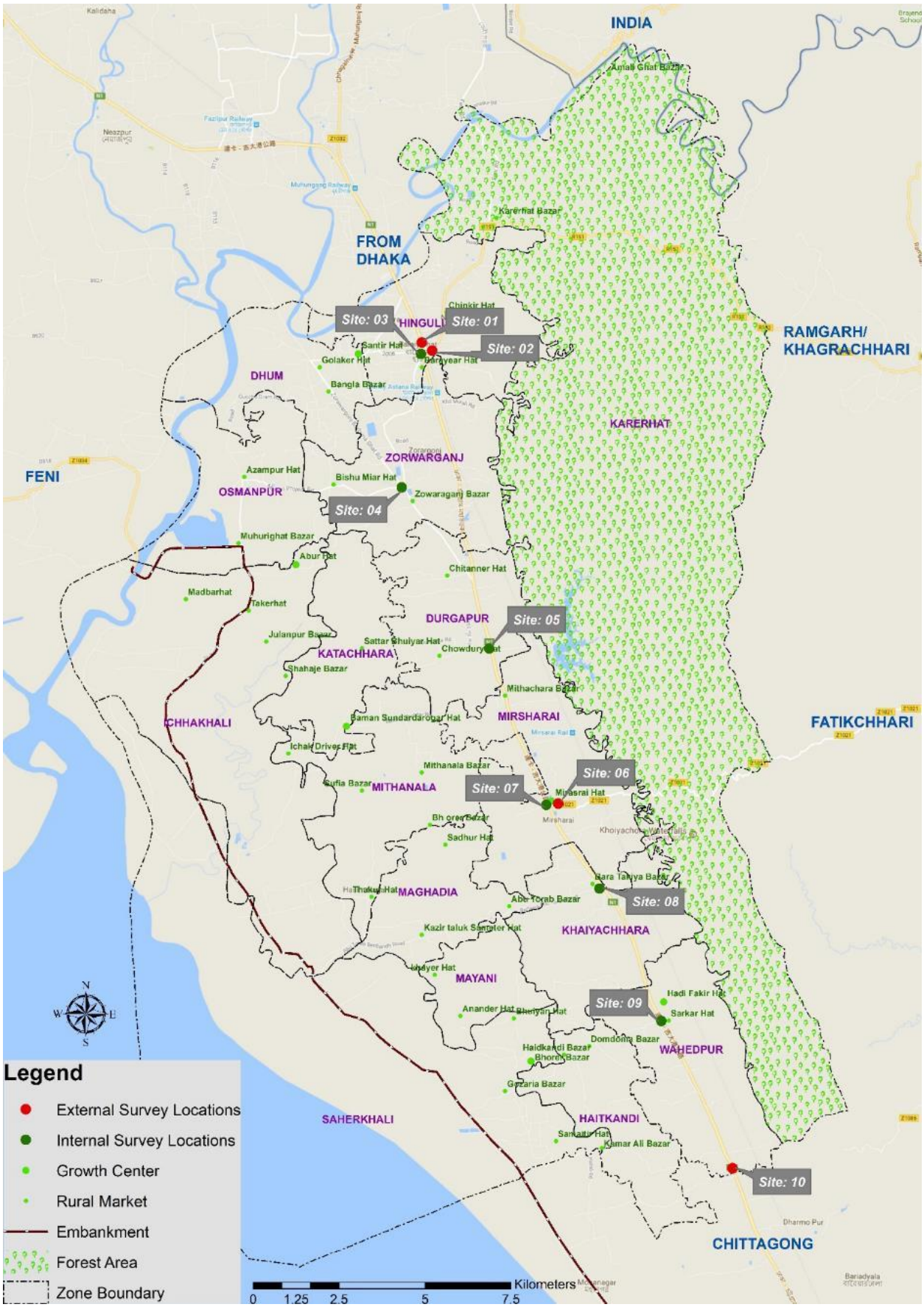


Figure 3.5: Vehicle Count and OD Survey Locations

3.4 Travel Time Survey

Seven (7) major routes were selected for Travel Time Survey and survey was conducted following the 'Average car technique'; where vehicles (typically a commonly available sedan car) having PCU value equal to 1, are driven through the traffic stream at average speed and travel time for each link of each route are calculated. The following steps were followed during the survey:

The steps followed were as follows:

- For each route, each day one passenger car was dispatched from one end of the route at specified time.
- Driver was instructed to drive at the speed of the average traffic stream.
- Each route was divided into nodes (nodes may be intersection or specific landmarks) and links (section between two intersections or landmarks), or only route was considered to find out continues travel time depending on the circumstances.
- Driver was presented with printed sheets containing the names of the nodes and instructed to note down the time 'after' crossing each node/note down the time traveling the entire route.
- Driver was also instructed to ensure that he did not make any stops while traversing a route. All stops for re-fueling, refreshment, etc. were performed after the driver had been reached one end. Special arrangements were made with gas stations to ensure that the vehicles did not have to queue to refuel.
- Each route was covered once (working days only).

The Travel time survey routes with nodes and links were:

Route 1: Janata super market-Santir Hat-Golaker Hat-Bishu Miar Hat-Abur Hat-Sattar Bhuiyar Hat-Baman Sundardarogar Hat GC-Sufia Bazar-Kazir Taluk Sameter Hat-Khayer Hat-Anander Hat-Bhuiyan Hat-Shaherkhali Bhorer Bazar GC-Haidkandi Bazar-Kamar Ali Bazar-Boro Daragar Hat

Route 2: Maulabhi Bazar-Osmanpur road-Azampur Hat-Muhurighat Bazar-BEZA Embankment

Route 3: Intersection of Zorawargonj-Borburia ghat road and Muhuri project road (M. Rahman Store)-Bishu Miar Hat-Azampur Hat

Route 4: Thakur Dighi Bazar-Chowdhuri Hat-Julanpur Bazar-Takerhat-Muhurighat Bazar-BEZA Embankment

Route 5: Mirsharai Paurashava HQ-Mithanala Bhorer Bazar-Sufia Bazar-Baman Sundardarogar Hat GC-Shahaje Bazar-Julanpur Bazar-Takerhat Bazar

Route 6: Bara Takiya Bazar-Abu Torab Bazar-Kazir Taluk Sameter Hat-BEZA Embankment

Route 7: Sarkar Hat-Domdoma Bazar-Haidkandi Bazar-Shaherkhali Bhorer Bazar Growth Center-BEZA Embankment

Table 3.3 lists the routes and survey dates and Figure 3.6 shows the routes selected for survey.

Table 3.3: Travel Time Survey Routes and Date

Route Name	Survey Dates
Route 1: Janata super market to Boro Daragar Hat via Baman Sundardarogar Hat GC and Haidkandi Bazar	12 January, 2018
Route 2: Maulabhi bazar to BEZA embankment via Azampur hat	12 January, 2018
Route 3: Zorawargonj intersection to Azampur hat via Bishu Miar hat	07 January, 2018
Route 4: Thakur dighi bazar to BEZA embankment via Muhurighat bazar	10 January, 2018
Route 5: Mirsharai Paurashava HQ to Takerhat bazar via julanpur bazar	10 January, 2018
Route 6: Bara Takiya bazar to BEZA embankment via Abu Torab bazar	09 January, 2018
Route 7: Sarkar hat to BEZA embankment via Haidkandi bazar	09 January, 2018

The following pictures show some landmark of different travel time routes and surrounding land uses.

Abu Torab Road

Taker Hat Road

Kamar Ali Bazar

Shaherkhali Bhorer Bazar

Sufia Bazar

Baman Sundardarogar Hat

Abur Hat

Bishu Miar Hat

Figure 3.6: Travel time survey routes

3.5 Stakeholder Interviews

From the preliminary reconnaissance survey and frequent discussions with the Client and locals, it was apparent that the following stakeholders are required to be consulted to prepare an acceptable sustainable transportation system for Mirsharai. Apart from UDD, the client, the name of the stakeholder organization, name of the concerned person and the meeting date; are listed below:

Sl.	**Stakeholder Organization**	**Name & Designation of the Representative**	**Date of Meeting/ Interview**
1	USAM (University Students Association of Mirsarai)	Md. Nahid Mahamood, Co-founder	November 25, 2017
2	Mirsharai Pourashava	Md. Gias Uddin, Hon. Mayor	November 25, 2017
3	Mohamaya Eco Park Authorities	Md. Gholam Kabir, Forest Beat Officer, Forest Department Tour Operator, Mohamaya Eco Park Representatives of BWDB	November 26, 2017
4	Baroiyar Hat Pourashava	Mr. Foyz Ahmed, Secretary to Mayor	November 26, 2017
5	Local People of Mirsharai (Tea Stall Meetings)	Individuals/ groups at different locations, Mirsharai	November 25-26, 2017
6	Baraiyarhat Pourashava	Md. Nizam Uddin, Hon. Mayor, Mr. Foyz Ahmed, Secretary to Mayor	January 10, 2018
7	Local People of Mirsharai (Tea Stall Meetings)	Individuals/ groups at different locations, Mirsharai	Jan 06, 2018 to Jan 12, 2018
8	BEPZA	Md. Hafizur Rahman, G.M (MIS) and Project Director (NARI)	March 11, 2018
9	BEZA	Md. Abdul Quader Khan, Consultant (BEZA)	March 21, 2018

4 TRAFFIC SURVEY RESULTS

4.1 Household Survey

The household survey represents the trip making behavior of each household including their demographic and social information. These insights will help calculate the **trip generation** in the first step of transport model. From the survey, the *modal share* and *purpose of the trip* will also be found which will help in understanding the existing scenario and in forecasting the future trip behavior of the people.

Consultant team conducted household interview survey in 16 zones namely, Karerhat, Hinguli, Dhum, Zorawargonj, Osmanpur, Durgapur, Katachhara, Ichhakhali, Mirsharai, Mithanala, Shaherkhali, Maghadia, Khaiyachhara, Mayani, Wahedpur and Haitkandi. Total 296 number of households were surveyed throughout the Mirsharai Upazila. Based on the survey data all households of every zone has been divided into three income categories:

i. Income Category- 1: 15000 or less than 15000
ii. Income category- 2: more than 15000 to 30000
iii. Income Category- 3: more than 30000

Note: here income level is denoted by the combined income of the earning members of a single household.

For the ease of analysis the consultant team categorized all purposes into five categories: Educational, Shopping (trips to bazar are also included), Work, Recreational and Others (personal, treatment etc.). The table below represents the average trips of different purposes generated from each zone.

Table 4.1: Summary of Household Survey

Zone ID	No. of Households	Avg. Educational Trip	Avg. Shopping Trip	Avg. Work Trip	Avg. Recreational Trip	Avg. Others Trip
Zone 1	15	4	2	2	0	0
Zone 2	21	3	1	2	0	0
Zone 3	15	4	0	3	0	2
Zone 4	24	3	1	4	1	1
Zone 5	15	3	1	4	0	1
Zone 6	18	2	1	4	1	0
Zone 7	15	2	2	3	0	1
Zone 8	14	3	1	2	0	0
Zone 9	17	1	1	1	0	0
Zone 10	18	2	1	2	1	0
Zone 11	20	3	2	3	0	0
Zone 12	20	2	1	2	0	1
Zone 13	21	2	1	2	0	0
Zone 14	24	3	1	2	1	0
Zone 15	21	4	2	2	0	0
Zone 16	18	3	3	2	1	1

From the above table it has been found that educational trips are highest than any other trips and shopping and work trips are almost same for each zone. **However, on an average, 7 trips generate within the study area per day**.

The following figure represents the trip making purposes as obtained from the household survey. It was seen that 39% of the trips are made for educational purpose; where 17% trips are made for shopping purposes. On the other hand, 35% trips are made for work purposes.

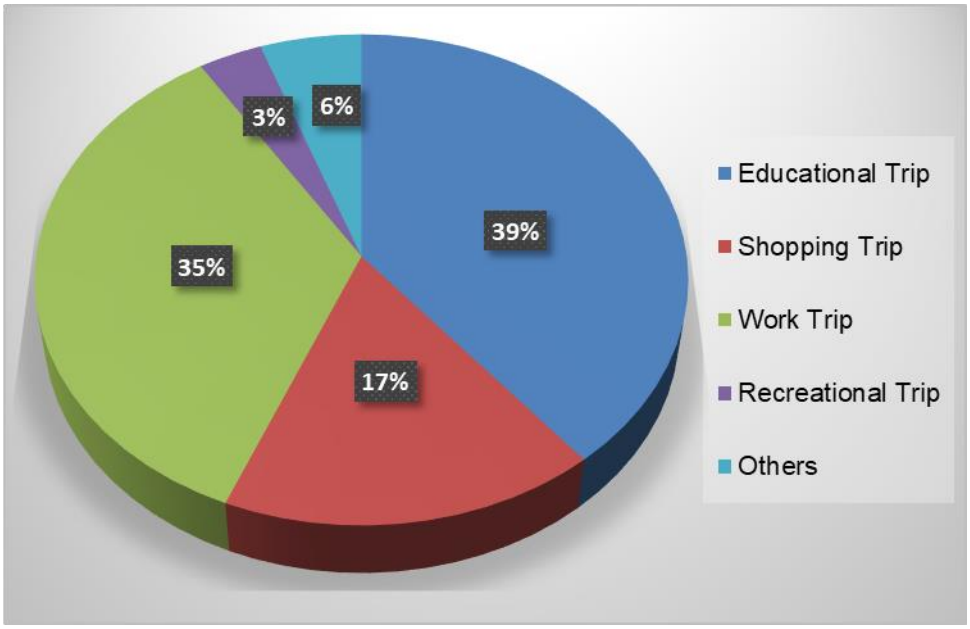


Figure 4.1: Trip Purpose (in percentage) of the Study Area

People make most of the trips by walking which is 29% of total trips. These trips are mainly short distance trips. Again, 26% and 21% trips are made by CNG and Walk + Jeep; which are mostly long or medium distance trips.

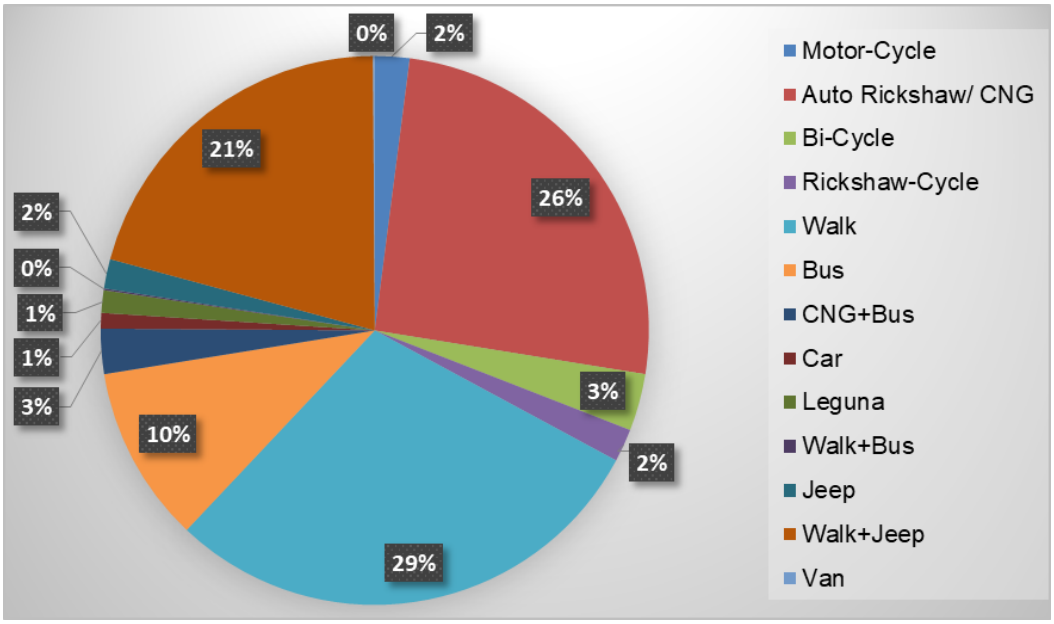


Figure 4.2: Mode of Travel in the Study Area

The following figure represents the mode choice of different income category people in Karerhat zone. The rest of the tables are included in the appendix. Prior mode of Category- 1 people (15000 or less than 15000) is walking as their economic condition is not that much good. The travel from home to motorized vehicle stoppage by "On Foot" or travel to their destination by walking most of the time. For long distance travel they give priority on Auto-rickshaw/ CNG, Leguna. In case of Category- 2 (more than 15000 to 30000) and Category- 3 (more than 30000) groups for short distance they use mainly CNG, rickshaw-cycle. Walking is the most common mode for them because to access other modes they have to travel by walking. In addition these two groups use bus, jeep, leguna for long distance traveling. Again, they own motor-cycle, bi-cycle and car, and these modes are also used as for their traveling means.

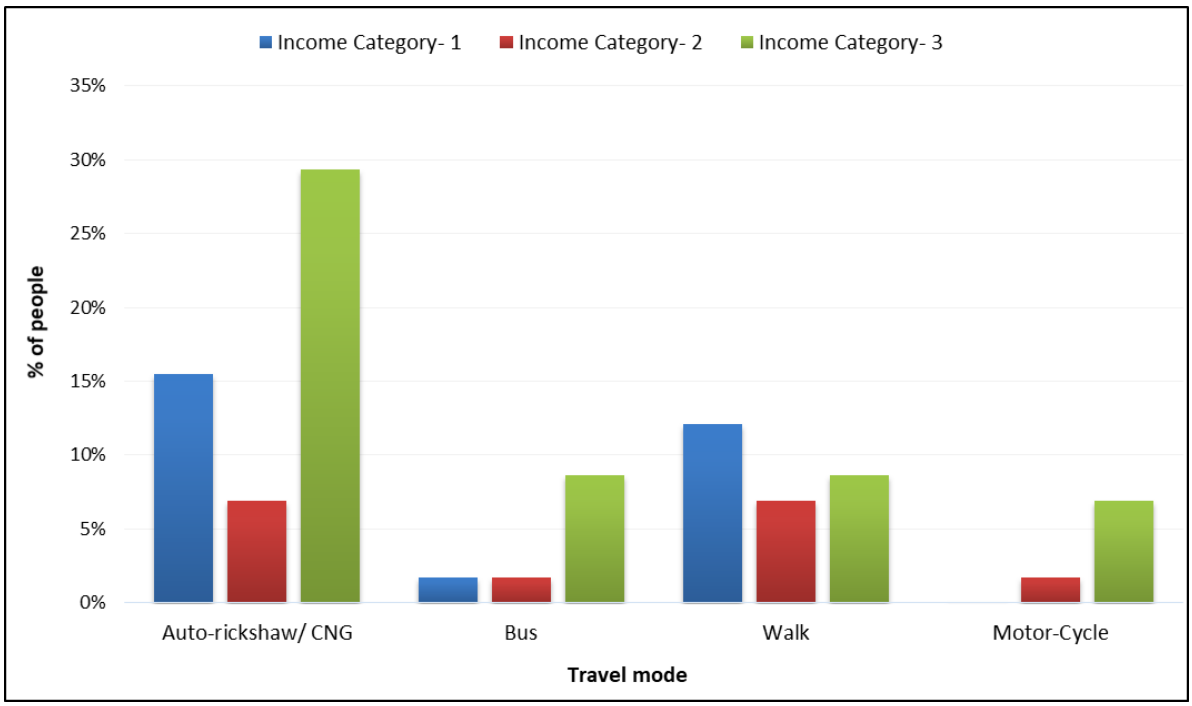


Figure 4.3: Mode choice of different income category people in zone- 1

Table 4.2: Average trip cost and main three travel modes of people of each zone

Zone ID	Avg. travel cost (tk.)	Most commonly used mode (Top three)		
		Mode 1 (%)	Mode 2 (%)	Mode 3 (%)
Zone 1	29	Auto-rickshaw/ CNG (52)	Walk (28)	Bus (12)
Zone 2	7	Walk (34)	Auto-rickshaw/ CNG (28)	Rickshaw-cycle (22)
Zone 3	98	Walk+ Jeep (91)		
Zone 4	38	Auto-rickshaw/ CNG (44)	Walk (30)	CNG+ Bus (10)
Zone 5	331	Walk+ Jeep (77)	Jeep (18)	
Zone 6	19	Walk+ Jeep (98)		
Zone 7	80	Walk+ Jeep (76)	Walk (8)	
Zone 8	46	Auto-rickshaw/ CNG (75)	CNG+ Bus (13)	Walk (9)
Zone 9	11	Walk (24)	Bus (21)	Auto-rickshaw/ CNG (21)
Zone 10	62	Walk (48)	Bus (26)	Auto-rickshaw/ CNG (19)
Zone 11	24	Walk (59)	Auto-rickshaw/ CNG (11)	Bi-cycle & Bus (9)
Zone 12	37	Auto-rickshaw/ CNG (69)	Walk (18)	Bus (14)
Zone 13	22	Auto-rickshaw/ CNG (65)	Walk (25)	Bus (8)
Zone 14	52	Walk (61)	Auto-rickshaw/ CNG (16)	Bus (13)
Zone 15	24	Walk (32)	Auto-rickshaw/ CNG (23)	Bus (18)
Zone 16	49	Walk (44)	Bus (23)	Auto-rickshaw/ CNG (14)

The above table represents that for short distance travel average cost is low and people travel through CNG or walking. For long distance travel people use mainly jeep and bus and in that case cost is pretty much high.

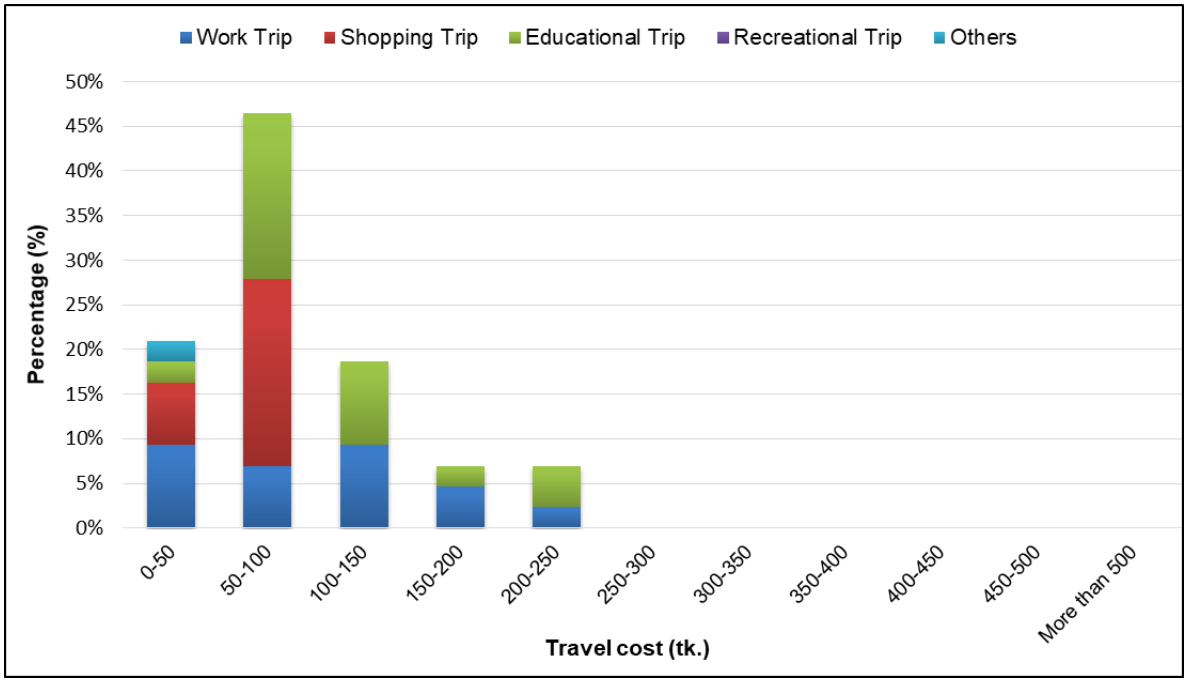


Figure 4.4: Travel cost of different trip purposes in Zone 1

Again, the Figure 4.4 shows, in what purposes people spend money. The rest of the tables are provided in the appendix. People spend money for all purposes not more than 200 tk. Only for long distance working and recreational purposes it costs people more than 500 tk.

The detail trip information including household size, persons going educational institution, information of income level, information about vehicle ownership of each zone has been attached in **Appendix C.**

Number of earning member in each household can be up to 5 persons and the income level also depends on the number of earning members. Vehicle ownership is also notable in a number of cases where up to 5 nos. of vehicle is owned in a single family and the owned vehicles are typically motorbikes, trucks, CNG rickshaws etc. The gender ratio, age distribution, income level, trip making purpose, modal of travel, travel costs for each zones are presented in the appendix as well. In the following table below the average trips and travel costs are represented with the basic statistics of each zone.

Table 4.3: Basic statistics with average trips and travel costs

Zone ID	Population	No. of Households	Avg. HH Size	Avg. Income	Avg. Trips	Avg. Travel Cost
Zone 1	35467	7362	6	21981	8	29
Zone 2	34934	7089	5	24484	5	7
Zone 3	22571	4619	4	43882	8	98
Zone 4	36182	7631	6	13178	9	38
Zone 5	14645	3046	4	38250	8	331
Zone 6	26534	5520	5	16000	8	19
Zone 7	23596	4366	5	14095	7	80
Zone 8	27980	5205	6	17667	5	46
Zone 9	22234	4333	6	22870	3	11
Zone 10	23109	4445	4	23690	5	62
Zone 11	16912	3049	6	9759	9	24
Zone 12	28812	6001	6	20474	5	37
Zone 13	23423	4879	7	22178	5	22
Zone 14	18285	3549	6	9952	7	52
Zone 15	24981	4752	6	19981	9	24
Zone 16	19051	3700	7	21154	9	49

4.2 Attraction Survey

Consultant team conducted Attraction survey in six major growth centers and two paurashavas of Mirsharai Upazila namely, *Shantir hat, Abur hat, Baman sundardarogar hat, Mirsharai hat, Hadi fakir market, Shaherkhali bhorer bazar, Mirsharai paurashava* and *Baraiyarhat paurashava*. The detail survey design and methodology has already been discussed in **Section 2.4 and Section 3.1.3.** During the survey, different facilities: bazars, government offices, private offices, shopping complex, shops and hospitals were surveyed to represent the trip demand of the entire Mirsharai Upazila.

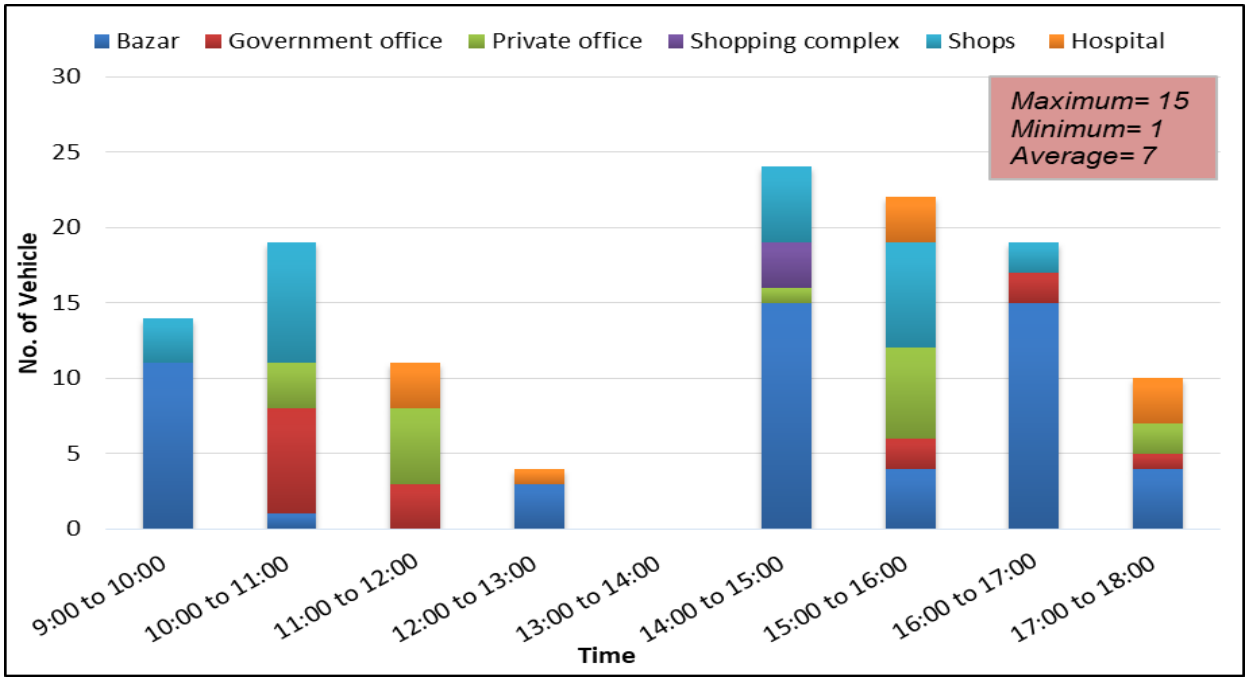


Figure 4.5: Demand in different facilities at different time

The above *Figure* 4.5 represents the vehicle demand in different facilities at different time of Mirsharai. At bazar area, the vehicle movement rate is high other than any facility. During 9:00 am to 10:00 am, 14:00 pm to 15:00 pm and 16:00 pm to 17:00 pm the demand is high in bazar. The reason may be that local people move during morning to the nearby markets to buy their daily necessities and the unloading of perishable products such as: vegetable, fruits and other necessary products usually occur in the early part of the day. Besides, the consultant team came to know from the local people that between 9:00 am to 12:00 pm and 14:00 pm to 17:00 pm, vehicle movement becomes high in every location which match with the survey data *(Figure* 4.5*).* The maximum vehicle demand is 15 (fifteen), minimum is 1 (one) and average vehicle demand is 7 (seven) in the entire Mirsharai Upazila.

From the Figure 4.6 it has been revealed that in two paurashavas, vehicle attraction is higher than other locations. From the Consultant's observation it is found that most of the development has taken place in these two paurashavas. Most of the schools, colleges, bazars, shops, hospitals, government and private offices are located in these two paurashavas. So the traffic demand is high in these two areas**.** As the Mirsharai growth center is located at paurashava area and adjacent to the paurashava headquarter the attraction rate is higher than the other growth centers. In case of rest of the growth centers attraction rate is same which is 10%.

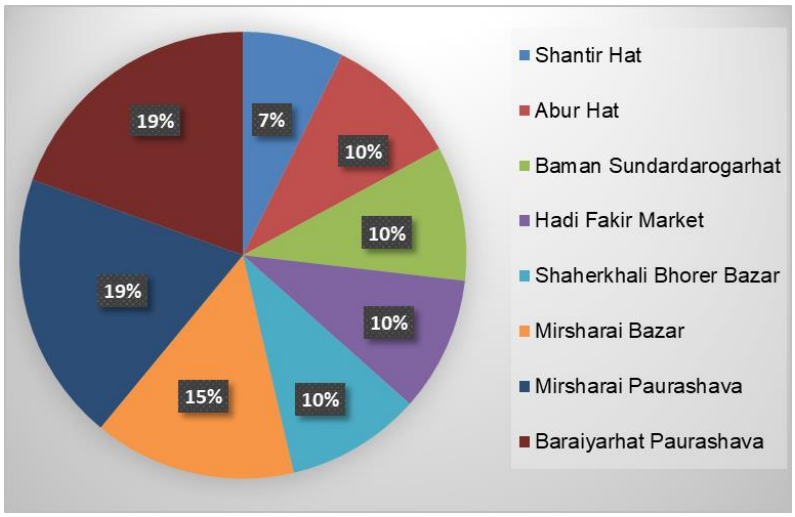


Figure 4.6: Attraction at different surveyed locations

From the Table 4.4, it has been seen that maximum number of trips attracted to Baraiyarhat and Mirsharai paurashavas, which are respectively 67 and 90 trips per hour. These two areas are the heart of business and all commercial activities of Mirsharai Upazila.

Table 4.4: Number of trips (per hour) attracted to different land uses at different locations

Locations	Trips (per hour) at different Land uses					
	Bazar	Govt. office	Private office	Shopping complex	Shops	Hospital
Shantir Hat	14	40				
Abur Hat	15	10	9		13	
Baman Sundardarogarhat	16	5	9		12	
Hadi Fakir Market	8	3	30		9	
Shaherkhali Bhorer Bazar	9	13	11		17	
Mirsharai Bazar	14		13		23	7
Mirsharai Paurashava	26	13	18		19	15
Baraiyarhat Paurashava	19		18	16		14

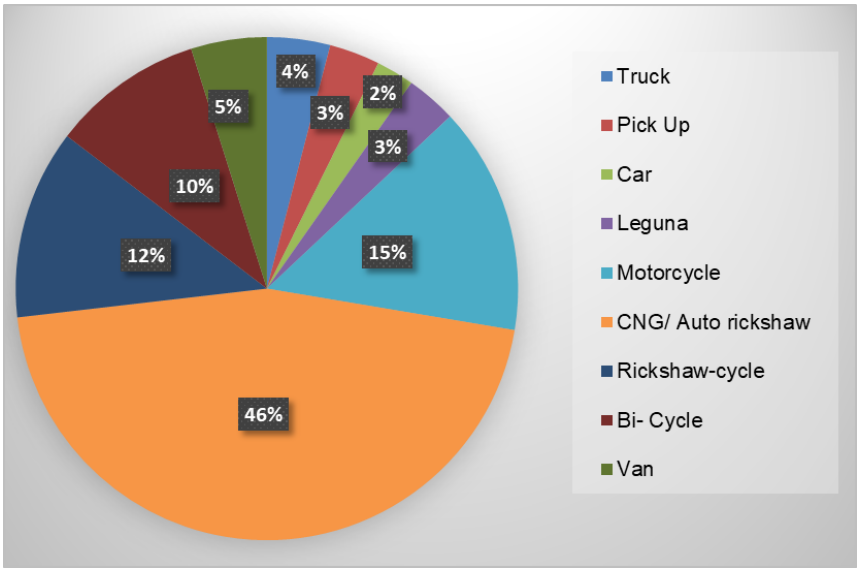


Figure 4.7: Vehicles attracted to commercial areas

CNG/ Auto rickshaw are main mode of transport at different commercial areas, which is 46%. Other than CNG/ Auto rickshaw, people use motorcycle (15%), Rickshaw-cycle (12%) for their movement. Pick-ups (10%) are used for loading and unloading of goods in commercial areas.

4.2.1 Educational Institution

Consultant team conducted survey at 16 (sixteen) educational institutions to understand the travel behavior of students like what kind of modes they use, cost of their travel, origin and destination and travel time. Total 95 (ninety five) students were surveyed. The list of the educational institutions is as follows:

- Mohajonhat School & College
- Jamalpur Madrasha
- Aburhat High School
- Bamonsundar F.A. High School
- Mirzabazar Islami Dakhil Madrasha
- Mirzabar Sorkari Prathomik Biddyaloy
- Shaherkhali High School

- Mithachara High School
- Mirsharai Pilot High School
- Mirsharai Girls High School
- Mirsharai Girls High School
- Mirsharai College
- Baraiyarhat College
- Al Hera School & College
- Baraiyarhat Girls High School
- Baraiyarhat College

Origin-Destination:

The below table describes the institutions where the survey was conducted and the zones from which students originate their trips.

Table 4.5: List of educational institution and trip generate zones

Educational Institutions	**Origin Zone ID**
Mohajonhat School & College	2, 3, 1, 4
Jamalpur Madrasha	3, 2
Aburhat High School	5, 8, 7
Bamonsundar F.A. High School	10, 7, 15
Mirzabazar Islami Dakhil Madrasha	15
Mirzabar Sorkari Prathomik Biddyaloy	15
Shaherkhali High School	11, 14
Mithachara High School	9, 10, 6
Mirsharai Pilot High School	12, 9, 10
Mirsharai Girls High School	12, 9
Mirsharai Girls High School	9, 10
Mirsharai College	9, 7, 12, 13
Baraiyarhat College	2, 4, 8
Al Hera School & College	2, 4
Baraiyarhat Girls High School	4
Baraiyarhat College	1, 3, 4, 9

Travel mode:

The major mode of travel as seen from the chart below is walking (36%) and CNG (24%) since most of the trips are made within the adjacent areas covering short distances. The trips made from distant places are done by Bus (1%), College Bus (3%) and Leguna (14%). Also, students use different modes to commute to their places of interest; such combinations include CNG+Leguna (5%), Leguna+Walking (3%), Walking+CNG (3%). Again, another vital mode used by the local pupils to commute is Bi-Cycle with a considerable share of 9%.

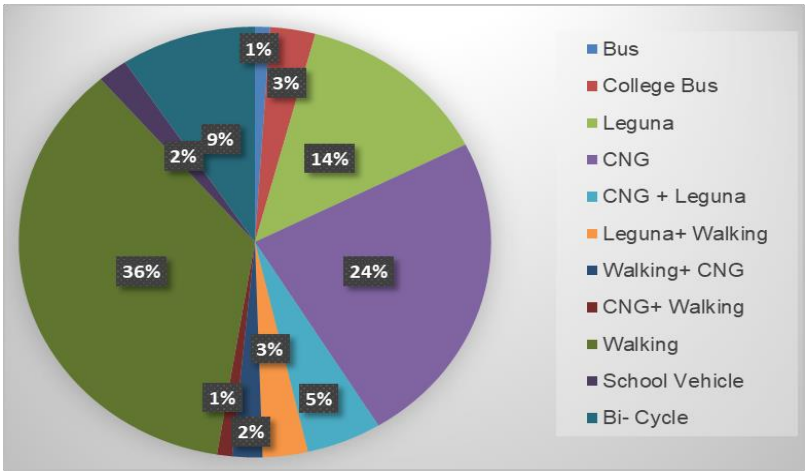


Figure 4.8: Mode of travel of students

Travel Cost:
The cost of commuting is usually cheaper and the average travel cost for students varies from 14 Taka to 43 Taka.

Travel Time:
The survey showed that the students usually start their journey between 8:30 am to 9:30 am and reach their destination between 9:10 am to 10:00 am. In addition, their travel time is in general within 30 to 40 mins on an average.

4.3 Traffic Counts

The consultant team conducted survey for 8 hours for external locations and 2 hours for internal locations. These time durations were the peak times of the typical work days. ***The travel demand model will be constructed for the peak hour focusing on providing enough capacity when the demand is at its peak***. The consultant team consulted with the local people and local survey teams and reconnaissance survey also conducted to ensure that the survey time can fully capture the peak hour from its formation till its dissipation. Combining all the data and information it was found that the peak flow of traffic is between 9:00 am to 12:00 pm and once more again after 3:00 pm to 5:00-6:00 pm for internal locations. And for external locations morning flow and evening flows are high exhibiting the typical nature of a highway.

Up direction: traffic flow toward the Mirsharai upazila from different locations

Down direction: traffic flow from the Mirsharai upazila toward different locations and through traffic.

Table 4.6 and Table 4.7 presents the hourly distribution of vehicles for count sites 01 to 10 respectively.

Table 4.6: Hourly distribution of vehicles for different directions for sites 01 to 05

Time	Site Number									
	01		02		03		04		05	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
9:00 to 10:00	0	0	0	0	0	0	0	0	141	114
10:00 to 11:00	460	498	324	241	0	0	0	0	113	100
11:00 to 12:00	632	520	314	314	0	0	0	0	0	0
12:00 to 13:00	532	471	244	221	0	0	0	0	0	0
13:00 to 14:00	486	523	273	292	0	0	0	0	0	0
14:00 to 15:00	580	512	336	362	0	0	0	0	0	0
15:00 to 16:00	607	544	370	250	225	219	280	247	0	0
16:00 to 17:00	529	555	327	298	233	240	291	275	0	0
17:00 to 18:00	509	693	344	345	201	244	276	264	0	0
18:00 to 19:00	506	717	203	166	190	220	197	200	0	0
19:00 to 20:00	472	686	220	121	142	161	133	158	0	0
20:00 to 21:00	0	0	196	189	41	63	99	138	0	0
21:00 to 22:00	0	0	54	46	0	0	0	0	0	0
Total	**5313**	**5719**	**3205**	**2845**	**1032**	**1147**	**1276**	**1282**	**254**	**214**

Table 4.7: Hourly distribution of vehicles for different directions for sites 05 to 10

Time	Site Number									
	06		07		08		09		10	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
9:00 to 10:00	103	80	114	104	0	0	147	114	261	498
10:00 to 11:00	95	75	130	109	0	0	142	125	351	551
11:00 to 12:00	95	89	0	0	0	0	16	15	414	633
12:00 to 13:00	76	104	0	0	0	0	0	0	441	558
13:00 to 14:00	81	55	0	0	0	0	0	0	460	540
14:00 to 15:00	97	60	0	0	0	0	0	0	407	535
15:00 to 16:00	102	67	0	0	143	162	0	0	429	556
16:00 to 17:00	0	0	0	0	174	170	0	0	577	466
17:00 to 18:00	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	74	85	0	0	0	0	0	0	0	0
19:00 to 20:00	62	77	0	0	0	0	0	0	0	0
20:00 to 21:00	49	67	0	0	0	0	0	0	0	0
21:00 to 22:00	13	23	0	0	0	0	0	0	0	0
Total	**847**	**782**	**244**	**213**	**317**	**332**	**305**	**254**	**3340**	**4337**

Neither traffic flow are same for national highway, regional highway, zila and upazila roads nor modal share. In this report traffic flow for each category of road has been discussed.

4.2.2 Traffic Distribution in National Highway (Dhaka-Chittagong, N1)

Two sites are on the National highway, site 01 (Baraiyarhat foot overbridge) and site 10 (Boro Darogar hat). The survey was conducted 10:00 am- 8:00 pm for site 01 and 9:00 am- 6:00 pm for site 10. Though the survey was to be conducted for 8 hours but the surveys were done for extra 2 (two) hours for site 01 and 1 (one) hour for site 10.

Figure 4.9 to Figure 4.12 represents temporal distribution of traffic of different vehicle types on national highway (site- 01 and site- 10) for both directions. From temporal distribution of traffic the parts of the day when the traffic is the highest can be identified. It is observed that peak is varied with the time of the day in the national highway. As Dhaka-Chittagong Highway is one of the busiest highways the traffic flow is always high in both directions. From the survey the peaks are:

	For UP direction	For DOWN direction
Site- 01	Peak 1: 10:00 am to 11:00 am (632)	Peak 1: 12:00 pm to 01:00 pm (523)
	Peak 2: 2:00 pm to 3:00 pm (607)	Peak 2: 5:00 pm to 6:00 pm (717)
Site- 10	Peak 1: 01:00 pm to 02:00 pm (460)	Peak 1: 11:00 am to 12:00 pm (633)
	Peak 2: 04:00 pm to 05:00 pm (577)	Peak 2: 03:00 pm to 04:00 pm (556)

Trucks comprise a major portion of all vehicles considered for the alignment and it has four sub-classes- Trailer, Large/ Heavy, Medium and Small trucks. From the study, it shows that the volume of truck traffic is high during the same period as the total flow is high (See Figure 4.13 to Figure 4.16).

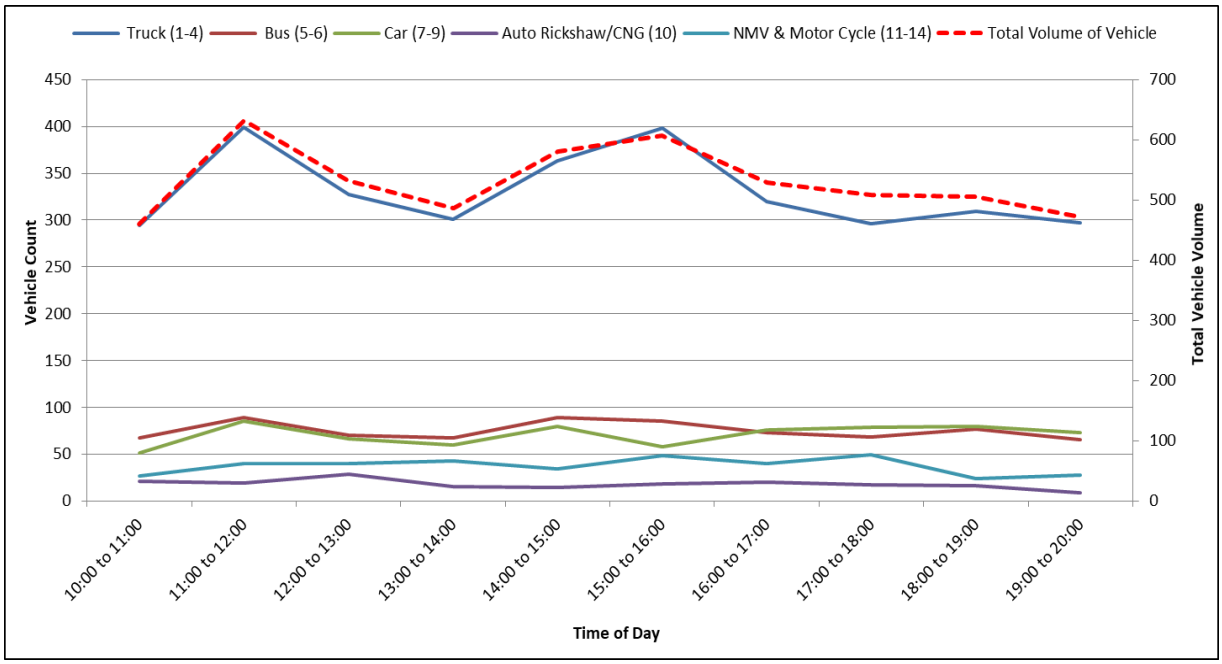


Figure 4.9: Temporal distribution of traffic by vehicle type (Site 01 – Up direction)

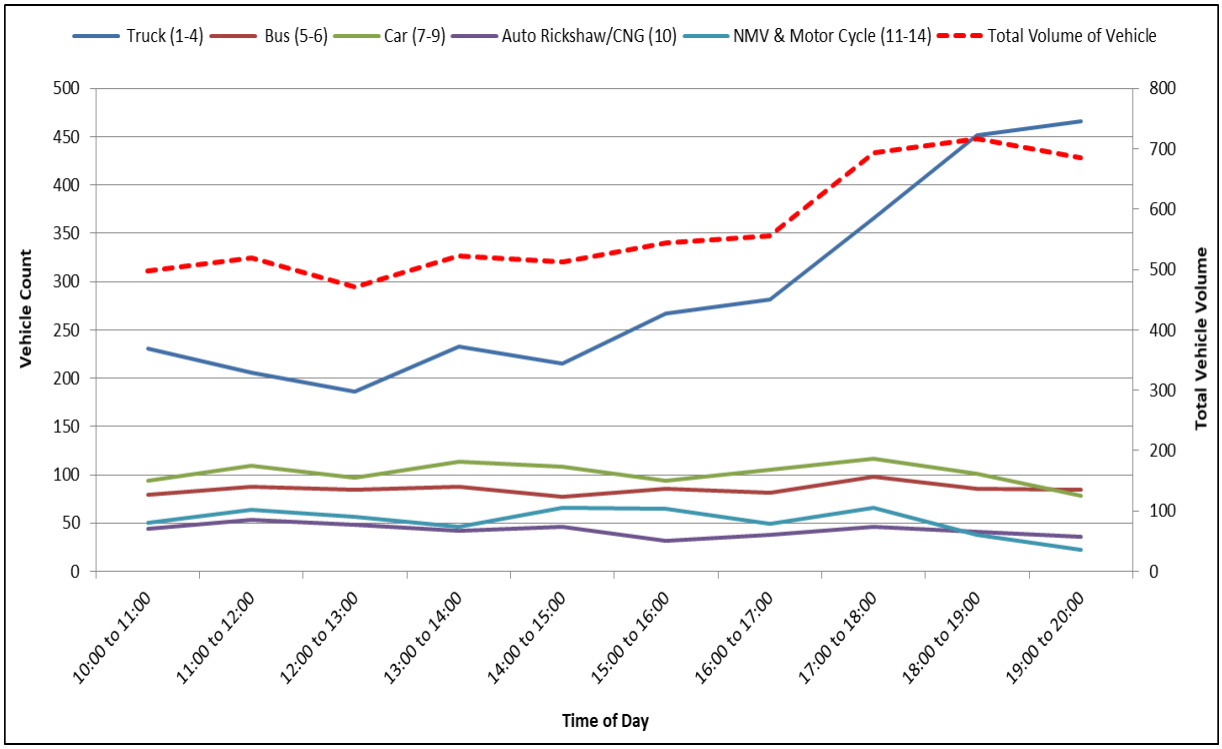


Figure 4.10: Temporal distribution of traffic by vehicle type (Site 01 – Down direction)

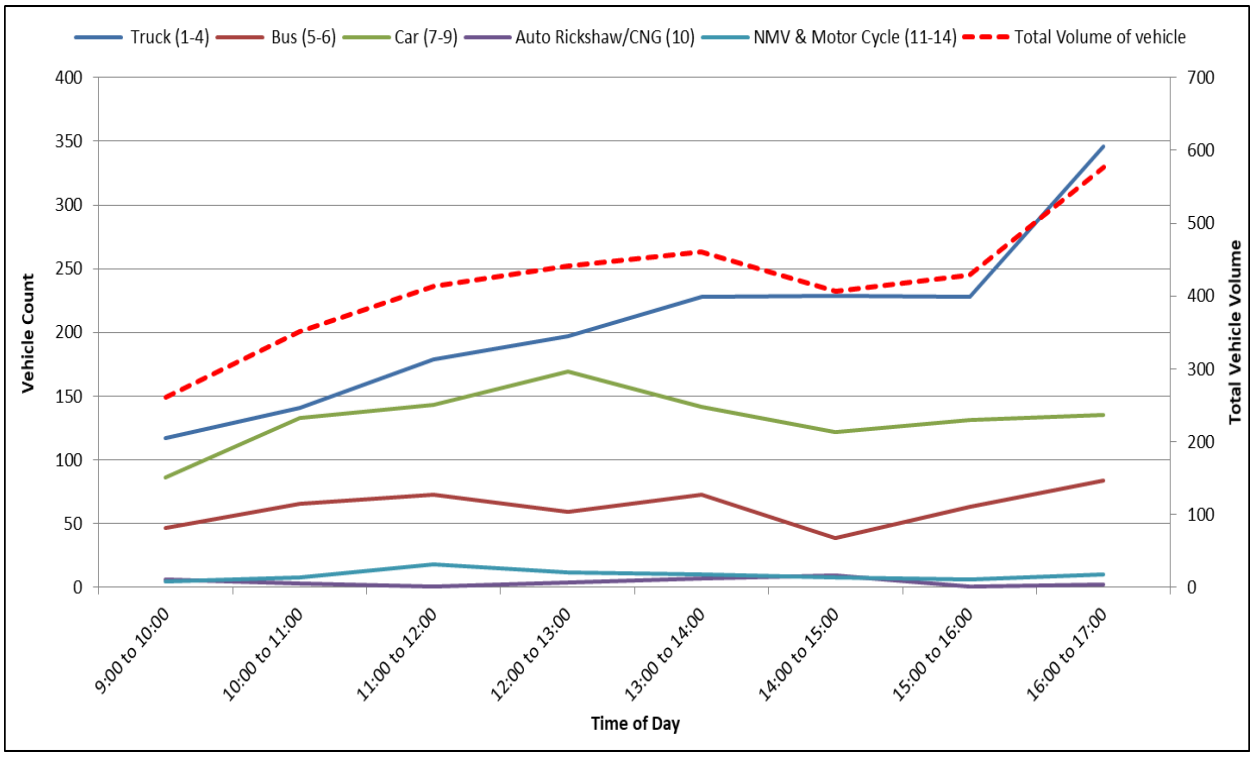


Figure 4.11: Temporal distribution of traffic by vehicle type (Site 10 – Up direction)

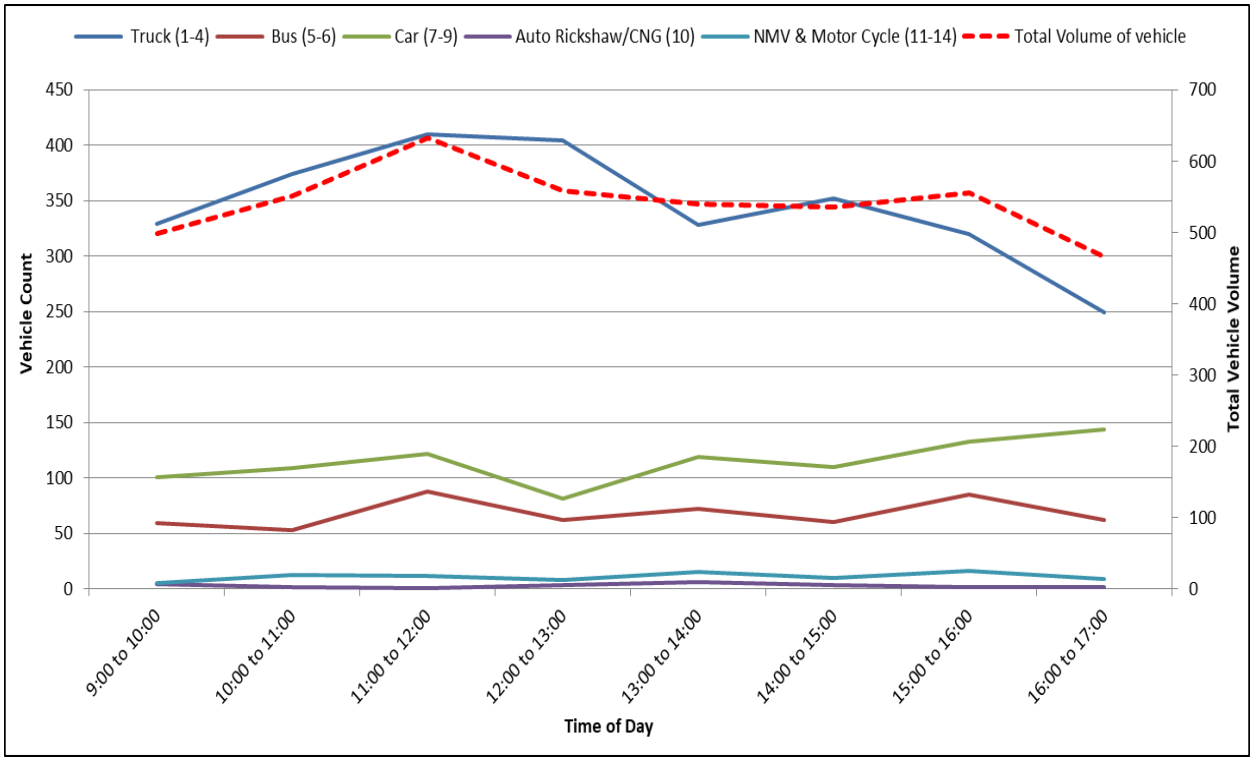


Figure 4.12: Temporal distribution of traffic by vehicle type (Site 10 – Down direction)

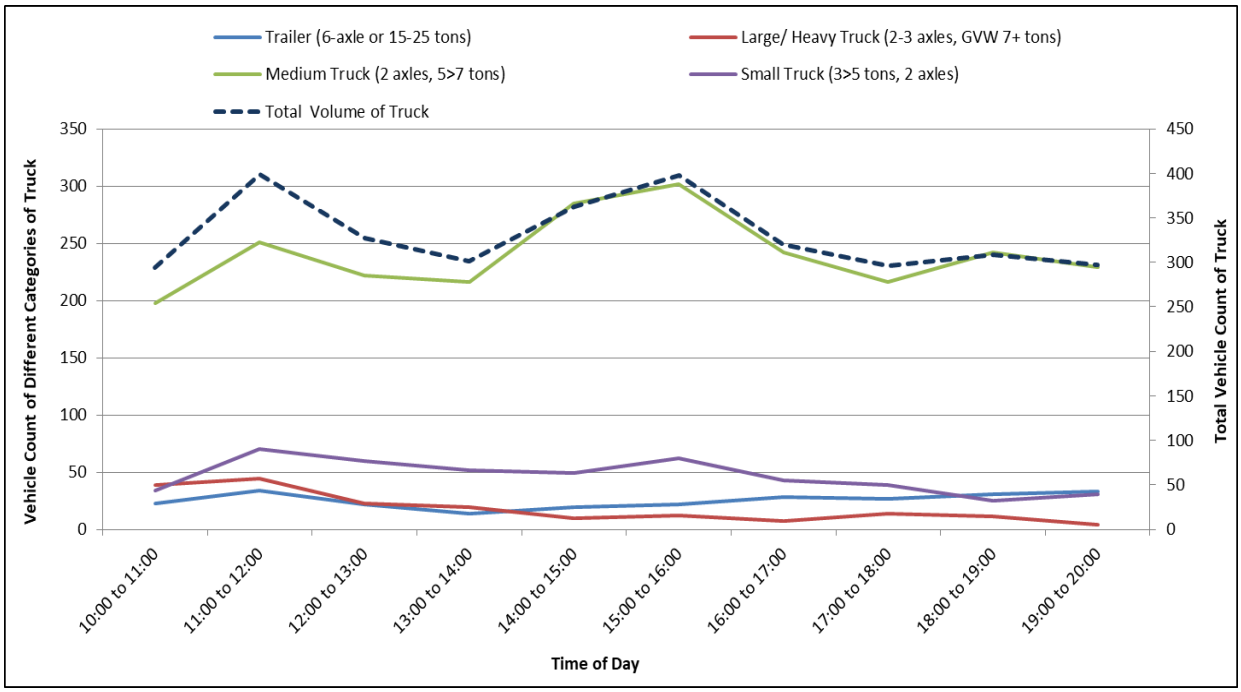


Figure 4.13: Temporal distribution of truck traffic (Site 01 – Up direction)

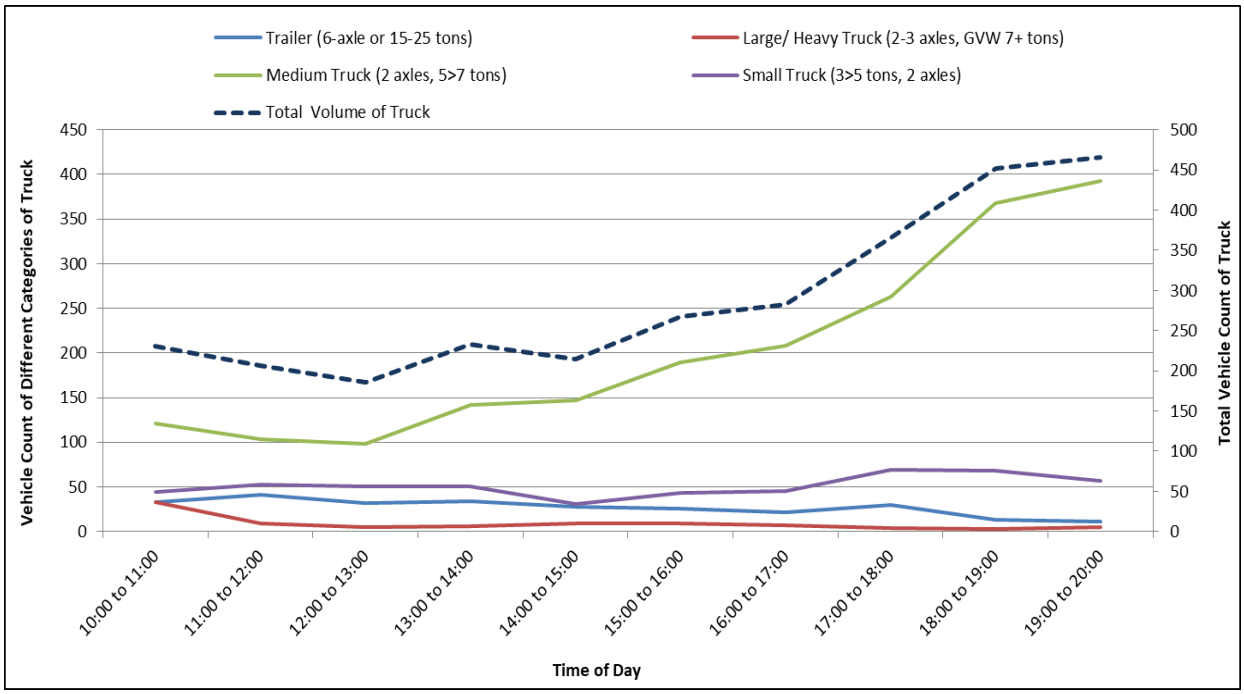


Figure 4.14: Temporal distribution of truck traffic (Site 01 – Down direction)

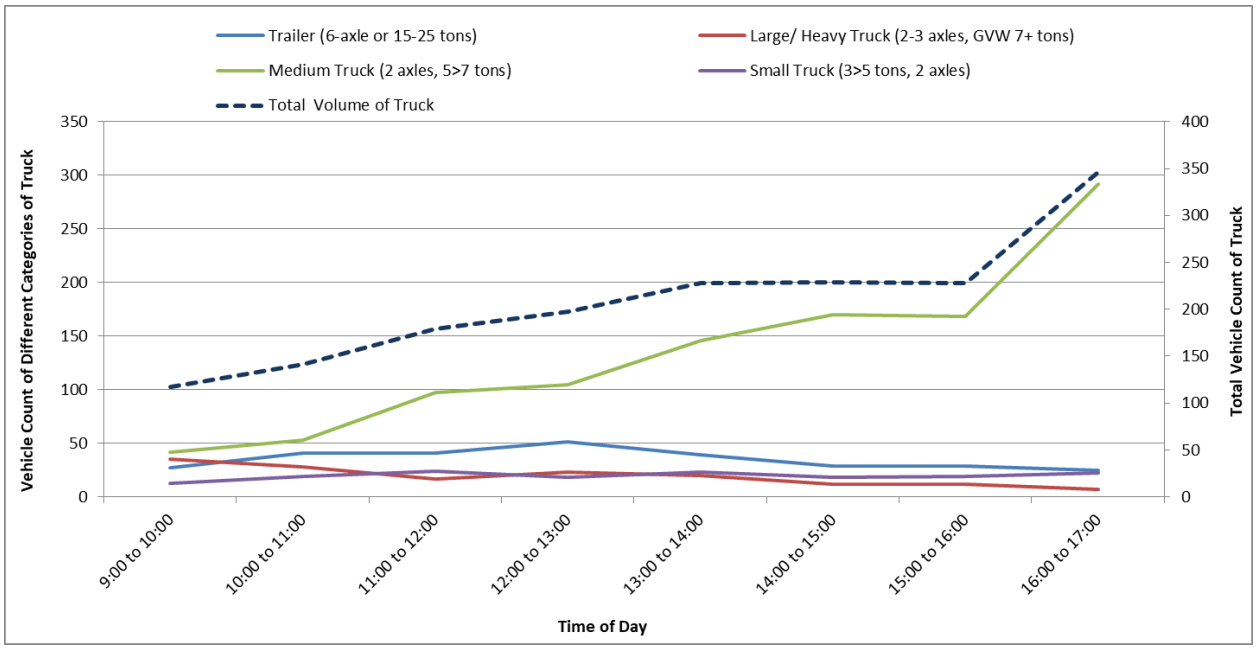


Figure 4.15: Temporal distribution of truck traffic (Site 10 – Up direction)

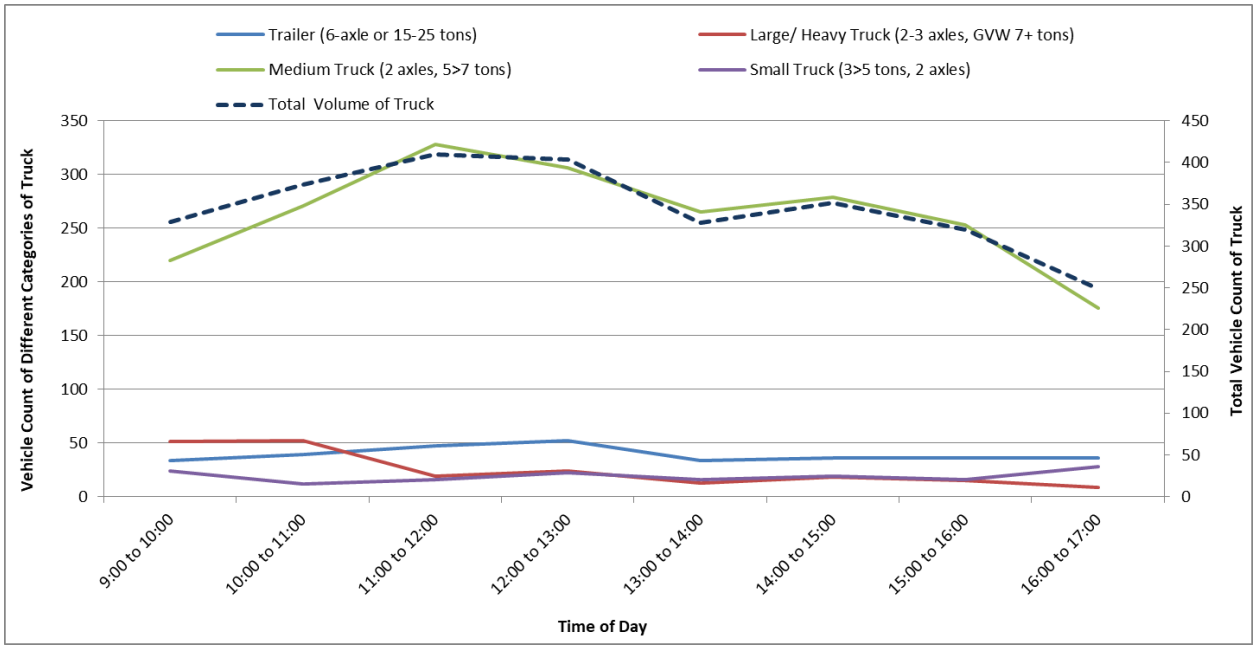


Figure 4.16: Temporal distribution of truck traffic (Site 10 – Down direction)

4.2.3 Traffic Distribution in Regional Highway (R151)

To find out the characteristics of the regional road and its flow and connectivity and major vehicle category, survey team selects a location on the regional highway of Mirsharai Upazila. The survey was conducted for 11 hours and 20 min as requested by the client (extra 3 hours and 20 min: 10:00 am to 9:20 pm).

For UP direction	For DOWN direction
Peak 1: 03:00 pm to 04:00 pm (370)	Peak 1: 02:00 pm to 03:00 pm (362)
Peak 2: 05:00 pm to 06:00 pm (344)	Peak 2: 05:00 pm to 06:00 pm (345)

Though it is the regional highway but the volume of non-motorized vehicles and unconventional transport (CNG) is high in this road. Among the truck traffic volume of medium truck is higher than the other truck categories and peak flow seen at 5:00 pm to 6:00 pm.

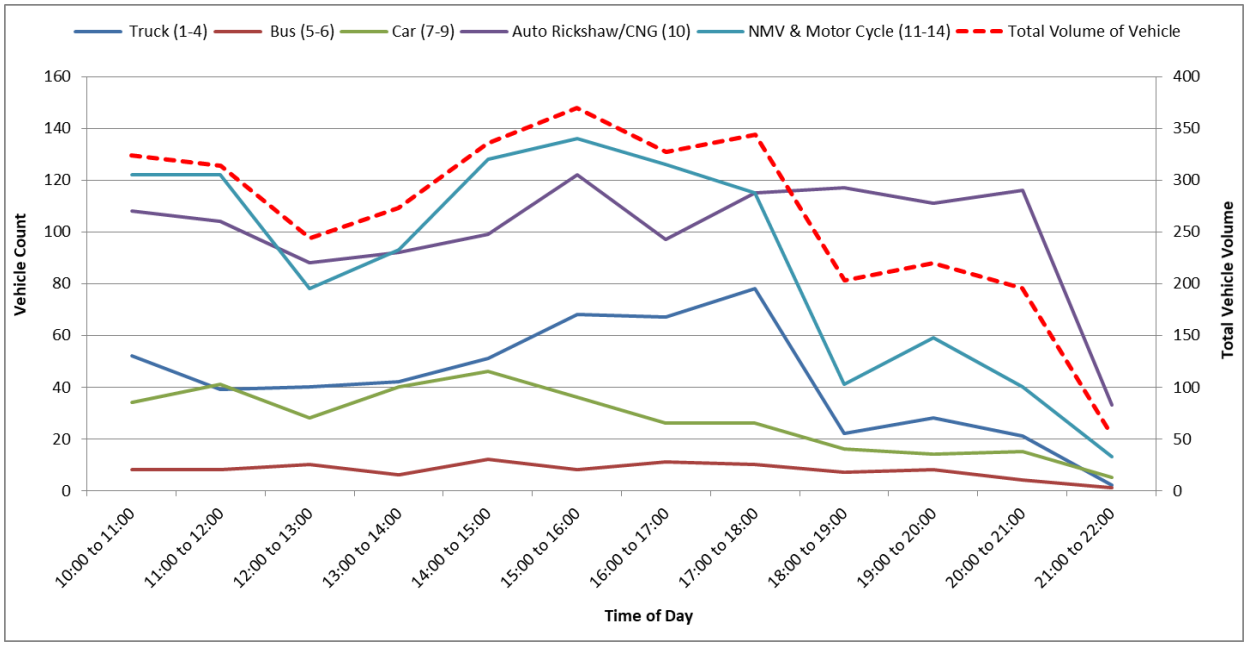


Figure 4.17: Temporal distribution of traffic by vehicle type (Site 02 – Up direction)

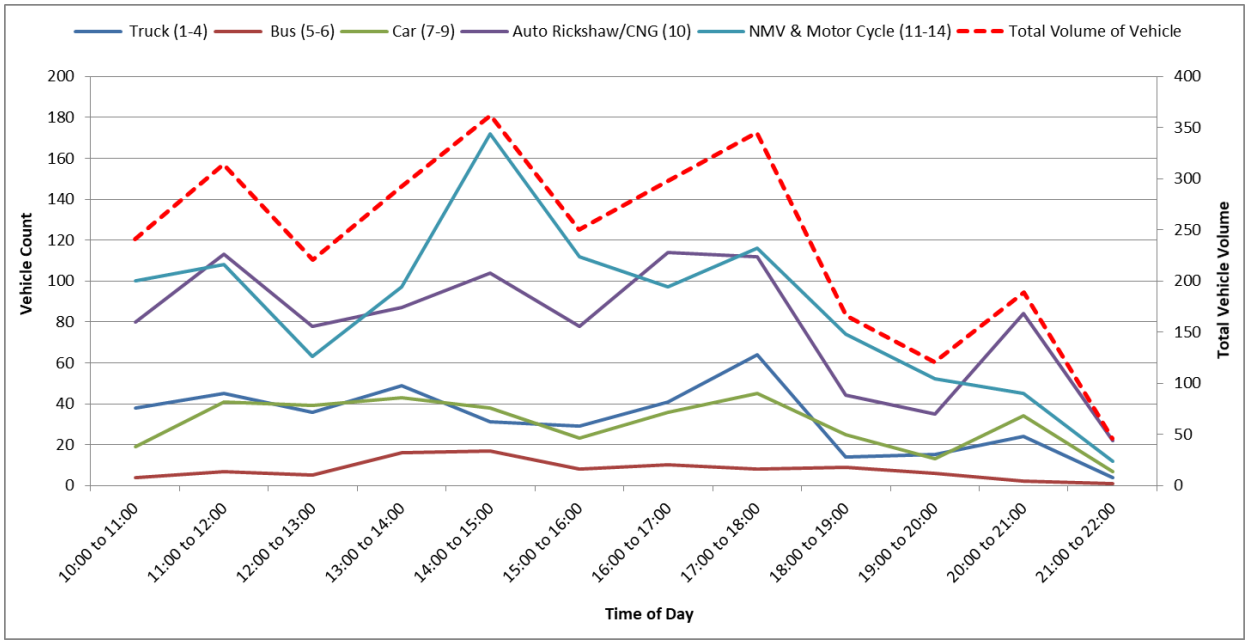


Figure 4.18: Temporal distribution of traffic by vehicle type (Site 02 – Down direction)

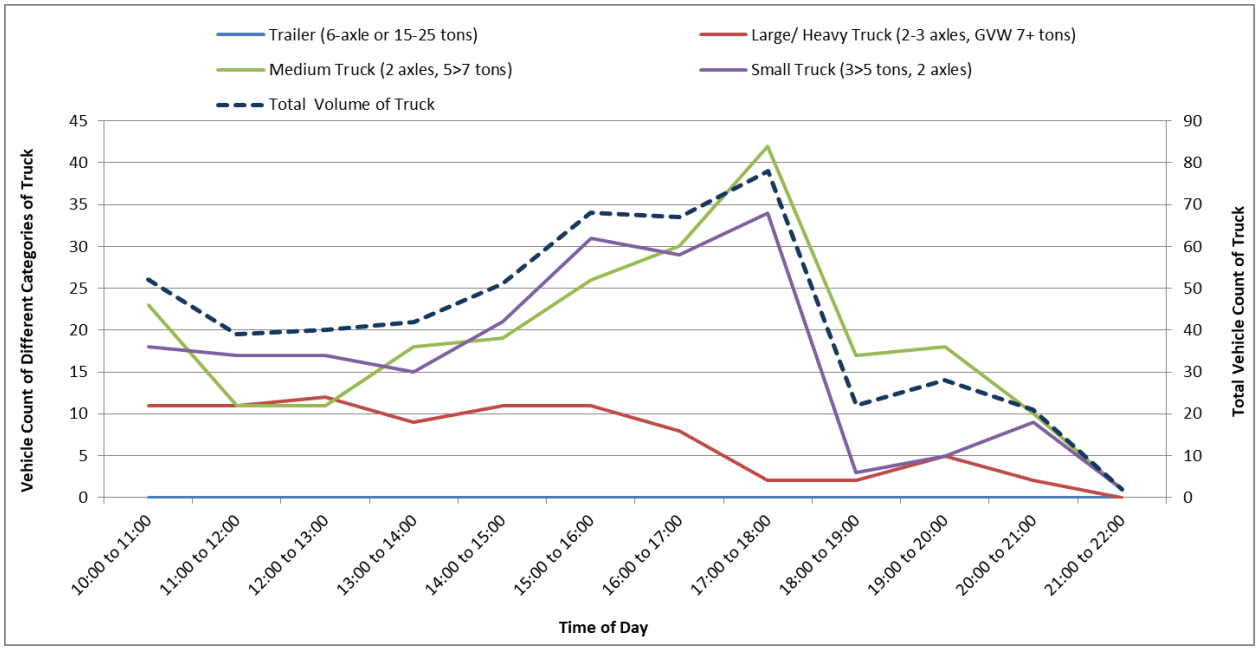


Figure 4.19: Temporal distribution of truck traffic (Site 02 – Up direction)

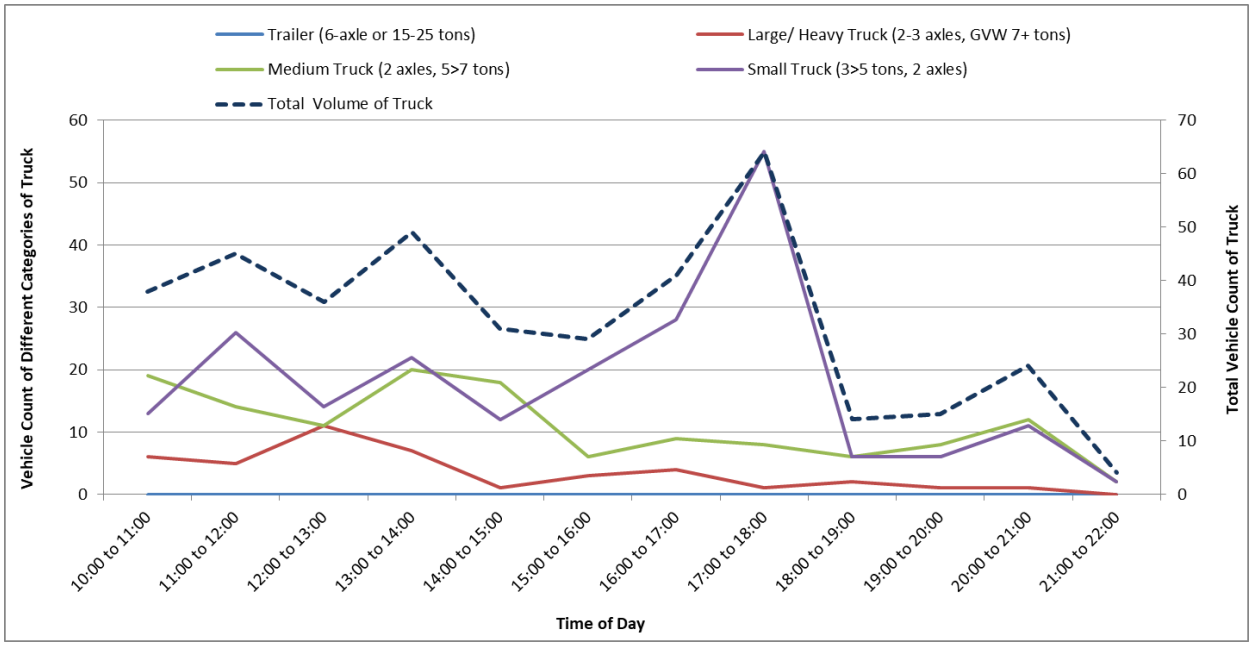


Figure 4.20: Temporal distribution of truck traffic (Site 02 – Down direction)

4.2.4 Traffic Distribution in Zila Road (Z1021)

Form the reconnaissance survey it has been observed that the zila road (leading to Fatikchhari) of Mirsharai Upazila is too narrow. Mainly CNG and NMVs are moving through the road rather than other vehicles. If the road can be widened then it can be a direct connectivity to Fatikchhari. And honorable Mayor of Mirsharai Paurashava also has the interest to widen the road and increase the better connectivity with other upazila. So Consultant team select a location on this road and conduct 12 hours survey 9:00 am to 4:00 pm and 6:00 pm to 9:00 pm (extra 3 hours as per request from the client).

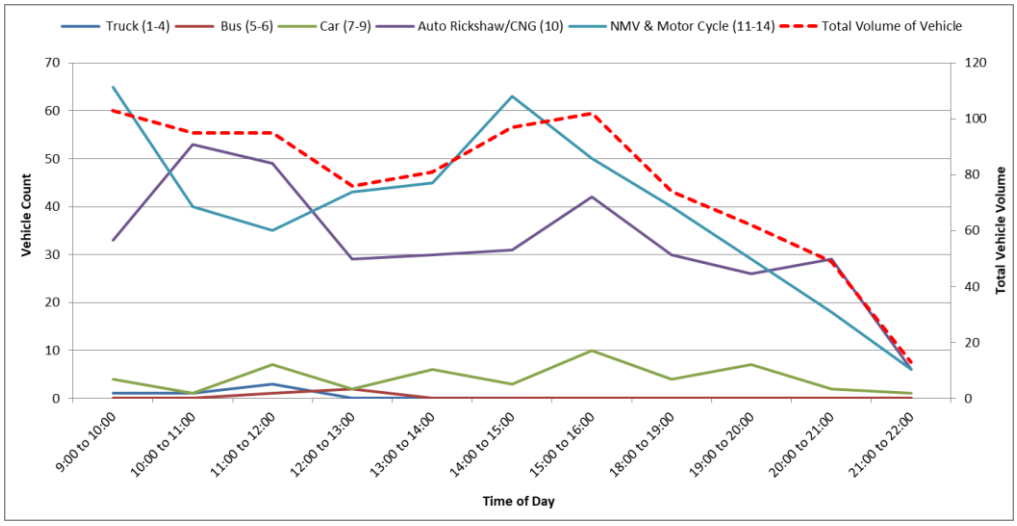


Figure 4.21: Temporal distribution of traffic by vehicle type (Site 06 – Up direction)

From the figures below it is observed that there are more than one peak time when flow is high. In the road CNG/ Auto-rickshaw and NMVs are contain the main volume of the road. The peaks of the typical day on Zila road are as follows:

For UP direction	For DOWN direction
Peak 1: 09:00 am to 10:00 am (103)	Peak 1: 12:00 pm to 01:00 pm (104)
Peak 2: 03:00 pm to 04:00 pm (102)	Peak 2: 11:00 am to 12:00 pm (89)

Volume of truck traffic is low as the road is too much narrow so there is not possible for trucks to move. A small amount of small and medium truck vehicles are seen which are use the road to unload just construction materials or other daily necessity goods in the bazar area.

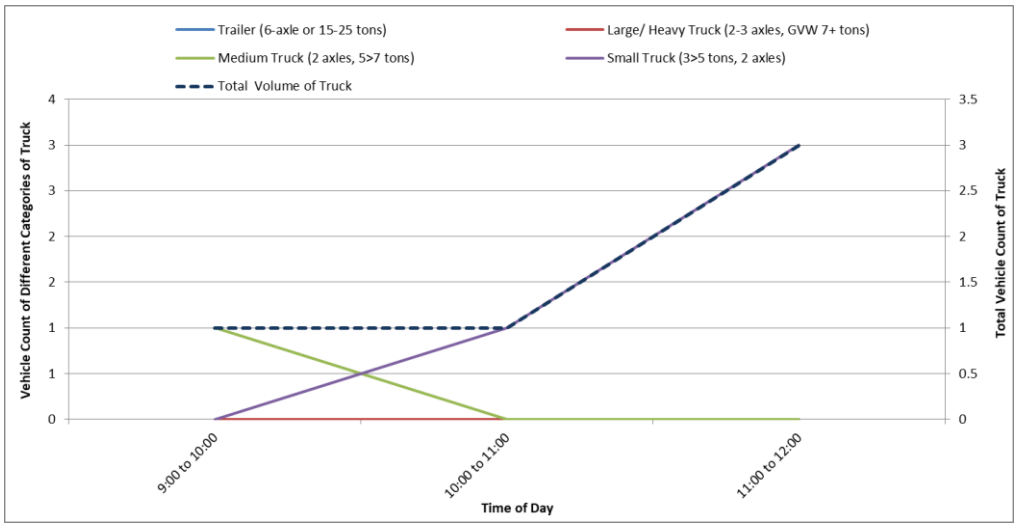


Figure 4.22: Temporal distribution of truck traffic (Site 06 – Up direction)

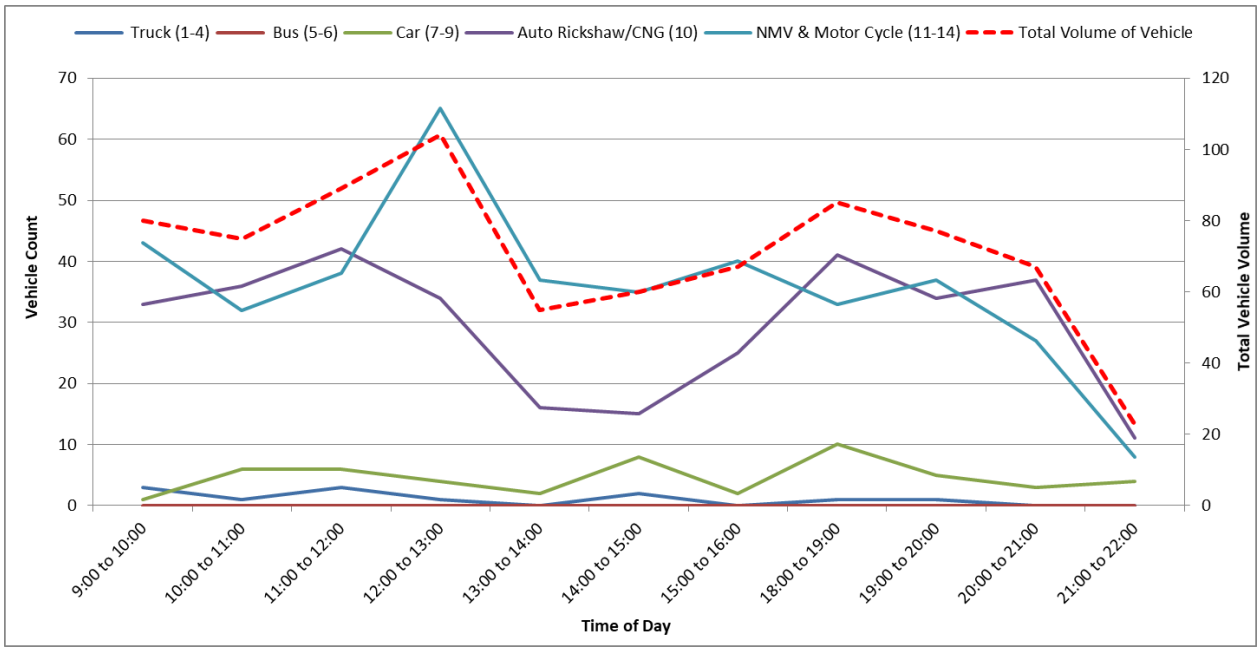


Figure 4.23: Temporal distribution of traffic by vehicle type (Site 06 – Down direction)

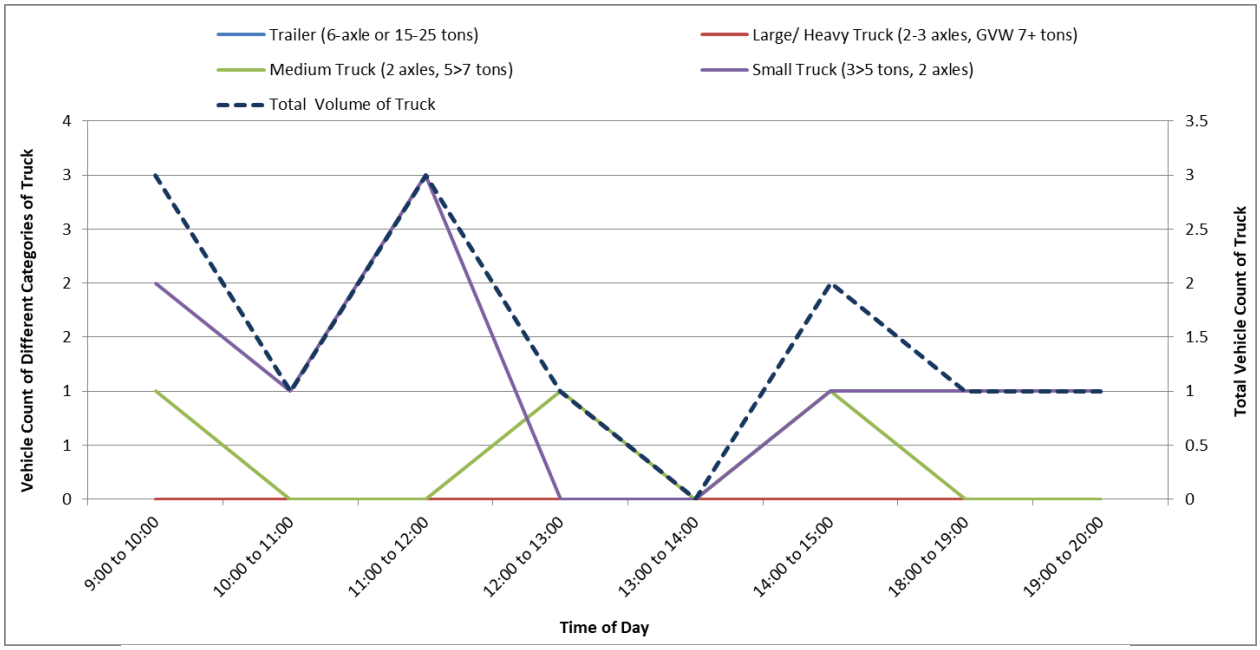


Figure 4.24: Temporal distribution of truck traffic (Site 06 – Down direction)

4.2.5 Traffic Distribution in Upazila Road (Internal)

Six internal locations were surveyed. As early said that survey time was fixed after discussion with local people and for two hours, two survey locations were surveyed, site 03 and site 04 more than two hours for the request of the client.

From the survey data of site 03 and 04 it is found that flow is being low after 6:00 pm as the area is rural people are not move as much as the city area. All the shops, bazars, shopping complex are almost closed at 9:00 pm.

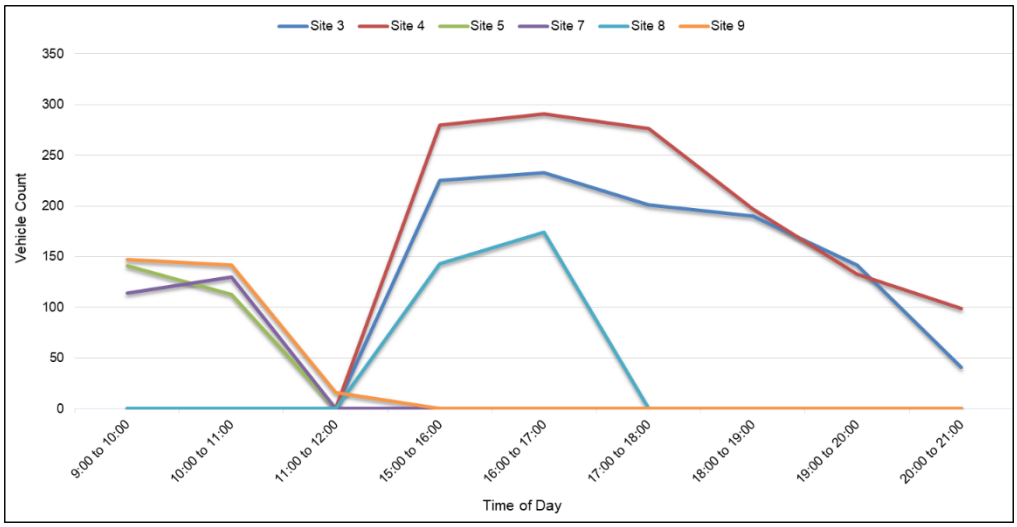


Figure 4.25: Temporal distribution of traffic of all Internal Sites (Up direction)

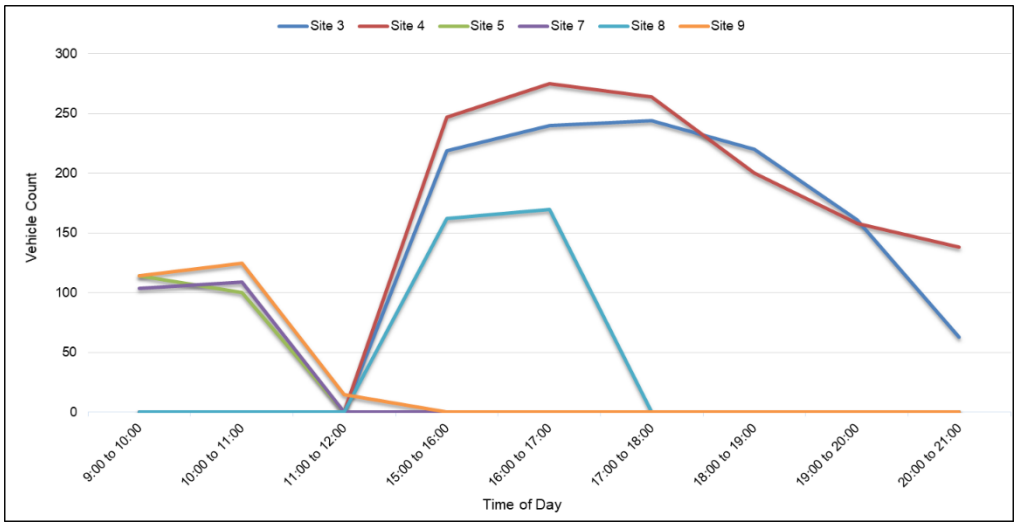


Figure 4.26: Temporal distribution of traffic of all Internal Sites (Down direction)

4.2.6 Modal Share

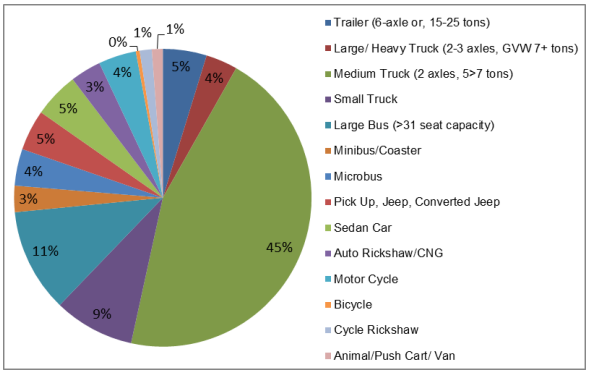
Figure 4.27 to Figure 4.30 represents the modal share of site 01 (external) and site 03 (internal). Rest of the figures have been given in the **Appendix C**. In sites 01 and sites 10 the share of motorized vehicles are high because the locations are on Dhaka-Chittagong highway. Among the vehicles modal share of medium trucks and large bus are high in both directions for both sites. In site 10 considerable amount of pick up and jeeps are observed.

Site 01	Site 10
Medium truck (45%, 36%)	Medium truck (32%, 48%)
Large bus (11% for both directions)	Large bus (14%, 11%)

In the regional highway (site 02) share of auto rickshaw/ CNG, motor cycle, bi-cycle and rickshaw are high. In case of Zila road (site 06) the scenario is same as the scenario of site 02.

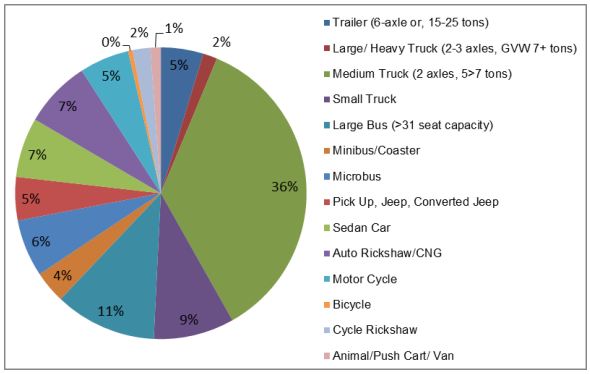
Site 02	Site 06
Auto Rickshaw/ CNG (37%, 33%)	Auto Rickshaw/ CNG (42% for both directions)
Motor-cycle (13%, 16%)	Motor-cycle (20%, 17%)
	Bi-cycle (20% for both directions)

For internal sites (03, 04, 05, 07, 08 and 09) shares of CNG, motor-cycle, rickshaw and bi-cycle are higher than rest of the modes. Shares of CNG varies from 40% to 60% (highest in site 05), motor-cycle 9% to 20% (highest in site 03), rickshaw 3% to 22% (highest in site 03) and bi-cycle 11% to 26% (highest in site 09).



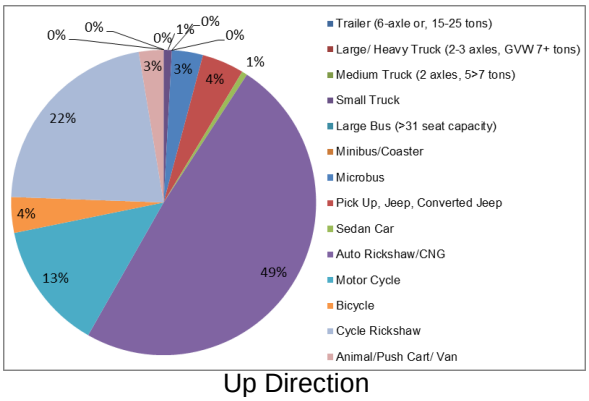
Up Direction

Figure 4.27: Modal share of vehicles on Site 01



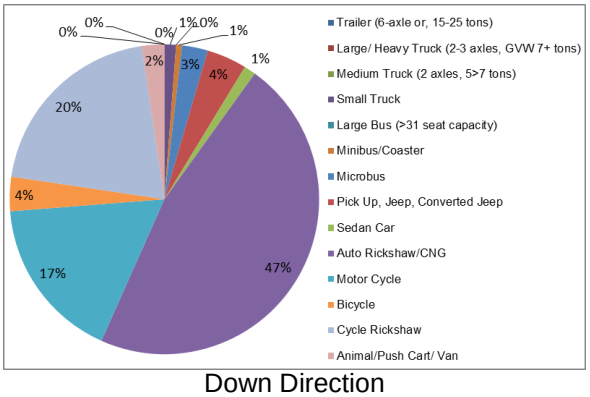
Down Direction

Figure 4.28: Modal share of vehicles on Site 01



Up Direction

Figure 4.29: Modal share of vehicles on Site 03



Down Direction

Figure 4.30: Modal share of vehicles on Site 03

4.3 Origin-Destination Survey

For each site, the OD data collection included information on origin, destination, type of vehicle, purpose of the journey and time of day when the data were collected. Only a fraction of the flow data were obtained as sample for the OD data collection to prepare base year OD matrix for each survey location. In OD matrix origin and destination are aggregated into zones. OD matrices are most important input in Trip Distribution step of Transport modelling. The consultant team has defined 23 zones for preparation of OD matrix. The following section describes how zoning has been done.

4.3.1 Zoning

The first activity involved in a travel demand forecasting is to identify the TAZs for the study area. From the raw OD data for each internal survey locations, the ***catchment areas*** (union, ward, mauza etc.) from which traffic are coming to Mirsharai were identified. Then, the national and regional highways feeding traffic to the study area from outside the internal catchment areas (Other areas outside the Mirsharai

such as Dhaka, Chittagong, Rajshahi etc.) were identified. Finally, combining the catchment areas and the relevant road networks, the ODs were aggregated into 23 zones as outlined in Table 4.8. These zoning will be same for the Household survey matrix.

- GIS Map of Mirsharai with all the political boundaries outlined (Union boundaries) was collected from LGED. After that the map was opened in Arc GIS 10.1.
- Also GIS map of Mirsharai including local roads was collected. From that map, all village roads except for RHD roads and the Union and Upazila roads, were eliminated because village roads are too narrow to move vehicle. In most of the case union roads which are too narrow and in poor operating condition were also excluded from the map. This map was also loaded in the same Arc GIS project.
- For ease of analysis, 16 unions were taken into consideration as internal Traffic Assessment Zones.
- External zones were identified based on the national, regional road connectivity.
- Substantial amounts of engineering judgement were also applied by the Consultant team to finalize the 23 zones.

Table 4.8 represents the TAZs for the study area.

Table 4.8: Traffic Assessment Zones (TAZ) for the Study Area

Zone ID	Zonal Catchment
1	Karerhat union
2	Hinguli union
3	Dhum union
4	Zorawargonj union
5	Osmanpur union
6	Durgapur union
7	Katachhara union
8	Ichhakhali union
9	Mirsharai union
10	Mithanala union
11	Shaherkhali union
12	Maghadia union
13	Khaiyachhara union
14	Mayani union
15	Wahedpur union
16	Haitkandi union
17	Chandpur, Noakhali, Lakshmipur
18	Feni, Comilla
19	Dhaka, Rajshahi, Khulna, Mymensingh, Rangpur, Barisal, Sylhet
20	Khagrachhari
21	Fatikchhari
22	Chittagong, Cox's Bazar
23	Mirsharai Economic Zone*

*:Economic zone is still under masterplanning process and requires several years from now to be operational. The zone is supposed to constitute a major portion of the Mirsharai traffic which is currently unavailable and has little effect on the present analyses. This zone is not effective right now and it was created only to be used in the model in a later period.

4.3.2 Household OD Survey

From the

Table 4.9, it is evident that the movement is mostly within the zone for all the zones except Zone-7. These movements are shown in violet colored cells. This may be due to the fact that most of the facilities such as rural markets, educational institutions, health facilities etc. are available within each zone and the local inhabitants do not usually have to move to other zones or distant places for their day-to-day activities. The physical features in the LGED map shown in Figure 4.39, shows the location of such facilities in different zones. The other major inter-zone movements are highlighted green in the same table below. These movements for the zones Karerhat and Hinguli are graphically presented in Figure 4.31 and Figure 4.32; and those for the other zones are in the **Appendix C**.

The Figure 4.33 to Figure 4.35 demonstrate the intra- and inter-zonal modal choice of the locals. The modes are categorized into five types, and designated with different colors in the bar charts showing their share in trips originated from a particular zone. The colours for different modes are shown in the following for better understanding of the pictorial demonstration.

Walk	
Rickshaw-cycle	
Bi-cycle	
Bus	
Other Motorized Unconventional Mode (MUCM)- CNG, Jeep, Microbus, Motorcycle etc.	

The figures show that when the movement is within the zone, the trip makers mostly use Walking and Other MUCM especially CNG for commuting. This also prominent for short distance trips where Walking, CNG, Rickshaw-cycle and Bi-cycle is commonly used. In other cases, where long distance trips are made, Bus and shared MUCM such as Jeep/ Leguna/ Microbus etc. are used particularly when the trip is originated from and destined to a zone where public transport (Bus) is easily accessible; i.e.; zones adjacent to the highway.

The following figures (Figure 4.36 to Figure 4.38) show distribution of purposes throughout the Upazila as obtained from the household survey. The survey was conducted for 5 types of purposes; Educational, Work, Shopping, Recreational and others. From the figures, it is obvious that most trips are made for three major purposes- Educational, Shopping and Work purposes. This is because these facilities are readily available within the zones; and the recreational trips are made occasionally in case of local residents.

Figure 4.40 to Figure 4.42 represents the trip flow of Mirsharai Upazila and trip flow of male and female population. For male and female population mode and purpose wise distribution has been shown. Figure 4.43 represents the trip functionality between different zones.

Table 4.9: Household's Origin-Destination matrix

Origin	Destination																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	47%	33%							5%									16%				
2	6%	73%	4%	2%					2%									12%				
3		28%	19%	14%	4%				2%						2%			14%				18%
4	1%	27%	11%	36%	1%	3%		2%	1%						2%			3%	1%			12%
5		11%		3%	46%			5%	11%						2%			7%	5%			10%
6		3%		6%	3%	22%	2%	5%	29%						3%			3%	3%			22%
7		6%		14%	4%		6%	49%	8%									6%	2%		2%	4%
8		3%		3%			6%	50%	19%						6%			3%			3%	6%
9									93%						3%							5%
10		2%				21%	7%		14%	35%					5%				7%			9%
11		1%							2%		71%	1%			9%	1%			1%			13%
12									25%			61%			2%							12%
13									14%			2%	73%		4%							8%
14									1%		8%	14%		60%	5%	1%		1%	1%			8%
15					1%				8%		1%		5%		58%	14%		10%				4%
16		1%		1%					3%		1%	3%			15%	53%			4%			19%

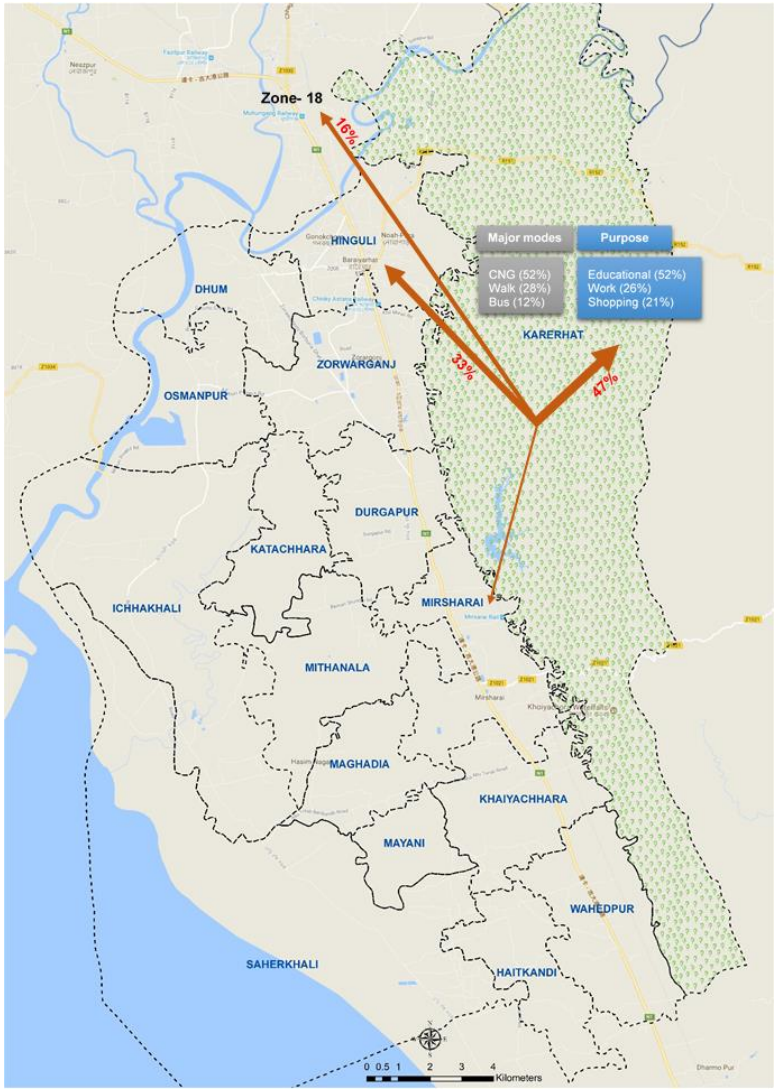


Figure 4.31: People's movement from Karerhat (zone-1) to different places

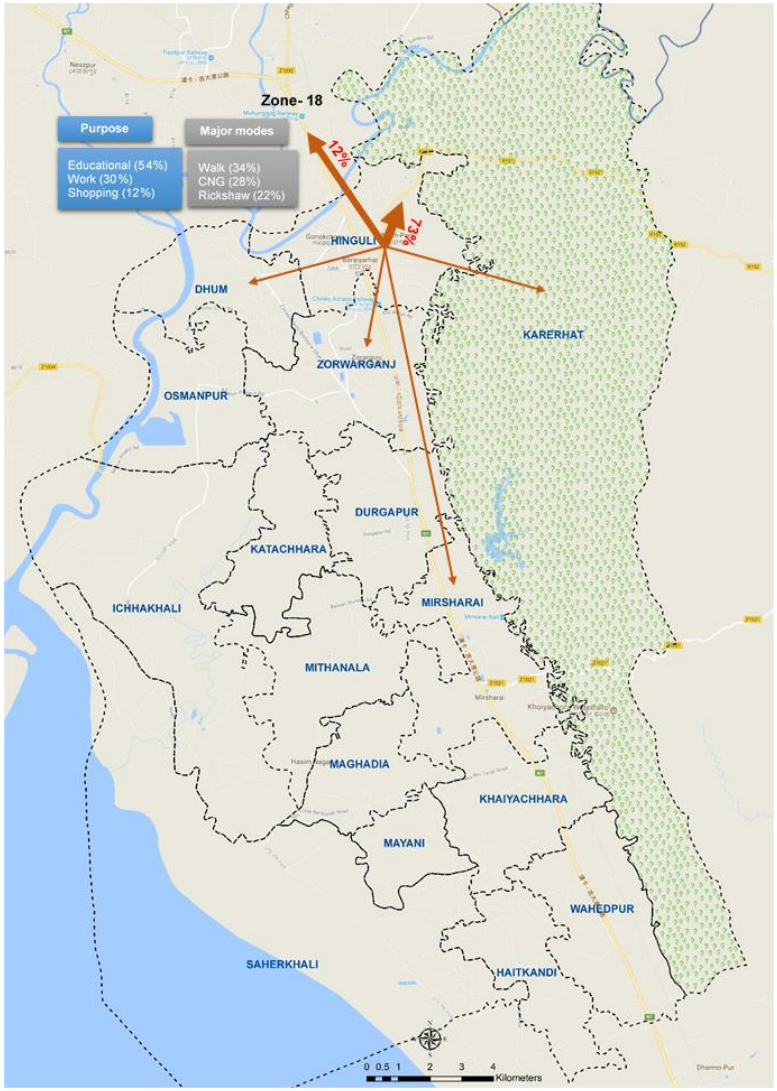


Figure 4.32: People's movement from Hinguli (Zone-2) to different places

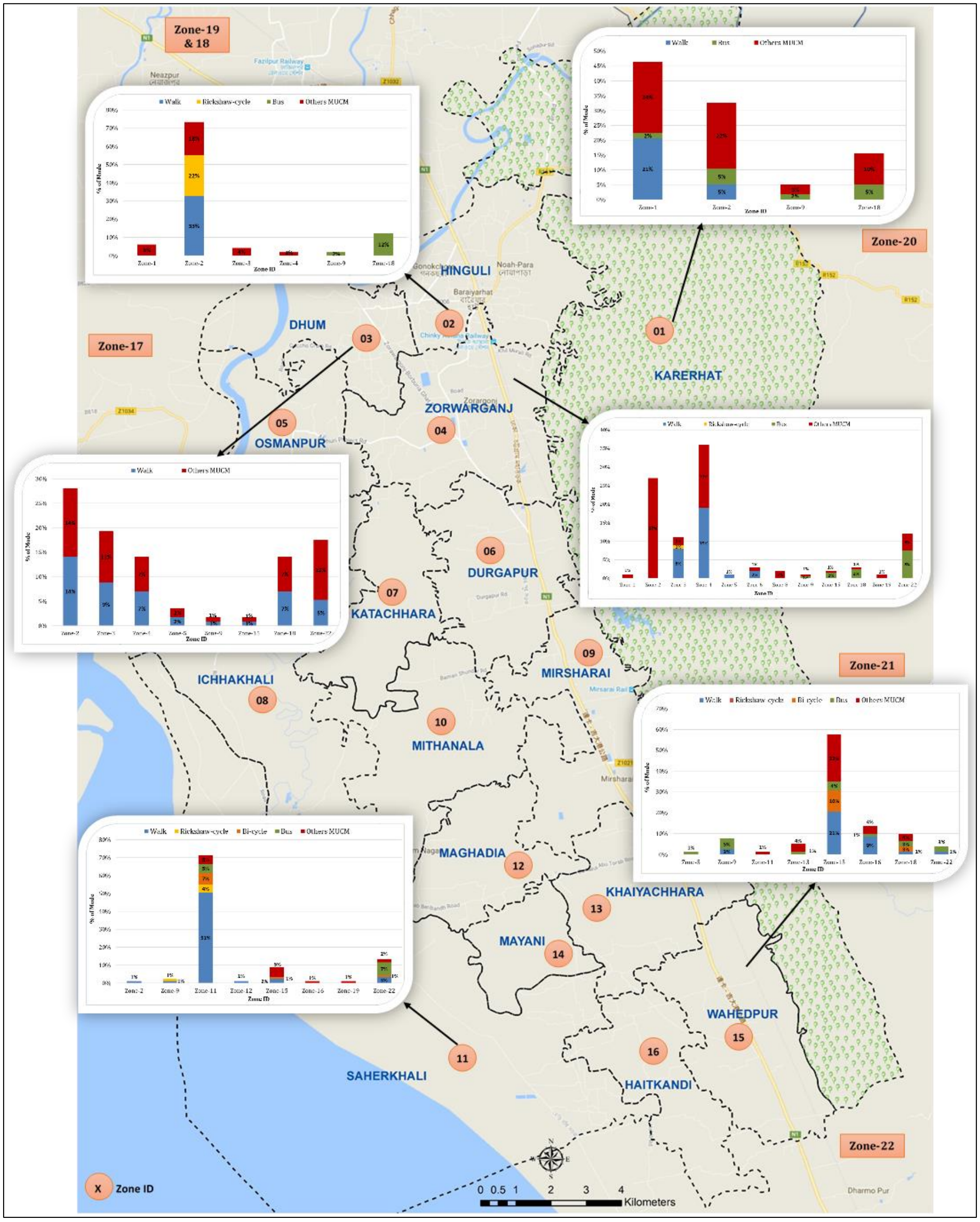


Figure 4.33: Modal distribution from Zone- 1, 2,3,4,11,15 to different places

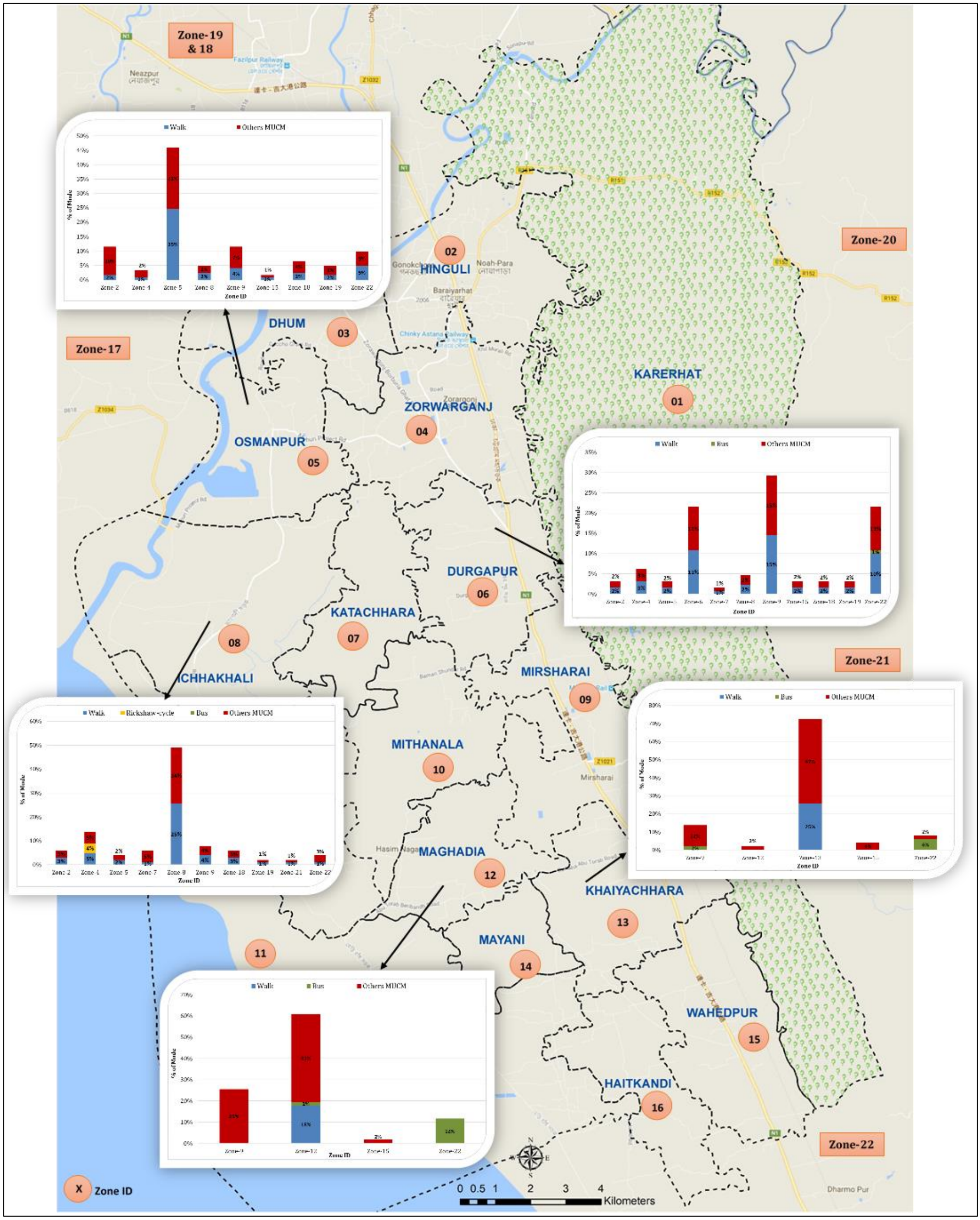


Figure 4.34: Modal distribution from Zone- 5, 6, 8, 12, 13 to different places

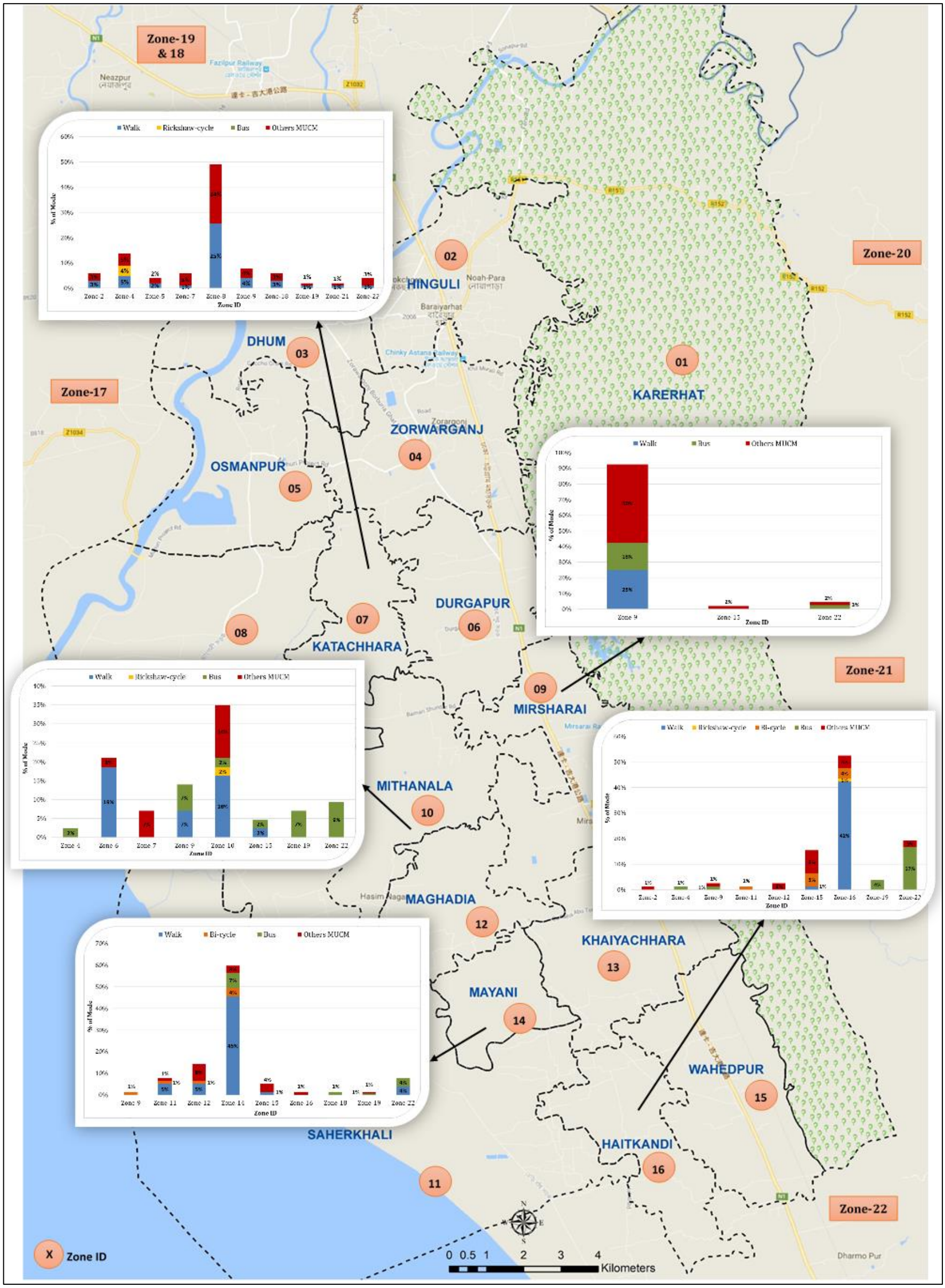


Figure 4.35: Modal distribution from Zone- 7, 9, 10, 14, 16 to different places

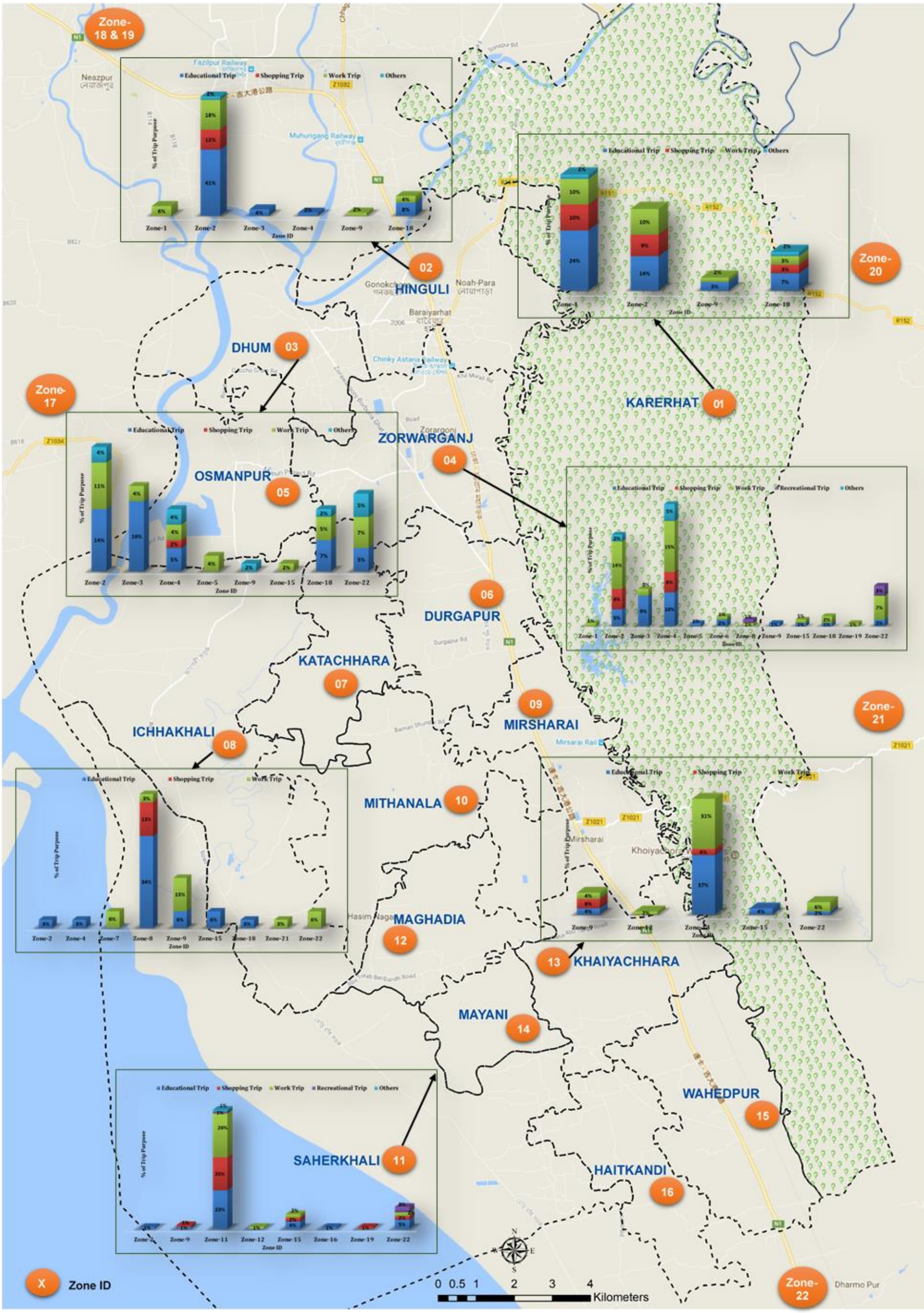


Figure 4.36: Distribution of Purpose from Zone- 1, 2, 3, 4, 8, 11, 13 to different places

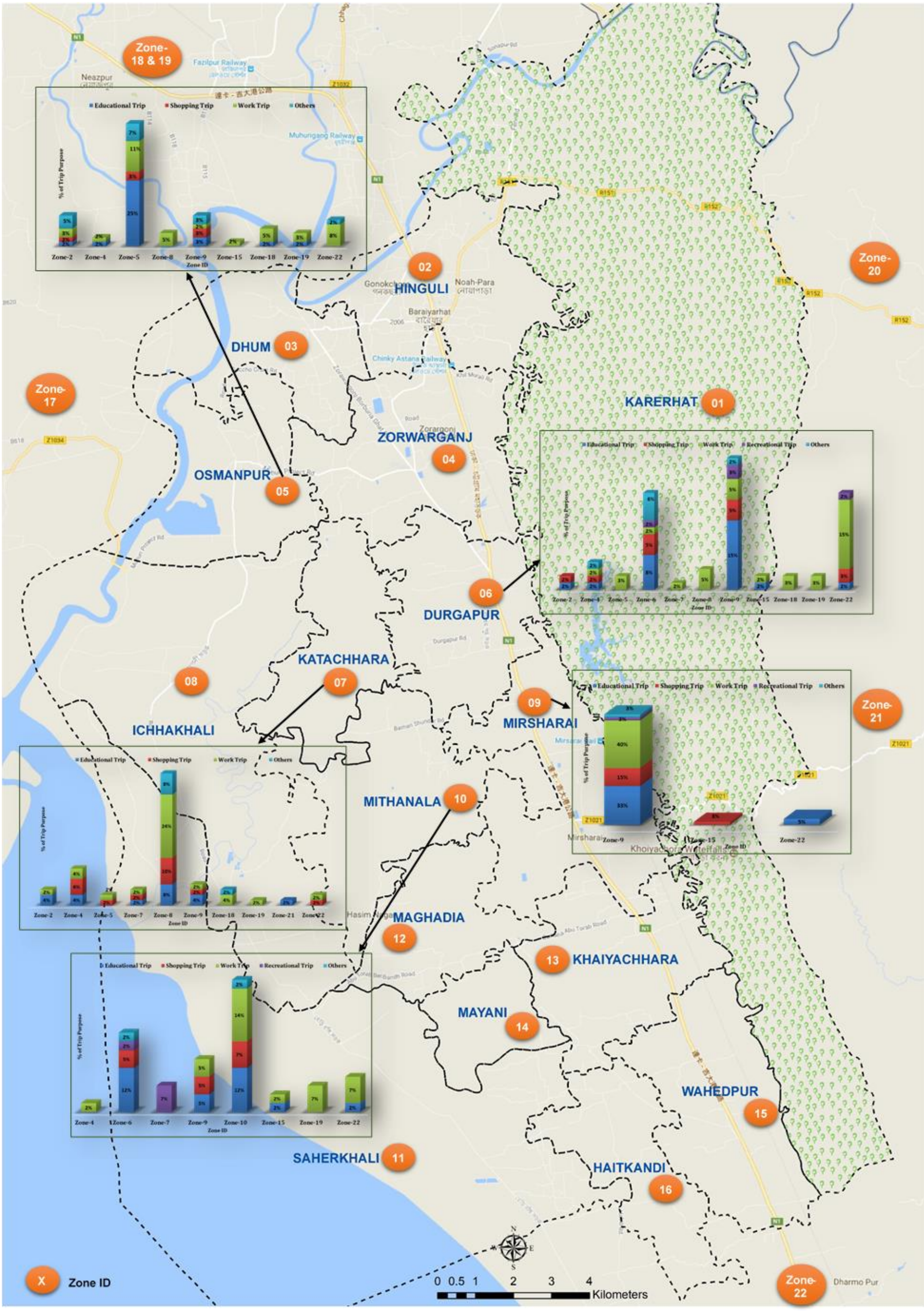


Figure 4.37: Distribution of Purpose from Zone- 5, 6, 7, 9, 10 to different places

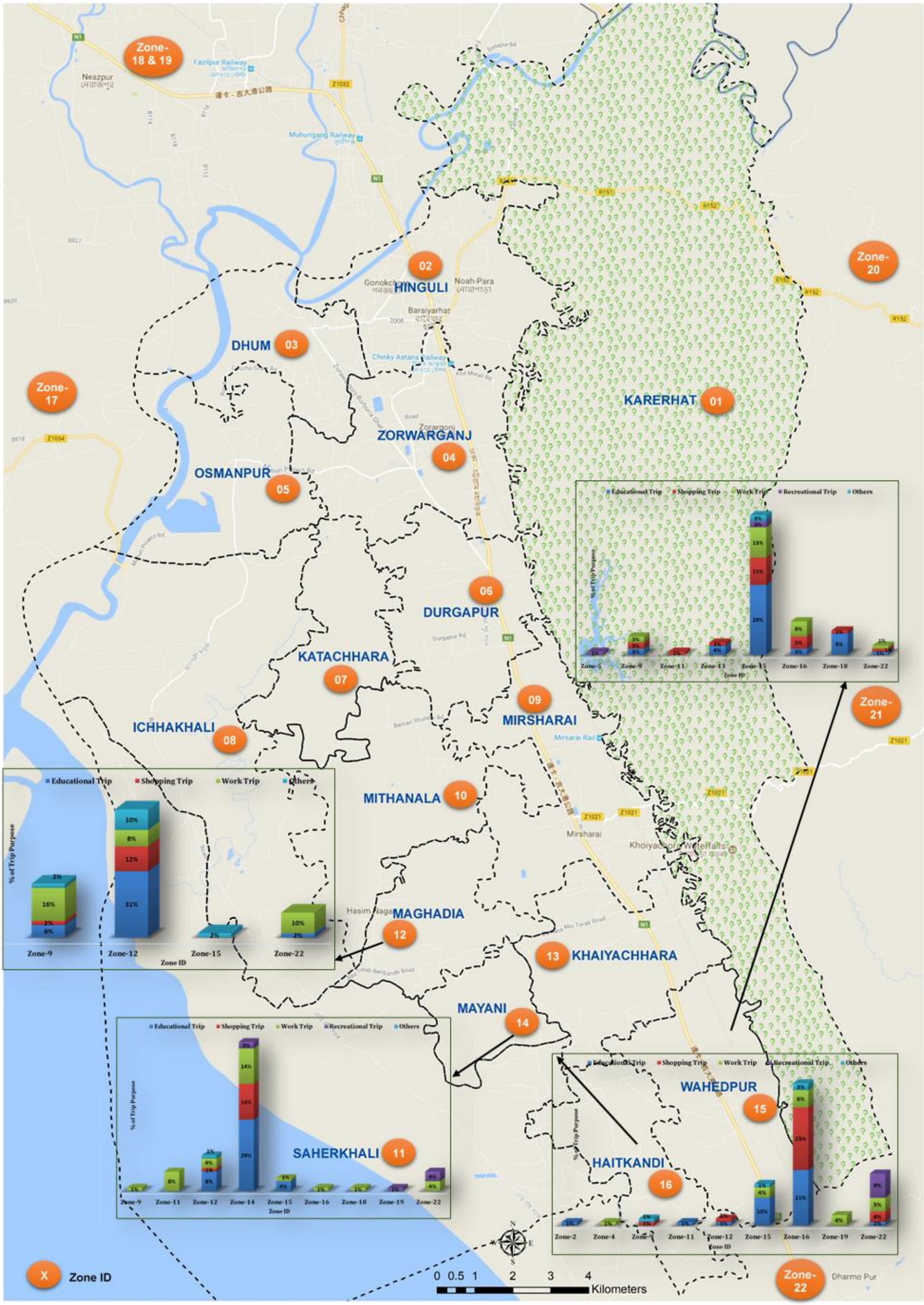


Figure 4.38: Distribution of Purpose from Zone- 12, 14, 15, 16 to different places

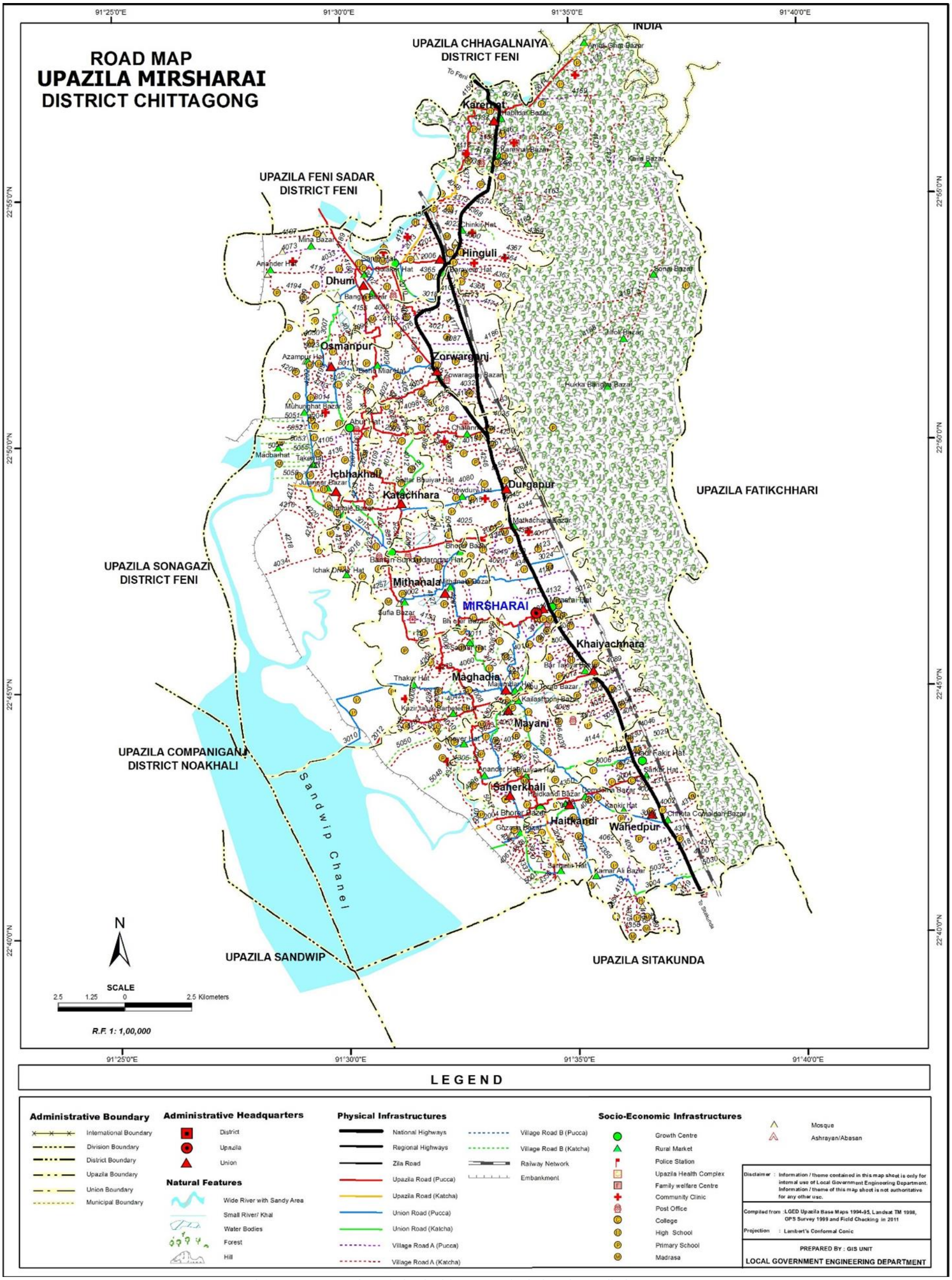


Figure 4.39: Location of physical features of Mirsharai Upazila in LGED map

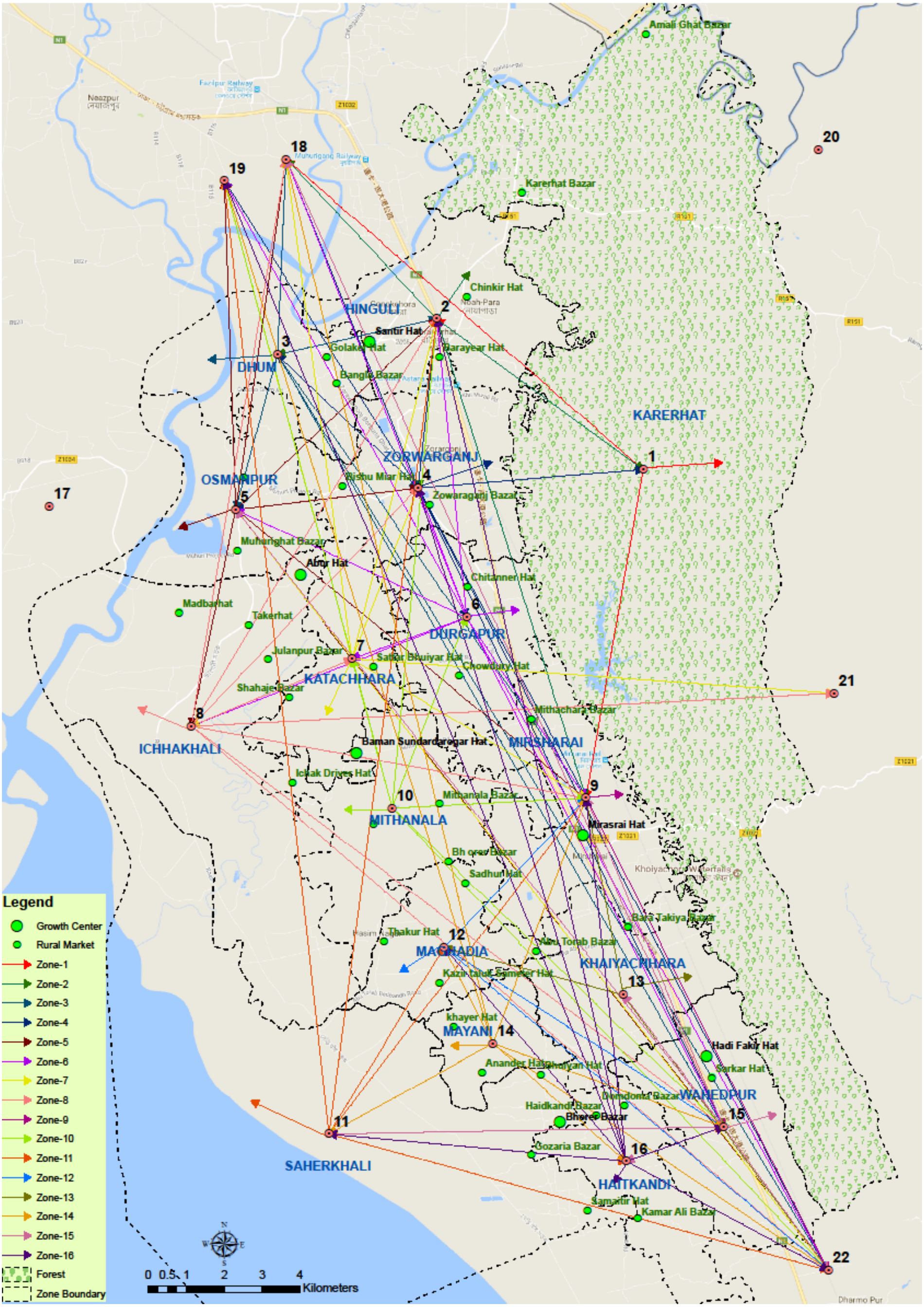


Figure 4.40: Trip Flow for Mirsharai Upazila

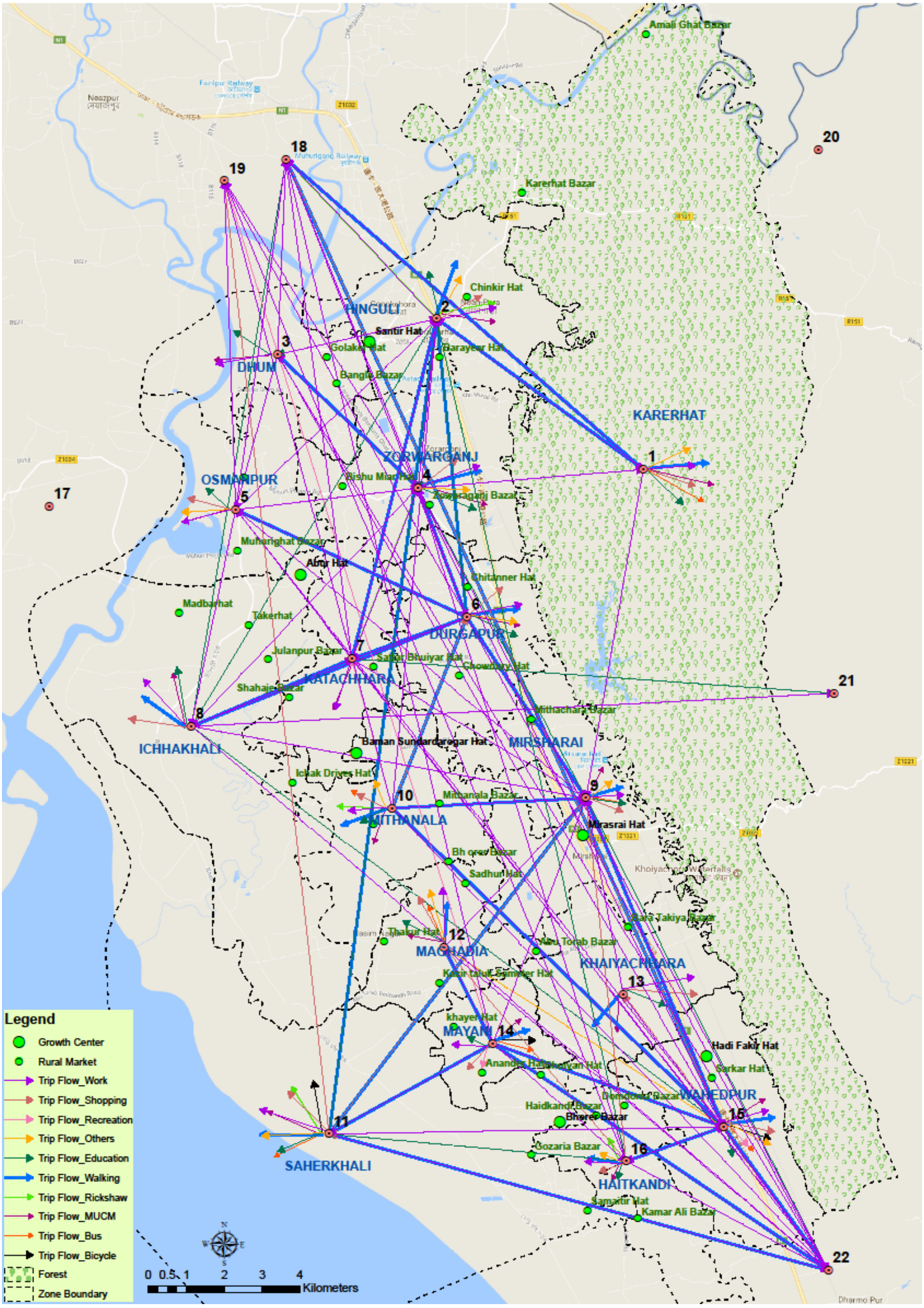


Figure 4.41: Trip Flow of Male Population, Mirsharai Upazila

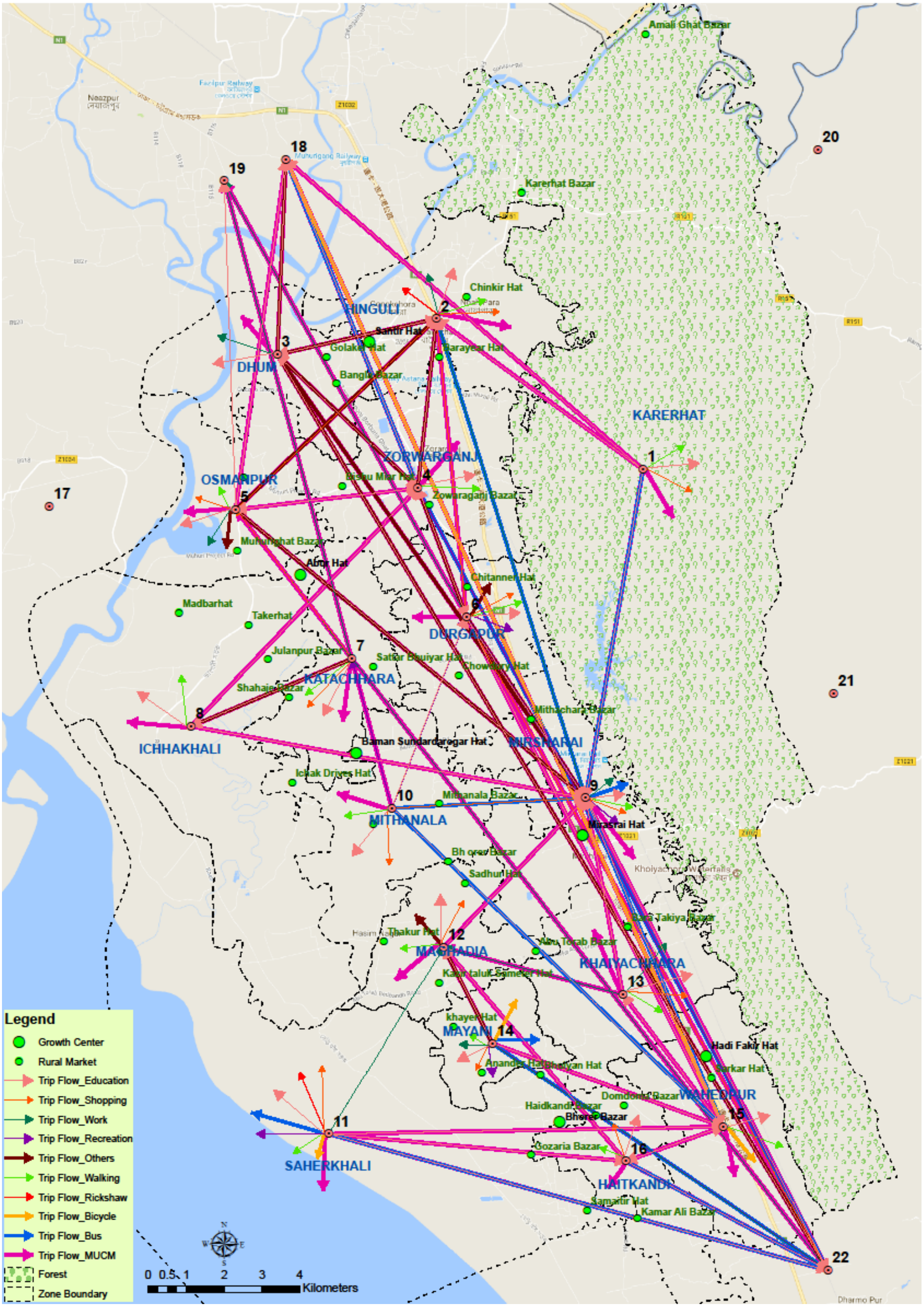


Figure 4.42: Trip Flow of Male Population, Mirsharai Upazila

Zone Name	Internal Trip (%)	External Trip (%)			
		Highest movement towards zones		Others Trip (%)	Total
		Trip (%)	Zone ID		
Karerhat	47	33	2	20	53
Hinguli	73	12	18	15	27
Dhum	19	28	2	53	81
Zorawargonj	36	27	2	37	64
Osmanpur	46	22	2 & 9	32	54
Durgapur	22	29	9	49	78
Katachhara	6	49	8	45	94
Ichhakhali	50	19	9	31	50
Mirsharai	93			7	7
Mithanala	35	21	6	44	65
Shaherkhali	71	13	22	16	29
Maghadia	61	25	9	14	39
Khaiyachhara	73	14	9	13	27
Mayani	60	14	12	26	40
Wahedpur	58	14	16	28	42
Haitkandi	53	19	22	28	47

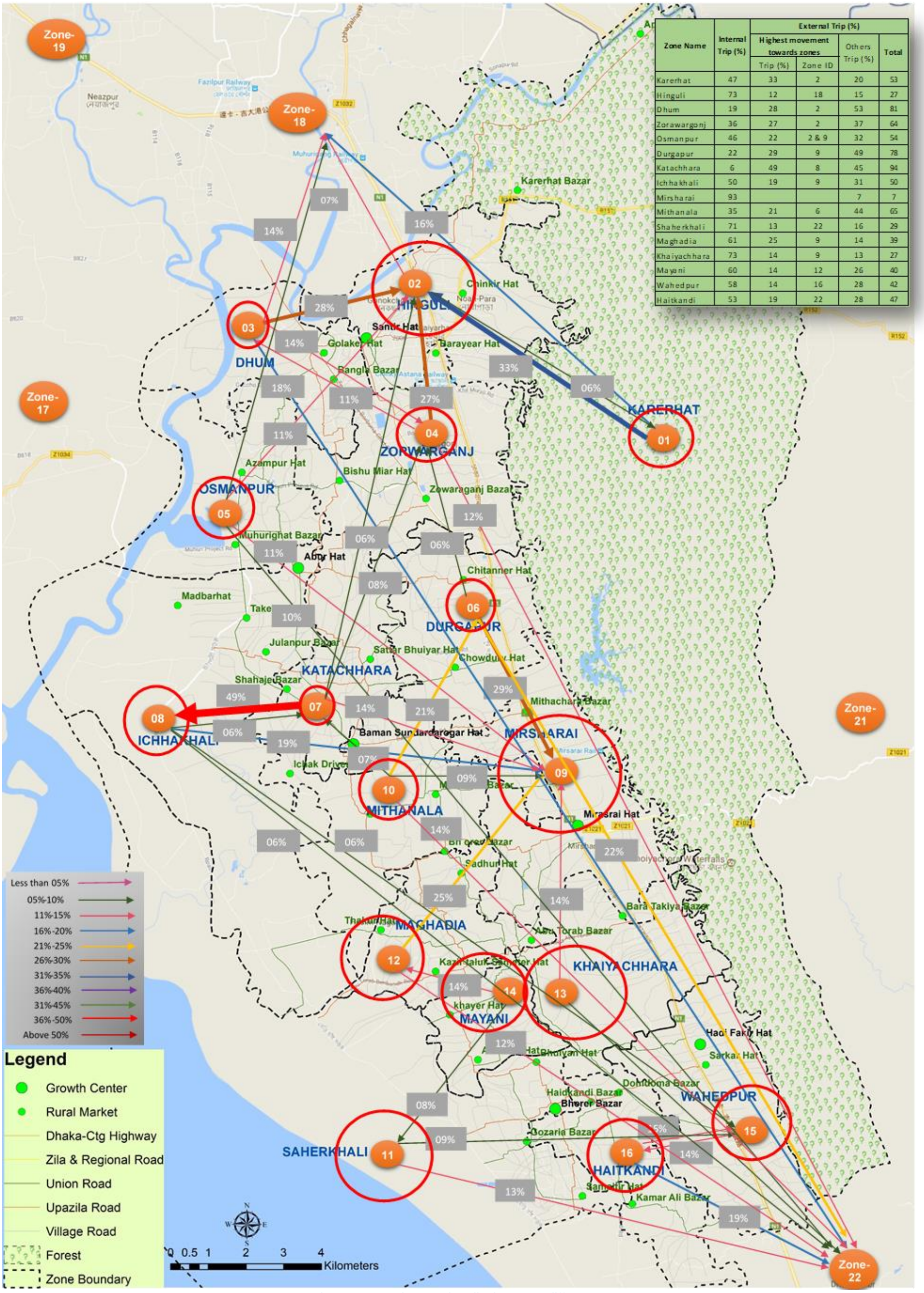


Figure 4.43: Trip Functionality between different zones

4.3.3 Roadside OD Survey

The roadside OD survey was carried out in both the external and internal survey stations along with the traffic count survey. However, for the internal locations only the peak hours were taken into consideration to obtain comprehensive OD information except for two internal stations; Muhuri Project Road (one of the access roads of EZ) and Shantir Hat (connecting Baraiyarhat intersection) where both peak and off-peak traffic were observed. The model will consider highest volume of traffic and so the OD matrices are also prepared accordingly focusing the peak hours at different survey stations.

The Table 4.10 to Table 4.13 show the OD matrices for peak and off-peak hours of one external station (Baraiyarhat Foot Overbridge) and one internal station (Muhuri Project road). Similar tables for other stations are given in Appendix C. From the internal OD matrices, it can be observed that trips are mostly within the zone and in between adjacent zones. As seen from the Household OD survey, this can be easily explained as the trips are mostly educational, shopping and work trips and the local people usually do not have to travel distant places for these purposes. In case of the External Locations, different scenario was observed because those stations were located in roads serving regional connectivity; National & Regional Highways and Zilla road. The OD matrices for all the external stations are however not the same. It is explained below:

Baraiyarhat Foot Overbridge and Boro Darogar Hat: These two locations are situated at the entry and exit points of the study area both on the Dhaka-Chittagong National Highway (N1); therefore the OD matrices for these two stations show similar characteristics mainly having External-External trips. The highest OD pair is between Dhaka (Zone ID: 19) and Chittagong (Zone ID: 22) Zones. Several Internal-External movement are also seen.

Baraiyarhat Rail Crossing: this station is located on the regional highway (R151) connecting Khagrachhari district with the National Highway. Therefore, a major portion of the traffic is from that region travelling to distant parts of the country. However, from the matrix it is evident that even in this external point, the highest trips are made within the zone. This may be because people usually move using the available short distance MUCM and for goods, a large portion of the truck traffic is using an alternate route for some reason. Also, there are few bus services along this route.

Mirsharai Stadium: this station is located on the Zilla road (Z1021) connecting Fatikchhari Upazila (Khagrachhari) with Mirsharai. On the contrary, the survey shows that the road serves very few external trips because of its narrow width and congested opening. In addition, this road is restricted for heavy traffic and thus no trucks and buses can enter this road.

Table 4.10: Origin-Destination Matrix: Location- Baraiyarhat Foot Overbridge (Peak Hour)

Origin	Destination																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																						5	
2	5	50				10			5													10	
3																							
4																							
5		5							5														
6																							
7																							
8																							
9	5	5							5													5	
10																							
11		5																					
12																							
13																							
14																							
15																							
16																							
17									5													95	
18	25	150							35				5						5	40		260	
19	5	15							10				10			5			5	10		415	
20																							
21																							
22																				5		5	
23																							

Table 4.11: Origin-Destination Matrix: Location- Baraiyarhat Foot Overbridge (Off-Peak Hour)

Origin	Destination																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																						4	
2	4	40				8			4													8	
3																							
4																							
5		4							4														
6																							
7																							
8																							
9	4	4							4													4	
10																							
11		4																					
12																							
13																							
14																							
15																							
16																							
17									4													75	
18	20	118							28				4						4	32		204	
19	4	12							8				8			4			4	8		325	
20																							
21																							
22																				4		4	
23																							

Table 4.12: Origin-Destination Matrix: Location- Muhuri Project Road (Peak Hour)

Origin	Destination																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																							
2																							
3				26																			
4		26		52		6		6	6													11	
5		57	6	170		6		6	11				6		6				6		6	42	
6																							
7																							
8		11		42	6																		
9		6																					
10																							
11																							
12				6																			
13																							
14																							
15																							
16																							
17				6																			
18		6																6					
19				26	6																		
20																							
21																							
22		6																					
23																						6	

Table 4.13: Origin-Destination Matrix: Location- Muhuri Project Road (Off-Peak Hour)

Origin	Destination																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1																							
2																							
3				11																			
4		11		22		3		3	3													5	
5		24	3	72		3		3	5				3		3				3		3	18	
6																							
7																							
8		5		18	3																		
9		3																					
10																							
11																							
12				3																			
13																							
14																							
15																							
16																							
17				3																			
18		3																3					
19				11	3																		
20																							
21																							
22		3																					
23																						3	

4.4 Travel Time Survey

The consultant's survey team has carried out the travel time study for 7 routes within Mirsharai Upazila. The detailed methodology and the description of the selected routes are already described in **Section 3.4**. The table below demonstrates the travel time (hour), total distances covered (km) and average speed (in km/ hr) of each route.

Table 4.14: Findings from the Travel Time Survey

Route No.	Total travel time (hour)	Total distance (km) (from GIS map)	Average Speed (km/ hr)
Route 1	2.20	43.39	20
Route 2	Inaccessible via passenger car due to bad road condition		
Route 3	0.28	4.54	16
Route 4	Inaccessible via passenger car due to bad road condition		
Route 5	1.23	14.39	12
Route 6	0.43	9.46	22
Route 7	0.38	7.42	19

However, the team could hardly access two of the 7 study routes- Route 2 and Route 4; and those data are not shown in the table as due to poor road condition it was not possible to travel using a passenger car. The total distance of Route 2 is 6.51 km (calculated from GIS). The survey team only could access the route from Maulavi bazar to Brindabonpur travelling 9 min. In case of route 4, the team could travel from Thakur dighi bazar to Julanpur bazar within 24 min, however, could not access further due to bad road condition. The distance of entire route is 11.53 km (calculated from GIS) and the survey vehicle could travel only 7.71 km approximately.

The average travel speed for different routes varied between 12 kph to 22 kph with Route 6 having highest speed and route 5 the lowest. The roads were observed to have narrow carriage width considering the requirements for two vehicles to pass side by side. The roads had several sharp turns as well. Also, the number of NMV is very high on these roads slowing down the motorized vehicles. The routes going through the bazar areas exhibited low travel speed automatically due to pedestrian movement across the roads and unauthorized parking of CNG/ Auto-rickshaws encroaching the road.

For better understanding a graphical presentation has been given in Figure 4.44.

Figure 4.44: Speed and Travel Time in different routes

4.5 Stakeholder Interview

From the stakeholder interviews conducted with various stakeholders has brought about the following findings/ requirements for a comprehensive transportation planning for Mirsharai:

Widening of the Mirsharai-Fatikchhari Road (Z1021) is important for improved regional connectivity
The Regional Highway R151 connects the Ramgarh Land Port and needs improvement (particularly risky bailey bridges)
Accommodation of good drainage system along with road design to eradicate flooding in municipal areas
Increased and safer accessibility to and in between the tourist spots to be ensured to attract foreigners
Provision of Parking facility in the tourist spots
A flyover at Baraiyarhat intersection can reduce congestion & facilitate EZ traffic movement to Ramgarh Land Port
Possible options could be there for accessing the EZ sites; which are (i) Hinguli-Santir Hat-Dhum-Azampur Hat-Muhurighat Bazar-EZ Embankment; (ii) Zorwarganj-Bishu Miar Hat- Azampur Hat-Muhurighat Bazar-EZ Embankment; (iii) Mithachhara to Embankment via Baman Sundar Hat GC; (iv) Thakur Dighi Bazar to EZ embankment through Chowdury Hat and Julanpur Bazar (Ichhakhali) (v) Dhumghat bridge-Golakar Hat-Azampur Hat to EZ via Muhurighat Bazar
Widening is required for the municipal (LGED) roads to eradicate traffic congestion
The Zorwarganj-Borburia Ghat Road can be reconstructed with a bridge across the river Feni to connect with the national highway with EZ bypassing the Baraiyarthat intersection
Better access to public transport and walking facility for the local people
Designated terminals for public bus, pick-ups, rent-a-cars, and other UCMs/ NMVs
To avoid accidents pedestrian's safety has to be ensured with necessary facilities and law enforcement
All the traffic will be using roadways and the cargos have trips from different ports mainly from Chittagong Port
A rail alignment is required passing through the EZ such as Fazilpur- Mirsharai Economic Zone-Sitakundo

5 CONCLUSION

The main purpose of the project is to develop land use integrated new and improved affordable and effective transportation network for Mirsharai Upazila using modern transportation modelling software after a thorough traffic survey carried out in the project area. To fulfill the purpose, Urban Development Directorate (UDD), the Client has taken initiatives and vested DevConsultants Limited (DevCon), Bangladesh with the responsibilities of required consultancy services. On the way of the mission and up to submission of the Inception Report, the consultants have finalized the project start up activities, identified and reviewed the secondary sources for data collection, shortlisted and discussed with the primary stakeholders, and reviewed ongoing as well as future projects having impact on the study area, developed traffic survey design & basic methodology for the assignment. In addition, a preliminary transportation network has also been proposed combining all these data and information available for now.

Since the submission of the Inception Report, the following progresses have been made:

• *Stakeholder Consultation:* After submission of the last two reports, comments and suggestions were obtained from the major stakeholders present in the TMC meeting in field of the transportation planning of Mirsharai.

• *Survey Activities:* Five types of survey were conducted in the study area which are as follows (further details available in Chapter 2):

i. Household Interview Survey (16 zones, 296 samples, 4 days)
ii. Attraction Survey (8 locations, 4 days)
iii. Traffic Count Survey (10 stations- 4 External & 6 Internal, 5 days)
iv. Origin-Destination (OD) Survey (Household OD- 296 samples; Roadside OD- peak/ off-peak hours)
v. Travel Time Survey (7 Routes throughout Mirsharai)
vi. Stakeholder Interviews (Primary and Secondary Stakeholders)

• *Data Analyses:* The survey data were analyzed and the detailed analyses can be found in Chapter- 4.

• *Works to Follow:*

- A larger scale Household Survey sampling from the socio-economic survey database; for a better understanding and presentation of the trip making behavior of local people, present condition of walking as a mode and access to public transports.
- A traffic count survey at Dhaka EPZ will be conducted in order to find a similar peak hour factor for Mirsharai EZ and to estimate the daily traffic volume.
- A meeting comprising BEZA, UDD and their consultants to coordinate and plan for a integrated masterplan for Mirsharai and the Economic Zone.