International Journal of Transportation Engineering and Traffic System
eISSN: 2456-2343
Vol. 4: Issue 2
www.journalspub.com

Analyzing the Impact of Land Use and Roadside Informal Activity on Transportation System: A Case Study in Rajshahi City Corporation, Bangladesh

Mahamudul Hasan[1,], Bishal Ganguly[1], Saadman Reza Chowdhury[1], Golam Asif Rahman[1], Samiul Sami[1], Joynob Sultana[1], Abdulla-Al Kafy[2], Anutosh Das[3]*

[1]Undergraduate Student, Department of Urban and Regional Planning, Rajshahi University of Engineering and Technology, Rajshahi, Bangladesh

[2]GIS Analyst, Rajshahi Development Authority, Rajshshi-6203, Bangladesh

[3]Lecturer, Department of Urban and Regional Planning, Rajshahi University of Engineering and Technology, Rajshahi, Bangladesh

ABSTRACT

Land use involves a management and modification of natural environment. Regulating land use in an efficient way is an important term in the urban planning. This study is based on land use pattern of Rajshahi city corporation area in Bangladesh. This study seeks to find out the impact of change in land use pattern over the overall transportation system. Another major objective is to find out the change in road width and shrinkage of pedestrian ways due to the roadside informal activities. The study was conducted in several phases including questionnaire survey, field observation, and analysis of field data and interpretation of the data. The research will act as a base study for implementing public transport mode like tram, bus in Rajshahi city, Bangladesh. To understand the impact of informal activity in Rajshahi city, this study will approach as a guideline.

Keywords: land use, informal activity, vendor's, carriage way

Corresponding Author
E-mail: hassan.ruet@gmail.com

INTRODUCTION

The transport system of Rajshahi city is a major issue at present. Various problems are linked with that issue. To provide an effective transport system, we need to identify the problems related to the transport system and land use, the study research is necessary. Land use is now not a minor term for assessing the impact of transportation (T. Litman & Steele, 2012). Classified land uses to determine the effect of the transportation system.

The influence of transportation research is becoming important and more frequently it should be main point of attraction for planning and developing land use pattern (Litman, 2012; T. Litman & Steele, 2012). At least, the transportation and land use require integrated facilities. Land use should be developed in an order, so that the transportation system remains well to use according to our demand. People need to access the opportunities, goods, service, education and other facilities, so the land use can make transportation viable for using. In a developing country like Bangladesh, the condition of road network works as an effective module to reduce the problems of the transportation system. The efficiency of roads can be gained through proper planning of land use. In order to prepare a proper transport planning and land use zoning in Rajshahi city, identification of land use impact on transportation system is necessary (Haque, Rahman, Khan, & Parvez, 2013).

Informal activities refer to the activities which are occurring for a period without approval. It may take place on the street, beside the street and on the footpath. Sometimes these types of activities occur for a long period or in that time when the place is busiest overtime (Gerxhani, 2004; Sibhat, 2014). Informal activity can be classified into some categories such as general merchandise, fabric, cloth etc. (Zheng, Zhang, Zhang, Li, & Ye, 2016). The business can be conducted for temporary or permanent period. If the activities are for the temporary period it does not create a long term impact for the roads and permanent period create long term effective impact on road side business activities. Sometimes the stalls cover all maximum portions of the footpath and carriage way length then it permits unfavorable space for the generated traffic(Okello, 2010).

To accumulate the impact, we need to find the road capacity and existing road volume of traffic. It is the normal practice to measure traffic on a road system. We convert the vehicle flow into equivalent passenger car unit by using equivalency factors. The flow is then expressed as PCU per hour or day (Kafy et al., 2018; Saha, Ahmed, Rahman, & Nahar, 2017). As our aim of the study is to analyze land use and roadside informal activity impact on the transportation system in Rajshahi City Corporation, so our first objective of the study is to identify the land use pattern of the city and second objective is to evaluate how the informal activity affects the effective roadway width. To conduct our first objective, we flow both the primary and secondary data set. Primary data collected through key informant interview/focus group discussion, questionnaire survey and secondary data collected from the master plan of Rajshahi city (2004). Simultaneously, we follow field observation, stakeholder survey technique to carry out our second objective.

METHODOLOGY

The research made use of both primary and secondary data and pertinent literature review. The secondary data was collected from various journals, reports, and the master plan of Rajshahi City Corporation of Bangladesh. For the primary data, a sample survey was conducted using a structured questionnaire on different land use. We classified the survey based on the categories of the land use. For six types of land use the sample size was different. Land area was not defined so we did not know the population time. For that reason, without residential and educational land use, we counted the total people passing through the road in one hour, and then we have made our sample size taking 10% confidence interval and 95% confidence level. By using the technique for different land use, we have calculated the sample size. For Padma residential area, commercial, industrial, medical, recreational land use the calculated sample size is accordingly 88, 42, 37, 44, 40. For educational land use we have considered 15 educational institutions and thus we have obtained the survey results.

Vehicle Volume Count

It is the normal practice to measure of traffic on a road system. We convert the vehicle flow into equivalent passenger car unit by using equivalency factors. The flow is then expressed as PCU/hour or day.

Design Capacity

To compare the design capacity with present traffic volume we have taken 12 feet width of the road per lane which can bear the volume of 1400 pcu/hour according to the standard (Bhattacharyya, 2009; Mohan & Chandra, 2018; Prothan, Islam, Rahman, & Pramanik, 2017).

Trip Rate Analysis

To find out the trip rate from different categories of land use, 6 hours survey has been conducted adjacent to the study area.

Total number of person entering in that land use and total number of persons going out is tallied out over the period of 6 hours. Then it is converted into the maximum and average hourly trip. To calculate the trip rate for average or peak period, gathered peak or average hour traffic at particular land use is divided by that land use area and convert it into 1000 square feet for determining hourly trip at 1000 square feet (Kafy et al., 2018; Prothan et al., 2017; Saha et al., 2017).

$$\text{Trip rate (Average/Peak hour traffic)} = \frac{\text{(Average /Peak hour traffic)x1000 square feet}}{\text{Land use area}} \quad (1)$$

LITERATURE REVIEW

To make the study resourceful, it is important to gather the information and knowledge about past studies on similar topic. This helps the study to fulfill the objectives by providing clear conceptions about the overall scenario. Before reviewing empirical evidence, it is useful to examine the theory behind landuse transport interactions (Clemett, Amin, Ara, & Akan, 2006; Mohan & Chandra, 2018; Rajshahi Development Authority, 2003; Rayle, 2008). Conceptually, the land use and transportation are two sides of the same coin (Litman, 2012; T. Litman & Blair, 2017; T. Litman & Steele, 2012). And together formed a complex set of interaction, where forces act within and upon the urban environment. The interaction between the land use and transportation is very much cyclic in nature. When transportation access to a parcel of land, the land becomes more attractive and is often developed for use, as land is developed, the greater amount of activity leads to an increase in travel demands. This increased demand, in turn, causes an overloading of the transport facilities responded to with a corresponding increase in supply (Litman, 2012; Okello, 2010). The cycle is then repeated.

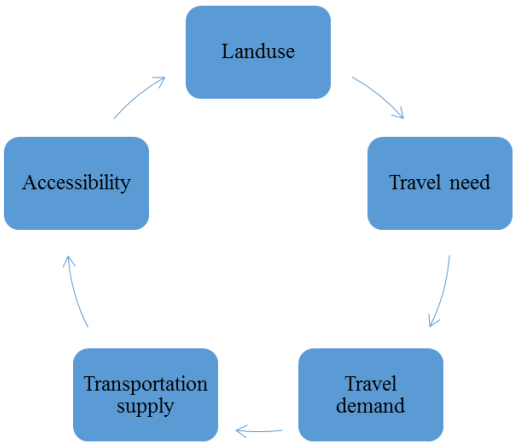

Fig. 1. *Land use and transport interaction.*

Several studies have been highlighted on this crucial issue. A study conducted by researchers Litman in 2008 revealed that various land use factors such as density, regional accessibility, mix, and roadway connectivity can have significant impacts on travel behavior with per capita vehicle travel, mode split, and nonmotorized travel (T. Litman & Steele, 2012). For evaluating the ability of land use policies such as Smart Growth, New Urbanism and Access Management to help achieve transport planning objectives that information is effective the paper is also examined. Another study was conducted by Still (2017) has explored that at the local authority (and structure plan) level there has been a very little study of the transport impacts on land use (T. Litman & Steele, 2017). The study finds that it is the certainly a rare case for land use responses to be formally examined and if so it is just a study not internalized into the development plan process. Zhang et al (2012) analyze, in Qixia District, Nanjing City, China as a typical urban-rural fringe area, the patterns and characteristics of land use change is identified using land use data from 2000 and 2008 along three major transportation arteries (Zhang, Pu, & Zhu, 2013). The study finds that construction land generally tends to be located close to major transportation arteries where railways have the most

obvious influence and expressways have a less significant impact on land use change in this (urban-rural fringe) area. Hu et al. (2016) highlighted on the land use features and amenities impact on public transport use. Results revealed that the amenity-related features are better predictors which suggest that high-resolution geo-information can provide more insights into the dependence of transit ridership on land-use (Hu, Legara, Lee, Hung, & Monterola, 2016). Litman examined that how transportation decisions affect land use patterns and result in economic, social and environmental impacts (T. Litman, 2016; Zhang et al., 2013).

The study also describes specific methods for evaluating these impacts in transport planning. In this study, the authors have tried to find out the result of informal activity, vehicle condition and transport facilities of different land use to the traffic. First objective of the study is to identify the impact of land use on the transportation system in Rajshahi City Corporation of Bangladesh. Firstly, the authors want to discuss the land use term. Land use also called the land development, spatial development, community design, urban design, cityscape or the built environment that refers to various land use factors, such as density, mix, connectivity and the quality of the pedestrian environment (Asif, Kafy, Sarker, Al-Fatin, & Hasan, 2018; Kafy et al., 2018; Prothan et al., 2017). Land use mix refers to the different types of land uses including residential, commercial, institutional, recreational, etc. This can occur at various scales, including mixing within a building (such as ground-floor retail, with offices and residential above), along a street, and within a neighborhood. Such mixing is normal in cities and is a key feature of new urbanism (Hu et al., 2016; Zheng et al., 2016).

Here land use is needed to identify clearly the impact on transport facilities. Land use categories have different emphasize on the transport system. Such as industries need more traffic if they need to cover the overall demand of our country and inter region. But, if the industries are only developed for meeting the demand of inters region and a few for outer regions then it does not need a large number of the vehicle. So, the vehicle pressure occurs lower impact on roads and another transportation system. And the educational institutions when attracting more students, it needs more traffic mode than the city belonging to that kind of institution needs more traffic vehicles than the other cities. If the city is operated as a divisional district it belongs a medical hospital for the treatment hospitality for the people. Usually, it exists as a large center of medical activity for outdoor and indoor activity, then it attracts vehicle in a large flow. The commercially and residentially developed areas are more attractive for the business and residents consequently. In center business districts the commercial activities are accomplished and for that, it creates large vehicular impacts on roads.

Because of rapid and unplanned urbanization, the threshold capacity of urban employment in urban areas exceeds its limits (Aguilar, 2008; Byomkesh, Nakagoshi, & Dewan, 2012; Rashidi, Mohammadian, & Zhang, 2010). Moreover, a large number of populations who are now coming in urban areas do not have sufficient education and skills to be engaged in urban formal employment, they ultimately involved in informal activities instead of returning to the rural sector (Dewan & Yamaguchi, 2009). Barmon, 2011 stated that informal business is profitable and sufficient enough to provide a daily livelihood for the engaged people (Barmon, 2011). Overall accumulation of capital for further expansion of business and to improve welfare, poverty reduction and generation employment this surplus income contribute much. Around 75.2% of the urban population engaged in the

informal economy (Clemett et al., 2006; Rajshahi Development Authority, 2003; Statistics, 2011).

Informal activities refer to the activities which are occurring for a period without approval. It may take place on the street, beside the street, on the footpath, parks, and pavements and within the shopping Centre; traders are choosing a place where easily visible to pedestrians and motorists (Mitullah, 2003). Traders use different structures such as mats, gunny bags, tables, racks, wheel barrows, handcarts and bicycle seats to display their goods (Mitullah, 2003). The other traders carry their commodities on their hands, heads, and shoulders). By considering its relative importance in employment creating and contributions to the economy, this sector is assumed at the core of today's economic and social system (Gerxhani, 2004). The urban informal sector in the public area of cities is particularly in street-based trading, which is commonly known as street vendors. Street vending is a major livelihood for the urban poor in developing countries (Bhowmik, 2005; Byomkesh et al., 2012). Tea and food stalls, mobile vending including artwork/pottery, cloths, and small stationary things are the most common type's street vendors in an urban area (Tinker, 1997). Ignoring the formal rule these vendors provide goods and service to satisfy needs and demands of urban consumers and to sustain their livelihood (Etzold, Hossain, & Rahman, 2014). These street enterprises are not paid tax, not registered and they involve very visible structures (Sibhat, 2014).

Generally, these activities can be conducted for temporary or long periods. If the activities occur for the temporary period, it does not create a long term impact for the roads. But if these types of activities occur for a long period or in that time when the place is busiest overtime, it covers all maximum portions of the footpath and carriage way length then it permits unfavorable space for the generated traffic. Previously both land use impact on the transportation system and informal activity has been examined separately. But none of the studies have been conducted considering both subjects jointly. In this perspective, the present study focuses on the impact of the landuse and roadside informal activity in the context of road capacity, effective road width and footpath condition in Rajshahi City Corporation of Bangladesh.

ANALYSIS

In the analysis section the discussion will be conducted the impact of land use on the transportation system and evaluate how informal activity affect the effective roadway width in Rajshahi City Corporation of Bangladesh.

Saheb Bazar Zero Points to Rail Gate Road Comparison (2004–2017).

Zero point to rail gate road is the, main development core. Newly constructed road is quite linear caused the linear urban development. With the pace of time demand increased and roadside land use development also increased. To cope with the increasing demand the road pattern have been changed in linear than previous zigzag pattern (Figure-2 and Figure-3).

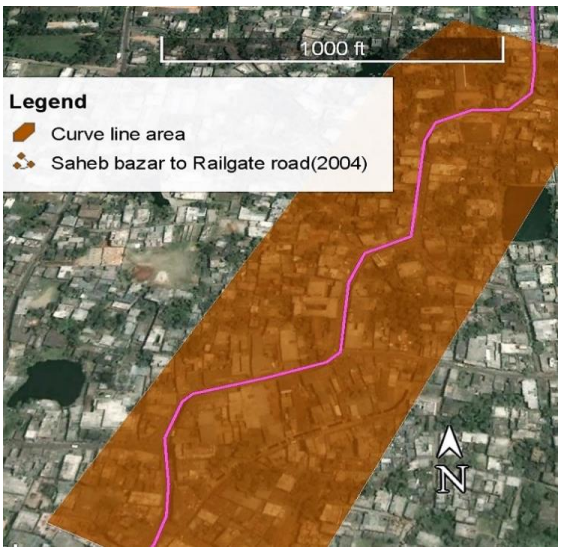

Fig. 2: *Map 2004.*
(Source: Google Earth Pro, 2017)

Fig. 3: *Map 2017.*

Roadside Land Occupancy (Zero Point to Rail Gate)

From Zero point to rail gate in case of commercial and mixed use land occupancy increased 21% and 4% respectively. Educational remains the same, but the residential land occupancy decreased 25% between 2004–2017 year (Table-1).

Due to locational advantage in this route commercial and mixed use both growing. Residential building turned in mix use like ground floor use for wholesale and retail purpose.

Design Capacity and Calculated Road Traffic

In Alupotti to Moni chottor road the average traffic is more than the total capacity because the route is a main connector of the heart for economic activity in Rajshahi city. This zone of Alupotti to Moni chottor attracts the main commercial activity. People need to come towards the road for taking the advantages of modern facilities related to business. After moderating the road after 2007, the total capacity has been increased to 2800 PCU/hr (Table-2). So, zero point to rail gate has become much enough to bear the average capacity. For establishing preferable journey facilities in railways and bus, the railway station and bus terminal have been become the center of action for travelling. Thus, the zero-point to rail gate road has obtained the importance of development. After the development the road attracts more traffic. Many of the brand shops have chosen their business activities alongside this road. Padma residential is the selected residential area.

Table 1. *Road side land occupancy*

Land use	2004(%)	2017(%)
Mix use	22	26
Residential	43	18
Commercial	31	52
Industry	1	0
Educational	1	1
Religious	2	3

(Source: Field Survey, 2017 and Master Plan, 2004)

Table 2. *Design capacity and calculated road traffic for different types of land use.*

Land use	Peak hour PCU/Hour	OFF Peak hour PCU/Hour	Average PCU/Hour	Standard Capacity
Alupotti to Moni chottor (commercial)	4573	1528.5	4052.75	2800
Zero Point to Rail gate (Commercial)	2576	456	1345.4	2800
Padma Residential Area	3120	770	1957.6	1400
Padma Garden (Recreational)	1298	27	387	1166.67
Medical Road	2755	390	1849.4	2800
Industry (Sapura)	510	260	385	1866.67

(Source: Field Survey, 2017; Author).

The average capacity of that road is more than the designed capacity because the road of the Padma residential area is only one lane. Along with the residential buildings there are Baring medical college and hospital and bus dipo. Sometimes the road of Padma residential area is used to pass buses meanwhile the main Rajshahi-Natore highway is remaining restricted. Padma Garden is the major recreational spot in Rajshahi city but the traffic flow is significantly fluctuated. The average traffic is lower than the designed capacity. The road attracts traffic in a fixed interval on a day. People generally leave their vehicle mode before entering that road. And the road containing a width of 10 feet is enough to accommodate the generated volume. According to the conducted volume survey Medical road capacity is enough to accommodate the average daily traffic. The main width of the carriage way of the medical road is 12 feet and for two lane it is capable to accommodate 2800 PCU/hour, but it doesn't need to accommodate more than 2800 PCU/hour, so it is moderately good at the measurement of level of service criteria (Table-3). In spite of being an important city located on a river bank, industrial development in Rajshahi does not grow in a possible extent. That's why the average traffic flow is too much lower than the provided road. There is a highway towards the Naogoan Zila and it serves as a by-pass road. So the volume of traffic in that road is satisfactory.

Trip Rate for Different Types of Land Use

Trip rate in commercial area is highest being a core area of commercial activity. On the other hand industry is deprived of essential facilities having a low producing demand of goods. For that it attracts less traffic than others.

Table 3. *Average and highest hourly trip rate for different types of land use.*

Land use	Average Hourly Trip Rate (Per 1000 square feet)	Highest Hourly Trip Rate (Per 1000 square feet)
Residential	1.72	2.79
Commercial	6.92	10.69
Educational	4.78	7.45
Medical	5.62	11.2
Recreational	6.73	9.56
Industry	0.72	1.34

(Source: Field survey, 2017 and Master plan, 2004)

Finding the "Land Use Change Traffic" from the Present Traffic Volume and Trip Rate

During the time period (2004–2017) road from rail gate to zero point has been transformed to straight pattern from zigzag. For this reason the residential land use has turned into commercial. For the increasing in length of rail gate to zero point the trip rate has been increased. By changing time from Alupotti to Moni chottor road has become economically significant. So the more lands have shifted to commercial land use. From 2004–2017 the commercial area land use changed to 31 % to 52% (table-1) and by this time the hourly person trip increase to 1552.685.

Table 4. *Finding the induced traffic for commercial land area change.*

Road Name	Commercial Area (square feet) 2004	Commercial Area (sq.ft) 2017	Changed Area (sq.ft)	Trip Rate-In Peak (Per sq.ft/Per hour)	Total Person trip/hour
Rail Gate - Zero Point	117333.65 (31.06%)	198655.29 (52.58%)	81321.63 (21.23%)	0.012967186	1054.512
Alupotti-Moni chottor	121214.04 (43.67%)	183527.84 (51.99%)	62313.82 (8.32%)	0.024917195	1552.685
Both way(average)	238547.69	382183.15	143635.6	0.018942191	1303.599

(Source: Field survey, 2017 and Master plan, 2004).

Future Traffic Forecasting

Natural growth traffic is derived from annual growth rate. Annual traffic volume growth rate of Rajshahi City Corporation is 5.1 % (Rajshahi Development Authority, 2003). For forecasting traffic volume for the year 2021, the traffic volume data of 2004, 2011 and 2015 are used. Only peak hour volume data have taken into account for forecasting future traffic volume. This highest data have been found during 5:00 PM to 6:00 PM. In Rajshahi City Corporation, we have got projected traffic 24098 PCU/hr in 2021 (Table-4 and Figure-4).

Don't use the same title in Figurers and caption. Remove the title of the Figurers which will enlarge the Figurers. Informal activity is a generator of informal economy. In this study, the informal activities alongside the roads of Rajshahi City Corporation have been considered as an indicator of problem creator. Informal activities in Rajshahi City Corporation area are basically categorized in three major categories (General merchandise, Craft/Artwork/Pottery, Cloths). These three categories are divided into sub-categories according to the activity of vendors. Vendors are basically the generator of informal activities in Rajshahi city. Vendors are also being classified into two category (Permanent vendors, Temporary vendors).

Vendor's Activity

According to the field observation survey, the occupied and non-occupied area for informal activity by vendors were determined by the percentage of area occupied and non-occupied. The total occupied area by vendors was found 91% of the total area (Figure-5).

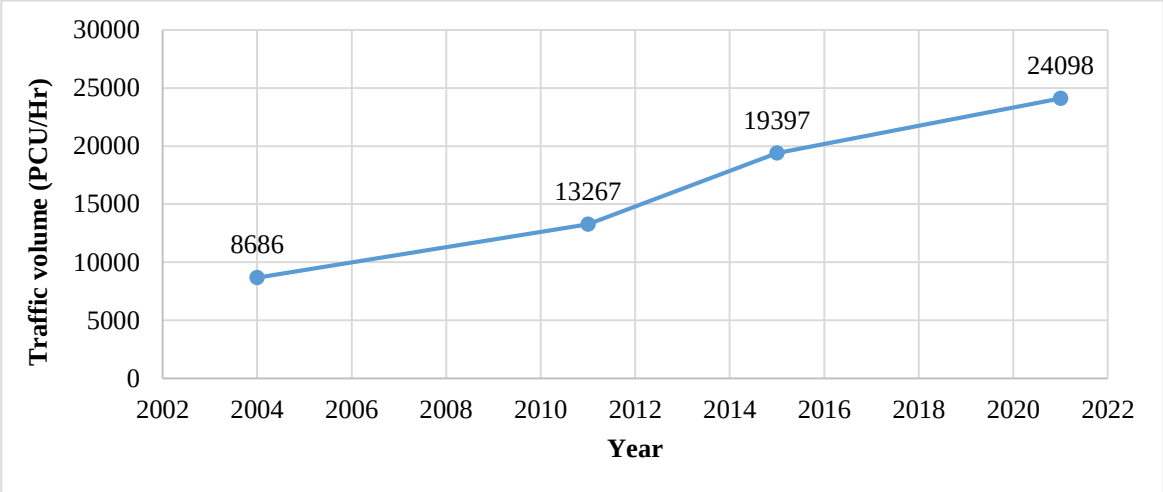

Fig. 4. *Forecasting of traffic volume in 2020.Source: (Haque et al., 2013)*

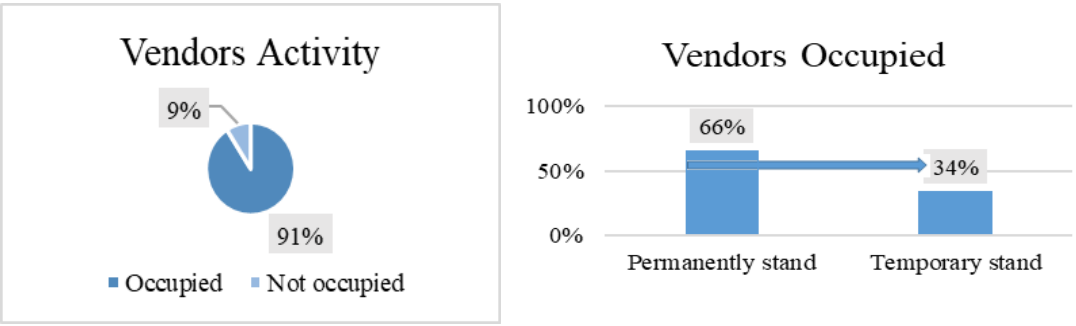

Fig. 5. *Vendors activity and occupied area.*
(Source: Field Survey, 2017; Author)

According to the study he permanently stand vendors seat on the foot path and temporary stand vendors seat on the shoulder of carriage way. Due to the foot path blockage by permanently stand vendors people tend to use carriage way rather using footpath. This consequence is because of the shrinkage of foot paths by vendors.

In case of temporary stand, vendors do their activity on shoulder of carriage way. Due to this kind of activity, shrinkage of carriage way occurs.

Fig. 6. *Footh path informal activity.*

Fig. 7. *Existing road situation.*

Another terrible effect of temporary vendors is over the parking facility. From the visual observation over the selected roads, it is found that due to temporary stand of vendors over shoulders auto-rickshaws and rickshaws stand on the carriage way which causes huge traffic congestion and interruption on the traffic flow (Figure-6 & 7).

Vendors Category

From the field observation vendors are categorized in three major categories for this study,

- General merchandise,
- Craft/Artwork/Pottery
- Cloths

According to the analysis general merchandise is 71% of the overall vendors. General merchandise basically focuses on tea stall and stationary on the survey area. Generally a tea stall occupies around 30 inch of the footpath area where a footpath is around of 48–60 inch of width. The tea stall and stationary are set to and fro of the footpaths which cause an interruption on the pedestrian flow and causes discomfort for the pedestrians. This situation push the pedestrians to walk on the carriage way. Again, a permanent vendor of garment products occupies 17% of the total vendors. They block around 67–75% of the total width of footpath as they consume around 40–45 inch of the total width of the foot path. This situation causes an interruption of pedestrian flow and push the pedestrians to walk on the carriage way.

Time Period Occupied by Vendors

Considering customers' availability vendors perform their activity on some fixed times. Like, From 12 AM–4:30 PM,10 AM–8 PM,8 AM–4:30 PM (Figure-8).

From the analysis it's been stated, the informal economy on an overall scenario gets hyped in between the time 10 AM–8 PM. This time period is considered as their perfect selling time and customers also gets available (Figure-9).

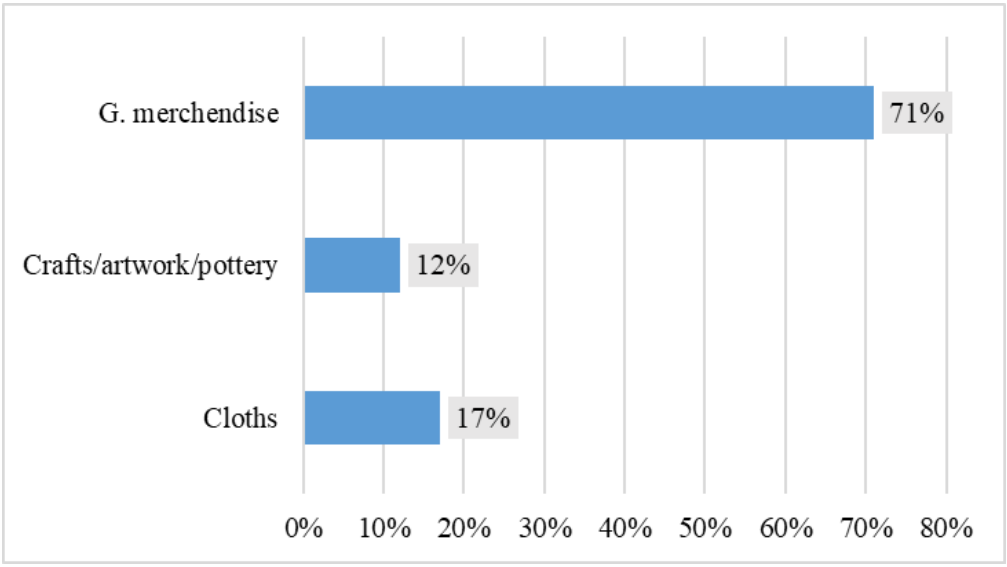

Fig. 8. *Vendor's category.*

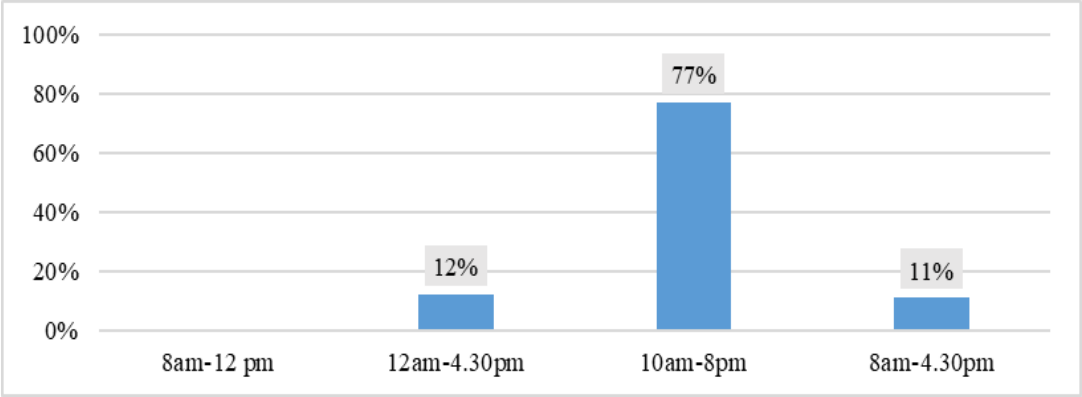

Fig. 9: *Time period occupied by vendor's.*

Client Types and Location Choice Factor

The client types found 59% for pedestrians, 5% for residents and 36% vendors responded for both pedestrians and residents. As more than half of the total percentages of the clients were found to be pedestrians, it can be easily said that vehicle flow is mostly interrupted by pedestrians due to unorganized vendors' activity over foot paths and shoulders (Figure-10).

Vendors generally seat on places where they can easily get in contact with public. Due to be center of business activity and customer availability vendors with low capital chose these places. The roads are generally crowded due to be center of business activity. But due to vendor's activity the roads get overcrowded and affect the road capacity as the road capacity is designed is keeping in consideration the crowd due to normal business capacity (Figure-11).

Causes and Hindrance

According to the most of the vendors response there is no hindrance on doing activity over footpath or shoulder, as there is almost no hindrance on performing vendors activity on these roads. Vendors with low capital and economic insolvency chose these roads of RCC to perform their activity (Figure-12).

Rather than other land use sections, residential area holds the most reason to generate a trip. Most of the people have the tendency of choosing Auto rickshaw people consider time before choosing their mode.

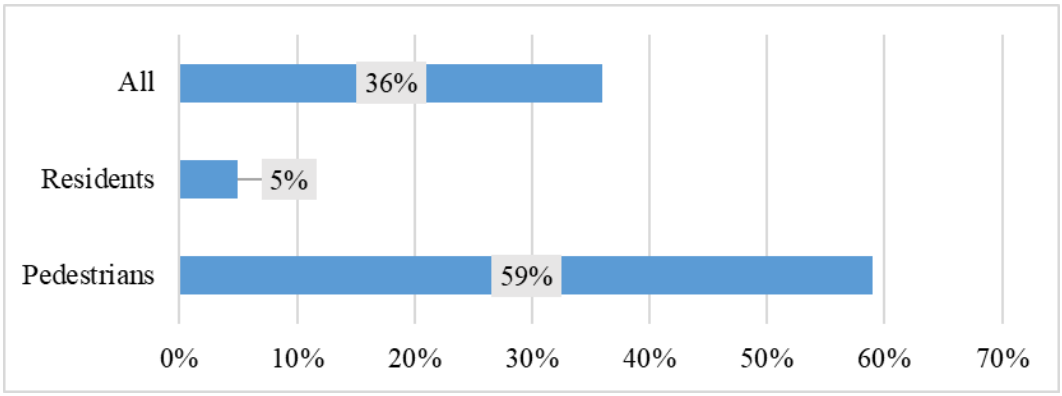

Fig. 10: *Client types.*

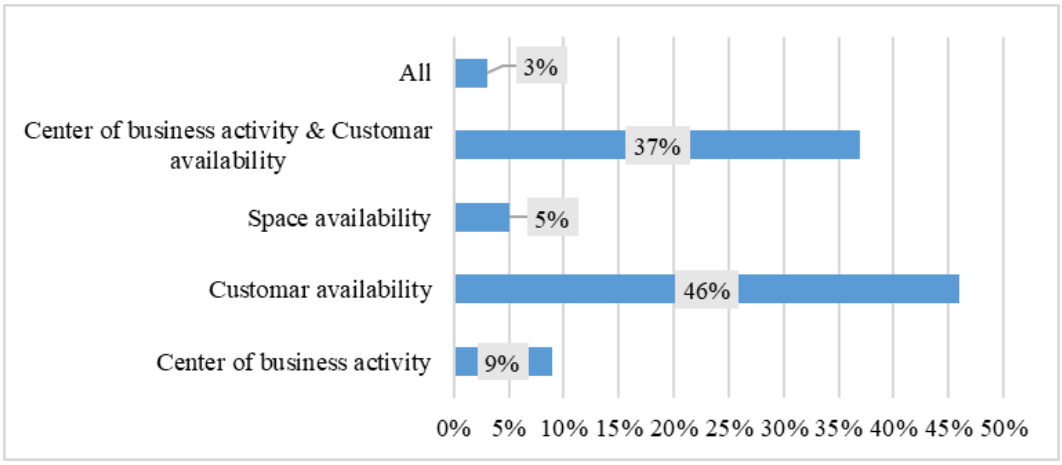

Fig. 11. *Location choice factor.*

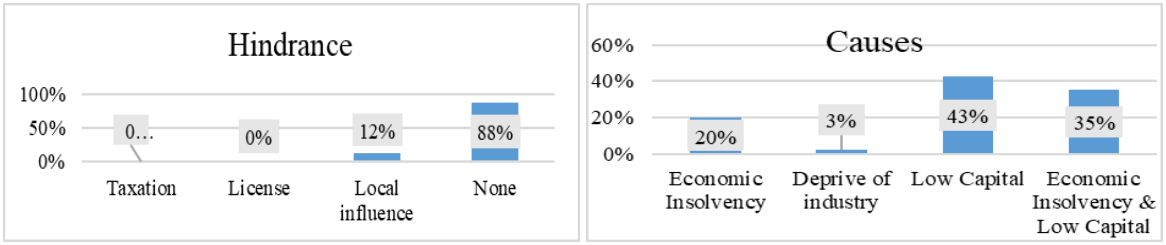

Fig. 12: *Vendor's causes and hindrance.*

FINDINGS

Those who consider time, mostly use private car and auto rickshaw. Trips include recreational, shopping, restaurant etc. For medical land use, due to unavailable parking place maximum number of traffic are affected congestion in the peak period. The parking on street covers most of the carriage way length in maximum times. There are no facilities of parking inside the Rajshahi Medical College and hospital. It also blocks the footpath. People need to use the main carriage way. For that it creates a large impact on transport over the peak time. For industrial land use, two board categories industry in Sapura. Rajshahi district is famous for cocoon and silk fabrics. These industries contribute 48% in trip generating weekly or monthly basis. Maximum industries trip generate according to demand. For recreational land use around 50% visitors prefer to use Boro Mosjid road. Most of them visiting cause is time passing. Auto share 52% of total transport system and 28% are Rickshaw.

Most of the people visit on weekend or public holiday. Most of the trips among educational institution are generated from Rajshahi University. Educational institution and dormitory are the dominating sector for generating trips in the study area. Traffic congestion slightly occurred at 9AM to 10AM and also at 4PM to 5PM in the study area. Besides educational purpose about 53% of trips are generated for recreation and food purpose. For commercial land use in most of the roads there are no specific parking spaces for the vehicles which carry the commercial goods. Their parking period is in peak time and the duration is less than 2 hours. For that smaller vehicle such as rickshaw needs great time to pass Alupotti to Moni chottor roads? They park most time in carriage way blocking the continued flow of vehicle.

By analyzing the vendor's activity as informal activities in the study area we obtained vendors stand on footpath and shrinkage footpath width. Shrinkage of carriage way is caused due to informal activity by temporary vendors. Interruption on the traffic flow due to vendors' activity and pedestrian movement over the carriage way is mostly caused by temporary vendors. Due to the use of carriage way by pedestrians to move, the normal flows of vehicle get interrupted which keep effect on the road capacity. Most of the problems occurred by vendors in between 10AM–8PM. The roads are generally crowded due to being center of business activity. But due to vendors activity the roads get overcrowded and affect the road capacity as the road capacity is designed is keeping in consideration the crowd due to normal business capacity. Due to having no hindrance vendors' activity is increasing to and fro. Again, on the turning point of roads, floating vendors are performing the activity. This is causing road accidents too and radius to turn vehicle is decreasing too.

Recently the government has taken steps to decentralize the Capital of Bangladesh to some selected divisional area. For that government needs to moderate the transportation system of those areas. Rajshahi is one of them. To make a sustainable city developing the transport facilities we need to consider the execution of terms related to transport problems. There is no doubt that improper distribution of land use is a major issue of Rajshahi transportation problem. Informal activity during the peak hour also creates a burden pressure to the existing traffic. It is one of the major issues which are needed to be controlled with a high importance.

ACKNOWLEDGEMENT

The authors are grateful for the continuous support and supervision particularly to Anutosh Das (Lecturer of the Department of Urban and Regional Planning, RUET). Such research work is only possible with the helpful and supportive mind of our surveyors, thanks to Joynob sultana, Golam as if Rahman and Samiul Islam. Additionally, we thank Abdulla - Al Kafy, GIS Analyst, Rajshahi Development Authority, Rajshshi-6203, for updating and monitoring the study.

REFERENCES

[1] Aguilar, A. G. (2008). Peri-urbanization, illegal settlements and environmental impact in Mexico City. *Cities*, *25*(3), 133-145.

[2] Asif, M. I., Kafy, A.-A., Sarker, D., Al-Fatin, S. A., & Hasan, M. M. (2018). Efficient Utilization of Urban Fringe Area for Smart Urban Growth with Proposed Compact Township Design: A Case Study in Pabna District, Bangladesh. *Urban Studies and Public Administration, 1*(2), 150.

[3] Barmon, B. K. (2011). Expenditure patterns of some informal sectors in Bangladesh: an empirical evidence of Dhaka city. *Bangladesh Journal of Agricultural Economics, 34*(1/2), 103-118.

[4] Bhattacharyya, S. K. (2009). *Highway embankment design in Bangladesh.* University of Birmingham.

[5] Bhowmik, S. K. (2005). Street vendors in Asia: a review. *Economic and political weekly*, 2256-2264.

[6] Byomkesh, T., Nakagoshi, N., & Dewan, A. M. (2012). Urbanization and green space dynamics in Greater Dhaka, Bangladesh. *Landscape and Ecological Engineering*, *8*(1), 45-58.

[7] Clemett, A., Amin, M. M., Ara, S., & Akan, M. M. R. (2006). Background Information for Rajshahi City, Bangladesh. *WASPA Asia Project Report*, *2*, 1-29.

[8] Dewan, A. M., & Yamaguchi, Y. (2009). Land use and land cover change in Greater Dhaka, Bangladesh: Using remote sensing to promote sustainable urbanization. *Applied Geography*, *29*(3), 390-401.

[9] Etzold, B., Hossain, M. A., & Rahman, S. (2014). Street Food Vending in Dhaka: Livelihoods of the Urban Poor and the Encroachment of Public Space.

[10] Gerxhani, K. (2004). The informal sector in developed and less developed countries: a literature survey. *Public choice*, *120*(3-4), 267-300.

[11] Haque, B., Rahman, M., Khan, A. S., & Parvez, M. (2013). Impact of land use parameters on household travel behavior. *American journal of civil engineering and architecture*, *1*(4), 70-74.

[12] Hu, N., Legara, E. F., Lee, K. K., Hung, G. G., & Monterola, C. (2016). Impacts of land use and amenities on public transport use, urban planning and design. *Land Use Policy*, *57*, 356-367.

[13] Kafy, A.-A., Ferdous, L., Poly, S. A., Arafat, M., Monira, S., Rahman, M. S., . . . Ahmed, T. (2018). Estimating Traffic Volume to Identify the Level of Service in Major Intersections of Rajshahi, Bangladesh.

[14] Litman. (2012). Evaluating Transportation Land Use Impacts Considering the Impacts, Benefits and Costs of Different Land Use Development Patterns. *Victoria Transport Policy Institute.*

[15] Litman, T. (2016). Evaluating transportation land use impacts: considering the impacts, benefits and costs of different land use development patterns.

[16] Litman, T., & Blair, R. (2017). *Managing personal mobility devices (PMDs) on nonmotorized facilities*: Victoria Transport Policy Institute.

[17] Litman, T., & Steele, R. (2012). Land use impacts on transport: How land use factors affect travel behavior: Victoria Transport Policy Institute Victoria, BC., Canada.

[18] Litman, T., & Steele, R. (2017). *Land use impacts on transport*: Victoria Transport Policy Institute.

[19] Mitullah, W. V. (2003). Street vending in African cities: A synthesis of empirical finding from Kenya, Cote d'Ivoire, Ghana, Zimbabwe, Uganda and South Africa.

[20] Mohan, M., & Chandra, S. (2018). Three methods of PCU estimation at unsignalized intersections. *Transportation letters*, *10*(2), 68-74.

[21] Okello, O. H. (2010). *The Effects of Informal Activities in The Road Reserve on The Transport System: The Case of Juja Road, Nairobi.* University of Nairobi.

[22] Prothan, J. I. J., Islam, M., Rahman, A., & Pramanik, A. (2017). Transportation System Analysis at the Major Road Intersection in the CBD Area of Rangpur City, Bangladesh. *International Journal of Transportation Engineering and Technology*, *3*(4), 74.

[23] Rajshahi Development Authority, G. o. t. p. s. r. o. B. M. o. H. a. P. w. (2003). Preparation of Structure Plan, Master Plan and Detailed Area Plan For Rajshahi Metropolitan City : Working Paper on Transport

[24] Rashidi, T., Mohammadian, A., & Zhang, Y. (2010). Effect of variation in household sociodemographics, lifestyles, and built environment on travel behavior. *Transportation Research Record: Journal of the Transportation Research Board*(2156), 64-72.

[25] Rayle, L. (2008). Tracing the effects of transportation and land use policies: A

review of the evidence: MIT Portugal Program-Transportation Systems Focus Area.

[26] Saha, A. K., Ahmed, B., Rahman, M., & Nahar, T. T. (2017). Analysis of Traffic Congestion and Remedial Measures at Traffic Mor in Pabna City, Bangladesh. *Biography Md. Jakirul Islam Jony Prothan graduated from Pabna University of Science and Technology (PUST), Pabna, Bangladesh in Urban and Regional Planning in*.

[27] Sibhat, E. E. (2014). *Cause and effect of informal sector: the case of street vendors in Addis Ababa, Ethiopia*.

[28] Statistics, B. B. o. (2011). Population and housing census 2011.

[29] Tinker, I. (1997). *Street foods: Urban food and employment in developing countries*: Oxford University Press.

[30] Zhang, R., Pu, L., & Zhu, M. (2013). Impacts of transportation arteries on land use patterns in urban-rural fringe: A comparative gradient analysis of Qixia District, Nanjing City, China. *Chinese geographical science, 23*(3), 378-388.

[31] Zheng, Y., Zhang, J., Zhang, G., Li, L., & Ye, B. (2016). *Survival Analysis on Passing Time of Minor Vehicle's Road Crossing at Un-Signalized Intersection in China*. Paper presented at the International Conference on Green Intelligent Transportation System and Safety.