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Operational Characteristics of Paratransit in Medium-sized City: A Case Study on E-rickshaws in Rangpur City, Bangladesh

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Abstract

Paratransit often provides demand responsive and flexible transport service. Due to lack of formal public transport or mass transit system, particularly in medium or small-sized cities in Bangladesh, people are mainly dependent on paratransit for their mobility. The purpose of this paper is to provide operational characteristics of E-rickshaws (battery operated three wheelers) in urban transportation of Bangladesh. Questionnaire interview of 397 drivers of E-rickshaws in Rangpur city as well as a Focus Group Discussion (FGD) with the owners and members of the association of E-rickshaws were conducted for collecting data regarding physical and operational characteristics. Compared with other modes such as rickshaws, auto-tempo or minibus, E-rickshaws provide several benefits to the passengers. It was found that most of the E-rickshaw operators tend to make short trips only within the city. The average daily income generated by E-rickshaw is Tk 850 and income-expenditure ratio for the driver-owned operating E-rickshaw is 1.45. The findings of this paper may help the government and relevant agencies to formulate policy guidelines for the paratransit, especially when the mass transit system is on the transport planning menu.

Introduction

The concept of paratransit differs in the context of developed and developing countries (Vuchic, 1981). In developed countries, paratransit is defined as the full range of demand responsive services, including complementary, general public dial-a-ride, and human service transportation (Transit Cooperative Research Program, 2003). Often paratransit is used for demand responsive systems such as shared-ride taxis, dial-a-ride and subscription buses. On the other hand, in developing countries, these privately operated, small-scale services are varyingly referred to as "low cost transport", "intermediate technologies", and "third world transport" (Cervero, 2000). Nevertheless, paratransit can be defined as "a service that is not quite full public transit, utilizing smaller vehicles, and it can be legal or illegal as defined by local rules and regulations" (Graeff, 2008; Grava, 2003).

Paratransit modes play a significant role in the urban transport sectors of developing countries by providing transport services to a large number of people (Cervero and Golub, 2007:450; Godard, 2006; Joewono and Kubota, 2007; Tangphaisankun, 2010; Vukan, 2007). For instance, E-rickshaw is the most commonly used motor vehicle in

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Mumbai for health care, education, shopping and social trips, after buses; and more frequently used than motorized two-wheeled vehicles for all trip purposes except work, personal business and entertainment (Baker, 2005); and Tiwari (2003) found E-rickshaws are used by both high-income and low-income groups. Dependence on paratransit is mainly because either formal public transport service is not available or very poor service quality of public transport (Senbil et al., 2005:2170). However, the existing qualities of paratransit services are only acceptable but they do not satisfy the user's needs (Tangphaisankun et al., 2009). For example, attitudinal study of Li et al. (2011) showed that the perceived performance of urban public transport system in Jakarta city rated very low. Another study by Weningtyas et al. (2011) mentioned that in Jabodetabek, angkot reach the highest score for operation frequency among all evaluation items while regrettably security in angkot reach the lowest evaluation score (2.87 out of 5). Although in fact, angkot's operation time is already more than 18 hours/day and the number of the units are very excessive (Subdit Lalu Lintas Perkotaan, 2008). Paratransit systems have distinct characteristics. They are operated along fixed routes that serve as corridors (Neumann and Nagel, 2011:11), but they have fairly loose timetables, and passengers are usually (though not always) picked up and dropped off anywhere along the routes (Cervero, 2000).

Paratransit modes are often regarded as an important component of urban transport in the cities of developing countries due to its distinguishing characteristics such as low carrying capacity, low speed, low energy requirements, higher labor intensity, more dependability and small area of coverage. Paratransit system can be classified broadly into two groups: non-motorized and motorized (Tangphaisankun et al., 2009). However, according to Ahmed (2008), the paratransit modes are classified into following four major groups:

(i) Type of usage: The paratransit services may be availed by different groups of users such as (a) fixed personalized mode of transportation (e.g. car rental and carpools); (b) semi-public paratransit (e.g. vanpools and subscription buses); (c) public (regular) paratransit (e.g. autorickshaw, cycle-rickshaw, tata magic).

(ii) Ownership of the vehicle or system: Paratransit vehicles may be owned and service provided by an organization not related to transportation (e.g. factory or school transport service), or by an individual who operates the vehicle (e.g. auto-rickshaw or cycle-rickshaw operator) or by an individual who does not operate but lease it to the operator (e.g. owner) or by an agency (e.g. taxi company or tourist agency).

(iii) Service type by routing: Generally, paratransit modes provide door-to-door services such as taxi, e-rickshaw and cycle-rickshaw provides. Sometimes they adjust the service partially to the user's destination (e.g. feeder service to the airport or bus terminal). A third group of mode has fixed routes but not fixed schedule (e.g. shared travel mode auto-rickshaw service).

(iv) Method of getting service: Users may have paratransit service available at fixed parking lots (auto rickshaw, cycle-rickshaw) or their trips may be pre-arranged (subscription paratransits) or they obtain it by hailing the vehicle on street sides, or calling it by telephone from the travel agencies.

Physical Characteristics of Paratransit

Urban public transport services in the developing countries consist mainly of a mixture of motorized vehicles of various sizes. In most of the cases, the cities do not have complete statistics of urban transport and it is very difficult to obtain the number of vehicles used for paratransit modes (Gambhir, 1992). The paratransit modes have a very wide range of physical characteristics. For instance, they have differences in terms of body size, motive power, capacity, and other technical features. The non-motorized vehicles such as becak in Indonesia, cycle-rickshaw in Bangladesh and India are essentially bicycles converted into tricycles for passengers' service. In some cities, it generates a considerable percent of employment opportunity and also does not require much public resources which is a major attraction in many cities of developing countries with shortage of funds (Fouracre, 1986). Status of paratransit modes in the cities of Bangladesh is shown in Table 1.

Table 1: Type of paratransit modes in the cities of Bangladesh

Operator	Vehicle type	Type of service	Capacity (Persons)
Bangladesh Road Transport Corporation (BRTA)	Bus	Fixed route & Fixed Stops	60
Private	Mini Bus	Fixed route & Fixed Stops	10-20
Private	Auto Tempo	Fixed route & Not Fixed Stops	6-10
Private	E-rickshaw/Easy-bike	Fixed route, Not Fixed route, & Door to Door	4-8
Private	Auto-rickshaw/CNG	Door to Door	2-3
Private	Rickshaw	Door to Door	2

Source: JICA, 2009.

Objectives and Methodology

The main purpose of this research is to provide operational characteristics of paratransit, particularly the E-rickshaws (battery-driven three-wheelers), operating in a medium-sized city of Bangladesh. The objectives are to analyze the present scenario of E-rickshaws and to identify the major technical, operational and legal issues pertaining to the e-rickshaw operations. This paper provides a clear and vivid picture of e-rickshaws which might be helpful for the policymakers to identify and understand the barriers of e-rickshaws and formulating policy guidelines to improve paratransit service and promote electric mobility in Bangladesh.

A case study was conducted in Rangpur city and both primary and secondary data were used. A review of relevant literatures provided the basic characteristics of paratransit in urban transportation system of Bangladesh. An inventory survey of existing traffic and transport infrastructure was conducted to identify existing traffic condition and problems on major roads. Traffic count survey was conducted in seven major intersections of the city. Interview of 397 drivers (at 5% confidence interval and 95% confidence level) of E-rickshaw were conducted using a pre-determined structured

questionnaire. Drivers were selected randomly from ten different points of the major roads in the city. The questionnaire had following four major parts: (i) socio-economic information, (ii) trip characteristics, (iii) vehicular information, and (iv) attitude and perceptions regarding e-rickshaw operation. Beside the interviews of drivers, a Focus Group Discussion (FGD) with the owners and the members of the association of E-rickshaw as well as the Key Informants Interview (KII) with the officials of Rangpur City Corporation (RpCC) and Rangpur Metropolitan Police (RpMP) were also conducted to collect the data regarding physical and operational characteristics of E-rickshaw as paratransit system in the city. The field survey was conducted during normal weekdays in September 2019.

Description of the Case Study City: Rangpur

Rangpur is the second largest city of the northern region of the country, located 335 kilometers north-west of the capital city Dhaka. Rangpur is one of the newly established City Corporations of Bangladesh. This city is situated on the bank of the river Ghagat- a moribund tributary of the river Teesta. Figure 1 and Figure 2 show the location of Rangpur City in the national context and the Rangpur City Corporation area respectively.

The projected population of the city using compound (exponential) method in different years stands at 7,13,541 in 2018, which is predicted to be 8,80,808 in 2023 and 11,37,599 in 2028 and 15,78,605 in 2033 (RpCC Master Plan, 2014). Table 2 shows the details of projected population with density on the basis of Core and Non-core area of RpCC.

Table 2: Projected population in different years by applying Compound (Exponential) Method

Year	Core Area		Non-core Area		Total Area	
	Population	Density (per acre)	Population	Density (per acre)	Population	Density (per acre)
2013	206183	32.12	379439	8.57	585622	11.56
2018	237287	36.96	476254	10.76	713541	14.08
2023	274414	42.75	606394	13.70	880808	17.38
2028	314281	48.96	823318	18.60	1137599	22.45
2033	361692	56.34	1216912	27.50	1578605	31.15

Source: BBS, 2011 and RpCC Master Plan, 2014

Figure 1: Location of Rangpur city in the context of Bangladesh

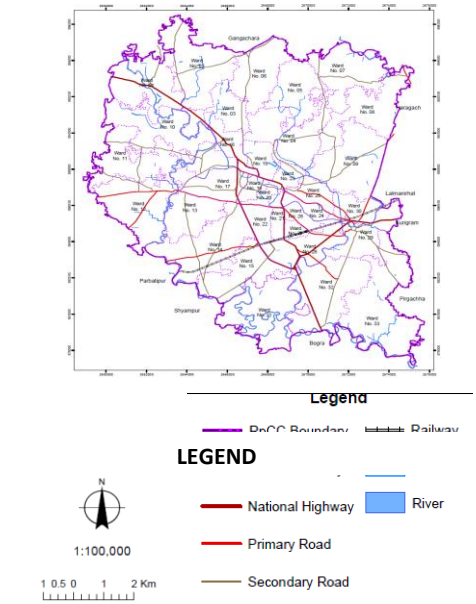


Figure 2: Rangpur City Corporation area

Considering the roadway hierarchy (functional classification), there are primary roads including national highways, secondary roads, tertiary and access roads in the city area. Distribution of existing roads as per roadway hierarchy is shown in Table 3 and Figure 3 depicts the existing road network in respect of functional classification.

Table 3: Distribution of existing roads as per roadway hierarchy

Functional Category	Length (km)	Length (mile)	%
National Highway	32.85	20.41	2.30
Primary Road	34.69	21.55	2.43
Secondary Road	99.98	62.12	7.00
Tertiary and Access	1259.93	782.88	88.26
Total	1427.44	886.97	100.00

Source: RpCC Master Plan, 2014

Traffic police are deployed at different intersections. There are six intersections where high traffic flow was observed and the major congestion-prone intersections in Rangpur are Jahaj Company Morr, Payra Chattar, DC office Morr, City Bazar, Town Hall, Medical Morr, and Lalbagh Chattar. During peak hours, overflow of rickshaws and E-rickshaws often causes traffic congestion in those intersections and traffic police face difficulties in controlling the traffic situation.

Both registered and unregistered informal transport modes are operating in and around Rangpur city. The total number of these vehicles was collected from different sources, as shown in Table 4.

Table 4: Number of paratransit modes in Rangpur city

Vehicles Name	Number of registered vehicle*	Total Number of Vehicle** (Approximately)
Cycle-rickshaw (Included electric-rickshaw)	3,000	3,300
Electric-rickshaw (Included cycle-rickshaw)	3,000	15,000
Electric auto-rickshaw (Easy-bike)	5,000	32,000

Source: BBS 2011*, RpCC*, BRTA*, RpMP**, Auto Bike Association**, 2019.

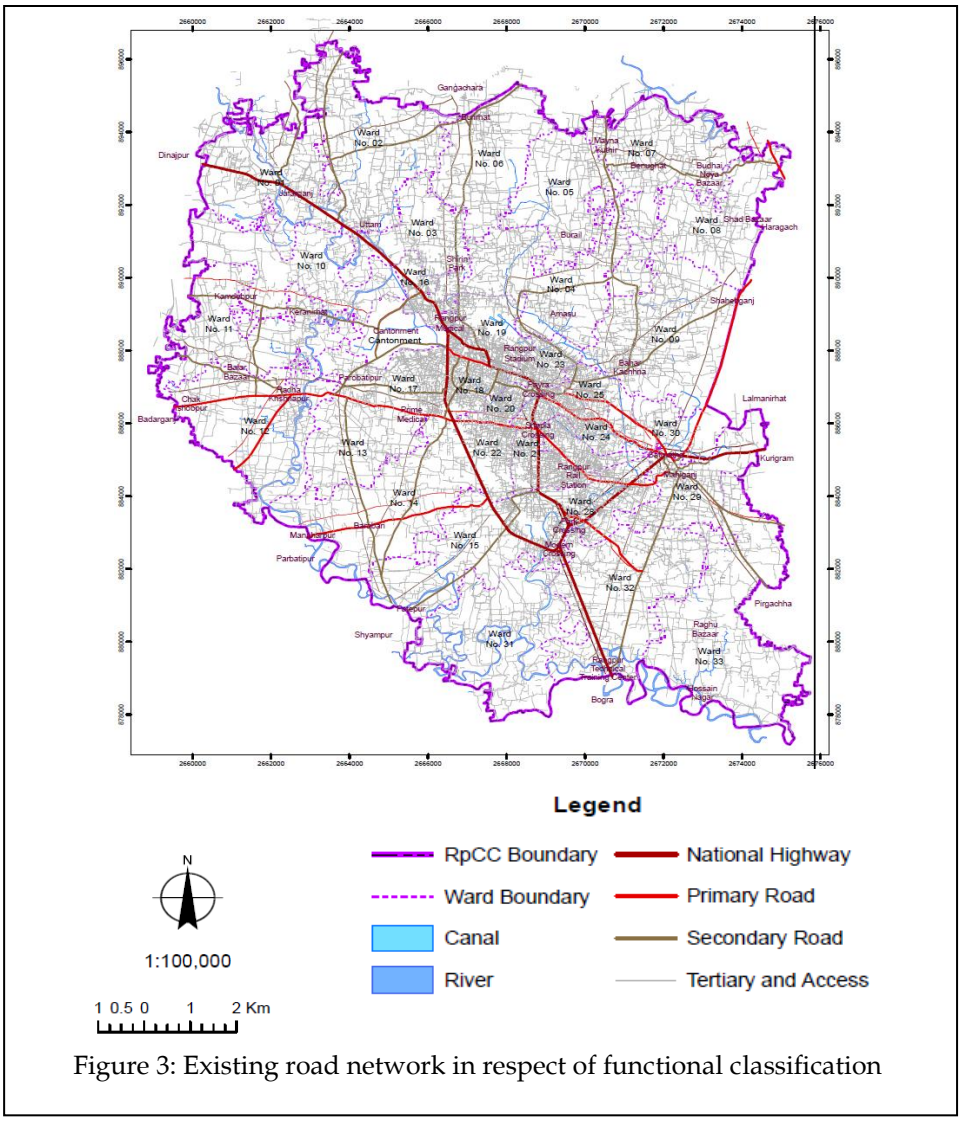
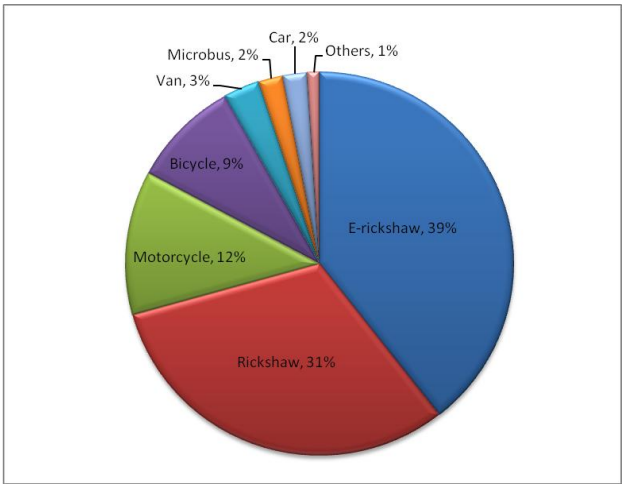


Figure 3: Existing road network in respect of functional classification

Major three types of paratransit modes such as cycle-rickshaw, Electric-rickshaw, E-rickshaw/Easy-bike are plying in Rangpur city. Among them, auto-rickshaw (E-rickshaw) has the highest percentage share of occupants. In order to investigate the nature of traffic movement and assess the traffic composition, traffic count survey in seven major intersections were conducted. From the survey, the study identified (Figure 4) that the traffic compositions are: e-rickshaw (39%), rickshaw (31%), motorcycle (12%), and bicycle (9%).



Source: Traffic Volume survey, 2019

Figure 4: Traffic composition in Rangpur city

A wide range of vehicles was found as public transport modes. All the vehicle types except pedal-powered cycle rickshaws are motorized and have different seating capacity. The vehicles can be classified into three distinct categories according to seating capacity: low-capacity vehicles, medium-capacity vehicles, and high-capacity modes.

Low Capacity Vehicles

Cycle-rickshaws/Rickshaw: Three-wheeled Cycle-rickshaws and Electric-rickshaws with seating capacities of up to 2 passengers and manufactured by local workshops and distributors. These were commonly found to be operating as low-capacity informal public transport vehicles all over the city (Figure 5).

Electric-Rickshaws/Tom-Tom: Three-wheeled battery-operated Electric-rickshaws with seating capacities of up to 3 passengers and manufactured by local workshops and distributors. It is powered by electricity and reserved in 3-4 medium capacity batteries. These were commonly found to be operated as low-capacity informal public transport vehicles all over the city (Figure 6).

Figure 5: Cycle-Rickshaw

Figure 6: Electric-Rickshaw

Medium Capacity Vehicles

E-rickshaw (Battery Operated Three-Wheeler/Easy Bike): Three-wheeled vehicles with medium seating capacities of 6 to 8 passengers were found to be in operation. It is powered by electricity which reserved in 4-6 high capacity attach the battery. The three-wheeled vehicles included Electric auto-rickshaws manufactured by Xinge, Speed Dowedo, Jet Fighter, Mainbon Tricycle, Gangchill, Xingebang, JT Tricycle, etc. These were commonly found as medium capacity informal public transport vehicles all over the Rangpur City Corporation area (Figure 7).

Auto Tempo: Mahindra: Another three-wheeled vehicle included auto tempo locally called Mahindra manufactured by Mahindra Limited can accommodate 5 passengers. Auto Tempo is operated by fossil fuel, like diesel. These were least commonly found to be operating as medium capacity public transport vehicles in some long routes traveling within the city (Figure 8).

High Capacity Vehicles

Leguna and Mini-bus: Leguna and mini-buses with seating capacities of 20 to 30 passengers and manufactured by automobile manufacturing companies like Tata Motors Ltd., Nitol Niloy Ltd., and SML Isuzu Ltd are operated by fossil fuel like diesel (Figures 9 and 10). These are found to be operating as long route traveling modes in different Upazilas of Rangpur city. Both modes are seemed as high capacity public transport.

Figure 7: E-rickshaw (Easy bike/auto)

Figure 8: Auto Tempo

Figure 9: Leguna

Figure 10: Mini bus

Operational Characteristics of E-rickshaw in Rangpur City

E-rickshaws in Rangpur can be classified in three groups based on their operation or movement pattern. E-rickshaws whose origin and destination are within the main city are placed under the 'Core to Core' category, while those having at least either of the origin or the destination within the main city are classified in 'Core to periphery' category. Those having both the origin and destination outside the main city and operating predominantly on the city periphery routes are classified in the 'Periphery to Periphery' category. Ten survey location points were selected, as shown in Figure 11, for data collection. Among the movement category, 57% routes are from core to periphery, while 28.5% routes are based on periphery to periphery movement and the rest 14.5% routes are core to core routes.

The average trip length for e-rickshaw operations is between 3 and 5 km. From the field survey, it was found that the nature of trips in the main city is very different from the city periphery. For example, in the main city, the majority (around 68%) of the respondents mentioned that e-rickshaws are their primary mode of travel and do not use for any intermodal connection. On the other hand, e-rickshaws in the periphery areas, are solely used for last mile connectivity. However, due to absence of road hierarchy or lack of alternative public transport service in Rangpur, e-rickshaws are plying on the arterial roads, national and regional highways. Almost 69% of the respondents consider that e-rickshaws as a paratransit mode in Rangpur have improved the connectivity and 31% of the respondents mentioned e-rickshaws are very easily available, therefore, they prefer this over other modes for travel.

Service Types and Regulatory Compliance

Discussion with the representatives of Rangpur Metropolitan Police (RpMP) and Rangpur City Corporation (RpCC) revealed that the permit for about 5,000 E-rickshaws and 3000 Electric-rickshaws were issued to operate in RpCC area. These vehicles are legally authorized with the legal permission to provide transport services. At present there are more than 30,000 battery-operated vehicles operating in and around RpCC. As an informal public transport mode, they rarely follow any permit or regulation in peri-urban areas. The services offered by e-rickshaws widely vary according to the local

demand. Another common route permit violation is the operation of vehicles outside their permitted zones or routes. Drivers are often infringed on route or zone rules to earn more money by operating in high-demand areas. Several vehicles were operating without any permit more prevalent when they operate outside the urban boundaries.

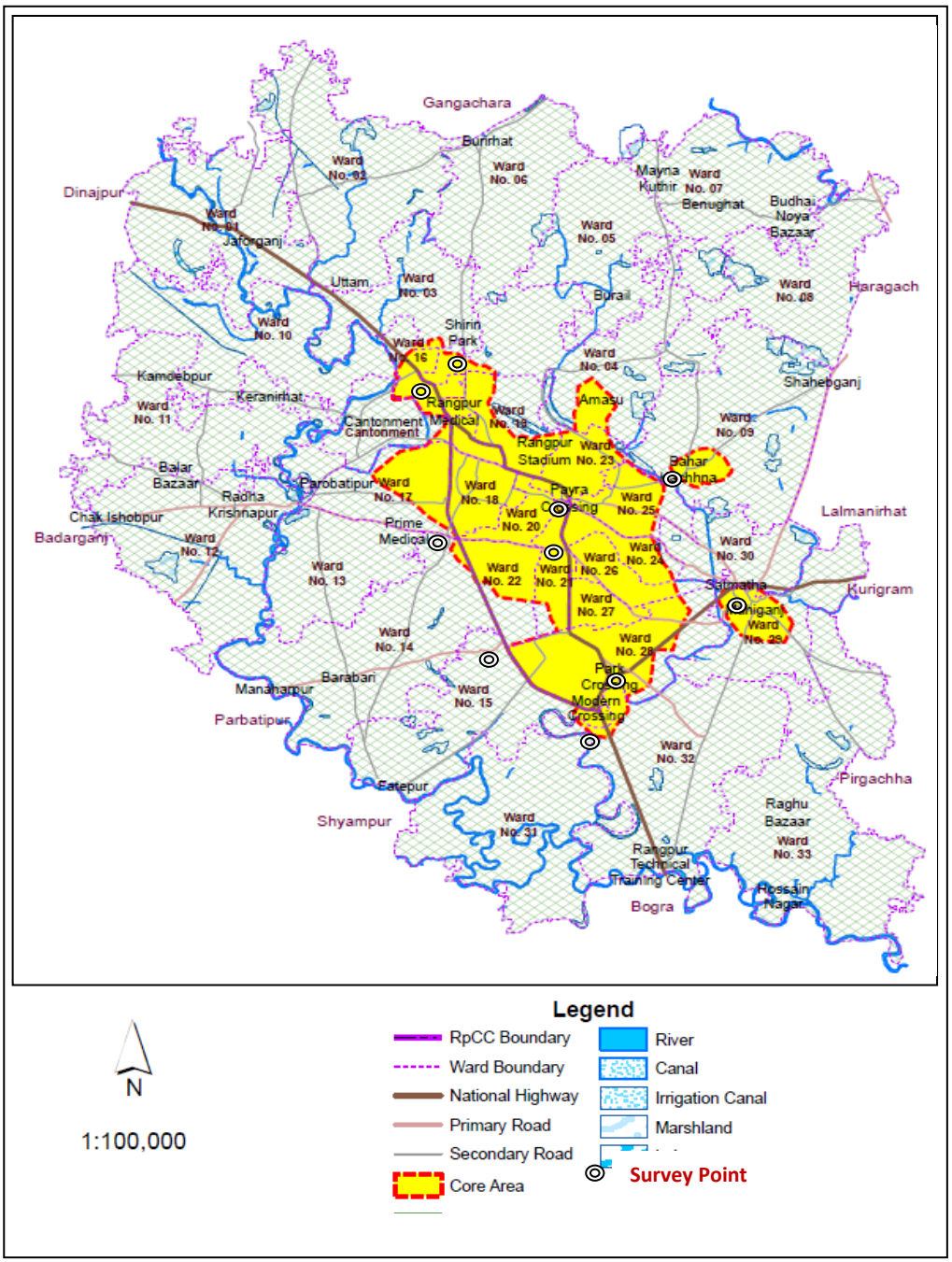


Figure 11: Map showing location of survey points in Rangpur city

Existing Rents and Fare Rates

Informal public transport systems are often operated by private individuals and operators. Providing transportation services is a business activity, which means that maximizing profit is the key objective of operating a vehicle. The rate of rent often depends on registration of the vehicles. Usually the daily rent for E-rickshaw is Tk 500 for registered one and Tk 400 for unregistered one. Travel cost in different routes is presented in Table 5.

Table 5: Travel cost in different routes of Rangpur city

Major routes	Route length* (Km)	Fare (Tk)	Average Fare (Tk/Km)
Medical Morr to City Bazar	3.2	10	3.13
Satmatha to Medical Morr	7.1	25	3.53
City Bazar to Railway Station	3.2	10	3.13
City Bazar to Satmatha	4.3	15	3.48
Modern Morr to City Bazar	5.1	15	2.94
Terminal to City Bazar	3.3	10	3.30

Source: Google map 2019*; Field survey, 2019

Routes of E-rickshaw Services

This study identified that the length of e-rickshaw route in peri-urban areas is longer compared with the routes those operating in city centre. A total of 18 routes (about 12 short routes and 6 major long routes through core area which link to non-core areas) of RpCC were examined, as shown in this section. Sometimes the drivers travel along the fixed routes on the basis of passengers' and drivers' intension. Distance service by e-rickshaw as informal public transport mode is also irregular.

List of 12 Short Routes

- Modern to Bus Terminal
- Terminal to Medical Morr
- Medical Morr to City Bazar
- City Bazar to Shapla Chattar
- Shapla Chattar to Railway Station
- Lalbag to Shapla Chattar
- Jahajcompany Morr to Satmatha
- Payra Chattar to Indra Morr
- Lalbag to Modern Morr
- Shapla Chattar to Bus Terminal
- Modern Morr to Satmatha
- Jahaj Company Morr to Shapla Chattar

List of Six Major Long Routes

- Medical Morr to City Bazar
- Satmatha to Medical Morr
- City Bazar to Railway Station
- City Bazar to Satmatha
- Modern Morr to City Bazar
- Terminal to City Bazar

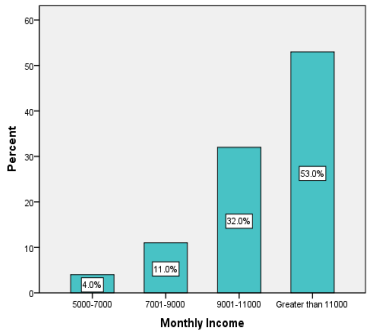
Employment Generation

Earning of the Owner

The owner of the Easy bike normally receives around Tk 400 to Tk 500 (depending on registration) per day for each e-rickshaw from the driver. Thus, the owner earns Tk 9,000 to Tk 12000 per month for one E-rickshaw. On the other hand, he has to spend almost Tk 90 per day (Tk 2,700/month) for maintenance and Tk 500/month for repairing of the E-rickshaw.

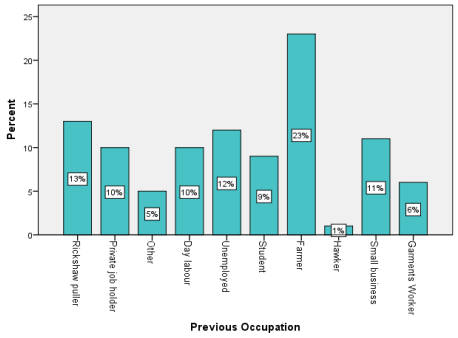
Earning of the Driver

The driver of the e-rickshaw drives his own vehicle or hires it from the owner on daily basis. Usually a driver earns Tk 800-1000 per day which depends on the size of the mode and the charging of the battery. This means, monthly income of a driver is around Tk 12000-16000 and with this amount a small family can survive well. However, their monthly income does not remain same or constant in every month. Figure 12 reveals that monthly income for 53% of the drivers is more than Tk 11,000 whilst the remaining 47% have less than Tk 11,000.



Source: E-rickshaw operators' survey, 2019

Figure 12: Average monthly income of the E-rickshaw drivers



Source: E-rickshaw operators' survey, 2019

Figure 13: Previous occupation of E-rickshaw operators

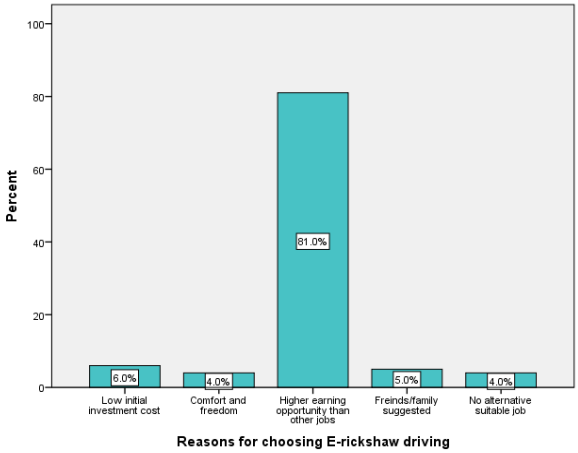
Previous Occupation of E-rickshaw Drivers

Almost 13% of the E-rickshaw drivers have chosen easy-bike driving as their occupation who previously pulled rickshaws. Figure 13 shows that the previous professions for 12%

of E-rickshaw drivers were unemployed, 10% were day-laborers, 23% were farmers, 9% were students, and 11% were small businessmen.

Reasons behind Choosing E-rickshaw Driving as an Occupation

On the basis of primary survey, 81% of the total respondents stated that they wanted to earn more money that was the main reason for selecting this occupation. Figure 14 shows that only 6% of the respondents had low initial investment cost whilst others mentioned unavailability of and other suitable job as the reason for choosing E-rickshaw driving as occupation.



Source: E-rickshaw operators' survey, 2019

Figure 14: Reasons for choosing E-rickshaw driving in Rangpur city

Financial Aspects of E-rickshaw Driving

Economic feasibility of e-rickshaw was determined along with evaluating its contribution in income generation in the context of Rangpur city. Information on initial purchasing cost, daily operating cost, monthly maintenance cost and daily average income from e-rickshaw were obtained from the survey of drivers/operators.

Investment Cost

E-rickshaws available on the major roads of Rangpur city are mostly imported from China and a few of them are from India. However, e-rickshaw manufactured in China is the most popular among the owners for their service and longevity. Now-a-days, some local workers are making the e-rickshaw in their workshop which is not as good as the product of China but still some people prefer this because of their lower cost. Normally, the cost for an e-rickshaw imported from China is about Tk 1,50,000 to Tk 2,00,000 (with the battery) depending on the size and capacity of the battery whilst the locally produced one costs only Tk 80,000 to Tk 1,00,000 (with the battery).

Operating and Maintenance Cost

Usually an E-rickshaw has 4 to 6 batteries, but most of them in Rangpur have 5 batteries. If it takes 10 hours to fully charge the 5 batteries and each consume 2 units for full charging then 5 batteries consume 10 (5×2=10) units. The unit cost of electricity for

commercial electric supply line is about Tk 9. So, the cost of charging of an e-rickshaw with 5 batteries is approximately Tk 90 (10×9= 90) daily. Thus, the annual average operation cost for an E-rickshaw is Tk 32,400.

Maintenance costs are the cost of periodical repairing and servicing, including the costs of consumable items like brake shoes, battery, tyres etc. Average cost for periodical maintenance and servicing was found Tk 1500 – Tk 2000 per month excluding the cost of batteries and tyres. In the primary survey, it was found that 64% of the respondents in Rangpur have a maintenance cost around Tk 1500 – Tk 2000 per month. While 24% have a cost more than Tk 2,000 per month, the rest 12% have maintenance cost below Tk 1500. Table 6 provides the calculation of income-expenditure ratio for the operators who have their own E-rickshaws.

Table 6: Income-expenditure ratio for E-rickshaw (own) operators

Expenditure/Investment	Vehicle purchasing cost	Tk 1,60,000
	Annual average operation cost	Tk 32,400
	Annual average maintenance cost	Tk 20,115
	Total annual expenditure/investment	Tk 2,12,515
Income	Annual average income	Tk 3,08,000
Income-Expenditure Ratio = (Annual Income/Annual Cost) = 1.45		

Social Aspects of E-rickshaw Driving

From the survey it is found that about 70% of the E-rickshaw drivers reported their financial condition or earnings are now better compared with their previous occupations. Remaining 30% mentioned that with E-rickshaw driving their financial condition have not changed at all. Nevertheless, approximately 20% drivers, who were previously engaged in hawking or other similar occupations, strongly agree that driving E-rickshaw has increased their social status and prestige. Many of the previously unemployed youth are now getting a good source of income. Therefore, many cycle-rickshaw drivers are also switching to driving e-rickshaws as it provides them a better social status, more revenue and less strenuous work.

Cycle rickshaws are perceived by many people to be 'violating human dignity'. It was found that people who earlier used to pull cycle-rickshaws or vans are trying to socially and economically 'upgrade' themselves. Even, people who were in low-paying jobs such as helpers in bus/tempo or small shops are also switching to this occupation for better earning and self-dependency. It has been found that petty crimes in Rangpur have been reduced after the induction of e-rickshaws. Though the exact figure in the reduction of crime rate is not available, the drivers and even the passengers confirmed this fact during the primary survey. This trend is predominantly visible in the periphery of the city.

Discussion

Bangladesh Road and Transport Authority (BRTA) has functional responsibility to provide driving license, checking the fitness of vehicles, license of vehicles, route permit, license renewal and registration for motorized vehicles and concerned on the highways

only. There is a controversy regarding whether these easy-bikes are motor vehicles or not. According to section 34(1) of the 'Motor Vehicles Ordinance 1983', an application has to be submitted under Form-H (as stated in the Schedule of the Ordinance) for registration of a motor vehicle. Again, according to sub-section (2) of section 34, a certificate is provided in Form-I of the Schedule under the Ordinance, which requires information regarding number of cylinders, chassis number, engine number, fuel used in engine, cubic capacity (CC) etc. These information cannot be provided for easy-bike as it has no engine number, cubic capacity, engine fuel in easy-bikes as per statutory requirements. Consequently, easy-bikes cannot be registered under this Ordinance. As a stop-gap arrangement, these three-wheelers are now plying on roads with parking numbers given by city corporations, municipalities and union councils. Licensing and management aspects of non-motorized vehicles such as cycle-rickshaws and non-fuel vehicles like battery-driven e-rickshaws and rickshaws are the responsibility of RpCC and RpMP.

RpCC only provide registrations and license of battery-driven vehicles and every year they renew these licenses. In 2012, new registration of battery-driven vehicles was terminated though continued the yearly re-registration process for the previously registered e-rickshaws and electric rickshaws. RpCC offers the opportunity to renew 5,000 E-rickshaws and 3,000 Rickshaws (Electric and Cycle), by charging an annual fee (Table 7). Moreover, due to shortage of manpower and functional limitations of RpCC, the responsibilities for traffic management have been transferred to Rangpur Metropolitan Police (RpMP).

Table 7: Registration fees of E-rickshaws and Rickshaws

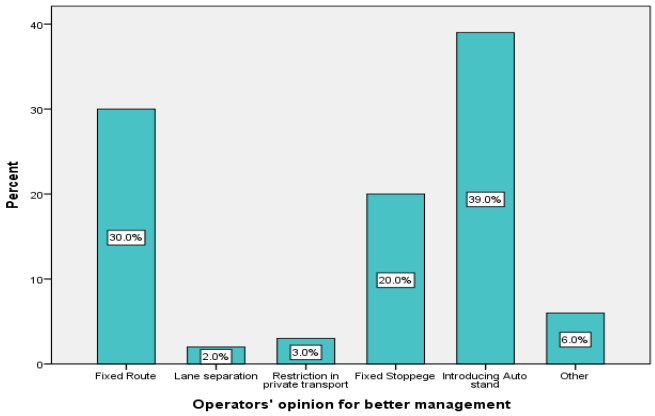
Vehicle	New Reg. Fees	Renew Fees (BDT)	No. of vehicles	Penalty Fees (BDT)
E-rickshaw/Easy bike	2500	2500	5,000	400
Rickshaw (Electric & Cycle)	1500	1000	3,000	400

Source: Trade License Department of RpCC, 2019

In order to improve traffic management system, RpMP has taken some initiatives such as deploying traffic police at major intersections, check post, CCTV coverage in important intersections, e-traffic system, etc. Operation of heavy freight vehicles (e.g. Truck, Lorries) is restricted during the day from 6 am to 6 pm.

Rangpur District E-rickshaw Owner-Driver Association (*Rangpur Zilla Auto-rickshaw Malik-Sromik Somobay Samiti*) was formed with a view to ensure legal support, welfare, and rights of owners and operators. The association is responsible to fix the route and fare. In the past, fare had been changed or revised at several occasions by the association. The elected leaders of the association work for ensuring the members' rights and providing emergency supports.

Study reveals that most of the drivers support the proposals, such as introducing formal stands, lane separation, fixed route and so on for improvement of informal transport management in the case study city Rangpur (Figure 15).



Source: E-rickshaw operators' survey, 2019

Figure 15: E-rickshaw operators' opinions for better traffic management

Conclusion

This study was conducted to understand the details about paratransit system particularly E-rickshaws in the context of Rangpur city, Bangladesh. The results provide a snapshot of the situation. Some of the advantages and issues identified due to presence of E-rickshaw in the city can be summarized as follows:

- E-rickshaws are providing the last mile connectivity as well as serving as a public transport in some routes.
- E-rickshaws are not completely illegal rather they are unregulated.
- E-rickshaws are proving direct and indirect employment to many people. However, without registration, drivers and users can not avail insurance benefits.
- Absence of legal framework for e-rickshaw operation in Rangpur is a major concern for its effective utilization.
- It is more difficult to control the fare since most drivers have not registered their career as paratransit drivers. This is also a barrier for the government to set up a fare regulation for paratransit in the city.

Alternatively, if the number of e-rickshaw operators can be defined, or they register their driving career for each operating zone in the study city, the fare of flexible paratransit service might be easier to regulate through route allocation. Proper facilities, such as stands and charging points would help smooth operation of E-rickshaws and therefore these should be provided. The influx of e-rickshaws needs to be based on plan considering the road capacity and future travel demand. Therefore, this research has proposed to emphasize the utilization of the existing transport modes and their advantages through the strategy of the integrated urban transport. Future study should focus on the alternative solutions to the impacted E-rickshaw drivers following the introduction of mass transit system like public bus around the city.

References

Ahmed, M. 2008. 'Socio – economic status of paratransit operator in the city of Assam', ITPI Journal, 2008, pp. 21-27.

Baker, J. 2005. 'Urban Poverty and Transport: The Case of Mumbai', World Bank Policy Research Working Paper 3693. Washington, DC: The World Bank.

BBS, 2011. Bangladesh population and Housing Census 2011, National Report, Volume-3: Urban area report (1st edition). Dhaka: Bangladesh Bureau of Statistics.

Cervero R. and Golub, A. 2007. Informal transport: A global perspective. Transport Policy,14(6), 445-457.

Cervero, R. 2000. Informal transport in the developing world. United Nations.

Fouracre, P. R. 1986. Intermediate Public Transport in Developing Countries. TRRL Laboratory Report 772. Crowthorne. England. Transportation Road Research Laboratory.

Gambhir, J. C. and Prakash, N. 1992. Urban Transport Condition in Delhi. Regional Development Dialogue, Vol. 13. No 3. 99-103.

Graeff, J. 2008. The Organization and Future of the Matatu Industry in Nairobi, Kenya. New York, NY.

Grava, S. 2003. Urban Transportation Systems. Choices for Communities. Mc Graw Hill Professional.

Harris, C. D. 1943. A functional classification of cities in the United States. Geographical Review, 33(1), pp. 86-99

Heikkila, E. and Xu, Y. 2014. Seven prototypical Chinese cities. *Urban Studies, 51*(4), 827–847. Improvement Plan. Main Report. Thailand.

Japan International Corporation Agency (JICA), 1990. The Study on Medium to Long Term Improvement/Management Plan of Road and Transport in Bangkok. Medium to Long Term Road.

Li, G., Nugroho, S. B., Fujiwara, A., Zhang, J. and Linh, T. N. 2011. 'Analysis of paratransit drivers' stated job choice behavior under various policy interventions incorporating the influence of captivity: a case study in Jabodetabek metropolitan area', Indonesia. *Eastern Asia Society for Transportation Studies*. Jeju, Korea.vol 8, pp. 1-5.

Mani, A., Pai, M. and Aggarwal, R. 2012. Sustainable urban transport in India: the role of the auto-rickshaw sector. Cochran, W.G.. Sampling techniques-3.

Neumann, A, and Nagel, K. 2011. A Paratransit-Inspired Evolutionary Process For Public Transit Network Design. Transportation Research Board Annual Meeting pp. 1–16.

Rangpur City Corporation Master Plan (RpCC), 2014. Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C), Government of Bangladesh.

Senbil, M., Fujiwara, A., Zhang, J. and Asri, D. 2005. 'Development of a choice model for evaluating sustainable urban form'. Proceedings of the Eastern Asia Society for Transportation Studies 5, 2164–2178. July 2005.

Subdit Lalu Lintas Perkotaan, 2008. Laporan Akhir Penyusunan Masterplan Jaringan Transportasi Perkotaan pada Kawasan Aglomerasi Bandung Raya. Bandung, West Java.

Tangphaisankun, A., Nakamura, F., and Okamura, T. 2009. Influences of paratransit as a feeder of mass transit system in developing countries based on commuter satisfaction. *Journal of the Eastern Asia Society for Transportation Studies*, 8, 2009–2009.

Tiwari, G. 2003. Transport and land-use policies in Delhi. *Bulletin of the World Health Organization: Special Theme - Health Impact Assessment*, 81(6).

Transit Cooperative Research Program, 2003. TCRP Report 100: Transit Capacity and Quality of Service Manual. Orlando, Canada: Kittelson & Associates, INC.

Vuchic V. R. 1979. Paratransit and Specialised modes", Urban Public Transportation: System and technology, Prentice Hall.

Weningtyas, W., Fujiwara, A., Li, G., Chikaraishi, M. and Nugroho, S. B. 2011. 'A Comparison Analysis of the usage of Angkot in Transportation System of Jakarta and Surabaya city'. The 11th International Congress of Asian Planning Schools Association. Tokyo, Japan. 1441-1452.