International Journal of Advance Study and Research Work (2581-5997)/ Volume 2/Issue 10/October2019

An Assessment of Battery Operated Auto Rickshaw's Impact: A case study in Rangpur city, Bangladesh

Md. Naimur Rahman*[1], Arif Mahmud Akash[2], Md. Abul Basar Rony[3], Rakibul Islam[4]
Department of Geography and Environmental Science, Begum Rokeya University, Rangpur, Bangladesh
*Email: 01naimur@gmail.com

DOI: 10.5281/zenodo.3526352

Abstract

Battery operated auto-rickshaw is a common three-wheeled fast-growing vehicle in Rangpur city. This paper describes the social, economic, environmental impact and shows the purposive comparison of solar-based auto-rickshaw within the battery oriented auto-rickshaw in the area of Rangpur city. In this work, various questions were asked to the auto-rickshaw drivers, passengers, and importers for acquiring the total scenario of social and economic condition of auto-rickshaw. And for the environmental impact different data were collected from the power supply authorities of Rangpur city. The findings say that the number of auto-rickshaw was 400 in 2012 which has risen in the number to 6,500 in 2019 to a great extent which is the cause for reducing unemployment problem in accordance with increasing traffic jams. The findings of the study also contain that the economic and social condition gets improved by the owner of battery-operated auto-rickshaw whereas the rented battery-operated auto-rickshaw driver is not getting improvement as much as the owner of the auto-rickshaw but both having enough income compared with their previous profession's income. And only 32.5% drivers consider that there is less social value for the profession. Auto rickshaw has no sound pollution, but it is creating trouble by consuming electricity, which is produced by burning fossil fuel and are the cause of continuous air pollution. And according to the field survey total of 21,800 auto rickshaw runs every day in the Rangpur city which is consuming 19.62 megawatts of electricity where the production of electricity is limited as well as it is the cause of both shortage of electricity and 9810 kg emission of carbon per day. But the shortage of electricity and emission of CO_2 could be reduced or mitigated by using solar oriented auto rickshaw.

Keywords: social; economic; environmental; solar auto; CO_2 emission; preferential choice and reasons.

Introduction

The rural and urban areas of Bangladesh largely depended on paddle rickshaw and the recent most common modification and replacement of paddle rickshaw are called battery-operated auto-rickshaws. It is making a great contribution to the unemployment sector, which reduces 2% of the unemployment problem of Bangladesh (Rahim, Joardder, Hoque, Rahman & Sumon, 2013). The auto-rickshaw is firstly introduced in the Rangpur City in the year of 2009. There are many concerns regarding the mode of auto-rickshaw as transportation and its functioning in the Rangpur city. The study area was selected at Rangpur City to assess different impacts of battery-operated auto-rickshaw. And it has been divided into two parts to cover the different aspects of the functioning of auto-rickshaw and those are:

(i) The social, economic and environmental impact of auto-rickshaw.
(ii) The preferring framework and conditions of passenger influencing the social, economic impact of auto-rickshaw.

Battery-powered auto-rickshaw is faster than a cycle rickshaw and carries three to six seats and consists of less fare compared to manually operated rickshaws and it is pollution-free and safe mode of transport which is mainly used by lower-income group of people (Ali, 2011). For this reason income of battery auto-rickshaw driver could be moderate but also it could be varied for both self-owned and rental auto-rickshaw drivers. In addition it could be largely used by not only lower income group of people but also middle-income group of people and as it has no direct cause for pollution but there could be indirect causes for pollution as well as it could have less safety measurement. As the government does not have any kind of training station or center for the auto-rickshaw driver as well as has no special rules for governing auto rickshaw. For this reason without being trained and skilled they can get their

auto-rickshaw to be registered and can get a license for driving an auto-rickshaw which could lead to road accidents that require careful attention. To run the auto-rickshaw it consumes electricity which could be the indirect cause of pollution and for electricity consumption solar oriented auto rickshaw could be implemented.

Literature Review

Battery operated auto-rickshaw is a very common and popular mode of transportation which mainly covers short distance. For this reason the discussions and descriptions of social, economic, environmental impacts and technical study of battery-operated auto-rickshaw increase the potentiality in the respected field. Several comprehensive researchers studied the field of the battery-operated auto rickshaw. And they mainly studied the mode of social, economic and environmental fields.

Rana, Hossain, Roy & Mitra, (2012) showed the role of urban income and the mode of transport in the Dhaka city on the field of auto-rickshaw. Rana, Hossain, Roy, & Mitra, (2013) found scientific outcomes that could be helped for the efficient transportation system and they also discussed as well as explored different aspects of battery-operated auto-rickshaw like trip characteristics, travel speed, travel fare, type of use, problems associated, etc. with a view to providing a generalized idea on the mode. Khan, Rahman & Hossain, (2012) discussed annual sunlight hours in Bangladesh and it's development in the renewable energy sector as well as social, economic and environmental constraints regarding this field. Another study by Mallik, Arefin, & Pal, (2017), showed that existing vehicles could be replaced or set aside through a micro cross-type system which is redesigned in a manner that could improve the efficiency of the vehicle and a recharging infrastructure is proposed which could be charged by the solar power.

Mahmood (2011) found that if air pollution in major four cities could reduce, it could help to save $200 million and $800 million per year, which indicates 0.7 to 3.0% of its gross national product. And the auto-rickshaw is playing a great role in reducing air pollution compared with other vehicles like petrol and diesel car which is mentioned earlier.

Data and Methods:

This paper has relied on field-based primary data and secondary data is also used here from internet browsing and studying different articles and newspaper. Before conducting all of the questionnaire survey reconnaissance was done. And this reconnaissance extended the efficiency of the questionnaire.

To conduct the social, economic and environmental impact of an auto-rickshaw total of 14 locations in different areas of the Rangpur City Corporation were taken as data samples, with a total of 280 batteries auto-rickshaw and 100 paddle rickshaw being sampled. The reason for being sampled of paddle rickshaw is to compare the economic condition with battery-operated auto-rickshaw. And the areas were chosen for having the data of the overall city corporation. The locations of the Rangpur City Corporation where sampling was done: Hasna Bazar, CEO Bazar, Medical Mor, Checkpost, Terminal, Modern Mor, Park Mor, Lalbag, Sathmatha, Saplachattar, Payrachattar, Kachari Bazar, Honumantola, Bankmor.

To obtain the data about preferring auto-rickshaw and the overall condition of passengers of auto-rickshaw a questionnaire was developed for interviewing the passengers. A total of 300 samples was collected from 15 different locations. And the locations were Hajirhat, Hasna Bazar, CEO Bazar, Medical Mor, Checkpost, Terminal, Modern Mor, Park Mor, Lalbag, Sathmatha, Saplachattar, Payrachattar, Kachari Bazar, Honumantola, Bankmor. For analyzing the obtained data Microsoft Excel 2013 and 2010 used for this work of study.

Parameters selection for impact assessment of the study

Objectives	Variables
To conduct the social and economic survey several parameters were used to focus the social and economic condition of the driver of battery-operated auto-rickshaw.	Initial Investment, Daily Cost, Daily Income, Net Daily Profit, Daily Rent, Previous occupation and it's Income, Job Security and Independence, Change in Social Status, Living Conditions, Education of the Drivers, Amount of Loan, Installment for the Loan, Monthly Savings, Savings Method, Planning for Leaving this Profession and It's Reason, Cause for choosing this Profession, Break time of a Week, Driver Training Conditions, Time of License Renew, Difficulty of getting License, Qualifications for License, Net amount of Goods, Market Size of Auto rickshaw, High Demand Locations, Daily Trip Characteristics, Battery Replacement Cost.

The auto-rickshaw does not create any pollution with its direct influence but it is responsible for the emissions of harmful gases indirectly. In addition, auto-rickshaw does not create sound pollution for direct or indirect causes. And for making visible of it is the indirect cause and how it could be less harmful to polluting the environment several parameters were selected	Smoking in Auto rickshaw, Amount of CO_2 Emissions, Electricity Production and Consumption, Sound Pollution, Solar Auto Rickshaw.
The aim of selecting and discussing the passenger's view is to measure the actual fact for the safety and effectiveness of various attributes.	Preferential Choice of Auto rickshaw, Purposes of Battery Operated Auto rickshaw, Reasons for Using Auto rickshaw, Auto rickshaw's Mode of Contribution, Safety and Accident, Rent Facilities, Opinion on Number of Auto rickshaw.

4. Social and Economic Impact:

Results and Discussion for the social and economic impact of the study

Number of Auto rickshaw

The process of giving registration of auto-rickshaw has started in the year of 2012 in the Rangpur City Corporation. And as mentioned earlier in the year 2019 the total number of auto-rickshaw in the Rangpur City Corporation is a 21800 where the number of authorized auto-rickshaw is 6,500. And the data are collected from the Rangpur City Corporation for the registered auto rickshaw. In addition to the calculation of the number of auto-rickshaw which is coming from the outside of the Rangpur City Corporation is estimated from different locations. And these locations are the entering point of the Rangpur City Corporation.

Rental and Self-Owned Auto rickshaw

Table 4.1 and Table 4.2 are the results of different parameters both for rental and self-owned auto-rickshaw drivers. And these tables indicate the net profit +450 for rental auto-rickshaw drivers and net profit +750 for self-owned auto-rickshaw drivers which is referring that earning economic condition of self-owned auto-rickshaw drivers are far better than rental auto-rickshaw drivers. But the relax time for self-owned auto-rickshaw drivers of a week is nearly 1 day larger than the rental auto rickshaw driver. It is found during the study, though self-owned drivers relaxed more time they earn better than rental drivers for the reason they do not have to pay rent for the auto-rickshaw. 65% of the auto-rickshaw driver does not carry goods and the net amount of goods bearing perspective is same for both rental and self-owned auto-rickshaw drivers. Auto-rickshaw drivers usually do not want to bear goods for the reason for the high amount of charge consumed by the auto rickshaw's battery. Initial investment differs for the new and second-hand auto-rickshaw which is shown in table 4.2. The battery replacement cost is indicating the set of a total of 05 batteries and daily cost includes electricity as well as toll cost.

Table 4.1 Rental Auto rickshaws:

Parameter	Mean Value (BDT)
Daily Income	914.77
Daily Rent	461.54
Net Daily Profit	+450
Break Time of a week	1 (Day)
Net Amount of Goods	120.71 (kilograms)

Source: Field Survey

Table 4.2 Self Owned Auto rickshaws:

Parameter	Mean Value (BDT)

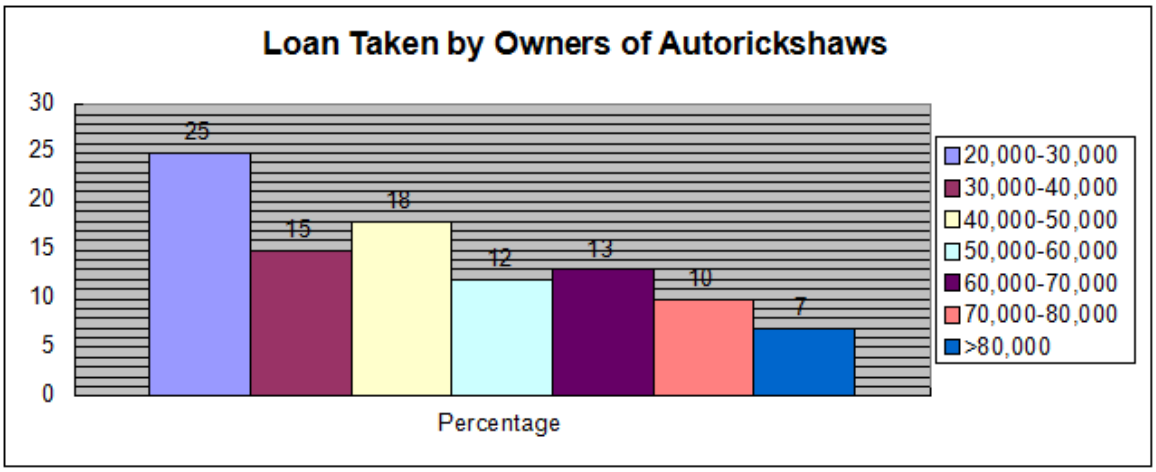
Initial Investment (For new auto-rickshaws)	1,55,400
Initial Investment (For Second-hand auto-rickshaws)	71,500
Daily Income (Same as rental auto rickshaw)	914.77
Daily Cost	156.5
Battery Replacement Cost	61570.56
Net Daily Profit	+750
Break Time of a week	1.5 (Day)
Net Amount of Goods (Same as rental auto rickshaw)	120.71 (kilograms)
Time of Auto rickshaw License Renew	1 (Year)

Source: Field Survey

Auto rickshaw Purchasing and Loan Capacity

The study findings indicate that the initial amount for new auto-rickshaw is 1,55,400 BDT and for second-hand auto rickshaw it is about 71,500 BDT. A total of 49% of the owner of auto-rickshaw has taken a loan for buying an auto-rickshaw. Among this 49% of the loan taken owner only 4.5 % of the owner has taken a loan for buying a second-hand auto rickshaw. And the percentage of loan taker within the range is shown in the figure:

Figure4.3 Loan Taken by Owners of Auto Rickshaws:



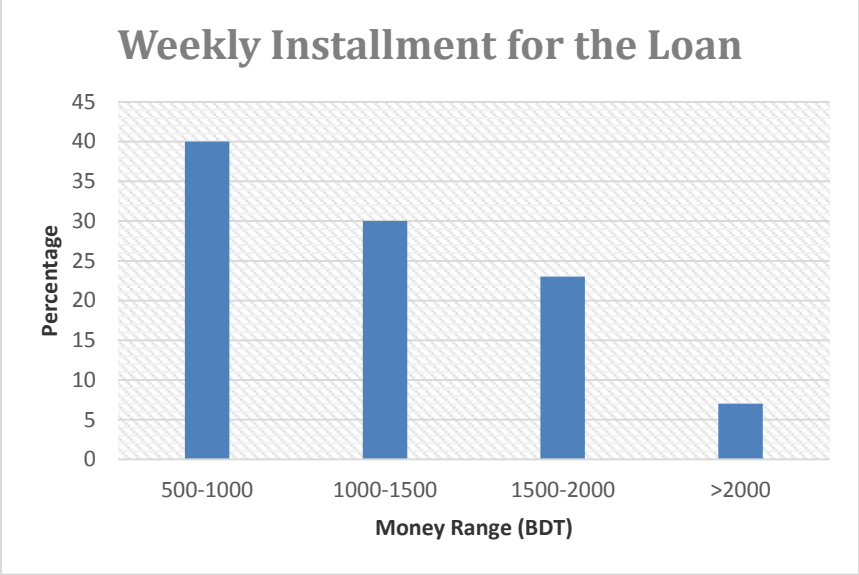
Source: Field Survey

However, the field analysis also describing that the auto-rickshaw is bought by own money of 51%, by getting loan 20% and by both getting loan and own money is 29%. In these circumstances, different banks and NGO are playing great role in providing loans. And among them, BRAC 15%, ASHA 10%, POPI 15%, GRAMEEN BANK 10%, BRDB 10%, Individual Person 15% and from other sources loans are coming 25%. In addition, it could be mentioned that not only the Bank or NGO playing role for the development of the auto-rickshaw sector but also the individual person is a great source.

Weekly Installment

The loan taken owners have to pay the installment for the taken loan. And the installment should be given to the interest of 10% (average). This percentage of interest is very much larger for the loan taker of auto-rickshaw drivers. Among the loan takers they have to pay weekly installment within different ranges as shown below:

Figure 4.4 Weekly Installments for the Loan:



Source: Field Survey

Furthermore, the field data analysis is indicating that 69% of loans taken owners of auto-rickshaw can not cope with their family economic condition because of the high range of loan interest.

Monthly Savings and Its Mode

A total of 78% rental auto-rickshaw driver doesn't make savings against 100% of rental drivers. And 35% self-owned auto-rickshaw driver doesn't make savings against 100% of the self-owned driver. In addition, field analysis indicates 22% of rental auto-rickshaw driver monthly saves 500.67 BDT(average) and 65% of self-owned auto-rickshaw drivers save 1083.33 BDT(average). Among this savings percentage, there is a variation of saving mode, including domestic savings, bank savings, different insurance or NGO savings. But the field analysis also indicates domestic savings are 17% for rental auto-rickshaw driver and 20% for self-owned auto rickshaw driver. And this savings pattern has a negative impact on the economic growth of the country as well as for the drivers because they are not using it for their profit.

Reasons for Choosing the Profession

The main reason for choosing this auto rickshaw profession is profit. And after thinking the profit the drivers of auto-rickshaw also think the investment of the profession is low and its work independence is high as well as social values also play an important role here. For this reason, 70% of auto-rickshaw driver chooses this profession that it is profitable, 15% for less investment, 9% for social values and 6% for work independence.

Planning for Changing the Profession

A total of 39.54% of self-owned auto-rickshaw drivers have plans to change the profession where the percentage of rental auto-rickshaw drivers is 65%. Before starting the profession auto-rickshaw drivers thought that there is enough social value but after starting the profession 49% rental auto-rickshaw driver and self-owned rickshaw driver is considering less social value is one of the most common and major issues for their planning to change the profession. And after less social value the main cause of the 16% self-owned auto-rickshaw driver for leaving this profession is heavy material replacement cost which includes battery replacement cost and other body parts replacement cost. In addition 26.97% of rental auto-rickshaw drivers have their own planning to change the profession because of high amount of rent and unsafe road conditions, but only 9.16% rental auto-rickshaw drivers consider that there is not enough money to earn. And the study findings told that after social status and unsafe road high rent is the main cause for 'leaving planning' to this profession for the rental auto-rickshaw drivers. Furthermore, after less social value, heavy material replacement cost is the main reason for the self-owned auto-rickshaw to change the profession.

Auto rickshaw's Daily Trip

According to the survey, average trips of auto-rickshaw are around 48 and it runs for the 125 average kilometers with total working time is nearly 11 hours. And the auto-rickshaw runs without passengers in kilometers is 4 km.

Table 4.5 Different Parameters of Auto rickshaw's Daily Trip

Parameter	Mean Value
Daily Trips (Average)	47.22
Traveling in Kilometers	125
Highest Trip Taken (Length in Kilometers)	4.85
Working Period (In Hours)	10.50
Travelling Period of Empty Kilometers (average)	4

Source: Field Survey

High Demand Locations

The Criteria for selecting high demand locations were asking the driver of the auto-rickshaw to select a location, from where most of the time they get passengers. And the highest demand locations on the basis of drivers' opinion is Medical Mor 33% and in the second position the locations were Payrachattar, Jahajcompany, and City Bazar 21%. In addition Sathmata contains 15%, Station contains 12%, Terminal contains 10% and Saplachattar contains 9% . For the reason of high demand, these locations contain highly beneficiaries for the daily trip of auto-rickshaw as well as also contains high traffic jams.

Market Size of Auto rickshaw

The website of Rangpur City Corporation (http://rpcc.gov.bd/introduction/city-corp-intro/) provides the information that the total area of Rangpur city is 205.76 square kilometers with 7,96,556 population. And the total number of the auto-rickshaw market size of auto-rickshaw in the Rangpur City Corporation is 21,800. So the proportion of auto-rickshaw with population will be 1:37. And this proportion indicates a very large number of market size of auto-rickshaw in the Rangpur City Corporation. Table 4.4 indicates divisional market size of auto-rickshaw. From this table, it can be clearly seen that the different divisional market sizes of auto-rickshaw are smaller than Rangpur City Corporation except for Dhaka and Chittagong.

Table 4.4 Market Size of Auto rickshaw:

Name of Division	Number 0f Auto rickshaw (Approximated on May 2014)	Number of Population	Auto rickshaw's Proportion with Population
Dhaka	67,753	4,74,24,418	1:700
Chittagong	63,580	2,84,23,019	1:447
Khulna	60,820	1,56,87,759	1:258
Rajshahi	54,342	1,84,84,858	1:340
Sylhet	56,885	99,10,219	1:174

Barisal	47,740	83,25,666	1:174
Rangpur	43,642	1,57,87,758	1:362

Source: (1) The New Age, 7 November 2013
(2) Statistical Pocket Book Bangladesh 2015(http://203.112.218.65:8008/WebTestApplication/userfiles/Image/LatestReports/PB2015.pf)

Battery Market Size

According to Mohammed Shahidul Islam, Secretary of the Bangladesh Accumulator & Battery Manufacturers Association every year 19 lakh battery is used for easy bikes (Easy bikes outgrowing limitations, 2017). Most auto rickshaw's battery is used for six to ten months. And then it needs to change after this short period of time. For this reason, the battery market is very large. And the market size of the battery was 8000 corer BDT in the year 2017 were five years ago, it was 2000-3000 corers BDT (Chakma, 2018). In addition, it is estimated that the battery market size has increased by 100% in the last two years.

The difficulty of Getting License and Illegal Business

Rangpur City Corporation is giving a limited number of licenses to the new auto rickshaw. But renewal of registered auto rickshaw is running. For this reason registered license is selling in two or three times higher prices illegally and the city corporation is losing its revenue. According to the field observation losing the amount of revenue is 15,00,000 to 19,00,000 per year. Another observation of the study indicates that a group of people is giving fake digital registration cards and by doing it they are earning a lot of money illegally (Arrested 1 on the charge of fake signature of Meyor, 2018). In addition, some auto-rickshaw owners are using the same registration card for another three or four auto-rickshaws and this illegal use of registration card is 7.8% of the total number of auto-rickshaw.

Previous Profession of Auto rickshaw Driver

The previous profession of the auto-rickshaw driver is an important economic factor to come to this profession. As mentioned earlier that 70% of auto-rickshaw drivers chose this profession because it is profitable more than their previous profession. So the shortage of earning capacity of their previous profession is the main cause to leave that profession. In addition, 29% of auto-rickshaw driver was the paddle rickshaw driver and the study says paddle rickshaw driver's income is 55% lower than the auto-rickshaw driver. In the section of day laborers, they have also claimed about their less income of the previous profession and 21% of auto-rickshaw drivers were day laborers. A total 5% of the auto-rickshaw driver had very small business so they were also facing the lack of income in their previous profession. And 15% of auto-rickshaw driver was unemployed persons among them some were student, some were migrants from the rural area of Rangpur division. In addition, a total 10% were farmed and according to the opinion of the farmer auto-rickshaw driver they are earning sufficient money comparing with their previous profession and other previous profession is containing 20%. So this previous profession of auto-rickshaw driver indicating the previous lower incomes and economic conditions.

Income Comparison

The tables 4.11 are describing the previous and present income comparison of the auto-rickshaw drivers. From the table, it can be clearly seen that the previous and the present income of self-owned auto-rickshaw drivers were higher than the rental auto-rickshaw drivers. And meanwhile, with the comparison, it is also describing the relation between the previous and present income of the auto-rickshaw drivers. Because compared with the self-owned auto-rickshaw driver the income is less for the rental auto-rickshaw drivers both for the present and previous income.

Table 4.5 Present and Previous Income Comparison:

Amount (BDT)	Present Income (Rental)	Present Income (Self-owned)	Previous Income (Rental)	Previous Income (Self-owned)
200-300	1	0	35	0
300-400	4	1	53	7
400-500	58	2	10	15
500-600	18	2	1	43
600-700	9	7	1	5
700-800	6	15	0	1
800-900	3	19.5	0	1
900-1000	1	40.5	0	0
1000-1200	0	11	0	0
1200-1400	0	1	0	0
>1400	0	1	0	0

Source: Field Survey

Fare Comparison

Due to the low traveling cost average, 57% of passengers are preferring auto-rickshaw (Shown in figure 7.1). And table 4.12 is also describing the lower cost of an auto-rickshaw. The fare of CNG is double compared with an auto-rickshaw fare. And compared with paddle rickshaw the fare is 200% bigger than auto-rickshaw. And because more passengers are preferring auto-rickshaw the earnings of the auto-rickshaw drivers are also increasing.

Table 4.6 Fare Comparison of Different Mode:

Mode	Distance	Fare Per Head (BDT)
Auto rickshaw	Bankmor to Burirhat	10
CNG	Bankmor to Burirhat	20
Paddle Rickshaw	Bankmor to Burirhat	30

Source: Field Survey

5. Environmental Impact:

Results and Discussion for the environmental impact of the study

Passenger's Pollution

The passengers do smokes in the auto-rickshaw. 31.33% drivers of auto-rickshaw responded that passengers do smoke in the auto-rickshaw and among them, 80% 0f the age between 21-35 rest is >35 aged person. And the findings say that the auto-rickshaw drivers usually do not try to stop smoking in auto-rickshaw because most of the drivers think that it would be badly impacting their profession.

Electricity Production, Distribution, Pollution and Emission

All over the country, more than 5,00,000 battery operated auto-rickshaw is running which is consuming 450 megawatts of electricity per day (Rasel, 2017). And most of the auto-rickshaw is charging by the household connections. The present field data says everyday Rangpur needs up to 500 megawatts of electricity and here installed capacity of electricity generation is 564 megawatts where present capacity is 484 megawatts.

In the RPCC area total of 21800 auto rickshaw is running and it is the cause for the consuming of(0.0009*21800)= 19.62 megawatts of electricity. It indicates that most of the lacked power is consumed by the auto-rickshaw. In addition lack of demanded electricity is created by auto rickshaw. And for this 19.62 megawatts of electricity, the power plants are producing 9810 kg(19.62*1000*500/1000) carbon per day.

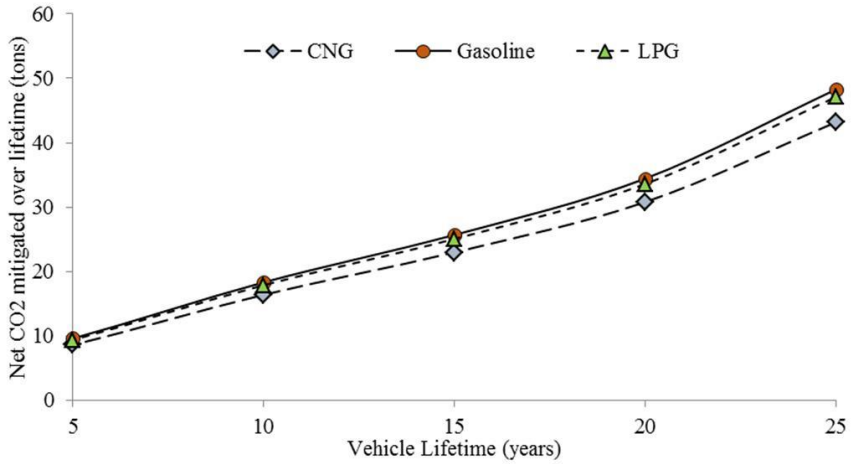
On the contrary, the auto rickshaw's average traveling period is 125 kilometers per charge and it consumes 11 kWh on every charging. So the total amount of energy consumed per kilometer is 0.088. According to field data power plants produces CO_2 500gm for 1 kWh. And for every auto-rickshaw power plant produces an average total (11×500) = 5,500gm CO_2 and it will be near about (5,500÷125) = 44 gm (average kilometer of auto-rickshaw is 125 km) per kilometer. In addition the website of SunEarthTools (SunEarthTools.comhttp://www.sunearthtools.com/ tools/CO_2-emissions-calculator.php) indicates 153.57 and 175.94 emissions occurs by the petrol and diesel car respectively. Another study shows that motor vehicle is responsible for over 70% of air pollution (Bull and Zimmann, 2000). So auto-rickshaw is polluting the environment indirectly with less amount comparing with another vehicle.

Auto rickshaw's Purposive Comparison with Solar Auto rickshaw

Considering the mode of transport pollution could be reduced and the most possible ways of reducing emissions are to use solar energy operated auto-rickshaw. The Auto rickshaw's battery could be charged in two ways, from the National Grid and Solar PV module (Mallik et al., 2017). For the charging facility of auto-rickshaw solar energy or thermal energy could be used. And the reason for solar energy has chosen here because Bangladesh gets a huge amount of energy from the sun (Khan et al., 2012; Mallik et al., 2017). A study has shown that if 1 pcs solar panel is used cost reduction for the auto-rickshaw will be 27 BDT per day and if 2 pcs solar panel is used cost reduction will be 54 BDT per day with power supply 12% and 24%. And this study also indicates that their model vehicle will consume 24% less energy which will be contributing to the reduction of CO_2 emissions by 18%-24% (Mallik et al., 2017). Another study has shown a solar-powered electric auto-rickshaw (SPEA) which is requiring less investment of USD 1950 and mitigation of CO_2. And for 25 years (considered as the vehicle lifetime) it could mitigate huge amounts of CO_2, which is shown in figure 5.1(Reddy, Aravindhan, & Mallick, 2017).

From this study, it can be clearly understood that solar auto-rickshaw is more effective in the sector of environment and the initial investment is less than a battery-operated auto-rickshaw.

Figure 5.1 Mitigation of carbon-dioxide emission over SPEA Lifetime (Reddy et al., 2017).



So for the profit and environment-friendly vehicle solar oriented auto rickshaw could play a great role in the regarding the field of transportation.

Battery and Pollution

The average lifetime of a battery is 7.5 months. And by throwing life expired batteries just anywhere pollution is happening. Throwing of life expired batteries is a common occurrence because there is no systematic method to dispose of the auto rickshaw's batteries in the Rangpur City Corporation.

7. Passenger's view:

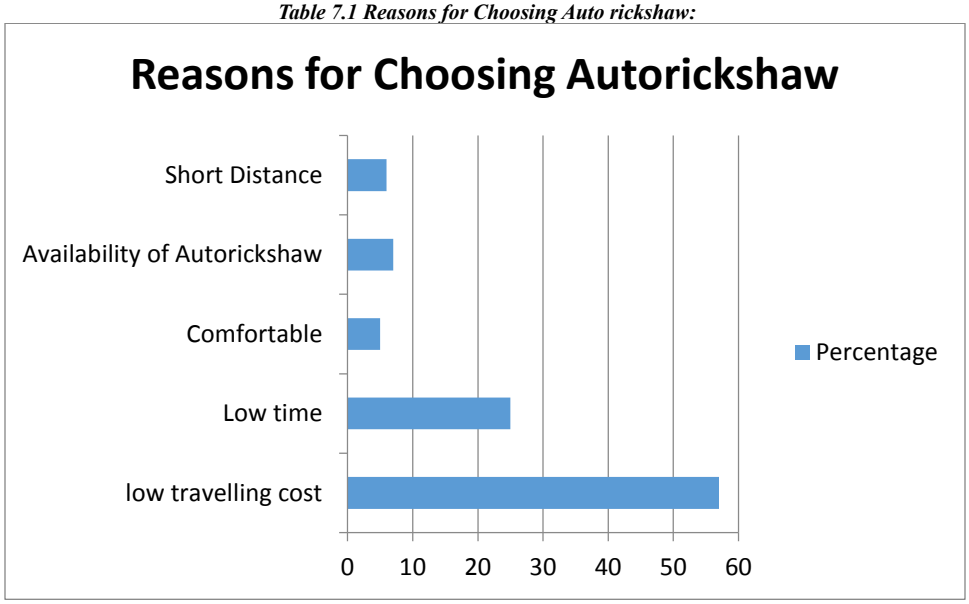
Results and Discussion for the passenger's view of the study

Preferential Choice and Reasons for choosing Auto rickshaw

Passengers were asked for their opinion on the topics of the easy mode of transportation and 71.11 percent of the total 100 percent passengers has given their opinion for auto rickshaw and other modes of transport choices are Paddle rickshaw 10.98%, CNG 4.76%, Bus/Microbus 2.46%, Others 10.69%.

The passengers have given their opinion on the basis of low traveling cost, Low time, Comfortable Condition, Availability of Auto rickshaw, Short Distance which is shown below in the table of 7.1 And it is indicating that most of the passengers prefer auto-rickshaw for its low cost and short period of time to go their destination.

Table 7.1 Reasons for Choosing Auto rickshaw:



Source: Field Survey

Mode Share

According to the respondent of the passengers, they are sharing different modes for different purposes. And with the comparison of CNG, Bus/Microbus, Paddle Rickshaw, Bicycle, Motorcycle, Car passengers are mostly using an auto-rickshaw for different

purposes. In addition, for both work purposes and education purposes, the highest number of passengers is using auto-rickshaw and which is 33.33% and 60.89%. However, for the medical emergency and health purposes highest number (29.13%) of passengers are using an auto-rickshaw because of the availability of the auto-rickshaw.

Safety and Accident

According to the field assessment that there is no technical safety setup as well as road, the condition is not favorable for the auto-rickshaw. And the body of auto-rickshaw is light and it could be damaged even by a light stroke (Sarker, 2009). For this reason, according to the study total 71% of auto-rickshaw driver respondents that they have got accident and 51% of the passengers got accident. Among this 51% passengers 32% responded that accidents were happened due to the driver's poor skill of driving auto-rickshaw. In addition the number of accidents on the road is increasing due to three-wheelers on highways including CNG, battery-run auto-rickshaw, and the engine has driven locally made Nosimon. And according to Bangladesh Road Authority (BARTA) data based on police's first information report 2,562 accidents were held where the number of accidents was 2,566 in the year 2016(Akhter and Monir, 2018).

Rent Facilities

Among the total respondent, only 13% claimed that the rental fees for their trips are excessive. And by this, it can be clearly understood that most of the passenger feels satisfied with the rent fee of auto-rickshaw for their daily trips.

Opinion on Number of Auto rickshaw

Passengers were asked their opinion on a number of auto-rickshaw in the Rangpur City Corporation and 19% passengers has given their opinion that the number of auto-rickshaw is moderate, 1.90% passenger has given their opinion that the number of auto-rickshaw is insufficient, 28.10% passenger has given their opinion that the number of auto-rickshaw is sufficient and 51% passenger has given their opinion that the number of auto-rickshaw is excessive.

Traffic jam

The traffic jam is a common occurrence in big cities and towns. And there could be various reasons for traffic jams. But in the Rangpur City Corporation auto-rickshaw is the main cause of traffic jams. Because in the last few years the number of auto-rickshaw has increased nearly 15 times higher than the previous time. Another cause of traffic jams is that there is no parking area for auto rickshaw. So the drivers pick their passengers and take them off anywhere on the road which causes traffic jams.

Findings

i. 'Profit of the auto-rickshaw profession' is the cause to choose the profession of the auto-rickshaw driver. And the previous income of the auto-rickshaw driver is less than the present time. So the economic development of auto-rickshaw drivers is gradual.
ii. There is no government authorized training facilities for the auto-rickshaw. And It is found in the field data that 87.55% of auto-rickshaw driver drives auto-rickshaw without having any kind of driving training and the rest of the 12.45% gets their training from unauthorized individuals.
iii. 71% auto rickshaw gets accident and more than 80% accident was happened due to the poor driving skill of the auto-rickshaw driver.
iv. Total 49% auto-rickshaw are bought by getting a loan from different banks, insurance company and NGOs as well as individuals who are playing a great role for the initial investment of an auto-rickshaw.
v. 69% of loans taken the owner of auto rickshaw's economic condition are poorer than other self-owned auto-rickshaw drivers.
vi. Most of the rental auto rickshaw drivers don't make savings, but most of the self-owned auto-rickshaw driver makes their savings which is indicating that the economic condition of self-owned auto-rickshaw is far better than rental auto rickshaw driver.
vii. Social value is decreasing in the profession of auto-rickshaw which is the main cause of 49% of the auto-rickshaw drivers for willing to change the profession.
viii. The highest demand locations in Rangpur city are Medical Mor.
ix. The market size of auto-rickshaw in Rangpur City is larger compared with other district divisional areas of Bangladesh. And 71.11% of passengers of auto-rickshaw choose it because of its low traveling cost, faster speed and availability

compared with other existing vehicles of Rangpur city which is also indicating the large market source of economic development for the auto-rickshaw drivers.

x. The market size of the battery has increased by 100% in the last two years.
xi. The Rangpur City Corporation is losing 15 lakh to 19 lakh BDT for the illegal selling of the old registration card of auto-rickshaw.
xii. The power plant produces 44 gm CO_2 for the per kilometer of auto rickshaw's travel.
xiii. The reduction of air pollution could save $200 million and $800 million per year.
xiv. If solar panels could be used for auto rickshaw it could save 27 BDT to 54 BDT per day and also it could be the cause of the reduction of CO_2 emissions by 18%-24% (Mallik et al., 2017).
xv. From 2012 54% of auto-rickshaw has increased in the Rangpur city which is excessive for traffic and consumption of power.

Recommendation

- For the increasing number of auto-rickshaw RPCC must stop their role to permit new registration of the auto-rickshaw and a monitoring cell must be created to monitor that unlicensed auto-rickshaw or 1 license of auto-rickshaw could not be used for several auto-rickshaw and public bus or transport service must be implemented for short destinations in the area of RPCC.
- Through the household connections, battery-operated auto-rickshaw is consuming electricity with minimum price as a household consumer but if it needs to control for increasing number of auto-rickshaw they must be considered as commercial basis consumers.
- Solar based auto rickshaw must be implemented so that it can cover a shortage of electricity and also can be decreased CO_2.
- As per government rules, auto-rickshaw should not be run on the highway, but in the Rangpur City Corporation, auto-rickshaw is continuously running, for this problem a separate lane can be created for the three-wheelers.
- To avoid auto-rickshaw accident there should be training facilities for the driver of auto rickshaw by the government.
- The battery of auto-rickshaw must perform for a long time, so it needs to be modified. And for the water-oriented battery, there needs much modification. Because within the charging time battery gets overflow which is the cause for the system loss of power-consuming.
- A systematic eco-friendly expired battery disposal unit must be installed.

Conclusion

Battery operated auto-rickshaw is a profitable job with 900+ average income per day. Rangpur city contains more high demand locations like medical or which contains 33% passenger demand of the entire city and large market size for the auto-rickshaw as well as auto-rickshaw contains low fare compared with other vehicles including rickshaw puller it costs 200 percent lesser amount which is positively economically affecting for the auto-rickshaw drivers. But its social value is less for 49 percent auto-rickshaw drivers. On the contrary, the drivers are satisfied economically with this profession because it's market size is bigger than any other city which is 1: 362. For the reason for battery-operated auto-rickshaw employment, the sector is also developing for more than 6500 persons. As it seems to be eco-friendly having no pollution but it is the cause huge amount of emission 44 gm for each auto rickshaw by consuming power 19.62 megawatts per day which can be effectively avoided 18-24% less through the implementation of solar oriented auto rickshaw. In addition it has a less adverse effect on the environment compared with other diesel or fuel-run vehicles. And directly it does not create emission as well as sound pollution. Its technology is very light and for greater use like present time, it needs modification. And it is contributing largely to the transportation sector of the Rangpur City because most of the people in this area are preferring auto rickshaw.
The extended recommendations propose a future course of action of creating an infrastructure for the electric vehicles so that it could be used for renewable energy and can be indicated eco-friendly vehicles with no direct or indirect emissions.

References

[1]. Akhter, S. & Monir, Z. (2018, July 05). Three-wheelers back on highways defying ban. The New Age (Bangladesh). Retrieved from http://www.newagebd.net/article/45201/three-wheelers-back-on-highways-defying-ban

[2]. Ali, T. (2019, March 19). Electric rickshaws run out of steam. *The Daily Star*. Retrieved from https://www.thedailystar.net/news-detail-187825

[3]. Arrested 1 on the charge of fake signature of Meyor. (2018, July 14*), The Daily Prothom Alo*(Bangla Newspaper). pp.1-20

[4]. Chakma, j. (2018, April 26). Automotive battery market revving up. The Daily Star. Retrieved from https://www.thedailystar.net/business/automotive-battery-market-revving-1567975

[5]. Easy bikes outgrowing limitations. (2017, September 19), *The Daily Star*. Retrieved from https://www.thedailystar.net/business/easy-bikes-outgrowing-limitations-1469200

[6]. Khan, S., Rahman, T., & Hossain M. S. (2012, June). A brief study of the prospect of solar energy in the generation of electricity in Bangladesh. *Cyber Journals: Multidisciplinary Journals in Science and Technology, Journal of Selected Areas in Renewable and Sustainable Energy (JRSE)*. Retrieved from https://www.researchgate.net/publication/316170323_A_BRIEF_STUDY_OF_THE_PROSPECT_OF_SOLAR_ENERGY_IN_GENERATION_OF_ELECTRICITY_IN_BANGLADESH

[7]. M.A. Bull, and R. Zimmann. (2000). Traffic Emission Data for Air Quality Reviews. *Clean Air, 27*, pp.138,

[8]. Mahmood, S. A. I. (2011). Air pollution Kills 15,000 Bangladeshis Each Year: The Role of Public Administration and Governments Integrity. *Journal of Public Administration and Policy Research*, *3*(4). Retrieved from https://www.researchgate.net/publication/228480343_Air_pollution_kills_15000_Bangladeshis_each_year_The_role_of_public_administration_and_governments_integrity

[9]. Mallik, A., Arefin, M. A., & Pal, S. K. (2017, December). Solar Based Micro Hybridized Auto-Rickshaw & its Feasibility Analysis for Bangladesh. Proceedings of the International Conference on Mechanical Engineering and Renewable Energy 2017 (ICMERE2017). Retrieved from https://www.researchgate.net/publication/319556203_Solar_Based_Micro_Hybridized_Auto-Rickshaw_and_its_Feasibility_Analysis_for_Bangladesh

[10]. Mallik, A., Arefin, M. A., Rashid, F. & Asfaquzzaman, (2017, December). Solar Based Plugged-in Hybrid Engine Driven rickshaw (Auto-Rickshaw) & its Feasibility Analysis for Bangladesh. *International Conference on Mechanical, Industrial and Materials Engineering 2017 (ICMIME2017).* Retrieved from https://www.researchgate.net/publication/322097354_Solar_Based_Plugged-in_Hybrid_Engine_Driven_rickshaw_Auto-Rickshaw_its_Feasibility_Analysis_for_Bangladesh

[11]. Rahim, M. A., Joardder, M. U. H., Hoque, S.M. N., Rahman, M. M., & Sumon, N. H. (2013, February).Socio-economic & environmental impacts of battery-driven auto-rickshaw at Rajshahi city in Bangladesh. Paper presented at the *International Conference on Mechanical industrial and Energy Engineering 2012*. Retrieved from https://www.researchgate.net/publication/252629845_Socio-economic_environmental_impacts_of_battery_driven_auto_rickshaw_at_Rajshahi_city_in_Bangladesh

[12]. Rana, M. S., Hossain, F., Roy, S. S., & Mitra, M. S. K. (2013). Exploring operational Characteristics of Battery operated Auto Rickshaws in Urban Transportation System. *American Journal of Engineering Research (AJER), 2*(4). Retrieved from http://www.ajer.org/papers/v2(4)/A0240111.pdf

[13]. Rana, M.S., Hossain, F., Roy, S.S., & Mitra S. K. (2012). Battery Operated Auto-rickshaw and Its Role in Urban Income and Employment-Generation. International Journal of Advancements in Research & Technology, *1*(5). Retrieved from http://www.ijoart.org/docs/Battery-Operated-Auto-rickshaw-and-Its-Role-in-UrbanIncome-and-Employment-Generation.pdf

[14]. Rasel, M. R. (2017, September 27). PDB for bringing the battery-run vehicle under traffic. *Dhaka Tribune*. Retrieved from https://www.dhakatribune.com/bangladesh/power-energy/2017/09/27/pdb-bringing-battery-run-vehicles-tariff-regulations/

[15]. Reddy, K. S., Aravindhan, S. & Mallick, T. k. (2017). Techno-Economic Investigation of Solar Powered Electric Auto-Rickshaw for a Sustainable Transport System. *Energies, 10*(6). doi: https://doi.org/10.3390/en10060754

[16]. Sarker, R. (2009, August 17). Electric rickshaws in Rangpur. *The Daily Star*. Retrieved from https://www.thedailystar.net/news-detail-101849

[17]. SunEarthTools. (2018). CO_2 Emissions. Retrieved from SunEarthTools.comhttp://www.sunearthtools.com/ tools/CO2-emissions-calculator.php