

## **STUDY ON NON-CONVENTIONAL MOTORIZED VEHICLE**

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### **ABSTRACT**

Within the last few years a massive revolution has been taken place in rural transportation system in Bangladesh by introducing locally manufactured non-conventional motorized vehicles that is gradually coming in international as well as national notice. These transport revolution is able to draw attention of the policy makers and researchers. These vehicles are modified form for transportation used normally in rural areas of Bangladesh. The aim of this study is to identify the existing conditions of the non-conventional motorized vehicle and focus on the critical issues that should be overcome to reach up to the standard mark. The field investigations were carried out on non-conventional vehicles considering the types, technical features, impact on socio-economy, environment, public health, etc. The results of the field investigation depicts that four types of vehicles are commonly available and are not safe for riding as well as environment friendly. However, they have a great positive contribution to rural socio-economy and transportation facilities and cannot be avoided from rural life. Therefore, further research need to be conducted for necessary improvement to overcome the short comings.

Keywords: NCMVs; rural transport; safety and risk; environmental impact; socio-economy

### **INTRODUCTION**

By the turn of civilization and over the years, numbers of vehicle has been introduced in the transportation system for the human hauling and goods carrying. These are usually conventional motorized vehicles such as bus, truck, trailer, tractor, private car, jeep, etc. that are serving all over the world. The development of these conventional motorized vehicles has been made by the result of long time research. The comfort, safety, breaking system, noise level, sustainability, stability in static and dynamic state, etc. of these conventional motorized vehicles have been studied to maintain up to a certain standard level. These conventional motorized vehicles are also used in transportation system of Bangladesh. Besides these conventional vehicles, another transportation technology which is known as non-conventional motorized vehicle (NCMV) has been introduced in the urban and rural transportation in Bangladesh very recently (Scott Justice, 2004).

So far our knowledge goes, a little formal studies have been carried out on the widespread use of such non-conventional motorized vehicles which are locally called as “Nosimon”, “Korimon”, “Botboti”, “Fighter” (Scott Justice, 2004; Bari and Haque, 2011). The names are given by the rural people by matching with their rural culture and for the distinctive sound makes by the single cylinder diesel engines of these vehicles. These NCMVs have made their space in rural and even in some cases in urban transportation system stealthy due to the inadequacy of conventional transportation facilities, availability of locally manufacturing facilities with very inexpensive Chinese diesel engines (1000taka per HP; Scott Justice, 2004). The designs of these non-conventional vehicles are simple due to the fact that the rural workshops, with a stick welder, a drill press and in some cases a very old lathe, are presently not able to fabricate more complicated machinery. These vehicles are mostly used in rural areas of Bangladesh and their number is increasing day by day. This study focuses on – categorizing of the vehicles, capacity of hauling, purposes of use, engine specification, driving mechanism, overall engine performance, safety measures, environmental effect and socio-economic feasibility of the operation.

## METHODOLOGY

A comprehensive field investigation was carried out at various places around Rajshahi City on non-conventional motorized vehicle to collect the detail information about the various types of NCMV used in rural and peri-urban areas. The investigation was conducted on types of vehicles based on the purposes of use, engine types, capacity of vehicle, specification of various engines used in particular purposes, physical dimension of vehicle, wheel size, breaking system, etc. Some opinion regarding the various subjects of NCMV from users were also collected by talking with the users. Finally, a summary was made based on the collected information and conclusion was drawn.

## RESULTS AND DISCUSSIONS

### *Description of Non-Conventional Motorized Vehicles*

Non-Conventional Motorized Vehicles are made in local workshops. The dimension of the vehicle depends on purposes and capacity of the engine. However, the size of these vehicles is made without any engineering design consideration. Components of these vehicles are same but most of the cases safety measures are not provided properly. The NCMVs are designed and fabricated as three wheeler rickshaw and tempo. There are four kinds of vehicles are observed around Rajshahi City those can be classified as (i) Motorized flatbed light rickshaw (MFBLR), (ii) Motorized flatbed heavy rickshaw (MFBHR), (iii) Motorized medium size tempo (MMST) and (iv) Motorized heavy duty tempo (MHDT). The characteristics of these NCMVs are summarized in Table 1.

Table 1: Characteristics of various types of non-conventional motorized vehicles

Items	MFBLR	MFBHR	MMST	MHDT
Local name	Nosimon /Fighter/ Botboti	Korimon/ Botboti	Noshimon/ tempo	Noshimon/ Botboti mini truck
Body	Length: 6 ft Width: 4 ft Height: 4 ft	Length: 9 ft Width: 4 ft-6 in Height: 4 ft		Length: 10 ft Width: 4 ft Height: 6 ft
Engine	CHANG FA (China)		EME (China)	CHANGCHAI ZS1115 (China)
HP	2.5 ~ 4	4 ~ 8	8~12	25
Output	1h rating output- 4.47 KW 12h rating output-3.88 KW		1h rating output- 6.47 KW 12h rating output – 5.88 KW	
Wheel	Normal vangari are used.	Diameter of wheel is 18 in.	Diameter of wheel is 18 in.	Diameter of wheel is 26 in. and 30 in.
Stirring	Rickshaw handle	Rickshaw handle	Rickshaw handle	Wheel stirring
Brakes	Belt type brake is provided		Indian auto-rickshaw's axle's rear brakes	Conventional brake
Axel rotation	By rubber belt			By differential
Axel	Axel of normal rickshaw	Axel of Indian auto rickshaw		Axel of Indian truck
Speed	30~35 kmph	35~40 kmph	40~45 kmph	45~55 kmph
Skid	About 6 ft	About 5 ft	About 4 ft	About 2 ft
Light	No light	No light	Single light	Double light
Mirror	No mirror	Two mirrors	Two mirrors	Two mirrors
Speed Meter	No meter	No meter	No meter	With meter
Fuel	Diesel			
Mileage	Approximately 15 km per hour	Approximately 15 km per hour	Approximately 20 km per hour	Approximately 15 km per hour
Mobil consumption	2 Liter of lubricant is used for about 2.5 months for about 2500 km.			
Capacity	4 ~ 6 Passengers	6 ~ 8 Passengers	8 ~ 10 Passengers	Goods carrier (cows/ buffalos)

### ***Motorized flatbed light rickshaw (MFBLR)***

The smaller motorized rickshaw vehicles have a 2.5 - 4 HP engines and feature a very simple “single speed” V-belt clutch/transmission where a foot peddle/lever with idler pulley slowly tightens or engages the belt to begin moving forward. There is no reverse gear provision. The frame surrounding and supporting the engine are made in local workshops. Many times the front forks are also manufactured locally as the factory rickshaw forks are not strong enough for increased speed and poor road condition. The remaining frame, axle, tires, etc. are the commercially available rickshaw frames and parts. The rear brake is a piece of 4 inch flat belt (normally to power threshers and mills) wrapped around a 5 inch hub fixed on the rear axle around the hub and connected and tightened by yet another foot peddle to provide friction for stopping. Many times the commercial rickshaw front-wheel brake is also provided. They normally can carry 250 - 400 kgs of cargo/passengers. Costs are reportedly under 400USD. This type of vehicle is usually used for both man and goods carrying in rural areas of Bangladesh. Fig. 1 shows the typical motorized flatbed light rickshaw.



Fig. 1: Motorized rickshaw flatbed with 3 HP Chinese engine

This motorized flatbed rickshaw has become obsolete very recently. The place of this motorized flatbed rickshaw has been taken by rechargeable battery (electric power) driven flatbed rickshaw van after coming the electric rickshaw in market. This newly imported electric power driven rickshaw van has gained popularity because of lighter weight, noise free, smoke free, low initial and maintenance cost and easy operation.

### ***Motorized flatbed heavy rickshaw (MFBHR)***

Fig. 2 shows the typical motorized flatbed heavy rickshaw and other features are presented in Table 1.



Fig. 2: Motorized flatbed heavy rickshaw or 'vangari'

The MFBHR is heavier than that of MFBLR structurally and engine capacity. The body frame is made in local engineering workshop with MS angle, flat bar, rod, etc. Diesel engine manufactured in China of 4 to 8 HP is mounted on bed under the driver sit. Tempo wheels of 18 inch are used. Similar “Single speed” V-belt clutch/transmission as well as braking system is used in this vehicle as MFBLR. They normally can carry 400 - 500 kgs of cargo/passengers. Costs are reportedly under 500USD. This is also used for both man and goods carrying in rural areas of Bangladesh.

#### ***Motorized medium size tempo (MMST)***

The medium size 3-wheeled vehicles are based on auto-rickshaw designs but whose frames and bodies are locally manufactured (Fig. 3). The engines are varying from 8-12 HP and have a similar belt transmission system but with heavier sometimes multiple V-belts. Many times these medium size vehicles may have two clutch levers with two sizes of drive pulley/drive belts on the engine that provide the machine a first and second gear. The rear axles are of various sizes can be from old Indian auto-rickshaws supplied from scrap yards, but with the planetary gears removed and a double chain or double belt pulley inserted in its place with a single drive axle/wheel. Tires and hubs are also purchased from scrap yards. These vehicles will sometimes have leaf spring suspension but coil springs seem to be the main suspension system and very few may have shock absorbers. The size and capacity varies greatly in this category. The brake system utilizes the Indian auto-rickshaw’s axle’s rear brakes and rarely features a front brake. They generally have a small simple belt driven dynamo attached for headlamp/night time driving. This category or vehicles are the most numerous and author estimates there could be upwards of 10,000 or more on the roads around Bangladesh. Their cost ranges from 500-1000 USD.



Fig. 3: Motorized medium size tempo (MMST)

#### ***Motorized heavy duty tempo (MHDT)***

Though in the beginning found in much fewer in numbers but in recent years the heavy duty 3-wheel vehicles are gaining popularity. They range from 12-25 HP engine capacity. The one shown below is a top-of-the-line model that uses a 25 HP Chinese diesel engine that is connected by three heavy V-belts to a heavy duty Japanese van’s 5 speed clutch and transmission and duel wheel rear axle (Fig. 4). An automobile battery/alternator charging system is belt driven from the engine and the vehicle has two front headlights and rear running lights and brake lights. It substantial main frame and front tire suspension is locally manufactured. The rear brakes are the Toyota’s and there is no front brake. The steering assembly is also cobbled together from the Toyota’s steering wheel and gear. Admittedly, this featured vehicle is one of the most sophisticated that the author has seen but illustrates what is possible in many of these less sophisticated but highly motivated workshops. Cost range over 1000 USD.

#### ***Short Comings of Non-Conventional Motorized Vehicles***

The vehicles are manufactured without following proper design considerations by any automobile engineer such as dynamic stability, braking efficiency, vibration, sock absorption, noise control, comfort, etc. Even though, most of the components fabricated locally are not designed following any

engineering analysis for choosing the section and size. Therefore, safety factors are not properly provided to the components of these vehicles.



Fig. 4: Motorized heavy duty tempo (MHD)

The short comings of the non-conventional motorized vehicles can be summarized as:

- i. Brakes are not sufficient in case of emergency.
- ii. Rubber belt and rotating shaft are used for braking which are not checked regularly.
- iii. As break system is not good it has skidding and slipping tendency.
- iv. Lighting arrangement of these vehicles is not sufficient but drivers don't hesitate to drive vehicle at night time. Passengers often take this risk to reach at home quickly.
- v. In most cases mirror is not used. So driver cannot get rear view and thus has risk of accident while vehicle from back tends to overtake.
- vi. The limit of speed often goes beyond the control of driver due to the absence of meter.
- vii. The capacity of these vehicles is not too much but drivers have a tendency to carry more people or goods at a time to earn more money. They are not aware and do not care about capacity of the vehicle.
- viii. Drivers are mostly of age about 14 to 25 years old. They do not have proper training or driving license.
- ix. Drivers have the competitive tendency for driving.
- x. There is no safety measure for passengers and even for drivers.
- xi. Sitting arrangement for driver is at very high level in most cases and uncomfortable.
- xii. The vehicles are not registered to road transport authority.
- xiii. There is no route permit and certification system for running.
- xiv. There is no information about number of vehicles, owner, address of owner, capacity, purpose of use, etc. to road transport authority.
- xv. The traffic management division is not able to take necessary action against them for disobeying the traffic rules.

#### ***Impact of Non-Conventional Motorized Vehicles on Socio-economy***

Nobody can deny the contribution, importance, necessity of non-conventional motorized vehicles in rural transportation system in our country though it has many negative impacts. The non-conventional motorized vehicles are mostly used in rural areas where transportation system is not improved and conventional motorized vehicles are rare or not sufficient. It has developed easy transportation system for carrying the goods as well as people in rural life which has also mobilized the social and economic development. The rural people easily can carry their products for selling in urban market at higher price. On the other hand, they also can run their business comfortably by buying necessary goods from urban market for selling in rural area. Therefore, this transportation system has made comfortable rural life with easily available urban advantages.

Furthermore, it has opened an opportunity for earning money from rural transportation business. Most of the cases the drivers are owner of their vehicle they drive. Many cases it is observed that this transportation business is the major earning source of the family. In this case mostly 3 to 6 people are

dependant on this income. A questioner survey was conducted among 143 drivers of non-conventional motorized vehicles around the Rajshahi City. The results are summarized in Table 2.

Table 2: Socio-economic survey of non-conventional motorized vehicles drivers

Items	MFBLR	MFBHR	MMST	MHDT	
Surveyed vehicle (Nos.)	36	28	62	17	
Driver age	12-15	12%	9%	16%	2%
	16-20	29%	19%	26%	16%
	21-25	43%	54%	47%	58%
	>26	16%	18%	11%	24%
Ownership	Self	100%	100%	94%	70%
	Other	0%	0%	6%	30%
Dependent	0	11%	9%	4%	0%
	1-2	13%	27%	11%	12%
	3-4	34%	23%	47%	47%
	5-6	42%	41%	38%	41%
Daily income	Tk.	500-700	500-800	600-800	800-1200

On the other hand, many engineering workshops have been developed in the rural areas. All the engineering workshops are very busy for manufacturing, repairing and maintenance of these non-conventional motorized vehicles. A good numbers of people are working in these workshops though in many cases children are found as worker. Mostly they are learners and not working as employee. It is also found that some children workers are to be paid though the amount is small. In some cases, it is observed that the children workers are earning person for their family. Therefore, these non-conventional motorized vehicles have great contribution to the socio-economy of rural life and many cases that is the only way to living for the low income rural people.

#### ***Impact of Non-Conventional Motorized Vehicles on Environment and Public Health***

Like as conventional motorized vehicles, non-conventional motorized vehicles have also effect on environment and public health as well. These are affecting the environment and public health directly, indirectly and cumulatively by their discharge, emission, partially burnt fuel exhaust and noise. Some times the noise exceeds 100 db based on engine types and conditions which is excessive comparing to the conventional vehicles and allowable limits. Bari and Haque (2011) has also measured the noise level at different distance from source which varying from 84 to 76 db.

#### ***Accident of Non-Conventional Motorized Vehicles***

The drivers have no institutional training and driving license. Moreover, vehicles are with least safety measures. Furthermore, as drivers are of young aged, they do not care about safety and drive recklessly. Therefore, they often fall on accident. The usual nature of accidents are overturning, falling in nearby ditch, head to head collision, pushing and knocking from back. As a result, numbers of people become injured and even died every year by accident.

## **CONCLUSIONS**

These vehicles are best choice for rural transportation now days and their numbers are increasing day by day. It has become an essential part for rural transportation system and absence of these vehicles will cause great problem for rural people. A number of people earn their lives by driving this vehicle. However, these vehicles are not environment friendly as well as safe for riding. The drivers have lack of awareness and proper training on driving. Therefore, the automobile engineers have to take the necessary initiatives to conduct research for the improvement of these non-conventional motorized vehicles to overcome the shortcomings. On the other hand, road transport authority and traffic management division should take proper step to make them aware and trained for safe driving and following traffic rules.

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