

SERVICE AREA ANALYSIS OF TRANSIT STATIONS FOR PUBLIC BUS SERVICES: A CASE STUDY OF KHULNA CITY

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ABSTRACT

Public transportation system has a great impact in accommodating transport demand for cities especially in the developing countries like Bangladesh. A well-planned transportation system helps to reduce VMT (Vehicle Miles Traveled). Khulna is the third largest city in Bangladesh, with a population of 1.5 million, where public bus service facilities are not satisfactory. People mostly prefer other modes of transport to meet their daily travel demand due to having unplanned, unsatisfactory and scarce public bus transport facilities. The main objective of this study is to identify existing service area of each transit station for public bus transport facilities. A GIS (Geographic Information System) based network analysis has been carried out to find out served and over-served area for each stoppage. The number of people served by each stoppage for the public bus transport has been calculated from the density of the respective ward in which the transit station exists. People who do not get public bus service facility as per standard has been calculated. This study will be beneficial to the city leaders and decision makers in providing better transport facilities for Khulna City to accommodate maximum people under the service.

Keywords: GIS; catchment area; Service analysis; transit station

1. INTRODUCTION

Transportation system has a major impact on socio-economic development for any country. From ancient times different modes are used for transportation purposes (Daniels, 2011). People of Bangladesh has spent their significant amount of money and time on transport, in search of a livelihood. Public bus transport is one of the most significant and reliable route that ascertain accessibility to all kinds of people. It has one of the most cabalistic and reliable mode of transport in most of the countries except Bangladesh. Inadequate Public Transport is unable to meet the travel demand of residents. With the changing mobility needs of urban residents, policy makers are now looking for ways which are economically, socially and environmentally sustainable. Public bus services are not available in all the districts, for that, are facing extreme traffic congestion and road accidents. The situation conspicuous in Khulna city, the third largest cities among Bangladesh. In Khulna city, only one town services are available here which conducts from Phultala to Rupsha which is considered as mode of public transportation. In here tempo services and auto rickshaw are available mostly operated on shared basis of Ferry Ghat to Daulatpur, Ferry Ghat to Khalishpur and Ferry Ghat to Phultala. Usually these routes are lingering and there is no available bus services in these routes. Besides, a great number of people in lower and middle class are living here and they are used to travel on buses to access to CBD area, commercial and industrial area. Public transportation situation in Khulna is worsening by day as the number people is increasing. People often chose rickshaw/auto rickshaw for commuting instead of town service bus, even though the fare is higher than that of bus. To provide people an efficient transportation system and reduce expenditure incurred, this situation needs to be improved. The main objective of this study is to identify existing service area of each transit station for public bus transport facilities.

2. STUDY AREA

For this study, only one public transportation route has been identified from phultala to rupsha which is about 22 km. Besides, other surrounding concern study area consist of phultala upazilla, sonadanga thana, and Rupsha Upazilla. About 46 square km. area is served under city corporation. Commercial contains 1.86%, industrial contains 28.13%, residential having 4.55%, transport and terminal having 4.96% and mixed zones having

1.04% (Khulna Development Authority, 2001-2020). About 1.5 million people are living here according to the population census. In Khulna city corporation, among all the upazila's, Dumuria has the highest population containing 305 thousand while Phultala Upazilla has the lowest of 85 thousand (Bangladesh Bureau of Statistics, 2011). The population growth rate is 3.8%. A great number of people are lower and middle class in Khulna which are the common user of public service. Among them 69.5% of the population are lower income group in here (Khulna City Corporation), 29.7% of the people are middle income group and only 1.8% of the people are higher class people (Bangladesh Bureau of Statistics, 2011). Here, a great number of people are involved in agricultural activity for their livelihood. Besides, a good number of people are associated with livelihood concerning activities in jute-mills, fish processing industries and export processing industries. Businessmen and service are greater in a number among them.

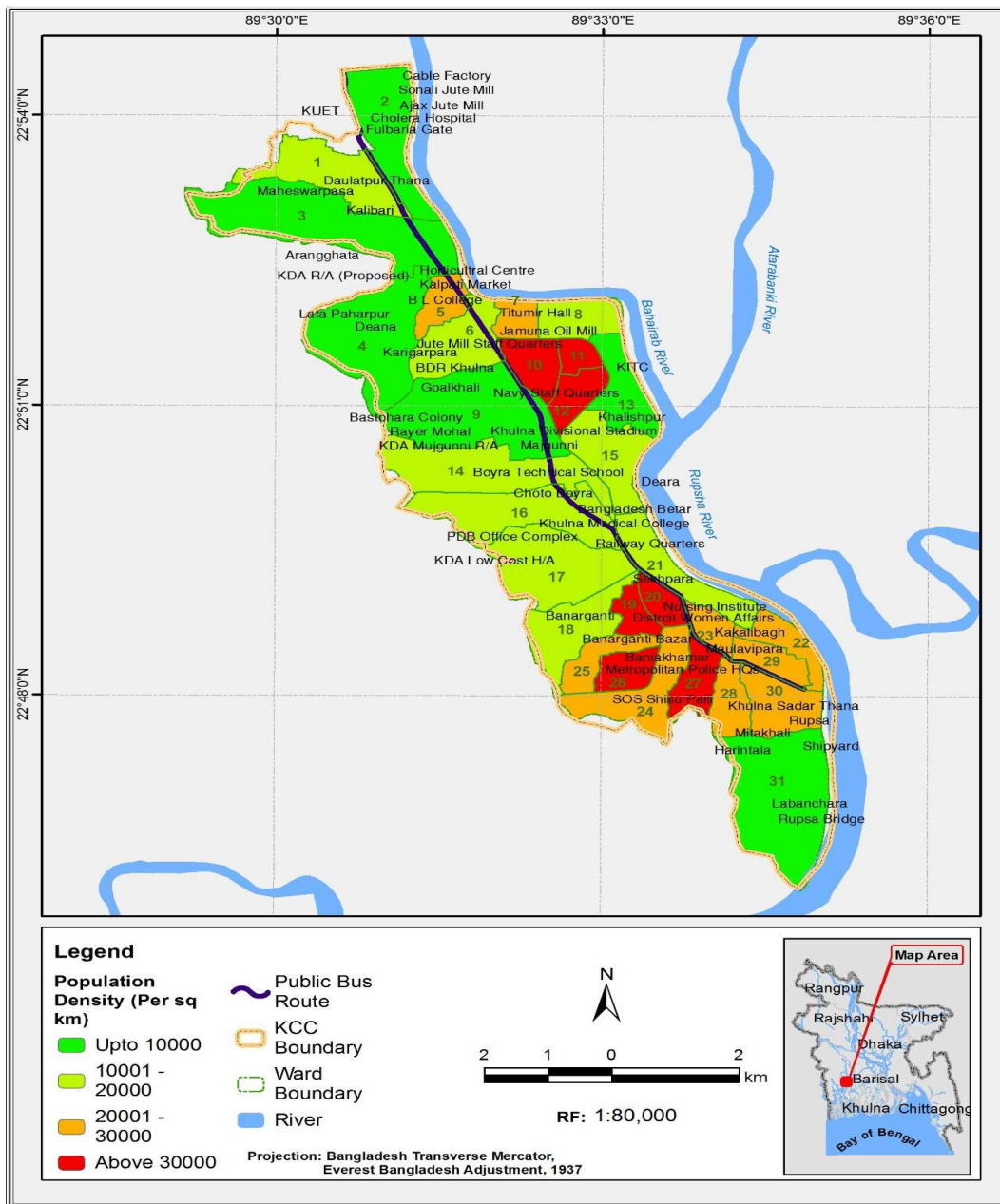


Figure 1: Population Density Map of Khulna City Area

3. LITERATURE REVIEW

A service area around a transit station or stop is broadly defined as the area from which potential riders are drawn. Delineating the service area around public transit stations is used to determine optimal stop spacing, identify redundancy and gaps at the route and system levels, and understand and predict demand for transit. Stop spacing here is referred to the distance between two consecutive stops along the same route. Redundancy occurs when the same parcel is being served by multiple stops along the same route due to short stop spacing or is being served by multiple routes leading to the same destination. Gaps occur in areas that are not served by any stops or routes. Many transit planners and engineers depend on simplified methods when determining service areas around transit stations especially in regard to walking. A 400-meter buffer (0.25 miles) is defined around bus stops. . On the other hand, some researchers feel that this definition is not comprehensive enough and accordingly they use a more inclusive service area based on a 482 meter (0.3 mile) buffer around the bus station (El-Geneidy, 2013). Transportation facilities in Khulna are mainly buses, CNG, Baby Taxy, and Auto Rickshaw, Easy bikes and Van. Khulna City inhabitant is more than 1.5 million people .Most of the middle and lower class people use well organized low cost bus transportation system. Bus service is one of the most important component than other component in city transportation systems (Khulna Development Authority, 1999). Location-allocation model is used to identify demand-oriented route for town service bus, with the application of GIS. The route should enable the travelers to access to their desire destination within shortest possible time within affordable expense. The whole model is applied on the using ARC INFO 7.2.1. The possible bus stop locations identified after the operation. The number of stop location (p) is restricted to 150. The possible location which covers the maximum demand is distributed on all the areas of Khulna city. However, all the roads do not have the capacity for bus plying. So, the roads which have the capacity to ply bus are identified. Then the road layer is over-laid on the possible bus stop location to find out the actual number of potential bus stop location. In this process some roads are identified as the potential route for bus (A.K.M. Fazlur Rahman, 2004).

4. METHODOLOGY

Existing bus stoppages were identified and GPS co-ordinates of stoppages were collected through field survey. In the method, 20 bus stoppages were taken which is within the Khulna city area for analysis. Then service area of each stoppages were calculated considering 400m buffer area through ARC GIS 10.1 software. From the service area analyses, the served and the over served areas were identified and the unserved areas in where people can't get any service from existing public bus transit were calculated. Density of each ward in Khulna city area was calculated to find number of people who is served by each stoppage for the existing public bus transport facility. Unserved areas were also calculated by subtracting the sum of served and over-served areas from the total area under City Corporation.

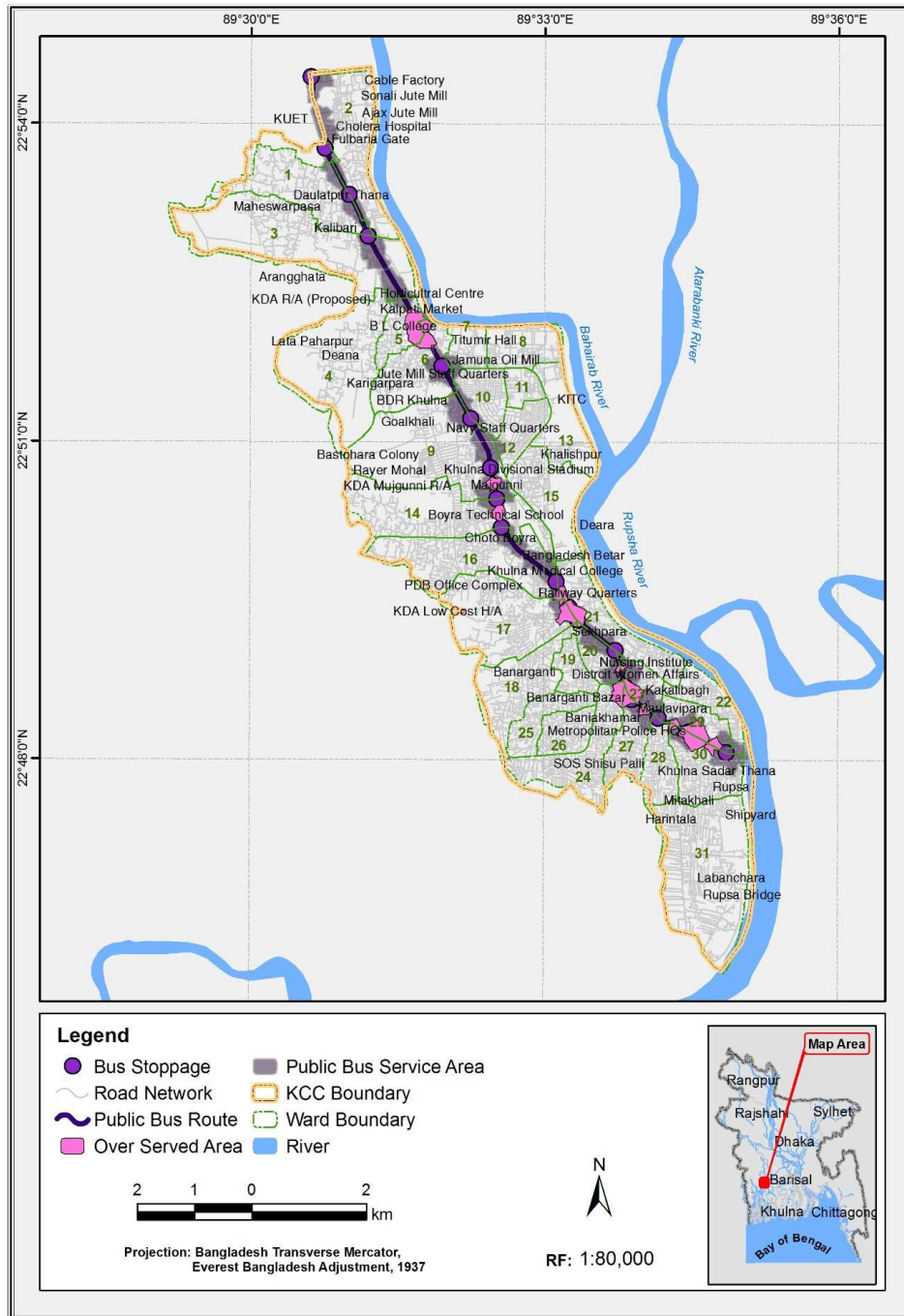


Figure 2: Existing Public Bus Service Analysis

5. ANALYSIS AND INTERPRETATION

From above table, it is seen that only 5.85 Square Kilometer area is served by the present public bus service and amount of served population is 93630. The main reasons behind it are unplanned design of bus stoppages and distance between two consecutive stoppages is not considered in the selection of bus stoppage. Density of population is also an important factor in the selection of bus stoppage which is not considered in the existing public bus service. As a result, a large part of Khulna City area is remained unserved and people have to prefer other modes of transportation to meet their travel demand which is relatively high cost than public bus services.

So, service level of existing bus service is very poor and location of existing stoppages are not suitable to accommodate more people in the public bus service facility.

Table 1: GIS based analysis following spatial service coverage of existing stoppages is calculated:

Buffer Distance From the bus stoppage	Stoppages	Coverage Area(sq.km)	Coverage Population
0-400	Badamtala	0.087222	901
0-400	Fulbari Gate	0.112866	1085
0-400	Maniktala	0.367835	2624
0-400	Raligate	0.31374	1935
0-400	Daulatpur	0.247957	4862
0-400	Notun rasta	0.324814	5515
0-400	Goalkhali	0.25981	4833
0-400	Mujgunni	0.32529	4298
0-400	Boikali	0.337845	3855
0-400	Boira college	0.312065	3923
0-400	Jora Gate	0.288558	3653
0-400	New Market	0.299607	4456
0-400	Shibbari moor	0.320255	6552
0-400	Ferry ghat	0.257298	4844
0-400	Santidham moor	0.364544	7125
0-400	Hotel Royal	0.311556	6918
0-400	PTI Moor	0.32022	7141
0-400	Grave place	0.345065	6589
0-400	Glasko moor	0.331372	6444
0-400	Rupsha	0.325947	6077
Total		5.85	93630

(Source: GIS based calculation)

Table 2: Over Served areas and Population between Stoppages:

Stoppage	Over served area (sq.km)	Population
Between Daulotpur &Notun Rasta	0.001987	28
Between Mujgunni & Boikali	0.041402	465
Between Boikali & Boira College	0.047589	561
Between Jora Gate & New Market	0.053294	146
Between New Market & Shibbari Moor	0.1539257	202
Between Ferry ghat & Santidham Moor	0.021258	106
Between Santidham Moor &Hotel Royal	0.189235	1156
Between Hotel Royal & PTI moor	0.038022	669
Between PTI Moor &Grave Place	0.0304494	479
Between Grave Place & Glasko Moor	0.181768	3465
Between Glasko Moor & Rupsha	0.051547	1004
Total	0.810477	8281

(Source: GIS based calculation)

From above GIS based analysis, considering 400 m buffer distance from each stoppages it is found that about 0.807 Square Kilometer area is over served and amount of over served population is 4432 which indicates that stoppages are not selected according to the demand of people.

From calculation of served and over served areas it is seen that a large part of Khulna City area is remained unserved from the existing public bus facility. From the analysis it is seen that the sum of served and over served area is 6.66 Square Kilometer. So, the total amount of unserved area is 40.777 Square Kilometer which is about 8 times than served area. So, new stoppages and routes are necessary to provide better public bus facility.

6. RECOMMENDATIONS

6.1 Identification of Possible Routes

For providing better public transport facility in the Khulna city following four routes can be selected for feasibility study to accommodate more people under the service. These routes can be suggested based on existing road network in Khulna City. These are as follows:

Route-1: Siromoni-Natun Rasta Intersection- Sondanga- Majid Sarani-KDA Avenue-Hotel Royal-Khan Jahan Ali Road- Rupsha.

Route-2: Siromoni- Natun Rasta Intersection-BIDC Road-Old Jessore Road-Khan Jahan Ali Road-Rupsha.

Route-3: Siromoni-Natun rasta Intersection- Sondanga- Gollamari-Sher-E-Bangla Road-Moylapota-Hotel Royal-Khan Jahan Ali Road-Rupsha.

Route-4: Siromoni-Natun Rasta Intersection- Jessore Road-Shibbari More KDA Avenue-Khan Jahan Ali-Road-Rupsha.

6.2 Improvement of Bus Service

In this section of the study some important improvement of existing bus service can be recommended. One of the important factors, for not choosing town service bus is the bad quality of service.

6.3 Increasing the number of buses

With the additional routes the number of buses should be increased

6.4 Abandon the Old Buses

Buses used in the current route are not in good condition. These buses are rejected from different long routes staff buses of different offices. The emission level of these buses is high compare to other vehicles. As a result, these buses should be dumped from the operation. These old buses seat is in the worst condition.

6.5 Construction of Passenger Shed

In the current situation town service buses have some fixed stoppages. But, passenger shed is not available in these stoppages. Passenger sheds are very essential at each stop, because it is disgusting and painful for the passengers to wait a long time for the bus under the sun or rain on the road.

7. CONCLUSIONS

Public bus service is an important mode of transportation to meet daily travel demand of people. To accommodate more people in the public bus services its facility should be increased by providing new stoppages and routes. Better public transport facility reduces use of private transport and thus provide sustainability in transportation sector. So, effective and efficient use of public bus service is necessary for proper development.

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