

Exploring the Nature of Urban Structure of Urban Areas in Bangladesh

Md. Mokhlesur Rahman; Md. Moniruzzaman; and S. M. Forhad Tasfi
(Email: mrahman.buet03@gmail.com, monir_buet0305@yahoo.com,
forhad03_buet@yahoo.com)

Abstract:

The study of spatial structure of a city always fascinates urban planners. City's spatial structure can assist urban planners to predict future development trend and help them to develop appropriate strategies to guide the current spatial structures. But, there is no such type of previous studies of the city structure in Bangladesh. In this study, the researchers made an attempt to find out spatial structure of cities in Bangladesh. Using spatial distribution of population and land use the researchers tried to explain the present scenario in Bangladesh. The researchers have found that for most of the cases there is a density gradient, which represents relationship between population density and distance from city centre to periphery, with high R square value follows a negatively sloped exponential curve from city centre to periphery of an urban area except in Barisal City Corporation (BCC). The density is high at the centre and it gradually decreases towards periphery. The Central Business District (CBD) of BCC is relatively larger than other municipalities/ paurashavas where commercial land use is dominant type of land uses. People are living outside the CBD due to high concentration of commercial and institutional land uses in the centre is the main reason of positively sloped exponential curve for BCC. The first important finding from land use analysis is that in most of the Paurashavas, there is a CBD which have been developed alongside a river network and newly developed commercial land uses have taken place along the major highway in that area. The study also showed that after three kilometers from the city center, agriculture is dominant type of land uses although there is a high rate of urbanization in Bangladesh. The researchers as urban planners conclude that, there is natural tendency of compactness in Bangladesh which should be encouraged.

Key words: Urban Structure, CBD, Gradient, Centroid, Density

1. Introduction

The spatial structure of a city can assist urban planners to predict direction of future development and help them to develop strategies to guide the current spatial structures. It is not possible to define an optimum city shape because city development objectives change with time. However, it is possible to identify the type of city shape that would be consistent with a specific objective. Planners have a role in influencing the evolution of existing structures but only if they understand these structures. They are be able to monitor the way the spatial structure evolves, and should have objectives and strategies to show what type of structure is desirable in the long run to meet the objectives. On the other hand, urban structures are path dependent, so the desired structure has to be compatible with current structure. This limit strategy choice much more than most planners are aware of it [3], [4].

Bangladesh is a developing country. Since independence, the country has been struggling to improve the present status of it. As a developing country, it is also deprived from various studies and research especially related to its urban spatial structure. There is no broad-spectrum and defined urban structure for the urban areas of Bangladesh. It is imperative that there is an urgent need to conduct a study for the generic urban structure of Bangladesh in order to formulate any urban planning policies. This study is the first study on the urban structure of Bangladesh. It endeavors to exemplify the present urban structure of Bangladesh that will lead the future growth of urban areas.

The main objective of this research is to identify a generic urban structure for the urban areas of Bangladesh, which help both policy makers and practitioners gain a better understanding of the key factors driving future development of the urban areas. In order to achieve this goal, two objectives have been fixed in this study. Firstly, the relationship among different types of land uses that will help to understand whether land is used efficiently for the benefit of the wider economy and population as well as to protect the environment. Secondly, density

gradients of those urban areas have been calculated to understand how the change in density in an urban area from the center to the periphery occurs.

2. Materials

2.1 Theoretical Framework

One of the first models describing the internal structure of the city was by Burgess in 1924. This model explained distribution of social groups within urban areas. Based on one single city, Chicago, Burgess described that city structure can be explained by five zones spaced like ring around Central Business District (CBD). However Homer Hoyt disagreed and provided Sector Theory, in which social groups are arranged around a series of sectors, or wedges, radiating out from the CBD in 1939. Since then many other theories has been developed describing spatial structure of the city (For example Multiple Nuclei Theory, Urban Realm Theory). However, these models mainly described the spatial structure of US and North American cities. Griffin (1980) described the spatial pattern in the Latin American cities while McGee (1967) describes the spatial structure of port cities of South-East Asia [7], [8]. Though Dutt (1986) provided two models of South Asian cities, these did not properly describe Bangladeshi cities which are part of South Asia [6]. One of the problems associated with all these models are they described land use pattern of the city on the basis of income and ethnical group living in the city. But, with the development of society especially in developing country this does not hold true. In mono-ethnical cities of developing country (like cities of Bangladesh) often high, middle and low income people reside side by side. This leads some urban planner (like Bertaud, Marshal) to think urban structure as a function of the average density in the built-up areas, the spatial distribution of densities, the pattern of daily trips, spatial distribution of land use. In this study we consider urban structure as a function of the average density in the urban areas, the spatial distribution of densities and spatial distribution of land use.

2.2 Recent Studies on Urban Structure

Alain Bertaud (2003) studied the Tehran spatial structure and find out that it has an exceptional spatial structure. It has a high density combined with a mildly polycentric structure. The absence of a strong center and the spatial dispersion of employment are usually associated with built-up densities below 30 people per hectare. Tehran's average built-up density at 146 people/ha is uncommon for a polycentric city. This unusual feature, not necessarily negative, suggests it would be necessary cautious in recommending solutions, which have been successful in other cities of the world with a completely different spatial structure [2].

In the study of the spatial organization of seven large cities (Shanghai, Jakarta, Moscow, Berlin, Paris, London and New York) Alain Bertaud (2001) used three types of indicators. The first one is land consumption per person. The second is the population density profile within a city, and the third is the degree of monocentricity, the share of trips with a central destination. However, there is no consistency in the result of analysis. Three indicators showed three different types of outcomes [1].

Alain Bertaud and Stephen Malpezzi (2003) studied "The Spatial Distribution of Population in 48 World Cities". The first important finding of the study is that in many cities, perhaps a surprisingly large number, negative exponential density gradient implied by the standard urban model fits the data quite well. On the other hand, in a number of cities, population density departs a lot from the standard model. A few cities that depart substantially are cities, like Seoul, that are usually characterized as market economies but have extraordinary regulatory environments for land use; some are centrally planned cities, like Moscow or Brasilia; and others are cities that developed under social policy, like Capetown. In a second stage model, we find that density gradients flatten with income, with city population, and with falling transportation costs, as the standard urban model predicts. We also find that cities

with extremely repressive urban regulations, as in South Africa, Korea and Russia, have flatter (sometimes inverted) population density gradients [4].

2.3 Study Area

Bangladesh has 260 urban areas which are known either as Paurashava or City Corporation [5]. Usually, the paurashava in larger town is declared as City Corporation. At present there are six City Corporations in Bangladesh. Though in ideal condition, all the urban areas should be considered but it is not possible due resource constraint. In this study, we collected data from Savar, Tongi, Narayangonj, Kushtia, Sherpur, Panchagarh, Manikganj, Moulavibazar and Netrokona paurashava and Barisal City Corporation.

3. Research Methodologies

This research considered spatial structure, static in nature. Accordingly, only static data was collected. Data on population distribution within the city was collected from Bangladesh Bureau of Statistics (BBS) and land use pattern in the city was collected from Local Government Engineering Department (LGED), Dhaka. Using the population distribution data, population density was determined. We found that there are around twenty types of land uses in the study areas. These were reclassified into seven categories according to land use classification manual developed by the Detroit Metropolitan Area Regional Planning Commission (Table-1).

However, one of the problems associated with determining spatial structure is to identify the Central Business District (CBD). In determining CBD, we identified polygons where there is the highest concentration of commercial land uses within the urban area. Once CBD is determined, its centroid is identified and Multiple Buffer Rings were created with an interval at 0.5 kilometer surrounding each centroid of CBD. Finally, these rings were overlaid over density maps to find out the relationship between population density and distance from CBD.

Table-1: Reclassification of collected land uses

Previous Land Use Classes	Present Land Use Classes
Residential and homestead, Rural settlement, slum	Residential
Commercial activities, business center, ware house	Commercial
Industry, Manufacturing and processing	Industrial
Administrative, Defense and security, Educational institutions, Research institutions, Health care, Missionaries, Orphanage, Religious, Restricted areas, Recreational facilities	Institutional
Agricultural land	Agriculture
Community service, Mixed use, Transport network, Utility and services, Bus/ Track/ Launch terminal, Culture and sports, Power plant station, Solid Waste dumping	Transport and Utility
Water body, River, Pond, Lake, Open space, Vacant land	Unused Space

4. Result and Analysis

From the land use maps of the Municipalities, it has been found that there is a well-defined Central Business District (CBD) in all Municipalities, except Kushtia, Maulavibazar and Netrokona. These CBDs are located either beside the river (Barisal City Corporation and Tongi) or at the center of the paurashava (Panchagarh, Savar, Sherpur and Manikganj) or at the convergence of major highways (Narayanganj). The Municipalities (Kushtia, Maulavibazar and Netrokona) which have no well defined CBD due to congregation of commercial activities along the roads and highways passing through the urban areas and distribution of commercial activities all over the Municipalities. Residential land use is the dominant type of land uses in most of the Paurashavas. However, surprisingly agriculture is one of the most dominant uses in those Paurashavas. This clearly shows that Bangladesh still is an agrarian and urbanization is not so pronounced even in urban areas. We also found that residential is a dominant land use around the CBD and with the increasing distance from CBD toward periphery concentration of residential land use decrease and concentration of agricultural land use increase.

At the periphery of the Municipalities, residential areas are appeared in linear shape along roads in between the agricultural lands. Industrial land use is a leading land use pattern in those Paurashavas that are directly connected with the national transport network system. In those cases, industries are located within 2 kilometers of centroid of CBD. High concentration of public buildings and offices is a common phenomenon of CBD and for that reason, most of the institutional land uses have been found at the verge of the CBDs. Beside, some other institutional land uses are also distributed within the residential and commercial areas and along the major highways. Unused spaces (river, small water bodies, vacant land etc.) are also distributed all over the Municipalities.

One of the parameters of spatial structure we observed was the relationship between population density and distance from City Center (centroid of CBD, for this study). We found that with few exceptions density gradient follows a negatively sloped exponential curve. This means that the density is high at the center and gradually goes down towards the periphery.

The density at the CBD is high because many people want to stay at the center for better living environment, better employment opportunities and to avail various facilities. At the periphery of the paurashava, there are plenty of agricultural lands and unused spaces including water bodies, open spaces etc. and these are the main reasons for low population density at that distance. In some other cases, it is found that density in the CBD is not the highest as there is lack of residential place in the main CBD area and for this reason many families want to live next to CBD. Density gradient of Sherpur Paurashava (one of the exceptions) is almost zero (0.0002). From the density profile, it is observed that the density is almost same all over the paurashava except the sudden change in densities at 2.5 km and 3 km from the CBD centroid. In between 2.5 km and 3 km from the CBD as a river crosses the paurashava which lower the density. Residential and commercial land uses are evenly distributed all over the paurashava is another reason for having almost uniform density.

The truly exceptional case is Barisal City Corporation (BCC). It is the largest of the studied urban areas. It shows positively sloped exponential curve. Density is low at the CBD and gradually increasing from CBD to the periphery. The size of CBD is comparatively large and occupied almost all areas in between 0.5 km and 1 km from the center of the CBD. As most of the land uses have been occupied by commercial land uses, residential land area is declined and this is the reason for lower density in the CBD. High institutional land uses, also found at the verge of the CBD, another causes for having lower density at the CBD. Again, few of the institutional land uses have found all over the place in BCC. At the periphery of BCC there are agricultural land and unused space including water bodies and open spaces. R square values (Table 2) of all Municipalities, except Kushtia and Sherpur, are significant which indicate that change in densities of the Municipalities is very much dependent on the increasing distance from CBD.

Table-2: Density Gradient and R-square Value of each Urban Area

Municipality	Density gradient	R-square value
Barisal City Corporation	0.0276	0.809
Kushtia Paurashava	-0.0145	0.21
Manikganj Paurashava	-0.0488	0.661
Maulavibazar Paurashava	-0.1082	0.49
Narayanganj Paurashava	-0.2326	0.849
Netrokona Paurashava	-0.1225	0.678
Panchagarh Paurashava	-0.2034	0.95
Savar Paurashava	-0.1027	0.775
Sherpur Paurashava	0.0002 (almost zero)	0.00009
Tongi Paurashava	-0.2113	0.636

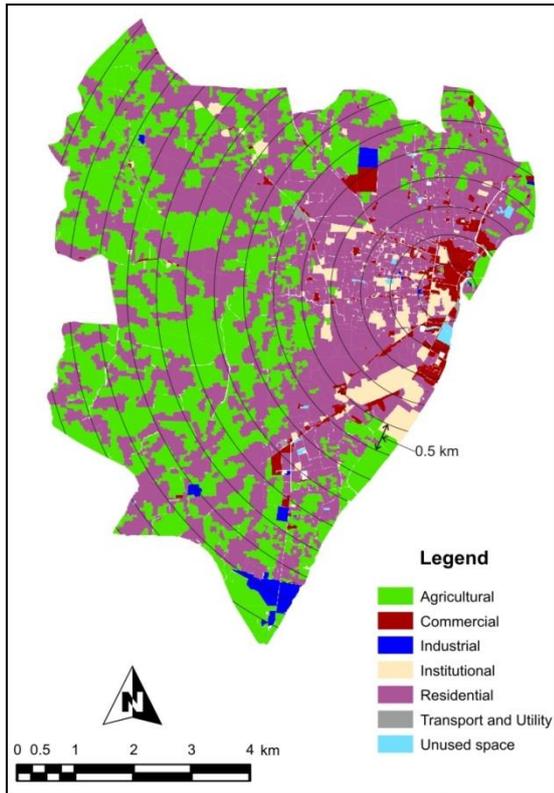


Figure-1: Land use Map of Barisal Paurashava with 0.5km buffer Intervals

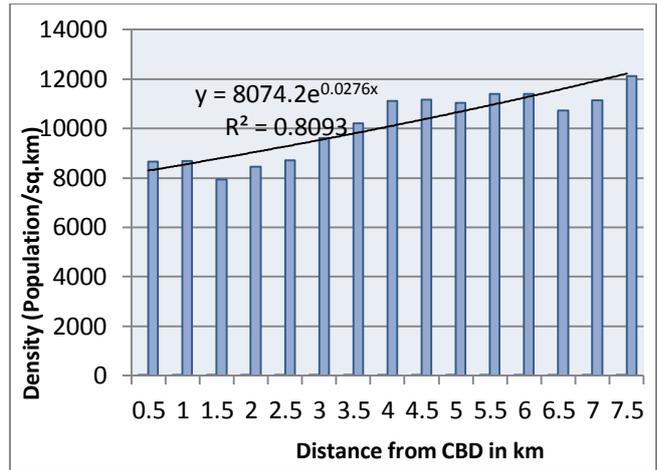


Figure-2: Density Profile of Barisal Paurashava

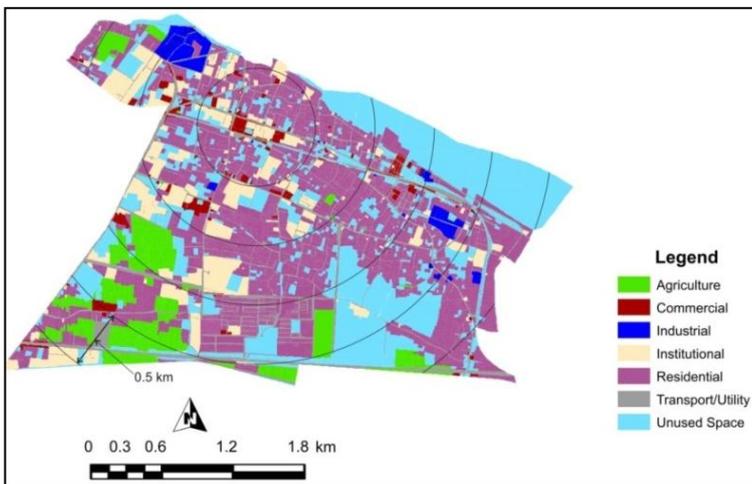


Figure-3: Land use Map of Kushtia Paurashava with 0.5km buffer Intervals

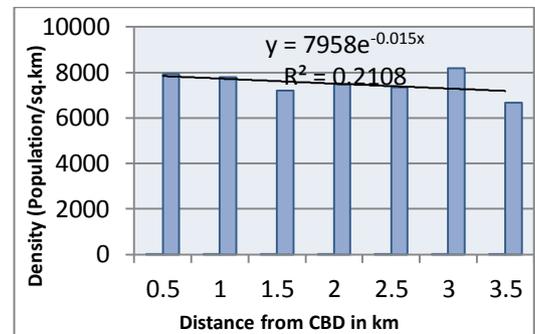


Figure-4: Density Profile of Kushtia Paurashava

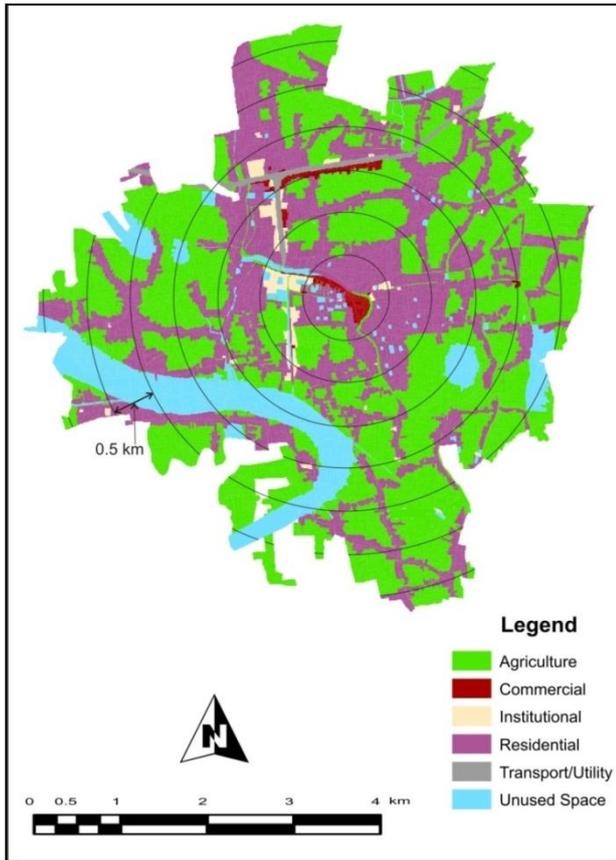


Figure-5: Land use Map of Manikganj Paurashava with 0.5km buffer Intervals

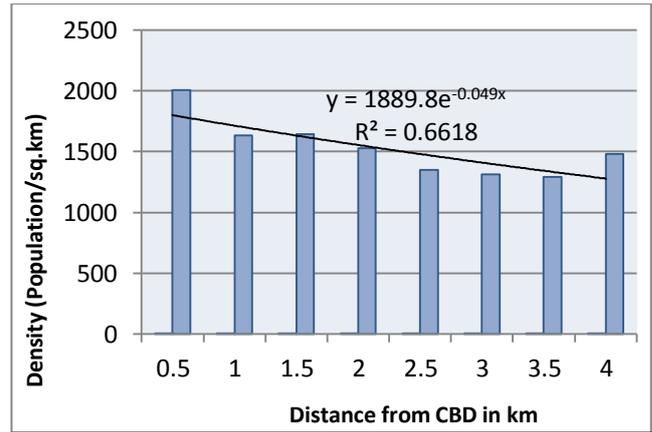


Figure-6: Density Profile of Manikganj Paurashava

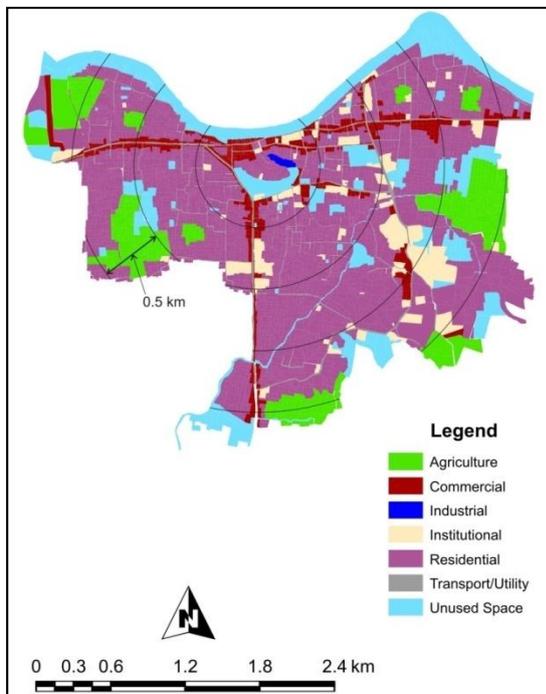


Figure-7: Land use Map of Maulavibazar Paurashava with 0.5km buffer Intervals

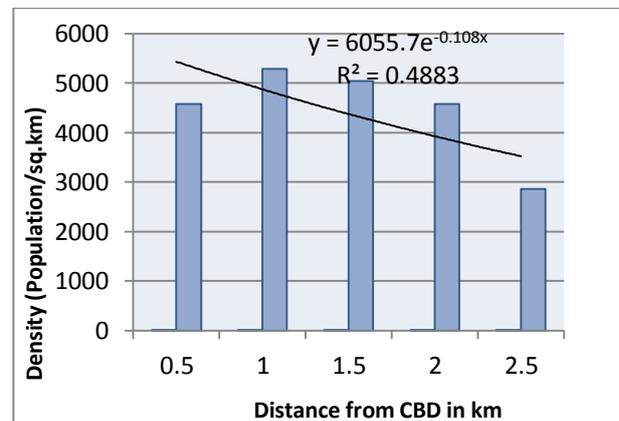


Figure-8: Density Profile of Maulavibazar Paurashava

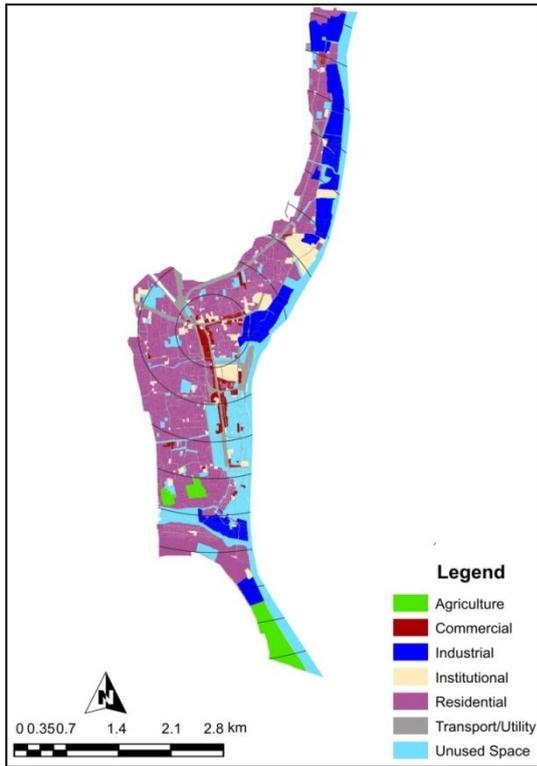


Figure-9: Land use Map of Narayangonj Paurashava with 0.5km buffer Intervals

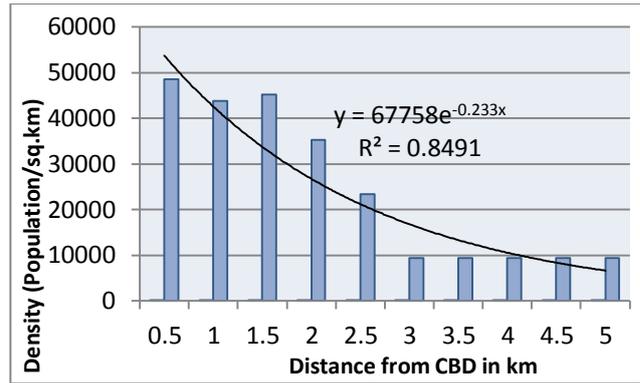


Figure-10: Density Profile of Narayangonj Paurashava

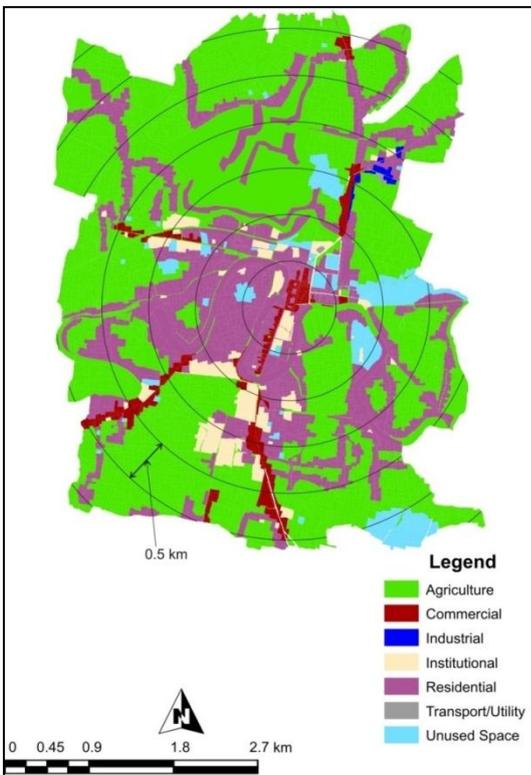


Figure-11: Land use Map of Netrokona Paurashava with 0.5km buffer Intervals

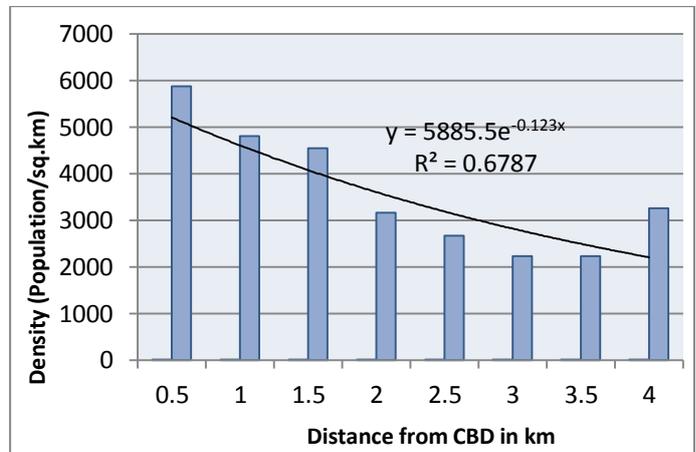


Figure-12: Density Profile of Netrokona Paurashava

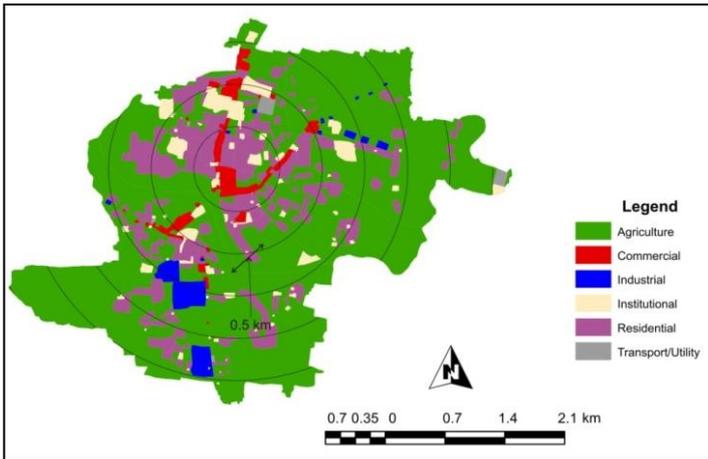


Figure-13: Land use Map of Panchagarh Paurashava with 0.5km buffer Intervals

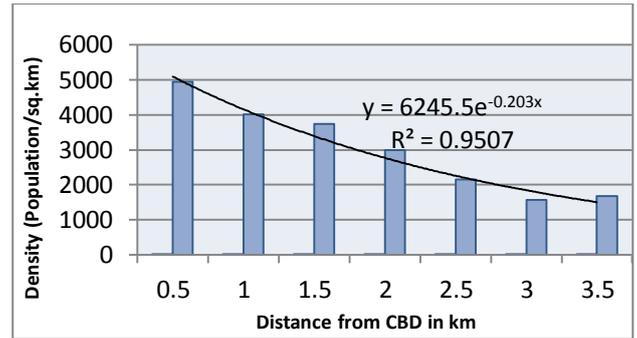


Figure-14: Density Profile of Panchagarh Paurashava

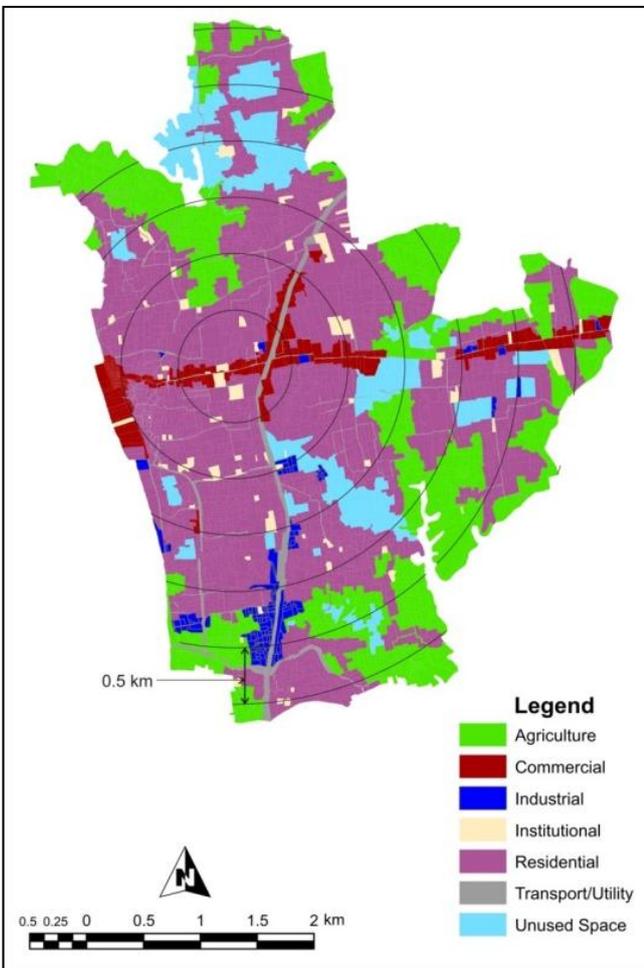


Figure-15: Land use Map of Savar Paurashava with 0.5km buffer Intervals

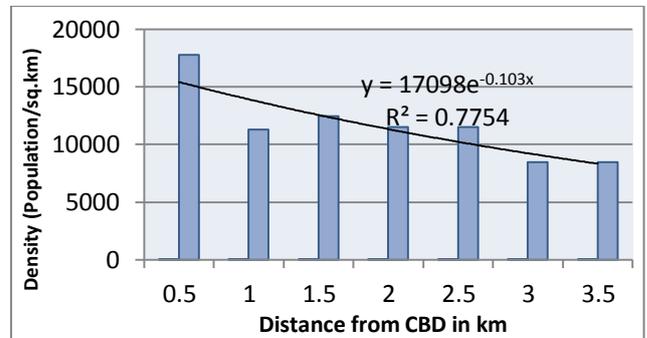


Figure-16: Density Profile of Savar Paurashava

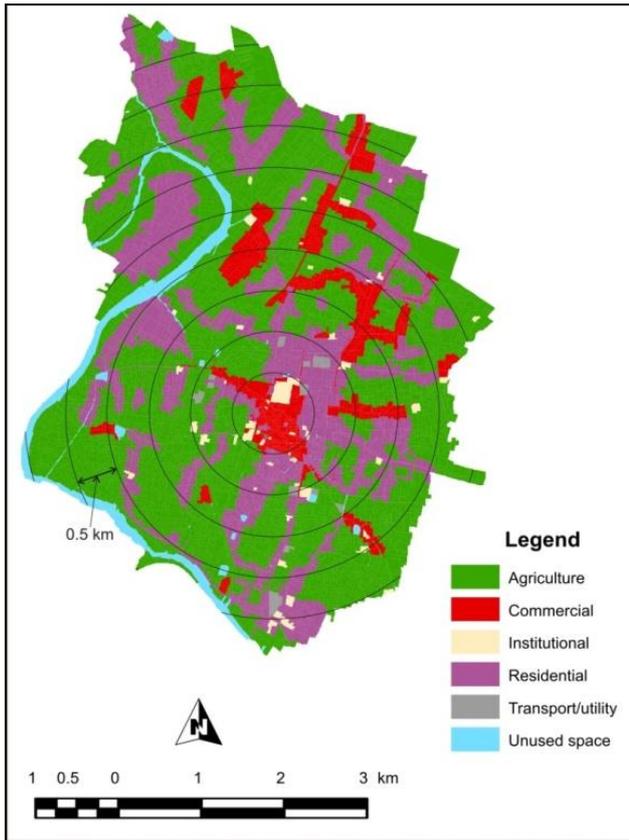


Figure-17: Land use Map of Sherpur Paurashava with 0.5km buffer Intervals

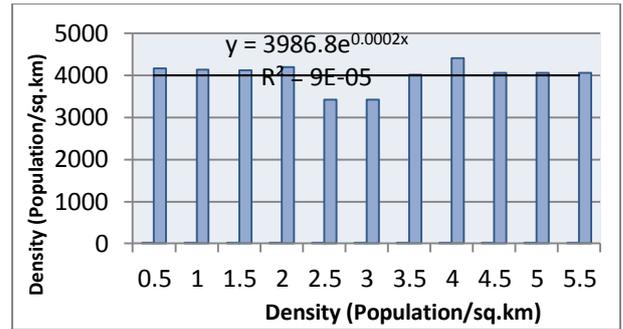


Figure-18: Density Profile of Sherpur Paurashava

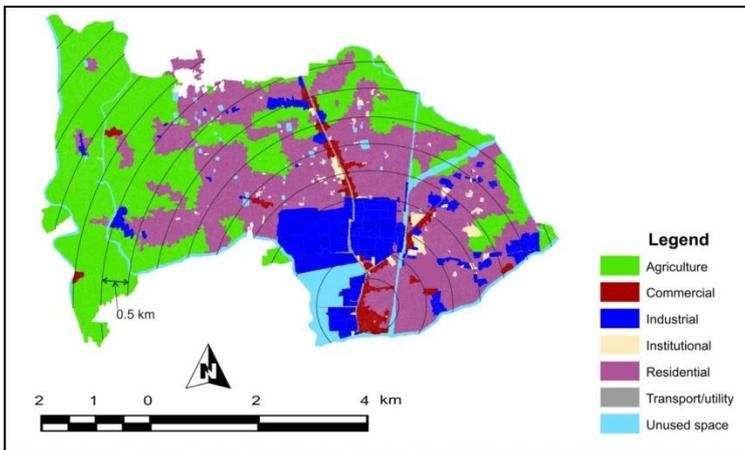


Figure-19: Land use Map of Tongi Paurashava with 0.5km buffer Intervals

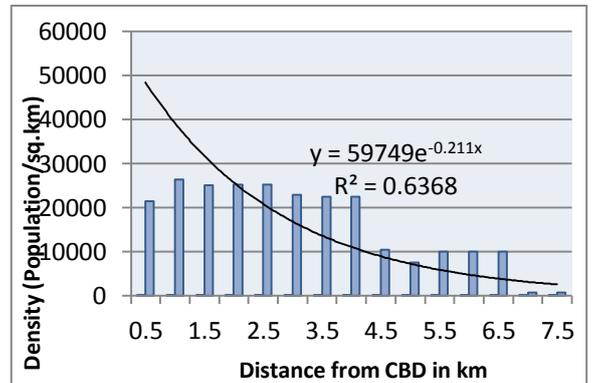
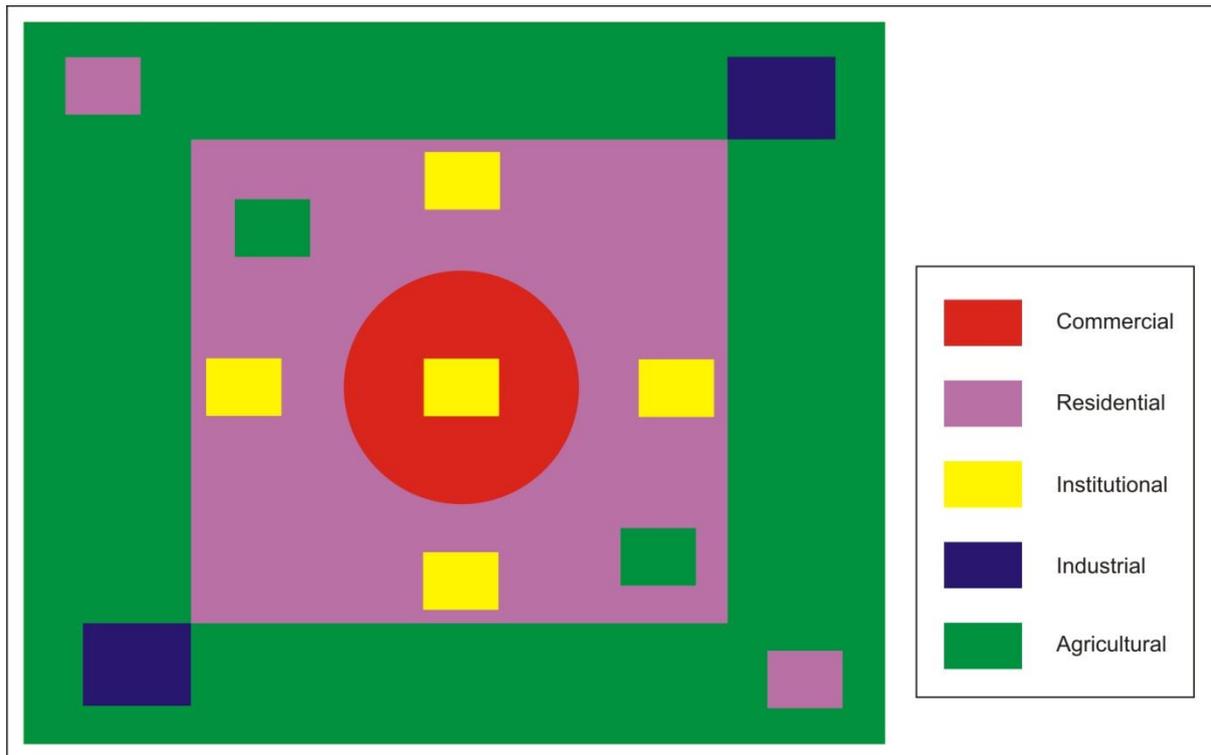


Figure-20: Density Profile of Tongi Paurashava

5. Concluding Remarks

We can conclude that even though there is high urbanization in Bangladesh, agriculture is still dominant land use in urban areas especially in the periphery, after 2.5 to 3 kilometers from the centroid of CBD. Also like traditional cities, CBD is developing along transportation spine. Population density decreases as distance from CBD increases. But it is not universal case as there is an example, Barisal City Corporation, where population density increases further from CBD. However, explanation for this exception is that the city is the largest among the studied urban areas, as a result most of the land uses in the CBD are occupied by commercial and institutional land uses and residential uses declined significantly. There is also one case where density gradient is almost zero, Sherpur Municipality, because the urban area does not have any well defined CBD and commercial land uses are very evenly distributed all over the area. Most of the urban areas of Bangladesh do not have any physical plan. Only recently Government took initiative to prepare plan for some of the cities. As the study shows density decreases from the city center or in other words natural trend showing more compactness of cities, planners should take steps and provide strategies to incorporate this. From the study it has been delineated that the structure of urban areas in Bangladesh is similar to the following figure-21.

Figure-21: A Generic Model of Urban Structure in Bangladesh



References

- [1]. Bertaud, Alain (2001), *Metropolis: A Measure of the Spatial Organization of 7 Large Cities*.
- [2]. Bertaud, Alain (2003), *Tehran spatial structure: Constraints and Opportunities for Future Development*, National Land and Housing Organization, Ministry of Housing and Urban Development, Islamic Republic of Iran.
- [3]. Bertaud, Alain (2004), *The Spatial Organization of cities: deliberate outcome or unforeseen consequence*.
- [4]. Bertaud, Alain and Malpezzi, Stephen (2003), *The Spatial Distribution of Population in 48 World Cities: Implications for Economies in Transition*, The Center for Urban Land Economics Research, The University of Wisconsin, USA.
- [5]. Bangladesh Bureau of Statistics (BBS, 2004), *Paurashava Manual: The People's Republic of Bangladesh*, GOB: Dhaka.
- [6]. Dutt, Ashok K.; Charles B. Monroc, and Ramesh Vakamudi (1986), Rural-Urban Correlates for Indian Urbanization, *Geographic Review*, Vol. 76:2, pp. 173-173
- [7]. Ford, Larry and Ernest Griffin (1980), A Model of Latin American City Structure. *Geographical Review*, Vol. 70:4, pp. 397-442.
- [8]. McGee, T.G (1967), *The Southeast Asian City, A Social Geography of the Primate Cities of Southeast Asia*, Praeger, New York.