

A Comparative Study on Land Use Change in Different Time Periods at Dhanmondi Residential Area

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Available online at: www.isroset.org

Received: 05/Dec/2021, Accepted: 07/Jan/2022, Online: 31/Jan/2022

Abstract— Dhanmondi residential area of Dhaka city is an extreme example of such an urban sprawl. This area has undergone radical changes in its physical form, not only in its vast territorial expansion, but also through internal physical transformations over the last decades. This study has focused to identify the pattern of land use conversion in Dhanmondi Residential Area during last 70 years. The main objective of this study was to find out the extent of land use transformation. In this study, the pattern of land use transformation has been examined by analyzing different data and land use maps of different years with the help of GIS tools. This research has also shown a comparison of Existing Land use with the Standards Recommended in DAP. Dhanmondi Residential Area has become an area of mixed land use. But the area was not designed for that. As a result, several civic problems arise which affecting day to day life of the inhabitants in this area. But this situation must not be continued. Appropriate policies and strategies should be taken to restore the habitable characteristics of Dhanmondi Residential Area.

Keywords— Transformation; Residential area; Non-residential area; Land use, GIS, Dhaka.

I. INTRODUCTION

In the same way as other different urban areas on the world, present day Dhaka is likewise the result of unconstrained quick development with no prior or orderly arrangement. As the development of the populace in Dhaka is occurring at a remarkably high rate, it has become one of the most crowded Mega Cities on the planet. This study tries to study the transformation of land use of Dhanmondi over last 70 years, with a view to understand how the whole area has changed from time to time.

The growth and development of Dhaka can be categorized into six periods [1], e.g. the pre-Mughal period (from year 1205 to 1610), the Mughal period (from year 1620 to 1757), the East India Company period (from year 1758 to 1858), the British colonial period (1858-1947), the Pakistan period (from year 1947 to 1971) and therefore the Bangladesh period (from year 1971). The population growth of Dhaka stands at 56.5% in the last decade, which is very high, among which rural to urban migration is causing a rate of increase in population by 5 % per annum [2].

Dhanmondi area has become a renowned commercial place and centre for educational institutions of the city [3]. Dhanmondi Residential Area has become an area of mixed land use. But the area was not designed for that. As a result, several civic problems arise which affecting day to day life of the inhabitants in this area. But this situation

must not be continued. Appropriate policies and strategies should be taken to restore the habitable characteristics of Dhanmondi Residential Area.

The study has been conducted to identify the transformation pattern of land use in Dhanmondi Residential area over last 70 years and also to compare the existing facilities with the planning standard recommended in Detailed Area Plan, DMDP, 1995-2015.

II. RELATED WORK

To achieve the objectives of this research and to gather knowledge to perform the work, many related literatures on land use principles, standards and existing land use pattern of Dhanmondi Residential Area were reviewed to gain ideas and examples. Different books, journals, reports, Government documents, published or unpublished thesis and other printed materials were surveyed. But it was surprising that most of the studies were about physical development of Dhaka city, not land use pattern. Very few studies were conducted about land use pattern of Dhaka city.

Zaman and Lau showed in their study that how Dhaka city lost its control over growth pattern due to population growth [4]. In their study two case studies were taken in Dhanmondi and Sukrabad to represent the uncontrolled growth pattern of Dhaka city. In the study the authors showed how Dhanmondi lost its identity over time.

According to their study about 30% of total land was used as non-residential purpose in 1993. They also showed change in building heights in the area.

Another study showed that Over the years, Dhaka city has had inconsistent transformation of land use and organic development; which in turn created crisis in residential areas or neighbourhoods and affected the city life adversely. According to that study Bureaucratic problems, political influence, lack of appropriate mechanism for land development for the residential areas, ineffective implementation, poor supervision and monitoring system are the main cause of violation of rules. For this several adverse impacts were imposed to the people of the city [5].

In the study titled 'Land use pattern of old Dhaka: A case study of Ward No. 68' comparison of land use pattern between Dhanmondi and Ward 68 was made [6]. From this study the land use pattern of old Dhaka and new Dhaka can be identified in some extent. Similar type of study was conducted by Nawaz, et al. titled as 'Land (space) use analysis of Dhanmondi residential area and its comparison with old Dhaka' [7].

Two recent studies about impact of commercialization in Dhanmondi Residential Area were conducted by Nancy and Shumi where socio economic impacts of commercial development in Dhanmondi were identified [8,9]. The study conducted by Nancy titled "Effects of Commercialization on the Adjoining Residential Areas of Dhanmondi and Banani" covers two residential areas, Dhanmondi and Banani. In her study the author compared similar types of housing techniques implemented home and abroad. While Shumi, in her study titled "Commercial Impact on Dhanmondi Residential Area" showed the pattern of commercial development during past years and its impact on day to day life. According to her study about 50% of the total land was partly or fully non-residential in Dhanmondi. She expressed that the revision of master plan of Dhanmondi was badly needed to protect its residential environment which was never done.

Various studies about the morphological change of Dhaka city were reviewed to get clear idea about the growth of Dhaka city. Among these studies "Spatial Logic of Morphological Transformation: A Paradigm of Planned - Unplanned Areas in Dhaka city" conducted by Khan and Nilufarcan be mentioned where morphological change and land use pattern were analyzed for three residential area Dhanmondi, Gulshan and Banani [10]. Another study conducted by Bayes, et al. titled "A case study of the morphological change of four wards of Dhaka city" was reviewed where transformation of urban form and the modern urban fabric of Dhaka City from 1947-2007 was analyzed in four wards [1].

From the book written by titled "Urban Land use Planning" some theories of land use were studied. In this book the author presented four perspectives in creating land use information model. The four perspectives according to that book, are: (1) land as functional space

devoted to various uses; (2) land as a setting for activity system; (3) land as a commodity to be developed and (4) land as perceptual image or esthetic resource. He also described several determinants of land use to determine the pattern of land use [11].

The DMDP (1995-2015) itself acted as a literature for this study. Dhaka Metropolitan Development Plan, a Package of Structure Plan, Master Plan and Detailed Area Plan were prepared to develop Dhaka City in a planned way for 20 years (1995-2015). The project was one of UNDP's aided projects implemented in cooperation with UNCHS/HABITAT in Dhaka. Different zones, permitted uses, conditional uses of the zones, land use policy guidelines and standards for the different DPZs of DMDP were reviewed to get clear idea about the study area [12].

III. METHODOLOGY

To achieve the objectives of the research and the probable sources for the required data were listed. The data sources include primary sources (field Survey, informal discussion etc.) and secondary sources (Dhaka City Corporation (DCC), RAJUK, PWD, maps, articles, books, journals, etc.). A field survey was conducted to know the present land use scenario in the study area. The land use and road network of the study area were digitized schematically by using Arc GIS 10.0 software, for easy visual interpretation, and to scale, for subsequent quantity analysis. Arc GIS, MS Excel (for calculation of percentage) etc. software was used to analyze all the data.

A. Profile of the study area

Dhanmondi is located about 5 km away from the city center. It is situated in Dhanmondi Thana at 23.7389° N and 90.3847° E. The area comprises almost whole portion of Ward 49 of DCC (currently Ward 15 of Dhaka South City Corporation) within zone 5. Total area of the site is about 527.8 Acres (2.07 Sq Km) including Mirpur Road and Shat Masjid Road though different values in different sources are observed. But all the values are around 500 acres. The study area is bounded by Mohammadpur and Lalmatia on the North, Rayer Bazar and Zigatola on the West, New Market and Azimpur on the south and Kalabagan and Sukrabad on the East. Dhanmondi Lake is situated in the middle part of the area. The total area of this lake is about 36 acres.

Dhanmondi residential area is situated in a medium high land area. The maximum elevation of this area is 9.93 mPWD and average elevation is 7.76 mPWD, RAJUK (2008). According to recent population census conducted in 2011 the population of Dhanmondi Residential Area is 47170. According to, BBS 2011, the literacy rate of Dhanmondi Thana is 78.8% [13]. Dhanmondi residential area is mainly inhabited by government officials, professionals, businessmen, political elites etc. about 30% is engaged in government service, 20% is engaged in private service, 25% is involved in business [9]. The land price of this area is very high. The plots adjacent to road

are about Tk120 to 130 lakhs per katha and are about Tk100 lakhs per katha for rest of the plots [14].

Table 1. Year Wise Population of Dhanmondi R/A

Year	1991	2001	2011
Population	15242	25512	47170

Source: BBS, 1991; BBS, 2001 and BBS, 2011 [13,16,17,18]

Dhanmondi’s streets are grid patterned and practically all the plots are rectangular and of a similar size (Afrin et al. 2012). Three kinds of road or streets were designed for the territory i.e. Major thoroughfare (Mirpur Road and Shat Masjid Road) of more than 30meter width, Secondary roads of 15-meter width and Access roads of 10 to 15 meter width. The total area of roads is about 122 acres [14,15].

IV. RESULTS AND DISCUSSION

A. Area wise land use scenario of Dhanmondi R/A from 1950 to 2012

Area wise land use pattern of Dhanmondi residential area from the year 1950 to year 2012 is shown in Table 2.

From the table 2, it is seen that about 230.55 acres of land was used as residential purpose in 1985 which is 47.39% of total land. On the other hand, commercial land was about 59.76 acre which is 12.28% of total land. Significant amount of land was also used as mixed use occupying 20.57 acres of land which is 4.23% of total land. It is observed that about16.51% of total land was used as non-residential purpose.

Table 2. Area Wise land use Scenario of Dhanmondi R/A from the year 1950 to year 2020

Types of Plot	Year 2020 ¹		Year 2012 ²		Year 2005 ³		Year 2000 ⁴		Year 1985 ⁵		Year 1950 ⁶	
	Area (Acre)	%	Area (Acre)	%	Area (Acre)	%	Area (Acre)	%	Area (Acre)	%	Area (Acre)	%
Residential	177.88	36.56	181.27	37.26	187.5	38.54	195.58	40.20	230.55	47.39	298.5	61.36
Commercial	24.87	5.11	25.46	5.23	43.59	8.96	45.32	9.32	59.76	12.28		
Educational	33.94	6.98	32.87	6.76	28.49	5.86					4.4	0.90
Industrial	0.97	0.20	0.84	0.17	15.22	3.13						
Health Service	14.27	2.93	12.45	2.56	1.64	0.34						
Service Activity/ Offices	13.92	2.86	14.81	3.04	187.5	38.54						
Religious	1.79	0.37	1.64	0.34	43.59	8.96	1.86	0.38	2.24	0.46	4.7	0.97
Eidgah	0.86	0.18	0.86	0.18								
Community Service	2.97	0.61	2.78	0.57	1.79	0.37						
Police Station	0.34	0.07	0.34	0.07								
Post office	0.09	0.02	0.09	0.02								
Governmental	3.67	0.75	3.67	0.75	3.08	0.63						
Mixed Use	45.41	9.33	42.67	8.77	35.5	7.30	73.93	15.20	20.57	4.23		
Open Space/playground	46.74	9.61	47.92	9.85	48.75	10.02	44.27	9.10	49.1	10.09	44.7	9.19
Water Body	36.17	7.43	36.39	7.48	38.17	7.85	44.22	9.09	42.52	8.74	44.6	9.17
Road	82.61	16.98	82.45	16.95	82.74	17.01	81.39	16.73	81.74	16.80	89.6	18.42
Total	486.5	100.00	486.5	100	486.5	100	486.5	100	486.5	100	486.5	100

¹Survey for this study in 2020 (Calculated Using Arc GIS 10.0); ²Field Survey for the study in 2012; ³Dhaka City Corporation (former); ⁴PWD, 1999; ⁵Alam, et al. [19]; PWD, 1996; ⁶PWD, 1958

Comparing the residential land in first master plan and in 1985 it is found that 22.76% residential land was converted to non- residential use during this 35 years’ time period.

Table 2 also shows that 40.2% of total land was being used as Residential purpose having 195.58 acres of land in 2000. Commercial land was about 45.32 acres and mixed-use land was about 73.93 acres. Mixed use land occupied 15.2% of total land which is 3 times more than that of 1985. But percentage of commercial land has decreased

from 12.28 to 9.32. This is because most of the commercial plots were converted to mixed use plots. In the year 2000 about 24.51% of total land was used as non-residential purpose. The conversion Percentage of residential to non-residential use from 1985 to 2000 was 15.17.

Only 38.54% of total land was being used as residential purpose having 187.5 acres of land in 2005. Commercial uses occupied 43.59 acres of land which was 8.96% of total land. Mixed use and educational use also occupied

significant amount of land having 35.5 acres and 28.49 acres. Service activity occupied about 3.13% of land. Religious, other community facilities and government offices occupied small portion of lands compared to others. In 2005 about 129.31 acres of land was used as non-residential purpose which was 26.58% of total land. The conversion Percentage of residential land was 4.13 from 2000 to 2005.

From table 2, it is also observed that, 37.26% of total land is being used as residential purpose in 2012. From the field survey it is observed that mixed use is the second dominant use having 42.67 acres of land. Commercial use occupies 5.23% of total land and educational use occupies 6.76% of land. 12.45 acres of land is being used as health services which is 2.56% of total land. Service activity and community service poses 14.81 acres and 2.78 acres of land. Total 138.14 acres of land are being used as non-residential purpose which is about 28.39% of total land. About 3.14 % of Residential land has been converted to non-residential use during 2005 to 2012. Land use Pattern of Dhanmondi R/A in 2012 shown in Figure 1.

In 2020, it is observed that 36.56% of total land is being used as residential purpose. But in a residential area around 60% should be used as residential and rest of the land should be used as open space, road, water bodies etc. Mixed use is the second dominant use having 45.41 acres of land. Commercial use occupies 5.11% of total land and educational use occupies 6.98% of land. 14.27 acres of land is being used as health services which is 2.93% of total land. Service activity and community service poses 13.92 acres and 2.97 acres of land. About 2.05 % of Residential land has been converted to non-residential use during 2012 to 2020.

B. Conversion Percentage of land in Different Time Period

Though Dhanmondi was planned as a fully residential area, it lost its characteristics with lots of non-residential development. The trend of these kinds of development was different in different time period. Four different time period was been analyzed to find out the trend of land use conversion in Dhanmondi Residential Area. As all the time period is not equal land conversion per year is calculated to obtain better picture about land conversion in the study area.

Table 3. Per Year Land Conversion in Different Time Period

Time period	Reduction of Residential Land (Acres)	Conversion Percentage	Conversion Percentage per year
1950-1985	298.5-230.55 =67.95	22.76	0.65
1985-2000	230.55-198.58 =31.97	15.17	1.01
2000-	195.58-187.5	4.13	0.83

2005	=8.08		
2005-2012	187.5-181.61 =5.89	3.14	0.44
2012-2020	181.61-177.88 =3.73	2.05	0.22

From table 3, it is found that from 1950 to 1985 the conversion Percentage of land from residential to non-residential was 0.65 per year. It increased to 1.01 in the time period of 1985 to 2000. After that the conversion percentage per year gradually decreased to 0.86 in 2000 to 2005, 0.44 in 2005 to 2012 and 0.22 in 2012 to 2020 time periods. The highest percentage of land conversion per year was in 1985-2000. This is because during this period most of the undeveloped land was developed and single or two storied buildings were started to convert in multi storied buildings with mixed use of structures. After that the conversion ratio decreased because most of the plots were already developed and conversion of structures to multi storied buildings become much lower.

C. Comparison of Existing Land use with the Standards Recommended in DAP

From the table 4 it is observed that for educational purpose total 12.89 acres of land should be enough to serve the present population. But there are 21.05 acres of excess land been using in this purpose. Total educational land is about 33.94 acres which is almost 3 times than preferred land. Dhanmondi Residential area is famous for its huge green lands and the lake situated here. From the table it is seen that there are about 42.97 acres of additional open space or playground serving the area. This is definitely positive for the environment of this area.

Community center is very necessary for an area. In Dhanmondi there is 2.97 acres of land devoted to community centers which is much higher than recommended standard though the standard area is proposed for a full ward. There is a post office in Dhanmondi Residential Area which poses 0.09 acres of land. But according to standard there should be 0.04 acres more land for a post office. Religious facility is also lower than required land. The situation for market is very alarming because there are 24.87 acres additional land been using for markets, shopping centers and other commercial activities in Dhanmondi residential area.



Figure 1. Land use Pattern of Dhanmondi R/A in 2012

Table 4. Comparison of existing facilities with DAP Standards

Sl. No.	Facilities	Recommended in DAP	Existing Land (Acre)	Land Needed According to DAP (Acre)	Land Needed According to DAP - Existing Land
1	Primary School	1 acre/ 15000			
2	Madrasha	1 acre/ 25000			
3	High School/ Intermediate College	2 acres/ 20000	32.87	12.89	-19.98
4	Degree College	2 acres/ 30000			
5	Park/Open Space	2 acres per 25000	47.92	3.77	-44.15
6	Community Center	1 in each ward. Area: 0.30 acre	2.78	0.30	-2.48
7	Health Center	Ward basis	12.45	-	-
8	Graveyard	Ward basis Area: 2 acres	-	-	-
9	Market	Ward basis Area: 0.30 acre	25.46	0.30	-25.16
10	Post Office	0.10 acre/ 35000	0.09	0.13	0.04
11	Fire Station	1 for every 4 wards Area: 1 acre	-	-	-
12	Mosque/Temple	0.30 acre/ 6000	1.64	2.36	0.72

V. CONCLUSION AND FUTURE SCOPE

During the time of urbanization, the physical characteristics of Dhaka City are changing step by step, as open spaces and water bodies are converted into built up areas. Land use change is another aspect that has immersed due to high population pressure and intension to get more profit. Dhanmondi has also been affected by this trend of transformation. Dhanmondi Residential Area was planned to accommodate high and higher middle-income people with beautiful residential characteristics. But for different reasons the circumstances changed and now it is a place of mixed land use. In original plan over 60% land was devoted to residential purpose which decreased below 50% in 1985. The decreasing rate continues as it came down to 40% in 2000 and 38.5% in 2005. At present the percentage of residential land is about 37%.

At present both educational and commercial facilities is much more than required for present population. These additional facilities pull huge number of external visitors' every day that impose high negative impact to the residents in this area. Traffic congestion, air pollution, noise pollution, road accidents etc. are the outcome of unplanned commercial development.

To maintain habitable quality of Dhanmondi Residential Area, it is the utmost necessity to prevent the inconsistent land use transformation and the natural development in the area. The condition of Dhanmondi is deteriorating day by

day and if this trend continues the area may not be suitable for living in future. Once picture perfect residential area will be converted to a busy commercial zone with numerous shopping complexes, educational institutions and other commercial facilities. The condition of Dhanmondi Lake is also affected by this massive transformation of land. The beauty and natural landscape are losing its appeal. But this situation must not be continued. Appropriate policies and strategies should be taken to restore the habitable characteristics of Dhanmondi.

ACKNOWLEDGMENT

The authors would like to give special thanks to S. M. Nawshad Hossain, Assistant Professor, Department of Urban and Regional Planning, Jahangirnagar University for his guidance. Authors wish to extend sincerest thanks to Md Kamruzzaman, Sub Division Engineer, Development Section, PWD; Mr. Helal, Sub Division Engineer, Dhanmondi Sub Division-2, PWD; the officials of Dhaka City Corporation and RAJUK for their cooperation in collecting necessary data to carry out this research.

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