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The Socio-economic Status and Land Use Pattern: A Micro-level Analysis in Bangladesh

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Abstract

To investigate the micro level existing land use pattern, socio-economic status and differences between urban and rural land use pattern, the Dumuria upazila in Khulna district in Bangladesh has been selected. Total 340 samples have been taken through a questionnaire survey and the plot-to-plot survey was conducted on 2657 plots and about 267 acres to fulfill the objectives. This study demonstrates that land use pattern in both urban and rural areas was different due to various socio-economic factors. In urban areas, land use pattern was mainly dominated by residential or homestead use about 26% of land and a significant portion of land was occupied by the commercial and industrial use which is about 13% of the land. On contrary, rural area was dominated by wetlands and agricultural land (cropland and inter-culture) about 40% and 23% respectively. The study indicates that forest and woodland cover was relatively high in rural areas was about 15.39 acre out of 141 acre (11%) but it was only about 4% in urban areas. Moreover, this study reveals that the rural area was mostly covered with natural forest and woodland, on the contrary, urban area was mostly man-made. However, the findings of this study provide valuable information to support the sustainable development of urban and rural land use and planning processes and forecasting future possible land use changes on that locality.

Keywords: GIS; land use pattern; rural-urban areas; socio-economic status.

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1. Introduction

Land use acts as an interface between people and the environment as it forms a unifying concept in which socio-economic and ecologic variables coincide [1]. The ecosystem services and its resources are significantly positively correlated with land use but some forms of land use degrade ecosystems and the services they provide [2]. Land use has important impacts on the functioning of socio-economic and environmental systems with important tradeoffs for sustainability, food security, biodiversity and the vulnerability of people and ecosystems to global change impacts [3].

The land is a limited resource, every year per capita land in Bangladesh is decreasing due to the unplanned utilization of land, and population pressure and overexploitation are ultimately influencing present land use structure and socioeconomic environment as well. However, in the course of time, the land use pattern has been changing in Bangladesh [4]. In addition to being a local issue through the extraction of resources in a specific locality, or regional through changing landscapes and landscape functions, land use is increasingly becoming a global issue [2]. Therefore, land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels [5].

Land use in Bangladesh is generally determined by physiography, climate and land levels [6]. For instance in coastal areas of Bangladesh like Khulna, Barisal districts are used for agriculture, shrimp cultivation and fish farming, forestry, salt production, ship-breaking yards, ports, industries, human settlements and wetlands and the land use features in these regions are very diverse, competitive and often conflicting [7, 8].

Currently, land-use and land-cover change analyses are concentrating among a wide variety of areas and interests for instances land use land cover modeling, or spatial and temporal patterns of land conversion [9, 10, 11]. To some extent, land use is still a complex issue regarding its process, dynamic and driving forces [12]. Therefore, a single research approach does not suffice for a complete analysis of land use status. Instead, a combination of multiple approaches is necessary for Land use status analysis. However, for the sustainable use of land resources, identifying land use status and condition are necessary to protect the limited land resource from unplanned utilization. The aims of this paper are to understand the existing land cover and land use pattern of Dumuria Bazar and Hajidanga Mouza and to figure out the socio-economic condition of the study area.

2. Materials and methods

2.1. Study area

The study area encompasses Dumuria upazila is located at in between 22°39' and 22°56' north latitudes and in between 89°15' and 89°32' east longitudes (Figure 1) [10]. Dumuria bazaar and Hajidanga Mouza (a small unit of the administrative division consisting of several villages) under Dumuria upazila in Khulna district were selected as study area (Figure 2). Dumuria Bazaar is a growing urban area while Hajidanga Mouza is a rural area.

2.2. Data preparation

In order to investigate land use condition, the base map of study area, mouza map, administrative maps were derived from the Survey of Bangladesh and the study area was selected and divided into 61 grids through studying boundary of these maps. Firstly, Google Earth images [14] of the study area were extracted to identify the boundary of the study area and then the combined image was divided into several grids according to the base map. Land cover and land use pattern data were obtained by the plot to plot survey and socio-economic data were acquired by questionnaire surveying in 2016. The plot to plot survey was conducted to accumulate primary data from respective grids nearly 2657 plots of about 267 acres. The main task was to evaluate the existing land cover and land use pattern and identify changes in land use with respect to the base map. A questionnaire survey was carried out to evaluate the socio-economic conditions of the study area. The household had been selected by random sampling method.

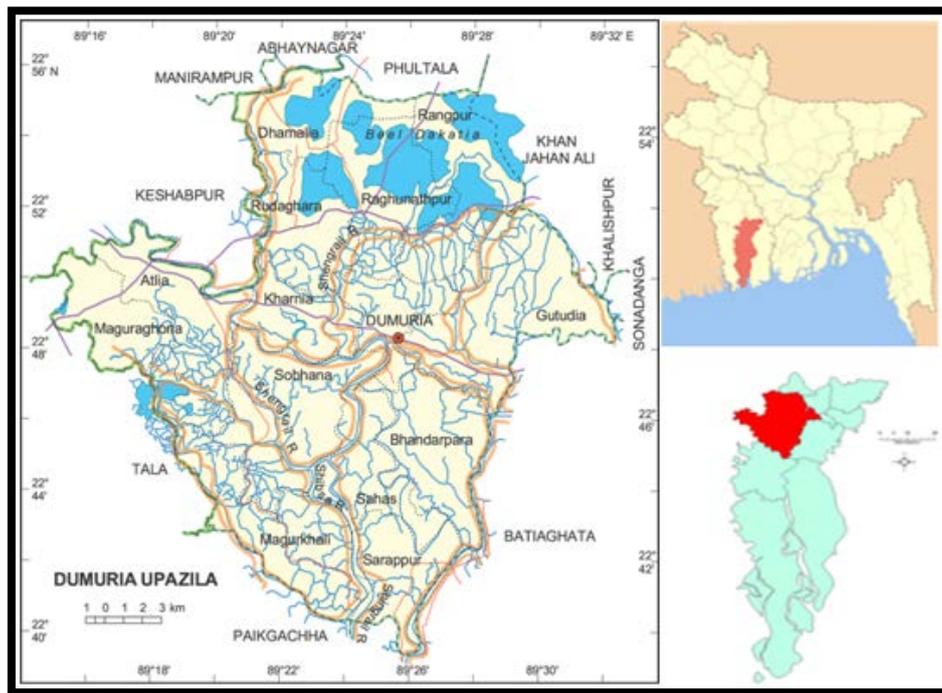


Figure 1: Study area showing Dumuria Upazila in Khulna District in Bangladesh

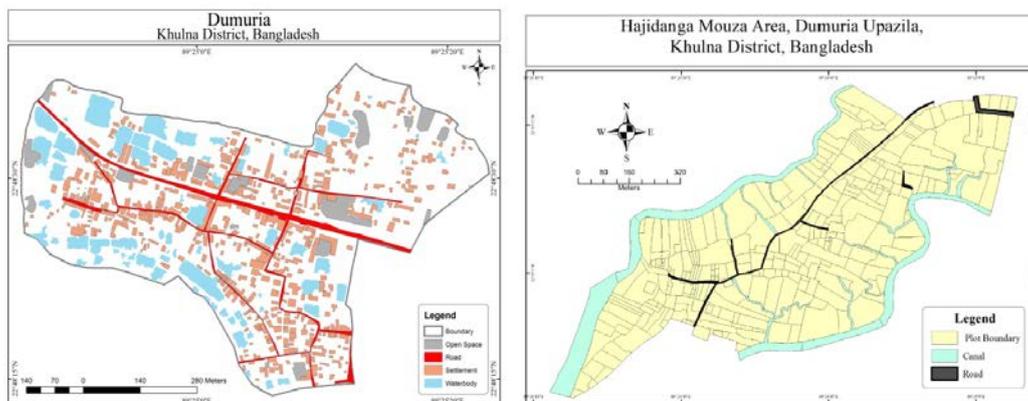


Figure 2: Site of the Land use survey Dumuria Bazaar (left) and Hajidanga Mouza (right)

2.3. Data analysis

There were a total of 340 questionnaire surveys where 255 questionnaire surveys have been conducted in Dumuria Bazaar (urban) and 85 have been completed in Hajidanga Mouza (rural). The collected quantitative data have been checked and exported to the spreadsheet in excel file. The descriptive statistics including mean, frequency and percentage have been analyzed in SPSS (Statistical Package for Social Science, version 20.0) software environment. Finally, land use data which was acquired from plot to plot survey was shown in the map using Arc GIS 10.3.

3. Results

In Dumuria (urban), most of the land level (land level is categorized based on the hierarchy of altitude) was in the second level (second level is represented as relatively high land) locally known as Vita which was about 65%. The land having dominant characteristic of moderate drainage was about 43% and about 24% of the area was waterlogged. The dominant soil was silt loam about 33% while about 27% was sandy loam.

In Dumuria, most of the land was free from the flood which was about 55%, only 1% of the land was deeply flooded and about 22% was permanent water bodies. Almost entire area was drought-free was about more than 99% while only 1 plot out of 1818 plot was rarely drought affected.

In Hajidanga mouza (rural), the land level was mostly lowest level (lowest level is represented as rivers, ponds etc.) which was about 57%, where only 2% of the land was at the highest level (highest level land is represented as small hills). About 29% of the land was the in the second level such as Vita. The land has characteristics of moderate drainage condition about 42% and about 39% of the land was waterlogged. In the mouza mostly dominated soil was clay loam about 42% where silt loam was 25%. Most of the land was low flood land about 42%, where about 26% of land flooded and about 13% of land was permanent water bodies. The land was characterized as drought-free area. About 93% of land was not affected by drought, where only 3% of land was seasonally affected and another 3% was occasionally affected.

In order to assess the characteristics of the study area during the land use survey, land use related to the settlement, agriculture, wetlands, forest and woodlands, agricultural practices categories were considered (Figure 3, Figure 4 and Table 1).

The land use pattern of Dumuria (urban) was mainly dominated by residential/homestead about 26% of land use was homestead where about 11% was commercial and about 2% was industrial land use. Commercial land use was in a linear pattern mainly along the road networks. The major and minor road network (transport and communication) covered about 9% of land use while only 7% of the land was institutional use.

Three cropping seasons were found in Dumuria in Kharif-1 season (December to June) about 6% land use was a permanent fallow, where about 0.5% land use was used for all seasons vegetables. In Kharif-2 season (June to November) most of the lands were remain fallow about 7% and only about 0.5% of land was used for permanent vegetables. In Rabi season (November to December) about 6% land use was permanent fallow and about 0.5%

land was used for winter season crops and only 0.5% land was used for all season's vegetables.

The dominant wetland of the urban area in Dumuria was permanent pond about 9% where about 1% was man-made. Dumuria was characterized as man-made vegetation than natural. The natural mixed forest was only 4% where the man-made mixed forest was 8%. About 1% land use was man-made bamboo bush and about 1% was natural timber trees.

In Hajidanga mouza, most of the lands was wetlands about 55.9 acre (Acre is a unit of land area used in the imperial and US customary systems. One acre equals 1/640 (0.0015625) square mile) out of 141 acre. The mouza was surrounded by canal from two sides. The other dominant land use was homestead found mainly along the village road. Rest of the land was mainly agricultural land-use sorted as crops, inter-culture.

The area is rich in Shrimp Farming and hatchery. There is 15.39 acre area of forest and woodlands where natural and manmade forest both is found. The transport and communication area is only 6.49 acre mostly kutchra and mud built which shows the typical scenario of rural communication networks in Bangladesh. Cropping area is only 3.08 acre while inter-culture (paddy + Fish) is in 29.7 acre. The ratio of crop cultivation is low due to high profit in Shrimp culture.

Table 1: Land use of both urban (Dumuria) and rural (Hajidanga) area

Area name/ Land use type	Dumuria		Hajidanga	
	Area (acre)	Area (%)	Area (acre)	Area (%)
Commercial	13.91	11.32	0.09	0.06
Fallow Land	8.37	6.81	3.81	2.69
Farms	0.12	0.10	2.26	1.60
Forest and Woodlands	18.32	14.91	15.39	10.88
Health Institute	0.08	0.06	22.84	16.15
Homestead/Residential	32.15	26.17	2.85	2.01
Horticulture	0.86	0.70	0.04	0.03
Industrial(Mill, Factory)	2.52	2.05	1.71	1.21
Institutional	7.91	6.44	29.69	21.0
Inter Culture	0.38	0.31	0.07	0.05
Transport and Communication	11.15	9.08	6.49	4.60
Vegetables	0.43	0.35	0.17	0.12
Wetlands	26.66	21.70	55.97	39.6
Total	122.86	100	141.38	100

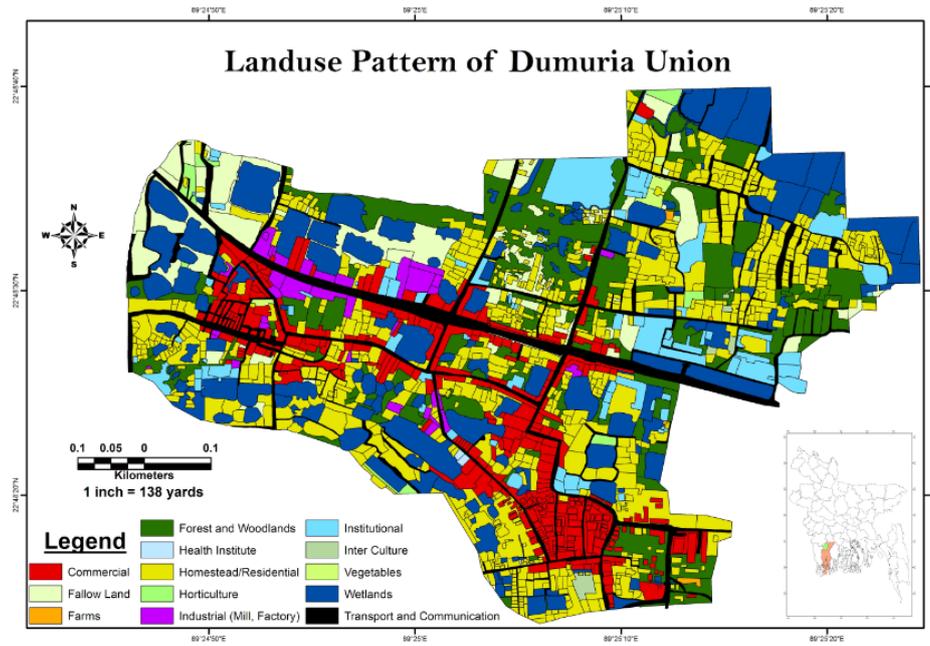


Figure 3: Land use pattern of Dumuria (urban)

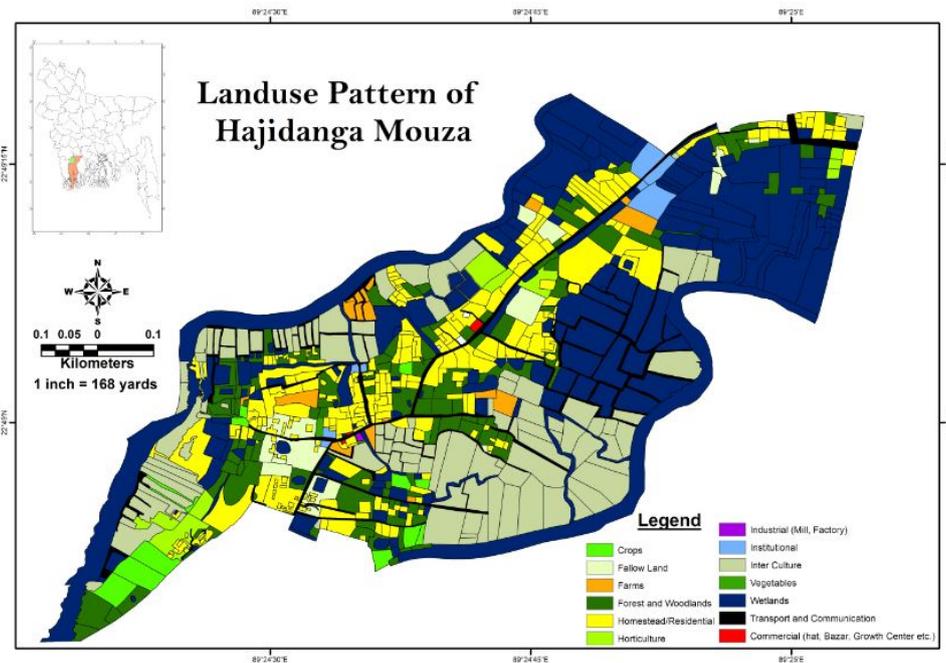


Figure 4: Land use pattern of Hajidanga Mouza (rural)

The Socioeconomic condition of Dumuria Bazaar (urban) and Hajidanga mouza (rural) is surveyed based on Socio-Economic, Settlement Related, Landuse Related, Health Related, and Environment Related Profile. In Dumuria Bazaar (urban) reflects typical urban family structure where about 72% respondents were Nuclear family, while in Hajidanga mouza a large number of joint family structures were found about 32%. In the urban area, 16% of respondents were illiterate while in rural it was 26%. The dominant occupation in urban areas was business about 40% while in rural it was farmer and day laborer about 20% and 15% respectively. In Dumuria

Bazaar present income-expenditure were relatively same. About 38% respondents income were more than 2 lacks while 20% respondent's expenditure was more than 2 lacks while ten years ago the majority of the respondents income-expenditure was in between 50 thousands to 1 lakh. In Hajidanga mouza present income-expenditure reflect the poor economic state. Frequency was high in the range of 20 thousand to 50 thousands about 18%. Pucca houses (pucca house is made with high quality materials) were dominant in the urban area which was about 47% other hand rural areas has dominant semi-pucca (semi pucca house is made with high quality materials either on wall or roof) housing structure about 45%. Majority of the household head was migrated for the job, business purposes, better living about 32% in urban areas while migration is not frequent in rural areas. Both urban and rural area shows conventional land use about 58% and 61% respectively. Majority of the sanitation condition in Dumuria was pucca about 77% while it was only 54% in rural. The environmental pollution rate is high in both areas. The noise pollution is comparatively high in the urban area than the rural.

4. Discussion

The land use changes have impacts on livelihood of the people or who are dependent on land directly or indirectly [4]. Land use and land cover was changed noticeably over the period of 2000 to 2007 in Khulna [15]. This trend is similarly noticeable from 2007 to 2014 which reflects the increased trend of urbanization and associated built up area [15]. Our present study reveals that majority of the land in urban area was second level which was above normal flood level is similar to another study on land use policies of Khulna [16] and the study showed that land level of Khulna is approximately 2.5 meter above the mean sea level and the district is more or less flat lying [17]. The drainage infrastructure and river channels in Khulna were less than satisfactory [18] and it was found that the whole Khulna metropolitan area is poorly drained [16], while our study found moderate drainage condition in both urban and rural areas. The dominant soil was silt loam and clay loam in urban and rural respectively which is similar to the study that illustrated the geology of the Khulna city and showed that the area is composed of sand, silt and clay in various proportions with small amount of coarse sand [17]. Flood is a recurrent phenomenon in Bangladesh [16], approximately 20% to 25% territory of the country is inundated during the monsoon [16]. Both Dumuria and Hajidanga was flood free and low flood land respectively, on the contrary, it was showed that in Dumuria impact of HM Disaster risk like Flood/ Waterlogging is high [19], but present study shows similarity with study which showed the the maximum land of Koyra upazila which is adjacent to Dumuria is under low flood-affected zone [20]. Almost entire area was drought-free both in urban and rural which shows similar characteristics with a report [21] showed that in Dumuria upazila, according to drought vulnerability ranking, Rabi rank is 171, Kharif-1 rank is 92, combined rank is 263, severity rank is 199 [21]. There is another study assessed and analyzed meteorological drought by SPI (Standardized Precipitation Index) method [22] which study was adapted [23, 24] and it showed that in particular, SPI was below -2.0 in southwestern part in 1997 and in 2010 the SPI was mostly below -2.0 where SPI value 0 to -0.99 is near normal, -1 to -1.49 is moderate, -1.5 to -1.99 is severe and -2 and less is extreme [22]. We found that the dominant land use pattern in urban (Dumuria) and rural (Hajidanga) was residential (26%) and wetlands (39.6%) respectively. In urban areas commercial land use was 11%, industrial 2%, road network 9%, institutional 7%, agricultural 21%, forest and woodland 15%, and in rural areas commercial land use was 0.06%, industrial 1.21%, road network 4.6%, institutional 21 %, forest and woodland 10.88%. Another study of demonstrated that in Madertala village in Dumuria upazilla, Khulna district showed the lands as settlement 9.33%, crop agriculture

21.83%, water body 10%, fisheries 5.21%, agri-fisheries 46.26%, road 4.27%, commercial 1.56%, institutional 1.55% [4]. Other study represented that in Khulna city and showed the land use structure which is consisted of 46% residential, 18% agriculture, 15% industrial, and 5% commercial [16]. The dominant occupation in urban areas was business about 40% while in rural it was farmer and day laborer about 20% and 15% respectively and present income-expenditure were relatively same in both areas while the study showed that there has significantly changed in the occupational pattern, most of the household head's occupations were agriculture in 1990 [4]. Later than due to the changes of land use most of the farmers have changed their principal occupation and switch over to gher (gher is a traditional agriculture system in Bangladesh use for shrimp farming), shrimp peddler, handicraft, transport, fishing and other services.

5. Conclusion

The natural land feature is usually used by man to meet their basics demand and it is changed and modified by human practices. So, it is important to explore the dynamics and spatial pattern of land use changes for a micro level study. There were some difficulties and limitation in our research, for instances, for plot-to-plot surveying plot identification was a challenge for the surveyors from the Google earth map due to existing unparalleled changes of land. Another limitation of this study is that taking of some physical features characteristics during the survey was difficult due to physical barriers of the environment. However, the output of the current research will be helpful in planning and policy development in a specific region of Bangladesh.

6. Recommendations

The result of this study suggests that the in-depth micro level land use study based on questionnaire survey with integration of digital image analysis is needed for obtaining better directions in zoning regulation, rural land use plan or spatial development plan. There is a spatial variation in different physical and land features were clearly indicated. It is recommended that this research should be expanded by exploring more areas adjacent to our study area or other micro level area to show a common scenario from different places of Bangladesh which could be used in implementing spatial development plan and regulation.

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