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URBANIZATION AND SPATIAL DEVELOPMENT IN BANGLADESH: AN APPLICATION TOWARDS MODIFIED GROWTH POLE MODEL

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Abstract

The modified growth pole asserts that urbanization and spatial development are interrelated process. The principal objectives of this study are to examine the broad rudiments of the modified growth pole theme and to examine the roles of six ecological variables on urbanization and spatial development in Bangladesh. The six hypotheses underlying this study were tested for both urbanization and spatial development separately and for the years 1974 and 1991. The modified growth pole model is examined in this study by employing multiple regression analysis. Results of this study provided an insight to the growth pole theory and its applicability in the Third World dual economic conditions. It is observed from the study that both urbanization and spatial development are inter-linked and urbanization accelerates the process of spatial development.

Keywords: Urbanization, Spatial Inequality, Spatial Development, Balanced Economic Growth, Growth Pole

Introduction

The research on urbanization and spatial inequalities in economic development and social change in the developing world has gained wide attention of scholars among a number of disciplines. This interest has been stimulated by problems of rapid population growth, unplanned urban development and even widening spatial inequalities between urban and rural areas in the Third World (Barke and O'Hare 1984; Geiger and Faissol 1982; Fay and Opal 2000), and by several theoretical constructs explaining urbanization and economic growth (Perroux 1950; Myrdal 1958; Friedmann 1966; Henderson 2000). These theories focus on either urbanization or economic development process as the source of spatial inequalities.

Regardless of the specific theme, most explanations of urbanization and spatial inequalities involve a number of controversial relationships and interpretations of them (Perroux 1950). For example, the role of physical environment and its constraints on spatial development and inequalities has not been demonstrated in the theories

of development. Also, empirical studies and applications of these theories have not involved the situations of extremely high population density and severe resource scarcity and environmental constraints. Due to those conditions that significantly hinder spatial development processes and gives rise to spatial inequalities.

Bangladesh is predominantly a rural country where over 80 per cent of the nation's 128 million people live in rural areas and actively engaged in agriculture. While 40 percent of Asian population is urban, only about one-fifth of Bangladesh's population is urban and the growth rate of urban population has been low (GOB 1997). The nation has had two and half decades of developmental efforts to avert poverty and to achieve economic development and social change. Despite large inflow of capital and foreign aid to augment meager domestic resources, the planned efforts for development have not been able to free the country from its low economic growth trap. The average per capita income is still low by the world standards (US$320) and over half of the country's population lives below poverty level (World Bank, 1995). Population explosion, resource scarcity, severe environmental constraints, and lack of technology are some factors responsible for such slow rates of economic growth and increasing poverty. While the government monitors and promotes urbanization and spatial development via allocation of resources, slow rate of urbanization and wide spatial inequalities are well documented in the country. The existing studies on urbanization in Bangladesh have largely focused on urban population dynamics, urban housing, health and sanitation, the relevancy of urbanization and spatial development theories in such conditions is largely undocumented.

This study examines various aspects of urbanization and spatial inequalities in economic development in Bangladesh. It analyses a set of spatial data collected from 64 districts which display variables that influence spatial development and particularly population density, degree of urbanization, environmental quality. The study seeks to examine the relevance of existing theories of urbanization and spatial development in the context of the conditions described in Bangladesh. In doing so, the study seeks to understand the process of urbanization and its impacts on spatial development and inequality in the country.

Theoretical construction and significance of the study

Contemporary literature on urbanization and spatial development has primarily dealt with the balanced economic growth and growth pole model. The balanced economic growth approach includes classical, neoclassical, dual economy theories of regional economic growth (Marx 1954 and 1956; Darwent 1969; Angotti, 1998; Parr 1999; Bhandari 2006; Richardson et.al. 2009; Garretson and Martin 2009). In contrast, the growth pole model consists of the growth pole theory and its modifications. While the classical and neoclassical debates on balanced economic growth are concerned primarily with the employment of either labour or capital or both, the growth pole theme focused on the role of urbanization and the development of growth centres on regional development and spatial inequality. From review of the sheer volume of literature on the growth pole theme, a general notion emerged has been the systhesis position in which it is agreed that no single theory of spatial economic development exists, but most theories link spatial development and inequality with urbanization.

Before employing growth pole theory in the context of Bangladesh, it is important to identify the theoretical basis of the present studies on urbanization, spatial development and inequalities using growth pole theories (Table 1).

Table 1: Conceptual development and theoretical base.

Theme	Conceptual Development	Contributors
Balanced Growth Theme: towards regional development	Homogeneous space, uniform opportunities, constant factor returns, roles of labour and capital, labour & technology[2]	Marx (1954); Darwent 1969; Angotti (1998).
Growth Pole Theme: towards balanced growth and development	Heterogeneous space, spatial economic development, propulsive industry[3], centre of attraction, spatial diffusion process, spontaneous growth centres, growth poles and lagging regions	Perroux (1955); Alonso (1969); Parr (1999); Henderson (2000).
Modified Growth Pole Theme: an application for Third World Reality	Space based economic activities, hierarchical urban system, economic growth filters (trickle down) and spreads (diffuse), negative effects (polarization or backwash)	Myrdal (1958); Friedmann, 1975; Mitchell-Weaver (1991); Fay & Opal (2000);

The present study is significant in several ways. *First*, it purports to examine the basic assumptions of the growth pole theory in a densely populated, environmentally and economically constrained Third World country. Such an attempt was done before or at least not well articulated in the literature on the growth pole theory. *Second*, the study examines the role of physical environment and its constraints on the development of growth poles and spatial economy. It also attempts to examine the role of technology in the context environmental constraints and its influence on the growth poles. A substantial contribution to our understanding of the growth pole theory and its modifications will be made if the complex interrelationships between urbanization, growth centre and spatial development inequalities, and physical environment and technology can be explored and thereby established. *Third*, in the context of Bangladesh, the study will generate and otherwise examine a large volume of district level data that has not been previously used to explore the patterns of urbanization, and spatial development inequalities. *Finally*, the study results will be used to formulate strategies for future urban and spatial development in Bangladesh with much emphasis on planning objectives.

Existing studies vary widely in scope and scale of study areas; they have either focused on the urban problems of Dhaka City, or assessed the urban and regional development situations on the basis of national data. They have not examined the patterns of urbanization and spatial development under the growth pole theoretical framework, which may yield significant policy implications for national economic development planning. This issue will be examined in the present study.

Objectives and principal hypotheses

The modified growth pole theme asserts that urbanization and spatial development and inequality are interrelated and that degree of urbanization determines the degree of spatial development and inequality. It is implied in this theme that the factors, either ecological or purely economic, affecting urbanization process also affects spatial development via affecting the trickle down processes and encouraging polarization and vice-versa. The principal objectives of this study are to examine the broader rudiments of the modified growth pole theme and to examine the roles of population pressure, environmental constraints, technology, socio-economic, institutional, and capital factors on urbanization, spatial development, and inequality in Bangladesh.

The present study purports to examine the roles of population pressure, environmental constraints, technology, socio-economic and institutional, and capital resource factors on urbanization and spatial development in Bangladesh. Following the modified growth pole theme, it is assumed that population growth is the key factor inducing both urbanization and spatial development. In these two aspects, it may be argued that an index of urbanization and spatial development related to the geographical and economic distribution of resources both on physical and human point of view.

The relationship between population growth and urbanization and spatial development can be examined by the population growth hypothesis that states:

- **H_1:** Spatial variation in the indices of urbanization and spatial development is positively related to percent change in population size.
- **H_2:** Spatial variation in the indices of urbanization and spatial development is negatively related to the spatial variation in the index of environmental constraints.
- **H_3:** Spatial variation in the index of urbanization is positively related to spatial variation in technology inputs used to reduce the environmental constraints.
- **H_4:** Spatial variation in the indices of urbanization and spatial development is positively related to spatial variation in the index of socio-economic conditions.
- **H_5:** Spatial variation in the indices of urbanization and spatial development is positively related to spatial variation in the index of institutional support.
- **H_6:** Spatial variation in the indices of urbanization and spatial development is positively related to spatial variation in the index of local resource base.
- **H_7:** Spatial variation in the index of spatial development is positively related to spatial variation in the index of urbanization.

Data and methods

a. Variables of urbanization and spatial development

The present study considers that the urban accretion has two characteristics namely, physical patterns of growth and the changing patterns which can be measured by an index of urbanization and composite index of urbanization at two different periods of analysis (1970s and 1990s or Census data for 1974[4] and 1991[55] During the study periods the comparable district levels data were not available for 2001.

The purpose of construction of an **index of urbanization** (Table 2) is to identify the growth pole centres and their spatio-temporal evolutionary patterns. This also allow us to examine the various trickle-down and polarization effects of the growth poles on their hinterland, it is necessary to construct the index of urbanization for both the base year 1974 and terminal year 1991 covered in this study. A rather simple index was used recognizing the limitations of data availability. The index of urbanization will be used as a dependent variable (Y) in the remaining analysis.

The purpose of construction of an **index of spatial development** was to identify districts of socio-economic development and inequality. It was also used to examine the various trickle-down and polarization effects of the growth poles on the hinterland. The growth pole theory assumes that the actual trickle-down effects are the evidenced by socio-economic changes occurred in the region during the period 1974 and 1991 and which take the forms of spatial development. The index of spatial development (Table 2), which will be used as a dependent variable (Y) in the analysis, was constructed using the following socio-economic variables after transforming them into LQ (location quotients).

Table 2: Variables and their indices for each of the 64 Districts in Bangladesh: 1974 and 1991

Indices	Definition and name of the variables
Urbanization variables	Urban population (UTRATO74, UTRATO91, change in urban population (GUP61_74, GUP74_91), rural-urban migration (MIGN6174, MIGN7491, location and spacing of urban settlements (SPACNG74, SPACNG91, hinterland population (HINTPN74, HINTPN91), size of urban areas (URAREA74, URAREA91, total manufacturing industries (MNFIND74, MNFIND91), urban and industrial labour force (URBLAB74, URBLAB91).
Spatial Development variables	Educational Institutions (EDINST74, EDINST91), Hospitals per 100,000 Population (HOSPIT74, HOSPIT91), Households with Sanitary Toilet Facilities (TOILET74, TOILET91), Households with Electricity Connections (ELECTY74, ELECTY91), Households with *Pucca* and *Semi-pucca* Buildings (HOUSIN74, HOUSIN91), Rural Market Centres per 100,000 Population (RMARKT74, RMARKT91), Banks and Financial Institutions per 100,000 Population (BANKFC74, BANKFC91), Food and Fertilizer Storage per 100,000 Population (GODOWN74, GODOWN91), Post Offices per 100,000 Population (POSTOF74, POSTOF91), Length of Roads, Highways, and Railways per 100 km^2 (RAILRD74, RAILRD91).
Exploratory variables	Density of Population (POPDEN74, POPDEN91), Depth of Annual Flooding (m), Winter Drought and Soil Salinity (ENVIDX74, ENVIDX91), Roads, Railways, Bridges and Ferry Services (TRANPT74, TRANPT91), Small Landholder Farmers and Landless People (LANDLS74, LANDLS91), Literacy Rate (LITRCY74, LITRCY91), Total Value added Resources by Agriculture, Fisheries, Forestry, Mining, and Manufactories (LOCRES74, LOCRES91), Capital Loan (in Taka) for Agricultural, Industrial, and Business from Banks, and Financial Institutions (CPLOAN74, CPLOAN91).

b. Exploratory variables

In the statistical analysis, explanatory or independent variables are popularly used to see the relationship with the dependent variables. The weights of the relationship between dependent and independent variables can be used to give a clear picture of the regions here those variables are exits. There are seven numbers of explanatory variables were used to test the hypothesis in the present study (Table 2).

c. Analytical methods

The study involved four stages of analyses of data: (i) the construction of a composite index for each spatial unit combining several variable indicators to identify spatially developed growth poles and spatially less or under-developed lagging regions or hinterlands, (ii) the exploration of the structure of urbanization and spatial development (iii) bi-variate statistical analyses to test the hypotheses underlying this study; and (iv) explore the multivariate ecological causes of spatial variability in urbanization and economic development.

The hypothetical data matrix table was prepared using the statistical package SPSS 10.0. By employing this computer software, the weightings were classified into two major classes: growth poles and lagging urban districts. Growth poles or developed urban districts were then again reclassified into two as equal intervals to a high and low growth poles and lagging urban districts or less urban district as equal intervals to a high and low growth poles, which has been chalk out in the mapping distribution of the districts.

Multiple regression analysis is often regarded as the best techniques to specify and evaluate models involving multiple variables. The growth pole theory assumes the development of growth poles is dependent on the influences of ecological factors pertinent to population, environment, technology, socio-economic and institutional characteristics of a region. To explore the magnitude of influence of those exploratory variables on the index of urbanization and spatial development, a multiple regression statistics has been used in this study. Based on the strength of contributions of each exploratory variable on urbanization and spatial development, a modified growth pole model has been developed.

Application of growth pole model and Third World reality: An experience from Bangladesh

While both urbanization and spatial development are interrelated, their consequences and principal determinants may vary in nature. It is therefore logical and appropriate to examine the consequences of urbanization and spatial development separately. In this study, attempts are made to explore the consequences of urbanization and spatial development by testing the seven hypotheses underlying the modified growth pole theory proposed in this study. This section has been devoted to the test of hypotheses for spatial development. Finally, multiple regression statistics has been employed to

test the modified growth pole theory by examining the influence of all seven selected ecological variables on urbanization in Bangladesh. Finally, in the fourth section, the multiple regression statistics have been used to test the modified growth pole theory by examining the influence of all seven ecological variables on spatial development.

Determinants of urbanization and spatial development: Bi-variate test of hypotheses

Based on the eight selected indicators of urbanization and ten indicators of spatial development, a composite index of urbanization and a composite index of spatial development were computed separately for the years 1974 and 1991. The urbanization and spatial development index were considered as the dependent variable (Y). To test the hypotheses underlying the modified growth pole theory, the index of urbanization and the index of spatial development were then correlated with seven selected ecological variables and that has been discussed in the following (Table 3).

Population pressure hypothesis (H_1)

Following the growth pole theory, it is hypothesized earlier that population growth (growth and changes in population density) is the key factor contributing to urbanization and spatial development. Population growth demands the simultaneous growth and establishments of urban biased services, amenities and industries. This attracts more rural people to migrate to urban centres and thus accelerates the process of urbanization and spatial development. In Bangladesh, population pressure encouraged spatial development via urbanization in several ways. First, as population in any location exceeded 5,000, that location was defined (GOB, 1974) as an urban centre. The new urban centre then provides goods and services to the rural hinterland and attracts the entrepreneurs towards the establishments of markets and service centres, educational institutions, hospitals, banks, businesses, storage, post offices, road and transport services and propelling industries to the urbanities. The centres also offer employment opportunities to rural surplus labours that eventually migrated to the new urban centres and contributed to further population growth, urbanization and further spatial development until a full growth pole centre is emerged with much prominent influence. Thus, population pressure induced urbanization in a progressive manner, which then led to spatial development.

It demonstrated this argument well. Both 1974 and 1991 indices of urbanization and spatial development show strong positive correlation with their respective population density data. Both correlation coefficients are significant at the 0.001 level (r = 0.77 and r = 0.88 for the indices of urbanization and r = 0.78 and 0.90 for the indices of spatial development for 1974 and 1991 respectively). These relationships were expected and they provide strong support to population pressure hypothesis underlying this study. The first hypothesis is therefore accepted.

Table 3: Correlation coefficients between indices of urbanization, spatial development and seven independent ecological variables: 1974 and 1991.

Dependent Variable	Independent Variable	Correlation Coefficient (*r*) 1974 Data	1991 Data
Index of Urbanization (UINDEX) 1974 and 1991 Correlation coefficients between indices of urbanization	Population Density	0.77** (POPDEN74)	0.88** (POPDEN91)
	Environmental Constraints	-0.47** (ENVIDX74)	-0.52** (ENVIDX91)
	Transport Development	0.82** (TRANPT74)	0.84** (TRANPT91)
	Percent of Farmers in Small Landholders & Landless Category	0.57** (LANDLS74)	0.50** (LANDLS91)
	Rate of Literacy	0.37** (LITRCY74)	0.47** (LITRCY91)
	Percent Distribution of Bank Loans	0.82** (CPLOAN74)	0.82** (CPLOAN91)
	Local Resource Base (Value added by all Agricultural, Mining, Forestry, and Industrial activities).	0.79** (LOCRES74)	0.83** (LOCRES91)
Index of Spatial Development (SINDEX) 1974 and 1991	Correlation coefficients between indices of spatial development		
	Population Density	0.78** (POPDEN74)	0.90** (POPDEN91)
	Environmental Constraints	-0.41** (ENVIDX74)	-0.51** (ENVIDX91)
	Transport Development	0.84** (TRANPT74)	0.83** (TRANPT91)
	Percent of Farmers in Small Landholders & Landless Category	0.60** (LANDLS74)	0.49** (LANDLS91)
	Rate of Literacy	0.48** (LITRCY74)	0.44** (LITRCY91)
	Percent Distribution of Bank Loans	0.70** (CPLOAN74)	0.81** (CPLOAN91)
	Local Resource Base (Value added by all Agricultural, Mining, Forestry, and Industrial activities).	0.80** (LOCRES74)	0.84** (LOCRES91)

*Significant at 0.001 level. **Significant at 0.05 level.

Environmental constraint hypothesis (H_2)

One can identified that the modified growth pole model has ignored the influence of environment and its constraints on the process of urbanization and spatial development. The present study expanded the modified growth pole theme to examine the role of physical environment on urbanization and spatial development.

This expansion was particularly important in this case study of Bangladesh where physical constraints such as prolonged and severe monsoon flooding, severe winter dryness or drought and soil salinity hinder human activities, hinder the construction of transport and communication networks, impede urbanization and development of growth poles, and affected their trickle down effects in several ways. First, it was observed that despite high birth rates, population density and population growth rates are lower in the deep flooded areas as well as drought and salinity affected in Bangladesh owing to lower rate of migration than the less environmentally constrained areas. It was also observed that the slow population growth and low population density in turn slowed down the process of urbanization. Second, high monsoon flooding, in particular, hindered the construction of transport networks, interrupted the inter-linkages between the growth poles and their hinterlands, and thus impeded the trickle down effects of urbanization. In respect to spatial development, it was also observed that despite high population density and population growth rates, the deep flooded areas in Bangladesh are spatially less developed simply owing to their constrained environmental conditions that hinder spatial development.

These inverse relationships between the indices of urbanization, indices of spatial development and environmental constraints were well demonstrated by the spatial and temporal data. Both indices of urbanization and spatial development showed moderately strong but significant negative correlations of urbanization (r = -0.47 and r = - 0.52 for 1974 and 1991 respectively) and significant negative correlations of spatial development (r = -0.41 for 1974 and r = - 0.51 for 1991) with their index of environmental constraints constructed by accounting the data on depths of flooding, winter drought and soil salinity for each district under study (Table 3).

The raw data on flood depth, drought and soil salinity were transformed into standard z-scores and added to obtain the index of environmental constraint for each district and for each census year. Low negative correlation coefficients were expected because not all of 64 districts were severely constrained by deep flooding or drought or salinity. Depth of flooding appeared to be the most important environmental constraint hindering urbanization.

Even several high flooded districts such as Dhaka, Narayanganj, Rajshahi (also drought affected), Chittagong and Khulna (salinity affected) experienced higher rate of urbanization and spatial development simply owing their location and administrative importance. Also the negative impacts of flooding have been greatly reduced by technological modification of the environment via construction of flood control embankments, roads and highways, river bridges and more frequent bus transport services. Although both the correlation coefficients for the years 1974 and 1991 were

found to be moderately negative but they were significant at 0.001 levels and provided support to accept the environmental constraint hypothesis.

Technological modification of the environment hypothesis (H_3)

The modified growth pole theme assumes technology as elastic. However, it has not explored the role of technology in the context of the physical environment and its constraints. Environmental constraints hinder urbanization by hindering population concentration and by impairing the diffusion of trickle down effects from the growth poles to the hinterlands.

It is the technological ability of the region that can reduce or combat the environmental constraints and facilitate the processes of urbanization and diffusion of its trickle down effects and thus can contribute positively to spatial development. The region with poor technological abilities to combat environmental constraints will suffer from spatial development inequality or polarization. This relationship between technological ability to combat flooding, drought and salinity and urbanization and spatial development has been well observed in Bangladesh. In general, districts with high flood propensity had low index of urbanization and index of spatial development. Only exception to this relationship was the districts those had flood control embankments and the government had constructed roads and highways, railroads, river bridges and established bus and railways transport services. Increased accessibility of road transportation to remote flood affected areas, largely, reduced the negative impacts of flood constraints on urbanization and growth pole development.

In this study, the construction of roads and highways and establishment of bus transportation services using ferries and river bridges were considered as surrogate to technological modification of the environment in order to establish accessibility in the remote flood prone areas. The technological modification of the environment, urbanization and spatial development hypothesis was tested by examining the relationship between the index of urbanization and the index of transportation for the years 1974 and 1991. The index of transportation was computed by accounting the length of road and highways, railroads, number of busses and trains and their daily service frequency from Dhaka to each district in Bangladesh. The raw data were transformed into standard z-scores and added to obtain the index of transportation for a given year.

Both 1974 and 1991 indices of urbanization and spatial development show strong positive correlations with the indices of transportation. This was expected because despite their high flood risks, districts with greater accessibility of road transportation had attained higher index of urbanization and higher index of spatial development and vice- versa. Very strong correlation coefficients (r = 0.82 and r = 0.84 for urbanization and r = 0.84 and r = 0.83 for spatial development in 1974 and 1991 respectively) and their very high level of significance at 0.001 level allowed to accept the technological-environmental modification of urbanization and spatial development hypothesis.

Socio-economic conditions and urbanization hypothesis (H_4)

The modified growth pole theory contends that socio-economic and institutional support for increasing innovation contributes positively to urbanization vis-à-vis spatial development (Friedmann 1973). In Bangladesh, degree of literacy and peoples' (farmers') access to land and capital resources are the socio-economic factors those encourage rural to urban migration and thus positively influence urbanization and spatial development several ways. Rural population who are able to receive higher education tend to migrate to cities and urban centres in search of better employment opportunities; when employed, these people often settle permanently in the urban areas. Literacy allows farm workers to adopt non-farm urban and industrial jobs; availability of cheaper literate and skilled labours encourages industrial and business entrepreneurs to establish new industries and businesses that bring capital and socio-economic development in the periphery. Growing landlessness in the rural hinterlands pushes farm workers to urban and industrial areas that, gradually with some education, will be transformed into skilled urban and industrial labour and would contribute toward industrialization. Their higher income and aspiration for better standard of life will then lead to spatial development in progressive manner.

In this study, the index of urbanization and the index of spatial development showed moderate and weak positive correlations (r = 0.37 and r = 0.47; r= 0.48 and r = 0.44 in 1974 and 1991 respectively) with the percentage of literate population in each district. However, it also showed strong positive correlations (r = 0.57 and r = 0.50; r = 0.60 and r = 0.49 in 1974 and 1991 respectively) with the degree of landlessness as indicated by the percentage of total farm households classified as functionally landless category.

These statistically significant relationships were expected and they demonstrate the positive impacts of literacy and landlessness on urbanization and spatial development. However, rapid migration of landless farm workers has caused serious health and sanitation problems in the growing urban areas. Based on the strength and degree of relationships between the index of urbanization and spatial development and two independent variables, degree of literacy and access to land resources, the socio-economy and urbanization hypothesis was accepted in this study.

Institutional support hypothesis (H_5)

Both government and non-government (NGO) institutions provide capital, technology, and extension services to the cities and urban centres and contributes toward further urbanization and spatial development by establishing educational institutions, health care centres, better housing, electricity and sanitation facilities. Wherever this institutional support system is lacking because of environment, technology or communication constraints, lower degree of urbanization and spatial development are likely to occur.

In this study, the volume of capital loans distributed to industrial and business entrepreneurs by the government and non-government banks and financial institutions were considered as a surrogate measure of institutional support to urbanization and spatial development. And the relationship between institutional support factor and

urbanization and spatial development were examined by correlating the index of urbanization and the index of spatial development with the percentage of capital loans distributed in each district in 1974 and 1991.

Both 1974 and 1991 data of bank loans showed strong positive correlations (r = 0.82 and r = 0.82 with the indices of urbanization and r = 0.70 and r = 0.81) with the indices of spatial development in respective years and the correlation coefficients were statistically significant at 0.001 level. It was observed that the districts receiving higher proportion of capital loans from government and non-government organizations also attained higher scores on urbanization and spatial development. The institutional support with the urbanization and spatial development hypothesis were accepted in this study. It implies that increased access to the capital through banking institutional loans would encourage industrial and business entrepreneurs to establish industries and business centres those will provide increased employment opportunities and increased family income that will bring spatial development in the region.

Resource base hypothesis (H_6)

The modified growth pole theory recognizes the dominant effects of the resource base on the growth pole development (Friedmann 1975). It is argued that transfer of resource from the peripheral region contributes positively to the growth pole development. Also, peripheral resource can attract capital investment from the core and the latter may increase the per capita income of the surplus labour of the peripheral region by reducing their unemployment. In addition, peripheral resources attract population concentration and movement in the periphery, and induce urbanization. Peripheral resource can positively contribute to the development of a core like periphery (Friedmann 1975).

In Bangladesh, this argument may find its relevance. There are many instances where the local resource base attracted the establishment of a rural market centre, a small town, an industrial town, and finally a large urban industrial city. The local resource base included high intensive cultivation of agro-industrial crops such as jute, sugarcane, cotton, silk, tea and leather, shrimp cultivation and off-shore fishing and fish processing, mining, forestry and lumbering, and rubber plantation as well as manufacturing industries. These resource bases attracted high-density population concentration and the establishment of urban settlement and spatial development such as rural markets, hospitals, educational institutions, post offices, better housing, electricity and sanitary toilet systems and so on.

In this study, the degree of concentration of resource base in a district was measured by the value added by agriculture, fisheries, forestry, and industrial sectors in each district for the years 1974 and 1991 expressed as a percentage of total national value added by these sectors. In other words, it is implied that each district's share of the gross national product is a determinant of the degree of urbanization as well as the degree of spatial development. Both indices of urbanization and spatial development showed strong positive correlation with the percent of the total national value added

by the district's local resource bases (r = 0.79 and r = 0.83 with the indices of urbanization and r = 0.80 and r = 0.84 with the indices of spatial development for 1974 and 1991 respectively). This relationship was expected because the districts showing higher concentration of agricultural, forestry, mining, and industrial resources attracted higher population concentration and higher degree of urbanization and higher degree of spatial development. This finding provides strong support to accept the local resource base hypothesis.

Urbanization as the source of spatial development and inequalities (H_7)
The study data and results suggest that both urbanization and spatial development are interlinked. The ecological variables those predicted the degree of urbanization also emerged as the principal determinants of spatial development. Since the ecological variables are same in urbanization and spatial development models, their similarities as predictors of both urbanization and spatial development simply are suggestive of strong association between urbanization and spatial development. This led to the examination of the relationship between the index of urbanization and the index of spatial development for both 1974 and 1991 data set. Surprisingly, both data set show strong positive association between urbanization and spatial development (r = 0.91 for 1974 and r = 0.85 for 1991). This strong association between the index of urbanization and the index of spatial development provides strong support to accept hypothesis H_7 that states that urbanization is the source of spatial development and inequality.

This strong association between urbanization and spatial development is quite expected and it has much relevance to the modified growth pole theory. The modified growth pole theme asserts that both urbanization and spatial economic development are positively associated and dependent on the spatial variation of population distribution and economic activity (Berry 1961; Boventer 1973). In Bangladesh, population growth is the key factor inducing urbanization and technological innovations. As population grows, few points on a geographic space such as Dhaka, Chittagong, Khulna, Narayanganj, Rajshahi and favouring rapid population growth over the other (hinterland or lagging region), emerged as fast urbanizing growth centres, and induced continuous technological innovations to achieve eminence in manufacturing and service specialization. Effects of urbanization and technological innovations spread both laterally and hierarchically into the hinterland such as the district headquarters and the former sub-divisional towns and the latter then experience economic growth and spatial development. Wherever these effects of urbanization cannot spread or spread slowly because of environmental constraints and poor socio-economic conditions, spatial development impairs and inequality occurs. The present study results provided strong support this notion of the growth pole theme.

Toward modified growth pole model of urbanization and spatial development

Modified growth pole model of urbanization: A multiple regression analysis
A multiple regression analysis was employed to explore the causes of urbanization in Bangladesh. The index of urbanization was considered as the dependent variable

while all seven independent ecological variables specified in the a priori model were selected for the multiple regression analysis to estimate their total contribution and relative importance to the spatial variation in the degree of urbanization. Accounting for all seven independent ecological variables, the multiple regression analysis was conducted separately for 1974 and 1991 data set. The results are presented in the following discussion.

Model of urbanization (1974 and 1991)

Accounting for all seven independent variables, the multiple regression model of urbanization 1974 and 1991 data set has explained 90 and 91 per cent of the total variation in the degree of urbanization in Bangladesh respectively (Table 4). The standardized regression coefficient (ß) provided strong support to all six hypotheses except for the socio-economic condition hypothesis involving the degree of literacy for both 1974 and 1991 data set.

Table 4: Stepwise multiple regression analysis of index of urbanization on seven independent ecological variables, 1974 and 1991.

Dependent Variable	Step	Independent Variables	Standardized Coefficients B	R^2 Change	t–value	Significance Levels
UINDEX74	Model of urbanization 1974					
	I	TRANPT74	0.203	0.662	2.79	.000
	II	CPLOAN74	0.423	0.170	7.65	.000
	III	LOCRES74	0.160	0.042	2.14	.037
	IV	ENVIDX74	-0.154	0.011	-3.35	.001
	V	POPDEN74	0.165	0.005	2.33	.020
	VI	LANDLS74	0.120	0.007	2.16	.030
	VII	LITRCY74 Excluded from the model.				
UINDEX91	Model of urbanization 1991					
	I	POPDEN91	0.230	0.770	2.76	.000
	II	TRANPT91	0.198	0.170	2.80	.000
	III	CPLOAN91	0.290	0.022	4.14	.000
	IV	LOCRES91	0.234	0.028	3.09	.003
	V	LANDLS91	0.115	0.010	2.65	.010
	VI	ENVIDX91	-0.100	0.007	-2.34	.020
	VII	LITRCY91 Excluded from the model.				

Of all seven independent ecological variables (population density, concentration of local resource base, transport network or services, and institutional support in the form of bank loans, concentration of local resource base and landlessness) emerged as the significant and strong predictors of urbanization in Bangladesh. The environmental constraint index exerted negative influence on urbanization for both 1974 and 1991. Degree of literacy, which showed weak correlation with the index of urbanization in both 1974 and 1991 did not appear as a significant predictor in the model and therefore, it is excluded in the model.

When examined for the strength and independent contribution of each independent variable to the variable in the index of urbanization in Bangladesh for 1974 and 1991 data set. The stepwise multiple regression analysis revealed that the transport network i.e., the technological modification of the environment, appeared to be the strongest predictor contributing 66.2 percent and population density emerged as the strongest predictor (77.0 percent) of the total variation of urbanization in Bangladesh for 1974 and 1991 respectively (Table 4).

The landlessness and the environmental constraint index variable entered in the model and explained only 0.7 per cent of the total variation both for 1974 and 1991. Although, initially population density variable appeared as a significant and strong predictor as indicated by bi-variate correlation coefficient, its influence were reduced significantly in the model because of multicolinearity. It suggests that as population grew, more and more small towns expanded in size and were urbanized.

Both 1974 and 1991 multiple regression models demonstrate several issues, which have theoretical significance. The results also identified the predictors of urbanization at a given year and explained the conditions of urbanization. *First*, holding environment, socio-economic conditions, transport technology, resource base as constant, population density alone emerged as a strong predictor of urbanization at any given time period. Population growth that increases the density at a given location demands various services and amenities that attracts industries and other production mechanism to move into the area and finally results urbanization to occur. In short, population growth induced urbanization in Bangladesh. *Second*, environmental constraints also influenced urbanization in a negative way. Severely constrained environments in the country had poor rates of urbanization. The constrained areas did not attract human population to settle. Also it did strongly favour the construction and building of urban structures such as roads and communication networks, business centres, and manufacturing industries. *Third*, socio-economic conditions such as, growing landlessness in country contributed positively to urbanization in both 1974 and 1991. Migration of large number of landless farm workers to nearby urban areas increased the population size of the latter and induced urban expansion. Many industrial entrepreneurs took the advantage of cheap labour supply to establish manufacturing industries and that contributed further to urbanization. *Fourth*, local resource base and transport network also played very strong role in urbanization in the country during both years. Exploration and development of new resource bases in isolated pockets attracted population growth in those areas and led to urbanization and the development of growth poles. *Finally*, institutional support in general, and

distribution of capital loans from the bank provided incentives to growing manufacturing industries and trade centres in various locations which then attracted population migration, and urbanization. The study results thus provide strong support to the modified growth pole theory of urbanization in Bangladesh. Both 1974 and 1991 spatial data yielded much identical results confirming the fact that urbanization through the time periods is a complex process in which population growth or density remains the key factor and a complex interrelationship between human, environment, socio-economic conditions, and resource and technological changes contributes to urbanization as well as the development of growth poles in the country.

Modified growth pole model of spatial development: A multiple regression analysis
Again, a multiple regression analysis was employed to explore the causes of spatial development in Bangladesh. Accounting for all seven independent ecological variables, the multiple regression analysis was conducted separately for 1974 and 1991 data set. The results are presented in the following discussion.

Model of spatial development (1974 and 1991)

Accounting for all seven independent variables, the multiple regression model of 1974 and 1991 data set has explained 84.6 and 90.3 per cent respectively of the total variation in spatial development in Bangladesh (Table 5). The standardized regression coefficient (ß) provided strong support to all six hypotheses except for the socio-economic condition hypothesis involving the degree of landlessness, literacy for 1974 and literacy for 1991. All seven independent ecological variables emerged as the significant and strong predictors of spatial development in Bangladesh. The environmental constraint index exerted negative influence on spatial development. Neither the percent of landlessness nor the degree of literacy appears as a significant predictor in the model.

Table 5: Stepwise multiple regression analysis of index of spatial development on seven independent ecological variables, 1974 and 1991.

Dependent Variable	Step	Independent Variables	Standardized Coefficients B	R^2 Change	t–value	Significance Levels
SINDEX74	Spatial development model 1974					
	I	TRANPT74	0.315	0.710	4.91	.000
	II	LOCRES74	0.257	0.070	4.65	.000
	III	CPLOAN74	0.190	0.043	2.14	.000
	IV	POPDEN74	0.243	0.010	2.33	.020
	V	ENVIDX74	-0.123	0.010	-3.35	.000
	VI	LANDLS74	0.140	0.003	2.04	.040
	VII	LITRCY74 Excluded from the model.				
SINDEX91	Spatial development model 1991					
	I	POPDEN91	0.330	0.798	3.82	.000
	II	LOCRES91	0.234	0.053	3.03	.004
	III	CPLOAN91	0.245	0.032	3.55	.001
	IV	LANDLS91	0.107	0.009	2.40	.020
	V	TRANPT91	0.150	0.006	2.10	.040
	VI	ENVIDX91	-0.090	0.005	-2.05	.045
	VII	LITRCY91 Excluded from the model.				

Like 1974, the environmental constraint index exerted negative influence on spatial development in 1991. The degree of literacy, which showed weak but significant positive correlation with the index of spatial development in 1991 did not appear as a significant predictor in the model.

When examined for the strength and independent contribution of each independent variable to the variable in the index of spatial development in Bangladesh. In 1974, the stepwise multiple regression analysis revealed that transport network i.e., the technological modification of the environment, and the density of population appeared to be the strongest predictor contributing 71 and 80 per cent of the total variation in spatial development for 1974 and 1991 respectively (Table 5). Although population density showed very strong and significant positive correlation with the index of spatial development for 1991, its influence was significantly reduced in the multiple regression models because of multicolinearity.

The 1974 data set suggests that construction and improvement of roads, highways, railroads, river bridges, bus and train services were necessary not only to reduce the impact of environmental constraints on spatial development, but also to facilitate the trickle down process of spatial development benefits to the periphery. But the 1991 data set indicated that the location of various resources attracted human population settlement encouraged the development of industries, communication arteries, increased employment opportunities and family income that demanded increased service facilities such as educational institutions, hospital, electricity, better housing and sanitation, and better market facilities - all contributing spatial development.

Again, both 1974 and 1991 multiple regression models demonstrate several issues, which have theoretical significance. The results also identified the predictors of spatial development at a given year and explained the causes of spatial inequalities. First, holding environment, socio-economic conditions, transport technology, resource base as constraint, population density alone emerged as the strongest predictor of spatial development at any time period. It suggests that as population grew, more and more small towns expanded in size and urbanized. They attracted more industries, business as well as skilled and non-skilled labours, increased urban employment and family income. Increased family income raised the aspiration level of the urban residents who for improved standard of living would demand the development of education, health and sanitation facilities, road and transport network, electricity and housing, post offices, storage and so on by increasing their number and frequency of services - all of which will bring spatial development. Wherever population density was low because of environmental and other socio-economic constraints spatial development retarded accordingly.

Second, environmental constraints that discouraged population growth via migration, influenced urbanization in a negative way, and hindered spatial development. Severely constrained environments in the country are areas suffering from spatial inequalities since they impede the construction and building of urban structures such as roads and communication networks, business centres, and manufacturing industries - all stimuli to spatial development.

Third, socio-economic conditions such as growing landlessness in the country contributed positively to urbanization in both 1974 and 1991. However, landlessness did not appear to have strong influence on spatial development. Migration of large number of landless farm workers to nearby urban areas increased the population size of the latter and induced urban expansion. However, the urban centres were not capable of improving the quality of life for their growing population by increasing the number of service facilities (schools, hospitals, markets, sanitary toilets, housing etc) simply because of inadequate development funding and severe economic constraints on the nation as a whole. Therefore, large- scale rural-urban migration to the district urban centres in fact reduced the level of spatial development. This is reflected in all major cities and district headquarters where housing, sanitation, educational institutions, hospitals, post offices, and transport services are not adequate. Fourth, local resource base and transport network also played very strong role in spatial development in the country during both the time periods. Exploration and development of new resource bases in isolated pockets attracted population growth in those areas and led to urbanization and the development of growth poles. Fifth, the institutional support in general, and distribution of capital loans from the bank provided incentives to growing manufacturing industries and trade centres in various locations which then attracted population migration, urbanization vis-à-vis spatial development. The study results thus provide strong support to the modified growth pole theory of spatial development in Bangladesh. Both 1974 and 2001 spatial data yielded much identical results confirming the fact that spatial development through the time periods is a complex process in which population growth or density remains the key factor and a complex interrelationship between human, environment, socio-economic conditions, and resource and technological changes contributes to urbanization as well as the development of growth poles in the country.

Conclusions

In this study, much detailed investigation was carried out to explore the consequences of urbanization and spatial development and inequality in Bangladesh during the periods 1974 and 1991. Both 1974 and 1991 data sets were treated separately for urbanization and spatial development. The six hypotheses underlying this study were tested separately for urbanization and spatial development. The modified growth pole model proposed in this study is examined by employing multiple regression analysis. Both 1974 and 1991 data for seven ecological independent variables were regressed against the indices of urbanization and spatial development for the years those two years. The bi-variate correlation analysis shows strong correlations between the index of urbanization and seven independent ecological variables. It also shows strong correlations between the index of spatial development and those seven ecological variables. However, when the seven ecological variables were regressed against the index of urbanization and the index of spatial development for both 1974 and 1991, population density, transport technology, local resource base and institutional support such as bank loans emerged as the key predictors of both urbanization and spatial development. In both models, environmental constraint index exerted negative effect on urbanization and spatial development. None of the socio-economic variables such as landlessness and literacy appeared as major contributors

in the model. The study results provided an insight to the modified growth pole theory and its applicability in the Third World dual economic conditions. It is observed from the study that the both urbanization and spatial development are interlinked and urbanization accelerates the process of spatial development.

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Endnotes

1 Dr M. Mizanur Rahman is a lecturer in the Department of Geography, University of Malaya.

2 Technological progress is seen as neutral (Harrod's Neutral) and is assumed to affect labour only but not the incremental capital-output relationship.

3 Most elemental type of industries that generates growth from its purchases and sales.

4 Due to Liberation War in 1971, the Census was held on 1974 instead of 1971.