INTRODUCTION

Urban centers are dynamic organisms. Centrifugal and centripetal forces are always working and leading to structural changes. The push factors in rural and pull factors in urban areas are simultaneously interacting and shaping the evolution of urban centers. Practically, this evolution involves both the modification of long-established functions and the addition of new functions (Colby, 1933). The rapid increase rate of urban population and uneven growth of urban facilities and amenities have been playing an important role in urban dynamics. In the process of evolution simple villages turn into town, town develop into cities and cities into metropolitan centers, with a complex web of functions. These transformations are occur in both spatial and temporal sense and the differential urban growth is the norm. A set of determinants determine this growth and act in a very complex way, which varies from place to place, and from time to time. These determinants of urban system mould the Urban Dynamics. The formulation of any single assumption is not possible for explaining the internal mechanism of urban dynamics.
1.1 OPERATIONAL DEFINITION AND CONCEPT:

1.1.1: Demographic and Socio-Economic Correlates

Demographic, social and economic correlates are the determinants of urban dynamics. These are in fact various demographic and socio-economic variables. Demographic variables are based on age and sex of urban population, fertility, mortality, migration, urban population growth rate, urban population density, urban literacy rate, dependency ratio, etc. On the other hand, social variables are post offices, government and private offices, park and playgrounds, schools, colleges, universities, cinema halls, electricity consumption, water supply, newspapers, street lights, hospitals, banks, telephones, televisions, buses, etc. and economic variable includes - monthly income, annual expenditure, worker in primary, secondary and tertiary activities, etc.

1.1.2: Urban Dynamics

Urban Dynamics here refers to the determinants of urban system change (Bhuiyan, 1988). It is a kind of kinetic process in which growth and development are pronounced features. The growth and changes are being regulated by demographic, social and economic correlates.

1.2: BACKGROUND STUDIES

The modern city is always characterized by both growth of new functions and change or addiction of old functions.

There are different approaches to 'Urban Dynamics' as is exemplified by the works of Berry (1961), Forrester (1969), Paelink (1974), Moody (1975), Bannister (1977), Boventer (1978), Beumer and et al. (1978), Thakur (1980), Morill (1984), Tkachanko (1984), Yixing and Qin (1984), Pumain, Saint and Sonders (1984), and Berg (1987). All of these studies have been focused a new dimension with a specific framework. Some of these are micro level study, but most of all are macro level approaches in 'Urban Dynamics' study.

For the identification of strong correlates and nature and magnitude of urban dynamics, following macro level discussion have been incorporated like - the origin and evolution of urban centers and growth of urban population of the world and as well as of developing countries. Genesis, distribution of urban centers from 1951 to 1981, rank-size and rank-order fluctuation, factors of urban growth, classification of urban centers of Bangladesh are all taken to understand the urban dynamics. Finally, the present attempt considers 40 sample urban centers for identification of strong correlates for urban dynamics. The factorial ecology covers both demographic and socio-economic dimensions.

In urban research on Bangladesh done so far, only some cross-sectional studies on urban population problems like urbanization, growth of towns, slums and squatters, rural-urban migration, urban poor, housing problems, etc. have been undertaken by the Center for Urban Studies (CUS), Dhaka University, and some skeletal individual research, i.e., road congestion, transport problem, housing problem process of urbanization have been dealt with. But there is no study of comprehensive and longitudinal urban growth dynamics. Moreover, it seems that other demographic, social and economic dimensions of urban growth have not yet been studied by Bangladesh geographers.

It is not only in Bangladesh or India alone that inter urban and longitudinal (three point of time) urban dynamics study has not been conducted in other parts of the world. This has been neglected and Intra-urban level or 'Social Area Analysis
(SAA) and factorial ecology of a particular town/city has been studied in West and America. But most factorial ecologies have been confined to one time period (the census date). A Indian case, Fakhruddin (1984) has discussed the quality of urban life for the Lucknow city as a social area analysis in one census tract (1971 census). He studied the factor structure of the temporal changes in the spatial pattern in the intra-urban analysis. Some of the intra-urban dynamics study have been done by Goheen (1969), Murdie (1969), and Berry and Murdie (1965) through detail discussion of the changing city of Toronto in each decade from 1850 to 1900 and in 1950 and 1960, and during the decade 1950 to 1960 respectively. Pedersen's (1967) study of Copenhagen is one of the most comprehensive urban ecological analysis in the intra-urban dynamics context. Two studies have come out, where demographic, social and economic correlates have been used for inter-urban hierarchy identification through factorial ecology, though these are cross-sectional (one time) analysis. Moser and Scott (1961) have classified 157 British towns with population more than 50,000 in 1951, on the basis of 57 indicators pertaining to population size and structure, population change, households and housing, economic characteristics, social class, voting behaviour, health, education and application of social amenities.

On the other hand Ahmad (1965) has classified the Indian cities through factorial ecology. He has selected 62
variables related to the following aspects -

1. Demographic (19 variables)
2. Spatial structure (11 variables)
3. Occupational structure (23 variables),
4. Households and housing (3 variables),
5. Health and hygiene (4 variables) and
6. Social amenities (2 variables).

Like, Moser and Scott, Ahmad applied the Principal component Analysis (PCA) and eliminated the weakness of Moser's classification of cities. Related to these two studies, Prabha (1979) has added another work on 102 Punjab towns with emphasis on the structural analysis. Her method is multivariate in nature. She has applied a considerable number of correlates in different sectoral analysis, like demographic typology, nature of economic base and occupational structure, industrial structure, and urban functions, and urban hierarchy.

Only Elahi (1987) has contributed a cross-sectional (one point of time) work on factorial ecology of Bangladesh for both rural and urban centers. The study has incorporated 40 and 25 geo-demographic variables for rural districts and urban areas respectively. More than 90 percent variance has been explained in unrotated factor matrix in both rural district and urban areas.
The social area analysis of single city and subsequently inter-urban structural analysis for the one point of time has been increasingly undertaken through factorial ecology during the last three decades but longitudinal (three point of time) inter-urban dynamics studies are few and far between in Bangladesh.

However, the present study is also multivariate in nature. Although, there is emphasis on different sectoral determinants of urban dynamics, identification of strong correlates on the basis of three point of time rather than one cross-sectional census tract has been undertaken.

The study is original in so far as it investigates the nature and trend of urban dynamics in three cross-sectional point of time for the inter-urban system.

A common set of correlates have been examined, which cover all the sectors of urban dynamics. Attempt has also been made to find out the nature of change of different correlates and the quality of urban life in the rapidly growing urban centers.

For the inter dependency of urban analysis the study will help of concept of Berry (1964). 'Cities As Systems within Systems of Cities' ---, according to this concept cities can be viewed as a inter dependency. But Berry's concept of rank-size rule does not hold good for Bangladesh towns.
The level and trend of urbanization of the world and specially, the nature of urbanization in the developing countries has also been studied. The transformation of urban indigenous civilization and its stage of development has also been discussed for the background study of urban dynamics.

The author thinks that this type of urban dynamics study is essential for giving total picture of urban environment and for the prospective planning of rapidly growing small, medium and large urban centers as well as the primate city.

1.3: SCOPE AND OBJECTIVES OF THE STUDY

Qualitative and quantitative processes of change in urban dynamics are determined by the cumulative effect of demographic, social, economic factors and infra-structure of the urban centers. Urban dynamics is the result of changes in national variables (Dendrinos, 1980). These changes may be due to continuous technological progress, for example, affecting differentially various urban areas within a nation due to the specialization in production, changes in the rate and location of extraction of natural resources, changes in tastes nationwide, or in other demographic, social, economic, political, scientific and technological factors. The purpose of this study is to explore the contribution of demographic, social, economic and associated variables in urban dynamics. The time for the study is 1961 to
1981, a period spread over two decades (three census periods). An urban settlement is a dynamic place where inter linked changes generated by certain cyclical process occur in their internal structure. These changes themselves are in a cyclical pattern and thus several stages can be distinguished. So, there is need to develop an integral theoretical concept of urban dynamics and to investigate the nature of urban systems and also to explore the kinetic forces of urban dynamics.

The primary thrust of the study is to evaluate the general pattern of urban system change and identify the causes and consequence of urban dynamics mechanism, through several statistical techniques (described elsewhere). The applicability of the determinates of urban systems change have been applied to the study of 40 selected urban centers of Bangladesh. Urban population growth, functions of urban growth and territorial growth of urban centers of Bangladesh have been studied in detail. Urban dynamics determinants have been examined through PCA. Strong variables of urban dynamics and it's changing nature and magnitude has been identified through correlation matrix and factor loading of different groups. The specific objectives of the study are:

i) to know the origin, evolution and growth of urban system in developing countries and special focus for Bangladesh,

ii) to search the influence of colonialism on urbanization in the developing countries.
iii) to explore the genesis of urban settlements in Bangladesh,
iv) to discuss the factors of urban growth,
v) to evaluate the nature and trends of urban population dynamics, and its implication,
vi) to examine the growth of urban settlements of different size-class,
vii) to measure the rank-size rule (distribution) and rank order fluctuation of urban centers,
viii) to illustrate the spatio-temporal dimension of urban population of the selected urban centers,
ix) to observe the demographic characteristics of Bangladesh urban centers,
x) to see the economic functions of urban centers of Bangladesh through Nelson's method,
xi) to plot the changing nature of economic activity through trilinear graph,

xii) to analyze the site and situation of urban settlements through physiography, road, railway and river networks,

xiii) to examine the nature and magnitude of urban dynamics of 40 urban centers with the help of above objectives,
xiv) to identify the strong correlates of urban dynamics through factor loading,
to classify urban centers with help of urban dynamics
nature in factor scores.

1.4: STUDY AREA

Urban dynamics directly or indirectly depends a great
deal upon physical contrasts and terrain differences, drainage, and
climatic characteristics of the study area. These factors are
inter-linked with demographic and socio-economic conditions of the
region and accelerate the urban growth and development as an
integrated programme (Taylor, 1951). The factors that have a
bearing on the growth and dynamics of urban centers of Bangladesh
are elaborated below.

1.4.1: Location and Extent

People's Republic of Bangladesh stretches latitudinally
between 20° 35'N and 26° 75'N, and longitudinally between 88° 03'E
and 92° 75'E. Bangladesh shares common borders with the Indian
states of West Bengal, Meghalaya, Assam, the Union territory of
Tripura on the West North and East (3718 km long) and Burma at
the extreme southeast (280 km long). The Bay of Bengal in the
south runs for over 717 km. Tibet (China), Nepal, Sikkim, Bhutan,
Nagaland and Manipur are close neighbours of Bangladesh.
Moreover, the country lies between the eastern margin of the Indian
subcontinent and the Western fringe of sprawling southeast Asia
(Fig. 1.1).
1.4.2: Area and Population

Bangladesh is a deltaic land with an area of 143,998 Sq.km. Its population is roughly 100 million (BBS, 1981). Out of 100 million there are 51.5 million males and 48.5 million females and annual growth rate is 2.17 per cent. The sex ratio is 1060 males per 1300 females. The density of population is 695 persons per square km. for the country as a whole. In 1981, only 15.54 per cent of the population of Bangladesh was reported to be living in urban area (BBS, 1987).

1.4.3: Physical Setting

The homogenous plain topography of Bangladesh, is conspicuous by the absence of climatic extremes, and this has been quite conducive to the growth of human settlements. The urban settlements, however, are not growing at a uniform rate. The development of road and railway network are enhancing the process of urban growth. Exception of flat topography can be observed in the North-Eastern (Sylhet district) and South-Eastern part (Chittagang hill tracts) of the country and these areas are less favourable for rapid urbanization but building materials are found in these areas for the construction of building and growing up new urban settlements.
1.4.4: Climate and Soils

The tropic of cancer passes through Bangladesh and so tropical monsoon characteristics are pronounced. Temperature varies between 9.8°C in January to 31.8°C in July and mean annual variation ranges from 13.9°C to 26.7°C. The summer monsoons are preceded by pre-monsoon rains in May that often arrive in the company of violent norwesters, and are frequently succeeded by cyclonic rainstorms and thunder showers that may go on well into November. Such storms and occasional tidal waves cause considerable devastation. Annual rainfall varies from 127 cm in the west to 254 cm in the south-east.

The Geological survey of India compiled a generalized soil study of the sub-continent of India in 1935 (Wadia, Krishnan and Mukerjee, 1935). According to this study, on the basis of their geological origin, Bangladesh soils could be divided into three types:

a) The newer and older alluvium areas, including north Bengal, the eastern plain and the Noakhali-Chittagong coast,

b) The deltaic area (bounded by the Ganga-Padma-Meghna) or deltaic alluviums. It had three sub-divisions, fine, silty clays to the north, followed by impure, peatv deposits to the south, and the deltaic swamps forming the sea face, and,
c) The sandy, gravelly and limy soils towards south Sylhet and the Chittagong Hill Tracts. Their origin was related to early Tertiary formations.

In addition, the forest area in this region were said to have damp, mixed soils.

1.5: METHODOLOGY (Methods and Materials)

In the present study, various methods and techniques have been applied. For general discussion of different indicators, percentage technique has been taken for the analysis. Rate, ratio and percentage techniques are used to identify the growth/trends of urban dynamics. Nelson's method has been applied to study the functional classification of urban centers. Principal Component Analysis (PCA) is used for the identification of strong variables, magnitude of change of the individual correlates. Moreover, association of variables and parameters factor loading has been tested through correlation matrix.

1.5.1: Data Base

Related data and literature were collected from various research papers, Bangladesh Bureau of Statistics (BBS) and concerned organisations both at home and abroad. In this connection, the basic data of demographic, social, economic and

However, all the secondary and tertiary data have been gathered from census of Pakistan, BBS, NILG and various research organization like, Center for urban studies (CUS), Dhaka University Library, Dhaka University, Bangladesh and research section, Department of Geography, Moulana Azad Library, AMU, Ratan Tata Library, Delhi University, India. Primary data through field investigation was collected in 40 urban centers of Bangladesh.

All the data have been processed both manually and by computer. Principal component analysis (PCA), and various other statistical techniques and methods have been used to understand the urban dynamics mechanism of Bangladesh. They are described in concerned chapters.

* Bangladesh was formerly part of Pakistan.
of the country. Ten urban centers have been chosen from each division, through stratified random sampling. Care is taken of a good regional coverage. Similar type of strata has been applied by Berry and Neils (1969). It had been defined through a multivariate grouping analysis of all SMSAs using as attributes in the process the factor scores for each SMSA that were the product of a factor analysis of an integrated set of demographic, social and economic indicators of urban environment.

The proper choice of variables is very complex and difficult from the point of view of methodology. Regarding selection of indicators, emphasis has been laid on the demographic, social, occupational and other economic variables as a matter of research theme. Change is the prominent feature of urban dynamics analysis. Different variables are changing their nature and magnitude in separate ways over the period of time, and reflect the overall trend and direction of urban dynamics. While selecting indicators the author has tried to be very cautious and judicious.

The author has tried to select indicators which faithfully reflect the urban dynamics and urban growth mechanism.

Keeping the above considerations in mind the following sets of variables had been selected for urban dynamics study. The detail of the variables used in the computer analysis are listed in Appendix - 1.1.
# TABLE 1.1: LIST OF URBAN DYNAMICS VARIABLES

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Notations</th>
<th>Name of variables</th>
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<tr>
<td>I) Geodemographic :</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Demographic Correlates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>TOTPOPULATION</td>
<td>Total population</td>
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<td>2.</td>
<td>DEGURBANIZAT</td>
<td>Degree of urbanization</td>
</tr>
<tr>
<td>3.</td>
<td>MEDIANAGE</td>
<td>Median Age</td>
</tr>
<tr>
<td>4.</td>
<td>POPGROWTHRAT</td>
<td>Population Growth Rate</td>
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<td>5.</td>
<td>POPULDENSITY</td>
<td>Population Density</td>
</tr>
<tr>
<td>6.</td>
<td>DEPENDERATIO</td>
<td>Dependency Ratio</td>
</tr>
<tr>
<td>7.</td>
<td>NETMIGRATION</td>
<td>Net Migration</td>
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<tr>
<td>8.</td>
<td>SEXRATIO</td>
<td>Sex Ratio</td>
</tr>
<tr>
<td>b. Geographic Correlates</td>
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<tr>
<td>9.</td>
<td>AREA</td>
<td>Area</td>
</tr>
<tr>
<td>10.</td>
<td>AREACHANGE</td>
<td>Area Change</td>
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<tr>
<td>II) Social :</td>
<td></td>
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</tr>
<tr>
<td>a. Social Facilities</td>
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<tr>
<td>11.</td>
<td>POSTOFFICE</td>
<td>Post Offices</td>
</tr>
<tr>
<td>12.</td>
<td>GOVERNOFFICE</td>
<td>Government Offices</td>
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<tr>
<td>S.No.</td>
<td>Notations</td>
<td>Name of variables</td>
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<tr>
<td>13.</td>
<td>PARKPLAYGROV</td>
<td>Parks and Playgrounds</td>
</tr>
<tr>
<td>14.</td>
<td>CINEMAHALL</td>
<td>Cinema Hall seats</td>
</tr>
<tr>
<td>15.</td>
<td>NEWSPAPERCIR</td>
<td>News Paper Circulation</td>
</tr>
<tr>
<td>16.</td>
<td>STREETLIGHT</td>
<td>Street Lights</td>
</tr>
<tr>
<td>17.</td>
<td>HOSPITALBED</td>
<td>Hospital beds</td>
</tr>
<tr>
<td>18.</td>
<td>BANK</td>
<td>Banks</td>
</tr>
<tr>
<td>19.</td>
<td>BUS</td>
<td>Buses</td>
</tr>
<tr>
<td>20.</td>
<td>FPC &amp; MCWC</td>
<td>F.P. Centerss and M C.W. Centers</td>
</tr>
<tr>
<td>21.</td>
<td>ELECTRICITY</td>
<td>Electricity</td>
</tr>
<tr>
<td>22.</td>
<td>WATER</td>
<td>Water</td>
</tr>
</tbody>
</table>

b. Social Amenities

| 23.   | TELEVISION         | Television                               |
| 24.   | TELEPHONE          | Telephones                               |

c. Transport, Communication, and Housing Environment

<p>| 25.   | HOUSEHOLDDEN       | House-hold Density                       |
| 26.   | KUTCHA HOUSE       | Kutcha House                             |
| 27.   | PUCCAROAD          | Pucca Road                               |
| 28.   | ROADCONVERGE       | Road Convergence                         |
| 29.   | ROAD DENSITY       | Road Density                             |</p>
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Notations</th>
<th>Name of variables</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>d. <strong>Educational Correlates</strong></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>LITERACYRATE</td>
<td>Literacy Rate</td>
</tr>
<tr>
<td>31.</td>
<td>SECONDSCHOOL</td>
<td>Secondary School</td>
</tr>
<tr>
<td>32.</td>
<td>COLLEGE</td>
<td>Colleges</td>
</tr>
<tr>
<td>33.</td>
<td>UNIVEREREQUINS</td>
<td>University and equivalent Institutions</td>
</tr>
<tr>
<td></td>
<td>III) <strong>Economic</strong> :</td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td><strong>Occupational variables</strong></td>
<td></td>
</tr>
<tr>
<td>34.</td>
<td>UNEMPLOYMENT</td>
<td>Unemployment Rate</td>
</tr>
<tr>
<td>35.</td>
<td>PRIMACTIVITY</td>
<td>Primary Activity</td>
</tr>
<tr>
<td>36.</td>
<td>SECOACTIVITY</td>
<td>Secondary Activity</td>
</tr>
<tr>
<td>37.</td>
<td>TERTACTIVITY</td>
<td>Tertiary Activity</td>
</tr>
<tr>
<td></td>
<td>b. <strong>Income and expenditure</strong></td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>PERCAPITAINC</td>
<td>Per Capita Income</td>
</tr>
<tr>
<td>39.</td>
<td>ANNUALEXPEND</td>
<td>Annual Expenditure</td>
</tr>
</tbody>
</table>
Due to the limitation of software techniques on PCA only 39 variables have been considered for analysis. The limitation of programme is that the number of variables should not exceed the number of observations (number of unit) in PCA. As a result, some indicators have been dropped in the present study. Similarly, the study had to drop certain variables owing to non-availability of data in the newly classified urban centers. Some of the variables are excluded because of their ubiquitous nature, like primary school and other lower order facilities and amenities. However, the results of both the cross-sectional and change analysis depend to a large extent on the reliability and validity of primary and as well as secondary data. But it is generally recognized by statisticians that some errors in the raw data are inevitable. Indeed, the severity of such errors varies across the urban center depending on a number of characteristics such as the nature of the variable being measured, the enumerator, the respondent, and the size of sample. Besides, sampling errors and non-sampling errors are associated with the analysis.

1.5.4: Technical and Analytical Procedures

For the study of urban dynamics of Bangladesh urban centers for the period of 1961 to 1981 a set of technical and analytical procedures have been formulated. As mentioned earlier, forty urban centers have been chosen for the study and individual urban center is an unit of study. For identification of strong variables thirtynine
indicators have been selected for all the three census periods 1961, 1974 and 1981. Similarly, 27 variables were sorted out for measuring the magnitude of urban dynamics. Fifteen socio-economic variables were chosen for urban hierarchy determination. Where appropriate, the census variables were transformed into rate, ratio and percentage values.

With the above objectives, in mind a multivariate statistical technique called Principal Component Analysis (PCA) has been applied to reduce the large number of variables (both secondary and primary), many of them interrelated to the few independent underlying dimensions, into factors/components, which were responsible for the variations among the indicators. After grouping, descriptive names were assigned to each factor based on the variables most closely related with that factor. Characteristics of urban centers are generally heterogenous in nature. Wider the heterogeneity, the factors in factor matrix increase in number. Main technique of PCA has been taken in the light of Ahmad's (1965) work.

1.5.5: Method of Principal Component Analysis

The Principal Components Analysis (PCA) is most commonly used in urban study to identify the groups of related variables, which, if they exist, indicate more general patterns than particular indices might suggest (Johnston, 1980). The mathematical derivation employed to determine the underlying kinetic dimensions of variation is known as the principal components analysis (Ahmad, 1965). Urban
center is most heterogenous in nature. It incorporates the covariance of demographic, social, and economic characteristics of urban centers which is a problem of multivariate nature. These heterogeneous nature of inter-relationships can be identified by the PCA being a superior technique of analysis. The heterogeneity of variables found within large urban agglomerations makes for a vast complex of relationships. So, it requires simplification in order to discover both the common and contrasting factors of the diversified nature of the urban centers.

The dynamic nature of centers can be measured if the PCA which treats the problem of interdependence of many variables is applied. For the identification of the total variability also (in this case, between urban centers) the PCA can be applied. The primary variables can be accounted for by a smaller number of new independent variables, called Principal Components. Subsequently, these underlying factors are used as the basis of classification of urban centers.

Berry suggests that a transformation to principal components scores will eliminate the redundancies incurred when several variables display a single pattern of concomitant variation. Each pattern of correlated variables is replaced by a single component which represents the pattern, and the point distribution can be described approximately in terms of a smaller number of uncorrelated component variables. In this situation the multiple regression analysis often fails to provide clear and meaningful answers. The coefficients of independent variables becomes unreliable in this situation and
sometimes carry wrong signs - since these become distorted by the inclusion of other independent variables with which these show a high degree of associations. The PCA, on the other hand, takes the correlation matrix into account, and produces components which are uncorrelated with one another, and so enable the research worker to bypass the problem of multi-collinearity.

Factor Analysis (FA) stresses shared common patterns but PCA takes care of all patterns - shared and unique. However, both the techniques result in the collapsing of a set of intercorrelated variables onto a smaller number of basic dimensions or composite variables (King, 1969).

All the tables in chapter IV are the products of principal components analysis subject to orthogonal rotation according to the normal varimax criterion. The study considered the orthogonal rotated factor matrix. In PCA, there is no hard-and-fast rule for taking up the eigen value of the components. But most frequently it interprets only those components for which the eigen value exceeds 1.0. The justification of more than 1.0 eigen values is that the variance of the original variables come into unity. The present study has considered eigen values of 2.0 or more for the identification of strong variables and 1.5 for the measuring the magnitude of urban dynamics for rotation. The rationals for this is to avoid increase of component is factor matrix, where the number of variables were very few with the value of 0.50 or more. Here the factor loading 0.50 or more is considered as a strong variable for the urban dynamics analysis.
The PCA produces components in descending order of their importance that is, the first component explains the maximum amount of variation, and the last component the minimum. It is often found that the first two or three components account for a sizable amount of variation - say 80 percent, and the subsequent components contribute very little.

The first component, which is also known as the principal component can be used as an index for ranking the observations on the basis of the general characteristics of the fixed variables.

The computations of this study were carried out on Aligarh Muslim University's VAX-11 computing System and the principal components method of factor analysis as a subroutine programme.

The following steps of computation were involved in the principal component analysis.

1) The computational analysis of PCA begins with \( n \times m \) order transformation of original data matrix \( x \), for \( n \) observations on each \( m \) variables.

2) An \( n \times m \) data matrix is replaced by a standard score matrix \( Z \), with standard scores for each of the \( n \) observations on the \( m \) transformed variables.

3) The transformation procedures from the \( Z \) standard score matrix to an \( m \times m \) correlation matrix \( R \), which is calculated through simple correlation co-efficients between each variable and every other variable.
4) The object of Principal component Model (PCM) is to resolve the correlation matrix $R$ into an $m \times r$ factor loading matrix $A$, where, $m=r$ was orthogonally rotated according to normal varimax criterion to reproduce a new factor matrix. The rotated factor matrix makes a minimum possible number of variable loaded high on each factor. In such a way, every factor became simpler and easier for interpretation in the common group.

5) Multiplication of standard score matrix $n \times m$ order and orthogonal rotated factor matrix $A$ of $m \times r$ order and produced a new factor score matrix $F$ of $n \times r$ order. The factor scores were then normalized to zero variance. This provide a measure for each observation on the new factors.

With the help of PCA, the study identified the strong variables in the factor matrix. So, the nature of urban dynamics can be detected through individual magnitudes of changing character of factor scores. Factor matrix and comparative change can be detected with the help of First principal component. Thus, the technique is designed primarily to synthesize a large number of variables into smaller number of components, so that they help to diagnosis the trends and direction of demographic, social, economic correlates of urban dynamics.
Urban dynamics is a kinetic process in which growth and changes are pronounced features. However, the main interest of this study is to identify the strong variables which alter the urban system. Urban environments are changing gradually with time and quality of life is also changing at different levels through physio-socio-economic and demographic characters of urban center. Urban dynamics nature is also varying with the size (both area and population) of the city.

The whole study has been divided into five chapters. The first chapter is an introduction.

Factors related to urban growth like - physical, cultural, demographic, social and economic features of the study area have been elaborated in chapter II. Chapter II also incorporates the classification of urban settlements. Rank-size rule and Rank-order fluctuation also tested in the last section of the chapter, but the genesis of urban places has been evaluated in terms of physical and infra-structural elements.

Spatial and temporal dimensions of urban dynamics of selected 40 urban centers have been discussed in chapter III. The temporal growth of population and area of the towns have been analysed and functional classification of 40 towns has been attempted through Nelson's method.
The theme of the chapter IV is mainly devoted to analysis the urban dynamics features according to normal varimax criterion to reduce a new factor loading matrix of large number of original variables. In this case Principal Components Analysis (PCA) has been applied for the identification of strong variables, grouping of cities through measuring the dynamic nature of demographic, social, and economic variables. However, all the sectors of the chapter IV, deals with the results of PCA and it's interpretation in the light of urban dynamics.

Chapter V is the concluding chapter is a discussion of the main theme. It conclude, with some suggestions for future.
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