RESIDENTIAL PATTERN AND QUALITY OF LIFE IN AIZAWL CITY

A Thesis submitted to the Department of Geography and Resource Management, Mizoram University in fulfillment of the requirements for the degree of

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by

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DECLARATION

I, Benjamin L. Saitluanga, hereby declare that the subject matter of this thesis entitled *Residential Pattern and Quality of Life in Aizawl City* is the record of the work done by me, and that the contents of this thesis did not form basis for the award of any previous degree to me or, to the best of my knowledge, to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/Institute.

The thesis is being submitted to Mizoram University for the degree of Doctor of Philosophy in Geography.

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CERTIFICATE

This is to certify that Benjamin L. Saitluanga, registered under MZU/Ph.D./428 of 09.11.2010 is a research scholar working under my supervision on a thesis entitled 'Residential Pattern and Quality of Life in Aizawl City'.

All through his research pursuance, I found Benjamin L. Saitluanga very serious, hardworking and dedicated. He could challenge his tasks with quality of scholarship and was able to carry out his assignment successfully.

I further certified that the thesis is this form is the report of the research scholar's original work. Certain extracts and quotes are duly referred to in an appropriate manner.

I recommend the thesis for due evaluation and recommendation.

Date: 22nd September, 2015

(Dr. Rintluanga Pachuau)
Supervisor

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CHAPTER-I

INTRODUCTION

Cities are spaces of differences. They have been acting as arenas where social differentiation has been manifested spatially. The process of urbanization is always accompanied by segmentation and differentiation of urban communities. According to Marcuse and Van Kempen (2002:11), “cities have always been divided…along a number of lines” and this spatial concentration of population group may take place along “lines of nationality, class, income, wealth, occupation, religion, race, colour, ethnicity, language, age household composition, personal cultural preference and lifestyle”. It has also been argued that urban societies have been marked by profound social differentiation along lines of “wealth, recency of arrival, or ethnicity” White (1998:1). This social differentiation within urban space has been determining residential pattern which in turn reshapes and sometimes, accentuates social inequality thereby affecting the quality of life (QOL) of urban residents.

Residential pattern is a by-product of intra-urban differentiation. Social differentiation among urban population creates different types of residential areas for different social groups. Similar residential areas or localities tend to occupy a segment of urban area usually in the form of zones or sectors due to various processes occurring therein. In this way, residential areas arranged in a more or less regular fashion to form pattern within a city and this physical arrangement of inhabited spaces occurred in a specific environment where the prevailing socio-economic system and physical environment interacts in sustained manner. Residential pattern, therefore, is not always similar through time and at all places. The underlying processes of residential differentiation in western developed cities and underdeveloped cities are not always similar. Similarly, hill and mountainous cities may show different residential pattern from plain cities.

In western industrialized cities, peripheral suburbs as well as localities along the best existing transportation lines, hilltops and land along lake, bay, river and ocean fronts are the home of the richer section while inner city areas and hill slopes are dominated by the poorer working class (Burgess, 1925; Hoyt, 1939). On the contrary, inner city areas in less developed and Mediterranean cities are occupied by social elites (Berry, 1963; Schnore, 1965; Leantidou, 1990). The latter case is basically a typical characteristic of pre-industrial cities (Sjoberg, 1960) where the political, religious and economic elites concentrate on city core areas. The city centre holds prestige and is socially and economically desirable as it provides easy access to prominent political, religious and economic institutions.

The physical form or spatial structure of a city is considered to be mainly determined by differentiation of urban population along socio-economic status, family status and ethnic status. Apart from socio-economic status, demographic and cultural attributes like age and family related measures and racial or ethnicity measures were found to bear significant values in the process of social differentiation. Among them, socio-economic factor is predominant in most cities and the classical urban land-use theories have been criticized for their economic biases by putting emphasis of socio-economic factor in determining intra-urban differentiation while neglecting demographic and cultural attributes (Pacione, 2009; Knox and Pinch, 2010). Another approach of urban social geography called 'social area analysis' gives due importance to other dimensions or axes of urban social differentiation.

It may, however, be noted that socio-economic factor, demographic attributes and ethnicity are not the sole determining factors of residential differentiation. Studies in different societies have maintained that residential patterns are more influenced by historical circumstances and cultural milieu than by purely economic reasoning in India (Chatterjee, 1960; Fakhruddin, 1991) and land-use planning and an allocation system based on resources and political influence in socialist country like China (Sit, 1999) as well as in multi-ethnic states like Isreal (Yiftachel, 2001). All these studies have indicated that residential patterns emerged through different processes of urbanization under different socio-economic settings.

Analysis of residential differentiation could not be confined to the two-dimensional urban space alone. The accelerating verticalization of cityscape in almost all types of terrain has compelled us to reconsider the role of multi-storey buildings in the process of residential differentiation. Although the classical urban land-use models have included the role of physical environment like 'hillslope', 'hilltops' and 'high grounds' in the process of residential choice, they failed to take into account the 'vertical differentiation' which is an important characteristic of Mediterranean cities (White, 1984; Leontidou, 1990; Maloutas and Karadimitriou, 2001).

Therefore, residential pattern is conceptualized here as the process of residential differentiation and its spatial implications, not only in two-dimensional space but also in three-dimensional space. Analysis of residential differentiation implies analysis of socio-economic processes on a specific environment. In fact, socio-economic changes in a particular place or region are best articulated within cities and these changes produce distinctive residential areas and through time, accentuate and reshape patterns of socio-spatial inequality. This reshaping has taken a spatial form in cities, not only in relation to the relevance of space for access to resources such as jobs or housing, but also in terms of people's conceptions of place. Quality of life - a concept that encompasses both quality of places and individual satisfaction - is therefore intrinsically linked with urban spatial structure.

Quality of life (QOL) is a broader concept of development which was usually measured by gross national product (GNP) related measures. After the 1950s, there was a call to conceptualize development as 'social well-being' which is a broader and more encompassing term that takes into account a wide range of indicators to evaluate human conditions(Veenhoven, 1996). Thus the concept of social well-being was introduced based on the argument that human condition should be evaluated on a wider range of indicators than just income whether at the national level or through national aggregates (Gregory *et al*., 2009). It was thought that evaluation of 'development' would be more encompassing if it includes 'social indicators' or those indicators pertaining to social well-being like education, economy, health, public safety, social and culture and government administration or civic participation. Social indicators, in fact, are different from common indicators of development. They have been defined as "statistics, statistical series, and all other forms of evidence that enable us to assess where we stand and are going with respect to our values and goals" (Bauer,1966:1). The emerging concept of QOL was then introduced into geography during the 1970s in studies of territorial social indicators (Smith, 1973; Knox, 1975) which was a part of social indicators movement.

A geographic aspect of QOL is suggested in the work of Canadian philosopher, McCall (1975) who maintained that from geographical perspective, the concept of QOL refers to quality of life in a certain region of the earth's surface. Myers (1987) has given geographical definition of QOL as the shared characteristics residents experience in places and the subjective evaluations residents' make of those conditions. Pacione (2002), however, maintained that the concept of the urban as a quality is related more to the meaning of urban places and the effect of the urban milieu on people's lifestyles in contrast to definition of the city as a physical entity.

Quality of Life (QOL) may be disaggregated into objective and subjective components. Objective QOL is usually measured at aggregate population and objective indicators are those which are related to observable facts that are derived from secondary data or data drawn from sample to measure concrete aspects of the built and natural environment as well as the socio-economic aspects of the population. On the other hand subjective QOL relates to assessment and evaluation of personal well-being “based on primary data collected through sample surveys in which people’s perceptions of quality of life domains are measured on scaled attributes relating to those QOL domains” (Stimson and Marans, 2011:33).

1.1 Significance of the Study

Space, due to its banality, had been obscured in the academic explanation for a long time. Social scientists used to put emphasis on sociological and historical explanations rather than geographical explanation on socio-economic processes (Soja, 2010). However, with the introduction of critical social theory in geography after the 1970s, a transdisciplinary diffusion of spatial thinking or in other words, a spatial turn in social science was witnessed and carried forward vigorously by scholars from various disciplines. The hitherto neglected spatial perspective then formed an important part of analysis alongside social and historical perspectives. Doreen Massey (1984:52) has forcefully argued that “For geography matters. The fact that processes take place over space…Just as there are no purely spatial processes, neither are there any non-spatial social processes”. It has also been argued that “everything that is social is simultaneously and inherently spatial, just as everything spatial, at least with regard to the human world, is simultaneously and inherently socialized" (Soja, 2010:6).

Socio-spatial inequality is now an important subject matter of human geography. In his monumental text on urban geography, Pacione (2009) posited that one of the main tasks of urban geography is to study socio-spatial similarities and contrasts that exist between and within towns and cities. Similarly, social geography, another important branch of geography is considered to be "concerned with the ways in which social relations, social identities and social inequalities are produced, their spatial variation, and the role of space in constructing them" (Pain *et al*., 2001:1).

An important question to urban social geographers, therefore, is to study the pattern of residential location within cities, the factors that determine the creation of social space on the basis of socio-economic class, demographic status and ethnicity and the processes operating the continuation of socio-spatial differentiation as well as the behavioural consequences of differentiation. These questions have been nicely put forwarded by Knox and Pinch (2010:1) as

> "Why do city populations get sifted out according to race and social class to produce distinctive neighbourhoods? What are the processes responsible for this sifting? Are there any other characteristics by which individuals and households become physically segregated within the city? How does a person's area of residence affect his or her behaviour? How do people choose where to live, and what are the constraints on their choices?…Thus, spatial pattern of socio-economic inequality has been an important area of research among geographers".

Geographers have important voices in tackling of accelerating social differentiation as every social process takes place in space. Spatial or territorial justice is a newly invented concept that deals with justice from a geographical perspective. The concept of territorial justice is about "the most appropriate distribution between areas…according to the needs of the population of that area" (Davies, 1968:16). The concept implicitly implies equitable distribution of resources and without it, social justice is almost impossible (Johnston, 1975). From the perspective of 'spatial or territorial justice', residential differentiation and segregation are unjust since they have defied the concept of social justice as certain social groups of people are segregated and differentiated from other social groups.

Inequitable distribution of resources has negative impacts on a person's quality of life. Cities in both developed and to a lesser extent, developing countries are known to develop 'gentrified spaces' and 'gated communities' that usually occupy the best locations while the poorer and disadvantage people are usually found at the least desirable and least accessible locations. In this way, poorer people tend to get "marginalized spatially, both in terms of their residential locations and in terms of their activity spaces" (Knox and Pinch, 2010:70) and they suffer the most dangerous and polluted environment as well as the most restricted mobility and the worst access to services (Hall, 2006). So, the concept of territorial justice is deeply related to improvement and enhancement of QOL.

Quality of urban life is becoming an important issue with increasing urban growth as the process of urbanization is accompanied by environmental degradation, cultural erosion and a number of social and economic problems. Harvey (2011:232) has rightly pointed out that "If we think about the likely qualities of life in the next century by projecting forward current trends in our cities, most commentators would end up with a somewhat dystopian view". Difference in quality of urban life is generally associated with spatial segregation, poverty, unemployment and lack of adequate social and physical infrastructure, crime, violence, homelessness and overcrowding. Negligence of increasing disparity in quality of life (QOL) may generate deep dissatisfaction and underlie episodes of social unrest and dysfunction.

Assessment of urban QOL is significant to assess intra-urban inequality in social and environmental qualities among various localities. This will help in identification of problems faced by localities so that policies and programmes may be taken up by the stakeholders. Enhancement of QOL is also an important requisite for urban development and competitiveness. It has been suggested that enhancing QOL should be a central objective in every city's economic transition strategy since they have broad implications for patterns of regional migration and regional economic growth (Kemp *et al*., 1997). Increasing quality of urban life through increasing provision of urban amenities would enhance their competitiveness since they are increasingly expected to compete for economic activity with other cities and metropolitan regions throughout the world (Scott, 1998). Moreover, increasing quality of urban life has been perceived as a means to provide a physically, socially and economically sustainable city that provides employment, adequate services and resources equitably as well as harmonious and safe living environment to its residents.

All the above questions and propositions on residential pattern and QOL have never been asked and tested on the hill city of Aizawl. The city was founded as a military station in by the colonial military. It has grown tremendously in the post-Independence period from a small town with less than 7000 population in 1951 to a city with more than 3 lakh population in 2011. The increasing growth of Aizawl city collocates with the transformation of Mizo society from a highly egalitarian tribe to an increasingly segmented primordial capitalist society. The city became an embodiment of the transformed society in which the division between affluence and poverty has been increasingly observed. With increasing scale of society, segmentation and heterogeneity have also been observed in the city.

Although much of our existing knowledge is based on studies related to western economies, culture and physical environment; any socio-spatial phenomena is a highly context bound issue. The observed residential pattern in the city and the underlying processes operating therein is expected to be different from the western context. This would help in the production of new knowledge, if any or the enrichment of existing knowledge on residential differentiation. Similarly, it would be fascinating to study for the first time about intra-urban inequality in QOL in the city.

1.2 Aims and Objectives

The study has the following objectives:

1. To identify residential pattern in Aizawl city with the help of factor analysis. This involves testing of the validity of the hypotheses of social area analysis as well as classical urban land-use models in Aizawl city.

2. To find out whether vertical pattern of residential differentiation exists or not in Aizawl city.

3. To identify dimensions of both objective and subjective QOL.

4. To measure and develop composite index of QOL in Aizawl city for ranking of all the 82 Local Councils in the city.

5. To identify localities with similar and dissimilar pattern of objective and subjective QOL. In other words, to find out the existence of spatial autocorrelation in objective and subjective QOL among different localities**.**

6. To measure the relationship between objective and subjective qualities of life.

7. To identify social areas of Aizawl city.

1.3 Hypotheses

Following the above objectives, the following hypotheses have been formulated.

1. Residential differentiation in Aizawl city on the basis of socio-economic status is sectoral along the main transport route that follows the main Aizawl ridge in North-South direction.

2. Unlike industrialized and western cities, residential pattern in Aizawl city is not differentiated on the basis of family or demographic status and ethnicity.

3. Vertical pattern of residential differentiation is present in multi-storey buildings in Aizawl city.

4. Quality of life is higher in centrally located localities than in peripheral localities.

5. Localities with similar QOL clustered significantly for both objective and subjective qualities of life.

6. Higher the objective QOL indices, lower is the subjective QOL indices. In other words, there will be no significant positive relationship between objective QOL and subjective QOL.

1.4 Organization of the Study

The first chapter is an introduction of the study. It includes the significance of the study, the aims and objectives of the study, the hypotheses of the study as well as review of literatures.

The second chapter is about theoretical approaches and review of literatures. The chapter is broadly divided into two sections - the first section is discussion and review of existing theories and literatures on residential pattern while the second section concerns with concept and literatures on quality of life.

The third chapter deals with the methodology of the study. It consists of the whole concept of research design including sampling technique, determination of sample size, scheme of preparation of schedule and method of data collection. A detail description is also given on quantitative techniques like Factor Analysis, Principal Component Analysis, Cluster Analysis and measures of spatial autocorrelation like Global Moran's I and Local Indicators of Spatial Association (LISA) all of which are employed in the study.

The fourth chapter is a general discussion on the physical and socio-economic characteristics of the study area. Important physical and socio-economic characteristics which could be linked up with the main themes of the study are described and analyzed. A detail analysis is also made on demographic growth of Aizawl city, land-use and land ownership as well as transportation network.

The fifth chapter deals with one of the main themes of the study - analysis of residential pattern in Aizawl city. This chapter is subdivided into two parts. The first part is a factorial ecological study of horizontal pattern of residential differentiation while the second part is a study on vertical pattern of residential differentiation.

The sixth chapter is a study on quality of life (QOL) in Aizawl city. It includes identification of dimensions and indicators of QOL, development of composite indices of QOL with the help of principal component analysis as well as analysis of spatial autocorrelation on dimensions of QOL. In this chapter, social areas of Aizawl city are also identified with the help of cluster analysis.

The last chapter is conclusion and summary of major findings.

CHAPTER-II

THEORETICAL APPROACHES AND REVIEW OF LITERATURES

2.1 Introduction

The thesis is about analyses of residential pattern and quality of life (QOL) in Aizawl city. These two topics are usually taken out differently, albeit largely interrelated (Smith and Gray, 1973; Bederman, 1974). Generally, analysis of urban residential pattern tries to examine processes and patterns of differentiation of urban population. On the other hand, analysis of QOL from a geographical perspective includes selection of either objective or subjective parameters or both of them to study spatial inequalities in QOL at individual, household or areal unit scale. In spite of the presence of overlapping areas, the two concepts are distinct and unique fields of studies. Hence, the present chapter is sub-divided into two parts - the first part deals with previous literatures on residential pattern and the second part deals with literatures on quality of urban life. Conceptual and theoretical approaches are also discussed whenever necessary.

2.2 Literatures on Residential Pattern

Urban residential pattern has been a subject of interest among scholars for a long period of time. One of the earliest writings on residential pattern could be traced back to Hippodamus of Miletus, called by Aristotle as the founder of city planning, who argued that cities should naturally be divided into three parts - one for artisans, one for farmers, and one for soldiers and that the land should further be divided into sacred, public and private lands (Marcuse, 2002). Spatial division of population on the basis of class was considered essential for the functional organization of society during the ancient Greek period (Plato *c*. 460 BC/1937: 422). Segregation of urban spaces may also take vertical form in the ancient cities as depicted by Lewis Mumford (1961:104-105) as-

> "Occupational and caste stratification produced in the ancient city an urban pyramid, which rose to a peak in the absolute ruler: king, priest, warrior, scribe formed the apex of the pyramid; but the king alone, at the highest point, caught the full rays of the sun. Below him the layers widened out into merchants, craftsmen, peasants, sailors, house servants, freed men, slaves, the lowest layer deep in perpetual shadow".

In his discussion on residential pattern in feudal cities in European nations, Sjoberg (1960) maintained that city society was made up of three groups - an upper class, a lower class and a group outside mainstream society which are mainly minority ethnic group like Jews. The upper class would live at the centre, close to the religious, ceremonial and political core. The lower class would live at more peripheral locations with the outcaste groups at the very edge or living in segregated communities. Although Jews were spatially segregated and confined to Jewish ghettos, the segregation "obviously did not apply to business" (Kostof, 1992: 107) and were admitted to the city each day and have played an important in the city's economic life.

During the colonial period, colonial cities were usually segregated into imperial space and colonized space. According to a well-known urban historian Anthony King (1990), class and racial polarization, spatially expressed, existed in colonial cities at international scale as a result of colonial policy, which also ensured strict segregation between colonial and colonized populations. Mabogunje (1992) has argued that the colonial town planning in Nigeria was segregationist in practice in order to ensure better health conditions for the European colonial officials. In colonial British India, the White population was concentrated within the walled cantonments while the Indian population was largely banished outside the walls (Home, 2013). Moreover, the colonial power often imposed segregation among different races in multi-ethnic cities. Different ethnic groups in Singapore were allotted separate geographical areas by its founder Starnford Raffles (Home, 2013). Nairobi city in Kenya was segregated into Asian Sector, African Sector, a small Asian enclave and European area (Washington, 2001). However, it is needed to mention here that even without any intervention by the hegemonic states through planning laws and zoning regulations, there is a natural tendency among various ethnic groups to maintain segregation from other groups.

After the 19th century, it was realized that the processes of industrialization and modernization have profound impacts on the spatial structure of western cities. A number of approaches were developed and presented to analyze residential patterns. The first well-known approach was developed under the influence of Social Darwinism. This approach, known as 'human ecological approach' seeks to find out spatial arrangement of social groups within cities as a result of competition, invasion, domination, segregation and other ecological processes for a particular location. The ecological approach was extended to formulate empirico-positivistic approaches like social area analysis and factorial ecology. During the 1960s and 1970s, dissatisfaction with the above approaches resulted into the introduction of neoclassical, behavioral and radical approaches to explain urban social differentiation. Thus, urban residential pattern has been studied from various approaches, each of which has significance in certain ways.

2.2.1 Human Ecological Approach

Human ecology is an approach to analyse patterns of social life with reference to (a) natural or biological forces operating beyond the consciousness of human agents, and (b) social organization as the product of unconscious evolution (Saunders, 2001). The concept of human ecology in urban social geography was developed during the 1920s and 1940s by Park, Burgess, McKenzie and their associates known as the Chicago School of Sociology. They conceived the city as a kind of social organism which grows from simple to the complex, from the general to the specialized; first to increasing centralization and later to decentralization (Park, Burgess and McKenzie, 1925).

Human ecology is an application of plant and animal ecology to analyse patterns of environment-societal relationship within a city. The Chicago school believed that the sitting of major urban settlements and the distribution of different types of neighbourhood within them can be understood in terms of ecological principles (Giddens, 2006). They focused on a particular geographical area identified as 'natural areas' in which the struggle for existence occurred among various groups of population through ecological processes like competition, invasion, segregation and economic differentiation, succession and dominance. In this way, they tried to find out processes of social differentiation in urban areas through these ecological processes. The process of competition for space resulted in the domination of space by certain social group and in certain cases, cohabitation of more than one groups while repelling other groups.

Burgess (1925) nicely brought out the concept of human ecology in his model of residential differentiation and urban structure based on Chicago. In his classical descriptive study on the spatial structure of Chicago, Burgess viewed the annular outward expansion of the city as a result of decay of inner cities and their invasion by lower status group. He identified five concentric zones, each of which were occupied by different classes. The first zone called the central business district was exclusively dominated by commercial activities. The second zone - the zone in transition - was undergoing transition from high class residential to mixed land-use due to invasion by the immigrant lower class. The third zone - the zone of working men's home - was occupied by more affluent immigrants who have escaped the second zone but still required easy access to their work place. The fourth zone - zone of better residence - was the home of middle class where men were outnumbered by women and subsidiary shopping centres have developed. The fifth zone - an affluent and exclusive suburban zone was dominated by single family dwellings.

Beyond the five urban zones, Burgess (1930) also recognized the sixth and seventh zones which were agricultural districts and metropolitan hinterland respectively. Burgess' model of urban spatial structure, however, has been criticized because of its nature as an ideal or constructed type rather than as a substantive generalization (Timms, 1971). Burgess himself accepted the model as an ideal construct and maintained that exogenous factors like climatic condition, geographical barriers like hills, lakes, mountains and types of street plan may have an effect upon the city structure (Burgess, 1953).

While formulating his well-known concentric zone model of urban land-use, Burgess (1929) also remarked that in cities with substantial degree of relief, terrain, rather than distance from the city centre will be the dominant factor in residential differentiation. Instead of concentric zone, an altitudinal zonation will be obtained, with "the poor in the valleys, the well-to-do on the hillsides, and the rich on the hilltops" (Burgess, 1929:119). This pattern of residential differentiation reflects the importance of environment as an important determining factor in residential locational choice. Blumenfeld (1959) considers this pattern to be of recent origin: a product of particular modern conditions like new means of transportation that had not obtained throughout urban history. Meyer (2005) revisited the ‘altitudinal zonation’ theory by studying the American city of Worcester. On the basis of 1891 data, he found out that most high-status residents of Worcester lived at moderate elevations up to 30 m above the city center. However, the five most elevated neighbourhoods were exclusively or overwhelmingly of working-class population.

Concentric model of urban spatial segregation was followed by ‘Sector theory’. In his analysis of spatial distribution of rental class in 142 American cities, Hoyt (1939) concluded that the tendency of high class people to occupy the most desirable lands, particularly along major transport routes from the central business district (CBD) and elevated areas commanding a fine view, safe from flooding and accessible to cooling breezes led to the formation of ‘sectors’ of residential areas rather than ‘zones’ as in the case of Burgess model. According to Hoytian sector model, if one sector of a city developed as a low rent residential area or a high class residential area, it will tend to retain the character for long distances as the sector is extended through process of the city’s growth. Thus, Hoyt’s sector theory assumed the existence of social stratification which translates into spatial differentiation. However, being an economist, he placed undue emphasis on the economic characteristics of areas, ignoring other important factors, such as race and ethnicity, which may also underlie urban spatial structure. Hoyt sector theory has been applied in many cities. Amato (1974) demonstrated that Bogota city in Columbia was continuing to develop along the same sector pattern identified by Hoyt. While there are enough differences and contradictions between Burgess’ Zonal model and Hoyt’s sector theory, they may also be considered "independent, additive contributors to the total socio-economic structuring of city neighbourhoods" (Berry, 1965:115).

Harris and Ullman (1945) provided another urban land-use theory called 'Multiple Nuclei theory' which, unlike the earlier theories, built around a number of separate nuclei. Putting economic activities as the basis of explanation of urban structure, the multiple nuclei theory tries to explain the multi-nodal nature of urban growth. The theory maintained that while certain economic activities tend to conglomerate to gain maximum profit from external economies of scale, certain activities like factory development and high-class residential development are 'detrimental to each other' and secondly, while some economic activities gained from locating at central locations, other activities could not afford high rents and, therefore, located elsewhere. Although the theory may be simple and less specific, the value of multiple nuclei theory lies in its recognition of the development of new nodes around outlying business districts corresponding to decline in traditional CBD. The theory concerned more on the impact of economic diversification rather than social differentiation on the spatial structure of cities. Moreover, they suggested that land-use patterns vary depending on local context and hence the "multiple-nuclei model may be closer to reality" (Pacione, 2009:143).

Better known as morphological or urban land-use models, these ecological models of urban spatial differentiation, however, has been criticized heavily as they did not pay enough attention to the role of choice, preference and social action (Hollingshead, 1947). They relied too much on a biological model (Firey, 1947; Jones, 1960), and their models were essentially descriptive. Moreover, they neglected the possible influence of institutional and political factors and developed their ideas on the basis of a free market economy. This made their approach inadequate for countries where the role of the state has been prominent (Bassett and Short, 1989). The significance of the classical land-use models was that they were “the first to appreciate that, while language, culture, religion and race provide the motivation for residential segregation in cities, geographical barriers and physical distances along with improved mobility provide the means to practice it. They ‘discovered’ that the physical features and two-dimensional spaces of the city are used by different cultural groups to accomplish social distancing and residential segregation” (Badcock, 2002:5).

A number of studies have been taken to test the validity of classical land-use models and if possible, to develop alternative models in both developed and less developed cities. More important studies include Mann’s model of urban land-use in medium-size British cities. Mann (1965) incorporated the climatic factor particular the prevailing west wind in his model such that the best residential area is located in the western fringe of the city, upwind of and on the opposite side of industrial area, the working class nearby the industrial zone and the lower middle-class housing on each side of the best residential area.

Apart from morphological models, another important study on Chicago was taken out during the 1930s. The concept of ‘urbanism as a way of life’ was proposed by Louis Wirth in 1938 to analyse the products of increasing urbanization at individual and community levels. From his study of Chicago, Wirth (1938) argued that individuals living in cities get fragmented due to increasing division of labour, socio-economic and cultural diversification which he measured using the criteria of size, density and heterogeneity.

2.2.2 Social Area Analysis and Factorial Ecology

Social area analysis is an approach developed to analyse urban residential pattern that arises with increasing scale of society and concomitant functional differentiation. On the basis of Wirthian theory of urbanism, social area analysis was developed by Shevky, Williams and Bell (Shevky and Williams, 1949; Shevky and Bell, 1955) in an attempt to identify the 'community or social areas' of Los Angeles and San Francisco. Thus, "Social area analysis, *sensu strictu*, provides a means of portraying the social geography of a city as part of a deductive model of social change based largely on Wirthian theory" (Knox, 1982:74). The social area analysis was based on the concept of social change and its impact on cities, especially large cities or metropolis.

The 'natural areas' in ecological approach were thus replaced by 'social areas' in social area analysis. Generally, social areas are considered to contain "persons having the same level of living, the same way of life, and the same ethnic background" and "persons living in a particular type of social area would systematically differ with respect to characteristic attitudes and behaviours from persons living in another type of social area" (Shevky and Bell, 1955: 20). Proponents of social area analysis argued that urban 'social' or 'community areas' were the product of three major trends deriving from the 'increasing scale of society' which, in Sheky-Bell model is synonymous with the emergence of urban-industrial society (Timms, 1971). In the simplest sense, increasing scale of society may be seen as change from traditional to modern lifestyle. It is largely associated with increasing functional differentiation of urban society and its concomitant socio-spatial differentiation with increasing size, mobility and heterogeneity of urban population.

To measure these changes, they proposed three constructs. The first of the constructs identified by Shevky and Bell (1955) is 'social rank' or 'socio-economic status'. It is related to a variety of socio-economic measures pertaining to employment and occupational status, years of schooling, cost of housing and possession of various household facilities. The second construct is labeled 'urbanization' by Shevky while Bell called 'familism' or 'family status'. This construct is usually indexed by indicators pertaining to measures like age and sex characteristics, type of tenancy, house structure etc. The indicators normally used in the computation of the index are fertility, women in the workforce, single family dwellings etc. The family status construct is believed to be a reflection of three interrelated aspects of societal change including the relationship between population and economy, the structure and function of kinship units, and the range of social relations which are centred on the city (Timms, 1971). In western cities, technological development and industrialization has led to striking changes in household size; kinship structure, relations and functions; as well as changes in the role of women from 'motherhood' to 'working woman'. The third construct is related to 'ethnic status' and concomitantly, migration status. The increasing heterogeneity or diversity of population through migration resulted into redistribution of population through isolation and segregation of ethnic groups. Since migration is usually age and sex selective, this construct is related to change in demographic characteristics.

Another approach, popularly known as 'Factorial ecology' emerged during the 1960s as "geography's adoption of human ecology" as well as a "formalization of many aspects of social area analysis thinking" (Fyfe and Kenny, 2005). It emerged as a reaction to theory-based social area analysis and its uni-dimensional nature of the indices to measure the urban social structure. An attempt was made to study residential pattern through empirical research, based on more set of variables which may help to formulate more generally acceptable theory. Factorial ecology, therefore, is a term given to the introduction of multivariate statistical techniques to extend the social area analysis/approach in order to reveal the bases of residential differentiation within the city using a larger set of diagnostic variables than the seven employed in social-area analysis (Timms, 1971; Davies, 1984; Pacione, 2009). Thus, factorial ecology is a purely technical procedure, and unlike social area analysis, there is no theoretical framework, and so no direct inferences can be drawn as to the nature of the processes which give rise to the social and spatial patterns which are revealed (Clark, 1982). Therefore, while the term 'social area analysis, *sensu stricto*' applies only to that mode of analysis originally outlined by Shevky, Williams and Bell (Berry and Rees, 1969) and deductive in nature; factorial ecology is an outgrowth of social area analysis and inductive in nature.

Thus, the difference between factorial ecology and social area analysis is that, in factorial ecology, a multivariate technique called factor analysis is used primarily as an inductive device with which to analyse the relationships between a wide range of social, economic, demographic and housing characteristics (Knox, 1978) where as in social area analysis, factor analysis is employed to validate the hypothesis of Shevky, Williams and Bell. It may, however, be noted that factorial ecology is not altogether different from social area analysis and input variables mainly relate to three factors of social area analysis.

A number of studies have been produced to test the validity of social area analysis as well as to explore the ecological structure through factor analysis. Some studies confined to extract the factors of differentiation only while some other studies tried to produce social areas.

One of the earliest studies on social area analysis is Shevky and Williams (1949). To classify more than 570 census tracts of Los Angeles, they took seven variables-three variables including occupational status, educational status, and income for social rank, three other variables like fertility, women in the labour force and the physical characteristics of neighbourhoods for index of urbanization, and the number of people in highly isolated population groups for index of segregation. In order to obtain composite index for the social rank and urbanization constructs, values for each variable were converted to percentile scores and the mean percentile score of the variables represents the index for each construct.

Another early work on social area analysis was Bell's (1953) study of San Francisco. Using centroid technique of factor analysis, he tried to ascertain whether social rank, familism and ethnicity did represent necessary, sufficient and separate axes of differentiation. They hypothesized that measures of occupational status, educational achievement and rent comprise an unidimensional index of social rank and measures of fertility, women in the workforce and single family dwellings comprise an unidimensional index of family status. His findings partially validated the theory as the 'data are clearly in agreement with the hypotheses' such that 'the indicants correlate with the underlying three factors in the predicted fashion' and there ware high inter-correlations among indicators of social rank and family status respectively (Timms, 1971).

In their case study of San Francisco, Shevky and Bell (1955) found out that the city was differentiated along social status, family status and ethnic status. They observed that high-economic-status tracts were found in hill and view locations away from industrial and port facilities; areas of nuclear-family status were displaced away from the urban cores; while areas of ethnic status emerged adjacent to the business zones and near industrial waterfront districts.

Van Arsdol, Camilleri and Schmid (1958) studied ten different cities in the United States. They took variables relating to occupation, education, fertility, women in workforce, single family dwellings and percentage of Negro population. With the help of factor analysis, they identified that the first three indicators formed social rank, the next two formed urbanization or familism and the last indicator formed ethnic status. However, as against the model, fertility which is an indicator of urbanization factor correlates highly with both indicators of social rank factor viz. education and occupation. Regarding individual cities, four cities deviated from the overall result and/or the idealized model. In these deviant cities, fertility correlates more highly with the social rank factor rather than urbanization or family status factor.

Timms (1971) studied Brisbane by taking data from 554 residential collectors' district. He selected 11 variables pertaining to social rank, family status and ethnic status. These indicators were analysed with factor analysis. The three factors captured 89 per cent of the communality. Correlation coefficients were derived with the help of product moment correlation. Analysis of data reveals the predicted model is clearly followed by the observed data. Within social rank construct, fertility shows high positive correlation with the proportion of single-family dwellings and a high negative correlation with the proportion of women in the workforce. Interestingly, the study found out that social rank and family status are independent bases of social differentiation, ethnicity is closely dependent on the other two axes. Thus, it was concluded that "social rank and familism emerge as by far the most salient of the social area constructs in the modern city" (Timms, 1971: 168).

Sweetser (1965) compared the residential structure of Boston and Helsinki which were largely similar in their status, functions and size. Twenty two variables were taken to represent the three constructs of Shevky and Bell. Then, they were analysed using principal components method. The analysis extracted three factors namely socio-economic, young familism or progeniture and urbanism factor in both Boston and Helsinki. To test the similarities and differences between the ecological structures of the two cities, a coefficient of congruence was computed. The values of coefficient of congruence were very high for the first two factors while the third factor urbanism was much less congruent. He interpreted that socio-economic status and progeniture were fundamental dimensions of ecological structure in both Helsinki and Boston.

In his factorial ecological analysis of Montreal, Canada for the years 1951 and 1961 using only 27 variables, Greer-Wootten (1972) identified all the three classic factors. Interestingly he also found out ethnic factor and socio-economic factor are not independent but related to each other due to pronounced English-French division. The English-speaking people are found to obtain higher social rank while the French speakers are found at the bottom of the social ladder.

Foggin and Polese (1977) analysed 368 census tracts of Montreal using 63 variables drawn from 1971 census. Using principal component analysis, they obtain six factors. Out of the six factors obtained, factors one and three comprised of variables dealing with socio-economic status, factors two and five are made up of demographic variables and factors four and six are exclusively of ethnic variables. The reason that each of the dimensions is represented by two factors is explained as an effect of large number of variables taken in the analysis. From their analysis, they observed that the city's richest neighbourhoods are located close to the city's centre.

They also found out that a few relatively poorer neighbourhoods developed within the high-income areas which according to them indicate the decline of the absorptive capacity of the inner city so that new immigrants have to settle nearby workplace.

Smith and Gray (1972) while studying the inter-census tract variations in social well-being in Tampa Bay, Florida maintained that the common finding of various studies in factorial ecology viz. socio-economic status, stage in life cycle and ethnicity were usually confined to variables derived from census reports. They claimed that such studies overlook social pathology factors like crime, diseases, overcrowding etc. The factor analysis on Tampa Bay, however, revealed that the maximum variance was explained by social problems which loaded high on health, crime and other social pathologies. Socio-economic dimension that reflects income, occupation, housing quality and education was second in explained variance. A racial segregation factor came third followed by social deprivation reflecting unemployment, poverty and infant mortality.

In their study on factorial ecology of Dublin City with the help of principal axis factoring, Brady and Parker (1975) has taken 56 variables and they extracted five factors which collectively explain 71.24 per cent of the variance of the data matrix. They have termed the extracted factors as housing conditions-twilightism, socio-economic status, family status, residual communities and professionalism.

Social area analysis and factorial ecology have been adopted to study cities in developing countries too although they frequently resulted in fewer dimensions or different patterns (Abu Lughod, 1969; Berry and Rees, 1969). In his study on Accra, Ghana, McElrath (1968) has taken four constructs of social rank, family status, migration status and ethnic status. For each construct, two indicators were taken. The inter-correlations among indicators clearly followed the predicted pattern except one- the correlation between fertility ratio and women in workforce was positive unlike the predicted negative correlation. He explained that the Ghanian women were usually involved in small-scale economic activity which can be taken up while having large family. He maintained that “family status does not operate as an independent form of sub-population differentiation in the urban area of a society where only limited changes of the structure of production have occurred” (McElrath, 1969:49). In the absence of independent family status factor, three independent dimensions of social differentiation were recognized: social rank, migration status and ethnic status with migration status being the most important axis.

One of the most cited works on factorial ecology in developing country was conducted by Abu-Lughod (1969). She analyzed the residential pattern of Cairo, Egypt. She conducted a factor analysis of thirteen indicators reflecting variations in socio-economic status, family status, demographic structure and ethnic composition over 216 census tracts. Three independent factors were extracted from the analysis- style of life factor relating to socio-economic status and family; male dominance factor and social disorganization factor. The importance of the study lies in the fact that the study failed to obtain independent social rank and family status factors in contrast to the pattern observed in American cities. This may be due to Egypt’s lagging position in the modernization process as indicated by high correlation between social rank and family status which was accounted for by family size since polygamy was a privilege of wealthy men (Maloutus, 2012)

Similar observation was also made on the study of Calcutta by Berry and Rees (1969). In fact, it was the first ever attempt to study residential structure of an Indian city using factorial ecology approach. In this study, 37 variables relating to family structure, literacy, type of employment, housing characteristics and land-use for 80 census wards of Calcutta were taken for analysis. Among the factors observed was a combination of social class and family status variables rather than showing distinct dimensions. In descending order of importance, the factors they have uncovered are as follows: Land-use and familism, Bengali commercial area, non-Bengali commercial caste, substantial residential areas, literacy, Muslim concentration and special land-use factors.

Berry and Spodek (1971) studied the factorial ecology of six large Indian cities. From these cities, they extracted 4 to 9 factors in which the socio-economic status factor was usually presented as the most important factor. They also extracted familism factor and communal or caste factor wherever data were available. They considered that the three factors were the general properties of India's urban ecology. From their analysis of maps of factor scores, they also found out that the dominant spatial pattern in India's large cities is the presence of high status neighbourhoods in central area and the low status neighbourhoods in the periphery.

Brush (1971) studied the factor-ecologic structure of Bombay (present Mumbai). He extracted five factors. The study also revealed that the spatial structure of Bombay proper is predominantly zonal but unlike the Burgess Model, the residential around the city centre attracts upper-class population.

Prakasa Rao and Tewari (1986) studied the factorial ecology of Bangalore using principal component analysis. They took twenty variables and they extracted four components viz. socio-economic status, religion-based segregation, congestion and household character. They grouped the component scores into high, high-medium, low medium and low groups and mapped accordingly to examine the spatial patterns of the dimension of ecological structure. They found out that the middle-class occupied the city centre while the high status and low status groups occupied the periphery.

In his study of social areas in Beijing, Sit (1999) employed principal component analysis to reduce 89 variables belonging to housing, socio-economic and family status to generate seven components or factors. The principal components are labeled as Inner-city slum, Post-1949 suburban and cultural environment, immigration communities, suburban farming, professionals, modern housing and high rent and elitist environment. Then, he identified eight social areas of Beijing with the help of Ward’s clustering method.

In his study of the factorial ecology of Tokyo special district, Takano (1979) extracted six significant factors out of seven variables from 124 census blocks. In those six factors, the two highest rank factors are the ‘social rank factor’ and the ‘urbanization factor’. Those two factors have strong influence on the social area differentiation of Tokyo special district. In addition, four lower rank factors suggestive of permanent or non-permanent residents, commuters' traffic facilities, employed or non-employed inhabitants and the slum-like inhabitants complicate the social area differentiation.

Li and Shanmugathan (2007) studied social areas of a small Beppu city in Japan by taking 90 variables for 163 census units with the help of geographical information system (GIS) technique. The research showed that in Japan, age or life stage is the most important factor that determines the socio-spatial division in Beppu city. It was also found out that socio-economic factor was also important while the study did not found any significant influence of ethnic factor.

Dickason and Kalamazoo (1989) studied social areas of Delhi by taking fourty variables which were derived from 1971 census of India. With the help of principal component analysis, they have extracted eight principal components that describe nearly 80 per cent of the total variance explained. The first component was termed informal/formal sector while the other components were named modernized white collar, manufactural employment, familism, informal commercialism, personal service worker, Informal entrepreneurship and westernization. Since variables related to ethnicity or religion was not available, the study could not highlight segregation factor.

Kalal (2002) studied the residential pattern of Pune cantonment following the social area analysis via factor analysis. He took 79 variables to study social areas of 125 wards of Pune cantonment. He extracted four factors which explained 72.5 per cent of the total variances. His factors were socio-economic status, ethnic factor, slum factor and Age-structure factor. Then he employed cluster analysis to group wards showing similar socio-economic and demographic characteristics. In total, seven clusters were identified.

In Northeast India, Sarma (1982) analyzed the factorial ecology of Guwahati city, Assam. He took 55 variables from 221 census blocks. With the help of factor analysis, he extracted as many as nineteen components to explain 72 per cent of the total variance. His first factor was socio-economic which explained 11 per cent of the total variance and the spatial pattern of which was essentially sectoral or zonal as found in the city structure of the developed countries. The second and third factors he extracted were social status and index of youthfulness which explained 10.6 per cent and 6.9 per cent of the total variance respectively. On the basis of the first three components, he grouped the city blocks into 6 socio-economic areas viz. 1) high middle status 2) low middle status 3) lower middle economic, high middle social and younger mixed family status 4) areas of lower economic, socially and younger mixed family status 5) areas of high middle economic, low social and older mixed family status and 6) High middle economic and social and older mixed family status areas.

After the early 1970s, urbanists started to realize that the internal spatial organization of cities could not be explained adequately with the relationships among social class, family status and ethnicity. The introduction of multivariate analysis to reveal the underlying structure of western cities has also been criticized to lead to a "crude Americanocentric generalizations" of the internal socio-spatial structure while undermining the nature of cities in other economies (Maloutus, 2012:8). Moreover, urban ecologists were accused of arbitrarily selecting the cities and variables achieve desired results.

2.2.3 Neoclassical-locational Approach

During the 1960s, neoclassical economics offered another explanation of residential differentiation based on assumption of rational economic behaviour of rental class. Much of this urban land-use theory is based on the work of Alonso (1964) and Muth (1969). As an application of Von Thunen's agricultural land-use theory, the theory began with a set of simplifying assumptions like monocentric city, featureless plain and linear transportation cost to distance. Individuals are also assumed to be identical in terms of income and preferences and will seek to maximize their unique utility functions with respect to land rents, prices and wages. Under these premises, neo-classical models theorized urban structure as a series of concentric circles, or Von Thünen's rings, emanating outward from the CBD which is the centre of economic gravity and most accessible area. Then, patterns of land-use are determined by land value that, in turn, is related to distance from the city centre. Naturally, land value declines outward from the CBD as envisaged by distance-decay theory if not disturbed by factor like quality of land (Alonso, 1960).

From neoclassical economic perspective, residential differentiation occurs since each social class has different bid-curve for different locations. The bid-rent curve is characteristically steep for the poor since they have little money to spend on transportation. Therefore, their ability to bid for the use of the land declines rapidly with distance from the place of employment. The rich group, on the other hand, characteristically has a shallow bid rent curve. When put in competition with each other, the poor group is forced to live in the centre of the city, and the rich group living outside. This means that the poor are forced to live on high rent land (Harvey, 1999). This is because commuting was costly and only the rich could afford to bear transport cost, they preferred to live in the healthier peripheral suburbs (Leontidou, 1990). Therefore, due to 'flatter' bid-rent curve of the wealthier ones, there is "a paradox in American cities: the poor live near the center, on expensive land, and the rich on the periphery, on cheap land" (Alonso, 1960:107). Households determine their residential locations based on the trade-off between the costs of commuting and land costs, and residents choose their residential locations in order to maximize utilities. This theory, therefore, is also known as 'trade off' theory of residential location since it represents each household as choosing its location by 'trading off' housing costs, which tend to fall with distance from the city centre, against transport costs, which tend to increase with distance from the centre (Evans, 1992). However, a number of studies have contrasted the Alonso model. In his study on Kent, Barbolet (I969) has pointed to the groups of lower middle-class home-owners who lived at some 60-80 minutes travelling time from London. Long journeys to work have also been documented in relation to Negroes in the American city (Berry and Horton, 1970; Harvey, 1972). Data from Reading show that professional, white-collar and blue-collar workers all travel significant distances to their work (Cripps and Cater, 1971).

Monkkonen (2010) in his study of Merida city in Mexico found that high-income groups concentrated in a central zone while low-income groups tend to disperse throughout the peripheral areas. Low-income residential areas exhibit lower density because they are on hillsides, or other areas where high-density development is not possible, or because they are recently settled areas that as yet have not urbanized completely. The paper also shows that levels of segregation of low-income households and ethnic minorities are not high in Mexico compared with those of the United States or Europe.

Neoclassical explanation of urban residential pattern is criticized on the ground that the model is static and is based on an 'economic man' assumption and other unrealistic assumptions such as the one that only transport between the residence and the city centre counts. It has also been shown that if some wealthy groups value the time used for transport more than high land consumption, they will prefer central to peripheral belts (Illeris, 2004). Another major shortcoming of the 'trade-off' model is the assumption of a monocentric city. Lastly, the model assumes the absence of government interventions which is, however, fairly common and can have profound impact on the distribution of Land-use and land value (Cadwallader, 1985).

2.2.4 Behavioural Approach

The behavioural approach to residential choice was described first by Wolpert in 1965. Unlike neoclassical economic perspective, behavioural approach was rooted in psychology. The theory claims that individual or household choices do not depend on rationality of human action and maximizing utility function. Instead, it acknowledges that residential segregation should be seen as at least partly a result of individual preferences, perceptions and decisions. Residential choice and decision making may be more influenced by the satisfying behaviour of individuals. Therefore, choice of residential location may be determined by household's characteristics including individual's position and events in the family life cycle rather than the trade-off between housing cost and location. Moreover, an individual's perception, memories and experiences of places may be a guiding factor in residential choice.

According to Wolpert (1965), the behavioural approach analyzed a person's residential preference and housing location with the help of place utility and threshold. It may be noted that place utility is simply a level of satisfaction with the place where one lives and is derived from the perceived levels of salient residential attributes in a particular neighbourhood or residential area. Behaviouralists seek to understand residential choice and pattern of residential location through the windows of individuals - their thoughts, knowledge, and decisions. They argued that individual behavior - their choice and preferences, has not been conditioned by economic factors alone, but may vary depending upon the family life cycle (Harman, 1975), satisfaction levels on present location, natural events. Residential stress, which describes the perceived disparity between present and desired residential conditions, may also form an important factor (Clark and Cadwallader, 1973; Brummel, 1981) although this may happen only when a certain threshold is reached (Van Kempen and Murie, 2009).

Van Kempen (2002) has given a special form of behavioural approach - ethnic cultural approach. Unlike the general behavioural approach which focuses on housing market, the ethnic cultural approach argues that housing conditions and residential patterns differ between groups, and these differences can be attributed to cultural or racial differences between these groups (van Kempen, 2002; Logan *et al*., 2002). In some cases, immigrants may possess the socio-economic and cultural means to integrate residentially with the host society, but may instead prefer to live amongst their own countrymen in immigrant enclaves.

The significance of ethnic-cultural approach is that processes of residential differentiation in the form of ethnic segregation have been driven by non-economic or non-market forces. As such, the residential pattern predicted by neoclassical model would not be applicable as residential choice is not influenced by income through location and distance. Contrarily, the main reasons of ethnic concentration are purely socio-cultural or political as the spatial segregation of different 'communities' helps to minimize conflict between social groups while facilitating a greater degree of social control and endowing specific social groups with a more cohesive political voice. Another important reason for the residential clustering of social groups is the desire of its members to preserve their own group identity or lifestyle (Knox and Pinch, 2010).

Johnston, Poulsen and Forrest (2006) analyzed ethnic residential pattern in Auckland, New Zealand using threshold method. Data were taken from 7100 census blocks in the city enabling them to have a detail study. They have identified 24 separate ethnic identities with other. They have found out that the Polynesian ethnic group was the most concentrated group while the European descendents lived in areas dominated by other groups. On the other hand, the New Zealand Europeans were concentrated as majority of them were found in areas they dominated and do not intermixed with either Polynesians or Asians.

Pacione (1996) studied Vienna where ethnic segregation was a relatively minor factor of social differentiation in the West European city. Data on the numbers and ethnic origins of residents in each of the 245 city wards were extracted from the 1991 census. He found out that districts with high levels of foreign residents tend to be in the inner suburbs around the urban core. He explained that such residential differentiation arises due to a combination of choice like a desire or mutual support and cultural contacts as well as constraint factors including lack of capital resources and ineligibility for council housing which result in some areas being favoured by immigrant group.

Massey *et al*. (1987) however found out that black in American cities attempted to improve their social rank through entry into more improved neighbourhoods of predominantly white population. They also find that very few blacks are successful in their attempt to 'spatially assimilated' into relatively poorer white neighbourhoods due to racial prejudice. This may be related to the observation that once blacks enter neighborhoods in significant numbers, the areas cease to be attractive to potential white settlers (Duncan and Duncan,1957; Taeuber and Taeuber,1965; Aldrich 1975).

In a study of Miami, it was found that low, middle, and upper-class blacks tend to live among other blacks, regardless of their socioeconomic standing (Boswell and Cruz-Báez, 1997:481). In Buffalo, New York, Trudeau (2006) found that low-income African Americans have lived in persistent segregation due to the spatial rootedness brought about by living in areas with existing social networks. This study implied that ethnic residential segregation can function as a survival strategy that utilizes social support to overcome shallow economic resources. In his study on Atlanta, Zhang (1998) identified that the most established Asian group, the Chinese, are the most integrated residentially while the more recent arriving Vietnamese are the most segregated. In a significant study on Irish residential pattern in Luton, Britain, Walter (1986) found out that residential clustering of Irish-born people in Luton arose as a by-product of distinctive cultural background.

The positivist approaches like behavioural and neoclassical approaches, however, have been criticized for paying too little attention to the constraints people faced in a housing system that embraced different tenures with different means of access to the market (Murie, Niner and Watson, 1976). It may also be noted that in comparison to classical models like urban morphology and social area analysis, neoclassical models and behavioural approaches are less followed with respect to analysis of urban residential pattern.

2.2.5 Marxist Approach

By the early 1970s, works on residential structure of cities through factorial and social area analyses of different cities in an attempt to link and test the traditional concentric and the sectoral models of urban structure declined considerably. It was realized that the ‘game of hunt of the Chicago model’ (Robson, 1969) had run into an explanatory *cul-de-sac,* with rapidly decreasing returns to effort and a general theoretical approach to the study of urban residential structure linked to changes in class structure and other factors was needed (Hamnett, 2009). Moreover, they, along with the neoclassical bid-rent theory and behavioural approach failed to take into account the role of institutions and underlying factors responsible for class formation which is one of the most important factors of residential differentiation. Due to lack of philosophical underpinnings, Harvey, a well-known Marxist geographer has called for a new theoretical position which centres on “specifying the necessary relationships between social structure in general and residential differentiation in particular" (Harvey, 1975:5). Thus, a new Structural-marxist perspective on urban socio-spatial differentiation has been developed to explain the process of urban differentiation and inequality in western capitalist cities (Harvey, 1973; Harvey and Chatterjee, 1974).

Therefore, the arrival of Marxist geography with the publication of David Harvey's *Social Justice and the City* (1973) resulted into the shifting away from the study of residential patterns *per se*, and a concern with household choice and preference as the explanatory variables, towards a concern with the underlying economic and social processes which structured the nature of the urban housing market and, in combination with the existing class and ethnic structure, produced residential patterns (Hamnett, 2009). According to Harvey (2001:384) "Divisions such as those between cities and suburbs…are actively produced through the differentiating power of capital accumulation and market structures". Thus, the production and reproduction of residential differentiation in urban space may be understood from the unequal distribution of resources in capitalist society. Such a model naturally stands on the concept of a free housing market and does not take into consideration the intervention of the state and the existence of a social system (Sibley, 1981). From Marxist perspective, capitalists seek profits by investing in property in the city, where it provides the maximum returns (Harvey, 1973; Gottdiener, 1985). There are two common ways to attain maximum profits - opening up of unused land at low cost and redevelopment of valuable land (Fong and Shibuya, 2000).

Criticizing the earlier explanations of residential differentiation like the deterministic classical ecological models and positivistic approaches like neoclassical and behavioral approaches, Harvey (1985) considered residential differentiation as a product of resource constraints in housing arising out from the wider structural forces within the economy and society and he argued that the preferences, choices and value systems of individuals are produced by forces external to the individual's will. From his studies on Baltimore, he concluded that financial and governmental institutions play an active role in shaping residential differentiation through housing market rather than social ecological processes, consumer preferences and utility-maximizing behaviours. Housing market has been controlled by land-owning investors seeking to obtain positive profits from selling of land. He attributed the active role of the land-owners as an outcome of the support of financial and governmental institutions. Thus, the ‘flight to the suburbs’ of the housing seeking middle class takes place when they were subjected to ‘blow-out’ from the inner city which has been characterized by inflow of low-income population and a rapid decline in basic services and amenities.

It may however, be worthwhile to mention that while Marxists reject the ecologists’ treatment of “geometric properties of spatial patterns as fundamental”, they acknowledge the opposite danger of seeing “spatial organization as a mere reflection of the processes of accumulation and class reproduction” (Harvey, 1982: 374).

2.2.6 Vertical Differentiation

Vertical social differentiation, also called ‘vertical segregation’ by White (1984) is an axial analogy of horizontal differentiation of residential pattern. The term refers mainly to the process of social differentiation along vertical space through differential occupation of building floors by different socio-economic classes. Vertical differentiation has received much less attention than horizontal social differentiation in urban geography mainly due to the development of urban geography in the Anglo-American context where it has been rather unimportant (Maloutas and Karadimitriou, 2001). The early models of urban structure like human ecology, social area analysis and factorial ecologies concentrated on horizontal structure only and neglected the vertical dimension. The only textbooks of urban geography that deal with vertical social differentiation are White (1984) and Leontidou (1990). Other literatures on vertical social differentiation can be found in Laquerbe (1967), Dopp (1968) and Maloutas and Karadimitriou (2001). All these papers deal with the Mediterranean cities.

Leontidou (1990) reported that vertical differentiation of urban functions (as well as social classes) is common throughout Mediterranean cities while single land-use zoning is rare meaning that a significant proportion of urban land serves multiple purposes. Many buildings have commercial, administrative or industrial uses at ground level and residences in their upper storeys. She explained that the intermixture of social classes, of residence with economic activity well as the inverse-Burgess spatial pattern in Mediterranean cities, is both a cause and an effect of the proximity of workplace and residence along with the proliferation of multi-storey apartment buildings which in turn may be attributed to "rising prices of land and construction, which rendered the single-family house inaccessible even to the middle classes" (Lichtenberger, 1976:90).

In his study on Naples in Italy, Allum (1973) has reported that the ground floors of the residential buildings were the famous *bassi* in which the poorer families live. The upper floors of the same buildings were inhabited by the upper classes. This cohabitation, according to him, 'accounts for the ideological unity of all social groups'.

Laquerbe (1967) took 20 per cent sample of buildings in central Montpellier, France. He found out that in buildings that were entirely in residential use, almost all ground-floor flats were occupied by the lower class or the *proletarian* class. The *proletarian* class, however, occupied only 85 per cent of the 3rd floor and above. He also found out that vertical differentiation was the strongest in the old city-centre where there was the highest representation of the richer *bourgeois* population.

2.3 Literatures on Quality of Life

Analysis of quality of life (QOL) is an outcome of the 'Social Indicators Movement' which originated from the United States of America. The social indicator movement has had its origins in the then American president Edgar Hoover's Presidency's Committee on Social Trends in the USA and its report *Recent Trends in the United States* in 1933 (Land, 1975). Coincidentally, much of the work was done by another Chicago school of sociologists under the chairmanship of William Ogburn. But, as pointed out by Smith (1973), the movement really took off between 1959 and 1966 with the publications *HEW Indicators* and *HEW Trends* by the US Department of Health, Education and Welfare (HEW). These reports were followed by a study on the impact and side effects of American space program on the society under the directorship of Raymond Bauer (Bauer, 1966). The study revealed that there was almost a complete lack not only of adequate data but also of concepts and appropriate methodologies for this purpose (Noll, 2002). In 1969, there was also the publication of the landmark report *Toward a Social Report* by the HEW (USDHEW, 1969), which was an attempt to produce a social equivalent of the annual Economic Reports. Another important work which deserves mentioning was Drewnoski (1970). A number of studies have followed these early works from different disciplines. Since it would be impractical to review all the previous studies, it is attempted here to review those QOL studies carried out by geographers and scholars from other disciplines who have carried out studies relevant to the present work.

2.3.1 Quality of Life in Developed Cities

In his well-known book *Human Geography: A Welfare Approach*, Smith (1973) studied the geography of social well-being in the United States and proposed seven 'general criteria' of social well-being relevant to the United States which are decomposed into 47 variables. His general criteria include income, wealth and employment, living environment, health, education, social order, social belonging, recreation and leisure. He extracted three principal components. The first of these explained 38.56 per cent of the variance; the second, 13.74 per cent; the third, 11.98 per cent. Smith has called the first two components as general socio-economic well-being and social pathology. He found difficulty in labeling the third component. The analysis produced clear inter-state variations in general social well-being. The southern eastern region forming the old cotton belt performed lower while the manufacturing belt of northeast region was performing relatively better. On the other hand, the social pathology pattern did not conform to the general social well-being.

In another study, Smith and Gray (1972) studied Tampa Bay, Florida, to make an attempt to develop indicators of social well-being. The study was very similar to the inter-state analysis done by Smith (1973), although there were some changes in indicators. Following the same methodology, the result of the study shows that the inner city adjacent to the central business district (CBD) shows relatively low level of social well-being.

Bederman (1974) developed an index to measure quality of life in Atlanta, Georgia. The indicators choosen were roughly similar to the above study of Smith and Gray (1972). Five criteria including health factor, public order factor, housing quality factor, socio-economic factor and density factor were identified and eleven variables were chosen to measure them. The analysis identified distinct, relatively homogenous zones bearing resemblance to the sector model of urban land-use. Similar results emerged from quality of life studies in Gainesville, Florida (Dickinson, Gray and Smith, 1972) which reveal sharp zonal and sectoral polarized city.

Johnston (1975) discussed the spatial pattern of inequality in quality of life and social well-being in New Zealand. He correlated the spatial inequality found in the country with the settlement pattern. He concluded that the residents of the largest cities are the most advantaged and that those in the smaller towns and the remote rural areas suffer the greatest relative deprivation. He also considered two components of spatial variable viz. division of an area into territories and accessibility were important determinants of levels of social well-being within New Zealand.

Knox and Scarth (1977) selected 41 objective variables to express the quality of life in 95 *départements* or regions of French. An index was derived from the calculated Z-Score. They also employed cluster analysis and multiple discriminant analysis to classify the whole regions into 9 groups. They found out that the quality of life in France varied markedly from region to region. Then the variables are grouped into clusters at the level of the *départements* a more sensitive pattern emerges which does not fit very clearly into any previously acknowledged regional distribution like physical regions of French or French planning regions.

Knox and MacLaran (1978**)** studied geography of social well-being in Dundee by taking 50 variables relating to health, housing, employment opportunities, education, personal security, income and consumption, leisure, social and political participation, access to amenities, environmental quality and social stability.

Liu (1976) employed 132 variables related to economic, political, environmental, health, education and social conditions to rank 243 United States metropolitan cities. In his study, he found out that the majority of large Standard Metropolitan Statistical Areas (SMSAs) with high quality of life were in the West, with substandard metropolitan areas concentrated in the south and north-east.

In their study of spatial patterns of QOL in the highlands of Scotland, Knox and Cottam (1981) have taken a number of data to measure both objective and subjective QOL. They have used an eleven-point equal-interval scale from ‘not at all satisfied’ (0) and ‘very satisfied’ (10) to gauge people's satisfaction with seven key domains of life including job, home, health services, district, primary education, secondary education, public transport, with various 'sub-domains' and with their subject’s lives as a whole. They have found out that people's levels of satisfaction were relatively high: about 8.5 out of 10 for most domains of life. People were particularly dissatisfied with those aspects of life for which public institutions and authorities are responsible, in contrast to more personal and self-determined aspects of well-being.

Pacione (1987) studied the socio-spatial inequality in southern Italian city of Naples by selecting a range of objective indicators to measure a variety of housing, economic, social and demographic aspects of life in the city by using principal component analysis and found out that there was a marked distinction between the inner- and outer-city.

In another study, Pacione (1998) has taken 54 variables to measure the social, economic and demographic characteristics of each of 122 neighbourhood districts that constitute the commune of Rome to provide insight into the basic socio-spatial structure of the city region. By using principal component analysis, he analyzed the social geography of Rome and identified 7 clusters of social areas.

MacLaren (1981) studied QOL of Dundee by taking both objective and subjective social indicators. He took 50 objective indicators from various quality of life domains like health, housing, employment, education, personal security, consumption, family and neighbourhood stability, leisure, quality of neighbourhood environment, access to urban amenities and participation in the democratic system. For subjective well-being, the respondents were asked to measure their levels of satisfaction on their living conditions within 0 - 10 point likert-scale. He found out that inner-city areas are relatively poor in housing, environmental quality and finance-consumption. On the other hand, suburbs and public housing estates in the periphery were showing more adequate levels. Significantly, a comparison between mean objective and subjective indicator scores revealed positive correlations for all domains apart from education.

In his analysis on supra-national variations in well-being in Europe, Ilbery (1984) has taken 27 objective variables to represent of seven major constituents of social well-being: demographic structure, housing, health, education, economic growth, material well-being, and leisure and recreation. Firstly, he employed correlation analysis to examine the degree of relationship between the variables. Then, principal component analysis was done to calculate a composite index of social well-being for each country. Lastly, cluster analysis was employed to produce a classification of countries on the basis of the major dimensions of social well-being derived from the principal components analysis. The study demonstrated clear core-periphery contrasts in social well-being. Interestingly, the results of the study imply that macro-variations in social well-being are reflective of inequalities in economic development.

Hemmasi (1995) selected 21 objective variables for his studies on QOL in North Dakota to assess spatial and temporal variations in quality of life in the 53 North Dakota counties from 1980 to 1990; and second, to explore relationships between quality of life indicators and migration rates for these counties. Using principal component analysis, he produced three basic quality of life dimensions for North Dakota counties including affluence, suffering, and demography.

Guhathakurta and Cao (2011) have selected six dimensions to study variation by place or community in the QOL of Greater Phoenix's residents. The dimensions include education, economy, income, and jobs, public safety, housing, transportation and mobility, and public health. Then, 28 towns within the study area were ranked on the basis of their score in indicators belonging to each dimension. Variable weights were assigned to each dimension. Their result shows that the exclusive, small, and mostly residential communities as well as the outer suburbs were the top ranked while the older and larger cities were in the lower half of the list. The study also found that the wealthy, exclusive, and small communities provide the highest QOL for its residents. But larger and more diverse cities also provide a relatively high QOL. Thus, size or age of communities does not significantly determine the level of residents' well-being.

Kweon and Marans (2011) investigated subjective QOL in Detroit Metropolitan area at multiple geographical scales. They classified the metropolitan area into various types of settlements like urban core, larger cities, mid-size cities, older suburbs, new suburbs, small towns and rural settlements. From the mean satisfaction scores on a 7-point and 5-point Likert scales for each type of place in Detroit, they found that people tended to be satisfied with their lives. However, people living in the larger places were less satisfied, while those living in the suburbs (older and newer), small towns, and rural areas were more satisfied. The satisfaction level in urban core was significantly lower than satisfaction levels in the old and new suburbs, small towns, and rural areas.

2.3.2 Quality of Life in Developing Cities

In his study on quality of life in Kwara state in Nigeria, Oyebanji (1982) first tried to develop territorial social indicators by selecting 31 objective variables under different dimensions including prosperity, environment, education, health and social disorder. Following Smith (1973), he employed standard score or Z-score method to compute the composite index of each dimension. Then, he transformed again the composite scores to compute the overall index or general social well-being for each region within the Kwara state. Finally, with the help of choropleth map, the author has shown high and low QOL regions.

Omuta (1988) investigated spatial variation in quality of life in Benin city, Nigeria. He adopted stratified random aligned traverse sampling method to select a sample of 1410 households from twenty one neighbourhoods in Benin. To assess the overall objective quality of life, five broad dimensions of quality of life including employment dimension, housing dimension, amenity dimension, educational dimension, nuisance dimension and socio-economic dimension are used. Each dimension comprises two or three variables. He also studied percieved or subjective quality of life for each dimension. On the basis of differences in quality of life, he was able to divide the whole city into three zones for planning purpose.

Rossouw and Naude (2008) undertook a study on temporal change in objective indicators of non-economic QOL for 354 sub-national magisterial districts in South Africa using principal components method to derive three indices. They found out that though income does matter for the overall QOL, non-income components of the QOL can make an important difference. They also found out that some of the relative income poor areas have improved their non-economic ranking during the study period. They also found out that the environmental QOL in South Africa is better in non-urban areas.

Tesfazghi, Martinez and Verplanke (2010) studied QOL at Kirkos sub-city of Addis Ababa, Ethiopia based on primary household survey and secondary data. They took data from a sample of 607 households from 11 *Kebeles* or neighbourhood administrative units through a stratified and systematic sampling method. Geographical information system (GIS) was used to derive proximity variables which were nearest distance to school and health facilities. Subjective quality of life was measured using a six point Likert scale that ranges from one for completely dissatisfied to six for completely satisfied. Coefficient of variation (CV) is applied to study the variability of the subjective QOL at *Kebele* level while factor analysis was applied to identify the dimensions of objective QOL in the sub-city. The QOL dimensions identified are crowdedness, socio-economic status, safety and proximity, housing and demographic dimensions. They found out that there is large variation between the QOL of the respondents in the sub-city.

Mridha and Moore (2011) examined the life experiences and satisfaction of residents on housing and neighbourhood environment in Dhaka, Bangladesh. They selected six different areas in Dhaka. After analyzing a sample of 204, principal component analysis was employed to extract six components of residential satisfaction. They are management and maintenance, architectural features, neighbourhood, neighbours, recreation facilities and ambient environment. The authors concluded that the factors clearly indicate the importance of the socio-physical neighborhood environment as a major contributor to residential satisfaction in Dhaka. They also found out that the overall socio-physical features of the neighborhood and community influence life satisfaction more than the physical features of the individual dwellings.

Malekhosseini and Joodaki (2011) collected both objective and subjective primary data to study QOL in various localities of Noorabad city, Iran. Number of samples by using Kokran formula and with regard to time and finance restrictions of research was determined With regard to gathering information from about 25 households in each locality, number of understudying households is 307 out of total households of more than twelve thousand. Residents were asked about their subjective QOL in various dimensions which they termed 'Life Territories' like housing, urban environment, quality of public services, public service convenience, economic situation and individual QOL. A six-point Likert scale was used for evaluation of rate of satisfaction with life territories. For objective QOL, factor analysis was employed to reduce 23 variables to obtain six dimensions like urban facilities and infrastructures, social activities, housing situation, social relation, social economic situation and health, treatment activities.

Fakhruddin (1991) has taken in-depth analysis of spatial variation in QOL in Lucknow, Uttar Pradesh. The study, claimed to be 'the first of its kind' in India analyzed 31 variables for determining quality of urban life. These variables were grouped to indicate material well-being, health and nutritional status, cultural level, housing standards, building standards, territorial stresses and spatial congestion

Stratified random sampling was adopted to select 5 per cent sample from each *mohalla* or neighbourhood from a total of 1184 *mohallas*. The selected variables were analyzed with the help of factor analysis and three distinct areas from the entire city were derived from the factor scores.

Chandramouli (2003) has taken Census of India 2001 data on housing to assess differences in quality of life among 155 divisions of Chennai city. A composite index was calculated with the help of Z-Score. The composite index does not show any pattern except that the central and western parts of the city have low negative index. The whole city was divided into two categories - high QOL areas and medium QOL areas. The census divisions categorized as medium and high were clustered in the northern, eastern and to an extent in the southern part of the city. Many of the census divisions in the high as well as medium category have a higher proportion of people in the lower and middle-income brackets.

Das (2008) studied QOL in Guwahati. By using purposive sampling for collection of data, she selects 10 per cent of municipal wards out of the total 60 wards. From each ward, 3 per cent of the total households were picked for interview to represent different income groups. In all, samples of 379 households were taken. To measure subjective QOL, 27 variables were taken for analysis apart from 7 objective variables. Principal component analysis was employed to analyse the data and she found out that satisfaction from condition of traffic, satisfaction from level of environmental pollution and satisfaction from availability of parks and greens scored very low where as satisfaction from own economic condition and satisfaction from cost of living are the two highest.

Bardhan, Kurisu and Keisuke (2011) studied the linkages between urban form and QOL in Kolkata. They found that the urban form of Kolkata was highly mono-centric. They also argued that the economically weaker populations are pushed away from the city centre that the city centre is losing population showing a trend of gentrification.

Kapuria (2014) estimated the QOL in Delhi, India with the help of Fuzzy sets theory. With the help of factor analysis, she extracted seven factors which were labeled as categories of QOL. She found that the differences in satisfaction on overall QOL and access were primarily influenced by location.

A review of various approaches to study patterns of urban differentiation and concepts and literatures on QOL has indicated the centrality of socio-spatial analysis in urban social geography. Within urban space, society and space interacts in such a manner that urban spaces have been continuously modified through accretion, addition and demotion of spaces and new forms of urban spaces have emerged through the modifications of urban landscapes that, in turn, influence the formation of new urban cultures and vice versa. According to Soja (1980), a two-way process of socio-spatial dialectic continuously operates in cities in such a way that people create and modify urban spaces while at the same time being conditioned in various ways by the spaces in which they live and work. Through the socio-spatial process, "Neighbourhoods and communities are created, maintained and modified; the values, attitudes and behavior of their inhabitants, meanwhile, cannot help but be influenced by their surroundings and by the values, attitudes and behaviour of the people around them" (Knox and Pinch, 2010:5). The present study is also about the outcome of socio-spatial interaction in Aizawl city.

CHAPTER-III

METHODOLOGY

3.1 Introduction

The methodology of the study includes preparation of Aizawl city base map and delineation of boundaries of local councils and municipal wards, determination of sample size, operation of sampling procedure for collection of data and analysis of tabulated data with the help of statistical techniques and graphical methods. The outputs of the analyses were mapped with the help of choropleth mapping techniques wherever appropriate.

3.2 Selection of Sampling Unit

Firstly, a base map of the Aizawl city was prepared with the help of ArcGIS software. Boundaries of Local Council (LC) areas were delineated. The local council is the lowest unit of local administration and lowest unit of enumeration. Each local council is represented by 5 to 7 council members. In local parlance, each local council area is known as *veng* which may be translated as 'locality' or 'neighbourhood' where residents are bound by unity and integrity. Normally, *veng* boundaries coincide with the boundaries of one branch of powerful community organization called Young Mizo Association (YMA). Altogether, there were 82 local councils in the entire city of Aizawl in 2011. These local councils come under 19 municipal wards. Normally, a municipal ward consists of 3 to 8 local councils.

Local councils are considered as suitable units of spatial analysis due to their small size, cohesiveness and presence of sense of belongingness among its residents. From methodological point of view, small areas are appropriate sites of study and it has been encouraged that studies on intra-urban difference should be taken out at smaller areas since patterns or degrees of inequality are more visible and the criticism of ecological fallacy is diminished at lower levels of aggregation (UNCHS, 2000; UN-HABITAT, 2003).

3.3 Sampling and Sample Size

Collection of precise and reliable data requires careful and judicious selection of sampling technique. Various literatures were surveyed before taking sample to determine sample size and sampling method appropriate for the present study. Das (2008) applied two-stage stratified purposive sampling method. In the first stage, 6 municipal wards were selected out of 60 municipal wards purposively to represent various wards of the city. In the second stage, households were picked selectively from each ward to represent various income groups. In each ward, 3 per cent of the total households were interviewed to make a total of 379 samples. Another sampling methods employed in the previous studies were random stratified sampling (Fakhruddin, 1991; Turkoglu *et al*., 2011), purposive, stratified and systematic sampling methods (Tesfazghi *et al*., 2010), multi-stage random sampling method (Oktay and Rustemli, 2011), purposive stratified sampling method (Mridha and Moore, 2011), and stratified random aligned traverse sampling method (Berry and Baker, 1968; Omuta, 1988).

In the present study, random stratified sampling method was employed to generate a sample of households for the entire city of Aizawl consisting of 82 local councils (LCs) belonging to 19 Municipal Wards. Since the sampling unit is very vast, a sample household of 5 per cent from the total household constitutes the sample size for each locality. In the end, a total of 1,600 schedules were supplied to the respondents and face-to-face interviews were conducted at their residences. Each schedule contained an information sheet mentioning that the identity of the respondents and his/her family should not be revealed and were free to decline answering the questions.

Before taking actual survey, a pilot survey was undertaken first to determine appropriate variables to be included in the study. Those features which were poorly understood, difficult to interpret and were of little or no importance to the public were excluded from further analysis. Thereafter, a schedule was developed based on previous studies but modified whenever necessary to meet the specific purpose of the study. The schedule was designed to collect objective parameters for measuring residential pattern and quality of life as well as to measure residents' perceptions and their evaluations about aspects of quality of life. Thus, it consists of two parts-the first part contains objective measures and the second part contains subjective measures. The final schedule comprised of 46 questions.

Selection of households was made to represent all sections of population within each local council unit. This includes arbitrary division of each locality into valley, slope and hill top bases on observation. Households were selected from each type of topography in proportionate to the total number of houses. Sometimes, stratification of local council was based on the existing division of Young Mizo Association's (YMA) branch which coincided with boundary of local council. Each YMA branch or *veng* is divided into a number of sections. These sections may also be taken suitably as strata in the sampling.

Objective questions provide ratio scale data which could be readily analyzed with any statistics. Regarding subjective questions, responses to each subjective question were measured on a linear numeric version of a Likert-type scale. Whereas the traditional Likert-type scale produces only ordinal data and is thus inappropriate for parametric statistics, linear-numeric scales lead to equal-interval data that may be analyzed using the most powerful parametric statistics (Alreck and Settle,1995). For the majority of the questions, respondents were requested to place a tick in one of the five boxes to indicate their level of satisfaction with each item on a five-point linear numeric version of a Likert scale, '1' standing for strong level of dissatisfaction and '5' representing a strong level of satisfaction. For instance, question such as 'How satisfied are you with the quality of roads in your local council area?' has to be answered on a 5-point scale from 1 = 'very dissatisfied' to 5 = 'very satisfied'. To get reliable and correct information, only respondents above 18 years of age were selected. The response rate was around 98 per cent since interviews were usually conducted at the respondents' residents during holidays and at nights. Night-time visit is common in the study area. Only those households without any available person during the visits were skipped.

3.4 Techniques of Analysis

A number of quantitative techniques and graphical methods are used in the present study. The main techniques are multivariate data analysis techniques like factor analysis (FA), principal components analysis (PCA) and cluster analysis (CA); measures of association like correlation and regression; spatial autocorrelation techniques like global Moran's I and local indicators of spatial association (LISA). Graphical methods like scatter plots, line graphs, histograms and choropleth maps are also used.

Factor analysis and principal component analysis are powerful multivariate techniques. The goal of research using PCA or FA is to reduce a large number of variables to a smaller number of factors, to concisely describe the relationships among observed variables, or to test theory about underlying processes (Tabchnick and Ridell, 2013). These techniques are data reduction methods that derive a composite, smaller set of correlated but independent variables known as factors or components from a large set of variables. Each of the factors or components may be thought as a 'super variable'.

PCA can be understood as a special case of factor analysis (FA) and is usually, but not always, the first step in a FA. Both of them are almost similar except in preparation of the observed correlation matrix for extraction and in the underlying theory. Mathematically, the difference between PCA and FA is in the variance that is analyzed. In PCA, all the variances in the observed variables are analyzed. In FA, only shared variance is analyzed and attempts are made to estimate and eliminate variance due to error and variance that is unique to each variable. In PCA, components are a function of the measured variables where as in FA; the measured variables are a function of factors. Second, FA estimates errors which are unique variance while PCA assumes that the measurement is without error.

FA and PCA are the most preferred techniques for measuring urban socio-spatial differentiation (Knox and Pinch, 2010). Specifically, PCA is a preferred method for data reduction while FA is a preferred method for detecting structure (Krishnan, 2010). Tabachnick and Fidell (2013) recommend the use of FA if the researcher is interested in a theoretical solution without error variability or without a unique mathematical solution. However, if the researcher needs an empirical summary of the data set that explains the maximum variance with a unique mathematical solution, then PCA is preferred.

PCA is, therefore, employed here to develop composite index of various dimensions of quality of life. FA, on the other hand, is employed to detect the underlying structure of residential differentiation or in other words to extract the main axes of urban social differentiation (Robson, 1969).

3.4.1 Principal Component Analysis

In PCA, an original set of variables is transformed into a fewer new set of orthogonal (uncorrelated) variables called principal components. Mathematically, principal components are linear combinations of variables with weights in terms of their eigen vectors. These eigen vectors are derived from the correlation matrix of the variables. Each principal component is a linear combination of Z's obtained as

$$\begin{aligned} Z_1 &= \alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1q}x_q \\ Z_2 &= \alpha_{21}x_1 + \alpha_{22}x_2 + \cdots + \alpha_{2q}x_q \\ &\cdots \\ Z_q &= \alpha_{q1}x_1 + \alpha_{q2}x_2 + \cdots + \alpha_{qq}x_{qm} \end{aligned}$$

Where $x_1, x_2, \ldots, x_q$ are the variables (indicators), q the number of variables and Z_i (i=1,…,q) represents the principal components. a_{ij} are the component loadings which are chosen as weights applied to the variables x_j in equation(1) so that the principal component Z_i satisfy the following conditions:

(i) they are uncorrelated (orthogonal);

(ii) the first principal component accounts for the maximum possible proportion of the variance of the set of x_s, the second principal component accounts for the maximum of the remaining variance, and so on until the last of the principal components absorbs all the remaining variance not accounted for by the preceding components, and

$$a_{i1}^2 + a_{i2}^2 + \cdots + a_{iq}^2 = 1$$

where $i = 1,2,\ldots,q$,.

PCA involves finding the eigen values λ_j, where $j = 1, 2,\ldots,q$, of the sample covariance matrix *CM as*

$$CM = \begin{bmatrix} cm_{11} & cm_{12} & \ldots & cm_{1q} \\ cm_{21} & cm_{22} & \ldots & cm_{2q} \\ \ldots & & & \\ cm_{q1} & cm_{q2} & \ldots & cm_{qq} \end{bmatrix}$$

Where the diagonal element cm_{ii} is the variance of x_i and cm_{ij} is the covariance of variables x_i and x_j. The eigenvalues of the matrix *CM* are the variances of the principal components and can be found by solving the characteristic equation where *I* is the identity matrix and λ is the vectors of eigenvalues.

An important property of the eigenvalues is that they add up to the sum of the diagonal elements of CM. That is, the sum of the variances of the principal components is equal to the sum of the variances of the original variables:

$$\lambda_1 + \lambda_2 + \cdots + \lambda_q = cm_{11} + cm_{22} + \cdots + cm_{qq}$$

In order to prevent some variables having undue influences on the principal components, variables are standardized first to have zero means and unit variances at the start of the analysis. The co-variance matrix *CM* then takes the form of the correlation matrix. Given that the correlation matrix rather than the covariance matrix is used in the PCA, all individual indicators are assigned equal weights in forming the principal components (Chatfield and Collins, 1980)

3.4.2 Factor Analysis

The procedure to construct factor analysis (FA) is similar to PCA. However, while PCA is based simply on linear data combinations, the FA model assumes that the data is based on the underlying factors of the model, and that the data variance can be decomposed into that accounted for by common and unique factors.

The mathematical equation of FA may be given as

$$
\begin{aligned}
X_1 &= \alpha_{11}F_1 + \alpha_{12}F_2 + \cdots + \alpha_{1m}F_m + e_1 \\
X_2 &= \alpha_{21}F_1 + \alpha_{22}F_2 + \cdots + \alpha_{2m}F_m + e_2 \\
&\cdots \\
X_q &= \alpha_{q1}F_1 + \alpha_{q2}F_2 + \cdots + \alpha_{qm}F_m + e_q
\end{aligned}
$$

Where X_i (i =1,…,q) represents the original variables but standardized with zero mean and unit variance; $\alpha_{i1}, \alpha_{i2,\ldots,} \alpha_{im}$ are the factor loadings related to the variable X_i; $F_1, F_2, \ldots, F_m$ are m uncorrelated common factors, each with zero mean and unit variance; and e_i are the q specific factors supposed independently and identically distributed with zero mean.

The procedures and applications of FA and PCA in geographical analysis are given Figures 3.1 and 3.2.

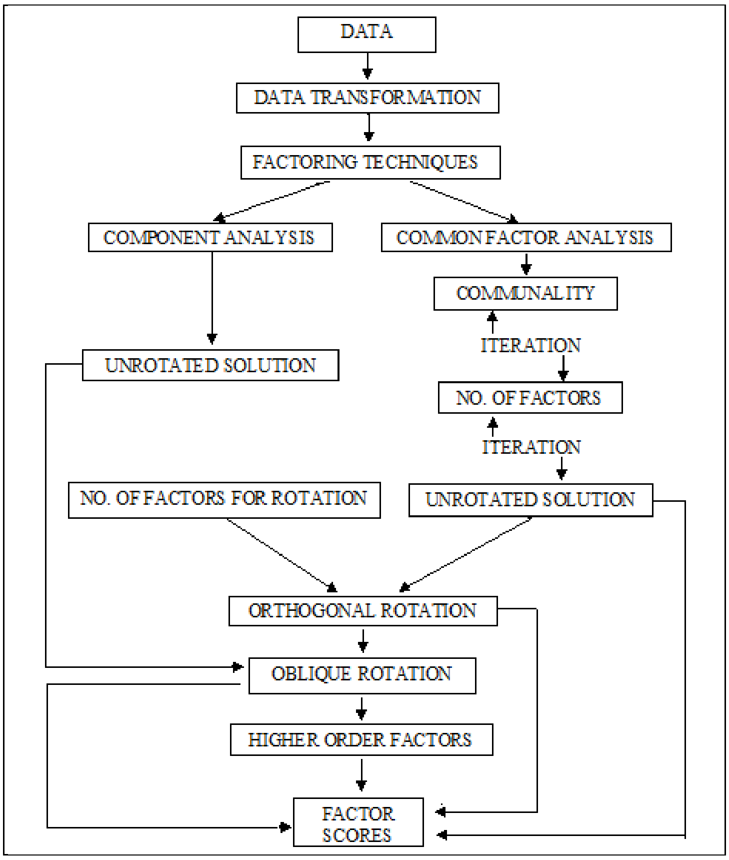

Figure 3.1 Schematic Diagram of Procedures of Factor Analysis and Principal Component Analysis (Source: Goddard and Kirby, 1976).

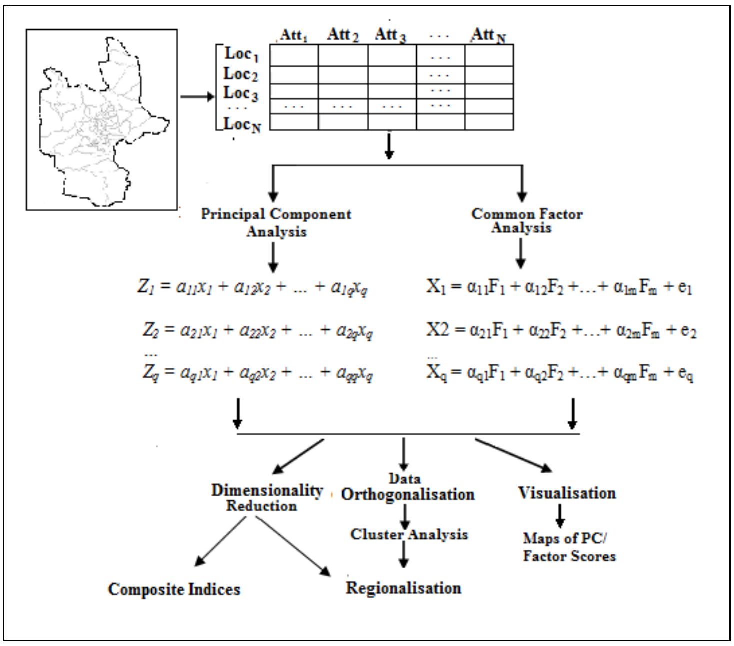

Figure 3.2 Applications of Factor Analysis and Principal Component Analysis (modified from Demsar *et al.*, 2001).

3.4.3 Steps in Factor Analysis

According to Ho (2014), there are three basic steps to FA including PCA. They are 1) computation of the correlation matrix for all variables 2) extraction of initial factors and 3) rotation of the extracted factors to a terminal solution.

1) Computation of correlation matrix

Factor analysis is based on correlations between measured variables. Extreme multicollinearity is not permitted to conduct FA as this would cause difficulties in determining the unique contribution of the variables to a factor (Field, 2000:444). A Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a statistic for comparing the magnitudes of the observed correlation coefficients. The concept is that the partial correlations should not be very large if distinct factors are expected to emerge from factor analysis (Hutcheson and Sofroniou, 1999).

The Kaiser-Meyer-Olkin (KMO) statistic is computed for each individual indicator, and their sum is the KMO overall statistic. The range of KMO value varies from 0 to 1. A KMO overall should be .60 or higher to proceed with factor analysis (Kaiser and Rice, 1974). Multicollinearity can also be detected via the determinant of the correlation matrix. If the determinant is greater than 0.00001, then there is no multicollinearity (Field 2000).

$$KMO = \frac{\sum\sum_{i=j}^{n} r_{ij}^2}{\sum\sum_{i=j}^{n} r_{ij}^2 + \sum\sum_{i=j}^{n} s_{ij}^2}$$

where r_{ij} is the correlation coefficient of variable i and variable j, and s_{ij} is the partial correlation coefficient.

The Bartlett's test of sphericity is used to test the null hypothesis that the individual indicators in a correlation matrix are uncorrelated, i.e. that the correlation matrix is an identity matrix. The statistic is based on a chi-squared transformation of the determinant of the correlation matrix.

2) Extraction of factors

The next step is to extract factors (or components in case of PCA) which are simply aggregates of correlated variables. According to Tabachnick and Fidell (2014), for something to be labeled as a factor it should have at least 3 variables. A factor with 2 variables is only considered reliable when the variables are highly correlated with each another ($r > 0.70$) but fairly uncorrelated with other variables (Yong and Pearce, 2013).

To extract factors or components, a number of methods are available. The choice of extraction method depends on the nature of research undertaken.

Principal component analysis (PCA) and common factor analysis (CFA) are two basic methods for obtaining factor solutions. Under common factor analysis model, there are six methods of extraction including principal-axis factoring, unweighted least-squares, generalized least-squares, maximum-likelihood, alpha factoring, and image factoring. Among the above methods, Principal Axes solution (or Principal Axis factoring) and PCA are the two most common extraction methods in geography (Clark, Davies and Johnston, 1974).

In the present study, PCA is used to determine composite index of quality of life (QOL). The method is suggested when the purpose of the study is no more than to reduce data in order to obtain the minimum number of factors needed to represent the original set of data (Ho, 2014). The method is preferred to other methods in the construction of composite index of various dimensions of QOL as all the variances in the observed variables are analyzed.

On the other hand, factor analysis, particularly principal axis factor (PAF) method is employed in the study of residential pattern particularly horizontal pattern of residential differentiation. The PAF method is based on the notion that all variables belong to the first group and when the factor is extracted, a residual matrix is calculated. Factors are then extracted successively until there is a large enough of variance accounted for in the correlation matrix (Tucker and MacCallum, 1997).

3) Determination of number of factors

There are two conventional criteria for determining the number of initial unrotated factors to be extracted. These are the eigenvalues criterion and the scree test criterion. The eigenvalues criterion is also called Kaiser's criterion which suggests retaining all factors that are above the eigenvalue of 1 (Kaiser, 1970). The Scree test rule is based on a visual plot of the eigenvalues against the number of factors in their order of extraction. In a Scree test, factors located above the break (i.e. point of inflexion) are retained. Sometimes, parallel Analysis is also recommended to extract reliable number of factors (Zwick and Velicer, 1986; Streiner, 1998; O'Connor, 2000). In parallel analysis, the eigenvalues derived from the actual data are compared to the eigenvalues derived from the random data sets. Factors are retained as long as the i^{th} eigenvalue from the actual data is greater than the i^{th} eigenvalue from the random data. The Kaiser's rule is followed in the present analysis.

4) Rotation methods

Factors are rotated for better interpretation since unrotated factors are ambiguous. The goal of rotation is to attain an optimal simple structure which attempts to have each variable load on as few factors as possible, but maximizes the number of high loadings on each variable (Rummel, 1970).

The most commonly used methods in factorial ecology are orthogonal (i.e. uncorrelated) and oblique rotation procedures. Orthogonal rotation is when the factors are rotated 90° from each other, and it is assumed that the factors are uncorrelated (Rummel, 1970). On the other hand, oblique rotation is when the factors are not rotated 90° from each other, and the factors are considered to be correlated. The difference between orthogonal and oblique rotation is, however, inconclusive (Giggs and Mather, 1975; Costello and Osborne, 2005).

The choice between orthogonal and oblique rotations depends on the purpose of the study. According to Ho (2014:206) "If the goal of the research is no more than to 'reduce the data' to more manageable proportions, regardless of how meaningful the resulting factors may be, and if there is reason to assume that the factors are uncorrelated, then orthogonal rotation should be used. Conversely, if the goal of the research is to discover theoretically meaningful factors, and if there are theoretical reasons to assume that the factors will be correlated, then oblique rotation is appropriate". Therefore, one orthogonal rotation method 'varimax' is used in PCA and 'direct oblimin', an oblique rotation method is used in factor analysis.

5) Factor scores

Factor scores are composite (latent) scores for each subject on each factor (Wells, 1999; Thompson, 2004). They are analogous to the $\hat{Y}$ scores in the regression equation and are calculated by applying the factor pattern matrix to the measured variables.

The factor score produced with the help of Bartlett estimation method in statistical software called ‘IBM SPSS’ is used for mapping the score of each observation in the factorial analysis of residential pattern. The method uses the least squared procedure to minimize the sums of squares of the factors over the range of variables (Bartlett, 1937). In Bartlett method, only the common factors have an impact on factor scores. The sum of squared components for the ‘error’ factors (i.e., unique factors) across the set of variables is minimized, and resulting factor scores are highly correlated to their corresponding factor and not with other factors. However, the estimated factor scores between different factors may still correlate.

Bartlett factor scores are computed by multiplying the row vector of observed variables, by the inverse of the diagonal matrix of variances of the unique factor scores, and the factor pattern matrix of loadings. Resulting values are then multiplied by the inverse of the matrix product of the matrices of factor loadings and the inverse of the diagonal matrix of variances of the unique factor scores. One advantage of Bartlett factor scores over the other two methods i.e Regression method and Anderson-Rubin method is that this procedure produces unbiased estimates of the true factor scores (Hershberger, 2005).

3.4.4 Construction of Weights using Principal Component Analysis

Principal component analysis and factor analysis can be used to weight and aggregate variables in a composite index. An advantage of these methods is that they require no *a priori* assumptions on the weights of the different dimensions.

One of our main objectives is to construct a composite index of quality of life (QOL) which includes objective and subjective measures. PCA has its own distinction as a weighting technique in the development of composite indices as it has the virtue of simplicity and allows for weights representing the information content of individual indicators (OECD, 2008:69). According to Booysen (2002) PCA and FA are the most frequently used multivariate statistical techniques used in the weighting of composite indices.

Following Greyling (2013) and OECD (2008), the novel method developed by Nicoletti *et al*. (2000) has been applied here as a weighting technique. The method uses PCA to weight the index objectively according to the explained variance in the data. This method considers the factor loadings of the entire extracted components to weight a composite index. The benefits of this method is that a higher proportion of the variance in the data set is explained (Greyling, 2013).

The approach used by Nicoletti et al. (2000) is that of

(1) Grouping the individual indicators with the highest factors loadings into intermediate composite indicators.

(2) The weight of each of the variables in the intermediate composite is derived by squaring the factor loadings of the variables and scaling it to unity sum

within each intermediate composite index. The squared factor loadings represent the proportion of the total variance of the indicator which is explained by the component.

(3) Once the intermediate composite indices have been constructed, they are aggregated by assigning a weight to each of them equal to the proportion of the explained variance of the component in the dataset. In other words, the weights assigned to the intermediate composite indices or weight of respective factor equals the explained variance divided by total variance of each factor. Then, weight score (W_i) is obtained by multiplying the variable weight and weight of respective factor. Finally, the resulting weight or final weight is obtained which is rescaled again to sum up to one to preserve comparability.

(4) After the final weights were obtained, the rank of each local council was obtained by as the product of normalized variable and the final weight.

3.5 Cluster Analysis

Cluster analysis is another multivariate data reduction technique. The difference between cluster analysis and factor analysis is whereas factor analysis groups similar variables (i.e. similarities among columns of data) based on patterns of variation among variables; cluster analysis groups similar observations (i.e. similarities among rows of data) based on similarity among variables (also called distance or proximity of variables). In cluster analysis we seek to reduce the n original observations into g groups, where $1 \leq g \leq n$. The goal of cluster analysis is to minimize the within-group variation and maximize the between-group variation. In other words, the observations within a cluster are more similar than observations between clusters, as measured by the clustering criterion (Wang, 2006).

There are two broad types of cluster analysis- agglomerative or hierarchical method and non-hierarchical or non-agglomerative method (Rogerson, 2001). Hierarchical clustering is more widely used (Wang, 2006). Hierarchical clustering starts with each observation as a separate cluster, i.e. there are as many clusters as cases, and then combines the clusters sequentially, reducing the number of clusters at each step until only one cluster is left.

3.5.1 (Dis)similarity Measure and Clustering Method

Cluster analysis uses dissimilarities or distances between observations to form clusters. There are various measures to express (dis)similarity or distance between pairs of observations. A straightforward and generally accepted way to compute distance or proximity between objects in a multi-dimensional space is by drawing a straight line between them. This type of distance is referred to as Euclidean distance. The Euclidean distance between two points (or locations) *i* and *j* is the hypotenuse of a triangle ABC. With regard to variable *X* and *Y* and their coordinates (X_{1i};X_{2i}) and (X_{1j} ;X_{2j}), the euclidean distance may be given as

$$D(i,j) = \sqrt{A^2 + B^2} = \sqrt{\left(X_{1i} - X_{1j}\right)^2 + \left(X_{2i} - X_{2j}\right)^2}$$

Objects with smaller distances between one another are more similar, whereas objects with larger distances are more dissimilar.

After determining measure of (dis)similarity, the next procedure is to choose clustering algorithm or the way in which clusters should be joined at each stage. A number of methods are again available. In the present study, Ward's method has been employed. In this method all possible pairs of clusters are combined and the sum of the squared distances within each cluster is calculated. The combination that gives the lowest sum of squares is chosen. Ward's distance between clusters C_i and C_j is the difference between the total within cluster sum of squares for the two clusters separately, and the within cluster sum of squares resulting from merging the two clusters in cluster C_{ij}.

$$D_w(C_i, C_j) = \sum_{x \in C_i} (x - r_i)^2 + \sum_{x \in C_j} (x - r_j)^2 - \sum_{x \in C_{ij}} (x - r_{ij})^2$$

Where as r_i is centroid of C_i, r_j is centroid of C_j and r_{ij} is centroid of C_{ij}.

3.5.2 Dendrogram - Selection of Number of Cluster

A tree-structured graph called Dendrogram is a graphical representation of the resulting clustering. It is used to illustrate the arrangement of the clusters produced by hierarchical clustering and also used to determine the number of clusters. Dendogram consists of vertical line and horizontal line. The vertical line denotes the relative similarities or dissimilarities between observations or clusters, while the horizontal line represents the observations or clusters. Clusters are formed along the horizontal line by joining individual observations or existing clusters at nodes.

In a dendrogram, the clusters are linked at increasing levels of dissimilarity. The height of the node (or joining point of observations/clusters) can be thought of as the distance value between the right and left sub-branch clusters. Any sudden increase in the difference between adjacent steps will indicate an appropriate number of clusters to consider. But whatever cut-off point is used, cluster analysis does not necessarily establish an optimal or unique solution (Mather, 1969).

3.6 Correlation Analysis

Pearson's product moment correlation is employed to measure association between selected variables. The technique is one of the most popular methods in quantitative geography. It measures the magnitude and direction of association between two or more variables. The formula of product moment correlation for *x* and *y* variables is

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2]\,[n(\sum y^2) - (\sum y)^2]}}$$

The value of correlation coefficient ranges between -1 and +1. A value of -1 refers to perfect negative correlation while a value of +1 refers to perfect positive correlation. If the value is 0, it implies no relationship.

3.7 Measurement of Spatial Autocorrelation

One of the main objectives of the study is to locate the incidence of similar and dissimilar pattern of various indices of quality of life (QOL). The composite indices of QOL were analyzed with spatial autocorrelation statistics like global Moran's I and its local equivalent, called Local Indicator of Spatial Association (LISA). These spatial statistics enable the measurement of spatial clustering and identification of spatial clusters or axes and spatial outliers in the studied data set (Goodchild, 1987). Spatial autocorrelation is very similar with correlation. However, the difference between them is "whereas correlation shows relationships between or among variables, spatial autocorrelation shows the correlation within variables across georeferenced space" (Getis, 2008: 298). The statistic is based on Tobler's first law of geography which says that "everything is related to everything else, but near things are more related than distant things" (Tobler, 1979: 236).

3.7.1 Global Moran's I

Developed by P. Moran in 1948, Global Moran's I spatial autocorrelation identify clusters of variables with similar spatial patterns. Moran's I is a test for spatial randomness; rejection of the null hypothesis implies with a certain degree of certainty that spatial autocorrelation exists. Moran's I has an expected value of – [1/ (n-1)], that is, the value that would be obtained if there was no spatial pattern to the data. If the value I exceed s –[1/ (n-1)], it indicates positive spatial autocorrelation while if the value of I is less than the expected value, it indicates negative spatial autocorrelation.

Like Pearson's correlation coefficient, values of Moran's I range from +1 indicating a strong positive spatial autocorrelation (high values tend to be located near one another and low values tend to be located near one another) to –1 meaning a strong negative spatial autocorrelation, wherein 0 indicates a random pattern or absence of spatial pattern. However, it may be noted that Moran's I differs from Pearson's product moment correlation in the sense that space is included by means of a *W* matrix and instead of finding the correlation between two variables, the goal is to find the correlation of one variable with itself vis-à-vis a spatial weights matrix (Getis, 2010).

The Moran's I statistic for spatial autocorrelation is given as:

$$I = \frac{N \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \, (x_i - \bar{x}) \left(x_j - \bar{x}\right)}{\left(\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}\right) \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

whereas N is the number of observations (points or polygons), $\bar{\boldsymbol{x}}$ is the mean of the variable, X_i is the variable value at a particular location, $\boldsymbol{X_j}$ is the variable value at another location and w_{ij} is a weight indexing location of i relative to j. If the variables are transformed into Z-scores $Z = \frac{X - \bar{X}}{\sigma}$ where $\bar{X}$ and σ are mean of variable X and its standard deviation respectively, Moran's I may be given as

$$I = \frac{n \sum_i \sum_j w_{ij} \, z_i z_j}{(n-1) \sum_i \sum_j w_{ij}}$$

The spatial weight matrix defines the structure of spatial relationships in the study region. It delimits the extent of clustering that the clustering technique is able to detect. The choice of *W*, therefore, should be considered carefully in clustering analysis. (Aldstadt, 2010:281).

There are several groups of commonly applied methods such as contiguity, inverse distance, *k*-nearest neighbours and distance band methods. The simplest and one of the most commonly used set of spatial weights is the binary contiguity matrix. Here, W_{ij} is equal to one if units *i* and *j* share a common boundary and zero otherwise. Contiguity can be defined as 'linear contiguity' when regions which share a border with the region of interest are immediately on its left or right, 'rook contiguity' when regions share a common side with the region of interest, 'bishop contiguity' when regions share a vertex with the region of interest, and 'queen contiguity' when regions share a common side or a vertex with the region of interest (LeSage, 1999).

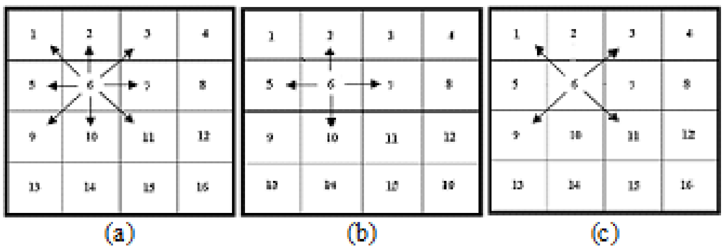

Figure 3.3 Spatial contiguity weights. (a) Queen (b) Rook (c) Bishop

The spatial weight matrix employed in the present study is a simple binary contiguity W matrix based on the concept of Queen contiguity in GeoDa software. Queen contiguity is given as polygon contiguity (first order) in ArcGIS. If a district *i* shares a border or a vertex with another district *j*, they are considered as neighbours, and W_{ij} takes the value 1 and 0 otherwise. This matrix is also zero along its diagonal implying that a district cannot be a neighbour to itself.

The weights matrix used in cluster analysis is standardized so that the elements of each row sum to one (row standardization). This procedure serves to equalize the weight given each observation in the analysis with respect to its number of neighbors. The elements of this standardized matrix are calculated as

$$w_{ij}^{s} = \frac{w_{ij}}{\sum_j w_{ij}}$$

Another important component of spatial autocorrelation is visualization of spatial autocorrelation by means of a Moran Scatter plot (Anselin, 1995; 1996). This is a specialized scatter plot with the spatially lagged transformation of a variable on the y-axis and the original variable on the x-axis. A spatial lag of a variable is defined as a weighted average of observations on the variable over neighbouring units (Drukker *et al*., 2013). For example, a locality with three neighbouring tracts that had a value of 2, 4 and 6 would have a spatial lag of 4; that is (2+4+6/3=4). A row-standardized spatial weight matrix is used in the construction of the spatial lag and simply represents the average rate of each neighbouring tract. Thus, the spatial lag is the spatially weighted average of the values at neighbouring units, and is calculated as

$$lag_i = \frac{\sum_{j=1}^{n} w_{ij} x_j}{\sum_{j=1}^{n} w_{ij}}$$

The Moran I scatter plot (Figure 3.4 below) places the unit values (x_i) on the horizontal axis and the spatial lag (lag_i) for the same variable on the vertical axis. The axes of the plot are drawn so that they cross at the average value of x_i and lag_i, respectively. The four quadrants of the plot separate the spatial association into four components. Units that fall into the quadrants labelled High-High (HH) and Low-Low (LL) represent clustering of high and low values respectively. The remaining two quadrants High-Low (HL) and Low-High (LH) indicate spatial randomness. Units that fall into these quadrants have negative association with their neighbours and can be considered as spatial outliers. A spatial outlier may arise from a cluster consisting of just one unit. The Moran scatter plot is a useful visualization tool for assessing spatial pattern and spatial clustering.

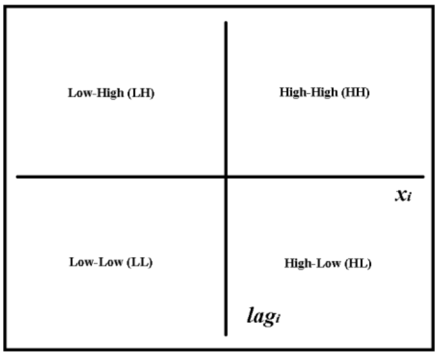

Figure 3.4 Moran Scatter plot

Moran's I is not only a descriptive statistic but also an inferential statistic and the result of the analysis have to be interpreted within the context of null hypothesis. In other words, statistical inference analysis is required to statistically confirm Moran's I value against the null hypothesis of spatial randomness.

The null hypothesis (H_0) and the alternative hypothesis (H_1) may be stated as

H_0: $I = 0$ or H_0: spatial randomness

H_1: $I \neq 0$ or H_1: spatial dependence (clustering or dispersion)

The null hypothesis can be accepted or rejected by comparing the nominal significance level α with the pseudo *p*-value. Since the *p*-value depends on the number of permutations, it is often called pseudo *p*-value. The null hypothesis (H_0) is rejected when the pseudo p-value is less than the specified significance level (α) which is normally 0.05.

3.7.2 Local Indicators of Spatial Association (LISA)

While global Moran's I quantifies the spatial autocorrelation as a whole, the local indicators of spatial association (LISA) measures the degree of spatial autocorrelation at each specific location (Anselin, 1995) by using local Moran's I. It is a measure to identify patterns of spatial clustering and spatial outliers (Harries, 2006) and the formula is given by Levine (2004) as

$$I_i = \frac{z_i - \bar{z}}{\sigma^2} \sum_{j=1, j\neq 1}^{n} \left[W_{ij}\left(z_j - \bar{z}\right)\right]$$

where $\bar{z}$ is the mean value of z with the sample number of n, z_i is the value of the variable at location i; z_j is the value at other locations (where $j \neq$ i); σ^2 is the variance of z; and W_{ij} is a distance weighting between z_i and z_j.

3.8 Choropleth Map

Choropleth or choroplethic maps are planimetric representations of volumetric statistical distributions, and are normally symbolized by patterns which divide the area into sub-regions (Jenks and Coulson, 1963). A number of choropleth maps were prepared and used as an important analytical tool.

A widely discussed and debatable issue in preparation of choropleth map is determination of class interval which is an intrinsic component of choropleth map. Selection of appropriate class interval method helps in more accurate generalization and effectiveness of the map. The problem of selecting classes is, therefore, the most important phase of constructing a statistical map since in this step the map-maker controls map interpretation (Jenks and Coulson, 1963).

Different methods to determine class interval for choropleth map have been suggested. One of the most popular methods is 'equal interval' method which place boundaries between classes at regular (equal) intervals. This is the simplest and the most appropriate method for variables with a rectangular frequency distribution (Monmonier, 1972). Equal interval method does not account for data distribution, and may result in most data values falling into one or two classes, or classes with no values. Another method is 'quantile method' in which each class contains an equal number of observations or data. A quantile classification is well suited to linearly distributed data. The problem with quantile schemes is that they often place similar values in different classes or very different values in the same class. Another popular method is standard deviation method (Armstrong, 1969). In this method, data are classified into groups according to the variances from the data's mean value by subtracting or adding the calculated standard deviation from the mean of the data set. The main constraint with standard deviation method is that it works well only for data that exhibit normal (Gaussian) distribution. No method may be considered as the best method since each has its advantages and limitations.

In the present study, natural break data classification method developed by Jenks and his associates has been adopted for determining class interval. This method is known as 'Jenks Natural Breaks' method or 'Jenks Optimization method' is an algorithm used to classify features using natural breaks in data values. The method partitions statistical data into classes using an algorithm which calculates groupings of data values based on the data distribution (Jenks, 1967). The method is designed to determine the best arrangement of values into different classes by minimizing variance within groups and maximizing variance between groups. In other words, Natural-breaks schemes minimize differences between values within classes and maximize differences between values in different classes. However, manual calculation is almost impractical as there are an overwhelming number of different ways to set map ranges. As such, Jenks method is calculated using ArcGIS software that automatically figures the natural breaks. The number of classes for all the choropleth maps were specified at five since fewer classes often result in distinct patterns while more classes often result in complex patterns.

3.9 Limitations of the Study

1. Both objective and subjective indicators identified in the present study are not definitive. A number of indicators were dropped to conform to the technical specificities required by the statistical techniques employed.

2. The impartiality of the respondents is invalidated. They may provide faulty answers depending on their personal integrity, aspirations and level of knowledge.

3. The scope of the study is also limited by the impossibility of presenting temporal analysis due to unavailability of time-series data.

4. One of the limitations of factor analysis and principal component analysis is that naming the factors/components is purely subjective and can be problematic. Factor names may not accurately reflect the variables within the factor.

6. Some variables are difficult to interpret because they may load onto more than one factor which is known as split loadings. These variables may correlate with each another to produce a factor despite having little underlying meaning for the factor.

CHAPTER-IV

A GEOGRAPHICAL INTRODUCTION TO AIZAWL CITY

4.1 Introduction

Situated between 23°39'52"-23°48'43"N latitudes and 92°39'49"-92°46'39"E longitudes at the northern part of one of the smallest states of India, Aizawl is the administrative capital of the state of Mizoram. The city derived its name from a combination of two *Mizo* words, '*Ai'* meaning *Aidu* (Amomum dealbatum) and *'zawl'* meaning 'flat'. It may mean a piece of flatland where *Aidu* grows. Presently, the place from where Aizawl derives its name is located near Raj Bhavan - the official residence of the Governor of Mizoram.

Aizawl is the primate city of Mizoram. It comprises 26.89 per cent of the entire population of the state. In 2011, the population of Aizawl was 293,416 and classified as a class I city as per the Census of India classification of urban centres. The city is administered by Aizawl Municipal Council (AMC). In 2011, there were 19 Municipal wards under the AMC which altogether comprises 82 Local Councils (LCs). These Local Councils, previously known as Village Councils (VCs) are the lowest administrative units. Each Local Council is locally known as *Veng*. However, it is to be noted that the term *veng* has more meaning than a mere administrative connotation. It is related to neighbourhoods where residents are bound by unity and feelings towards each other through shared history, participation in religious congregations and/or community organizations like Young Mizo Association (YMA) within the territory of *veng*. Throughout the book, terms like *veng*, locality and neighbourhood have been used synonymously.

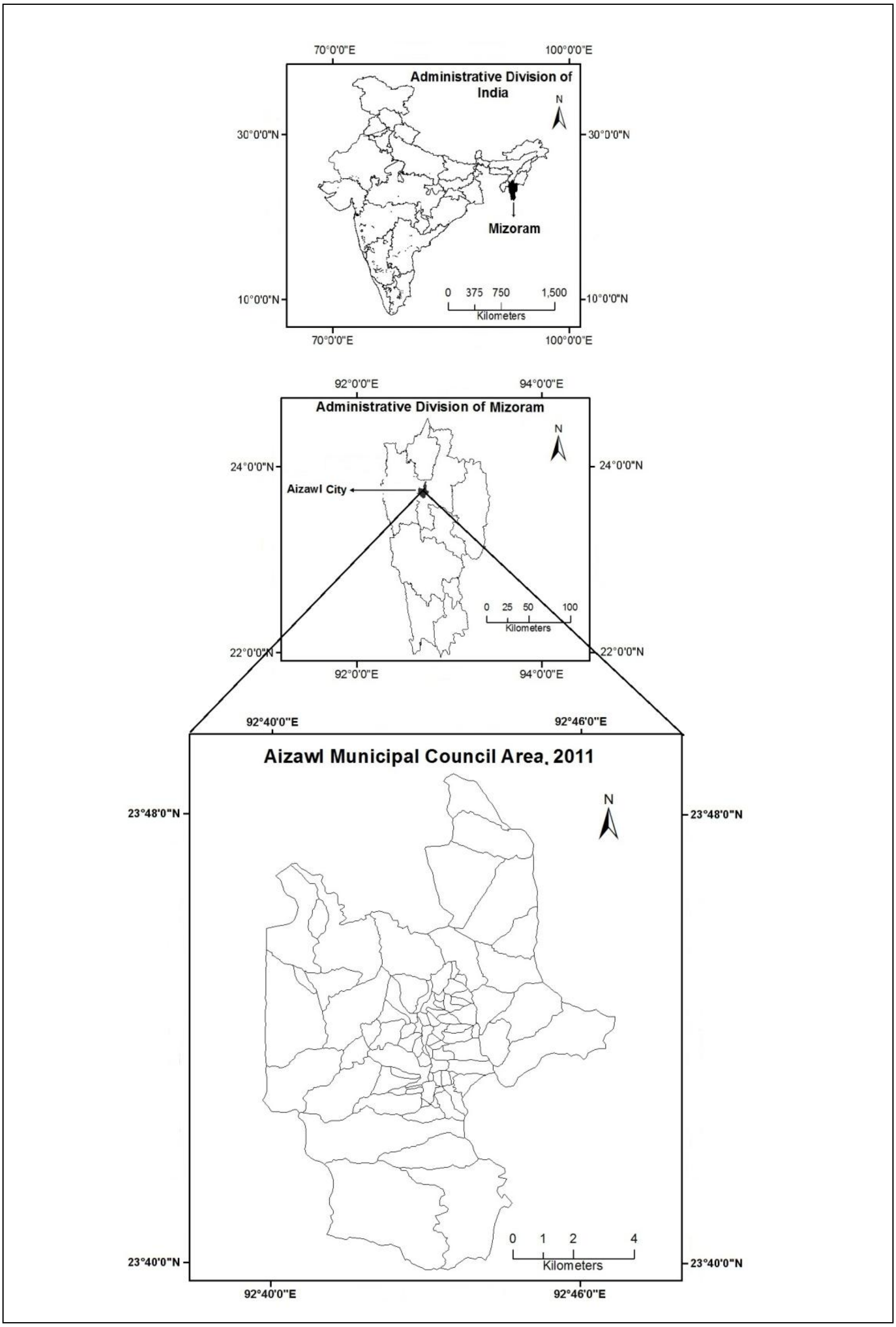

Figure 4.1 Location of Aizawl City.

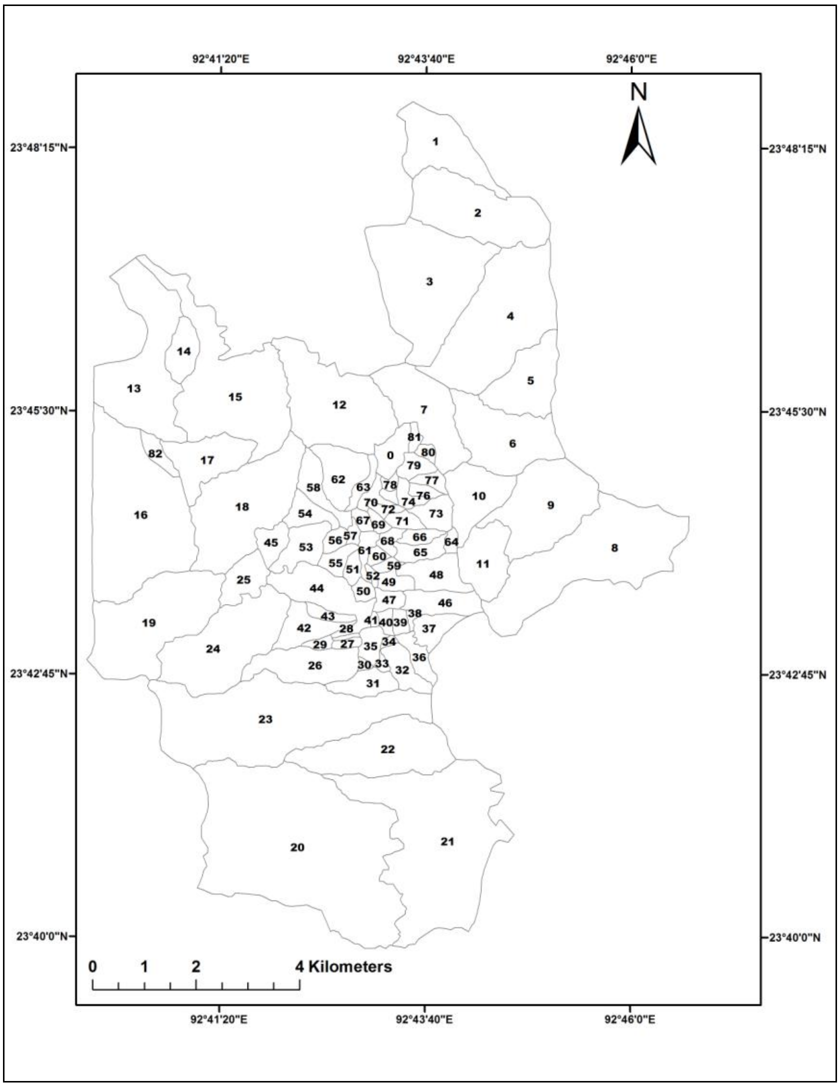

Figure 4.2 Locations of Local Councils, Aizawl City.

Code	Local Council	Code	Local Council	Code	Local Council	Code	Local Council
0	Chaltlang	21	Melthum	42	Bungkawn	63	Chite
1	Selesih	22	Saikhamakawn	43	Bungkawn Vengthar	64	Armed Veng South
2	Durtlang North	23	Tlangnuam	44	Khatla	65	Armed Veng
3	Durtlang	24	Maubawk	45	Zonuam	66	Zarkawt
4	Durtlang Leitan	25	Govt. Complex	46	College Veng	67	Chhinga Veng
5	Muanna veng	26	Mission Vengthlang	47	Venghlui	68	Electric
6	Zuangtui	27	Khatla South	48	Bethlehem Vengthlang	69	Chanmari
7	Bawngkawn	28	Khatla East	49	Bethlehem	70	Ramthar
8	Zemabawk	29	Nursery	50	Tuikual South	71	Aizawl Venglai
9	Zemabawk North	30	Model veng	51	Tuikual North	72	Ramthar North
10	Thuampui	31	Kulikawn	52	Chawnpui	73	Ramhlun South
11	Falkland	32	Venghnuai	53	Zotlang	74	Ramhlun Venglai
12	Edenthar	33	Thakthing	54	Dinthar	75	Ramhlun SC
13	Sakawrtuichhun	34	Damveng	55	Kanan	76	Ramhlun Vengthar
14	Phunchawng	35	Mission Veng	56	Dawrpui Vengthar	77	Laipuitlang
15	Rangvamual	36	Salem	57	Vaivakawn	78	Ramhlun North
16	Tanhril	37	ITI Veng	58	Tuithiang	79	Bawngkawn South
17	Chawlhhmun	38	Republic Vengthlang	59	Saron	80	Chaltlang North
18	Luangmual	39	Republic	60	Dawrpui	81	Tuivamit
19	Lawipu	40	Upper Republic	61	Hunthar		
20	Hlimen	41	Tuikhuahtlang	62	Chanmari West		

4.2 Growth of Aizawl City

'Fort Aijal' was established in 1890 as a military station by the colonial Britishers who invaded (or pacified in colonial parlance) the Mizos and subsequently occupied their homeland to prevent them from invading their neighbouring tea estates. The Aizawl outpost consists of a military barrack and a few bungalows only. The newly established outpost was fortified to accommodate around 200 military personnel only. With increasing migration from the surrounding areas, the outpost was gradually surrounded by civilian residential areas.

The population of Aizawl increased rapidly after the British occupation from 325 persons to 2890 during 1901-1911. The colonial administrators, however, perceived the Aizawl outpost as an enclave. To restraint the increasing native people around the fortified outposts, the colonial administrators imposed two methods of exclusion–restrictions on number of houses for each locality and imposition of a new kind of tax known as 'Personal Residence Surcharge' (PRS). The number of houses was fixed for each locality. The following Table 4.1 gives the number of houses permitted in each locality amounting to a total 722 houses within the settlement. Thakthing veng which is presently a small locality was permitted the highest number of houses while Maubawk was permitted only 20 houses. Although there were a few government quarters at Babutlang, Zarkawt, the area was not considered as residential area at the time. Apart from these localities, there were residential areas like Sriman Tilla (Present Zotlang), Dokhama veng (present Bungkawn), Survey Tilla (present Dinthar), Vaivakawn, Rangvamual, Zemabawk and Chanmari veng which consists of Hmarkaii Nu Veng and Suklala Veng at the present Chanmari West. No Mizo houses was found in the first four localities but were occupied by the immigrant Gorkhalis and, the other localities were expected to be "discontinued by natural process"

(McCall, 1950:101). As such, number of permitted house was not earmarked for these localities. By this time, the population of Aizawl was a little higher than 3000 only.

Table 4.1 Number of Houses Permitted in Various Localities of Aizawl, 1932.

Sl. No.	Name of locality	No. of Houses permitted
1	Venghlui	30
2	Tlangnuam	50
3	Thakthing	150
4	Kulikawn	50
5	Khatla	10
6	Maubawk	20
7	Mission veng	82
8	Dawrpui	30
9	Chhinga veng	25
10	Chaltlang	75
11	Luangmual	50
12	Hlimen	50
13	Durtlang	100

Source: McCall (1980:101).

The personal residence surcharge (PRS) was introduced only in Aizawl (Fort Aijal) and Lunglei (Fort Lungleh) – the headquarters of North Lushai Hills and South Lushai Hills respectively. The main objective of the system was "to control and discourage settlement around Aijal and Lungleh" (McCall, 1980:78). The colonial administrators justified the enactment of this tax by maintaining that increasing migration to these two settlements would increase reduction of forest through shifting cultivation and consequent decline of rainfall and accelerated denudation. The tax was not levied to government employees. The government also exempted the permanent staff of the Welsh Mission at Mission Veng from payment of PRS although the number of houses was fixed at 82 by mutual agreement between the two parties.

The occupation of Aijal by the British introduced not only a new kind of political and economy system, it also created a new form of residential pattern markedly different from the native settlements. Firstly, segregation was observed. The colonizers fenced their residences and barracks to separate them from the local people out of fear of death or invaliding from epidemic and other contagious diseases. Fenced residences were provided with proper drainage, ventilated housing, better sewage disposal and water supply. All these provisions were made to reduce the risk of infection from native diseases like malaria and other contagious diseases. It is argued that fear of catching native diseases provided a pretext for segregation in colonial cities (Home, 2013).

The case of the missionaries was different. For the missionaries, it was unthinkable to segregate themselves from the local people whom they have to befriend and proselytize. However, they maintained strict regulation on Mission Veng which they set up as their headquarters after buying from the chief of Tlangnuam. They maintained that houses should be kept apart by 75 foot distance and every household should have toilet and domestication of animal was not allowed. The intention of the missionaries was to keep their backyard clean and to prevent native diseases from spreading. Mission veng may be considered as the only locality which was established with at least minimal efforts on planning.

The post-independence era has witnessed unprecedented growth of Aizawl population. During 1951-1991, the decadal growth rates of Aizawl had continuously exceeded 3 digits which may be unparalleled in the history of urban growth. A number of factors may be attributed to the high growth rates witnessed during this period. Firstly, with the Independence of India in 1945, the strict migration control policy imposed by the Colonial Raj came to an end. This resulted in uncontrolled migration to Aizawl from various corners of Mizoram due to various socio-economic push-pull factors.

Table 4.2 Growth of Population, Aizawl City, 1901-2011.

Census year	Population	Inter-censal year	Decadal Growth Rate (%)	Average Annual Exponential Growth Rate
1901	325	-	-	-
1911	2890	1901-1911	789.23	21.85
1921	3034	1911-1921	4.98	0.48
1931	3250	1921-1931	7.12	0.68
1941	4780	1931-1941	47.07	3.85
1951	6950	1941-1951	45.39	3.74
1961	14,275	1951-1961	105.40	7.19
1971	31,740	1961-1971	122.35	7.99
1981	74,493	1971-1981	134.69	8.53
1991	1,55,240	1981-1991	108.39	7.34
2001	2,28,280	1991-2001	47.05	3.85
2011	2,93,416	2001-2011	28.56	2.51

Source: District Census Handbook, Aizawl District, 1961-2011, Directorate of Census Operation, Mizoram.

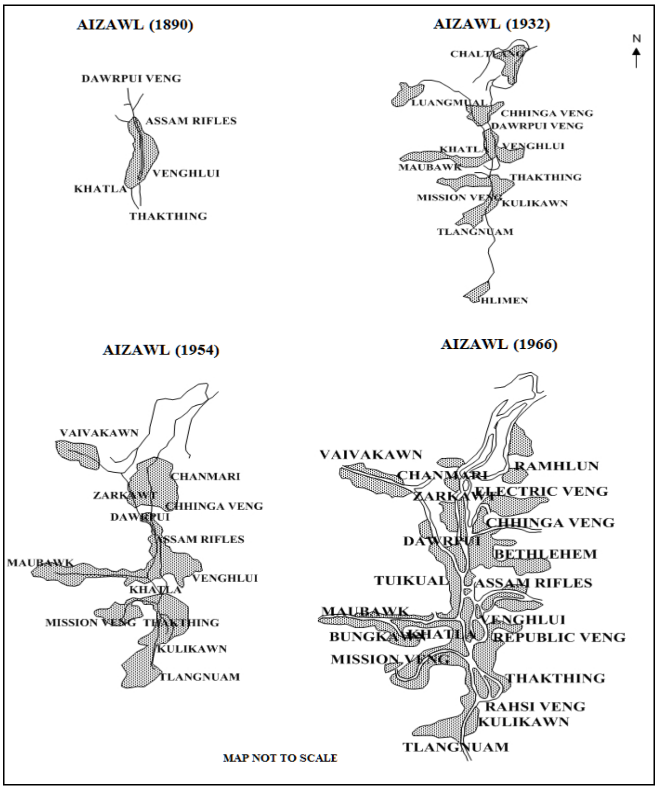

Figure 4.3 Growth of Aizawl City (Source: Town and Country Planning Wing (2002), Government of Mizoram).

Secondly, a state-wide insurgency happened between 1966 and 1986. During the 20 years of insurgency, Aizawl received a large number of ‘war refugees’. This resulted in large-scale migration to the relatively safer Aizawl town out of fear of violence, better economic opportunities and quality of life in the growing city. Thirdly, the upgradation of Mizo Hills District Council into Union Territory in 1972 was highly significant in the process of urbanization. With the attainment of Union Territory, the power and functions of the local government increased manifold which resulted in large-scale opening of government jobs and concomitant increase in employment opportunities in other sectors. The growth of population during 1961-1981 was spectacular. The decadal growth rates were 122.35 per cent and 134.70 per cent during 1961-1971 and 1971-1981 respectively. Apart from these, outlying villages were subsequently incorporated within the city proper. In 1982, the number of localities was only 26 and it has increased to 82 in 2011.

Interestingly, a reversal of population growth rate has happened after the 1980s. During 1981-1991, the decadal growth rate was reduced to 108.39 from 134.69 in the preceding decade. After the 1990s, the growth rate has declined abruptly to 47.05 during 1991-2001. The growth rate went down further to 28.56 during 2001-2011. It seems that the pull factors of the city has been waning with increasing population as a result of decreasing employment opportunities in the post-statehood era, deterioration of physical infrastructures etc that diseconomies of scale started to operate. Moreover, the official declaration of 4 bigger settlements as ‘notified towns’ in 1981and another 16 settlements in 1991 as well as the creation of 5 new districts in 1998 may also contributed in reduction of inflow of internal migrants from other places.

(a) A View of Northern Part of Aizawl City from Pi Hangi Lunglentlang, Durtlang Leitan.

(b) A View of Western Part of Aizawl City from Babutlang, Zarkawt.

Plate 4.1 Picturesque Landscapes of Aizawl City from Vantage Points.

The rapid urbanization in the post-Independence era has led to the proliferation of housing units at less favourable sites like pre-uninhabited low lying or very steep sloping surfaces as well as at more favourable sites in the peripheral areas of the city. Peripheral settlements were gradually incorporated into the city while existing localities were divided into multiple localities as less favourable sites in these existing localities were occupied. Moreover, multi-storey buildings started to dominate the skyline of the inner city to accommodate the increasing population.

4.3 Physical Environment of Aizawl City

Residential pattern and quality of life of a particular place are largely determined by the nature and characteristics of the physical environment. Certain locations are avoided for human settlements although poorer people are usually compelled to stay at these unfavourable locations. In this way, physical environment also have significant impacts upon the well-being and quality of life of the residents.

Being the southernmost part of the Patkai Hills of the Eastern Himalaya, Mizoram or in geographical term, the 'Lushai Hills' comprises of many hills. The crests of these hills have been the abode of the early Mizo settlers the reasons of which may be a number of factors mainly due to health and defensive reasons. Pachuau (2010) has maintained that the configuration of land surface, climate, water availability and proximity to arable are important factors determining location of settlements in Mizoram. He classified settlements in Mizoram into four types on the basis of location viz. settlement on the hilltops and hill-slope, settlement along the watershed, settlement along the main road and settlement along the river. He also mentioned that about 50 per cent of the total settlements in Mizoram are situated on hilltop and hill-slopes. Aizawl city is also a hilltop settlement, resting on the crest of a north-south trending hill which is surrounded by a number of hillocks.

4.3.1 Altitude and Slope

Two relief maps have been prepared to show the spatial variations of altitude and slope of the entire city. The raw data for these maps were obtained from the Linear Imaging Self-Scanner (LISS-III) images of Indian Remote Sensing (IRS) satellites and the process of 'Digital Elevation Model' (DEM) was carried out to obtain these maps with the help of ArcGIS software.

As shown in Figure 4.4 below, the entire city of Aizawl is classified into 5 altitudinal areas viz. very high, high, medium, low and very low altitudinal areas by applying equal interval method of classification. The highest class with above 1200 meters occupies an area of 2.26 per cent of the total geographical area of 97 km^2. On the other hand, an area of 0.39 km^2 that constitute 0.41 per cent of the total area is classified under the lowest group (below 300 m). Half of the city's geographical area lies within the height of 600 to 900 meters and is classified as medium altitudinal range as shown in Table 4.4 below.

Table 4.3 Classification of Altitude and Slope, Aizawl City.

Category	Altitude		Category	Slope	
	Area (in km^2)	Percentage		Area (in km^2)	Percentage
Very High	2.19	2.26	Very Steep	3.40	3.51
High	29.93	30.86	Steep	16.66	17.20
Medium	48.65	50.16	Moderate	37.54	38.70
Low	15.83	16.32	Gradual	30.88	31.80
Very Low	0.39	0.41	Gentle	8.52	8.78
Total	97.00	100		97.00	100.00

Source: Computed from LISS-III, IRS-1C, 2008.

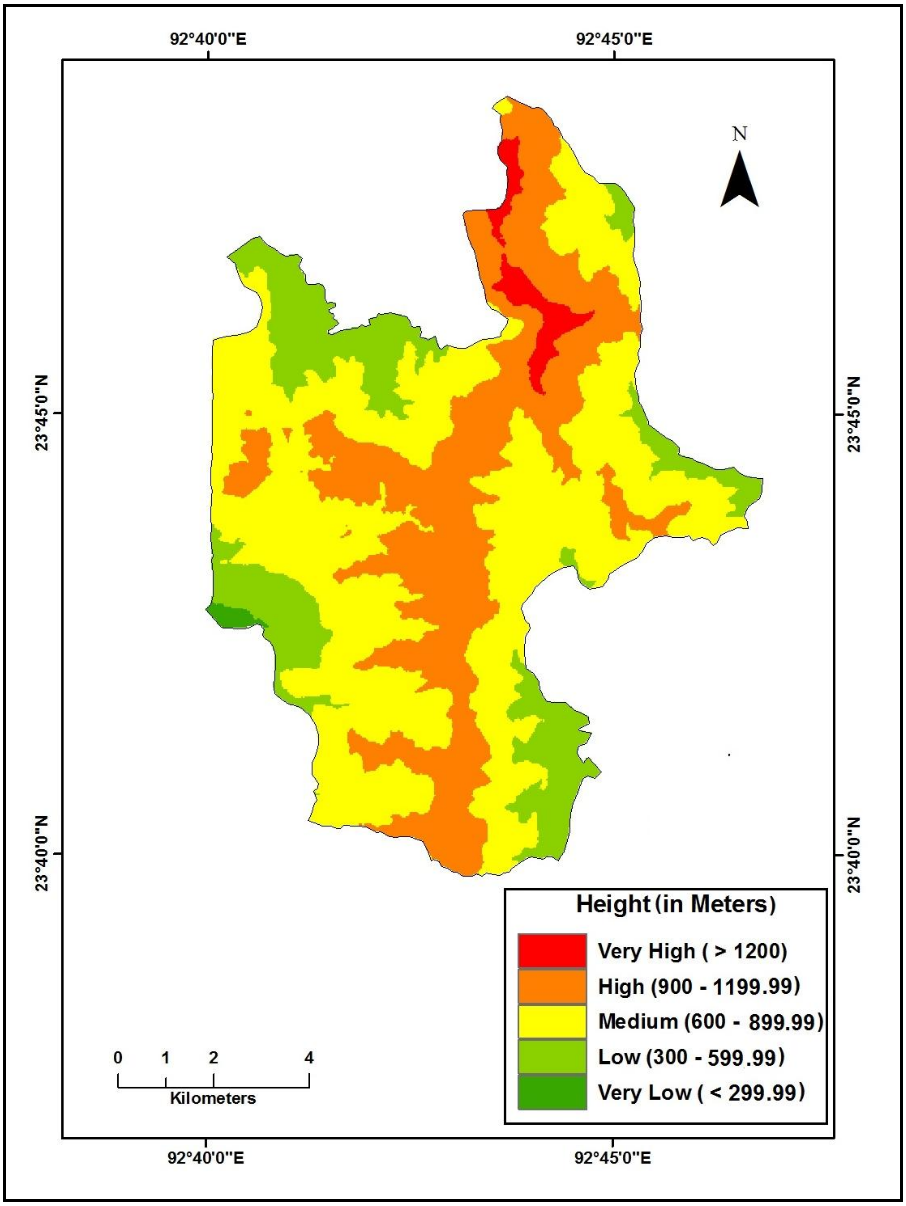

Figure 4.4 Altitude Map of Aizawl City.

The spatial distribution of altitudinal classes shows an interesting pattern. From Figure 4.4, it may be observed that an elongated ridge cuts across the entire city into western and eastern parts. This is the main ridge on the crest of which the most important road in the city is running through. Some ridges extend from the main ridge in the western and eastern directions. Low altitudinal places (below 600 m) are normally found at the peripheries. The highest points are found at the most northern part of the city. Although the city's landscape is distinctly defined by the elongated

Aizawl Tlang (Hill) from which the city takes its name, the city may be described as 'City of Hillocks' as it comprises a number of small hills. Some of the more important hillocks and their altitude are given in Table 4.4 below.

Table 4.4 Hillocks and their Altitudes, Aizawl City.

Sl. No.	Hillocks	Altitude (metres)
1	Durtlang	1362
2	Lapuitlang	1160
3	Chaltlang	1143
4	Beraw Tlang	1042
5	Seventhday Tlang	1026
6	Zotlang	985
7	Luangmual	1063
8	Tuikhuahtlang	1125
9	Tlangnuam	1112
10	Thakthing	1068
11	Hlimen	1165

Source: Computed from LISS-III, IRS-1C, 2008.

Slope is another important aspect of relief. The city is divided again into five zones on the basis of degree of slope viz. very steep slope with more than 40°, steep slope (30-39.9°), moderate slope (20-29.9°), gradual slope (10-19.9°) and gentle slope (>9.9°) as shown in Figure 4.5. Very steep and steep sloping surfaces constitute 20.71 per cent of the total area while 40.58 per cent comes under less than 20° slope.

Many parts of the city are steeply sloping surfaces and they look like uninhabitable areas. In the past, steep hill-slopes and low lying areas are usually avoided. However, due to population pressure, even the most steeply sloping surfaces have been utilized for construction of residential buildings. Landslides frequently occur on these steeply sloped terrains during rainy season when excessive Monsoon rain falls on the relatively young and immature geology of the Mizo Hills.

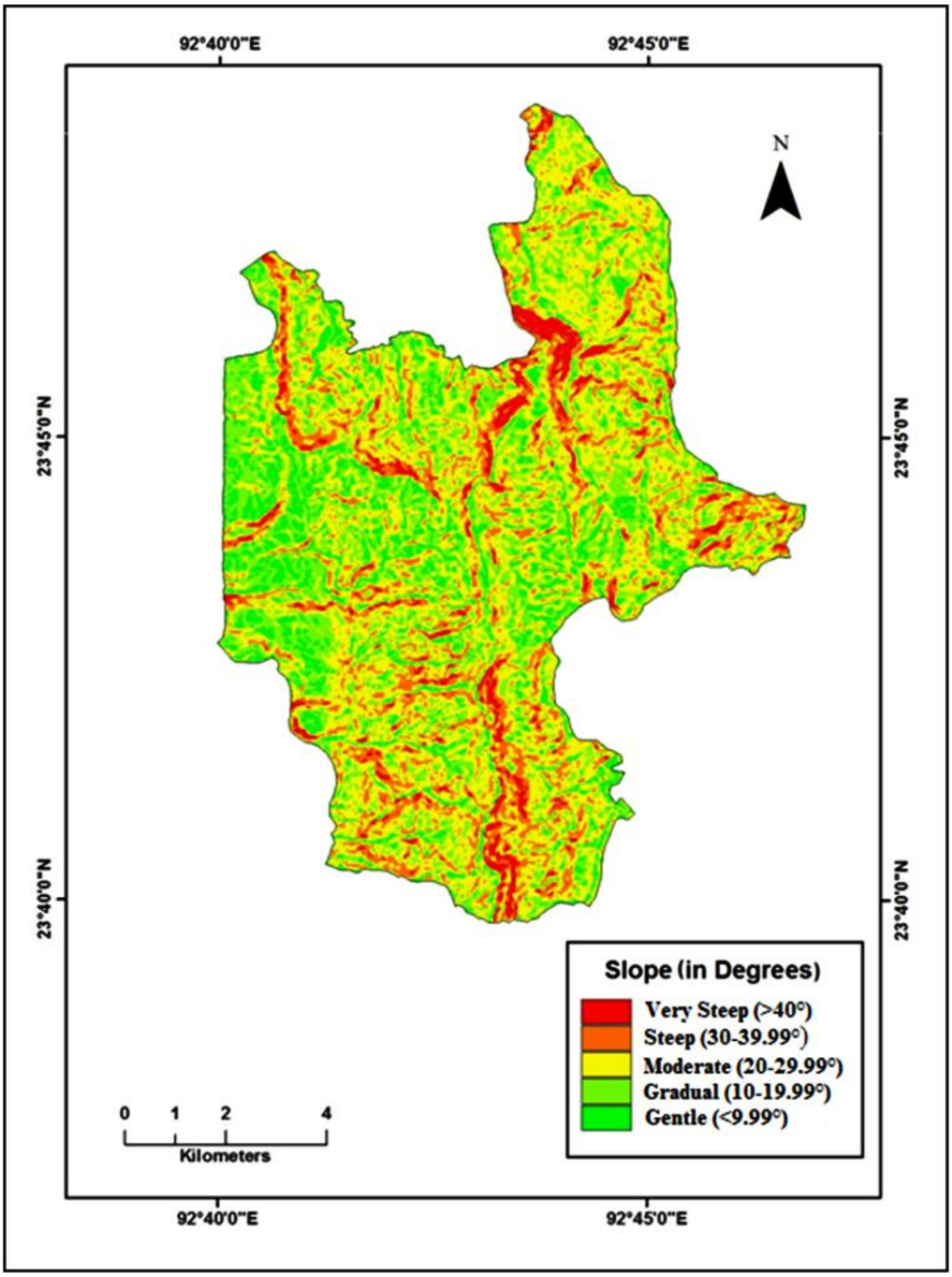

Figure 4.5 Slope Map of Aizawl City.

Slumping or sinking of land is another geological hazard that frequently occurs during Monsoon in some parts of the city. Tectonically, the region is a product of prolonged subduction of the Indian plate into the Asian plate. As a result, the geology is unstable and the region is one of the most earthquake-prone regions of the country.

4.3.2 Climate

In spite of its tropical location, Aizawl city enjoys a pleasant and moderate temperature throughout the year due to its altitude and forest. The climate is considered to be Cwa according to the Köppen-Geiger climate classification. The maximum and minimum temperature of Aizawl ranges between 26.3°C in April and 11.4°C in January during 1937 and 1992. Local climatic condition does not differ much in comparison to other attributes of physical environment. In the absence of secondary data and the difficulty to ascertain micro-climatic differences at small area, no attempt was made to analyse spatial variation in climatic condition. However, it has been observed that valleys and low-altitudinal places are relatively warmer and more humid in comparison to hilltops. They were considered less healthy due to occurrence of malaria and other diseases. The widespread availability of medicines has allowed man to overcome limitations imposed by nature and people started to inhabit these places.

Table 4.5 Mean Monthly Temperature and Rainfall, Aizawl City, 1937-1992.

Month	Mean Temperature (°C)		Mean Rainfall (mm)
	Maximum	Minimum	
January	20.4	11.4	13.4
February	21.7	12.8	23.4
March	25.2	15.6	73.4
April	26.8	17.5	167.7
May	26.3	18.1	289.0
June	25.5	18.9	406.1
July	25.3	19.1	320.4
August	25.5	19.1	320.6
September	25.7	19.2	305.2
October	24.7	18	183.7
November	23	15.1	43.2
December	21	12.2	15.3

Source: India Meteorological Department (www.imd.gov.in/doc/climateimp.pdf).

Seasonal distribution of rainfall affects the quality of life and environment in a number of ways. Mizoram receives heavy excessive rainfall during Monsoon season that lasts for 6 months while very little rainfall has been received during the remaining 6 months. The average annual rainfall in the city is 2350.9 mm. out of which 60-70 per cent falls during the Monsoon period. The marked seasonal variation in rainfall distribution has heavily affected the domestic water supply. For domestic use, the city is almost wholly depending upon Tlawng River which is the longest river system in the State that runs along the western side of the city. Normally, the volume of the river heavily declines during the last months of dry season. A number of city dwellers are forced to buy water from private sellers while many low income households have to depend on public water springs. The public-owned springs are not found in every locality but mainly available in the lower reaches of the hill-slopes. In any case, people have to wait for a long time to fill up their buckets during extreme dry months.

4.4 Land-use and Land Ownership

Cities are built on land and the nature of land on which the city is founded may determine the layout of the city. They layout of a plain city may be different from the layout of a hill city due to difference in the nature of land. Moreover, the location and characteristics of land influence the value of the land which in turn affects residential choice. Hilltops are more preferred and more valued than hill-slopes and valley floors. The values of hill-slopes may also vary depending upon the degree of slopes.

Land is a highly valued and scarce resource in Aizawl city mainly due to availability of a few good and suitable lands for housing. Land use is directly related to land value. A particular land use may increase or decrease the value of the land. It also affects the quality of the natural environment, with impacts on air quality, water quality, water supply, the costs of natural hazards such as flooding and earthquakes, the probabilities of hazards including flooding, and the functioning of terrestrial and aquatic ecosystems. Land-use decision affects the well-being of individuals.

Geographical attributes like location, slope and altitude are important determinants of urban land-use and land-cover. Again, LISS-III images from Indian Remote Satellite (IRS) have been used to obtain raster data of land-use/land-cover. These raw data were processed through supervised classification in Erdas Imagine software to classify the data into various types of land-use/land-cover.

Forest covers as large as 68.52 per cent of the total geographical areas of the city. The physical environment including climate and topography is highly suitable for natural vegetation. High proportion of forest cover may be attributed to the topography of the city and the gradual incorporation of peripheral localities within the ambit of municipal area. Very steep sloping areas with rocky surfaces are not suitable for housing and are normally come under scrub or open forest depending on the utilization of the land.

Table 4.6 Distribution of Various Land-use/Land Cover in Aizawl City.

	Area covered (km^2)	Percentage
Dense Forest	27.22	28.06
Open Forest	39.25	40.46
Cropping Area	6.15	6.34
Scrub	10.69	11.03
Settlement	12.38	12.76
Others	1.31	1.35
Total	97	100

Source: Computed from LISS-III, IRS-1C, 2008.

Dense forests are found at the low-lying, unpopulated peripheral areas. In hilly-tropical areas, the undergrowths of forests are thickly covered by plants and shrubs which provide an ideal home for poisonous insects and malarial parasites. As a result, the importance of green spaces like natural parks and forested areas has been undermined by many people. However, with increasing awareness on the importance of forest for conservation and maintenance of biodiversity, regulations of micro-climate and water flows, a lot of preservation of forest and reforestation works has been taken out by local people as exemplified in the case of dense forest in Pachunga university college area.

Built-up area concentrated along the main ridge of the city which is the also the most densely populated part of the city. Generally, built-up areas coincide with the crest of the hills and the hill-slopes. Roadways are usually constructed at the crest of the hills in which settlements are usually set up. New settlements may come up after construction of roadways.

Built-up area may be differentiated into a number of land-use including residential land-use, commercial land-use, industrial land-use, institutional land-use, recreational land-use, transportation land-use etc. Identification and differentiation of commercial land-use and residential land-use is rather difficult because shops and markets are usually found together with residential dwellings at the same building. The geographical areas covered by industrial and recreational land-uses are almost negligible. Therefore, no attempt has been made to sub-divide built-up areas.

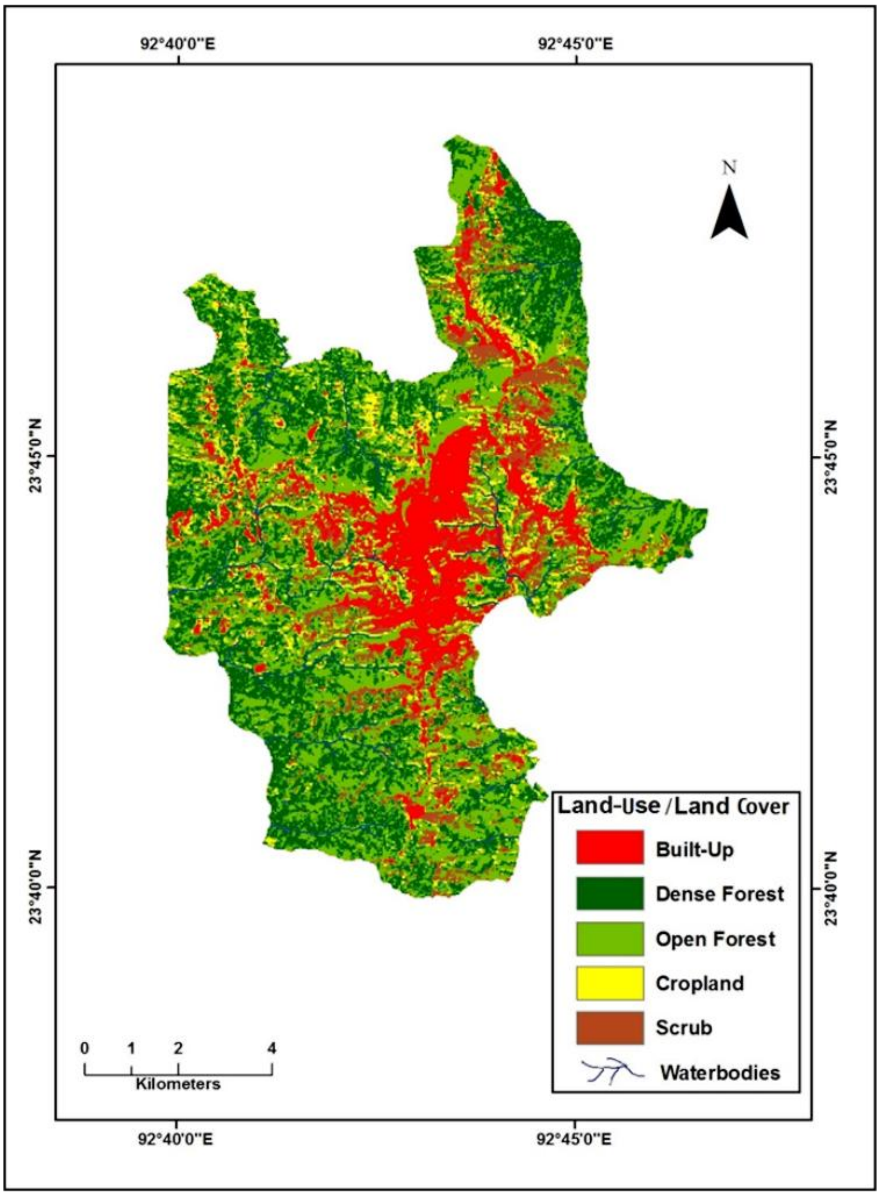

Figure 4.6 Land-use/Land Cover Map of Aizawl City.

Land ownership is another important factor influencing urban residential pattern and quality of life. In a traditional Mizo context, land belonged to the Chief while the commoners have free access to every pocket of land except the Jhum field allotted to a particular household for a particular year (Saitluanga, 2014:281). Within a village, the Chief's house usually sited at the most accessible, good view-point, usually flat hilltop which was surrounded by the houses of the chief's councilors. The common people were allotted the hill-slopes and less favourable sites. In bigger villages, there were a number of localities or *veng* which were differentiated on basis of clan. The poorer households were usually found at the peripheries.

The disruption of the traditional culture of the Mizo society after the British occupancy including the abolition of chieftainship and the introduction of monetized economy has led to the opening of land to the market. After Independence, Village councils were constituted in every village as elected representatives to administer the villages on behalf of the government. The village council has the right to allocate land for residential purposes. The government issued Land Settlement Certificate (LSC) to those who obtained village council pass for holding the land. In this way, land becomes a freely saleable commodity.

With increasing urbanization, land becomes a scarce resource and a highly valued immoveable property. The value of land has been sky-rocketing in bigger towns. The poorer section of the population could not afford to buy a parcel of land in the more accessible locations. Here, there is a continuity of the past traditional residential pattern. The richer section occupies the central areas and the poorer section moves to the peripheries. The richer people utilize their advantageous position and locational advantage by obtaining and accumulating land and also inventing in their owned land by constructing multi-storey buildings for renting to accommodate the flourishing commercial activities and increasing population. This kind of process may be described as the starting point of capitalism or in Marxian terminology, a process of ‘primitive accumulation’ which is the process of accumulation that logically has to precede capitalist accumulation (Marx, 1967).

4.5 Transportation Network

Transportation networks shape patterns of urban growth. Good and efficient transport network is a pre-requisite for urban development and enhancement of quality of people's life. Generally, the best locations in the city are the most accessible locations. In fact, transport network is an important factor that affects land values within a city. In western cities, the 'flight to the suburbs' happened as a result of the introduction of mass transit system. In contrast to developed plain cities, suburbs failed to develop in less developed hill cities like Aizawl city due to underdeveloped transport network as a result of unfavourable topography.

Table 4.7 Important Transport Routes in Aizawl City.

Sl. No.	Name of Road	Average Width (in metre)	Length (in km.)
1	Zemabawk - Bawngkawn	7.70	2.98
2	Bawngkawn - Ramhlun	7.60	1.18
3	Bawngkawn - Chaltlang	6.20	1.20
4	Chanmari - Kulikawn (Main road)	8.12	3.50
5	Chanmari - Zion Street	4.45	0.90
6	Vaivakawn - Chanmari	6.20	1.06
7	Vaivakawn - Temple Square	7.30	1.34
8	Zodin Square - Sikulpuikawn via Khatla	6.90	1.02
9	Treasury square - Sikulpuikawn via Republic	6.90	1.02

Source: Town and Country Planning Wing (2002), Government of Mizoram.

Transport network in Aizawl city is highly determined by the physiography of the city. The most important route runs along the North-South direction at the crest of the main ridge of the city. This route - Bawngkawn to Kulikawn route (B-K route) connects the most important sites of economic, social and political institutions. Land value is the highest along this B-K route. Other important routes which are connected to B-K routes include Vaivakawn to Temple road which meets B-K route at Temple square, Vaivakawn to Chanmari road at Chanmari veng, College Veng to Republic road at Sikulpuikawn, Ramthar-Electric Veng-Bazar Bungkawn road at Bazar Bungkawn and Maubawk-Bungkawn-Khatla road at Khatla.

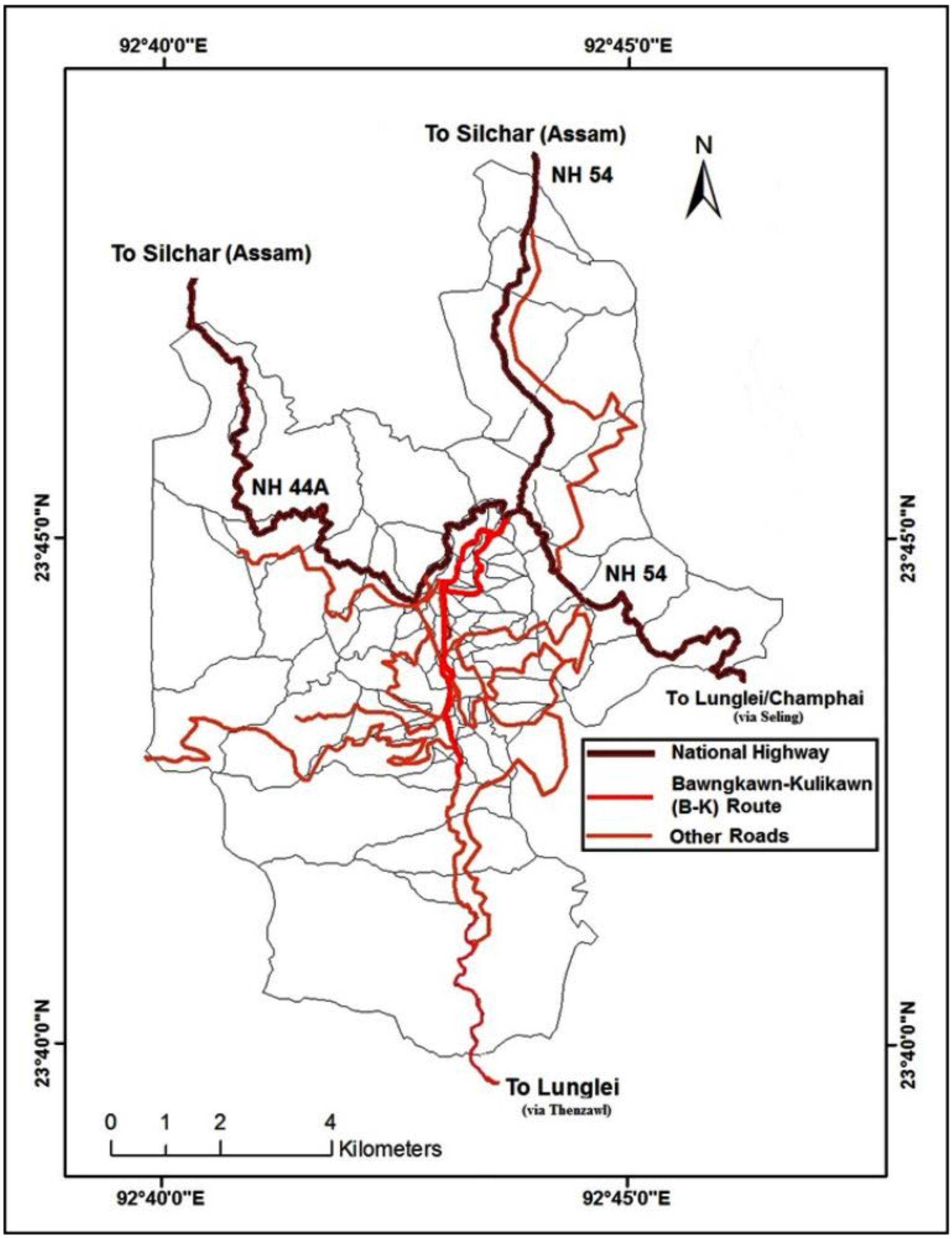

Figure 4.7 Road Map of Aizawl City

Traffic congestion is one of the most challenging problems faced by the city. Roads are usually narrow and congested. Absence of land-use planning, rampant growth of vehicles, narrow roads and maximum utilization of space along prominent transport routes have combined to create the city as one of the least inaccessible cities in the country. The quality of life of urban dwellers and the livability of the city have been adversely affected by the bad quality of roads.

The city has been witnessing expansion of residential areas along existing or new transport routes and vacant areas nearby existing neighbourhoods which were not populated earlier their unfavourable siting. With underdeveloped transport networks and problem of accessibility, proximity factor became an important factor determining residential choice. Therefore, unfavourable sites nearby markets and high status residential areas are gradually inhabited. These sites could be obtained at a very reasonable price. It seems that, under factors of different constraints, an individual's residential choice is more determined by the price of land as well as distance to markets and well-established localities.

4.6 Economic and Social Environment

Cities are the focal points of regional growth and development. The immature process of development in the state has been lopsided and highly imbalanced in favour of Aizawl city. It has been argued that the increasing accumulation of resources by the city due to sustained favouritism has been creating discontentment among the lower towns thereby producing serious repercussions in the political economy of the state (Saitluanga, 2010).

Change in the occupational structure is considered as one of the most reliable measures of development. From Table 4.8, the urbanization effect may be observed as the percentage shares of both cultivator and agricultural labour have been declining consistently during 1981-2011. On the other hand, the proportion of 'other workers' comprising of workers engaged in trade and commerce, government jobs, teaching, transport, factory, plantation and mining and construction etc has been increasing from 80.97 per cent to 91.79 per cent during the same period.

Table 4.8 Sectoral Distribution of Workers, Aizawl City, 1981-2011.

Year	Main workers to total population (%)	Cultivator to total workers (%)	Agricul-tural labourer (%)	Household industry worker (%)	Other workers (%)	WPR (main + marginal)	Female WPR (main + marginal)
1981	32.03	9.52	6.20	3.29	80.97	32.91	18.47
1991	36.94	9.02	4.26	1.02	83.57	45.40	37.57
2001	33.77	3.57	2.16	1.89	92.53	44.15	38.46
2011	34.80	2.96	2.20	1.83	91.79	40.78	31.37

Source: District Census Handbook, Aizawl District, 1961-2011, Directorate of Census Operation, Mizoram.

The above data clearly reflects the economy of the city as well as the regional economy that has been witnessing the decline of traditional economy and the rise of market economy. In the absence of large-scale manufacturing industries, the overwhelming share of 'other workers' may also reflect the status of the city as the main administrative, commercial and educational centre.

It may be seen that work participation rate (WPR) has increased tremendously from 32.91 per cent to 45.40 per cent during 1981-1991 but has also declined rapidly to 40.78 per cent in 2001-2011. Female work participation rate has shown a positive trend until 2001 but also declined considerably during 2001-2011. The declining work participation rate after 1991 census may indicate the problem of unemployment which is one of the most acute problems in the state. The city attracts many unemployed youths from various corners of the state. Many of them are educated people who seek blue collar jobs while there are also skilled and semi-skilled job seekers who want to live out of unproductive 'Shifting or Jhum cultivation' and hope to earn a living in petty business, construction works and low government jobs.

Large-scale rural-urban migration is one of the main reasons behind the rapid growth rate of Aizawl city. The city also attracts manual workers from its neighbouring states. These non-local inter-state migrants are mainly employed in informal and service sectors as porters, construction workers, barbers etc. Without industrialization, the city failed to provide employment opportunities to job seekers.

It seems that the absence of large-scale industrialization, however, helps in the process of social homogenization in terms of racial and ethnic distribution. Inter-state migrants are few and the city's population is dominated by the local Mizo tribe. A number of tribes belonging to Mizo-Kuki-Chin group from outside Mizoram are also settled. These people have their own dialect but they also speak the local Lusei dialect and by and large, socio-spatially assimilated into the Mizo mainstream. Besides, many of them are not permanently settled but short-term migrants due to employment and other reasons.

The ethnic homogeneity has been maintained due to internal and external forces that keep the entire state isolated from the rest of the country. The remoteness of the state in terms of location and distance, low level of industrialization and the failure of the state to integrate in the globalizing world could be considered as the main reasons behind the economic isolation and ethnic homogeneity. An important explanation may be the presence of legislative provisions like 'Inner Line Regulation' and those land laws that barred non-local people to obtain or purchase land within the

State. Thus, while most of the cities throughout the world are tending towards heterogeneity, Aizawl has shown the opposite by increasing the proportion of the tribal population who are mostly local people. From Table 4.9, it may be seen that the proportions of Scheduled Tribe population (ST_P) has shown an increasing trend during 1981-2011 while the Scheduled Castes population (SC_P) and those who are neither Scheduled Caste nor Scheduled Tribes hereby denoted as 'General' population (Gen_P) has been decreasing during the same period.

Table 4.9 Composition of Ethnic Population, Aizawl City, 1981-2011.

Year	Scheduled Tribe Population (%)	Scheduled Caste Population (%)	General Population (%)
1981	88.68	-	11.32
1991	91.42	-	8.58
2001	91.95	0.06	7.98
2011	91.83	0.18	7.99

Source: District Census Handbook, Aizawl District, 1961-2011, Directorate of Census Operation, Mizoram.

In terms of social development measures, Aizawl city has set a high standard among its contemporary cities in India. Literacy rate is relatively high with 98.36 per cent of the total population considered literate. It has increased from 76.45 per cent in 1981. On the other hand, average size of household has been decreasing as experienced in western developed countries. During 1981-2011, the mean household size decreased from 5.91 to 4.83. Decreasing household size may imply fragmentation of households which in turn lead to increasing demand for housing. It may also imply the decline of traditional lifestyle in which large family size was equated with honour and prestige.

Table 4.10 General Socio-Economic Characteristics of Aizawl City, 1981-2011.

Year	Total Population	Household Size	Sex Ratio	Literacy Rate (%)	Female Literacy Rate (%)
1981	74,493	5.91	895	76.45	-
1991	1,55,240	5.49	926	95.41	94.6
2001	2,28,280	5.09	968	97.35	97.39
2011	2,93,416	4.83	975	98.36	98.2

Source: District Census Handbook, Aizawl District, 1961-2011, Directorate of Census Operation, Mizoram.

Gender equality is an important social characteristic of the Mizo society. Female literacy rate is almost equal to male literacy rate. Sex ratio is also considerably high with 975 females per 1000 males. The gap between female work participation rate and total work participation rate is also decreasing as shown in Table 4.10. Females are involved in almost all kinds of work except in transport and related sectors. On the other hand, they dominate trade and commercial activities. All these indicate the presence of low level of gender discrimination, if not absent at all.

Religion is an aspect of culture of paramount importance. Religions affect political systems and policies; shape environmental values; impact economic development; and, frequently, are used by politicians to create dissension and strife (Weightman, 2011). Christian population constitutes 87 per cent of the total Mizoram population in 2013. According to Crusadewatch - an international Christian Organization which has collected city-wise Christian population in India, the percentage of Christian population in Aizawl was 90 per cent in 2000. Christianity in Mizoram is divided into a number of denominations. The two major denominations are the Presbyterian Church and the Baptist Church which dominated the northern and southern parts of Mizoram respectively. Being located in the northern Mizoram, the most dominant denomination in Aizawl City is the Presbyterian Church. Non-local residents are either Hindus or Muslims while some of them are converted to Christianity.

The present condition of Aizawl city reflects the absence of planning. There was no proper physical planning except the minimal planning taken out by the Missionaries at Mission Veng. The most visible characteristics of the city including residential buildings at steep hill-slopes, narrow roads, highly condensed settlement, stepped footpaths, absence of sidewalks along major roads, absence or limited spaces between two adjacent buildings etc are good indicators of absence of planning. As a result of negligence of planning, buildings were allowed to construct at dangerous places. There are no available spaces for establishment of parks and leisure places within the city proper. The costs of construction and widening of existing roads would be very high. The future of quality of life in the city seems to be very bleak.

CHAPTER-V

RESIDENTIAL PATTERN IN AIZAWL CITY

5.1 Introduction

A city consists of a number of residential areas which are called by different names like locality, residential district, local community or neighbourhood. They are lived-spaces constituted by a collection of individual housings and characterized by a bundle of spatially based attributes associated with a cluster of residences, sometime in conjunction with other land uses (Galster, 2001). These residential areas are central to the analysis of spatial organization in cities since they function simultaneously as institutional, sociological, economic, political, and geographic entities at multiple levels (Warf, 2006). According to Harvey (1985), these residential areas provide distinctive milieus for social interaction from which individuals to a considerable degree derive their values, expectations, consumption habits, marker capacities, and states of consciousness. Thus, they are places where individuals are brought up, oriented and cultured to conform to the values and common ideas of the residents.

Residential areas or localities do not have similar characteristics everywhere across a city. They are usually different in terms of socio-economic status, household characteristics, demographic composition or ethnic/racial composition. On the basis of these dimensions of differentiation, localities are spatially arranged and the pattern produced by the spatial arrangement of these dissimilar localities within a city may be termed as residential pattern. The spatial arrangement is the result of differential occupation of urban space by different social classes and ethnic groups. Pattern is a term frequently used by geographers that imply some sort of spatial regularity (Ebdon, 1977).

Residential pattern is thus 'essentially a morphological form' (Sengupta, 1988) that results from the "development of the different areas of a city under different types of households as differentiated by the dimensions of social stratification" (Northam, 1979:287). It is not only an outcome of a social process but also a spatial process that allocate members of the various social groups-in differing proportions-to the diverse types of urban environment (Shaw, 1979).

The socio-spatial processes that operate to produce residential pattern have been explained through different approaches. In a highly deterministic fashion, the human ecological school maintained that, under free market system, residential pattern emerges due to processes of competition and differentiation among social class in the same way that plants and animals do. Neoclassical school, on the other hand, argued that residential differentiation occurs due to unequal economic power that determines residential location among different social classes. Behavioural school maintained that socio-cultural attributes like lifestyle and ethnicity have highly influenced residential choice and decision making. A strong argument has also been put forwarded by the Structuralists who maintained that socio-spatial differentiation arises through capitalist accumulation.

Residential pattern is conceptualized here in a three-dimensional space to include horizontal and vertical dimensions. Horizontal dimension of residential differentiation is far more popular than vertical differentiation. It denotes the spatial arrangement of residential areas in terms of household attributes like socio-economic characteristics, lifestyle or ethnicity along the horizontal plane. Vertical pattern of residential differentiation, on the other hand, refers to the social differentiation of households along the vertical dimension. Considering the topography of Aizawl city and its monocentricity, it is felt that increasing vertical extension of urban space has significant implications in the residential pattern of the city.

5.2 Horizontal Pattern of Residential Differentiation

An attempt is made here to find out horizontal pattern of residential differentiation in Aizawl City. Methodologically, there are two popular methods in the study of horizontal residential pattern. The first one is measures of segregation like dissimilarity index, isolation index, relative concentration index, absolute centralization index and spatial proximity index (Massey and Denton, 1988). These indices were mainly applied to study ethnic segregation.

Another popular approach to study residential pattern is social area analysis via factor analysis or urban factorial ecology. An outgrowth of social area analysis, factorial ecology developed from the application of computer assisted factor analysis to an extended or larger set of socio-economic variables including those originally selected by Shevky and Bell (1955). Factor analysis, a multivariate statistical technique is mainly employed by urban ecologists to find out pattern of urban residential differentiation. In fact, the popularity of the technique has led to the naming of study of urban residential pattern as factorial ecology. Moreover, it was found out that social area analysis via factorial ecology has close relationship with urban morphological models developed by human ecologists. According to Berry and Rees (1969), if socio-economic status were the sole factor, cities would tend to divide into sectors; if family status were dominant, the spatial order would be concentric zones; and if ethnicity were the major factor, the pattern would be one of multiple nuclei.

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To measure residential pattern, selection of indicators was taken out with utmost care in order to successfully extract factors that may be considered as the axes of social differentiation in Aizawl city. After careful consideration, 24 indicators were finally selected. The selected indicators are described in Table 5.1. It may be explained that household income was categorized in to four classes - very high income household with average monthly household income of above Rs. 100,000, high income household (Rs. 50,000-99,999), medium income household (Rs. 10,000-49,999) and low income household (less than Rs. 9999). Similarly, household rent was categorized in to four - very high household rent with average monthly rent of Rs. 8000 and above, high household rent (Rs. 5000-7999), medium household rent (Rs. 2000-4999) and low household rent (less than Rs. 1999). Rent is defined as the permitted amount for renting for owned households. The classification of household income and household rent were taken out with the help of standard deviation method of determination of class interval. The method creates classes as portions of standard deviations above and below the mean.

The selected variable indicators were standardized with the help of Z-score method to make them scale-free. The formula of Z-score method is $Z_i = \frac{X_{ij} - \overline{X_j}}{\sigma_j}$ where Z_i is the Z-score for the i^{th} unit, X_{ij} is the X variable in the i^{th} unit and j^{th} variable, $\bar{X}_j$ is the mean of j^{th} variable and σ_j is the standard deviation of the j^{th} variable.

After selection and standardization of indicators, Principal Axis Factoring (PAF), also known as Common Factor Analysis (CFA) with Varimax rotation of all factors with eigenvalues exceeding unity was used to analyze 82 x 24 data matrix to extract the factors or dimensions of residential differentiation in Aizawl City. Before factor analysis is done, correlation analysis and test statistics like Kaiser-Meyer-Olkin (KMO) and Bartlett's test sphericity were computed to assess the appropriateness of using factor analysis.

Table 5.1 Indicators of Horizontal Pattern of Residential Differentiation, Aizawl City.

Sl. No.	Code of Indicators	Description of Indicators
1	Computer	Number of computers/household.
2	VHH_Income	Percentage of very high and high income households.
3	VHH_Rent	Percentage of households under very high and high rent category.
4	Profe	Percentage of professional technicians from total population.
5	RCC	Number of reinforced cement concrete (RCC) buildings/household.
6	Edu12	Number of persons who have studied up to Class 12 and above/household.
7	L_Rent	Percentage of households under low rent category.
8	L_Income	Percentage of low income households.
9	F_Grad	Percentage of female graduate population.
10	P_1565	Percentage of population within age group 15 to 65.
11	P_014	Percentage of population within age group below 15.
12	W_1549	Percentage of female population within age group 15 to 49.
13	Cw_R	Child-Woman ratio.
14	F_Mar	Percentage of female married population.
15	HHSize	Average household size.
16	Person4	Number of households with less than 4 persons.
17	Person2	Number of households with less than 2 persons.
18	Distance	Areal distance of mid-point of locality from central business district.
19	Rented	Percentage of rented households.
20	Male_MW	Percentage of male main workers.
21	Fem_FW	Percentage of female main workers.
22	Fem_TW	Percentage of total female workers.
23	No_ST	Percentage of non-Scheduled Tribe (ST) population.
24	NonST_M	Male non-ST population in each locality/total male non-ST population in Aizawl city.

Table 5.2 Inter-correlation of Indicators of Horizontal Pattern of Residential Differentiation, Aizawl city

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24
X1	1	-.53	.73	.67	-.46	.64	.51	.67	.70	.28	-.34	-.14	.24	.05	-.02	-.28	-.23	.13	-.29	.27	.12	.21	-.05	-.21
X2		1	-.59	-.60	.47	-.51	-.58	-.59	-.44	-.42	.43	.26	-.23	-.21	.13	.52	.21	.07	.34	-.19	-.04	-.19	.19	.19
X3			1	.73	-.54	.73	.61	.66	.55	.31	-.36	-.21	.23	.08	-.03	-.29	-.29	.04	-.28	.27	.17	.36	-.01	-.36
X4				1	-.63	.72	.71	.73	.63	.46	-.52	-.36	.33	-.03	.05	-.27	-.46	-.08	-.43	.14	.16	.41	.13	-.41
X5					1	-.62	-.65	-.51	-.34	-.28	.33	.13	-.03	.02	-.11	.16	.36	.17	.15	-.04	-.14	-.40	-.15	.40
X6						1	.55	.60	.44	.26	-.37	-.16	.13	.08	.01	-.26	-.39	-.05	-.28	.14	.10	.35	-.01	-.35
X7							1	.46	.44	.41	-.43	-.23	.25	-.20	.25	-.07	-.48	-.14	-.27	.22	.08	.38	.29	-.38
X8								1	.73	.47	-.49	-.25	.33	.23	-.21	-.35	-.25	.04	-.52	.19	.07	.18	.01	-.18
X9									1	.51	-.50	-.35	.47	-.02	.01	-.23	-.32	-.05	-.56	.16	.01	.11	.03	-.11
X10										1	-.93	-.60	.64	-.24	.21	.01	-.43	-.09	-.47	.04	.06	.19	.07	-.19
X11											1	.65	-.59	.25	-.25	-.03	.48	.07	.46	-.12	-.02	-.19	-.06	.19
X12												1	-.48	.39	-.28	-.17	.45	.14	.32	-.05	.15	-.07	-.01	.08
X13													1	-.23	.14	-.08	-.31	.03	-.57	.05	.07	.14	.13	-.14
X14														1	-.90	-.62	.47	.21	-.13	-.02	.13	-.09	-.36	.09
X15															1	.55	-.45	-.17	.18	.04	-.11	.09	.30	-.08
X16																1	-.22	-.14	.29	.01	-.28	-.14	.29	.14
X17																	1	.38	.13	.03	-.03	-.36	-.29	.36
X18																		1	-.09	.55	.02	-.25	-.07	.25
X19																			1	-.13	.06	.04	-.01	-.04
X20																				1	.06	-.02	.07	.02
X21																					1	.69	.13	-.69
X22																						1	.30	-.01
X23																							1	-.31
X24																								1

X1=Profe, X2=L_Income, X3=VHH_Income, X4=Computer, X5=L_Rent, X6=VHH_Rent, X7=RCC, X8=Edu12, X9=F_Grad, X10=P_1565, X11=P_014, X12= CWR, X13=W_1549, X14=HHSize, X15=Person4, X16=Person2, X17=Distance, X18=No_ST, X19=F_Mar, X20=NonST_M, X21=Fem_Tw, X22= Fem_Fw, X23=Rented, X24=Male_Mw.

The correlation coefficients in Table 5.2 reveal that most of the variables were inter-correlated and there was no extreme multicolinearity. The KMO measure of sampling adequacy is a scale of 0-1 and should be greater than 0.50, while the level of statistical significance (p-value) for Bartlett's test of Sphericity should be less than 0.1 (Norusis, 2012). The KMO test showed a value of 0.803 which indicate a high sampling adequacy for conducting factor analysis. The Bartlett's Test of Sphericity tests the null hypothesis that the variables in the correlation matrix are uncorrelated. The Bartletts's test of Sphericity was significant at 0.05 level of significance indicating that the null hypothesis could be rejected

After calculating KMO and Bartlett's test of Sphericity, the principal axis factoring produced a communality value for each of the 38 variables. The communality is a numerical estimation of the variance and it provides a value of the strength of relationship between each variable and the factor that factor analysis has produced. Most of the communalities have a value of more than 0.7 showing the high correlation between variables selected.

Thirdly, eigenvalues were generated. The eigenvalues helped to determine two features of the factor analysis: (1) the order of importance for the factors and (2) the number of components to extract from the dataset. Factors with high eigen values indicates that the factors explains more of the variation in the dataset than the factors with lower eigenvalues.

Fourthly, factor loadings were generated. These factor loadings were correlation coefficients that show the association between the original variables and the newly derived factors. In other words, they measure the degree to which each original variable in the dataset contributed to the meaning of each new factor. A factor loading of 0.821 could be interpreted as being 82.1 per cent positively correlated with the factor.

Table 5.3 Rotated Factor Loadings of Significant Variables for Horizontal Pattern of Residential Differentiation, Aizawl City[a].

	Factor				
	1	2	3	4	5
Computer	**0.821**	0.332			
VHH_Income	**0.819**				
VHH_Rent	**0.802**				
Profe	**0.760**				
RCC	**0.722**				
Edu12	**0.712**	0.399			
L_Rent	**-0.712**				
L_Income	**-0.653**				
F_Grad	**0.580**	0.506			
P_1565		**0.851**			
P_014	-0.325	**-0.806**			
W_1549		**0.765**			
Cw_R		**-0.629**			
F_Mar		**-0.603**			
HHSize			**-0.932**		
Person4			**0.868**		
Person2			**0.700**		
Distance	-0.373	-0.32	**-0.494**		
Rented			**0.409**		
Male_MW				**-0.940**	
Fem_FW				**0.940**	
Fem_TW				**0.759**	
No_ST					**0.855**
NonST_M					**0.648**
% Variance explained	23.169	14.903	12.589	11.039	5.960

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
[a] Rotation converged in 6 iterations.

5.2.1 Interpretation of Factor Loadings

Factor 1: Socio-economic Status

The first factor is made of 9 variables as shown in Table 5.3. It accounts for 23.17 per cent of the total variation indicating its prime importance in the residential differentiation of Aizawl city. Variables with high positive loadings include computer (0.821), high and very high income (0.819), high and very high rent (0.802), professional (0.760), RCC (0.722), Edu12 (0.712). On the other hand, low rent (-0.712) and low income (-0.653) have high negative loading. Female graduate has shown moderate positive loading (0.580) as it also loads moderately on the factor 2. The first factor, therefore, captures all variables related to socio-economic dimension in the data set. Therefore, the first factor is conveniently labeled as Socio-economic status factor.

The socio-economic status factor has a well-defined bipolar structure as it differentiate between high rent, high income families and low rent, low income families across localities. Zarkawt, Chanmari, Tuikhuahtlang and Dawrpui Vengthar were the localities with relatively high rent values and high income households. On the other hand, peripheral localities like Phunchawng, Lawipu, Tuivamit and Rangvamual were found to have more buildings with relatively cheaper rent values and low income households.

It was expected that the spatial distribution of socio-economic status will conform to sector theory. Localities with high socio-economic status were pre-supposed to found along major roads. Surprisingly, the above Figure 5.1 shows that localities with high socio-economic status tend to cluster around the central part of the city in such a manner that ‘concentric pattern’ could be regarded as the spatial structure of Aizawl city. However, a closer look at the map reveals that the socio-economic status largely followed the main K-B Road which starts from Kulikawn to Bawngkawn after traversing Mission Veng, Tuikhuahtlang, Khatla, Tuikual South, Dawrpui, Electric Veng, Zarkawt, Chanmari, Ramhlun South, Chaltlang, Ramhlun

North, Laipuitlang etc. All these localities are categorized under either high or very high classes.

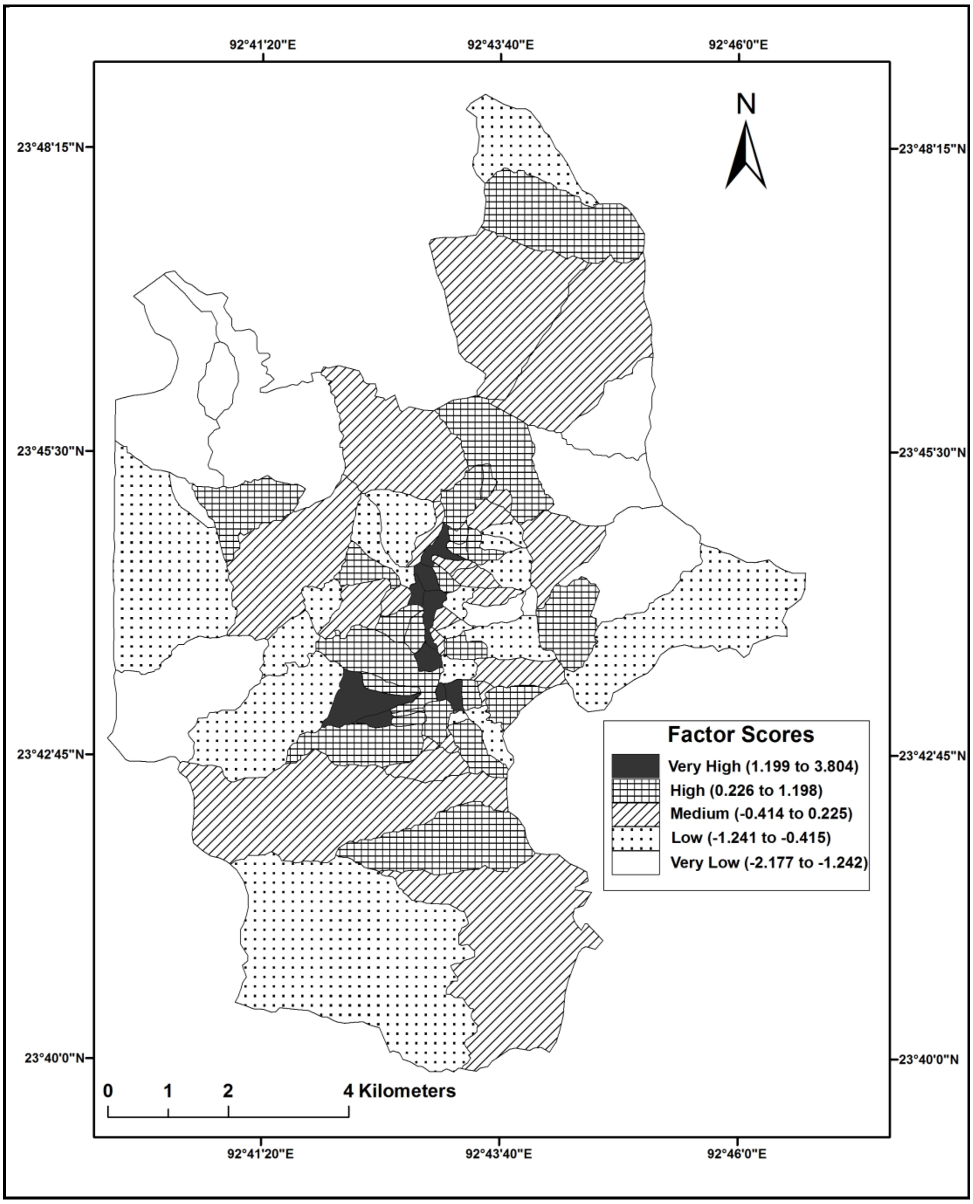

Figure 5.1 Socio-economic Status, Aizawl City.

From the above map of socio-economic status factor score, it may be observed that localities with high socio-economic status are found along the main road of the city as predicted by sector theory of urban land use. However, the monocentricity of the city, relatively low population and underdeveloped transport system has largely restricted the formation of sectors in different directions but mainly along the Bawngkawn-Kulikawn (B-K) route only.

Secondly, contrary to the residential pattern observed in western industrialized cities, the city centre attracts high social status population and the peripheral areas are occupied by low socio-economic status population. This finding, therefore, largely agrees with the argument that urban growth in peripheral capitalism conforms to an 'inverse-Burgess' spatial pattern (Schnore, 1965). In cities with less intensified capitalism, the rich tend to live in the centre and the poor on the periphery in contrast to cities in advanced capitalism. Arguably, the existence of high and middle class localities nearby the central business district may be attributed to the geographical inertia developed at these old localities wherein the early settlers accumulated wealth by obtaining land. Other high status localities evolved through time along the main road.

Finally, some localities at higher altitude were found to be inhabited by high status population as envisaged by Burgess' altitudinal zonation theory (Burgess, 1929). Hilltop localities like Tuikhuahtlang, Laipuitlang, Chaltlang and Thakthing are all high status localities. However, contrary to the altitudinal zonation theory, the hill-slopes are not necessarily the home of well-to-do people the reason of which may be attributed to the relatively steeper slopes in comparison to cities in western countries. Very steep sloping hillsides and the bases of the hill-slopes are usually the home of the poorer people. Moderate hill-slopes are occupied by the well-to-do households.

Factor 2: Family Status

The second factor accounts for 14.90 per cent of the total variance. This factor may be labeled as family status as most variables relate to household demography.

Variables with high positive loadings are persons belonging to age group 15-65(0.851) and women belonging to age group 15-49 (0.765). On the other hand, variables with negative loadings include persons belonging to age group below 14 (-0.806), child-woman ratio (-0.629) and percentage of married female (-0.603).

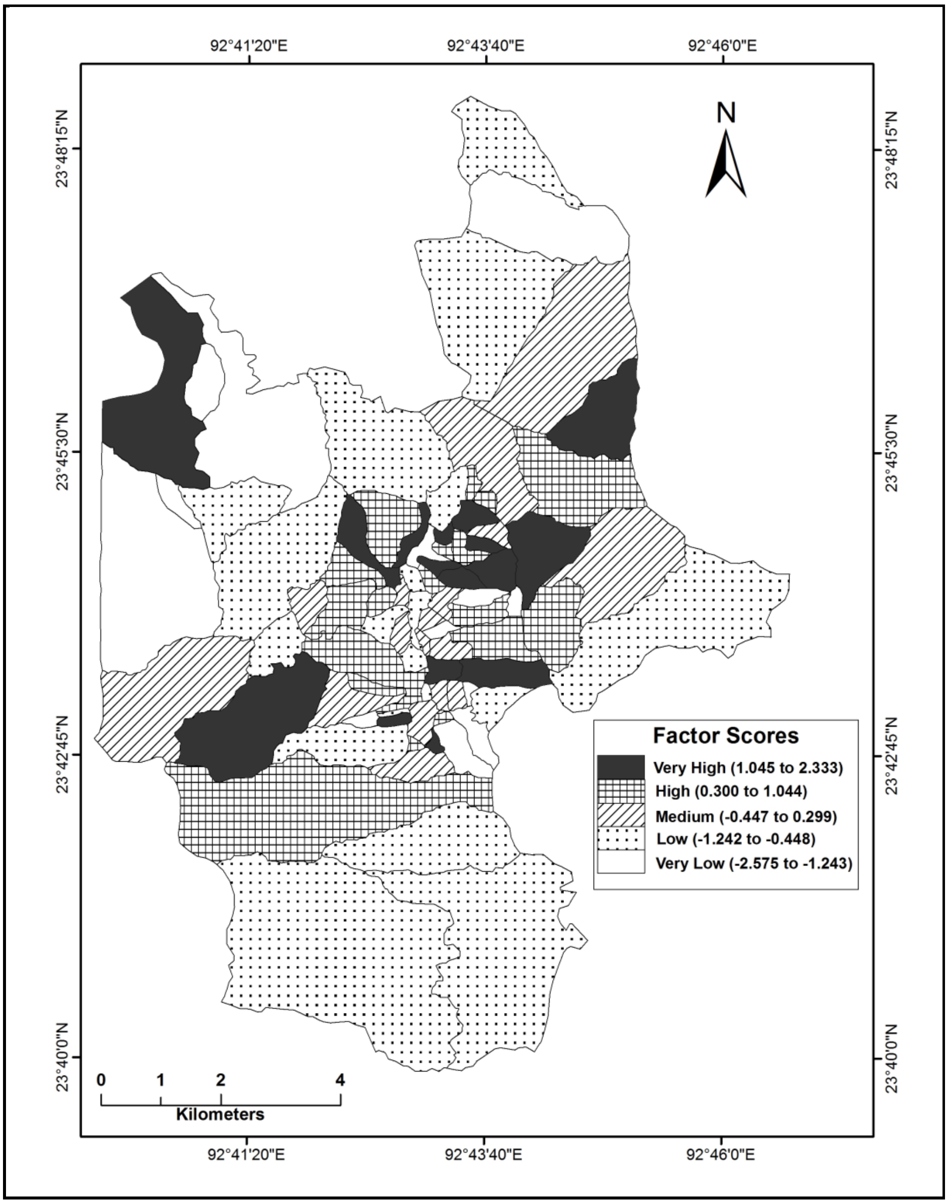

Figure 5.2 Family Status, Aizawl City.

Choropleth map of factor scores (Figure 5.2) reveals that very high and high factor scores were found at the periphery indicating the clustering of youthful population at the outskirts of the city. On the other hand, the inner city localities score lower than their peripheral counterparts. The inner city areas have higher percentage of female graduate but lower percentage of married female.

Centrally located residential areas are more preferred by newly migrated students, job seekers and workers and they usually stay at rented buildings. On the other hand, relatively poorer families at the early stage of their life cycle with young children are either stagnated or migrated at the peripheral areas. Due to relatively lower land value, poorer people could have their own home at the peripheries.

Factor 3: Household Size Status

Factor 3 accounts for 12.59 per cent of the total variation and is made up of 5 variables mostly pertaining to household size. In fact, variables under factor 3 were pre-supposed to merge with variables under factor 2.

The nature of factor 3 with high negative loading by mean household size (-0.932) and low negative loading by distance from city centre (-0.494) indicates that household size has a moderate tendency to increase away from the city centre. This is corroborated by positive loadings by households with less than 4 persons (0.868) and households with less than 2 persons (0.700). Percentage of rented house also loads positively (0.409) indicating the inverse relationship between distance and rented household.

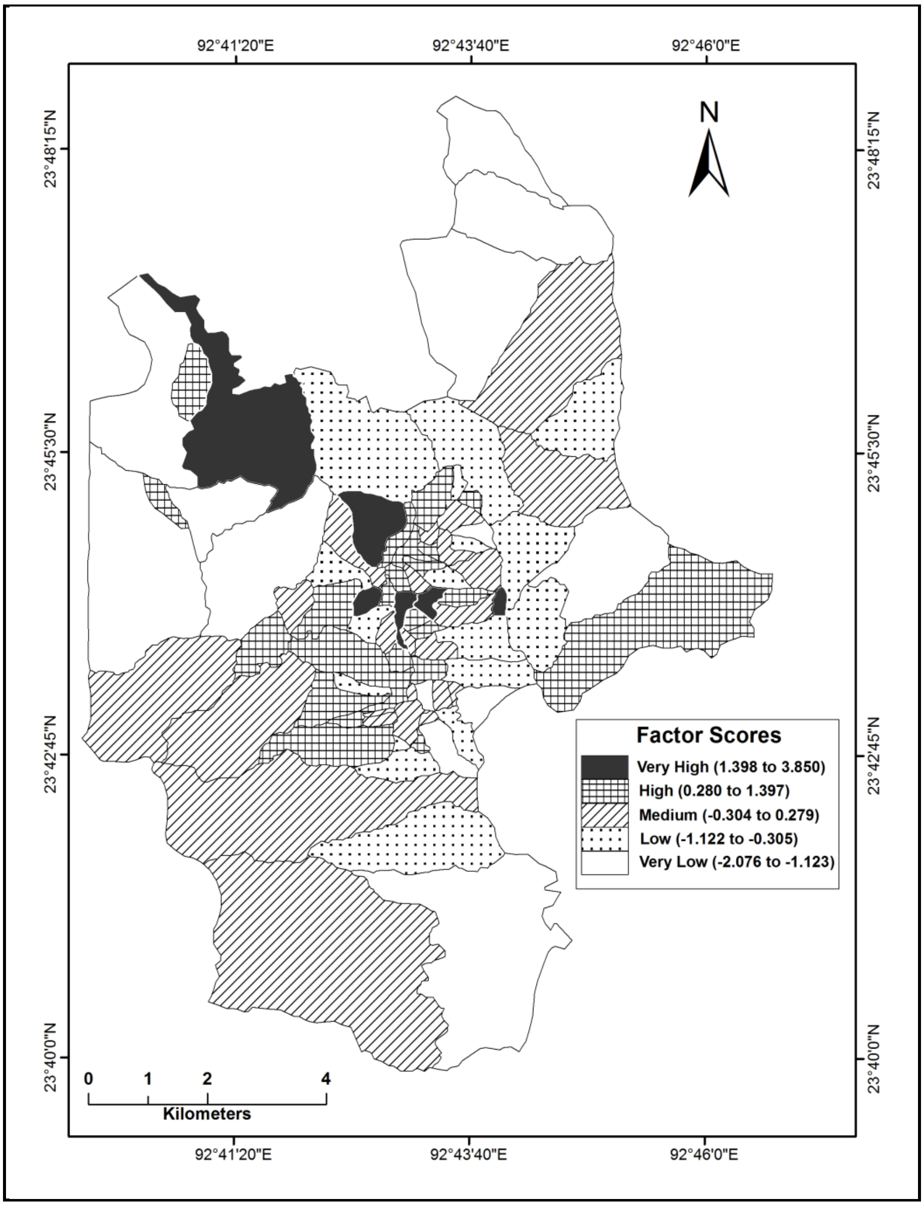

Figure 5.3 Household Size Status, Aizawl City.

Figure 5.3 shows that peripheral localities like Selesih, Melthum, Zemabawk North, Tanhril, Sakawrtuichhun etc have scored relatively higher in comparison to their centrally located counterparts. The main reason behind the occurrence of bigger family size in these localities may be low socio-economic condition. On the other hand, inner city areas like Dawrpui, Chhinga Veng, Saron, Chanmari, Electric and

Dawrpui are all under very high or high category. In the inner city areas, the average household size is relatively smaller. One of the reasons of smaller household size in central localities may be the presence of small-size basement floors in multi-storey buildings. Many of these basement floors are occupied by small-size families including students and migrant workers.

Therefore, it has been observed that family size increases with distance from the city centre as conceived by Burgess' concentric zone theory. However, unlike western cities where cities are older and bigger, a clear-cut zonal or concentric pattern failed to evolve in Aizawl city.

Factor 4: Workers Status

The fourth factor comprises three working population-related variables and accounts for 11.039 per cent of the total explained variance. Out of the three variables, percentage of male main workers to total male workers (Male_MW) has high negative loading (-0.940) while percentage of female main workers total female workers (Fem_FW) and percentage of female workers to total main workers (Fem_TW) load positively with high factor loadings of 0.940 and 0.759 respectively.

Localities with the lowest scores in percentage of male main workers like Chite and Falkland come under very low class. The second lowest class comprises 16 localities including Khatla South, Chawlhhmun, Lawipu, Maubawk, Durtlang North, Selesih, Tuikual South, Muanna Veng and others. On the other hand, the highest factor scores were found in 7 localities including Rangvamual, Phunchawng, Electric, Thakthing, Republic, Chhinga Veng and others.

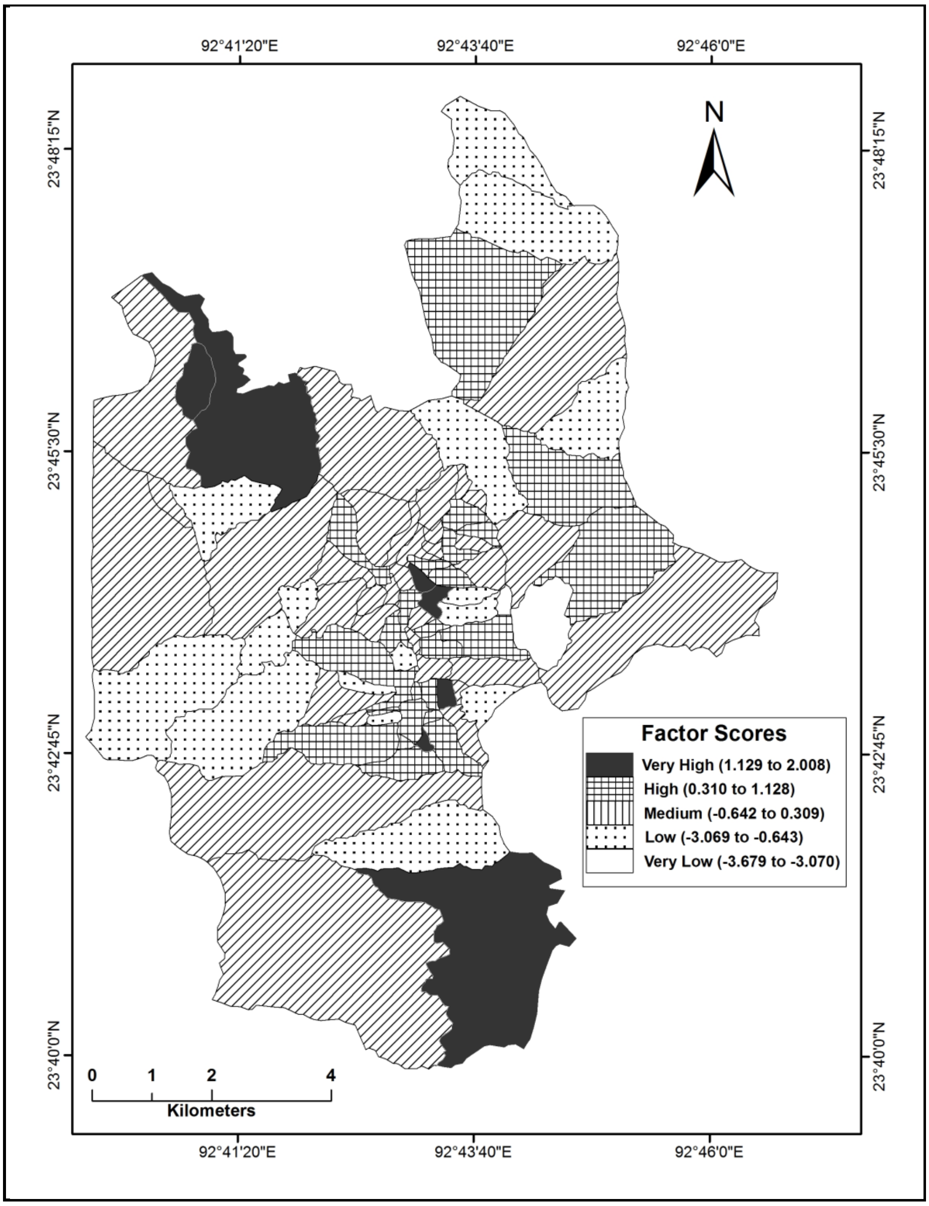

Figure 5.4 Workers Status, Aizawl City.

As shown in Figure 5.4, the spatial distribution of working population presents a striking pattern. High percentages of female workers are found in two contrasting group of localities. The first group consists of peripheral localities including Rangvamual, Phunchawng and Melthum. In these localities, workers are mostly engaged in primary activities in which female workers have also actively participated.

The other group consists of localities including Electric, Chhinga Veng, Thakthing and Republic. These localities are found nearby markets and occupied by moderate income population. It seems that a large number of female workers are engaged in trade and business, the avenues of which have been offered by the nearby markets.

Factor 5: Ethnic Status

The fourth factor accounts 5.96 per cent of the total variance explained. Only two variables with high positive loadings formed the factor which is labeled as 'Ethnic status'. The variables that formed ethnicity factor are percentage of non-Scheduled Tribe (Non_ST) population and proportion of male non-Scheduled tribe population (NonST_M) with 0.852 and 0.673 component loadings respectively.

It was expected that ethnicity would not form a separate factor due to the homogenous population of the city. The non-scheduled tribe population constitutes only 8.17 per cent of the city's population in 2011. However, the factor analysis has revealed that non-scheduled tribe population was concentrated in a few peripheral localities as shown in Figure 5.5. Localities with relatively high concentration of non-scheduled tribes include Melthum, Muanna Veng, Zemabawk, Lawipu, Khatla, Thuampui and Dawrpui. Except Dawrpui and Khatla, all other localities are found at the outskirts of the city. Muanna Veng, Thuampui and Zemabawk are located nearby to the military cantonment. These peripheral localities, in fact, owed their existence much to the presence of the military cantonment.

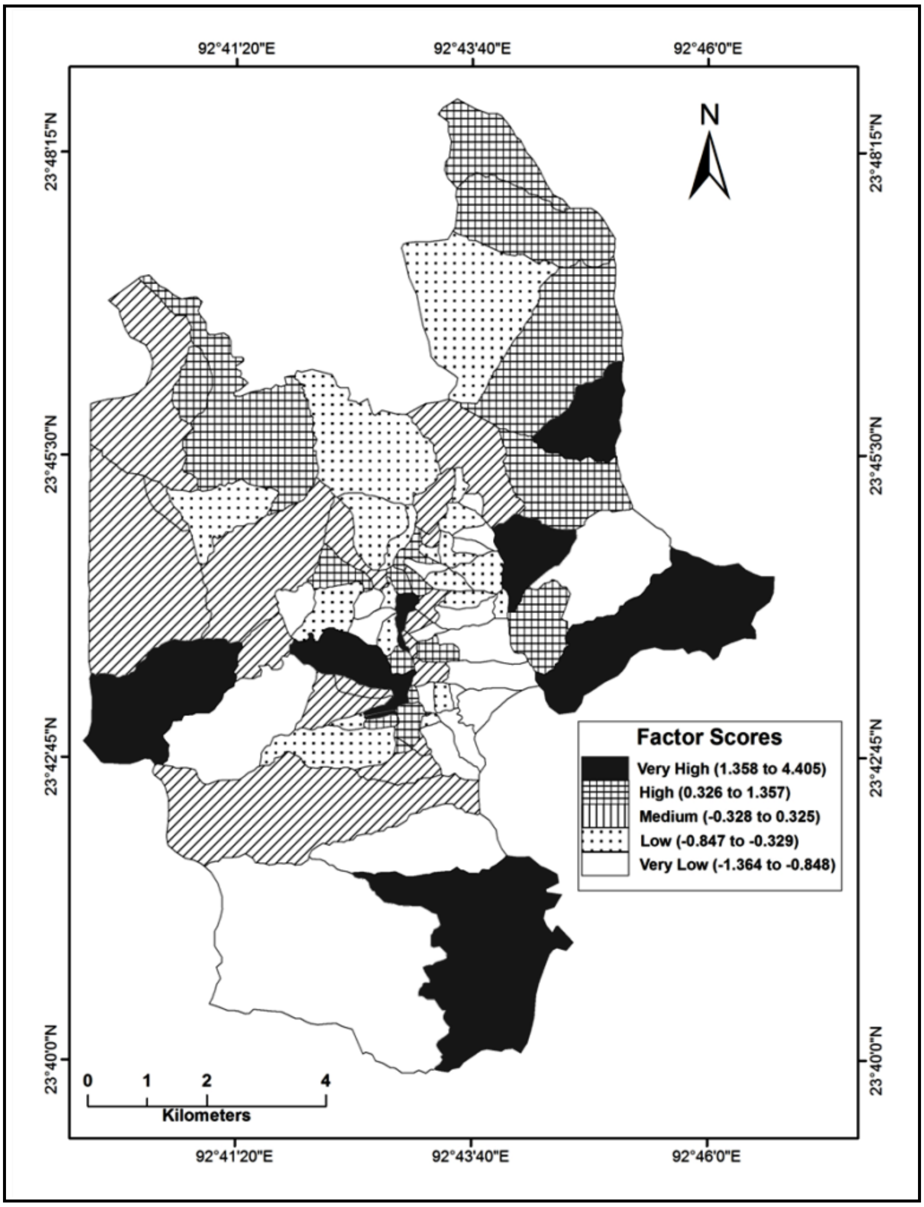

Figure 5.5 Ethnic Status, Aizawl city.

Dawrpui is the main commercial area in the city and many non-local workers have settled in this locality due to its proximity to the market. Khatla locality, on the other hand, was established for the residence of the wives of the Assam Rifles personnel, the para-military force who have settled for a long time nearby this locality. The name Khatla itself is derived from an Urdu word *Khata* meaning ‘sour’. A number of non-local traders are found in this locality. Moreover, the spatial distribution of non-scheduled tribe population largely conforms to multiple nuclei model which maintains that the locations of these nuclei are determined by the tendency of some social-group to separate from others due to externality effects.

The above factorial ecological study of Aizawl city identifies that the main axes of social differentiation on horizontal space are socio-economic status, household status, family status, workers status and ethnic status. These main axes may also be said as dimensions of socio-spatial differentiation. Out of these axes or dimensions, socio-economic status emerged as the most dominant factor determining the city's residential pattern.

The social geography of Aizawl city is different from those in the metropolises of advanced industrialized, firm-centered and highly individualistic modern societies. The binding force that keeps the society together is still very strong in the pre-industrialized community in comparison to western societies. Community-consciousness is more dominant than class-consciousness among the hill tribes. Dispersal of high status population from the city centre has been restricted by absence of favourable sites for sitting of houses, inadequate transportation and undue negligence of peripheral areas to attract the potential movers. These restrictions imposed limitations on residential choice.

Peripheral areas are poorer areas inhabited by larger families and ethnic minorities. The majority of residents in these poorer localities are engaged in agricultural sector. For them, there is no need of paying frequent visit to the main commercial areas but only on saturdays when they bring their farm products to sell in the weekly markets. However, there is a large chunk of working population who needs to access to the central business district daily. This group of population mainly consists of petty traders and informal workers. They, instead of occupying a separate space, seem to be distributed in and around the central business district. Although many of them could not afford to pay high rent, they are easily accommodated in these high status localities due to the presence of multi-storey buildings. This led to the inter-class cohabitation of buildings particularly nearby the central business district and consequently, produce vertical differentiation.

5.3 Vertical Pattern of Residential Differentiation

Vertical social differentiation has received much less attention than horizontal differentiation mainly due to the development of urban geography in the Anglo-American context where it has been rather unimportant. The phenomenon is mainly presented in the study of Mediterranean cities and is bound to be present wherever there is a vertical differentiation of apartment attributes and apartments are allocated through the market (Maloutas and Karadimitriou, 2001).

Aizawl city has witnessed rapid growth of population. Due to increasing demand, housing has becoming a flourishing sector and multi-storey buildings have been constructed by individual owners for renting purpose in residential areas. In the absence of housing laws and regulations before the existence of Aizawl Development Authority (ADA) Building Regulations as late as in 2008, high rise buildings were constructed even on disaster-prone, unfavourable sites. These multi-storey buildings are occupied by families and individuals belonging to different social group.

5.3.1 Design of Multi-storey Buildings

To begin our analysis on vertical differentiation, it is first necessary to discuss the two location-based designs of multi-storey buildings in Aizawl city. This will be helpful in visualizing the analytical process. It will also reflect the role of topography in the design of multi-storey buildings and consequently, the process of socio-spatial differentiation occurring in the city.

Broadly, multi-storey buildings in Aizawl city could be differentiated into two major types on the basis of site of construction as shown in Plate 5.1. The first type is those buildings constructed at hill-slopes which are normally designed in such a way that the lowest basements are the smallest and the size of the apartments gradually increases until it reaches the road after which the apartments are more or less the same in size. The apartment which is adjacent to the road is designated here as F0 (Floor zero or Ground Floor) and the subsequent apartments above this floor are designated as F1 (First Floor), F2 (Second Floor) and so on. The apartments below F0 are labeled B1 (Basement 1), B2, B3 and so on in order of descend. In some cases, the entire building may be constructed in such a way that a lower elevated road runs along the lowest basement and the other road runs at the higher elevation along the ground floor (F0).

(a) (b)

Plate 5.1 Location-based Types of Buildings in Aizawl City.
(a) Building Constructed at Hill-Slope. (b) Building Constructed at Flat Land/Hilltop.

The second type is those buildings constructed at flatlands which are found at the top or crest of the hills. These buildings are normally without basement and the size of the apartments are normally similar from the ground floor (F0) to the top floor. It may, however be noted that the second type of buildings are almost insignificant and relatively less common in comparison to the first one since the areas cover by sloping surface is much larger than flat lands and hilltops.

5.3.2 Analysis of Vertical Differentiation

To analyze vertical pattern of residential differentiation, 21 localities comprising of three from Municipal Ward No. 5 and one each from the remaining 18 municipal wards have been selected for the whole city. The selection of localities is based on the availability of multi-storey buildings since our samples from every locality do not give adequate number of multi-storey buildings for analysis. Secondly, multi-storey buildings with at least 3 floors as residential household have been selected randomly. Although the specification that 'at least 3 floors as residences' is not the best criteria for selection but it could serve our purpose since two or three floors in many buildings were used for commercial activities. The selected localities and their corresponding Municipal Wards are given in Table 5.4.

Simple line graphs and bar graphs were prepared to show the pattern of vertical differentiation. Median monthly household income has been taken as a proxy for the overall socio-economic status. Household income is calculated in terms of median in order to subdue the effect of outliers which is undesirable in the analysis.

Table 5.4 Selected Localities for Studying Vertical Differentiation in Aizawl City.

Sl. No.	Local Council	Munipal Ward No.	Sl. No.	Local Council	Municipal Ward No.
1	Durtlang Leitan	I	12	Zotlang	X
2	Chaltlang	II	13	Luangmual	XI
3	Ramhlun Vengthar	III	14	Tuikual S	XII
4	Ramhlun South	IV	15	Dawrpui Vengthar	XIII
5	Chanmari	V	16	Khatla	XIV
6	Electric Veng	V	17	Bungkawn	XV
7	Zarkawt	V	18	Bethlehem	XVI
8	Edenthar	VI	19	Republic	XVII
9	Thuampui	VII	20	Mission Veng	XVIII
10	Armed veng	VIII	21	Kulikawn	XIV
11	Dawrpui	IX			

Figure 5.6 shows that the median household income declines from top to bottom floors indicating the presence of wealthy households at the top floors and poorer people at the basements. The wealthiest people were found at the first floor (F1) while the poorest people were found at the lowest basement. Usually, the ground floors (F0) were occupied by commercial activities in market areas and densely populated neighbourhoods. The owners of the buildings usually occupied the first floor in commercial cum residential areas. In purely residential areas, ground floors were normally occupied by the owners.

To study inner city condition, four inner localities were selected again. The selected localities are Chanmari, Dawrpui, Electric Veng, and Zarkawt. These localities are mixed residential and commercial areas and are considered as the wealthiest localities in the city.

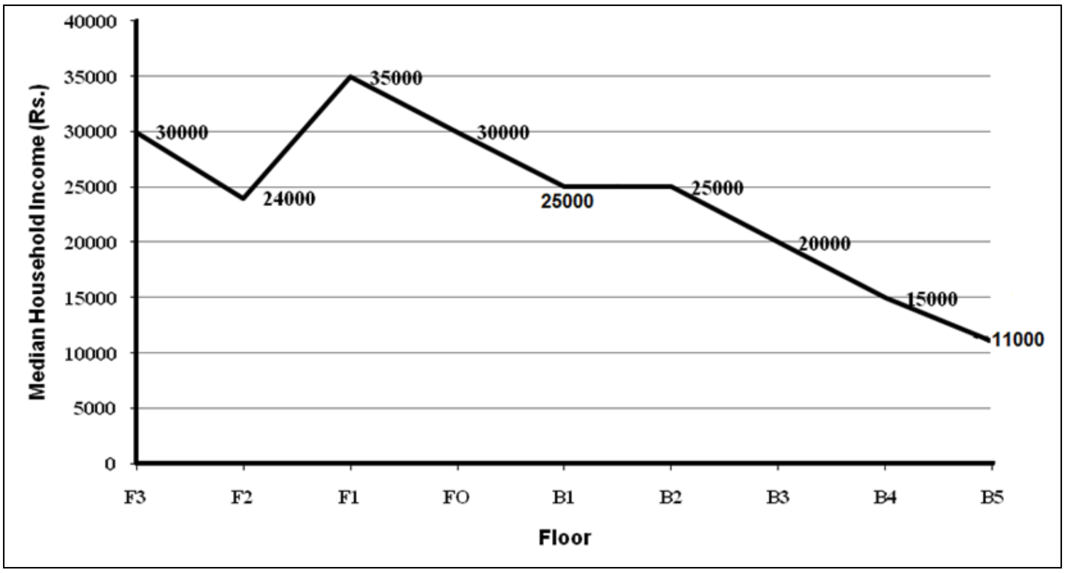

Figure 5.6 Apartment Floor and Household Income, Aizawl City.

Figure 5.7 below roughly corresponds to the above Figure 5.6. The line representing the median household income also declines from top to bottom floor. The main differences between the two figures are at F2 and B4. This could be explained by the higher percentage of owners at the inner city localities which resulted in relative increase in household incomes for the two floors.

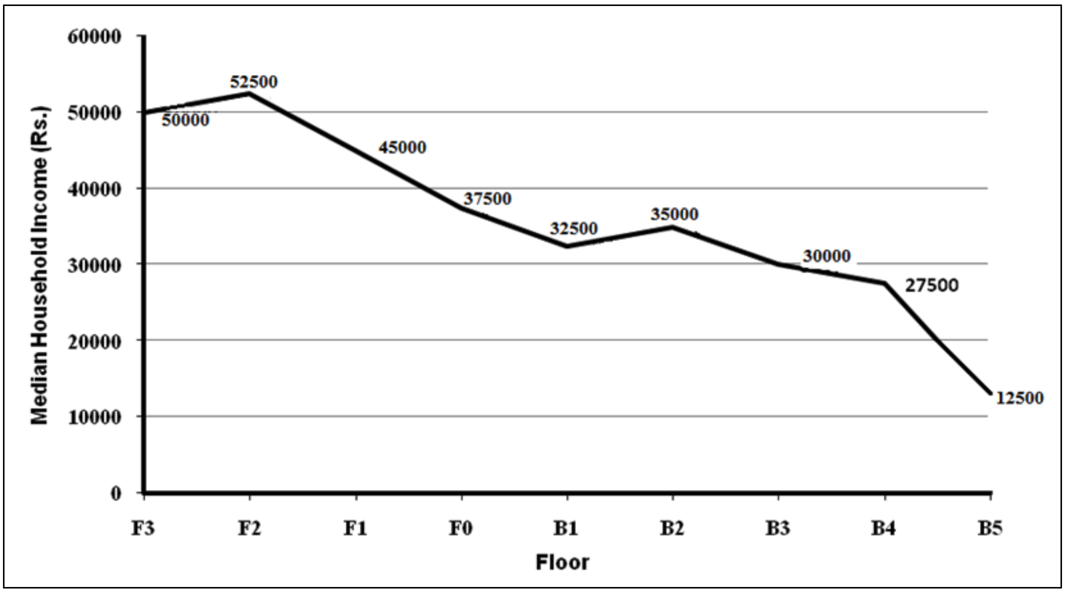

Figure 5.7 Apartment Floor and Household Income, Inner City, Aizawl City.

Secondly, the spatial distribution of owners and renters along the vertical plane has been examined with the help of bar graphs. Multi-storey buildings are the abode of the renters who are either landless or who do not occupy their own lands. For the whole city, all the apartment floors were dominated by renters except the ground floor. The percentage distribution in the Figure 5.8 below shows that 65 per cent of the occupants of ground floors were owners. The preference of owners is also clearly visible. While owners occupy 33- 47 per cent of the top half, they occupy only 15-36 per cent of the basement floors.

The median income for the entire city does not vary much from the inner city areas. Among the basement floors, the lowest income is found at the bottom-most floors for both the entire city and the inner city. The difference is, however, very small as shown in Figures 5.8 and 5.9. On the other hand, the income difference between the entire city and the inner city for the upper floors is relatively high in comparison to the lower floors. This implies that the inner city areas are relatively better in economic measures in comparison to the other parts of the city.

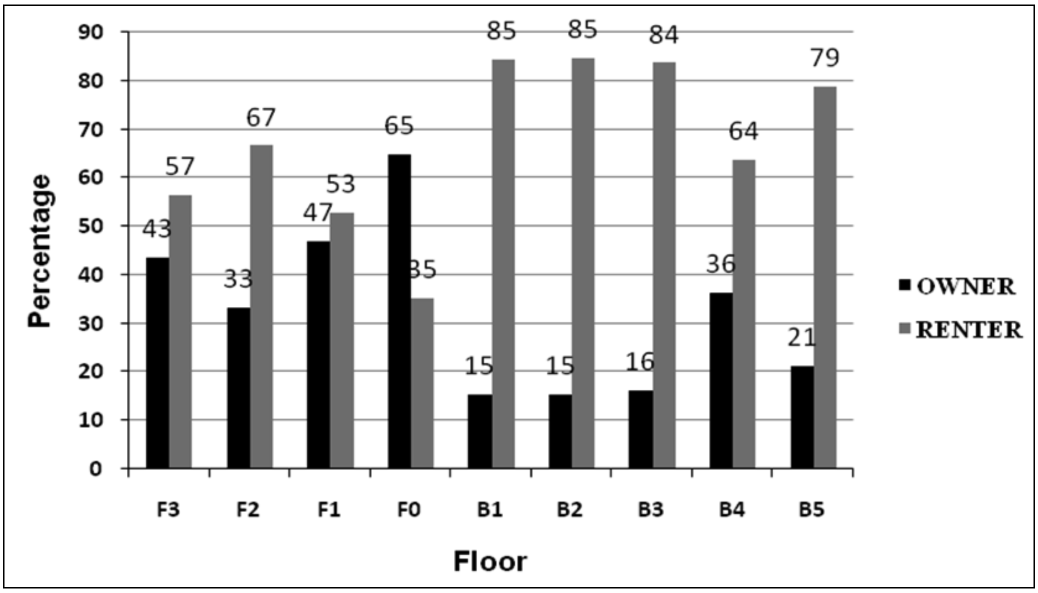

Figure 5.8 Vertical Distribution of Owners and Renters in Aizawl City.

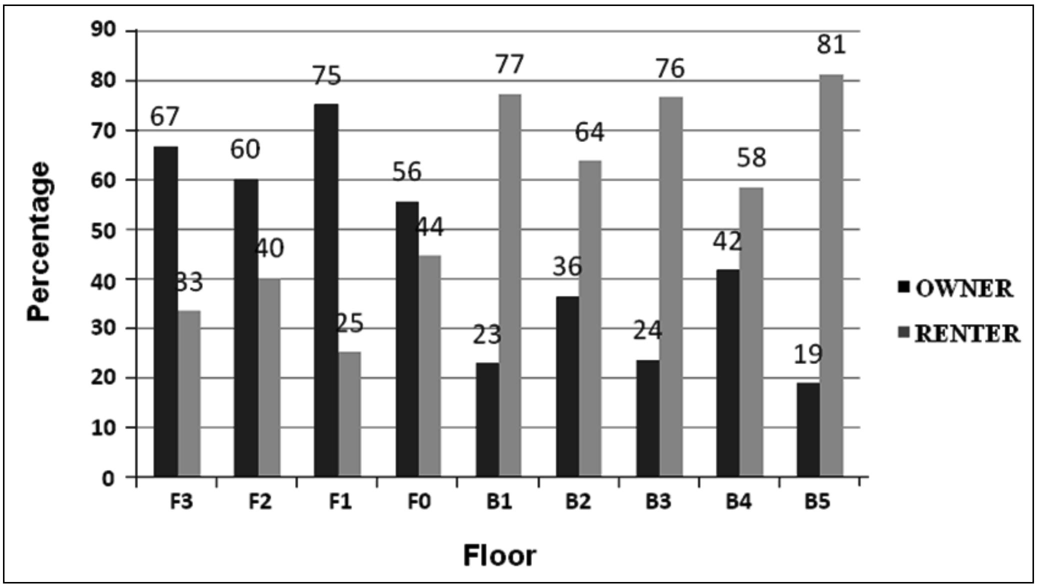

Figure 5.9 Vertical Distribution of Owners and Renters, Inner City, Aizawl City.

Thirdly, the residents of multi-storey buildings in the whole city were differentiated into four different class viz. very high income, high income, medium income and low income. Households with an average income of more than Rs. 90,000 per month were classified as very high income, between Rs. 50,000 and Rs.89,999 as high income, between Rs. 10,000 and Rs. 49,999 as medium income and less than Rs. 9999 as low income households.

In Figure 5.10, the vertical line (y-axis) shows the relative positions of different lines while the horizontal line (x-axis) shows the floors. The bottom most line (regular line) represents very high income class while the topmost line (dash-dotted line) represents the medium income class. It may be observed that the peak of very high income line is found at F1 and diminish at B4. This implies that the highest percentage of very high income population is found at the first floor while they were not found beyond the 4th basement (B4). Similarly, the line representing the high income group (dashed line) gradually declines from the top floor down to the B1 from where it fluctuates to reach the baseline at B5.

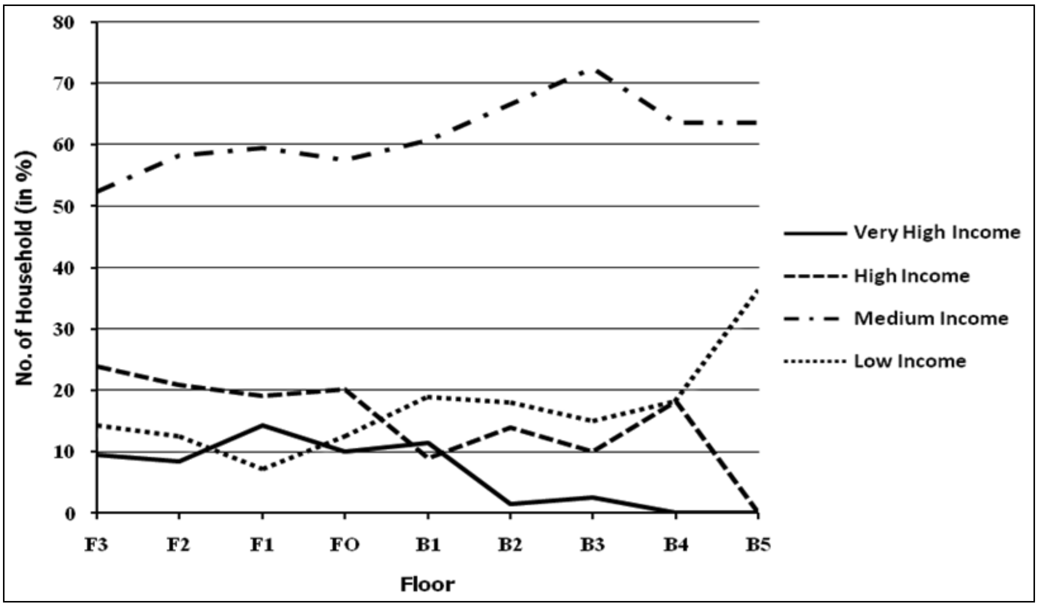

Figure 5.10 Income Structure, Household and Apartment Floor, Aizawl City.

Contrary to this, the line representing the low income class (dotted line) reached its lowest ebb at F1 and increasingly upward to reach its peak at B5 which indicates that the lowest proportion of low income people were found in the first floor while the lowest basement has accommodate the highest proportion of low income people. An almost similar pattern may be observed for the medium income class.

The above graphical analyses convincingly show that vertical differentiation did exist in Aizawl City. Different social classes occupied the same building in an almost orderly and regular fashion. The rich are found at the top and the poor at the bottom. This type of residential pattern, also termed as vertical segregation by White (1984), is also found in many Mediterranean cities (Maloutas, 2012).

What are the reasons behind this cohabitation of different social classes? The first direct answer may be the design of the buildings. Due to the imposition of hilly topography, buildings were constructed so that the size of apartments declined from ground floor to the lowest basements. In this way, a particular building may be available for tenants from different classes.

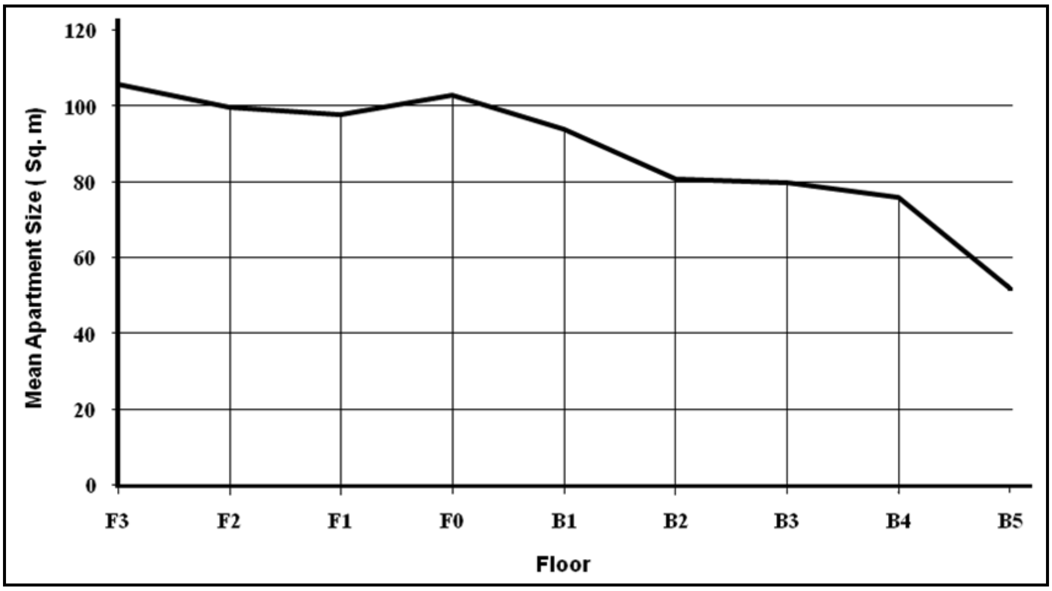

Figure 5.11 Apartment Size and Floor, Aizawl city.

Figure 5.11 shows the size of apartment at various floors. The mean apartment size gradually decreases from the top floors to the lowest floors. The decreasing trend of apartment size towards the lowest basement may be attributed to the design of the buildings at hillslopes. It may also be observed that the ground floor (F0) has formed a new peak indicating the mean size of ground floor apartments is little bit bigger than the second and third floors. This may be explained that some buildings are constructed in such a way that corridors at the upper floors are occupying bigger space so that the actual floor surface gets reduced.

It may, however, be absurd to argue that cohabitation of social classes as a sole response to the physical geography of the city since we cannot take apart the spatial process from the social process (Massey, 1984). Instead, cohabitation is required to serve the concomitant purposes of increasing population and limited available space for living within the city proper. Underdeveloped lands at the peripheral areas are not highly valued for residence due poor infrastructures and services. Access to market or city core is difficult from peripheral areas due to underdeveloped transport network. Moreover, land value is usually high along the existing roads even in the peripheral areas. Therefore, people usually choose to stay at the basement of multi-storey buildings in the city proper rather than paying a hefty price for land in peripheral areas where infrastructures and services are inadequate.

The coexistence of different households in vertically differentiated flats may be seen as an adjustment of the society to the increasingly urbanized and transformed society rather than a continuity of the past tradition of social homogeneity. Different social class may not like to share the same building and we share the same thought that “neither end of the social hierarchy has chosen to coexist in these vertically segregated areas” (Maloutas and Karadimitriou, 2001:715). It seems that cohabitation is a product of socio-spatial forces that keep the owners and the renters to share similar spaces. The owners of the buildings see their owned spaces as home and source of income while the renters see the basement floors as ‘spaces of transition’ and they occupy temporarily hoping to find better place in future.

CHAPTER-VI

QUALITY OF LIFE IN AIZAWL CITY

6.1 Introduction

Quality of life (QOL) is a broad concept and no single discipline can deal effectively with questions about the quality of life (Hill *et al*., 1973). It has been studied by a range of disciplines like sociology, geography, economics, planning, psychology and public health, among others. With its increasing popularity and widening application, QOL becomes an elusive concept, the meaning of which is very much dependent on the context within which it is used (Smith, 1996). The concept is now a nebulous term, with multiple related concepts, including 'well-being', 'level of living', standard of living', and 'liveability' (Van Kamp *et al*., 2003; Craglia *et al*., 2004).

Quality of life studies have entered into geography during the late 1970s. Corresponding to the 'relevance movement' in geography during the late 1960s, urban geography has also turned towards social issues to put the discipline relevant for the corresponding period. Various relevant social issues including social justice (Harvey, 1973), social well-being (Smith, 1972, 1973; Knox, 1975), geography of crime (Harries, 1974) as well as quality of life (Helburn, 1982) were taken up by contemporary geographers.

The shift in interests from the study of 'urban as a physical entity' to 'urban as a quality' coincides with the paradigm shift in geography from positivist spatial science to critical social theories. Emphasis was given to explore the relationships between social processes and spatial form (Harvey, 1969; Buttimer, 1969). An attempt, therefore, was made to ‘restructure geography to the needs of a new kind of society’ (Smith, 1973). Consideration was given to such hitherto neglected topics like poverty, health, hunger, crime and environmental pollution, and their contribution to the general quality of people’s lives as a spatially variable condition (Smith, 1973). Thus, the concern for QOL within geography has been witnessed in geography as reflected by an increasing number of studies of environmental quality, territorial social indicators and regional well-being (Knox and Scarth, 1977).

6.2 Dimensions and Indicators of Quality of Life

The concept of QOL, as applied to the urban environment, is usually understood in two ways. The first way concerns the living environment and involves the patterns of inequitable advantages and opportunities (Dansereau and Wexler, 1989) that affect each citizen through accessibility to services, facilities and amenities. It may also include economic vitality and social equity. The second approach to understanding urban QOL, according to Perloff (1969) relates to the natural environment in urban spaces. This approach holds that such factors as air, water and soil quality as well as the amount of green space available affect the way we live.

Quality of life, according to Helburn (1982), may have two meanings: one personal, the other environmental; one internal, the other external; one quite subjective, the other more objective. The concept of QOL is considered to possess three principal characteristics. First, it focuses on individual’s life situations and their perceptions; secondly, it is multidimensional, covering multiple life domains and their interplay; and thirdly, it brings together objective information on living conditions with subjective views and attitudes to provide a picture of well-being in society

(Shucksmith *et al.*, 2009). A subjective dimension has been added to the understanding of a good QOL as equivalent to the enhancement of human capabilities *a la* Sen (1993).

It is universally agreed that QOL is both subjective and objective as shown in Figure 6.1. MacLaren (1996:27) claims that "there is fairly widespread agreement in the literature that two distinct types of indicators are appropriate for measuring societal well-being. The first type comprises objective indicators which measure concrete aspects of the built environment, the natural environment, economy and social domain. The second type is subjective indicator, which is an evaluative statement of an individual's sense of well-being or satisfaction with a certain aspect of life".

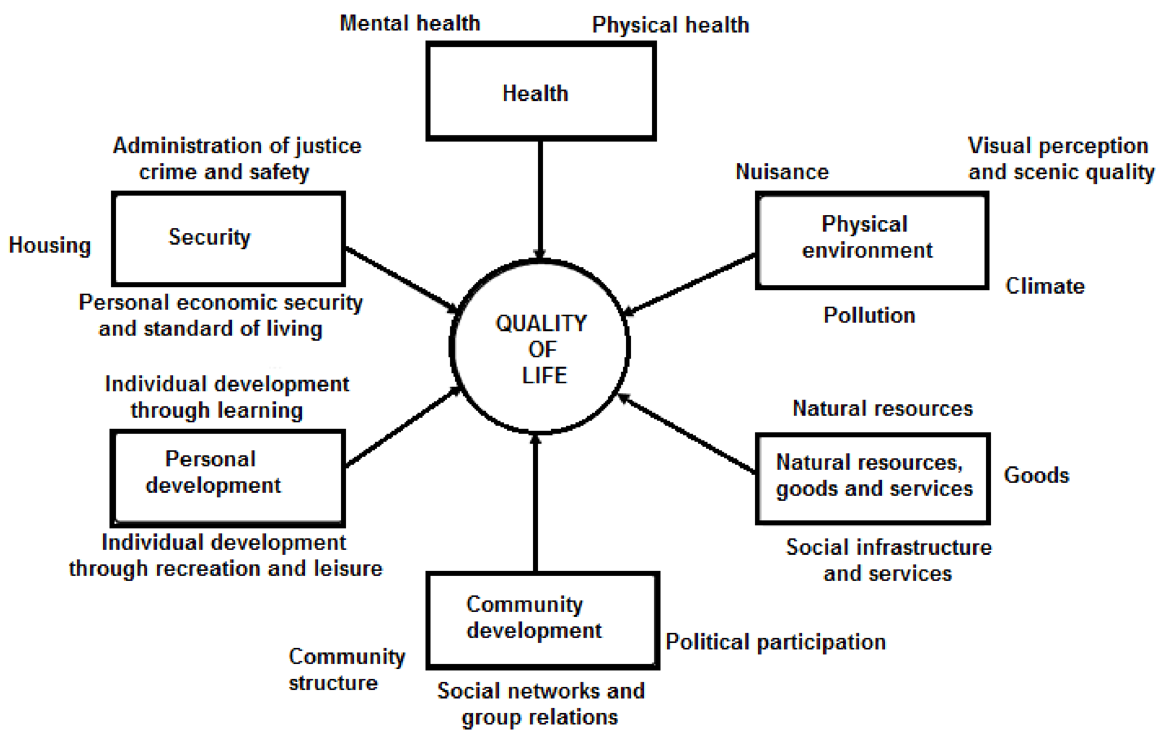

Figure 6.1 Components of Quality of Life (Source: Mitchell, 2000).

Assessment of objective QOL is more popular than evaluation of subjective QOL. At city level, there is not much discussion of the subjective side of quality of life (Okulicz-Kozaryn, 2011). Quality of life, however, is inadequate to be determined by objective conditions only and it is important to take into account subjective well-being of individuals. The way individuals perceive objective conditions and the evaluation they make of their own lives are central aspects of the concept.

Both subjective and objective dimensions of QOL have their own disadvantages. While objective indicators have high measurement reliability, they have low validity in assessing human well-being (Foo, 2000). It has been even claimed that subjective methods are preferred over objective methods, particularly for planning and policy purpose, as it is able to provide more valuable feedback (Ibrahim and Chung, 2003; Lee, 2008). Quality of urban life is hereby measured by both subjective indicators using surveys of residents' perceptions, evaluations and satisfaction with urban living and by objective indicators using data pertaining to objective personal well-being and environmental attributes.

Therefore, the QOL concept encompasses all (or at least many) domains of life and subsumes, in addition to individual material and immaterial well-being, such collective values as freedom, justice, and the guarantee of natural conditions of life for present and future generations (Land, 2000). However, there is little agreement on the range of indicators to be included in order to assess the qualities o people's lives (Pacione, 1982), and there appears to be no consensus on the method by which the indicators should be selected (Rogerson *et al*., 1988). This is mainly because QOL is a relative rather than an absolute term whose precise meaning depend on the place, time, and purpose of the assessment and on the value system of the assessor (Pacione, 1990).

6.3 Quality of Life: A Principal Component Analysis

Spatial variation in QOL across Aizawl city is measured in the present study by using principal component analysis as a method to develop composite indices. Two composite indices have been developed for the two dimensions of QOL - composite index of objective QOL and composite index of subjective QOL. The selected variable indicators for the two dimensions of QOL were described in Table 6.1.

Out of the 39 selected variables, 18 indicators were objective indicators while 21 indicators were subjective indicators. The selected indicators include a wide range of variables to comprehend the broad concept of QOL. The objective dimension comprises indicators pertaining to socio-economic, infrastructural and accessibility measures. The subjective dimension may also be decomposed into indicators pertaining to satisfaction of residents from socio-economic environment, infrastructural condition, municipal services and physical environment.

The selected indicator variables were normalized using the minimum-maximum method which put the indicators to have an identical range (0 to1). The formula of Min-Max method is $X = 1-[(X_{max}-X_{ij}) / (X_{max}-X_{min})]$ where X_{ij} is the value of the indicator variable *i* of the Local Council, X_{min} is the minimum value of the indicator variable *i* and X_{max} is the maximum value of the indicator variable *i*.

Table 6.1 Dimensions and Indicators of Urban Quality of Life, Aizawl City.

Dimension	Code of Indicators	Definition of Indicators
Objective	F_Grad	Percentage of female graduate population.
	Edu 12	Number of persons who have studied up to Class 12 and above/household.
	Bank	Number of bank accounts/ household.
	Profe	Percentage of professional and technicians from total population.
	M_Grad	Percentage of male graduate population.
	Computer	Number of computers/household.
	Income	Average monthly household income.
	4Wheel	Number of four wheel vehicles/household.
	Rent	Average rent value per household.
	Electric	Average last month electricity bill.
	Hospital	Number of health centers/1000 population.
	Playground	Average distance to playground.
	No_Agri	Percentage of workers engaged in non-agricultural sectors.
	Community	Number of community owned assets/1000 population.
	Bank_D	Average distance to nearest bank.
	Water	Number of water connections/household.
	RCC	Number of reinforced cement concrete (RCC) buildings/household.
	F_Lit	Female literacy rate.
Subjective	S_School	Satisfaction from quality of schools within locality.
	S_Municipal	Satisfaction from municipality services within locality.
	S_Upchild	Satisfaction from quality of locality for upbringing of children.
	S_Transport	Satisfaction from availability of public transport within locality.
	S_Infrawater	Satisfaction from distribution system of drinking water within locality.
	S_Infraroad	Satisfaction from condition of road within locality.
	S_Disaster	Satisfaction from safety from natural hazards.
	S_Crime	Satisfaction from incidence of crime within locality.
	S_Slope	Satisfaction from slope of house site.
	S_Safety	Satisfaction from safety of children and elders within locality.
	S_Sunlight	Satisfaction from length of receiving sunlight from houses.
	S_Clean	Satisfaction from cleanliness of locality.
	S_Noise	Satisfaction from level of noise pollution within locality.
	S_Smell	Satisfaction from level of odour within neighbourhood.
	S_Park	Satisfaction from availability of playground and parks for children within locality.
	S_Leisure	Satisfaction from availability of leisure and recreational places within locality.
	S_Participate	Satisfaction from participation in community activities.

6.3.1 Objective Quality of Life

Objective QOL is measured using objective indicators which are related to observable facts that are derived from secondary data or data drawn from sample. Most geographical research on QOL has been based on objective measures of personal well-being and environmental quality (Omuta, 1988; Pacione, 1990).

To employ Principal component analysis (PCA), correlation analysis and test statistics like Kaiser-Meyer-Olkin (KMO) and Bartlett's test Sphericity were computed again to assess the appropriateness of using the technique. The correlation coefficient matrix in Table 6.2 shows that most of the variables were inter-correlated and there was no extreme multicolinearity. The value of KMO for the selected data is 0.890 which is good enough to run PCA.

The Bartlett's Test of Sphericity showed a significance level of 0.00 and we can reject the hypothesis since the probability is less than 0.05. Then, principal component analysis (PCA) was run in the computer software 'Statistical Package for Social Sciences' (SPSS) to extract communalities and components. Using Kaiser's criterion of taking eigenvalues more than 1, 3 components were extracted which altogether explain 66.75 per cent of total variation in the data set. The percentage of variation explained is considered good enough to carry forward the analysis.

After component loadings were estimated, the individual indicators with the highest component loadings are grouped into intermediate composite indicators. Since we extracted three components, there are also three intermediate composites as shown in the right hand side of Table 6.3.

Table 6.2 Inter-correlation of Indicators of Objective Quality of Life in Aizawl City.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
X1	1																	
X2	.71	1																
X3	.58	.66	1															
X4	.67	.64	.57	1														
X5	.62	.77	.40	.70	1													
X6	.64	.75	.63	.66	.70	1												
X7	.60	.69	.47	.72	.75	.76	1											
X8	.25	.47	.32	.45	.52	.51	.52	1										
X9	.31	.52	.50	.63	.58	.72	.63	.64	1									
X10	.34	.49	.42	.504	.57	.63	.60	.64	.64	1								
X11	.09	.14	.11	.17	.18	.29	.19	.15	.25	.18	1							
X12	.13	.23	.22	.15	.23	.32	.27	.09	.16	.19	.46	1						
X13	.45	.45	.39	.32	.45	.52	.40	.21	.29	.35	.36	.40	1					
X14	-.36	-.39	-.33	-.29	-.32	-.35	-.35	-.10	-.18	-.16	-.37	-.51	-.50	1				
X15	.42	.39	.37	.35	.39	.51	.45	.28	.38	.38	.46	.24	.74	-.37	1			
X16	.48	.55	.44	.47	.52	.68	.59	.26	.57	.40	.35	.44	.55	-.46	.51	1		
X17	.44	.47	.36	.51	.54	.63	.64	.39	.59	.45	.33	.38	.45	-.38	.56	.56	1	
X18	.36	.44	.35	.48	.51	.55	.48	.36	.46	.38	.36	.36	.46	-.29	.49	.45	.52	1

X1=F_Grad, X2=Edu12, X3=Bank, X4=Profe, X5=M_Grad, X6=Computer, X7=Income, X8=4Wheel, X9=Rent, X10=Electric, X11=Hospital, X12= Playground, X13=No_Agri, X14=Community, X15=Bank_D, X16=Water, X17=RCC, X18=F_Lit

The intermediate composites were normalized squared rotated component (factor) loadings. The squared factor loadings represented the proportion of the total unit variance of the indicator, which was explained by the component. The first intermediate composite includes F_Grad (with a weight of 0.176), Edu12 (0.144), Bank (0.109), Profe (0.105), M_Grad (0.091), Computer (0.084) and Income (0.081). Likewise the second intermediate composite is formed by Wheel_4 (0.174), Rent (0.169) and Electric (0.149). The third intermediate composite is composed of Hospital (0.153), Playground (0.149), No_Agri (0.133), Community (0.118), Bank_D (0.117), Water (0.087), RCC (0.073) and F_Lit (0.068). It may be seen that weights are normalized squared factor loadings and scaled to unity sum. The weight of the first variable F_Grad (0.176) is derived by the squaring of the highest loading of F_Grad variable (0.880) divided by the explained variance which is the portion of the variance of the first factor explained by the variable F_Grad. For e.g. 0.176 = (0.880 x 0.859)/4.412. In the same manner, the weights of the other variables were derived and included in the intermediate composite index.

The first column of Table 6.3 shows component loadings, the second column shows communalities and the third one shows the intermediate composite indices. The first component consists of variables like percentage of female graduate (F_Grad), percentage of population who have studied up to class 12 (Edu12), number of bank account per household (Bank), percentage of population who are engaged in professional and technical (Profe), percentage of male graduate (M_Grad), number of computer per household (Computer) and average monthly household income (Income). The component may be labelled as 'socio-economic' dimension. It is the most important component that determines variability in objective QOL as it explains 24.51 per cent of the total variance.

Table 6.3 Intermediate Composite Indices of Objective Quality of Life.

Variables	Components			Communa-lity	Squared Factor loadings (scaled to unity sum)		
	1	2	3		1	2	3
F_Grad	**0.880**	0.098	0.164	0.810	**0.176**	0.002	0.007
Edu12	**0.796**	0.357	0.182	0.794	**0.144**	0.032	0.009
Bank	**0.692**	0.232	0.174	0.563	**0.109**	0.014	0.008
Profe	**0.680**	0.482	0.107	0.705	**0.105**	0.059	0.003
M_Grad	**0.633**	0.524	0.197	0.714	**0.091**	0.070	0.011
Computer	**0.610**	0.564	0.346	0.810	**0.084**	0.081	0.033
Income	**0.596**	0.572	0.247	0.743	**0.081**	0.083	0.017
Wheel4	0.146	**0.828**	0.025	0.707	0.005	**0.174**	0.000
Rent	0.285	**0.816**	0.183	0.780	0.018	**0.169**	0.009
Electric	0.260	**0.767**	0.147	0.677	0.015	**0.149**	0.006
Hospital	-0.150	0.199	**0.748**	0.622	0.005	0.010	**0.153**
Playground	0.049	0.038	**0.737**	0.547	0.001	0.000	**0.149**
No_Agri	0.386	0.106	**0.698**	0.647	0.034	0.003	**0.133**
Community	-0.389	0.118	**0.657**	0.597	0.034	0.004	**0.118**
Bank_D	0.269	0.267	**0.654**	0.571	0.016	0.018	**0.117**
Water	0.456	0.301	**0.563**	0.616	0.047	0.023	**0.087**
RCC	0.320	0.488	**0.515**	0.606	0.023	0.060	**0.073**
F_Lit	0.243	0.444	**0.497**	0.503	0.013	0.050	**0.068**
% of explained variance	24.51	21.92	20.32				
Expl. Var. (Eigenvalue)	4.412	3.946	3.657				
Expl./Total	0.367	0.328	0.304				
Total Var.	12.015						

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations.
Note: Expl.Var. is the variance explained by the component and Expl./Total is the explained variance divided by the total variance of the three components.

The second component explains 21.92 per cent of the total variation. It includes three variables including number of four wheelers per household (Wheel4), rent value (Rent) and average monthly electricity bill per household (Electric). All the component variables have high positive loadings. This component may be labelled ‘Household Amenity’ dimension. Other variables that have significant loadings include Income (0.572), Computer (0.564), M_Grad (0.524), RCC (0.488), Profe

(0.482) and F_Lit (0.44). This explains that the second component has been made up of ‘household amenities’ which are heavily linked with socio-economic status.

The third component includes variables like average distance to nearest health centre (Hospital), average distance to nearest playground (Playground), percentage of workers engaged in non-agricultural sector (No_Agri), average distance to nearest bank (Bank_D), number of water connection per household (Water), number of reinforced cement concrete buildings per household (RCC) and female literacy rate (F_Lit). All these variables have loaded positively while community variable has negative loading. This component may be labelled as ‘accessibility’ dimension.

Table 6.4 Weights for Objective Quality of Life Variables.

Variables	Domain Weight	Weight for respective factor	Weight Score (W_i)	Resulting Weight ($\sum W_i = 1$)
F_Grad	0.176	0.367	0.064	0.089
Edu12	0.144	0.367	0.053	0.073
Bank	0.109	0.367	0.040	0.055
Profe	0.105	0.367	0.038	0.053
M_Grad	0.091	0.367	0.033	0.046
Computer	0.084	0.367	0.031	0.043
Income	0.083	0.328	0.027	0.038
Wheel4	0.174	0.328	0.057	0.079
Rent	0.169	0.328	0.055	0.077
Electric	0.149	0.328	0.049	0.068
Hospital	0.153	0.304	0.047	0.065
Playground	0.149	0.304	0.045	0.063
No_Agri	0.133	0.304	0.041	0.056
Community	0.118	0.304	0.036	0.050
Bank_D	0.117	0.304	0.036	0.049
Water	0.087	0.304	0.026	0.037
Rcc	0.073	0.304	0.022	0.031
F_Lit	0.068	0.304	0.021	0.028

Once the intermediate composite indices have been constructed, they were aggregated by assigning a weight to each of them equal to the proportion of variance explained by the respective component (Table 6.4). In other words, the weights assigned to the intermediate composite indices or weight of respective component equals the explained variance divided by total variance of each factor. Weight Score (W_i) is obtained by multiplying the variable weight and weight of respective component. Finally, the resulting weight or final weight is obtained which is rescaled again to sum up to one to preserve comparability. After the final weights were obtained, the rank of each Local Council was obtained by the product of normalized variable and the resulting weight. Each Local Council was ranked and mapped as per their rankings as shown in Figure 6.2.

As expected, Zarkawt Veng obtained the first rank in objective QOL. Zarkawt Veng is one of the most centrally located and most accessible neighbourhoods within the city. It is one of the oldest localities in Aizawl. The locality comprises of two adjacent hillocks-Macdonald Hill and Babutlang. The first two British Missionaries started their services from Macdonald Hill in1894. Adjacent to this hillock in the southwestern part is another hillock called Babutlang which was a residential area for the government clerks known as *babus*. In between these two hillocks is the main Zarkawt point in which a few Mizo clerks were settled. The area became one of the most prominent places in Aizawl. The first High School in Mizoram was established in this locality and a number of senior government officer quarters were also constructed. Presently, it contains a number of important offices and landmarks including Chief Minister's Office, Mizoram State Museum, Mizoram State Archive, and other important government offices. The most important route of the city (i.e. B – K route) runs across the neighbourhood and commercial activities occupied the lower floors of the buildings due to their higher bid-rent while the upper floors were residential units. The locality, therefore, is partly a residential area and partly a commercial area. The second highest ranked locality is Tuikhuahtlang veng which may be described as a residential cum administrative locality. The locality stands at the hill top that overlooks many other localities. Many important offices like All India Radio and Chief Minister’s Bungalow are located here. Raj Bhavan-the official residence of Governor of Mizoram is also located at a near distance.

At the bottom of the ranking lie two peripheral localities namely Rangvamual and Phunchawng. These two localities are located at a relatively far distance from the city proper in comparison to other localities. Although Rangvamual is one of the oldest localities in Aizawl, it has been failing to grow and develop due to distance effect and undue negligence by the state government. Till 2010, there was no government owned schools in these two localities.

Presently, Rangvamual has two private higher secondary schools while Phunchawng has only one. All of the middle and primary schools found in these localities were government aided schools. No health centre, public library and indoor stadium were found in these two adjoining localities.

Broadly, the high ranked localities were found at central location and important junctions where buildings are mixed with both residential and commercial functions. Dawrpui or Bara Bazar may be considered as the central business district (CBD). On the other hand, the lowest ranked localities are the most peripheral localities. They serve as counter magnets for poorer immigrants.

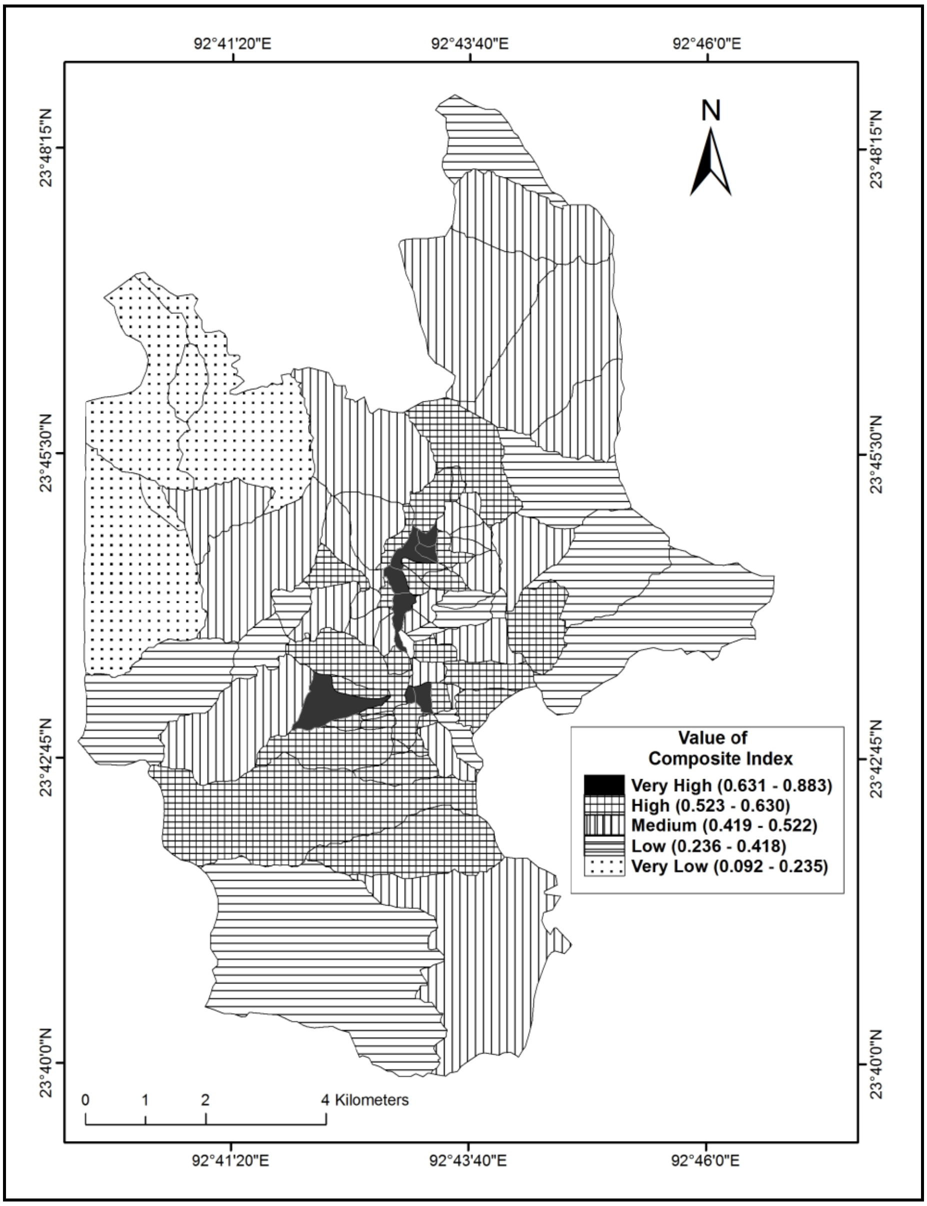

Figure 6.2 Composite Scores of Objective Quality of Life, Aizawl City.

6.3.2 Subjective Quality of Life

To construct a composite subjective QOL index, the indicator variables were first normalized again. The correlation coefficients in showed that most of the variables were inter-correlated and there was no extreme multicolinearity (Table 6.5).

Table 6.5 Inter-correlation of Indicators of Subjective Quality of Life in Aizawl City.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
X1	1	.61	.61	.45	.33	.39	.15	-.10	.12	.32	.29	.11	.16	.14	-.20	.08	.14
X2		1	.40	.41	.38	.25	.09	-.07	.08	.40	.34	-.07	-.09	-.07	-.21	.04	-.01
X3			1	.37	.18	.31	.28	.07	.32	.35	.26	.13	.26	.19	-.16	-.07	.11
X4				1	-.01	.40	.42	.20	.19	.50	.48	.09	-.03	.02	-.22	-.10	.18
X5					1	.16	-.28	-.29	-.11	-.10	-.22	.00	.22	-.26	.13	.13	.14
X6						1	.17	.06	.23	.20	.17	.35	.17	.24	-.19	.04	.08
X7							1	.32	.47	.56	.46	.28	.20	.42	.07	.04	.17
X8								1	.60	.39	.05	-.01	-.06	.08	.20	.16	.24
X9									1	.42	.29	.11	.10	.29	.08	.08	.28
X10										1	.49	.09	.06	.27	-.17	-.13	.10
X11											1	.09	-.11	.15	-.25	-.24	.01
X12												1	.70	.53	.23	.17	.01
X13													1	.53	.27	.13	.23
X14														1	.16	.11	.16
X15															1	.67	.32
X16																1	.26
X17																	1

X1= S_School, X2= S_Municipal, X3= S_Upchild, X4=, S_Transport, X5= S_Infrawater, X6= S_Infraroad, X7=S_Disaster, X8= S_Crime, X9= S_Slope, X10= S_Safety, X11= S_Sunlight, X12= S_Clean, X13= S_Noise, X14= S_Smell, X15= S_Park, X16= S_Leisure, X17= S_Participation

The KMO measure of sampling adequacy value was acceptable (0.663) and the Bartlett's test of Sphericity was significant at 0.05 level of significance.

Table 6.6 Intermediate Composite Indices for Subjective Quality of Life.

Indicators	Component				Commu-nality	Squared Factor loadings (scaled to unity sum)			
	1	2	3	4		1	2	3	4
S_School	**0.853**	0.031	0.107	0.012	0.739	0.231	0.000	0.005	0.000
S_Municipal	**0.803**	0.049	-0.196	-0.027	0.686	0.204	0.001	0.016	0.000
S_Upchild	**0.666**	0.213	0.203	-0.019	0.530	0.141	0.015	0.017	0.000
S_Transport	**0.583**	0.465	-0.032	-0.137	0.576	0.108	0.070	0.000	0.009
S_Infrawater	**0.556**	-0.522	-0.061	0.350	0.707	0.098	0.089	0.002	0.056
S_Infraroad	**0.511**	0.117	0.333	-0.048	0.388	0.083	0.004	0.045	0.001
S_Disaster	0.125	**0.733**	0.327	-0.013	0.660	0.005	0.175	0.044	0.000
S_Crime	-0.140	**0.723**	-0.140	0.361	0.692	0.006	0.170	0.008	0.060
S_Slope	0.123	**0.719**	0.082	0.259	0.606	0.005	0.168	0.003	0.031
S_Safety	0.395	**0.689**	0.059	-0.120	0.649	0.049	0.155	0.001	0.007
S_Sunlight	0.339	**0.544**	0.036	-0.385	0.561	0.036	0.096	0.001	0.068
S_Clean	0.061	0.032	**0.872**	0.067	0.770	0.001	0.000	0.311	0.002
S_Noise	0.123	-0.100	**0.834**	0.233	0.775	0.005	0.003	0.285	0.025
S_Smell	-0.023	0.317	**0.771**	0.028	0.697	0.000	0.033	0.243	0.000
S_Park	-0.258	-0.020	0.196	**0.807**	0.756	0.021	0.000	0.016	0.297
S_Leisure	0.002	-0.043	0.091	**0.791**	0.636	0.000	0.001	0.003	0.286
S_Participate	0.157	0.241	0.034	**0.591**	0.433	0.008	0.019	0.000	0.159
% of variance explained	18.56	18.06	14.37	12.88					
Expl. Var. (eigenvalues)	3.156	3.071	2.443	2.190					
Expl./Total	0.2906	0.2828	0.2250	0.2017					
Total Var.	10.860								

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
[a] Rotation converged in 6 iterations.
Note: Expl.Var. is the variance explained by the component and Expl./Total is the explained variance divided by the total variance of the four components.

Similar to the steps observed in objective QOL, component loadings were extracted from the 17 indicator variables (see Table 6.6). By taking Kaiser's criterion of more than eigenvalue 1, four components were extracted. The first component consists of 6 variables which may be clubbed together as 'satisfaction from infrastructures'. Indicator variables like satisfaction from quality of schools within locality (S_School) and satisfaction from municipal services (M_Municipal) have the highest positive loadings with 0.853 and 0.803 respectively. This component also includes indicator variables like satisfactions from upbringing of child (S_Upchild), transport facilities (S_Transport), distribution of water (S_Infrawater) and quality of road (S_Infraroad) within locality. The first component explains 18.56 per cent of the total variance explained.

The second component explains 18.06 per cent of the total variation and is the second most important component. This component may be labeled as 'satisfaction from physical and social environment'. Variable indicators like satisfaction from disaster (S_Disaster), satisfaction from crime within neighbourhood (S_Crime), and satisfaction from slope (S_Slope) have high positive loadings while satisfaction from safety (S_Safety) and sunlight (S_Sunlight) have moderate positive loadings.

The third component explains 14.37 per cent of the total variation. This component may be termed 'satisfaction from cleanliness within neighbourhood'. The variables that loaded in this component are satisfaction from cleanliness (S_Clean), Noise (S_Noise), and Smell (S_Smell).

The fourth component may be labeled as 'satisfaction from leisure places'. The component consists of 3 variables such as satisfaction from park (S_Park), satisfaction from leisure places (S_Leisure), and satisfaction from participation in community organizations (S_Praticipate) all which were loaded positively. Altogether, the three variable indicators combine to explain 12.88 per cent of the total variance.

Table 6.7 Weight for Subjective Quality of Life Variables.

Variables	Domain Weight	Weight for respective factor	Weight Score (W_i)	Resulting Weight ($\sum W_i = 1$)
S_School	0.231	0.291	0.067	0.083
S_Municipal	0.204	0.291	0.059	0.074
S_Upchild	0.141	0.291	0.041	0.051
S_Transport	0.108	0.291	0.031	0.039
S_Infrawater	0.098	0.291	0.028	0.035
S_Infraroad	0.083	0.291	0.024	0.030
S_Disaster	0.175	0.283	0.049	0.061
S_Crime	0.170	0.283	0.048	0.060
S_Slope	0.168	0.283	0.048	0.059
S_Safety	0.155	0.283	0.044	0.054
S_Sunlight	0.096	0.283	0.027	0.034
S_Clean	0.311	0.225	0.070	0.087
S_Noise	0.285	0.225	0.064	0.079
S_Smell	0.243	0.225	0.055	0.068
S_Park	0.297	0.202	0.060	0.074
S_Leisure	0.286	0.202	0.058	0.072
S_Participate	0.159	0.202	0.032	0.040

Weights for subjective variable indicators were obtained by following the same procedure to obtain weights for objective variable indicators. The last column of Table 6.7 shows the final weights for each variable indicator. The product of this resulting weight and the normalized data provides the score of each variable indicator. Figure 6.3 shows the mapping classification of composite QOL scores of subjective indicators.

Localities with very high composite scores of subjective QOL are mainly found at the eastern and western parts of the city. The eastern localities include Zemabawk, Zemabawk North, and Thuampui. Sakawrtuichhun locality in the western part of the city also scores very high. Localities nearby the central part of the city like Chanmari West, Venghlui, Dinthar and Ramthar are also categorized under very high class. The residents of these localities are relatively more satisfied in the quality of their neighbourhoods. If we look at the other extreme, it was surprising to find that most of the very low scoring localities are found at the central part of the region. Residents of centrally located localiities like Chhinga Veng, Aizawl Venglai, Ramhlun Venglai and Chaltlang as well as residents of peripheral localities like Melthum, Saikhamakawn, Maubawk, Chite and ITI were also highly unsatisfied with the quality of their neighbourhoods.

Unlike the objective dimension, the spatial distribution of subjective QOL index does not show any pattern. It is not easy to explain the reason behind the random distribution of composite score of subjective indicators. Both peripheral and relatively centrally located localities come under very high category and intriguingly, very low scoring localities are also found in these two contrasting parts of the city. Residents of peripheral localities were expected to score relatively lower in comparison to their counterparts in centrally located localities. However, our result shows that they were satisfied with the various facets of determinants of QOL found and available within their own localities.

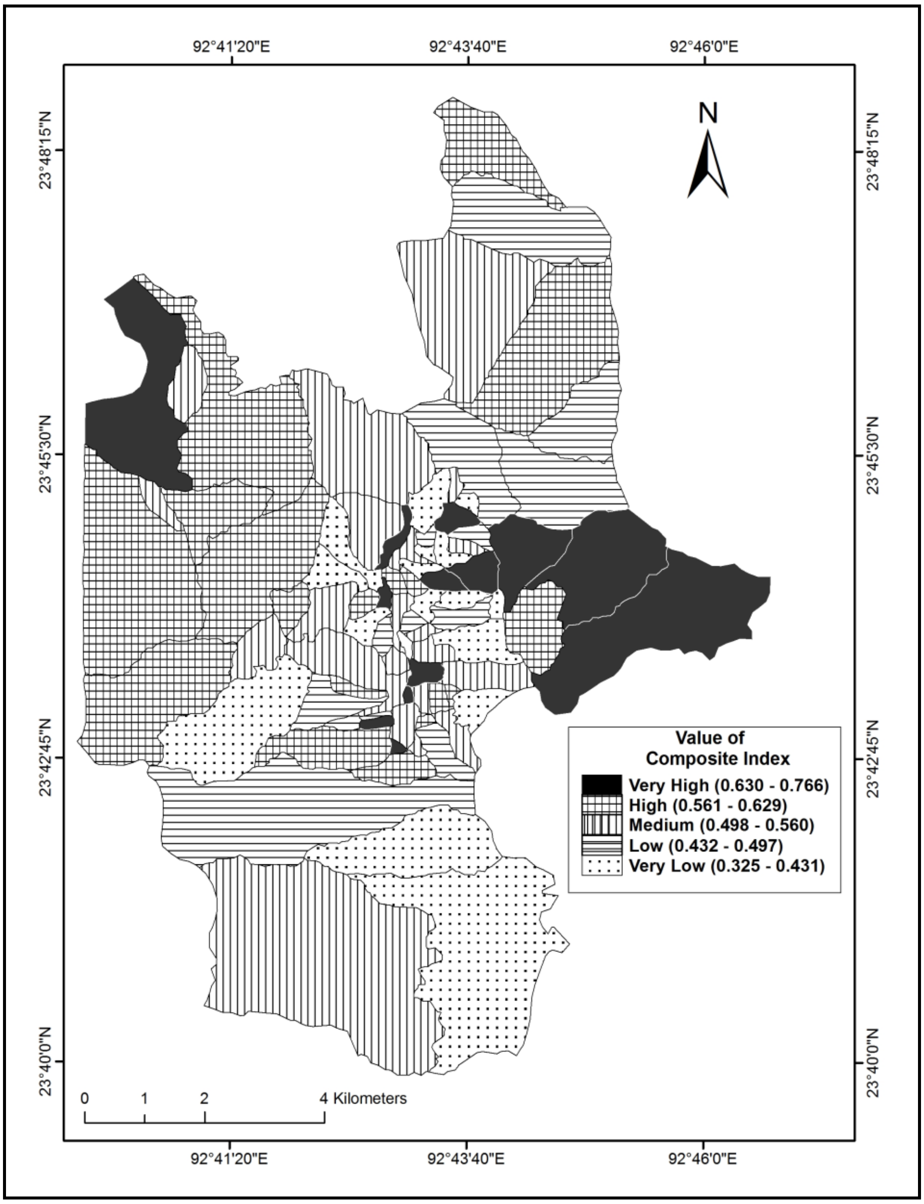

Figure 6.3 Composite Scores of Subjective Quality of Life, Aizawl City.

6.3.3 Overall Quality of Life

The overall QOL index is simply derived by addition of objective and subjective QOL indices. Figure 6.4 shows the classification of localities into five classes on the basis of their performances in the combined QOL indices.

Broadly, high scoring localities are found at the central part of the city. There are 9 localities and 24 localities that come under very high category and high category respectively. Included among these two categories are Zarkawt and Dawrpui that come under very high category while high category includes Chanmari and Electric veng. These localities have performed relatively better in the objective QOL in comparison to subjective QOL. However, there are localities which have performed relatively better in subjective QOL within the top-half group. Among them are Chanmari West, Ramthar, Model, Khatla South, Ramhlun North, Republic, Dam Veng, Ramthar North, Venghlui etc which are mainly found at the outer core and transition to inner periphery.

On the other hand, almost all peripheral localities are found within the low and very low categories of overall QOL index. 18 localities and 6 localities have come under low and very low categories respectively. Localities like Govt. Complex, Bethlehem Vengthlang, Lawipu, Hlimen, Sakawrtuichhun, Selesih and Tanhril are found within low class category while very low class category includes Phunchawng, Tuivamit and Rangvamual. All these localities have something in common which is that their subjective QOL scores are higher than their objective scores. These localities are found at the outer peripheral parts of the city. Some localities at the outer core are also found at the bottom-half of the ranking. These localities like Aizawl Venglai, Bawngkawn South, Vaivakawn, Chhinga Veng have performed relatively better in objective QOL than subjective QOL. It seems that the residents of these localities have low levels of satisfaction with the qualities of their environment as well as the facilities and services they obtained from the authorities.

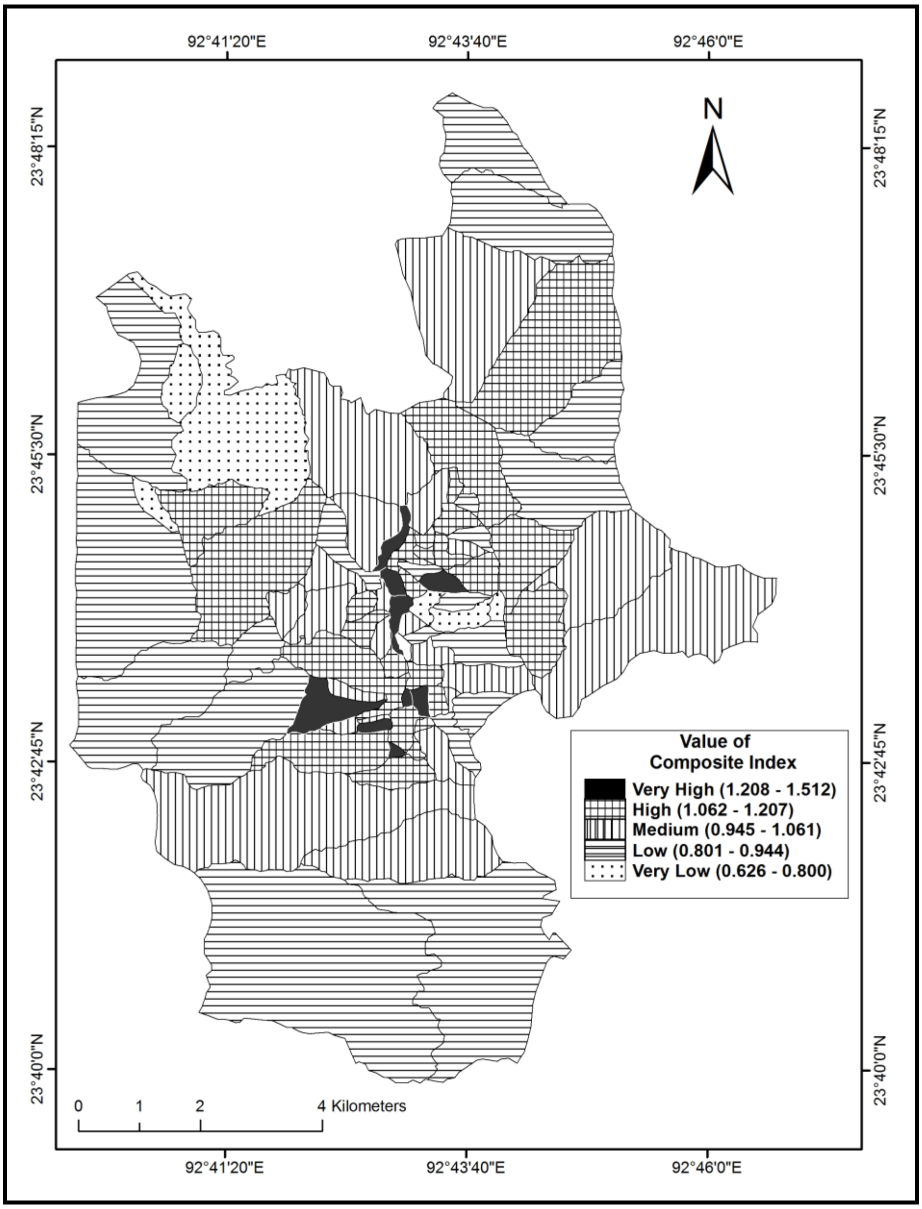

Figure 6.4 Composite Scores of Overall Quality of Life, Aizawl City.

The high subjective QOL scores in poorer localities do not mean there is no need to improve these localities. In spite of their relatively lower levels of socio-economic status and more difficult accessibility, residents of these localities were found to be satisfied in various facets of the quality of their immediate environment. The objective measureable space which has been assessed objectively with different

QOL indicators is perceived differently by its inhabitants. Although this subjective place is individually measured, perceived, defined and very personal, they are not entirely based on individual feelings but shaped in large part by the social, cultural and economic circumstances in which individuals find themselves (Rose, 1995:89). Individuals enjoyed their everyday lives in these localities and they seem to develop deep attachments to their lived-spaces through their experiences, memories and intentions. The bond between people and place is referred to as 'topophilia' by renowned geographer Tuan (1972) and is nearly related to the concept of 'sense of place'. Quality of life is a broad term and the concept of 'quality' may differ from one person to another at different time and different place. As Leitmann (1999) argued, the definition of quality is in the eyes of the beholder. The difference in the concept of QOL may be conditioned by differences in socio-physical environment that an individual has encountered in his/her lifetime and at the same time, mould his/her behaviour and opinion.

6.4 Relationship between Objective and Subjective Qualities of Life

The above analysis of quality of life has shown marked difference in the composite scores between the objective QOL and the subjective QOL. Local Councils with high objective QOL scores were found to score relatively lower in the subjective QOL.

A scatter plot is drawn to find out the relationship between objective and subjective QOL composite scores. The scatter plot (Figure 6.5) shows that the scores of objective QOL and subjective QOL are uncorrelated. The value of Pearson's product moment correlation coefficient (r) is 0.022 and the R^2 value is 0.0048. The value of correlation coefficient implies that the objective QOL parameters do not have any influence on the perceived satisfaction levels of the sampled individuals. It may also imply that a person's subjective environment is not influenced by his/her socio-economic status and the physical environment where he/he lives.

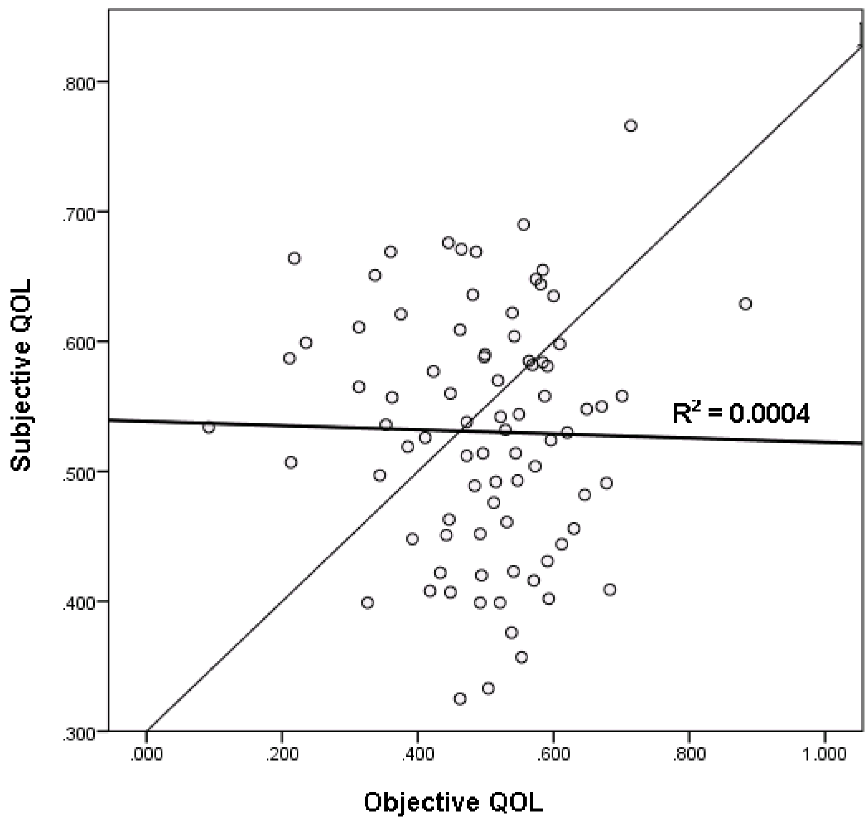

Figure 6.5 Relationship between Objective and Subjective Quality of Life.

Our result is complementary to the result obtained in previous studies (Schneider, 1975; Chan *et al.*, 2002; Das, 2008). The absence of relationship between objective QOL and subjective QOL reflects the difference between an individual's evaluation of the quality of his/her immediate environment as well as the services he/she obtained from the authorities and the objective QOL measured by aggregating indicators relating to socio-economic status of individual household, community assets and ease of accessibility Neither the wealthiest localities are considered as the best places to settle by its inhabitants nor the poorest people assessed their localities as the worst places. A family with high socio-economic status may be found in such a neighbourhood which ranks very low in their assessment of the quality of the neighbourhood. At the same time, a neighbourhood with high proportion of low socio-economic status household may found their environment a highly livable place. It may also indicate that the residential location of one's household is not affected by the perceived quality of a neighbourhood's environment

The uncorrelated relationship between objective and subjective QOL indices has prompted us to re-evaluate the nature of the selected variables. Most of the objective indicators pertain to social and economic well-being as well as accessibility measures while most of the subjective indicators are related to an individual's assessment of quality of his/her neighbourhood. The household objective indicators like per capita income, educational level might not be directly related with people's evaluations of the quality of their local environment. A household with high socio-economic status may be found at a locality which the family members deemed undesirable to settle permanently due to certain local environmental characteristics such as high incidence of crime, frequent occurrence of natural disasters, deteriorating municipal services etc based on their personal evaluations. These characteristics of local environment are not taken into account as they are difficult to quantify and information about them are not available at a small geographical scale. Even in developed countries, information about local amenities such as climate, environmental and urban conditions is difficult to collect in surveys on representative samples (Balducci and Checchi, 2009).

Moreover, the concept of QOL cannot be confined to environmental aspects alone. Although 'quality of place' is an important component determining a person's well-being, the concept of 'quality of life' is more comprehensive by cutting across a broad aspects of life including an individual's personal and social well-being, the condition of his/her immediate environment and the subjective evaluation of his/ her personal and social well-being and the environment.

6.5 Analysis of Spatial Autocorrelation

The constructions of composite indices of QOL with the help of principal component analysis (PCA) have also provided important information, apart from dimensionality reduction, about the position of each observation unit in relation to other units. However, PCA failed to address the particularities of spatial data like spatial heterogeneity and spatial autocorrelation. Spatial statistics such as global Moran's I and local Moran's I have provided important information about the association among spatial units.

In the present section, an attempt has been made to integrate multivariate PCA and spatial aspects which has been ignored by multivariate statistics. The simplest approach to integrate the two is a two-step procedure where the data are first summarized with multivariate analysis such as PCA which has to be followed by application of univariate spatial statistics to PCA scores (Dray and Jombart,2011).

6.5.1 Global Moran's I

Global Moran's I is a descriptive statistic that provides a value between -1(negative autocorrelation) and +1 (positive autocorrelation) representing dispersion and clustering patterns respectively. 'Dispersed spatial pattern' means that each value from its neighboring values is located far from each other in a uniformed manner while 'random spatial pattern' means the distribution of the values is homogenous or independent in nature. ‘Clustered spatial pattern,’ on the other hand, indicates that most of the values are concentrated to nearby locations or adjacent together (Goodchild, 1986). Moran’s I is also a significance test since a statistical significance (Z-score) is calculated for these values to determine whether the corresponding Moran’s I value indicates a significant autocorrelation.

Figures 6.6a and 6.6b plots the logarithm of objective QOL scores (Obj_Score) against its spatial lags (lagged Obj_Score) and of the subjective QOL scores respectively. The scatter plots are obtained with the help of GeoDA softwares. Figures 6.6c and 6.6d are the global Moran’s I graphical result of the same data with the help of ArcGIS software.

The slope of the regression line in Figure 6.6a expresses the global Moran’s I value for objective QOL score which is 0.385. The positive value of global Moran’s I indicates the existence of moderately strong spatial correlation. The value corresponding to Z-Score (5.450) is significant at 95 % level of confidence as shown by pseudo p-value of 0.001 at 999 permutations as shown in Table 6.8. The ArcGIS result (Figure 6.6c) also indicates that the value is even significant at 99 % level of confidence. Thus, we reject the null hypothesis that ‘there is no spatial clustering’ but statistically proved that objective QOL scores are highly clustered.

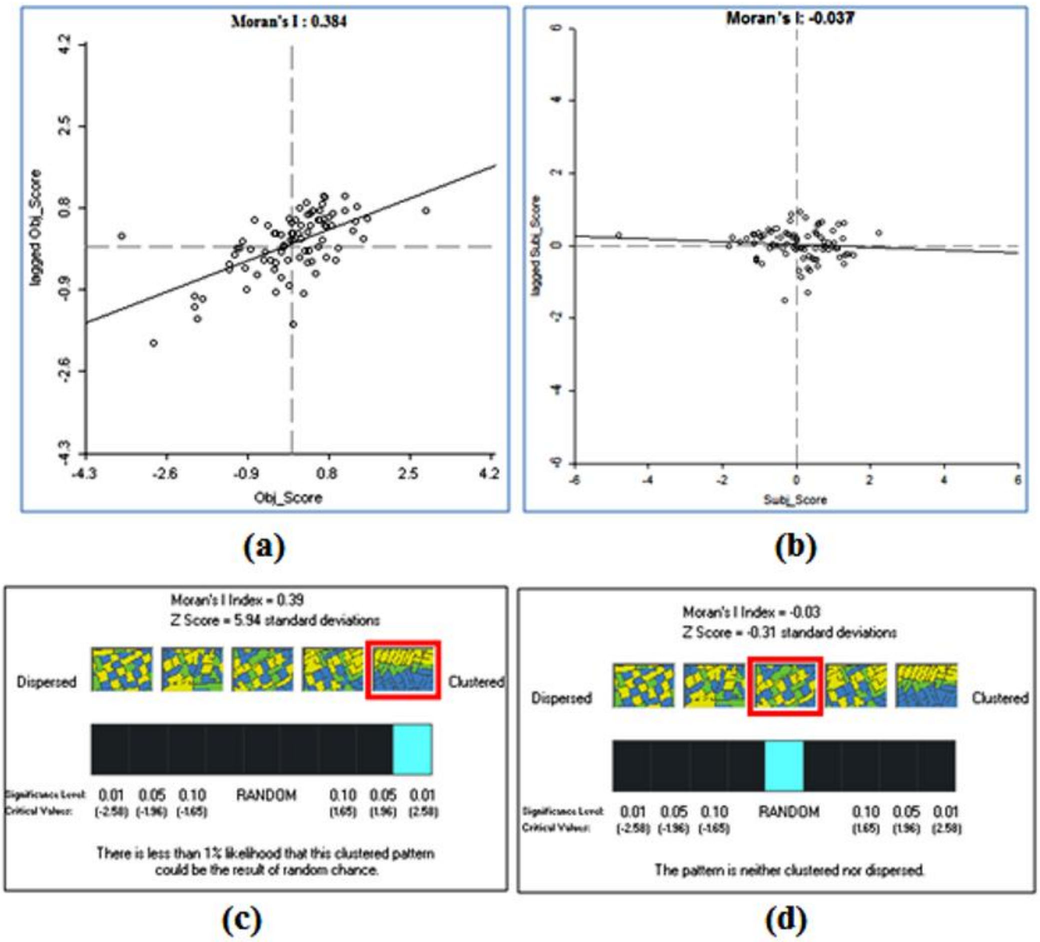

Figure 6.6 Global Moran’s I Results for Objective Quality of Life.
(a) Moran’s I scatter plot for objective QOL score using Queen Weight in GeoDa.
(b) Moran’s I scatter plot for subjective QOL score using queen weight in GeoDa.
(c) Moran’s I visualization result for objective QOL score using polygon contiguity (first order) in ArcGIS.
(d) Moran’s I visualization result for QOL score using polygon contiguity (first order) in ArcGIS.

Table 6.8 Descriptive and Inferential Statistics for Moran’s I in Geoda.

Statistics	Result		
	Objective QOL	Subjective QOL	Overall QOL
Global Moran's I	0.384	-0.037	0.141
SD	0.071	0.066	0.063
Z-Score	5.450	-0.398	2.415
P-Value	0.001	0.354	0.007
E(I):Theoretical Mean	-0.012	-0.012	-0.012
Mean	-0.005	-0.011	-0.012

On the other hand, Figure 6.6b provides the Moran's I scatter plot for subjective QOL score. The global Moran's I value is -0.038 which is almost zero with pseudo p-value of 0.354. Although the value is negative, it is not strong enough to indicate negative spatial autocorrelation which suggests that a significant number of localities with high (or low) index value would be found in the vicinity of low (or high) index value. These localities are known as spatial outliers. Thus, we may conclude that subjective QOL scores are neither clustered nor dispersed but randomly distributed as shown in Figure 6.6c. The scatter plot result produced with the help of GeoDa software is also corroborated by the ArcGIS result (Figure 6.6d). The non-existence of spatial pattern-clustering or dispersion may be explained as the outcome of consensus among neighbouring localities in their perceived levels of satisfaction.

6.5.2 Local Indicators of Spatial Association (LISA)

For objective QOL score, a cluster map based on LISA statistics is prepared. The map identifies the units for which the local Moran statistic was considered statistically significant (pseudo p-values < 0.05 based, on a random permutation procedure). Two distinct spatial clusters which correspond to positive spatial autocorrelations are clearly visible. The High-High (H-H) cluster consisting of 14 localities was found at the central part of the city. Localities forming H-H cluster are Laipuitlang, Ramhlun Venglai, Chanmari, Chanmari West, Aizawl Venglai, Zarkawt, Electric Veng, Dawrpui Vengthar, Tuikual South, Vaivakawn, Khatla, Bungkawn Vengthar, Mission Veng and Mission Vengthlang. The High-High cluster is also known as 'hot spot'. As shown in Figure 6.7, some medium performing localities are included under hot spot as they are lying nearby high scoring localities On the other hand, the Low-Low (L-L) cluster consists of 7 localities including Rangvamual, Phunchawng, Sakawrtuichhun, Tanhril, Luangmual and Tuithiang. Except the last one, all localities are found at the northwestern corner of the city. The Low-Low cluster is also known as 'cold spot'.

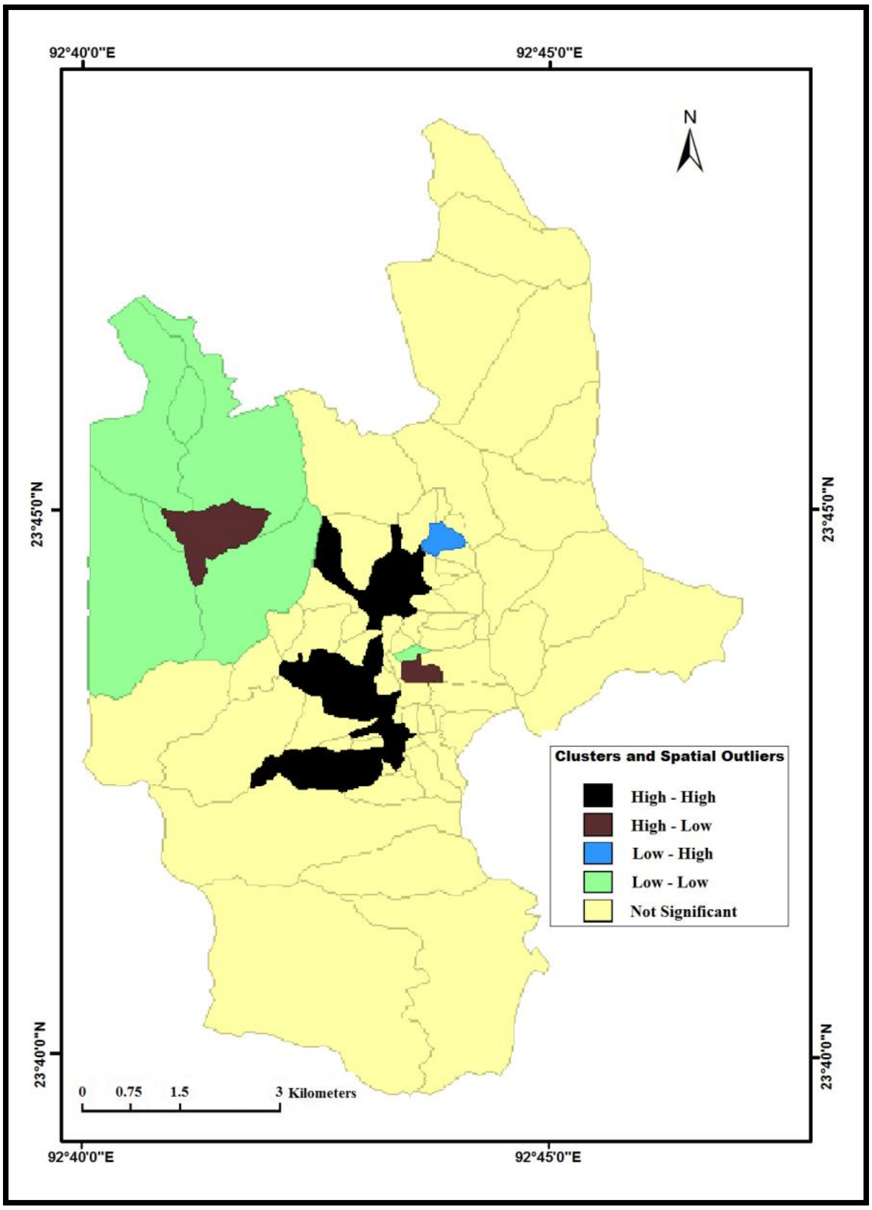

Figure 6.7 Univariate LISA Cluster Map for Objective QOL using Queen Weight in GeoDa.

Adjacent to these hot and cold spots are High-Low (H-L) and Low-High (L-H) localities which are known as potential spatial outliers. Relatively high scoring localities like Chawlhhmun and Bethlehem Veng form separate H-L clusters as they located nearby to low scoring localities while only Bawngkawn South comes under L-H cluster. Spatial outliers are few and may be considered virtually residual. It may also be seen that a large majority of localities (57 localities) do not show any significant spatial autocorrelation. In sum, the LISA map for objective QOL shows that higher objective QOL scores clustered at the central part of the city while lower scores concentrated in the northeastern periphery.

For subjective QOL score, the global spatial autocorrelation statistic shows no clustering or dispersion and almost all localities are not significant. Only two localities form hot spot and only one locality forms a cold spot. Thus, LISA map is not prepared for subjective QOL score.

The Moran's I scatter plot for overall QOL and its LISA cluster map are presented in Figures 6.8a and 6.8b. The Moran's I value for overall QOL is 0.141 which is low positive spatial autocorrelation. The value is, however, significant at 95 per cent level of confidence (or 0.05 significance level) as the pseudo p-value is greater than the global Moran's I statistic.

For overall QOL, the LISA cluster maps shows that there are two High-High (H-H) clusters. One cluster is formed by Chanmari, Zarkawt and Electric veng. Another H-H cluster is formed at the southern side of the inner city comprising of localities like Upper Republic, Mission Veng, Nursery and Mission Vengthlang.

The LISA cluster map also shows two L-L clusters or cold spots - one at the western periphery and the other at the inner part of the city. The L-L cluster at the western corner is comprised by Phunchawng and Rangvamual while the cold spot at the inner city is consisting of Saron Veng and Tuithiang. Adjacent to these cold spots are two spatial outliers (H-L) - Chawlhhmun and Bethlehem respectively. Another spatial outlier (L-H) consisting of localities like Chaltlang, Aizawl Venglai, Dawrpui Vengthar and Tuikual North is found at the central part of the city. These low performing localities are found nearby to the better performing localities.

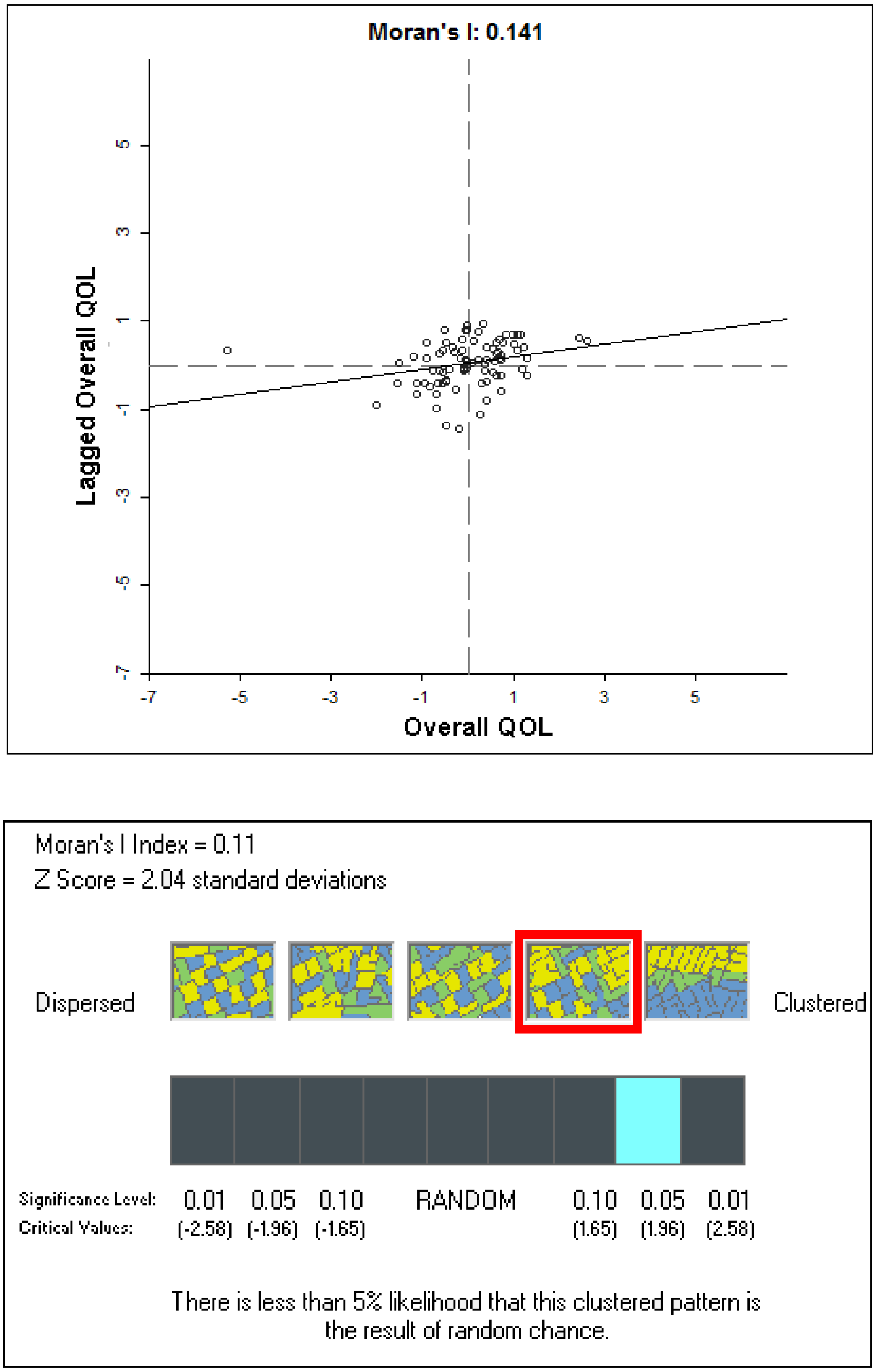

Figure 6.8 Global Morans's I Results for Overall Quality of Life.
(a) Moran's I scatter plot for objective QOL score using Queen Weight in GeoDa.
(b) Moran's I visualization result for QOL score using polygon contiguity (first order) in ArcGIS

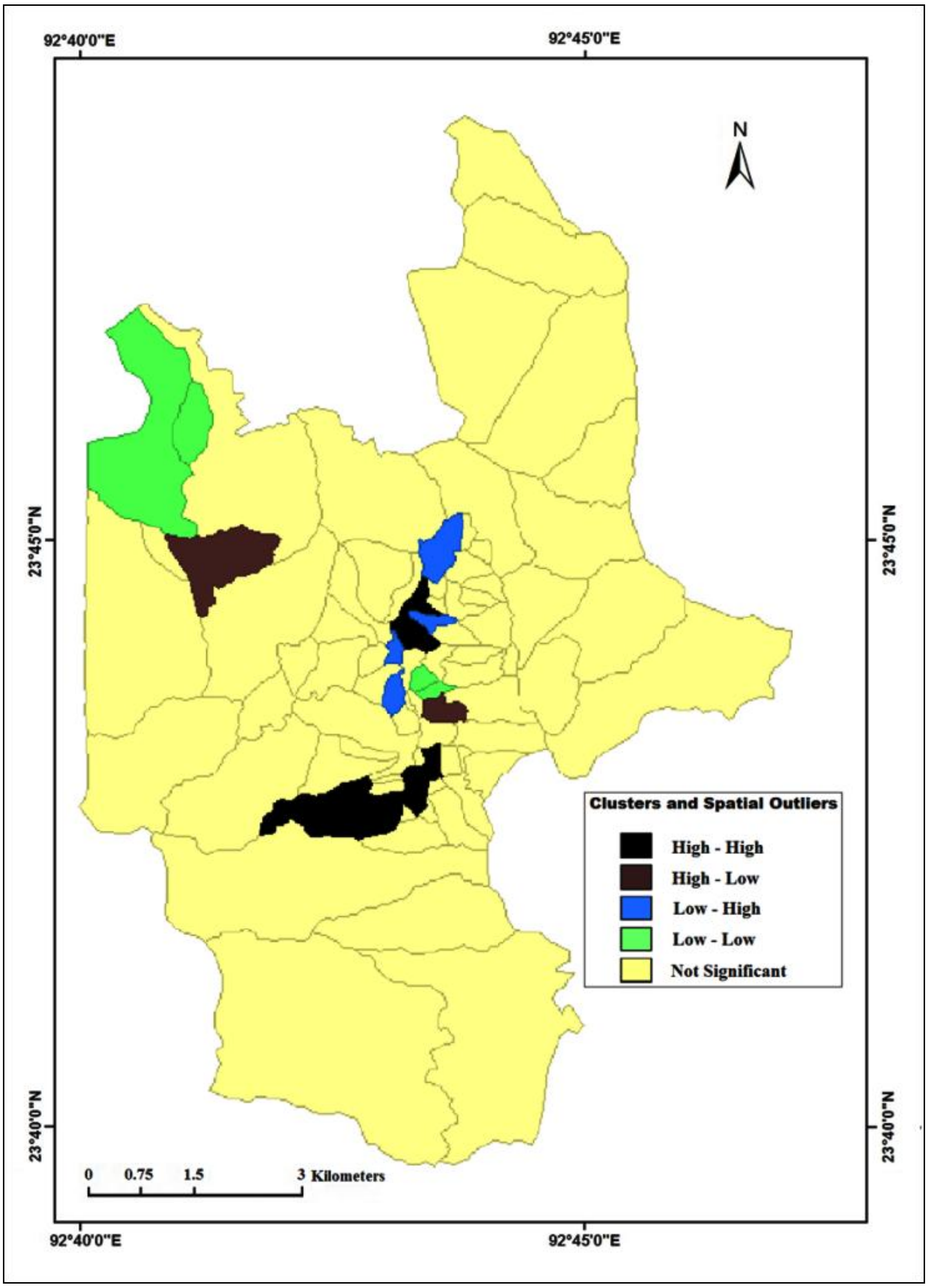

Figure 6.9 Univariate LISA Cluster Map for Overall QOL using Queen Weight in GeoDa.

As a whole, the LISA map for overall QOL scores shows that both low scoring and high scoring localities are found in inner city areas. Some localities in the inner city area which perform very well in objective QOL measures failed to score high in the subjective measures. As a result, the inner city area is characterized by high scoring localities at the core surrounded by low scoring localities. On the other hand, some other localities with high objective QOL scores like Zarkawt, Chanmari and Electric Veng also scored high in subjective QOL. Thus, they formed a cluster of high scoring localities for the combined score of objective and subjective QOL.

6.6 Social Areas and Quality of Life

In the present section, an attempt has been made to identify groups of localities on the basis of their scores in different dimensions of residential differentiation as carried out through factor analysis in Chapter 5, and to observe the mean composite QOL scores of the identified clusters or groups of localities. This would help in identifying the quality of life in various clusters of residential areas.

Identification of clusters or groups of residential areas on the basis of similarities in their characteristics is done with the help of cluster analysis. Cluster analysis is different from the above LISA clustering method that while the univariate LISA cluster map is produced with the help of spatially weighted variables in a georeferenced space, cluster analysis is aspatial, multivariate data reduction method by taking distance along variables for grouping observations. Here, cluster analysis is preferred to spatial autocorrelation statistics because we are not interested in finding pattern in which observations from nearby locations are more likely to have similar magnitude than by chance alone.

Cluster analysis has been popularly employed by geographers for the purpose of regionalization and city classification (Mather, 1969; Knox, 1961, Dawson, 1972; Kalal, 2002; Wang, 2006). Unlike discriminant analysis, the technique creates new groupings without any preconceived notion of what clusters may arise.

To perform cluster analysis (CA), the factor scores were taken as variables to group localities into different types of clusters or social areas. The five variables were processed with the help of hierarchical clustering method by taking Euclidean distance as distance or dissimilarity measure and Ward's method as clustering method. Then, a dendrogram was produced with the help of which the number of clusters have to be determined.

Figure 6.10 shows a dendrogram with 82 observations or cases. The horizontal line represents observations while the vertical axis indicates a distance or dissimilarity measure. A good cluster solution is one with small within-cluster distance, but large between-cluster distance. After considering different cut-off points, a line is drawn at 19 dissimilarity distance unit to obtain a seven cluster solution with one cluster for each point where a branch intersects the cut-off line. The identified clusters are depicted in Figure 6.11.

The characteristics of the identified clusters are described with the mean scores of the five factors and mean composite QOL scores as given in Table 6.9. It may be noted that both objective and subjective QOL scores were normalized with the help of Min-Max method of normalization having a range 0 - 1. Factor scores, on the other hand, were the result of standardized variables with the help of Z-scores with zero mean.

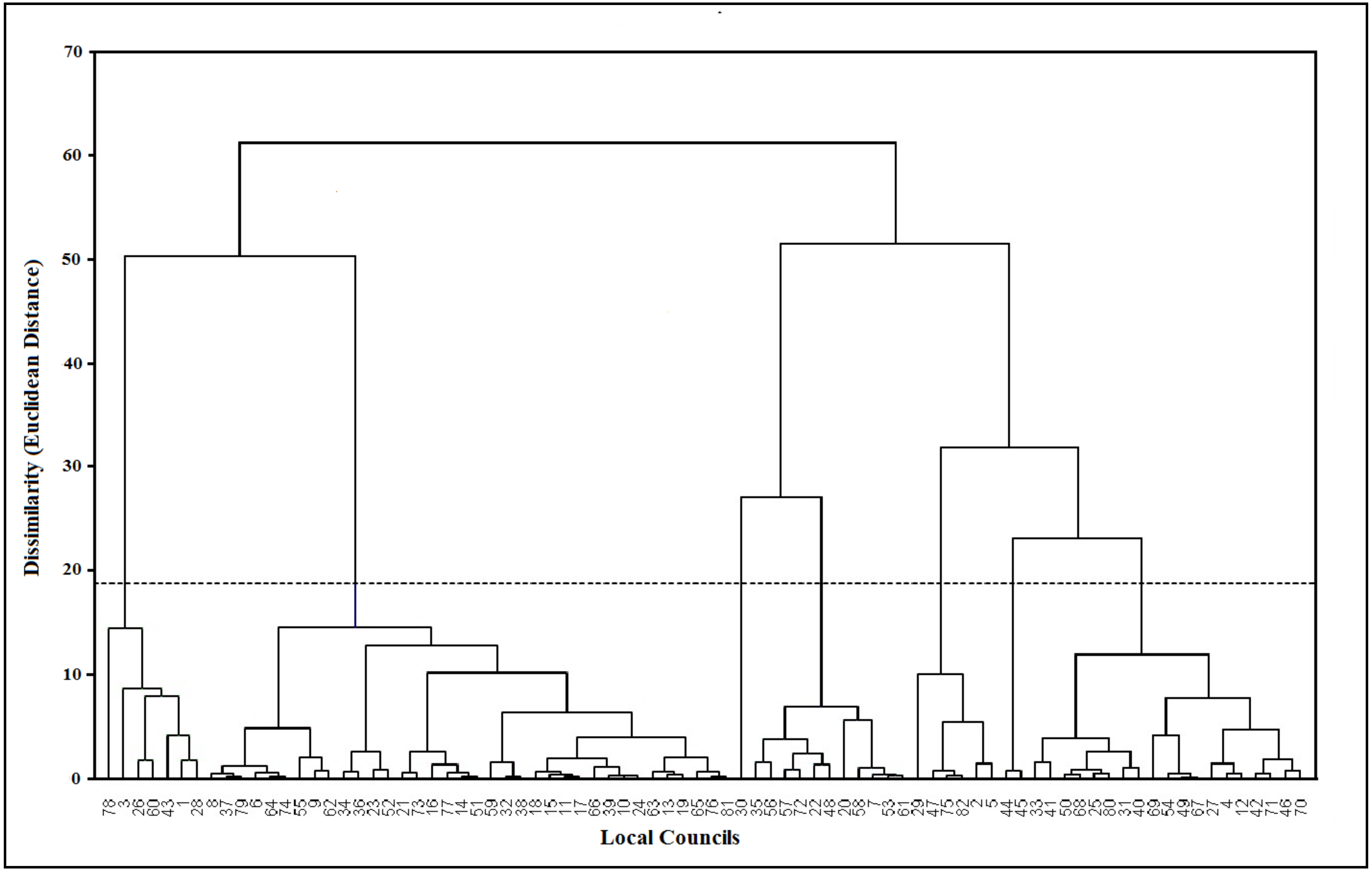

Figure 6.10 Dendrogram of Hierarchical Cluster Analysis.

* Figures 1-82 along the horizontal line refers to serial number of Local Councils as given in Appendix-B (Page No. 212-213).

Table 6.8 Mean Scores of Indices of Quality of Life and Factor Scores by Clusters.

Cluster	Objective QOL	Subjective QOL	Overall QOL	Socio-Economic status	Family Status	Household Status	Worker Status	Ethnic Status
1	0.370	0.561	0.931	-1.279	0.434	-0.553	-0.082	2.234
2	0.485	0.495	0.980	0.501	-0.722	-1.363	-1.739	-0.073
3	0.437	0.548	0.986	-0.290	-0.726	-0.503	0.221	-0.742
4	0.534	0.521	1.055	-0.014	0.770	0.183	0.155	-0.272
5	0.650	0.537	1.187	1.580	-0.605	0.817	0.043	0.706
6	0.326	0.399	0.725	-1.344	-1.322	3.850	-3.070	-0.560
7	0.152	0.561	0.712	-2.032	-2.333	1.102	1.904	0.751
Mean	0.498	0.531	1.028	0	0	0	0	0

Cluster 1: Outer Peripheral Low-Class Ethnic Enclave

The first cluster consists of Zuangtui, Muanna Veng, Zemabawk, Thuampui, Sakawrtuichhun, Lawipu and Melthum. These are peripheral localities and are distinguished from other localities by relatively lower socio-economic status and higher non-scheduled tribe population. This cluster is therefore labeled ‘Outer Peripheral Low Income Ethnic Enclave’. This cluster is also characterized by larger family size and low female workforce.

This cluster is characterized by relatively lower overall QOL score in comparison to other clusters except Clusters 6 and 7. The mean objective QOL for Cluster 1 is much lower than the mean objective score for the entire data set. On the other hand, the mean subjective QOL score for this cluster is higher than the mean score for the entire data set. This indicates that while the personal QOL of the residents of this cluster is relatively low, they are more satisfied with the quality of their immediate environment than the residents of half of the localities.

Cluster 2: Proto-Urbanized Outer Periphery

The second cluster is formed by localities with contrasting character. The residents of Durtlang North, Falkland, Chawlhhmun, ITI and Saikhamakawn are enjoying relatively higher socio-economic condition but still characterized by larger family size, younger age structure and male dominated workforce.

The mean scores of objective QOL and subjective QOL for this cluster are 0.485 and 0.495 respectively for a range of 0 to 1. The scores are both slightly lower than the averages for the entire data-sets. Residents of these localities are less satisfied in their qualities of life than all other clusters except Cluster 6. On the other hand, their objective QOL comprising of socio-economic and accessibility dimensions is less than Clusters 4 and 5 only. For overall QOL, this cluster is the 4th highest ranked cluster.

Cluster 3: Low-Class Inner Periphery

The third cluster comprises 19 localities which are characterized by low socio-economic status with the exception of Upper Republic. The age structure is relatively younger with higher proportion of married female population. Percentage of female workers is found be relatively higher in comparison to the first two clusters. With the exception of Tuivamit and Govt. Complex, these localities have relatively lower proportion of non-local population. Many of them are newly formed localities which were inhabited after the Insurgency period. The old localities like Durtlang, Tanhril, Salem, Venghnuai and Hlimen could not translate the advantage of their earlier existence into benefits due to locational disadvantages.

Cluster 3 is slightly performing better than cluster 2 for overall QOL. The mean subjective QOL score is higher 0.548 while the mean objective QOL score of the cluster is lower than average (0.437). The relatively high subjective QOL score says that residents are more satisfied with the quality of their environment and services provided to them in comparison to their personal well-being.

Cluster 4: Medium-Class Modern Lifestyle Outer Core

The outer core surrounding the inner core areas are inhabited by medium socio-economic class. Altogether, this cluster comprises 36 localities. With the exception of Bawngkawn, Ramhlun Venglai, Mission Veng, and Ramhlun South, localities belonging to this cluster are all categorized below medium socio-economic class. Other characteristics of this cluster are relatively mature population and smaller family size. The proportion of female working population to total working population is also relatively high. In spite of the prevailing relatively lower socio-economic condition, all these characteristics indicate a modern lifestyle, a departure from traditional large family, male dominated working population. This cluster comprises the northern group of localities that stretch from Ramhlun South to Bawngkawn and the southern group including Mission Veng and its surrounding areas like Model Veng, Thakthing, Dam Veng, Kulikawn, and Tlangnuam. It also comprises localities at the eastern and western slopes of the main Aizawl ridge.

Cluster 4 scores higher than the preceding clusters for overall QOL. The mean overall QOL score of cluster 4 is 1.055 which is also higher than the mean score for all localities except cluster 5. This cluster performs better in the objective QOL than the subjective QOL. The relatively higher score in objective QOL indicates the higher socio-economic status of the localities within this cluster and the better condition of these localities with respect to accessibility to infrastructural services.

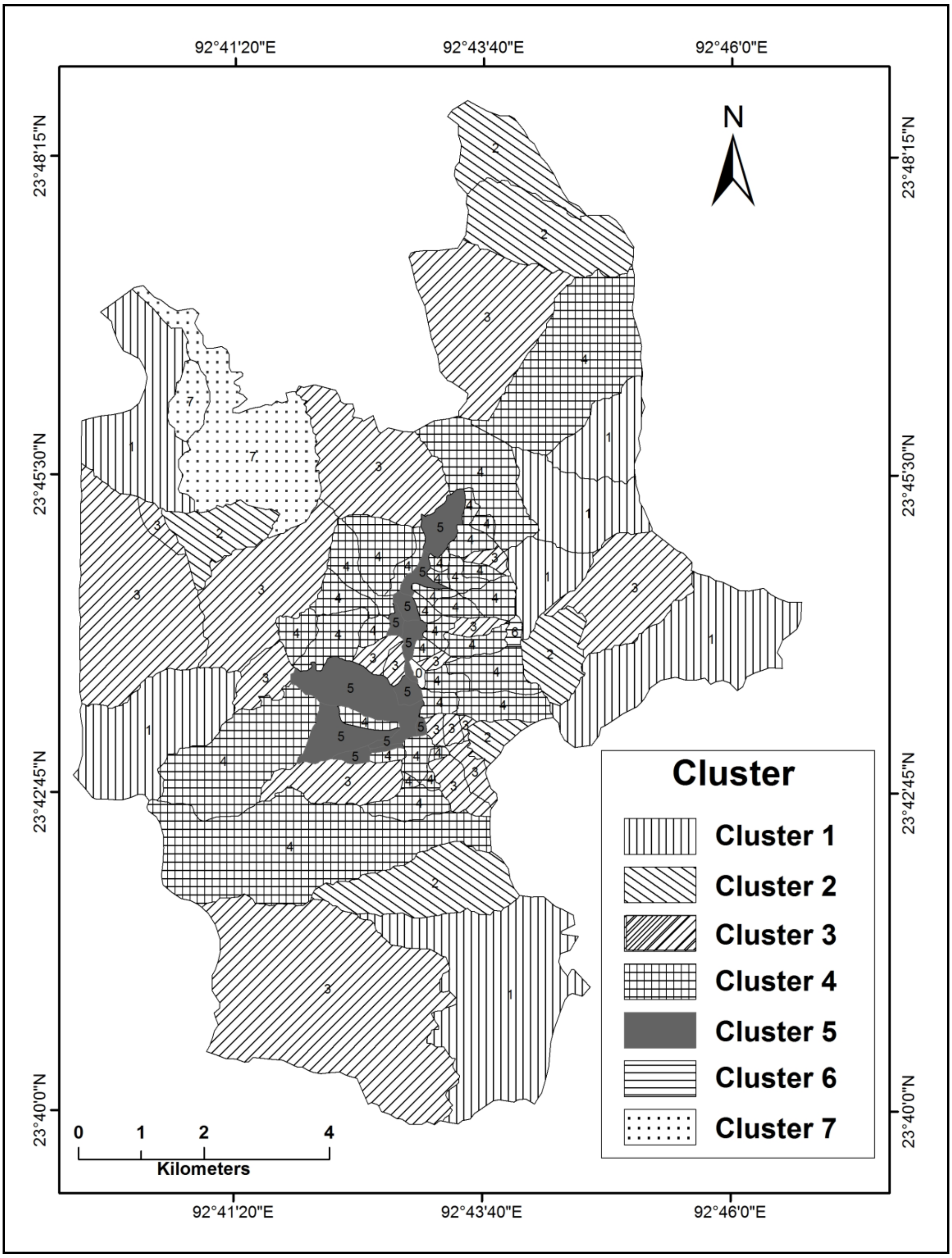

Figure 6.11 Clusters of Localities showing Social Areas of Aizawl City.

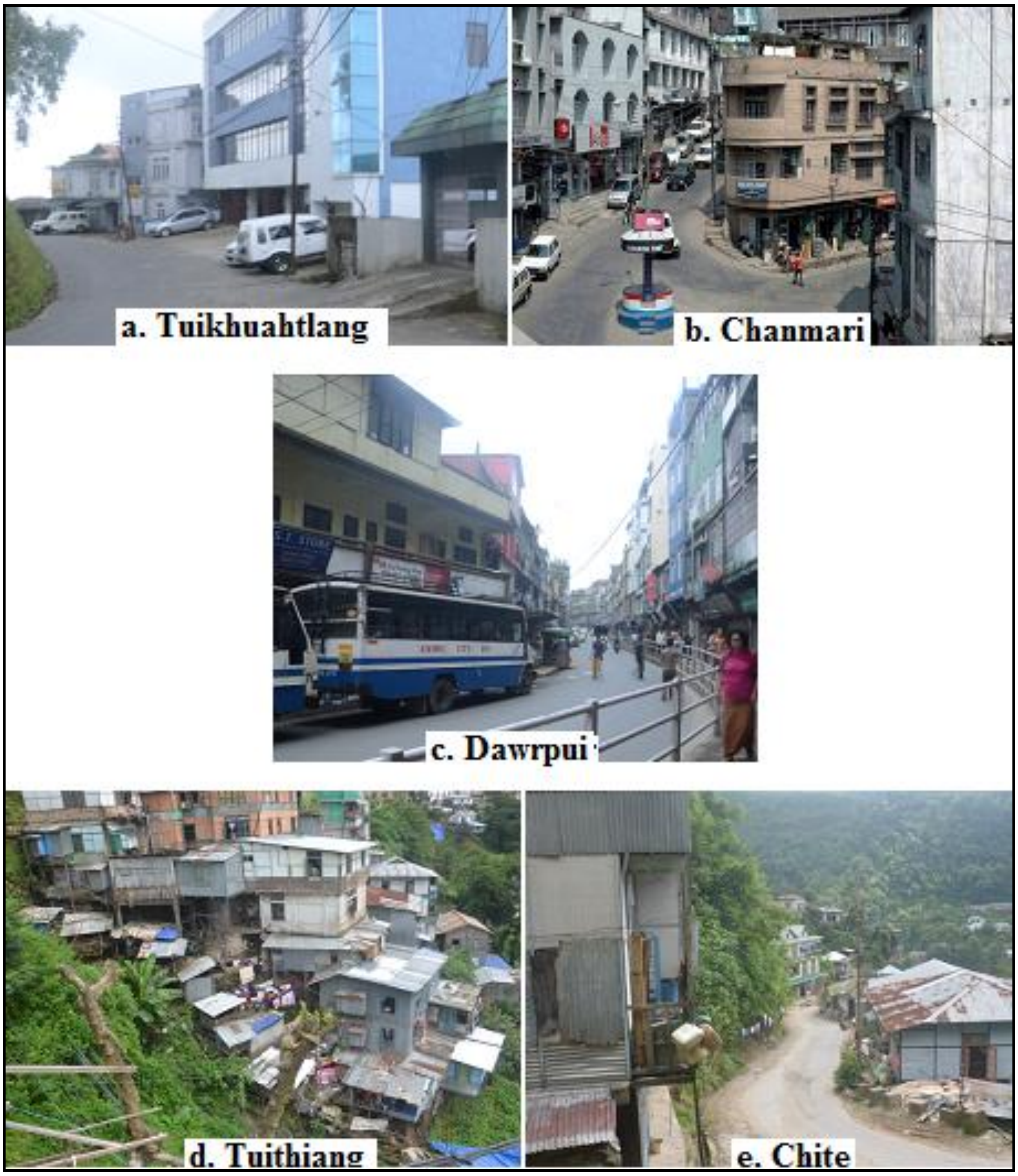

Plate 6.1 A Collage of Photographs showing Localities in Aizawl City.

Cluster 5: High-Class Modern Lifestyle Inner Core

This cluster may be sub-divided into cluster based on geographical locations. One sub-cluster is found at the Northern part of the central business district (CBD). This sub-cluster comprises the wealthiest localities like Zarkawt, Dawrpui, Chanmari, Chaltlang, and

Dawrpui Vengthar. Another sub-cluster is found at the southern part of the CBD. This sub-cluster comprises contiguous localities like Khatla, Khatla East, Tuikhhuahtlang, Nursery, and Bungkawn. Tuikual South is found in between these two sub-clusters. All these localities possess urban characteristics including small and young family, high proportion of female working population and a significant proportion of non-local population.

This cluster is the best cluster in terms of objective QOL with mean score of 0.650. However, the mean subjective score is the third lowest among the seven clusters. In spite of this, it retains the top spot in the overall QOL score owing to the much better score in objective QOL. This cluster may be considered as the most wealthy and most accessible cluster but with low satisfaction level of its residents to their surrounding environment and on services provided to them.

Cluster 6: Isolated Slum

Chite Veng emerged as a separate cluster. Located nearby the small River Chite from which the locality has taken its name, Chite veng is one of the most inaccessible and underdeveloped parts of the city. It has been physically separated from other localities due to poor linkages. It is a newly established locality (that the Mizos had the tradition of avoiding valleys for settlement) that has been mainly inhabited by poorer people with limited residential choice. Surprisingly, the area is inhabited by small family households.

Chite cluster/locality has low mean scores for both objective and subjective QOL. In terms of overall QOL, it is the second lowest ranked cluster. The peculiarity of this cluster is neither objective QOL nor subjective QOL has high score while all other clusters have shown considerable difference between the two.

Cluster 7: Outer Peripheral Slum

These two neighbouring localities are found at the western corner of the city. They are the least developed localities. They are located at a considerable distance from other localities and from each other by uninhabited land. They are old localities and even existed during the colonial period. Today, they are known as 'liquor towns' due to number of people who are involved in selling prohibited local liquor'. Drinking of liquor is considered as a taboo by the 'christianized Mizo society' and has been prohibited by the State for a long time. These two localities act as 'havens' for liquor sellers and drinkers on account of their distance from the main city and low socio-economic condition. The age structure is young population with relatively high female work participation rate. Female work participation rate as measured by percentage of female main workers to total main workers and percentage of female workers to total workers is very high due to opportunity to work on agricultural field and informal sector.

The quality of life of the residents of this cluster is the worst among all the residential clusters identified within the city. The mean objective QOL score is very low (0.152) indicating the extreme level of deprivation of the residents. Intriguingly, the mean subjective QOL (0.561) is relatively high which suggests that residents of this two localities are satisfied enough with the quality of their environment and, to a lesser extent, the services extended to them.

CHAPTER-VII

CONCLUSION

Every social process has cause and effect relationship with geographical space. Social processes and events took place in space and a geographer's role is to read, analyse and interpret the complex nature of two-way interrelationship between society and space. Spaces are created, modified and even destroyed by society while individuals are being conditioned and influenced in various ways by the spaces in which they live.

Residential pattern and spatial variation in quality of life are the products of socio-spatial interaction. To understand the underlying process and the nature of interaction between nature and culture on a particular urban space is an important task in the production and enhancement of knowledge. The complexity and dynamics of their interaction often resulted in differentiation of urban space but organized in a more or less regular fashion to produce patterns. The present study is also an attempt to observe the processes and patterns of urban differentiation and spatial variation in quality of life in a rapidly growing hill city.

Aizawl city was selected as the site of study as the fast growing hill city in the eastern Himalayan region has not received any kind of study like this before. Hill cities across the world have been usually neglected in research work. Moreover, the city is particularly interesting - it is a monocentric city with negligible proportion of industrial workers and a highly homogenous population in terms of ethnicity.

The city has grown out of colonial military outpost to become a city with 3 lakh population during a period of 100 years. The growth rate of the city's population was very high during 1901-1911. This was the initial period of consolidation of Aizawl as the official headquarters of the colonial British Empire in Mizo Hills. The colonial administrators however maintained strict regulation to discourage migration as a result of which the growth of population remained stagnant during the colonial period.

The post-Independence period has witnessed rampant growth of Aizawl population. The decadal growth rate of Aizawl has continuously exceeded 3 digits during 1951-1991. This may be attributed to a number of factors including removal of the strict migration control policy, the infamous 'insurgency' that occurred during 1966-1986 and the attainment of Union Territory in 1972 which resulted into large-scale opening of government jobs and concomitant increase in employment opportunities in other sectors.

After witnessing a long period of rapidly increasing growth rate, a significant slowdown of population growth has been witnessed after the inter-censal year of 1981-1991. In fact, there is a reversal of population growth rate of Aizawl city. The decadal growth rate has been declining continuously from 134.69 in 1971-1981 to 28.56 in 2001-2011. A number of factors like lack of employment opportunities, deterioration of infrastructures, notification of a number of bigger villages as urban centres after 1981 census, and creation of new districts have been attributed as the main causes of rapid declining of population growth rate of the city.

The negligence of planning in the post-Independence period has created Aizawl city as a highly congested, compact, monocentric, un-orderly and chaotic city. Inadequate and narrow roadways restricted mobility and expansion of settlement took place along the few roadways. This limitation encourages intensive use of land in the inner part of the city. Multi-storey buildings are constructed even at high degree sloping surfaces. When the heavy torrential Monsoon rain falls on the unstable geology, the hill slopes often fail to hold together resulting into landslide and slumping.

Residential pattern is studied horizontally and vertically. Horizontal pattern of residential differentiation was analyzed with the help of factor analysis. It was found out that the city's urban space was differentiated along five axes - socio-economic status, family status, household size, working population status and ethnic status.

The horizontal pattern of residential differentiation is highly comparable with those of western industrialized cities. The horizontal space of the city is differentiated along socio-economic status, family status, household status, workers status and ethnic status. Like western cities, the most important factor determining urban social differentiation is found to be socio-economic status.

Our first hypothesis that residential pattern in Aizawl city is primarily differentiated along socio-economic status has been validated successfully. Variables related to socio-economic status form the first factor which explained the largest variance. It has also been found out that localities with high socio-economic status are found along the most important route in the city i.e. Bawngkawn-Kulikawn (B-K) route that runs through the main commercial area. The residential pattern, therefore, largely conforms to the Hoytian sector model. It has also been found out that family size increases with distance from the city centre as conceived by Burgess' concentric zone theory. However, unlike western capitalist cities which are older, bigger and highly industrialized, a clear-cut zonal or concentric pattern failed to evolve in Aizawl city.

It has also been identified that high socio-economic status localities are normally found at the inner parts of the city while localities with low socio-economic statuses are found at the peripheral areas. This implies that 'inverse-Burgess pattern' is an important characteristic of residential pattern in Aizawl city. The pattern is also commonly observed Mediterranean cities and some developing cities.

Another important finding of the study is that localities at higher altitude or hilltops were found to be inhabited by high status population as envisaged by Burgess' altitudinal zonation theory (Burgess, 1929). Hilltop localities like Tuikhuahtlang. Laipuitlang, Chaltlang and Thakthing are all high status localities. However, all hilltop localities are not the most developed localities, but only those localities which are either lying along or nearby the Bawngkawn- Kulikawn (B-K) route are classified under high status.

The second hypothesis of the study is that 'unlike industrialized and western cities, residential pattern in Aizawl city does show any differentiation on the basis of family or demographic status and ethnicity'. This hypothesis was framed keeping in mind the lower level of societal scale in comparison to western society and the relatively few non-local population in the city. Our analysis, however, revealed that the city is also differentiated along family status, household size status and ethnic status. Ethnic localities are mostly found at the peripheral areas of the city. Interestingly, the spatial distribution of non-scheduled tribe population largely conforms to multiple nuclei model which maintains that the locations of these nuclei are determined by the tendency of some social-group to separate from others due to externality effects. It may be noted that the only significant difference between the general horizontal pattern of the study area and most western cities is that family related variables failed to form under a single dimension but disaggregated into two factors viz. family status and household size status. This may be related to the difference in social structure between the tribal society and industrialized society.

Confirming to the third hypothesis, vertical pattern of residential differentiation is observed in the city. The lowest basements of multi-storey buildings were occupied by the lowest income classes and the top floors were occupied by the highest income classes. In terms of composition, medium income households were the most numerous while very high and low income groups are the least numerous classes. Coincidently, the basement households were usually renters and the topmost households were the owners of the building. Household income generally declines from top to bottom floor. The poorer people stay at the lowest basement while the richer sections are found at the top floor. The basements of multi-storey buildings may be considered as 'spaces of transition' where the residents were temporarily staying in the early stage of their life cycle.

The pattern of vertical differentiation is, however, not similar to the pattern observed in Mediterranean cities where the lower classes are more concentrated at the top floors. The difference is due to the popularity of basement floors in multi-storey buildings in Aizawl city which have been constructed by following the configuration of hilly terrain. Thus, Aizawl city has its own distinction by presenting both horizontal and vertical patterns of residential differentiation.

Quality of life is another main focus of the study. It was found that the composite scores of objective quality of life were higher in inner city localities in comparison to localities at greater distance from the city centre. On the other hand, the inner city localities did not perform better in the measurement of subjective QOL. Obviously, the overall QOL is better in centrally located areas in comparison to peripheral localities. The fourth hypothesis that states that QOL is higher in centrally located localities than in peripheral localities is, therefore, verified successfully.

Analysis of relationship between objective and subjective qualities of life with the help of correlation analysis did not show any significant relationship between the two. High scoring localities in objective QOL have scored relatively low while high scoring localities in subjective QOL includes were some of the lowest scoring localities in objective QOL. It has been maintained that residents of socio-economically poorer areas are no less satisfied than their counterparts in richer localities but even more satisfied with their perceived personal well-being and the quality of their immediate environment.

The analysis of spatial autocorrelation to show the spatial clustering or dispersion of localities on the basis of their composite scores on both objective and subjective qualities of life has been taken out with the help of global Moran's I. For objective QOL, the value of global Moran's I indicated that a moderately strong spatial autocorrelation existed among the localities. The null hypothesis that 'there is no spatial clustering' is also rejected at 95 % level of significance. Thus, we have statistically proved that objective QOL scores are highly clustered. For subjective QOL score, the global Moran's I value is found to be very low which indicates that localities are neither spatially clustered nor dispersed but are randomly distributed. The random distribution of localities with respect to subjective QOL score may be explained as the absence of spatial effects on individuals' perception to quality of life.

Local indicators of spatial association (LISA) is another spatial autocorrelation technique that measure the characteristics of individual localities and provides a map that shows spatial clusters and spatial outliers. The LISA map for objective QOL shows that 14 high scoring localities at the central part of the city are found adjacent to each other thereby forming hot spot or high-high cluster. On the other hand, 7 adjacent localities at the western part of the city together formed cold spot or low-low cluster.

For overall QOL, the global Moran's I value is 0.141 which is low positive spatial autocorrelation. The value is however significant at 0.05 significance level. This implies that clustering rather than dispersion is observed. Two hot spots were identified for overall QOL. One hot spot includes three centrally located wealthy localities such as Chanmari, Zarkawt and Electric Veng. Another hot spot is formed by four localities at the southern side of the inner city. Adjacent to these two hot spots were four low scoring localities. The existence of low scoring localities at the inner part of the city is attributed to their low scores on subjective QOL. Two cold spots were also identified-one at the western periphery and the other at the inner part of the city. The cold spot at the western corner was formed by Phunchawng and Rangvamual while the cold spot at the inner city consisted of Saron Veng and Tuithiang. Adjacent to these cold spots were two high scoring localities.

The culmination of the study is the identification of clusters of related variables pertaining to residential pattern and the aggregate QOL in each cluster. Cluster analysis was used to group localities on the basis of the factor scores obtained from factor analysis. Seven clusters were identified. They are outer peripheral low-class ethnic enclave, proto-urbanized outer periphery, low-class inner periphery, medium-class modern lifestyle outer core, high-class modern lifestyle inner core, isolated slum and outer peripheral slum. These clusters may be conveniently identified as 'social development planning zones' for obtaining equitable and inclusive development in Aizawl city.

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APPENDICES

Appendix-A: Schedule for Household Survey

The Survey is about the condition of residents of Aizawl City and is purely intended for research purpose. Participation is completely voluntary. The responses will be kept confidential.

Ward No. : _______________ Name of Local Council : ____________

House No. : _______________ Block No : ____________

Part A: Objective Questions

1. Type of House :
2. No. of Storey (if any) :______________
3. Floor No.: (Tick Any one from below)

B1	B2	B3	B4	B5	B6	B7	B8	F0	F1	F2	F3	F4	F5	F6

4. Floor Area (sq. ft.) :________________
5. Ownership : Owner/Renter (Quarters/Private Building)
6. If rented, House rent : Rs. ______________/month
7. If owned, rent value : Rs. _____________ / month
8. Age of Building : __________________ years

9. Family & Occupation Status

Sl. No.	Name	Sex (M/F)	Age	Relationship with head	Occupation (be specific)	Edu. Qlfn.	Avg. Monthly Income Rs.)
1							
2							
3							
4							
5							

10. Ethnic Status

Sl. No.	Name	Religion/ (Denomination)$	(Mother Tongue) Ethnicity *	If migrated, Origin#	Year	Reason(s)
1.						
2						
3						
4						
5						

$ Religion includes Christian (Presbyterian, Baptists etc), Hindu, Muslims, others.
* Ethnicity includes Lusei, Hmar, Paite, Lai, Mara, SC, OBC, General & others).

Origin indicates name of village/states/country.

11. Household Amenities

Amenities	No.	Amenities	No./Rs.
Rooms		Motor vehicle (4 wheelers)	
Bank account		Mobile phone	
Television		Landline connection	
Refrigerator		LPG connection	
Computer		Water connection	
Internet connection		Electric bill (last month)	
Motor vehicle (Two wheelers)		Newspaper subscribed	
Motor garage		Insurance scheme subscribe	

12. Distance from home

Sl. No.	Place	Kms./Feet	Sl. No.	Place	Kms./Feet
1	Main road		2	Church	
3	Nearest food market		4	Nearest playground	
5	Nearest restaurant		6	Nearest bank	
7	Nearest health centre (any)		8	Nearest primary school	
9	Nearest school		10	Spring	
11	Distance to work place (Hrs./Min)				

13. Health

1. Is there any family member having chronic disease? If yes, How many?	
2. Is there any family member who had died before attaining 5 years? If yes, How many?	

14. Reason of residing in the neighbourhood (Tick any one)

Reason	Tick	Reason	Tick
Central location		Cheaper land value/House rent	
Presence of friends/relatives		Nearness to children’s school	
Nearness to work place		Original residence by descent	
Good environment		Others	

Part B: Subjective Questions

1. Education	Level of Satisfaction				
	1	2	3	4	5
1. Are you satisfied with the quality of school within your neighbourhood?					
2. Are you satisfied with your educational level?					

2. Economic Condition	1	2	3	4	5
1. Are you satisfied with your income?					
2. Are you satisfied with your job?					

3. Leisure and Recreation	1	2	3	4	5
1. Are you satisfied with the availability of leisure places within your neighbourhood?					
2. Are you satisfied with the availability of recreational places for children within your neighbourhood?					

4. Health	1	2	3	4	5
1. Are you satisfied with the condition of your neighbourhood for upbringing of children?					
2. Are you satisfied with the condition of health of your family?					
3. Measure your family's level of happiness?					

5. Pollution	1	2	3	4	5
1. Are you satisfied with cleanliness of your neighbourhood?					
2. Are you satisfied with level of noise within your neighbourhood?					
3. Are you satisfied with the level of bad odour in your neighbourhood?					

6. Crime & Security	1	2	3	4	5
1. Are you satisfied with personal security from crime within your neighbourhood?					
2. Do you think that your neighbourhood is safe for children and elderly people and give level of satisfaction?					
3. Give your level of satisfaction on occurrence of robbery within your neighbourhood?					

7. Disaster	1	2	3	4	5
1. Do you think that your neighbourhood is safe from natural hazards like Landslide?					
2. Give your level of preparation for disasters?					
8. Living Convenience	1	2	3	4	5
1. Are you satisfied with availability of public transport within your neighbourhood?					
2. Are you satisfied with the cost of living in your neighbourhood?					

9. Participation and Administration	1	2	3	4	5
1. Are you satisfied with your level participation in Church, NGO or politics within your neighbourhood?					
2. Are you satisfied with the system of governance or municipality's services within your neighbourhood?					

10. Infrastructures and Amenities	1	2	3	4	5
1. Are you satisfied with condition of road within your neighbourhood?					
2. Are you satisfied with distribution of drinking water within your neighbourhood?					
3. Are you satisfied with distribution of LPG within your neighbourhood?					

11. Community	1	2	3	4	5
1. Rate your closeness with your neighbours?					
2. Do you have any problems with your neighbours regarding water distribution/garage and give level?					

12. Location	1	2	3	4	5
1. Give scale on the slope of your house site?					
2. Do you think that your house has received good sunlight and give scale?					
3. Are you satisfied with the condition of your residence?					

Appendix-B: Household and Population of Local Councils, Aizawl City, 2011.

Sl. No.	Locality	Code	Household	Population
1	Zuangtui	LC1	819	6370
2	Selesih	LC2	127	625
3	Muanna Veng	LC3	250	1017
4	Durtlang	LC4	625	3205
5	Durtlang Vengthar	LC5	328	1677
6	Durtlang Leitan	LC6	918	1078
7	Chaltlang#	LC7	2738	29296
8	Chaltlang North*	LC8	2738	29296
9	Bawngkawn	LC9	1552	7386
10	Bawngkawn South	LC10	470	2508
11	Ramhlun Venglai	LC11	559	2901
12	Ramhlun Vengthar	LC12	501	2497
13	Ramhlun Sport Complex	LC13	206	1039
14	Ramhlun North	LC14	1109	5660
15	Laipuitlang	LC15	394	1841
16	Ramthar#	LC16	468	2346
17	Ramhlun South	LC17	1020	5220
18	Aizawl Venglai	LC18	488	2767
19	Ramthar North*	LC19	468	2346
20	Zarkawt	LC20	398	1992
21	Electric Veng	LC21	1254	4906
22	Chanmari	LC22	1222	5959
23	Hunthar	LC23	556	2758
24	Chanmari West	LC24	1143	5598
25	Edenthar	LC25	617	2835
26	Zemabawk	LC26	4427	17269
27	Zemabawk North	LC27	762	3094
28	Thuampui	LC28	668	3039
29	Falkland	LC29	260	1470
30	Chite	LC30	86	550
31	Armed Veng North	LC31	852	3256
32	Armed Veng South	LC32	936	4940
33	Tuithiang	LC33	438	2050
34	Saron Veng	LC34	457	2277
35	Dawrpui	LC35	511	2366
36	Chhinga Veng	LC36	1320	6520
37	Zotlang	LC37	554	2510
38	Zonuam	LC38	640	2520
39	Chawnpui	LC39	850	3208
40	Govt. Complex	LC40	430	1710
41	Tuivamit	LC41	320	1653
42	Tanhril	LC42	673	3827
43	Sakawrtuichhun	LC43	284	1520

Sl. No.	Locality	Code	Household	Population
44	Rangvamual	LC44	338	1461
45	Phunchawng	LC45	391	1693
46	Luangmual	LC46	698	3378
48	Tuikual South	LC48	1193	5132
49	Tuikual North	LC49	1023	4620
50	Dinthar	LC50	1351	6656
51	Vaivakawn	LC51	868	4170
52	Kanan Veng	LC52	725	3100
53	Dawrpui Vengthar	LC53	691	3522
54	Mission Vengthlang	LC54	950	3750
55	Khatla South	LC55	1173	7813
56	Khatla#	LC56	540	3120
57	Khatla East*	LC57	540	3120
58	Bungkawn Nursery	LC58	458	2581
59	Maubawk	LC59	847	4250
60	Lawipu	LC60	168	790
61	Bungkawn	LC61	990	4194
62	Bungkawn Vengthar	LC62	581	1936
63	College Veng	LC63	673	2813
64	Bethlehem	LC64	979	4903
65	Bethlehem Vengthlang	LC65	1473	7545
66	Venghlui	LC66	950	3940
67	Republic	LC67	872	4691
68	Republic Vengthlang	LC68	522	2497
69	Upper Republic	LC69	320	2305
70	Venghnuai	LC70	456	2130
71	Salem Veng	LC71	546	3502
72	Tuikhuahtlang*	LC72	1518	7543
73	Model Veng*	LC73	1518	7543
74	Mission Veng#	LC74	1518	7543
75	ITI Veng	LC75	919	4646
76	Dam Veng	LC76	330	1433
77	Thakthing	LC77	235	1176
78	Melthum	LC78	221	1024
79	Kulikawn	LC79	907	5348
80	Hlimen	LC80	562	2688
81	Tlangnuam	LC81	743	3608
82	Saikhamakawn	LC82	318	1459

* marked Local Councils are created after 2011 Census and their populations are given as their parent Local Councils which are # marked ones.

Appendix C: Normalised Indicators of Horizontal Pattern of Residential Differentiation*

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
LC1	-1.47	0.85	-0.97	-0.98	0.89	-1.24	-1.14	-0.93	-1.45	-0.15	-0.05	-0.04
LC2	-1.14	-0.25	-1.54	-1.13	0.85	-1.22	0.18	-1.15	-1.09	-1.25	1.74	2.06
LC3	-0.33	1.15	-1.08	-1.13	1.49	-1.04	-0.89	0.64	0.78	0.55	-0.86	-0.40
LC4	0.63	-0.89	-0.32	0.29	0.15	-0.86	-0.73	-0.26	-0.62	-0.64	0.73	0.51
LC5	0.69	-0.31	1.05	-1.22	0.53	-0.05	-0.43	1.04	-0.37	-1.12	1.33	3.04
LC6	0.97	-0.29	-0.12	-0.04	0.37	-0.39	-0.36	0.03	0.88	0.01	0.07	1.66
LC7	0.71	-0.70	0.24	0.42	-0.68	1.22	1.06	-0.06	0.29	-0.04	0.06	0.35
LC8	0.33	-0.50	0.18	1.13	-0.73	-0.24	0.96	0.92	0.65	0.67	-0.80	-0.32
LC9	0.71	-0.41	0.75	0.47	-1.10	0.92	1.27	1.06	0.44	-0.12	-0.46	-0.31
LC10	-0.61	-0.55	0.11	0.25	-0.73	-0.72	0.78	0.38	0.65	0.69	-0.53	-0.78
LC11	0.80	-0.58	0.61	1.03	-0.48	0.94	1.32	0.87	1.12	1.51	-1.17	-0.63
LC12	-1.63	0.01	-0.89	0.09	-0.30	0.15	-0.48	0.21	-0.26	0.23	-0.34	0.52
LC13	-0.31	0.55	-0.32	-0.54	0.34	-0.15	-0.89	0.13	0.80	0.61	-0.28	0.42
LC14	0.12	-0.95	1.49	0.35	1.97	-0.24	0.21	-0.14	1.44	0.50	-0.19	-1.38
LC15	0.39	-1.13	0.29	1.24	-0.33	1.64	-1.05	1.68	1.88	1.28	-1.37	-0.91
LC16	0.40	0.24	1.11	0.17	-0.30	0.26	0.04	0.92	1.79	1.98	-1.32	-1.32
LC17	1.02	-0.82	0.42	0.86	-1.62	-0.62	1.20	1.32	0.22	1.22	-0.59	-0.49
LC18	-0.25	-0.41	-0.17	1.06	-1.48	-0.51	1.11	0.84	0.50	1.86	-1.49	-1.00
LC19	0.49	0.31	-0.28	0.35	1.97	-0.24	-0.39	-0.14	1.44	0.28	-0.19	-1.37
LC20	3.40	-0.33	3.28	3.48	-1.74	4.62	1.69	1.81	1.14	-0.24	-0.57	-0.33
LC21	0.96	-0.38	0.70	0.37	-0.47	0.39	1.83	0.82	0.56	0.88	-1.08	-0.44
LC22	1.49	-0.86	2.05	1.31	-1.44	0.94	2.03	0.19	0.62	-0.57	0.56	0.30
LC23	-0.88	0.80	-1.06	-0.18	0.02	-0.95	-0.80	0.82	-0.71	0.84	-0.32	-0.90
LC24	-0.23	0.34	-0.35	0.24	-1.34	-0.18	1.58	0.41	0.29	0.99	-1.12	-1.15
LC25	-0.36	-0.12	-1.18	-0.75	-0.50	-0.29	0.39	-0.16	-0.40	-0.70	0.82	0.78
LC26	-0.44	0.55	-1.01	-1.34	1.16	-1.02	-0.87	-1.04	-0.44	-1.37	1.01	0.46
LC27	-1.01	0.46	-0.86	-1.01	1.68	-0.86	-1.05	-0.66	-1.32	-0.71	0.34	0.54
LC28	0.76	-0.30	0.50	-0.08	1.57	-0.24	-0.30	0.05	0.41	1.30	-0.91	-0.47
LC29	1.80	-0.25	0.50	0.35	-0.19	-0.64	-0.69	1.77	2.22	-0.01	-0.80	-1.05
LC30	-2.11	3.38	-1.54	-1.99	1.31	-1.58	-0.75	-2.16	-1.87	-0.61	0.94	-0.64
LC31	-0.89	0.04	-1.11	-0.79	0.80	-0.81	-0.09	-1.09	-0.66	-1.81	1.78	0.42
LC32	-1.66	0.10	-1.08	-0.68	1.73	-0.91	-0.59	-1.13	-1.08	0.03	-0.08	-0.69
LC33	-1.13	0.95	-1.03	-1.52	1.17	-0.39	-1.16	-1.24	-1.33	-1.77	1.38	0.67
LC34	-0.13	-1.02	0.57	-0.54	-0.57	-0.34	0.65	-0.71	-0.81	0.73	-0.41	-0.21
LC35	2.59	0.02	1.17	1.37	-1.07	0.80	1.96	0.55	1.40	0.73	-0.71	0.86
LC36	-0.16	0.29	-0.68	-0.20	0.80	-0.74	0.36	-0.88	-0.69	-0.32	-0.28	-0.43
LC37	1.26	0.21	0.20	0.73	-0.15	0.46	-0.66	1.08	1.38	0.09	0.06	0.23
LC38	-0.53	0.85	-0.78	-0.83	1.01	-0.24	-1.29	-0.49	-1.28	0.08	-0.13	-0.21
LC39	1.16	0.48	-0.19	-0.01	0.36	0.00	-0.66	0.72	0.60	0.58	-1.03	-0.93
LC40	0.00	-0.15	-1.00	-1.48	1.37	-0.32	-1.08	-0.87	-0.43	-0.35	0.49	2.89
LC41	-1.72	2.47	-0.93	-2.07	2.14	-1.36	-1.53	-2.01	-1.32	-1.52	1.13	-0.43
LC42	-0.94	0.46	-0.81	-1.46	2.02	-1.15	-0.96	-1.18	-1.31	-1.68	2.23	1.26
LC43	-0.73	0.15	-1.03	-1.32	2.38	-1.46	-1.69	-0.96	-1.15	0.82	-0.56	-0.80
LC44	-1.60	3.13	-1.54	-1.76	0.31	-1.41	-2.13	-2.34	-1.87	-2.36	1.94	0.56

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
LC45	-2.11	4.38	-1.54	-2.07	0.31	-1.41	-2.17	-2.24	-1.58	-2.68	3.01	2.74
LC46	0.35	-0.51	-0.18	-0.73	-0.21	0.34	-0.89	-0.14	-0.40	-0.88	0.91	0.30
LC47	-0.56	-1.05	0.50	0.19	-0.85	0.01	-0.18	0.73	0.63	-0.57	0.83	0.64
LC48	0.60	-0.77	0.75	1.36	-0.04	0.92	1.67	0.50	1.20	-0.22	0.36	-0.09
LC49	-0.29	-0.11	0.99	0.14	-0.36	0.64	0.99	-0.13	-0.14	0.04	0.18	0.14
LC50	-0.31	-0.57	-0.52	0.14	-0.17	-0.15	0.50	0.34	-0.68	-0.69	0.52	0.42
LC51	1.47	0.40	-0.11	-0.54	-0.19	-0.24	0.15	-0.93	2.01	1.16	-0.99	-0.47
LC52	-0.63	-0.25	-0.50	0.45	-0.91	0.51	1.11	-1.71	-0.46	1.23	-1.89	-1.32
LC53	0.15	-0.37	0.08	2.39	-0.65	1.26	1.75	0.27	0.41	-0.08	0.12	-0.61
LC54	0.71	-0.51	-0.05	0.17	-0.74	0.42	0.86	-0.30	-0.41	0.02	0.02	1.22
LC55	0.64	-0.68	0.38	0.10	-0.50	-0.05	0.25	1.04	2.16	1.22	-0.94	-0.62
LC56	0.68	-0.70	0.50	0.62	0.19	-0.15	1.17	0.28	0.63	0.52	-0.12	-0.98
LC57	0.95	-0.78	1.17	-0.08	-0.43	0.66	0.89	0.92	0.25	-0.61	0.52	0.36
LC58	0.72	-0.28	1.25	1.09	-0.84	-0.65	0.43	0.48	0.29	-0.80	1.26	-0.24
LC59	-0.99	-0.20	-1.28	0.33	0.28	-0.35	0.53	-0.48	0.05	1.31	-1.72	-1.41
LC60	-0.77	2.15	-1.54	-1.13	2.51	-1.46	-1.96	-1.52	-1.28	-1.32	1.30	1.12
LC61	1.30	-0.93	1.16	0.53	-1.46	2.27	0.71	0.79	0.50	-0.07	-0.77	-1.12
LC62	-0.02	-0.70	0.11	0.17	-0.91	1.99	-0.57	1.33	-0.15	0.66	-0.65	-1.16
LC63	-0.41	0.06	0.88	0.30	-0.48	0.94	0.05	0.08	-0.42	1.79	-1.59	-0.58
LC64	-0.36	-0.41	0.47	0.88	-0.50	0.14	-0.09	0.31	0.09	-0.24	-0.57	-0.19
LC65	-0.53	0.61	-1.13	-0.62	0.40	-0.85	-0.81	-0.70	-0.34	0.29	-0.43	-0.03
LC66	-1.46	-1.10	0.14	-0.11	-0.16	-0.47	0.15	-0.89	-1.17	1.31	-0.95	-1.11
LC67	-0.29	-0.17	0.29	1.12	-0.24	-0.15	0.87	0.58	0.08	-0.18	0.07	0.12
LC68	-0.63	-0.87	-0.94	-1.02	-0.78	-0.12	-0.31	-1.47	-1.45	-1.05	0.79	0.34
LC69	0.73	-0.71	1.84	1.80	-0.53	1.24	0.63	2.44	1.69	-0.11	-0.12	-0.10
LC70	-0.60	0.44	-0.71	-0.05	-0.78	0.61	-0.09	0.31	-0.24	-1.14	1.40	2.80
LC71	-1.39	1.21	-0.81	-1.25	0.39	-0.77	-0.45	-1.49	-1.35	-1.58	1.79	1.60
LC72	0.65	-1.25	3.04	0.94	-0.91	1.99	1.11	1.06	0.01	0.14	-1.05	0.29
LC73	0.32	0.37	-0.13	0.97	0.53	0.24	-1.02	1.18	0.70	0.65	-0.13	-0.29
LC74	0.29	-0.75	1.65	0.93	-1.47	1.22	0.63	-0.55	-0.68	0.69	-1.02	-0.27
LC75	0.91	-0.13	0.25	0.01	-0.68	1.16	-0.51	0.44	-0.30	-1.14	0.44	-0.10
LC76	-0.54	1.12	-0.46	0.20	-0.65	0.00	0.05	-0.07	0.01	1.27	-0.89	1.35
LC77	0.06	-1.13	0.29	0.00	-0.62	1.10	1.11	0.92	0.13	1.68	-1.30	-0.86
LC78	0.78	-0.58	0.51	0.17	-0.19	0.21	-0.49	-0.21	-1.55	-0.69	1.03	0.72
LC79	-0.21	-0.46	0.37	0.74	-0.33	-0.26	0.24	0.83	0.17	0.30	-0.61	-0.43
LC80	-0.60	0.06	-1.00	-0.64	-0.59	-0.33	-1.22	-0.97	-0.72	-0.35	0.82	-0.90
LC81	0.46	-0.87	0.69	0.17	0.30	-0.71	-0.94	0.32	0.13	0.03	0.19	-0.51
LC82	0.53	-0.59	0.29	-0.18	-0.91	0.24	-0.09	-0.05	1.13	-1.05	1.24	-0.64
Mean#	7.90	25.67	8.41	0.65	40.77	7.35	51.88	1.46	16.62	73.24	21.99	0.20
SD#	3.75	19.31	6.20	0.28	17.42	5.41	20.80	0.59	8.89	6.25	6.18	0.12

* X1=Profe, X2=L_Income, X3=VHH_Income, X4=Computer, X5=L_Rent, X6=VHH_Rent, X7=RCC, X8=Edu12, X9=F_Grad, X10=P_1565, X11=P_014, X12= CWR.

Mean and Standard deviation (SD) are calculated from raw data.

Appendix-C: Normalised Indicators of Horizontal Pattern of Residential Differentiation (Contd.)*

	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24
LC1	0.08	0.27	0.03	0.64	0.55	1.38	-0.39	1.08	0.29	-0.08	0.10	0.08
LC2	-0.05	2.11	-1.54	-1.14	3.30	1.11	-1.28	-0.55	-1.84	-1.87	-0.66	1.87
LC3	2.13	0.33	0.48	-0.95	1.16	3.82	-2.57	1.93	0.29	-1.65	-0.66	1.65
LC4	-0.85	1.16	-0.98	-0.95	1.77	-0.67	1.23	-0.66	0.82	0.77	-1.42	-0.76
LC5	-1.04	2.24	-1.60	-0.29	2.69	0.72	0.73	0.08	-0.43	-1.60	-0.12	1.59
LC6	0.31	-0.42	0.78	-0.59	1.47	-0.29	-1.11	-0.09	1.50	-0.10	-0.82	0.10
LC7	-0.38	-0.45	0.43	0.98	-0.36	-0.44	0.77	1.06	-0.21	0.24	-0.01	-0.24
LC8	-0.72	0.60	-1.11	0.10	-0.06	-0.44	-1.09	1.06	-0.21	0.24	0.10	-0.24
LC9	-0.06	0.71	-0.25	-0.37	0.25	0.16	-1.24	1.42	-1.19	-0.47	-0.66	0.47
LC10	0.94	-0.67	0.63	-0.14	-0.36	-0.85	-1.17	-0.90	-0.87	0.26	0.62	-0.25
LC11	0.70	-0.41	0.91	-0.51	-0.97	-0.41	-0.48	-0.54	-0.56	0.58	0.95	-0.58
LC12	-1.88	1.07	-0.81	-0.96	-0.36	-0.49	0.35	-0.58	1.21	0.82	-0.91	-0.82
LC13	1.71	0.09	-0.25	-0.37	-0.67	-0.93	-1.48	-0.96	-0.32	-0.36	0.09	0.36
LC14	2.13	-0.57	0.03	-0.44	-0.36	-0.80	-0.36	-0.65	0.15	1.11	-1.13	-1.11
LC15	0.05	-0.21	0.48	-0.66	-0.67	-0.08	-1.43	-0.50	0.47	0.39	0.56	-0.39
LC16	2.77	-0.10	-0.67	-0.61	-0.97	-0.70	-0.85	-0.62	0.87	0.98	0.28	-0.98
LC17	1.23	-0.44	0.35	-0.91	-0.67	-0.63	-0.04	-0.48	0.09	0.94	0.89	-0.94
LC18	0.11	-0.84	0.48	-0.66	-0.97	-0.72	-0.48	-0.78	-0.08	0.82	1.13	-0.82
LC19	1.68	-0.57	0.03	-0.44	-0.67	-0.80	-0.09	-0.91	0.42	0.11	-1.13	-0.11
LC20	0.55	0.04	0.67	-0.61	-1.28	0.07	-0.85	-0.26	0.21	1.20	0.13	-1.20
LC21	1.09	-0.11	-0.64	0.24	-1.28	0.36	-0.36	0.97	1.26	1.50	1.15	-1.50
LC22	0.20	-0.87	0.98	-0.17	-0.97	-0.19	0.10	0.45	0.63	0.58	0.78	-0.58
LC23	1.51	-1.78	1.06	3.02	-0.67	-0.71	0.87	-0.80	-0.31	-0.01	0.78	0.01
LC24	1.76	-0.88	0.32	1.85	-0.67	-0.62	-1.21	-0.36	-0.10	0.15	1.02	-0.15
LC25	-0.45	0.18	-0.83	-0.83	0.25	-0.20	-0.10	-0.40	0.88	-0.23	0.85	0.23
LC26	-0.58	-0.49	0.76	0.47	1.16	0.77	0.99	3.98	-0.02	-0.85	-0.42	0.85
LC27	0.34	1.64	-1.99	-0.41	0.55	-0.84	-0.19	-0.83	-0.52	-0.04	-0.47	0.04
LC28	0.46	0.17	-0.53	-0.56	-0.06	1.83	0.55	1.58	-0.97	-0.65	-0.29	0.65
LC29	-0.50	0.55	-0.73	0.40	-0.06	1.78	-0.94	0.28	-2.40	-3.43	-1.13	3.42
LC30	-1.88	-3.25	3.46	4.75	-0.36	-0.46	2.19	-0.90	-3.62	-2.79	0.02	2.79
LC31	-0.55	-0.53	0.48	0.12	-0.97	-0.47	0.68	-0.50	-1.87	-0.63	1.09	0.63
LC32	0.51	0.21	-0.28	0.64	-0.97	-0.68	0.09	-0.61	-0.94	-1.17	0.75	1.17
LC33	-0.44	-0.47	0.48	0.40	-0.97	-0.94	1.94	-0.94	0.61	0.67	1.22	-0.67
LC34	0.26	-1.19	1.60	0.47	-1.28	-0.20	1.79	-0.16	0.69	0.45	0.72	-0.45
LC35	-0.37	-1.46	1.96	1.03	-1.28	0.86	1.06	1.09	1.34	0.94	1.22	-0.94
LC36	-0.41	-1.71	1.85	1.71	-1.28	-0.48	-0.14	0.19	0.50	1.18	0.99	-1.18
LC37	0.74	0.16	-1.43	-0.70	-0.67	0.52	-0.50	0.05	-0.43	0.16	-0.66	-0.15
LC38	-0.42	0.10	-0.43	2.07	-0.36	-0.74	0.25	-0.79	-0.98	-0.81	-2.31	0.81
LC39	-0.33	-0.88	1.12	0.00	-0.67	-0.65	0.30	-0.63	-0.09	-0.13	0.78	0.13
LC40	-0.13	-0.62	1.12	-0.51	0.25	-0.15	0.27	-0.63	-1.62	-1.48	0.11	1.48
LC41	-2.07	-0.39	0.24	1.93	1.47	0.19	1.16	-0.20	-1.03	-0.67	1.22	0.67
LC42	-1.88	1.18	-1.70	-1.18	1.77	0.19	0.87	-0.20	-1.03	-0.67	-1.42	0.67
LC43	-0.43	1.02	-1.14	-1.04	1.77	0.03	0.54	-0.49	2.67	-0.57	-1.92	0.57

	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24
LC45	-1.30	-0.39	-0.25	0.78	1.77	0.48	1.06	-0.55	1.38	1.15	1.98	-1.15
LC46	-1.11	1.52	-1.27	-0.24	0.25	0.03	1.37	0.41	0.16	0.04	-0.66	-0.04
LC47	-0.67	1.65	-1.27	-0.88	0.86	-0.26	0.30	-0.38	-0.29	-1.58	-1.50	1.58
LC48	0.18	-0.98	0.72	0.20	-0.67	0.68	-0.40	1.76	-0.44	-0.67	1.22	0.67
LC49	-0.52	0.45	-0.15	0.26	-0.97	-0.62	-1.17	-0.51	1.11	1.24	0.38	-1.24
LC50	-0.88	0.57	-0.40	-0.33	-0.97	-0.56	0.56	-0.28	-0.06	0.39	-0.01	-0.38
LC51	0.98	0.27	0.03	0.64	-0.36	-0.43	-1.12	-0.41	0.35	0.85	0.28	-0.85
LC52	0.96	-2.50	2.71	1.35	-0.97	-0.73	0.87	-0.76	-0.85	0.06	-0.98	-0.06
LC53	1.10	-0.52	0.69	-0.51	-1.28	-0.39	-1.81	-0.14	0.22	0.29	1.44	-0.29
LC54	-0.67	-0.42	0.56	-0.72	0.25	-0.69	0.64	-0.62	1.04	1.07	-0.05	-1.06
LC55	1.17	0.01	0.48	-0.29	-0.06	0.75	-0.17	1.07	-1.26	-1.71	-1.13	1.71
LC56	0.43	-1.21	0.65	1.49	-0.67	0.92	-1.23	2.78	0.84	0.57	1.85	-0.57
LC57	-0.45	0.06	0.08	-0.24	-0.06	0.92	0.43	2.78	0.84	0.57	0.18	-0.57
LC58	-1.01	-0.53	0.01	-0.77	-0.06	-0.72	0.51	-0.77	-0.10	-0.02	-0.34	0.02
LC59	0.53	-0.54	0.38	0.45	0.55	-0.42	0.07	-0.40	-1.61	-1.42	-0.29	1.42
LC60	0.11	-0.67	-0.73	0.40	1.47	2.08	-0.48	-0.41	-0.41	-2.40	-0.03	2.40
LC61	-0.21	-0.32	0.76	-0.64	-0.06	0.11	0.33	0.32	-0.06	0.41	-0.81	-0.40
LC62	0.43	0.47	-0.54	-0.83	-0.36	0.31	-1.07	-0.11	-0.80	-0.68	-0.74	0.68
LC63	1.62	0.38	-0.38	-0.51	-0.36	-0.69	-1.67	-0.72	0.65	-0.35	0.28	0.35
LC64	0.18	0.11	0.19	-0.49	-0.97	0.69	-0.77	0.80	-0.07	0.43	1.19	-0.43
LC65	-0.59	0.41	-0.18	0.83	-0.67	-0.75	0.39	-0.61	0.01	0.36	-0.36	-0.36
LC66	0.72	-0.78	1.11	-0.33	-0.67	0.29	-0.57	0.70	-0.27	0.19	-0.21	-0.19
LC67	0.08	0.21	0.24	-0.95	-0.36	-0.69	0.05	-0.61	1.87	1.52	-0.10	-1.52
LC68	-1.17	0.16	0.15	-0.74	-0.36	-0.78	1.09	-0.87	-0.44	0.13	-1.26	-0.13
LC69	-0.11	2.02	-1.63	-0.61	-0.36	-0.73	-0.77	-0.81	0.73	1.08	-0.17	-1.08
LC70	-1.64	1.54	-0.84	-0.74	0.25	-0.55	1.18	-0.75	0.69	0.64	-1.01	-0.64
LC71	-1.18	1.40	-0.79	-0.66	-0.06	-0.67	1.56	-0.71	1.04	-0.74	0.70	0.74
LC72	-0.87	0.03	-0.13	-0.08	-0.36	0.50	0.01	1.77	0.15	0.78	-1.61	-0.78
LC73	0.93	0.46	-0.92	-0.19	-0.06	0.50	-1.28	1.77	0.15	0.78	0.50	-0.78
LC74	0.06	0.05	-0.31	-0.40	-0.06	0.50	0.28	1.77	0.15	0.78	0.03	-0.78
LC75	-0.77	1.49	-1.58	-0.40	-0.06	-0.59	-0.18	-0.50	-1.21	-0.75	-0.58	0.75
LC76	-0.44	0.33	-0.16	1.52	-0.06	-0.33	0.61	-0.71	0.95	0.53	0.78	-0.53
LC77	0.64	-0.92	0.48	0.20	-0.06	-0.09	-0.60	-0.67	0.28	1.55	1.13	-1.55
LC78	-0.37	2.41	-1.95	-1.52	2.08	5.29	0.87	0.56	1.30	0.60	-1.13	-0.60
LC79	0.08	0.51	-0.61	-0.01	2.08	0.02	0.82	0.17	-0.06	0.42	3.07	-0.42
LC80	-1.30	-0.31	0.27	0.00	0.25	-0.60	0.52	-0.62	0.26	-0.50	-1.38	0.50
LC81	1.32	-0.11	0.38	-0.59	1.16	-0.50	-0.57	-0.52	0.29	0.26	-1.78	-0.26
LC82	-1.38	0.44	-0.89	-0.44	1.47	-0.95	-1.06	-0.95	-1.17	-0.77	-0.78	0.77
Mean#	64.42	4.82	43.41	8.82	2.59	9.17	59.95	1.44	31.0	35.50	45.04	65.50
SD#	6.61	0.56	13.73	5.80	1.64	9.45	7.75	1.50	7.57	6.62	17.68	6.62

* X13=W_1549, X14=HHSize, X15=Person4, X16=Person2, X17=Distance, X18=No_ST, X19=F_Mar, X20=NonST_M, X21=Fem_Tw, X22= Fem_Fw, X23=Rented, X24=Male_Mw

Mean and Standard deviation (SD) are calculated from raw data.

Appendix-D: Factors extracted using Factor Analysis

Sl. No.	Local Council	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1	Zuangtui	-1.685	0.441	-0.167	0.620	1.357
2	Selesih	-0.992	-0.760	-2.076	-1.358	0.427
3	Muanna Veng	-1.738	2.165	-0.621	-0.643	4.020
4	Durtlang	-0.110	-0.756	-1.241	0.904	-0.763
5	Durtlang North	0.473	-1.504	-1.948	-1.417	0.782
6	Durtlang Leitan	-0.080	0.113	0.069	-0.027	0.422
7	Chaltlang	1.008	-0.730	0.778	-0.114	-0.061
8	Chaltlang North	0.648	0.538	-0.667	0.065	-0.360
9	Bawngkawn	1.198	-0.079	-0.455	-0.752	0.325
10	Bawngkawn South	0.017	0.903	0.421	0.016	-1.012
11	Ramhlun Venglai	0.870	1.044	0.427	0.188	-0.492
12	Ramhlun Vengthar	-0.415	0.017	-1.123	0.946	-1.200
13	Ramhlun Sport Complex	-0.668	1.177	-0.506	-0.329	-1.023
14	Ramhlun North	-0.161	1.099	0.066	1.100	-0.460
15	Laipuitlang	0.677	1.375	-0.154	0.137	-0.256
16	Ramthar	-0.254	2.330	-0.522	0.997	-0.563
17	Ramhlun South	0.641	0.852	0.220	0.662	-0.572
18	Aizawl Venglai	0.225	1.445	0.489	0.527	-1.035
19	Ramthar North	-0.487	1.091	0.050	0.112	-0.636
20	Zarkawt	3.804	-0.999	0.516	0.198	0.405
21	Electric	0.391	0.903	0.080	1.548	0.738
22	Chanmari	2.055	-1.257	1.222	-0.011	0.433
23	Hunthar	-0.945	0.949	1.565	-0.058	-0.640
24	Chanmari West	-0.066	1.285	0.803	-0.057	-0.566
25	Edenthar	-0.290	-0.590	-0.403	-0.132	-0.335
26	Zemabawk	-0.862	-1.035	0.765	-0.391	2.003
27	Zemabawk North	-1.339	0.142	-1.818	0.363	-1.295
28	Thuampui	-0.385	1.229	-0.337	-0.300	1.906
29	Falkland	0.984	0.657	-0.633	-3.679	1.347
30	Chite	-1.344	-1.322	3.850	-3.070	-0.560
31	Armed Veng	-0.249	-1.576	0.778	-0.746	-0.745
32	Armed South	-1.242	0.632	-0.225	-1.052	-1.153
33	Tuithiang	-1.029	-1.479	0.685	0.849	-0.955
34	Saron	-0.024	0.025	1.397	0.309	-0.085
35	Dawrpui	1.666	-0.448	1.997	0.559	1.718
36	Chhinga Veng	-0.547	-0.179	1.937	1.184	-0.019
37	Zotlang	0.485	0.363	-0.610	0.136	0.422
38	Zonuam	-0.888	0.182	-0.116	-0.780	-1.171
39	Chawnpui	0.069	0.626	0.760	-0.348	-0.466
40	Govt Complex	-0.629	-0.512	0.510	-1.453	-0.138
41	Tuivamit	-1.791	-1.248	0.712	-0.193	0.214
42	Tanhril	-0.977	-1.665	-1.304	-0.232	-0.158
43	Sakawrtuichhun	-2.177	1.351	-1.634	0.181	-0.049
44	Rangvamual	-1.945	-2.090	1.636	1.799	0.719
45	Phunchawng	-2.119	-2.575	0.568	2.008	0.783

Sl. No.	Local Council	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
46	Luangmual	0.078	-1.068	-1.211	0.170	-0.225
47	Chawlhhmun	0.783	-0.672	-1.613	-1.805	-0.774
48	Tuikual South	1.473	-0.515	1.163	-1.065	1.290
49	Tuikual North	0.421	-0.298	-0.194	1.128	-0.683
50	Dinthar	0.313	-0.792	-0.358	0.247	-0.928
51	Vaivakawn	-0.499	1.321	-0.239	0.978	-0.269
52	Kanan	-0.121	0.940	2.527	-0.372	-0.849
53	Dawrpui Vengthar	1.309	0.019	0.630	-0.199	-0.329
54	Mission Vengthlang	0.464	-0.668	0.420	0.893	-0.526
55	Khatla South	0.483	1.302	-0.104	-1.881	0.818
56	Khatla	0.350	0.422	1.315	0.631	1.981
57	Khatla East	1.012	-0.957	0.263	0.590	1.801
58	Nursery	1.287	-1.318	0.428	-0.493	-0.635
59	Maubawk	-0.599	1.600	0.279	-1.567	-0.858
60	Lawipu	-1.830	-0.372	0.165	-1.705	1.994
61	Bungkawn	1.532	-0.348	0.483	-0.035	0.230
62	Bungkawn Vengthar	0.544	0.774	-0.716	-0.866	-0.234
63	College Veng	-0.160	1.863	-0.709	-0.438	-0.848
64	Bethlehem	0.370	0.169	0.051	0.432	0.647
65	Bethlehem Vengthlang	-1.007	0.400	-0.305	0.526	-1.121
66	Venghlui	-0.703	1.225	0.660	0.306	0.175
67	Republic	0.384	-0.158	-0.191	1.443	-0.623
68	Republic Vengthlang	-0.245	-1.243	-0.013	0.052	-1.364
69	Upper Republic	1.703	-0.057	-1.862	0.713	-1.016
70	Venghnuai	0.402	-1.783	-1.178	0.616	-1.038
71	Salem	-0.719	-1.692	-0.964	-0.532	-1.001
72	Tuikhuahtlang	1.880	-0.519	0.188	0.414	0.930
73	Model	-0.172	0.976	-0.705	1.059	0.912
74	Mission Veng	0.844	0.091	0.110	0.684	0.775
75	ITI	0.916	-0.956	-1.303	-1.040	-1.065
76	Dam Veng	-0.441	0.562	-0.132	0.606	-0.571
77	Thakthing	0.090	1.268	0.597	1.467	-0.157
78	Melthum	-0.274	-0.743	-2.044	1.666	4.405
79	Kulikawn	0.156	0.299	-0.498	0.476	0.193
80	Hlimen	-0.491	-0.578	0.200	-0.528	-0.918
81	Tlangnuam	-0.145	0.470	-0.275	0.295	-0.213
82	Saikhamakawn	0.841	-1.094	-0.606	-1.132	-1.154

Factor 1=Socio-economic status, Factor 2=Family status, Factor 3=Household size status, Factor 4=Worker status, Factor 5=Ethnic status .

Appendix-E: Standardized Indicators of Objective Quality of Life*.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
LC1	0.05	0.29	0.44	0.12	0.09	0.20	0.24	0.13	0.17	0.25	0.87	0.79	0.98	0.06	0.80	0.20	0.25	0.27
LC2	0.15	0.25	0.52	0.18	0.10	0.17	0.24	0.33	0.17	0.22	0.38	0.63	0.66	0.42	0.66	0.00	0.39	0.07
LC3	0.64	0.62	0.49	0.32	0.25	0.17	0.24	0.43	0.01	0.32	0.92	0.89	0.79	0.13	0.80	0.00	0.31	0.00
LC4	0.27	0.43	0.56	0.50	0.18	0.43	0.24	0.41	0.32	0.44	0.83	0.75	0.55	0.24	0.80	0.04	0.35	0.59
LC5	0.34	0.71	0.66	0.51	0.37	0.15	0.51	0.43	0.22	0.52	0.39	0.82	0.34	0.23	0.61	0.00	0.42	0.63
LC6	0.66	0.50	0.56	0.56	0.33	0.37	0.46	0.33	0.27	0.38	0.83	0.67	0.86	0.24	0.98	0.05	0.44	0.74
LC7	0.51	0.48	0.47	0.51	0.33	0.45	0.46	0.46	0.38	0.58	0.96	0.96	0.82	0.02	0.95	0.62	0.78	0.62
LC8	0.54	0.92	0.65	0.44	0.37	0.42	0.35	0.30	0.38	0.13	0.92	0.77	0.82	0.02	0.89	0.65	0.76	0.62
LC9	0.55	0.71	0.52	0.51	0.51	0.46	0.51	0.50	0.56	0.50	0.99	0.88	0.97	0.07	1.00	0.74	0.83	0.50
LC10	0.60	0.57	0.52	0.27	0.52	0.42	0.57	0.13	0.27	0.16	0.97	0.79	0.99	0.00	0.98	0.62	0.71	0.58
LC11	0.73	0.67	0.77	0.53	0.50	0.56	0.57	0.45	0.48	0.74	0.97	0.92	0.99	0.04	0.97	0.73	0.85	1.00
LC12	0.37	0.53	0.51	0.09	0.21	0.39	0.24	0.32	0.38	0.30	0.99	0.98	0.95	0.10	0.85	0.65	0.41	0.58
LC13	0.64	0.52	0.55	0.33	0.27	0.60	0.24	0.18	0.27	0.29	0.92	0.99	0.97	0.25	0.86	0.51	0.31	0.63
LC14	0.81	0.46	0.42	0.40	0.20	0.44	0.57	0.02	0.00	0.06	0.84	0.95	0.99	0.05	0.90	0.59	0.58	0.88
LC15	0.93	0.84	0.75	0.45	0.69	0.60	0.51	0.46	0.34	0.31	0.87	0.83	0.99	0.21	0.90	0.62	0.27	0.89
LC16	0.67	0.79	0.53	0.45	0.57	0.50	0.57	0.34	0.42	0.10	0.84	0.97	0.99	0.11	0.90	0.59	0.53	0.69
LC17	0.49	0.76	0.40	0.57	0.63	0.53	0.57	0.42	0.48	0.17	0.98	0.83	0.98	0.07	0.80	0.58	0.82	0.84
LC18	0.56	0.66	0.36	0.34	0.47	0.56	0.57	0.18	0.38	0.22	0.84	0.83	1.00	0.09	0.90	0.59	0.80	0.64
LC19	0.81	0.46	0.42	0.47	0.20	0.44	0.54	0.02	0.00	0.02	0.84	0.95	0.99	0.11	0.90	0.59	0.43	0.14
LC20	0.73	0.87	1.00	1.00	0.74	1.00	1.00	0.73	1.00	1.00	0.98	0.98	0.99	0.20	0.99	1.00	0.84	0.93
LC21	0.64	0.66	0.49	0.56	0.35	0.44	0.54	0.27	0.38	0.29	1.00	0.92	0.99	0.05	0.95	0.68	0.78	0.97
LC22	0.60	0.53	0.60	0.65	0.55	0.61	0.67	0.49	0.54	0.35	0.98	0.95	0.99	0.17	0.99	0.50	0.93	0.88
LC23	0.25	0.66	0.39	0.22	0.59	0.48	0.24	0.22	0.33	0.31	0.92	0.92	0.97	0.19	0.95	0.59	0.33	0.42
LC24	0.51	0.57	0.44	0.34	0.41	0.42	0.35	0.35	0.38	0.33	0.96	0.96	0.98	0.05	0.98	0.61	0.91	0.69
LC25	0.33	0.46	0.35	0.32	0.28	0.24	0.30	0.13	0.38	0.38	0.92	0.92	0.86	0.37	0.95	0.59	0.62	0.07
LC26	0.32	0.27	0.30	0.30	0.15	0.13	0.24	0.12	0.17	0.15	0.78	0.67	0.53	0.05	0.87	0.49	0.32	0.23
LC27	0.09	0.35	0.36	0.20	0.26	0.19	0.24	0.18	0.06	0.10	0.92	0.92	0.42	0.13	0.93	0.57	0.27	0.68
LC28	0.54	0.50	0.45	0.52	0.42	0.36	0.48	0.24	0.17	0.05	0.99	0.83	0.78	0.13	0.95	0.64	0.45	0.19

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
LC30	0.00	0.04	0.20	0.00	0.05	0.02	0.07	0.26	0.06	0.08	0.92	0.95	0.93	0.47	0.90	0.22	0.35	0.67
LC31	0.33	0.26	0.31	0.22	0.14	0.23	0.26	0.00	0.17	0.21	0.97	0.98	0.97	0.12	0.98	0.61	0.50	0.57
LC32	0.24	0.25	0.32	0.08	0.12	0.25	0.26	0.07	0.14	0.34	0.92	0.92	0.98	0.05	0.95	0.49	0.38	0.46
LC33	0.15	0.23	0.18	0.18	0.18	0.10	0.22	0.26	0.17	0.13	0.98	0.83	1.00	0.19	0.80	0.23	0.25	0.45
LC34	0.22	0.34	0.32	0.36	0.30	0.28	0.57	0.17	0.27	0.29	1.00	0.99	0.98	0.23	1.00	0.50	0.68	0.70
LC35	0.80	0.60	0.49	0.85	0.71	0.62	0.67	0.33	0.48	0.55	0.99	0.95	1.00	0.11	1.00	0.97	1.00	0.94
LC36	0.25	0.31	0.26	0.35	0.27	0.34	0.37	0.18	0.17	0.36	0.99	0.99	1.00	0.04	0.99	0.52	0.61	0.72
LC37	0.79	0.72	0.50	0.61	0.44	0.51	0.35	0.49	0.38	0.48	0.84	0.67	0.99	0.21	0.80	0.68	0.37	0.57
LC38	0.10	0.39	0.43	0.29	0.30	0.22	0.25	0.09	0.17	0.13	0.94	0.93	0.96	0.05	0.40	0.40	0.21	0.73
LC39	0.59	0.64	0.27	0.59	0.52	0.37	0.35	0.25	0.27	0.28	0.33	0.67	1.00	0.16	0.80	0.59	0.37	0.48
LC40	0.32	0.31	0.37	0.38	0.36	0.11	0.24	0.28	0.06	0.09	0.92	0.96	0.92	0.30	0.70	0.38	0.26	0.44
LC41	0.09	0.07	0.22	0.07	0.02	0.00	0.09	0.10	0.06	0.15	0.84	0.94	0.04	0.39	0.00	0.44	0.16	0.05
LC42	0.09	0.24	0.21	0.21	0.15	0.11	0.17	0.13	0.17	0.12	0.97	0.83	0.04	0.17	0.00	0.02	0.29	0.05
LC43	0.13	0.29	0.23	0.25	0.22	0.13	0.18	0.07	0.06	0.00	0.29	0.92	0.19	0.34	0.10	0.00	0.12	0.48
LC44	0.00	0.00	0.13	0.09	0.00	0.06	0.04	0.39	0.27	0.14	0.97	0.17	0.00	0.71	0.50	0.00	0.01	0.00
LC45	0.02	0.02	0.00	0.00	0.02	0.00	0.04	0.02	0.13	0.09	0.00	0.00	0.00	1.00	0.40	0.00	0.00	0.00
LC46	0.33	0.46	0.57	0.45	0.34	0.24	0.28	0.20	0.38	0.19	0.84	0.67	0.92	0.15	0.90	0.59	0.31	0.67
LC47	0.60	0.64	0.65	0.28	0.36	0.41	0.54	0.46	0.38	0.37	0.17	0.95	0.96	0.08	0.50	0.77	0.48	0.23
LC48	0.75	0.68	0.46	0.49	0.57	0.62	0.78	0.29	0.32	0.47	0.97	0.83	0.99	0.10	0.99	0.77	0.81	0.44
LC49	0.40	0.46	0.57	0.33	0.28	0.40	0.46	0.14	0.38	0.24	0.97	0.92	0.99	0.08	0.98	0.63	0.77	0.61
LC50	0.26	0.60	0.54	0.33	0.30	0.33	0.41	0.15	0.27	0.32	0.97	0.83	0.98	0.18	0.94	0.58	0.65	0.55
LC51	0.96	0.29	0.44	0.65	0.52	0.20	0.26	0.13	0.27	0.21	0.91	0.79	0.93	0.12	0.89	0.20	0.36	0.77
LC52	0.31	0.13	0.53	0.27	0.23	0.45	0.35	0.33	0.48	0.34	0.75	1.00	0.95	0.17	1.00	0.69	0.80	0.54
LC53	0.54	0.55	0.51	0.41	0.36	0.80	0.37	0.32	0.43	0.42	0.92	0.90	0.99	0.18	0.93	0.51	0.95	0.62
LC54	0.33	0.43	0.54	0.51	0.26	0.40	0.46	0.19	0.38	0.45	0.92	0.92	0.96	0.45	0.85	0.62	0.73	0.73
LC55	1.00	0.71	0.67	0.50	0.31	0.39	0.39	0.32	0.27	0.27	0.75	0.67	1.00	0.13	0.90	0.72	0.59	0.64
LC56	0.60	0.55	0.55	0.51	0.35	0.48	0.35	0.53	0.38	0.27	0.98	0.95	0.99	0.07	0.99	0.60	0.81	1.00
LC57	0.50	0.68	0.51	0.55	0.47	0.36	0.30	0.41	0.38	0.13	0.83	0.75	0.99	0.07	0.90	0.55	0.74	1.00
LC58	0.51	0.59	0.50	0.51	0.65	0.57	0.57	0.35	0.48	0.49	0.93	1.00	0.99	0.10	0.90	0.77	0.63	0.69
LC59	0.45	0.39	0.49	0.20	0.27	0.43	0.30	0.47	0.27	0.37	0.83	0.97	0.79	0.00	0.90	0.63	0.65	0.48

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
LC61	0.56	0.66	0.73	0.62	0.53	0.66	0.61	0.56	0.58	0.61	0.97	0.98	0.98	0.06	0.90	0.75	0.70	0.84
LC62	0.39	0.77	0.58	0.38	0.39	0.65	0.35	0.50	0.38	0.48	0.99	0.98	0.96	0.13	0.90	0.59	0.39	0.59
LC63	0.32	0.51	0.61	0.31	0.14	0.43	0.35	0.55	0.48	0.29	0.94	0.91	0.99	0.09	0.98	0.66	0.54	0.76
LC64	0.46	0.55	0.54	0.32	0.38	0.53	0.54	0.38	0.38	0.26	0.83	0.75	0.99	0.05	0.90	0.69	0.50	0.69
LC65	0.35	0.34	0.50	0.29	0.33	0.26	0.24	0.15	0.22	0.31	0.95	0.79	0.97	0.07	0.95	0.26	0.24	0.55
LC66	0.13	0.30	0.26	0.12	0.24	0.35	0.35	0.34	0.27	0.40	0.95	0.75	1.00	0.17	0.96	0.51	0.44	0.87
LC67	0.45	0.61	0.65	0.33	0.50	0.58	0.35	0.29	0.32	0.43	0.98	0.99	0.98	0.11	0.80	0.59	0.74	0.80
LC68	0.14	0.18	0.34	0.27	0.11	0.19	0.27	0.31	0.38	0.15	0.95	0.92	0.96	0.05	0.95	0.59	0.45	0.64
LC69	0.88	1.00	0.74	0.51	0.56	0.70	0.70	0.19	0.38	0.58	0.99	0.83	0.98	0.11	0.95	0.78	0.35	0.80
LC70	0.37	0.55	0.52	0.27	0.23	0.36	0.33	0.26	0.38	0.24	0.99	0.98	0.96	0.31	0.99	0.46	0.50	0.54
LC71	0.14	0.18	0.21	0.13	0.10	0.15	0.18	0.23	0.22	0.26	0.99	0.99	0.98	0.07	0.97	0.36	0.42	0.41
LC72	0.44	0.71	0.02	0.50	1.00	0.54	0.89	1.00	0.53	0.85	0.98	0.99	0.99	0.24	0.97	0.59	0.80	0.97
LC73	0.62	0.74	0.51	0.44	0.44	0.55	0.46	0.32	0.27	0.55	0.95	0.92	0.99	0.24	0.90	0.73	0.28	0.97
LC74	0.26	0.37	0.49	0.63	0.26	0.54	0.59	0.62	0.48	0.43	0.99	0.67	0.99	0.24	0.99	0.61	0.58	0.97
LC75	0.36	0.58	0.50	0.55	0.42	0.37	0.40	0.30	0.48	0.47	0.92	0.97	0.99	0.08	0.90	0.79	0.40	0.47
LC76	0.44	0.47	0.61	0.28	0.22	0.41	0.24	0.28	0.27	0.23	0.99	0.98	1.00	0.64	1.00	0.52	0.54	0.88
LC77	0.47	0.68	0.48	0.39	0.56	0.37	0.46	0.41	0.27	0.34	1.00	0.92	0.98	0.22	0.95	0.71	0.80	1.00
LC78	0.03	0.45	0.47	0.52	0.25	0.39	0.52	0.42	0.48	0.11	0.98	0.98	0.35	0.25	0.65	0.54	0.41	0.41
LC79	0.48	0.68	0.28	0.34	0.37	0.52	0.57	0.73	0.35	0.56	0.99	1.00	0.98	0.12	0.96	0.61	0.58	0.80
LC80	0.25	0.29	0.21	0.27	0.07	0.26	0.33	0.15	0.38	0.08	0.97	0.96	0.07	0.15	0.60	0.49	0.23	0.76
LC81	0.47	0.61	0.76	0.47	0.37	0.44	0.41	0.29	0.27	0.31	0.83	0.92	0.75	0.11	0.90	0.74	0.30	0.76
LC82	0.73	0.57	0.51	0.48	0.33	0.48	0.46	0.31	0.40	0.14	0.94	0.97	0.56	0.27	0.75	0.67	0.60	0.60
Mean#	16.58	1.47	1.90	7.89	20.38	0.68	22134	0.31	2692	492	2438	2691	91.60	1.34	5174	0.88	50.93	86.06
SD#	8.28	0.60	0.59	3.72	9.86	0.30	8480	0.15	772	192	3696	3177	15.30	1.22	6883	0.38	20.55	2.41

* X1=F_Grad, X2=Edu12, X3=Bank, X4=Profe, X5=M_Grad, X6=Computer, X7=Income, X8=4Wheel, X9=Dwell, X10=Electric, X11=Hospital, X12= Playground, X13=No_Agri, X14=Community, X15=Bank_D, X16=Water, X17=RCC, X18=F_Lit

Mean and Standard deviation (SD) are calculated from raw data.

Appendix-F: Standardized Indicators of Subjective Quality of Life*.

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
LC1	0.60	0.21	0.16	0.42	0.39	0.41	0.47	0.44	0.48	0.46	0.76	0.68	0.58	0.81	0.46	0.47	0.47
LC2	0.45	0.77	0.84	0.59	0.16	0.47	1.00	1.00	1.00	1.00	1.00	0.35	0.29	0.92	0.03	0.00	0.00
LC3	0.18	0.15	0.09	1.00	0.00	0.92	0.83	0.51	0.58	0.75	0.82	0.64	0.38	0.96	0.12	0.14	0.30
LC4	0.66	0.32	0.84	0.75	0.14	0.26	0.71	0.54	0.50	0.57	0.55	0.55	0.80	0.80	0.45	0.40	0.35
LC5	0.47	0.69	0.41	0.51	0.00	0.13	0.44	0.75	0.47	0.52	0.72	0.29	0.22	0.64	0.22	0.63	0.44
LC6	0.67	0.53	0.67	0.67	0.26	0.40	0.60	0.55	0.56	0.48	0.60	0.61	0.66	0.76	0.41	0.49	0.54
LC7	0.60	0.30	0.59	0.36	0.56	0.63	0.32	0.26	0.51	0.21	0.43	0.76	0.37	0.71	0.12	0.14	0.16
LC8	0.51	0.39	0.50	0.44	0.65	0.53	0.40	0.59	0.43	0.32	0.31	0.65	0.59	0.67	0.66	0.80	0.58
LC9	0.67	0.51	0.55	0.65	0.62	0.61	0.13	0.37	0.41	0.32	0.54	0.39	0.56	0.45	0.28	0.32	0.67
LC10	0.53	0.38	0.42	0.56	0.66	0.61	0.36	0.48	0.51	0.32	0.35	0.35	0.48	0.62	0.06	0.06	0.35
LC11	0.65	0.38	0.47	0.65	0.63	0.67	0.44	0.37	0.25	0.40	0.42	0.26	0.46	0.57	0.12	0.14	0.45
LC12	0.71	0.75	0.44	0.69	0.71	0.32	0.35	0.26	0.24	0.54	0.69	0.34	0.32	0.47	0.37	0.34	0.30
LC13	0.51	0.39	0.11	0.63	0.82	0.28	0.23	0.27	0.09	0.57	0.63	0.45	0.66	0.55	0.41	0.30	0.59
LC14	0.74	0.35	0.84	0.67	0.28	0.82	0.71	0.70	0.78	0.58	0.69	1.00	0.85	0.97	0.35	0.27	0.65
LC15	0.31	0.02	0.09	0.40	0.32	0.26	0.35	0.45	0.30	0.11	0.01	0.85	0.71	0.88	0.91	0.91	0.51
LC16	0.76	0.30	0.84	0.69	0.35	0.82	0.65	0.70	0.69	0.62	0.65	0.96	0.78	0.86	0.55	0.29	0.52
LC17	0.70	0.50	0.63	0.62	0.58	0.62	0.31	0.47	0.35	0.34	0.49	0.63	0.57	0.79	0.51	0.54	0.50
LC18	0.52	0.30	0.19	0.51	0.47	0.61	0.18	0.39	0.30	0.21	0.41	0.28	0.48	0.43	0.41	0.46	0.36
LC19	0.74	0.35	0.84	0.69	0.28	0.82	0.71	0.70	0.78	0.62	0.69	1.00	0.85	0.97	0.35	0.27	0.62
LC20	0.73	0.72	0.47	0.64	0.63	0.62	0.61	0.39	0.19	0.60	0.44	0.93	0.89	0.83	0.52	0.47	0.64
LC21	0.78	0.76	0.70	0.68	0.59	0.75	0.69	0.47	0.40	0.60	0.58	0.46	0.64	0.57	0.05	0.71	0.64
LC22	0.72	0.72	0.81	0.67	0.51	0.80	0.60	0.25	0.10	0.50	0.50	0.66	0.54	0.68	0.30	0.56	0.36
LC23	0.56	0.50	0.49	0.51	0.59	0.51	0.18	0.98	0.50	0.36	0.33	0.53	0.50	0.49	0.60	0.56	0.43
LC24	0.74	0.71	0.75	0.70	0.81	0.80	0.39	0.63	0.68	0.53	0.63	0.67	0.63	0.73	0.81	0.83	0.69
LC25	0.68	0.59	0.64	0.65	0.75	0.48	0.05	0.49	0.54	0.43	0.48	0.53	0.47	0.62	0.63	0.60	0.51
LC26	0.64	0.15	0.50	0.76	0.53	0.59	0.72	0.62	0.83	0.48	0.76	0.97	0.83	0.85	0.48	0.70	0.53
LC27	0.65	0.27	0.67	0.74	0.41	0.48	0.91	0.62	0.63	0.55	0.80	0.99	0.70	0.76	0.60	0.77	0.61
LC28	0.74	0.32	0.84	0.69	0.25	0.74	0.71	0.64	0.78	0.59	0.68	0.93	0.85	0.86	0.28	0.27	0.51

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
LC30	0.00	0.00	0.39	0.19	0.41	0.28	0.44	0.49	0.60	0.25	0.62	0.51	0.52	0.59	0.65	0.24	0.82
LC31	0.08	0.11	0.33	0.50	0.46	0.34	0.63	0.49	0.42	0.45	0.57	0.60	0.63	0.71	0.73	0.14	0.49
LC32	0.13	0.08	0.24	0.28	0.44	0.30	0.55	0.36	0.37	0.31	0.45	0.53	0.63	0.66	0.56	0.34	0.70
LC33	0.69	0.63	0.56	0.37	0.62	0.49	0.44	0.19	0.25	0.56	0.49	0.96	0.91	0.81	0.41	0.32	0.26
LC34	0.73	0.58	0.61	0.60	0.58	0.72	0.04	0.10	0.00	0.19	0.72	0.94	1.00	0.81	0.07	0.24	0.21
LC35	0.77	0.77	0.74	0.70	0.60	0.70	0.54	0.41	0.50	0.64	0.63	0.55	0.48	0.62	0.00	0.53	0.53
LC36	0.78	0.74	0.70	0.64	0.38	0.75	0.08	0.14	0.15	0.02	0.68	0.00	0.00	0.49	0.10	0.09	0.38
LC37	0.48	0.37	0.39	0.49	0.39	0.00	0.42	0.31	0.31	0.12	0.63	0.73	0.39	0.40	0.48	0.37	0.20
LC38	0.69	0.62	0.57	0.56	0.60	0.49	0.44	0.56	0.60	0.58	0.39	0.75	0.69	0.83	0.62	0.77	0.32
LC39	0.59	0.64	0.46	0.49	0.57	0.36	0.38	0.33	0.45	0.41	0.50	0.46	0.57	0.54	0.60	0.69	0.46
LC40	0.48	0.74	0.57	0.69	0.67	0.65	0.62	0.65	0.45	0.60	0.57	0.37	0.44	0.51	0.37	0.44	0.39
LC41	0.44	0.63	0.64	0.75	0.73	0.17	0.56	0.35	0.46	0.35	0.77	0.71	0.61	0.18	0.44	0.36	0.59
LC42	0.50	0.57	0.50	0.65	0.44	0.19	0.63	0.34	0.48	0.47	0.82	0.79	0.73	0.85	0.74	0.57	0.58
LC43	0.77	0.77	0.42	0.64	0.60	0.63	0.71	0.47	0.43	0.62	0.84	0.73	0.63	0.83	0.78	0.62	0.62
LC44	0.66	0.79	0.00	0.72	0.43	0.70	0.48	0.50	0.57	0.48	0.75	0.75	0.43	0.73	0.47	0.72	0.80
LC45	0.56	0.76	0.44	0.67	0.54	0.73	0.23	0.41	0.30	0.57	0.74	0.63	0.40	0.83	0.38	0.47	0.63
LC46	0.71	0.47	0.51	0.63	0.72	0.56	0.40	0.56	0.50	0.50	0.63	0.74	0.78	0.89	0.46	0.43	0.85
LC47	1.00	0.51	0.85	0.43	0.67	0.25	0.63	0.20	0.29	0.47	0.72	0.55	0.61	0.81	0.66	0.66	0.33
LC48	0.51	0.39	0.65	0.46	0.45	0.67	0.16	0.46	0.57	0.41	0.81	0.86	0.87	0.67	0.37	0.26	0.41
LC49	0.61	0.71	0.36	0.60	0.64	0.59	0.53	0.36	0.19	0.48	0.73	0.70	0.48	0.41	0.37	0.36	0.29
LC50	0.70	0.59	0.80	0.67	0.78	0.79	0.53	0.20	0.32	0.48	0.43	1.00	0.95	1.00	0.44	0.50	0.55
LC51	0.27	0.07	0.13	0.16	0.34	0.21	0.23	0.32	0.22	0.07	0.30	0.65	0.59	0.69	0.38	0.43	0.14
LC52	0.77	0.34	0.49	0.67	0.60	0.72	0.54	0.62	0.62	0.33	0.22	0.46	0.59	0.63	0.76	0.72	0.89
LC53	0.57	0.41	0.39	0.55	0.61	0.47	0.25	0.30	0.14	0.40	0.50	0.44	0.58	0.43	0.40	0.40	0.36
LC54	0.78	0.85	0.61	0.73	0.84	0.27	0.59	0.65	0.47	0.47	0.54	0.70	0.88	0.83	0.42	0.19	0.46
LC55	0.75	0.45	0.71	0.56	0.75	0.76	0.59	0.62	0.74	0.26	0.44	0.57	0.64	0.71	0.66	0.94	0.86
LC56	0.61	0.67	0.53	0.51	0.75	0.59	0.40	0.16	0.22	0.18	0.48	0.75	0.64	0.70	0.53	0.59	0.36
LC57	0.64	0.47	0.74	0.66	0.67	0.54	0.00	0.67	0.32	0.41	0.61	0.62	0.59	0.54	0.29	0.38	0.33
LC58	0.32	0.35	0.34	0.52	0.67	0.41	0.41	0.21	0.12	0.25	0.34	0.88	0.92	0.78	0.39	0.04	0.32
LC59	0.41	0.18	0.53	0.51	0.61	0.09	0.41	0.52	0.43	0.41	0.34	0.28	0.50	0.54	0.31	0.24	0.63

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17
LC61	0.62	0.57	0.51	0.65	0.74	0.78	0.54	0.52	0.46	0.49	0.59	0.82	0.64	0.62	0.42	0.46	0.56
LC62	0.49	0.12	0.60	0.46	0.68	0.12	0.35	0.60	0.45	0.41	0.42	0.30	0.52	0.61	0.36	0.22	0.63
LC63	0.85	0.65	0.65	0.74	0.78	0.67	0.64	0.23	0.80	0.33	0.81	0.17	0.58	0.53	0.12	0.18	0.53
LC64	0.75	0.01	0.80	0.65	0.51	0.81	0.57	0.31	0.12	0.56	0.65	0.82	0.80	0.78	0.22	0.29	0.57
LC65	0.60	0.16	0.12	0.48	0.41	0.39	0.50	0.40	0.50	0.44	0.80	0.68	0.54	0.82	0.45	0.46	0.47
LC66	0.63	0.59	0.82	0.62	0.75	0.85	0.60	0.32	0.57	0.43	0.47	1.00	0.96	0.93	0.57	0.63	0.52
LC67	0.59	0.58	0.56	0.45	0.60	0.70	0.43	0.47	0.55	0.30	0.45	0.91	0.80	0.80	0.45	0.48	0.45
LC68	0.41	0.48	0.45	0.42	0.60	0.68	0.45	0.61	0.62	0.50	0.36	0.83	0.82	0.73	0.54	0.59	0.42
LC69	0.69	0.59	0.47	0.63	0.66	0.70	0.39	0.63	0.49	0.52	0.37	0.69	0.56	0.54	0.46	0.45	0.43
LC70	0.59	0.53	0.50	0.28	0.72	0.45	0.27	0.14	0.56	0.43	0.62	0.59	0.54	0.73	0.34	0.48	0.18
LC71	0.22	0.01	0.40	0.40	0.56	0.53	0.29	0.76	0.54	0.08	0.29	0.59	0.81	0.76	0.76	0.79	1.00
LC72	0.97	1.00	1.00	0.79	1.00	1.00	0.71	0.19	0.75	0.50	0.82	1.00	0.93	0.92	0.42	0.45	0.64
LC73	0.74	0.79	0.72	0.69	0.77	0.72	0.59	0.70	0.78	0.62	0.69	0.57	0.65	0.60	0.37	0.40	0.58
LC74	0.70	0.70	0.73	0.21	0.77	0.22	0.02	0.23	0.65	0.63	0.25	0.34	0.72	0.78	0.29	0.33	0.87
LC75	0.32	0.09	0.15	0.00	0.53	0.38	0.15	0.18	0.11	0.00	0.00	0.68	0.70	0.77	0.47	0.70	0.20
LC76	0.35	0.23	0.40	0.40	0.56	0.65	0.58	0.72	0.52	0.36	0.50	0.70	0.64	0.87	1.00	1.00	0.50
LC77	0.66	0.50	0.44	0.44	0.80	0.77	0.43	0.67	0.60	0.62	0.45	0.72	0.57	0.43	0.47	0.44	0.54
LC78	0.39	0.32	0.26	0.38	0.65	0.71	0.11	0.36	0.51	0.28	0.32	0.67	0.62	0.56	0.35	0.31	0.00
LC79	0.65	0.54	0.76	0.66	0.72	0.84	0.55	0.29	0.63	0.46	0.68	0.85	0.63	0.78	0.38	0.42	0.49
LC80	0.41	0.43	0.52	0.47	0.71	0.66	0.40	0.50	0.55	0.38	0.54	0.61	0.60	0.54	0.68	0.89	0.08
LC81	0.57	0.28	0.68	0.33	0.61	0.57	0.33	0.00	0.17	0.22	0.60	0.63	0.65	0.73	0.53	0.50	0.35
LC82	0.44	0.23	0.34	0.36	0.65	0.60	0.24	0.45	0.41	0.34	0.36	0.80	0.58	0.48	0.28	0.35	0.17
Mean#	3.74	3.44	3.48	3.76	2.84	3.26	3.49	3.12	3.89	3.59	3.63	2.08	2.12	3.09	2.42	2.50	3.19
SD#	0.35	0.37	0.42	0.39	0.48	0.70	0.56	0.59	0.33	0.45	0.31	0.84	1.10	1.04	0.50	0.44	0.28

* X1= S_School, X2= S_Municipal, X3= S_Upchild, X4=, S_Transport, X5= S_Infrawater, X6= S_Infraroad, X7=S_Disaster, X8= S_Crime, X9= S_Slope, X10= S_Safety, X11= S_Sunlight, X12= S_Clean, X13= S_Noise, X14= S_Smell, X15= S_Park, X16= S_Leisure, X17= S_Participate

Mean and Standard deviation (SD) are calculated from raw data.