SPATIAL ANALYSIS OF RENTAL HOUSING IN AIZAWL CITY, MIZORAM

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

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LALHMANGAIHZELA

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BY

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SUBMITTED

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CERTIFICATE

This is to certify that Lalhmangaihzela, registered under MZU/Ph.D./1205 of 24.08.2018 is a research scholar working under my supervision on a thesis entitled 'Spatial Analysis of Rental Housing in Aizawl City, Mizoram'.

All through his research pursuance, I found Lalhmangaihzela a serious, hardworking and highly dedicated student. I am grateful that he has completed his work with recommendable standard of scholarship.

I further certify that the thesis in 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.

Dated:

(Prof. BENJAMIN L. SAITLUANGA)
Supervisor

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APRIL 2024

DECLARATION

I, Lalhmangaihzela, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do 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.

This is being submitted to the Mizoram University for the degree of Doctor of Philosophy in Geography and Resource Management.

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I hope this thesis will suffice the purpose.

(LALHMANGAIHZELA)

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Abbreviations

AHP	Analytic Hierarchical Process
AMC	Aizawl Municipal Corporation
ANOVA	Analysis of Variance
BPL	Below Poverty Line
BSUP	Basic Service to the Urban Poor
CBD	Central Business District
CFA	Confirmatory Factor Analysis
COVID-19	Coronavirus Disease 2019
CPI	Consumer Price Index
CREDAI	Confederation of Real Estate Developers' Associations of India
DC	District Commissioner
DLC	District Level Committee
DUS	Dwelling Unit Satisfaction
EF	Equipment Factor
EFA	Explanatory Factor Analysis
EFA	Explanatory Factor Analysis
FA	Factor Analysis
FAF	Facilities Accessibility Factor
GDP	Gross Domestic Product
GPS	Global Positioning System
GWR	Geographical Weightage Regression
HAI	Housing Affordability Index
HCSE	Heteroskedasticity-consistent Standard Errors
IC	Inner Core
ILP	Inner Line Permit
IP	Inner Periphery
JNNURM	Jawaharlal Nehru National Urban Renewal Mission

KMO	kaiser-Meyer-Olkin
MLR	Multiple Linear Regression
MLRM	Multiple Linear Regression Model
MoHUPA	Ministry of Housing and Urban Alleviation
NCR	National Capital Region
NCT	National Capital Territory of Delhi
NDMA	National Disaster Management Authority
NDVI	Normalised Difference Vegetation Index
NES	Neighbourhood Environment Satisfaction
NESAC	North Eastern Space Applications Centre
NGO	Non-Governmental Organisation
NSS	National Sample Survey
OC	Outer Core
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
OLS	Ordinary Least Squares
OP	Outer Periphery
PCA	Principal Component Analysis
PF	Physical Factor
PRH	Public Rental House
PRS	Personal Residential Surcharge
R&TAI	Rental and Transportation Affordability Index
RCC	Reinforced Cement Concrete
RHAI	Rental Housing Affordability Index
RSAT	Residential Satisfaction
RSI	Residential Satisfaction Index
RSI_h	Residential Satisfaction Index (Household-wise)
RSI_l	Residential Satisfaction Index (Locality-wise)

RTE	Right of Children to Free and Compulsory Education
RU	Research University
SAT	Scholastic Aptitude Test
SC	Scheduled Caste
SES	Socio-economic Status Scale
SHF	Student Housing Facilities
SIF	Safety and Incivility Factor
SPSS	Statistical Package for Social Science
VC	Village Council
VIF	Variance Inflation Factor

CHAPTER – I

INTRODUCTION

The post-industrial revolution witnessed rapid urbanisation across the world and created a scarcity of urban space for housing in the city (Harvey, 1974). Despite the aspiration for ownership, housing in urban areas is not ubiquitous for everyone due to constraints of affordability and a limited supply of land. In a capitalist world, the land is private property (George, 1879) that turns into 'real estate' (Gottdiener and Budd, 2005), and housing which is a basic human need is now regarded as a consumer good rather than social entitlement (Pacione, 2001). Many of the people from rural areas migrated to urban areas in order to accumulate resources. With the growing demand for land for housing, owning a dwelling house becomes more and more difficult, especially for the economically weaker section. Rental housing, therefore, plays a crucial role by providing the much-needed 'room for manoeuvre' (Oakpala, 1981) to lessen the burden of migrants, and becomes important in the 'poverty-risk period' (Pugh, 1995).

According to Kumar (2001), 'the term 'rental housing' is used to denote the totality of the process of the letting of accommodation by landlords and the payment of rent for rights over the use of the accommodation that is rented by tenants. Rental housing can be understood and studied through the demand side and the supply side. On the demand side, a diverse group of people engaged in rental housing. They are generally low-income households like the workers who the public sector employees who are posting without accommodation or the informal workers who shifted to the city in search of work, students who moved for education, and young couple households who are trying to gain a foothold to access the urban economy and its opportunities (Harish, 2016). Rental housing provides affordable housing for such diverse supply groups and offers more flexibility and freedom to move whenever necessary.

On the supply side, there are two subcategories of rental housing according to the form of provision - social or public rental housing and private rental housing

(Lux and Sunega, 2010). Social or public rental housing is typically according to need supplied by non-profit organisations or government-sponsored programs at all levels of society from the local to the national. On the other hand, private rental housing is supplied by households who can afford to build more than they require, and the allocation process of private rental housing supply is largely determined by market forces like demand conditions (Gottdiener and Budd, 2005; Mahadevia, 2011). Social housing landlords are usually non-profit while private landlords are mostly profit, physical and legal entities (Lux and Sunega, 2010). UN-Habitat (2003) distinguished private landlords into commercial and non-commercial based on the size of their operations. Commercial landlords comprise those who let to ten or more tenant households, and non-commercial landlords to less than ten.

Rental housing is generally higher at the city level than at the national level in every country and shares a significant proportion of housing in a city. Generally, the proportion is higher in developed countries, but rapid urbanisation phenomena in developing countries in recent years put pressure on the demand for rental housing in the cities of developing countries. Therefore, rental housing plays a crucial role in urban functionalities in terms of social, demographic, economic and polity. It has a significant contribution to a reduction in urban poverty, and economic and social vulnerability of the city (Kumar, 2001). Rental housing provides shelter for the people until they can find a stable job and save for their own house in the city (Mahadevia, 2011).

As per the census of India, India's experienced a sharp decadal increase in urban rental housing. The rate of growth of rental housing in India (35.3%) is greater than the rate of the total number of households (28.5%), and almost 90 per cent of the rental houses increase was contributed by the urban sector (Kumar, 2016). India experienced rapid urbanisation in recent decades which caused urban congestion and led to the housing shortage in many cities. According to the estimates of the Technical Group on Urban Housing Shortage set up by the Ministry of Housing and Urban Poverty Alleviation (MoHUPA), there is an unmet demand for about seven million rented houses across urban India (MoHUPA, 2012).

However, the urban housing shortage might seem to contradict the decadal growth of the vacant census houses. As per the 2011 census, the growth rate of the number of vacant houses is 56 per cent, which is far higher than the rate of households living in rented houses (35.3%). It was believed that the sharp increase in vacant houses revealed the problems of housing affordability in urban India. The higher vacant houses did not mean a decline in demand for houses, but unafforded decent houses by the urban poor people. Some cities experienced a decline in rental housing mainly because of the introduction of rental control laws by their respective government. Extremely low returns of profits to the landlords caused by the implication of the rigid laws led to the decline of investments in new rental housing and then continuing dilapidation of the existing rental housing stock (Tandel *et al.*,2015).

The migration of rural poor people to the city in search of livelihoods is one of the main contributions of urban poverty (Jha, 2020). The Indian cities failed to provide sufficient and affordable housing for all the residents, especially for those migrants. A large number of migrants seek refuge in slums and other informal dwellings that have lower-quality housing conditions in terms of not only the housing itself but also limited access to amenities and services, improper sanitary and high social vulnerability (ibid). As per the 2011 census, of which 78.86 million urban households, 17.37 per cent lived in slums, and 32.13 per cent could access only one-room tenements.

All the interventions of the government on housing development through different schemes focused on ownership of housing mainly for vulnerable populations. However, almost all these schemes succeed only in rural areas or small towns where higher availability of vacant land (Jha, 2020). Moreover, public/social rental housing should not be considered a permanent solution for housing problems in the city (ibid). Public rental housing provides shelter for newly poor migrants till they are unable to afford the housing markets. After they set a foothold in the city, they would be replaced by other households. However, various government schemes for public rental housing seem to have failed to achieve the said tenants' cycles

because many of the tenants remain unaffordable with their own after a specific period.

According to the Knight Frank Affordability Index Level Report of 2023, the median Affordability Index of the eight major cities of India including Ahmedabad, Pune, Kolkata, Bengaluru, Chennai, Delhi-NCR, Hyderabad and Mumbai is 28 per cent (Hindustan Time News Desk, 2023). Mumbai became the least affordable city with an index of 55 per cent, while Ahmedabad is the most affordable with a 23 per cent ratio. Three cities including Delhi-NCR, Hyderabad and Mumbai are unaffordable housing cities that exceed the minimum standard of 30 per cent on housing expenditures.

The present study area, Aizawl City is the primate city of Mizoram in the northeastern region of India. Mizoram is one of the most urbanized states in India. With more than half of the population living in 23 urban centres, it is the fifth most urbanized state in India. The urban population in the last fifty years (1961-2011) has increased from 14,257 to 580,106 recording around 40 times increase (Singh, 2017). However, among the urban centres, only Aizawl city can be categorised as a Class I city as per the Census of India classification of urban centres. The city comprises 26.89% of the entire population of the state. It has been witnessing large-scale rural-urban migration mainly because of the limited scope for non-agricultural activities in rural areas and the pull factors of cities including better employment opportunities, a more secure social environment, and a better quality of life (Saitluanga, 2017). However, Aizawl was not properly planned and designed to cater for a large population. Moreover, the topography and underdeveloped nature of the economy have limited the scope of the physical expansion of hill towns (Khawas, 2006). As a result, demand for accessible land becomes higher and higher and leads to high prices of land. Under such circumstances, rental housing plays an important role by providing shelter to poorer new migrants.

1.1 Significance of the Study

It is a fact that most households aspire to own their housing, and homeownership has become the cornerstone of government housing policy in most

countries in the Third World (Kumar, 2001). The government's approach to urban poor housing has been focused on providing them with ownership of housing and land titles (Mahadevia, 2011). This has led to neglect of the importance of rental housing, and uninterested in rental housing markets, except to convert the tenants into homeowners during policy-making. As a consequence, India has given little attention to the rental housing segment (Jha, 2020) and the study of rental housing markets has remained largely unexplored (Banerjee *et al.*, 2014).

Millions of rural poor people migrated to the cities to access the accumulation of urban resources by taking up informal jobs for livelihood. The shelter is a basic necessity for everyone. Rental housing is the first entry point for those migrant people in the city. Therefore, rental housing is an integral part of cities and plays a crucial role in urban functionalities. The study of rental housing encompassed a wide range of topics, not only the architecture or the design or the conditions of housing itself but also the livelihood and the quality of life, sustainability, environment, economy, demography and even politics.

Urban poverty can be measured by assessing the quality of housing or residential environment. Housing is the manifestation of an individual or household's quality of life or livelihood. A study of rental housing revealed not only the housing condition or quality but also the socio-economic conditions of the tenants. The residential pattern is largely determined by the spatial distribution of geographical phenomena like topography, accessibility, services, resources etc. Poorer people tend to live in marginalized areas where an unfavourable environment for dwelling, while the richer people occupy a favourable place in a city. This phenomenon led to the formation of residential differentiation or segregation within a city. The quality of rental housing depends on the quality of the locality or the community, and therefore rental housing can access the level of segregation and the local or community level of development.

Rental housing served not only the tenants but the economy of the landlord. The study found that a large proportion of landlords are as poor or even poorer than their tenants (Kumar, 2001), and their livelihood solely depends on their rental

markets. Many cities have not implemented the Rental Housing Act for landlords to price their property. Landlords charge their rental amount based on probably by guessing or deciding arbitrarily or copying their adjoining properties (Wickramaarachchi, 2016). As a result, many landlords have been undercharging or overcharging their properties, leading to varying prices for houses of similar nature and quality (Kimani *et al.*, 2021). Analysing the factors that determine the rental price provides a framework to landlords for charging their properties. Moreover, it helps to understand the landlords as well as developers, investors, and planners which way to improve the rental housing markets.

Recently, residential satisfaction has been used as one of the significant indicators of modern quality of life that has turned into a popular topic of interest in the field of urban studies and geography (Galster, 1987; Ge and Hokao, 2006; Ghafourian and Hesari, 2018). Huang and Du (2015) stressed the way studies on residential satisfaction could be categorised into two from their review of different kinds of literature. The first is to assess the degree of inhabitants' residential satisfaction towards their residential environment, and the other is to examine the impact factors of residential satisfaction.

The findings of residential satisfaction studies can be helpful for a better understanding of residential satisfaction in several ways by planners, architects, developers, policymakers, and especially landlords. They are:

(a) Assess residents' quality of life; current housing condition; better understanding of residents' needs and priorities, and housing modification (Galster, 1985; Ibem and Amole, 2012; Huang and Du, 2015; Etminani-Ghasrodashti *et al.*, 2017).

(b) Predict residents' behaviour, such as residential mobility and patterns of mobility (Galster 1985; Mohit *et al.*, 2010; Etminani-Ghasrodashti *et al.*, 2017).

(c) Measure the performance of housing projects in private and public sectors (Galster 1985; Mohit *et al.*, 2010; Ibem and Amole 2012).

(d) Give feedback to policymakers and professionals for improving social housing policy, housing design practice, and the quality of the residential environment (Fatoye, 2009; Buys and Miller, 2012; Ibem and Amole, 2012).

(e) Provide a conceptual framework for identifying the factors influencing or determining residential satisfaction (Mohit and Nazyddah, 2011; Huang and Du, 2015).

In the case of Aizawl City, the tenancy is not only confined to the new rural-urban migrants but is also found among the residents of the urban fringe. Moreover, there are immigrants like Nepali and non-local residents who cannot possess land legally. As a result, the demand for rental housing become higher and higher, creating numerous different problems and becoming one of the most challenging urban problems to study.

There has been no proper study on account of rental housing in Mizoram. Although the government had been making acts and regulations regarding rental housing, most of the people had not been familiar with the rules and regulations. So, the tentative study may be the pioneer work and it would have a good contribution to Mizo society; it is useful for the people who have been involved in rental housing and the government for drafting the policies and programmes.

1.2 Scope of the Study

Traditionally, social theorists put more emphasis on sociological and historical explanations and neglected spatial context for studying social processes in general and urban housing systems in particular (Saitluanga, 2017). However, the social geographers stressed that every social process takes place in space and the intra-urban social differentiation is the product of dissimilarities of social spaces (Soja, 2010). And then the residential pattern is the manifestation of intra-urban social differentiation (Saitluanga, 2017). The territory is unjust, some regions have more advantages than others. The uneven distribution of resources causes social differentiation. Therefore, the spatial perspective cannot be neglected in the analysis of intra-urban rental housing.

Most of the literature related to rental housing is based on the plain cities. A vast literature review suggested that only a few studies had considered the geographical-related features. Unlike plain areas, the topography, altitude, relief and slope have an immense impact on residential environments in the way of construction of buildings, building safety, building characteristics, accessibility and even the local climate. Due to these, the present study puts more emphasis on the spatial context but does not neglect the traditional social and historical perspectives.

Since one of the main tasks of urban geography is to study socio-spatial similarities and contrasts that exist between and within towns and cities (Pacione, 2009), the present study mainly focuses on analysing the factors that affect the spatial distribution and differentiation of rental housing in Aizawl City. Studying the different characteristics of tenants concerning socio-economic, demographic and migration patterns will give us to understanding of the nature, importance, present conditions and future perspective of rental housing. The study also emphasises the impact of the spatial distribution of the geographical phenomena on residential rental housing in terms of patterns, value and even the tenants' satisfaction within the city of Aizawl.

1.3 Objectives of the Study

The main objectives of the study are:

1. To study the residential rental housing markets and rental housing pattern in Aizawl City
2. To study the socio-economic characteristics of tenants in Aizawl City
3. To investigate the spatial variation of rental housing affordability in Aizawl City
4. To find out the factors that determine rental values in Aizawl City
5. To examine the intra-urban variation of residential satisfaction of tenants in Aizawl City.

1.4 Limitations of Study

1. Since no proper study on rental housing has been conducted in the present study area, the scope of the study is limited because of the impossibility of presenting temporal analysis due to the unavailability of time-series data.

2. Some samples were dropped due to being unfit for the technical specificities required by the statistical techniques employed.

3. In the case of subjective data, the respondents may provide invalid or biased answers depending on their personal integrity, aspirations and level of knowledge.

1.5 Organization of the Chapters

To present a systematic analysis, the study has been divided into the following chapters:

An introductory chapter is given at the outset, where the significance of the study of rental housing is highlighted. It also includes the scope of the study, the aims and objectives of the study and the limitations of the study.

The second chapter is about a review of the literature. The literature review focused on the previous research on rental housing studies incorporating the study objectives.

Chapter 3 deals with the methodology of the study. It consists of the whole concept of research design including sampling technique, determination of sample size, description of the study area and method of data collection. A detailed description of quantitative techniques which are employed in the study like Correlation, Kuppuswamy Socioeconomic Status Scale (SES), Diversity Index, Regression Techniques, Factor Analysis and Principal Component Analysis are also narrated.

Chapter 4 is a general discussion of the spatial distribution of residential rental housing in the study area. It includes the spatial distribution of residential

rental settlements concerning the service centres, neighbourhood characteristics and topographic features.

Chapter 5 is an analysis of the socio-economic and demographic conditions of tenants, and how the socio-economic classes are spatially distributed in the city. The housing affordability, residential segregation and the origin of the tenants are also analysed.

Chapter 6 is a descriptive study of the 'rental housing' markets and the housing conditions such as building characteristics, housing services and amenities. Forced displacement and the important housing features for renting are also discussed.

Chapter 7 deals with the factors that determine the rental values in Aizawl City. Analysis has been carried out based on the structural characteristics, accessibility characteristics, topographic features, neighbourhood characteristics and socio-economic conditions of the tenants.

Chapter 8 deals with the residential satisfaction of tenants in Aizawl City. It includes measuring the satisfaction level of the tenants and the critical factors of such satisfaction with the help of descriptive statistics and factor analysis, respectively. Area-based analysis of residential satisfaction was carried out by constructing the residential satisfaction index.

The last chapter is the conclusion and summary of the major findings.

CHAPTER – II

REVIEW OF LITERATURE

2.1 Introduction

With the rapid urbanisation process, especially in developing countries, studies on rental housing gained much interest in the late 20th century till today. Rental housing can be studied at both macro and micro - levels. At the macro level, studies have been conducted by comparing and contrasting the rental housing between and among cities at either national or international scale. At the same time, the micro-level studies focus on intracity differentiation in rental housing. Some are concentrated on the housing environment itself – the physical characteristics, the attributes, the quality, the location, the prices, etc, while others deal with the tenants that reside in the rental house – their socioeconomic and liveability, affordability and satisfaction etc.

The thesis is about the geographical study of residential rental housing in Aizawl City. It particularly focuses on the rental housing conditions and the socioeconomic conditions of the tenants, the factors that determine the rental values and the residential satisfaction of tenants in Aizawl City. Reviewing literature focussed on the previous research which related to the present study objectives. Conceptual and theoretical approaches are also discussed whenever necessary.

2.2 Literatures on Rental Housing

Though the concept of rent or land rent was familiar from the time of classical political economy, the rent theories proposed by the classical economists were mostly based on agricultural land and unable to fit with the urban land. Agricultural land is a natural resource, its value depends on the qualities of the land and its distance from the market (Ricardo, 1817; Thunen, 1826), while urban land acquires its value through society without making any improvements at all which means that the value of urban land depends not only on the land itself but also on the development of the surrounding area (Gottdiener and Budd, 2005).

According to the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) (2015), “Rental Housing simply means a property occupied by someone

other than the owner, for which the tenant pays a periodic mutually agreed rent to the owner". Gilbert (1991) identified two basic types of rental housing: the formal or controlled market, and the informal or uncontrolled sub-market in his study of rental housing in Mexico. Formal rental type has a lease agreement between the owners who provide renting and the tenants and bond it with the competent authority while informal rental housing is run by private or individual landlords with no agreement or registration to the competing authority or the government. Informal rental is widespread especially in developing countries because many owners are enabling to avoid taxes or burdensome laws and regulations set by the competing authorities (Peppercorn and Taffin, 2013). Wadhva (1989) identifies a third type of rental market in Ahmedabad, the semi-controlled market, that neither falls into the regulation of the competing authority nor in the open uncontrolled market.

Several bases of classifications of rental housing have been identified. Based on the ownership or supplier, Peppercorn and Taffin (2013) classified rental housing into three types: individuals or small-scale owners, institutional investors, and nonprofit or limited-profit providers of social rental housing, including the government. On the other hand, Gilbert *et al.* (2011) identified five types of owners: small-scale landlords, commercial landlords, public-sector landlords, social landlords and employer landlords. From these two classifications, rental housing can be categorised into two types: private rental housing and public rental housing. In private rental housing, two types of owners can be identified - individual or small-scale owners and commercial owners with medium or large scale. The owners are run with their own benefits in a business manner. Individual or small-scale owners are the most common in most countries. It is generally an informal type of market, mostly the landlords rent out a room in their house or an apartment in the same building in which they live. Public rental housing is mostly run by the government or non-profit institutions to provide accommodation without aiming the financial benefits.

Based on the housing features, the 1980 housing census of Bangkok classified rental housing based on two divisions: types of accommodation and construction materials. Five types of accommodation had been identified – detached houses, duplexes, row houses, apartments and rooms. More than half of the rental houses are

constituted by row houses. Again, there are five types of rental houses based on the construction materials – cement or brick, wood and, local materials and reused materials; and above 90 per cent of the houses are constructed by using cement or brick (43.7) and wood (45.7%). Based on the 1980 housing census, Angel and Amtapunth (1989) classified rental housing accommodation into five different types – concrete apartments, wooden apartments, low-cost houses, row houses in land subdivisions, and rooms and houses in land rental slums in their study of the low-cost rental housing market in Bangkok.

Ballesteros (2004) found six types of rental accommodations in his study of rental housing in the Philippines. They are – single houses in private subdivisions/ depressed settlements; shacks on rented plots (separate rooms with access to shared facilities), rowhouses (*accessoria*) in private subdivisions depressed settlements, rooms/beds in multi-unit buildings (tenements, medium-rise, high-rise), Rooms/beds in houses, Rooms/beds in commercial/industrial establishments (e.g., warehouse, factory, dormitories, hospitals, camps, etc).

On the demand side, the major components of the tenants are shared by migrants in the city (Mahadevia, 2011). In her case study of Rajkot rental housing, migrants are classified into three types - long-term or permanent migrants who settle down in the urban areas, but keep ties with their native or villages; seasonal migrants, defined as those who stay in the urban areas for more than 60 days in a year but return for some period to their villages, and lastly, migrants tied to the employers, who move from one place of employment to other.

Gilbert *et al.* (2011) classified tenants based on their characteristics in their study of rental housing in developing countries. They are – lower-income households, migrants, younger people, single-parent households and divorcees, people with different priorities, and gender.

Peppercorn and Taffin (2013) divided tenants into two – by constraint and by choice. A greater number could not afford to own the house but to rent, and then put as tenants by constraint. The low-income groups and new migrants can be put under this segment. Housing starters and other young couples and singles who want to remain

mobile, middle- and upper-income professionals who do not desire home ownership, and students were put as tenants by choice.

Household income has a huge impact on housing affordability. The theoretical statement is that higher-income households are more likely to afford rent or housing than lower-income households. Although, different researchers have proposed different methods for measuring affordability, the conventional and popular measurement of housing affordability is a 30 per cent income-to-rent ratio which means that the house can be affordable if the housing costs or rent do not exceed 30% of household income.

Beer (1998) measured the affordability of rental housing in non-metropolitan Australia and found that non-metropolitan tenants are less likely to have lower incomes than tenants in metropolitan cities. However, the rental prices of the non-metropolitan are lower than the capitals. As a result, tenants in non-metropolitan like small towns, rural areas or regional cities spend a lower proportion of their income on rent than tenants in capitals. The private tenants of non-metropolitan spend 27.5 per cent of their income on rent while 31.4 per cent is spent by the tenants in the capitals.

Murdie (2003) studied the housing affordability of Toronto's rental Market among the immigrants of Polish, Jamaican and Somali newcomers. He found that among the three groups, Somalis spent a higher portion of their income on rent, followed by the Jamaican and the Polish were the last. 71 per cent of Somali, 61 per cent of Jamaican and 39 per cent of Polish households spent more than 30 per cent of their income on rent. Half of the Somali households spent 50 per cent of their income on rent while only 19 per cent and 15 per cent of Jamaican and Polish spent their 50 per cent of income on rent.

Revington and Townsend (2016) studied the spatial distribution of intra-city housing rental affordability and compared the two metropolitan cities of Vancouver and Montreal, Canada. The study is concentrated on tenant households of the two lowest income groups such as very low income and low income; and the spatial model is based on the urban core, inner city, inner suburbs and outer suburbs. The study found that the affordability of renting is lowest in the urban core zones and higher in the outer

zones in both cities. The low-income groups were more likely to afford the houses than very low-income households. Montreal shared a higher proportion of affordability than Vancouver. In Vancouver, couples with children have limited options in the inner zones other than Montreal. In both cities, couples without children have greater flexibility in the rental market in terms of affordability and geographic locale.

Wu *et al.* (2020) developed a Rental and Transportation Affordability Index (R&TAI) in their study of rental and transportation affordability of Nanjing's (China) public rental housing. For rental housing affordability, they set a 50 per cent income-to-rent ratio, and the affordability is unbearable if the index score exceeds 1. The result indicates that the lower-income households who either commuted with private or public transportation have unbearable affordability problems. While lower-middle income households lived in affordable houses, but medium to heavy bearable burdens. The households who have commuted by public transport have a lower level of burden than those who commuted by private vehicles among the low-medium households.

Residential social differentiation is highly determined by urban morphology or the spatial distribution of urban space. The higher social classes tend to live in desirable places, and vice versa with the lower classes creating urban segregation. During the first half of the 20th century, the popular urban land-used models that differentiate land used and values in a city were developed by Burgess, and his associates known as the Chicago School of Sociology. In his concentric zone theory, Burgess (1924) explains the city in various concentric zones of land use stating that, even though the CBD or the innermost circle of the city has the highest land values because of the commercial centres, the poorest migrating to the cities, found their housing surrounded CBD, where the cost of living was cheapest and the poorest quality of housing. By enjoying the low-skill jobs provided by the CBD and by avoiding transport fares for journeys to daily work, the poorer people tend to live near the CBD. Burgess viewed the annular outward expansion of the city as the result of the decay of the inner city for social living which was created by the invasion of the poorer migrants (Saitluanga, 2015). The richer people move away from the city centres by avoiding the crowd and form the high-class residential areas in the peripheral city.

Hoyt (1939) found rent areas in American cities tend to conform to a pattern of sectors rather than Burgess's concentric circles from his study of 142 American cities. He concluded that the highest rent areas of a city tend to be located in one or more sectors of the city where the most desirable lands, particularly along the major routes from the CBD and elevated areas that are safe from flooding, provide better views and accessible to a better quality of air. And then a gradation of rentals downward from these high rental areas in all directions (Mahadevi and Gogoi, 2001).

Harris and Ullman (1945) contradicted the previous theories regarding the sole focal point of the city's growth or services by proposing the multiple nodes or nuclei that reemerged within the city. They suggested that the CBD remains at the city centres as functions as the commercial centres. However, with the expansion of the city, several growth centres called nuclei or mini-CBD developed in different parts of the city. The theoretical statement is that the nuclei areas have higher rental prices or land values than the surrounding areas.

However, land value is not only created by the nature of the land itself but also the society. Considering the land value in relation to the growth point advocated by the Chicago school of thought is not sufficient for understanding the intra-urban variations. Brigham (1965) stated that 'since land supply is fixed, land values in an urban area are determined by the demand for space'. The demand function for any site in any given metropolitan area is a function of the site's accessibility, amenity level, topography, certain qualitative phenomena that may be considered historical accidents, and the value of land in non-urban uses.

Sun *et al.* (2017) studied residential spatial differentiation based on urban housing types in Xiamen Island, China and found that the residential differentiation is largely demonstrated by the population size, followed by the land resources and the resources of green spaces. Of all the housing types, old town residences and staff apartments had the highest spatial differentiation. While commercial housing provided by both government and private for the general people had low degrees of spatial differentiation, luxury commercial housing, indemnificatory housing, villas, and urban villages had a medium degree of spatial differentiation.

Zhang and Wu (2023) investigated residential spatial differentiation at the community level in Hangzhou, China and found that the highest class is distributed in small areas near the traditional CDB and the new CBD where the house prices are highest in the city. The local middle-aged, elderly, and young who are engaged in commercial services reside in the northeastern and southeastern peripheral areas of the city, where the level of housing prices is comparatively low. Families with school-age children are mainly clustered where the educational facilities are convenient. Highly educated people who are engaged in industrial activities live in new areas of the city which is recently developed between the traditional downtown and the new CBD.

2.2.1 Literatures on Determinants of Rental Prices

A house is an immovable property made up of different facilities, such as structure, facilities, design and aesthetic aspects, internal settings, services etc., which are referred to as housing attributes. Each building has its own identity regarding the quality of such attributes (Ersoz *et al.*, 2018). The quality of housing attributes is not enough to estimate the value of the house; the location of the house is essentially the same as housing attributes. Likely, the price of the houses in the different regions cannot be the same even if they have the same value of housing attributes.

The heterogeneous nature of the house makes it difficult to fix the pricing value in the housing market as well as the rental value (Wickramaarachchi, 2016). In cities, especially in developing countries, the demand for rental houses is soaring due to rapid urbanisation, making it challenging to implement rental acts for the authorities. As a result of these, the landlords have the sole authority to fix the rental amount of their houses. Usually, the ultimate goal of landlords is to make high profits with little additional effort (ibid). Due to the lack of a tool that guides homeowners towards the pricing criteria, they charged the rental amount based on probably by guessing or deciding arbitrarily or asking charges of comparable adjoining properties without consulting the guideline (ibid). Previous studies found that many landlords have been undercharging or overcharging their properties, leading to varying prices for houses of similar nature and quality (Kimani *et al.*, 2021). Thus, there is a need to study the

determinants of rental values to develop the pricing model for estimating rental amounts.

Researchers attempted to identify the factors that determine the value of houses in different cities from different perspectives. House prices and rental rates are positively related to each other, which means that an increase in housing prices is synonymous with an increase in rental rates (Gallin, 2008). At the macro level, economic factors like income or per-capita GDP (Case and Shiller, 1990; Égert and Mihaljek, 2007; Leung *et al.*, 2008;), the employment rate (Clapp and Ciaccotto,1994), interest rate (Ito and Iwaisako,1996; Égert and Mihaljek, 2007; Leung *et al.*, 2008), government policy (Okina *et al.*, 2000) have a significant impact on house price, so as rental rates.

The literature reviewed at the local level reveals that the determining factors of rental values can be categorised into three groups: structural characteristics, neighbourhood environment and locational features. Structural characteristics have been considered the major determinant of rental rates and the deciding factor for renting by renters (Ruivo, 2010). Sirmans *et al.* (2005) reviewed the hedonic pricing models of 125 empirical studies across different countries. They listed the top 20 predicted variables frequently used for determining house prices with the nature of the relationship with the prices. Out of the top 20 list of predicted variables frequently used for determining house prices, the first eleven are the variables of structural characteristics (Table 2.1). The structural characteristics are disintegrated into facilities and amenities in some studies including the services provided by the landlords (Amenyah & Fletcher, 2003). In the neighbourhood environment, the common variables considered are the variables that can reveal the quality of the neighbourhood, like school quantity and quality, crime rate, greenery, services, population and air and noise quality. Sometimes, locational features can be referred to as accessibility and used to measure neighbourhood quality. The locational distance or proximity of the important site like CBD or central market, hospital, working place, public transport route or station etc. are considered in the locational features category.

Table 2.1 Previous Studies on the Determinants of Housing Prices

Variables	Appearances	Time Positive	Times Negative	Times Not Significant
Age	78	7	63	8
Square Feet	69	62	4	3
Garage Spaces	61	48	0	13
Fireplace	57	43	3	11
Lot size	52	45	0	7
Bathrooms	40	34	1	5
Bedrooms	40	21	9	10
Full Baths	37	31	1	5
Air Conditioning	37	34	1	2
Pool	31	27	0	4
Basement	21	15	1	5
Time On Market	18	1	8	9
Distance	15	5	5	5
Rooms	14	10	1	3
Brick	13	9	0	4
Time Trend	13	2	3	8
Stories	13	4	7	2
Deck	12	10	0	2
Ln Lot Size	12	9	0	3
Ln Square Feet	12	12	0	0

Source: Sirmans *et al.*, 2005

In the case of housing features, Zietz *et al.* (2007) in Utah, Marco (2008) in Michigan, Wickramaarachchi (2016) in Sri Lanka and Yılmazel *et al.* (2017) in Turkey, found that housing features like the floor area, number of bedrooms, number of bathrooms and toilets have a positive relationship with rental prices. However, contrary to the theoretical statement, Liman *et al.* (2015) found that an increase in the number of rooms leads to a decrease in house prices by 2.5 per cent in Minna City, Nigeria. The present studies followed the theoretical statement that the coefficient of the floor area (size), and number of bedrooms and bathrooms have a positive relationship with the rental prices. An increase in one unit of the said attributes would lead to an increase in rental prices by 0.4, 5.6 and 9 per cent, respectively. The number of bathrooms became the second most determinant of rental prices of all the selected variables and was followed by the number of bedrooms.

The availabilities of housing amenities and services are diverse across the cities, depending on the economic development of the country. For instance, economically developed countries have to provide additional housing amenities like air condition systems, heating systems, pools, gardens, security and elevators, generators, refrigerators, washing machines etc. (Mihaescu and Hofe, 2012; Onder and Turgut, 2018; Bui, 2020) which are absent in developing countries (Amenyah and Fletcher, 2013; Bhargava, 2013). The amenities like water and electric supplies appear to be ubiquitous in many countries, but in some less developed countries like Sri Lanka (Wickramaarachchi, 2016), Nigger (Inuwa *et al.* 2019) and Ghana (Darfo-Oduro, 2020), the availability of such services have a significant effect on house value. In developing countries, the values of rental prices hugely depend on the utilitarian value (Darfo-Oduru, 2020), and the renters as well as the landlords cannot afford the luxurious commodities.

Sirmans *et al.* (2005) found that the age of the building is the most frequent variable in explaining the rental prices or housing values and is mostly found to be inversely correlated. Based on theory, the building age and the housing or rented values have an inverse correlation which means that older houses are more likely to have low prices than newer houses. Against the theoretical statement, positive relationships were found in some studies. For example, in the Dimapur City of Nagaland, Kumar De and Vupru (2017) found a positive relationship between the age of the house and rental values mainly because the buildings in the central part are generally older than the buildings in the adjacent peripheral area.

The extended literature review suggested that different criteria are used to represent the type of house or buildings in housing studies. For example, attached and detached types of houses (Haines, 2008; McCord, 2014), ownership-based like apartments or Condos (Agustos, 2018; Onder and Turgut, 2018), mixed commercial and residential buildings (Djurdjevic *et al.*, 2008), based on the size of the floor (Chung, 2012). However, the type of building based on the material used in the construction is rare in the literature, especially in economically developed countries. This is mainly because the construction of houses should be expected as concrete-related structures in many countries. However, in some developing countries like

Turkey (Selim, 2008) and Ghana (Darfo-Oduro, 2020), as well as the present study area, the type of building categorised on the material used in the construction, was found relevant.

The variables floor levels are mainly used in the rental house and mostly found significance in the multistorey building where no elevator exists in the building. Ferlan *et al.* (2017) witnessed that the importance of the floor level of the apartment was decreased in the buildings with elevators. In multistorey buildings, especially in developed countries, an elevator becomes a common asset, it enables to make equal accessibility of the different floors. As a result, only a few works of literature have found the variation of rental prices based on floor levels. For example, Djurdjevic *et al.* (2008) studied the rental market in Switzerland and found that the rate of rental price increased with an increase in the floor level of the apartment in the building. Brunauer *et al.* (2010) also support that the rental prices of the higher-level of the floor of apartments were higher than the lower-floor level apartments by 10 per cent. In the multistorey rental apartment where no elevator exists, Ferlan *et al.* (2017) found the rental price was highest on the first floor, and then decreased with increasing the floor level. The apartments on the ground floor are less desirable than the first floor probably due to high exposure to the outside world.

However, most of the literature is on real estate and differs from the rental housing context. The following literature review concentrates only on the residential rental house, not the real estate or other forms of housing property value.

Selim (2008) studied the determinants of rental house prices in Turkey, covering the urban and rural areas of the country. He used 46 variables, including locational characteristics, housing structure and amenities, to determine the rental prices. Using a hedonic price model, he found that the type of house, type of building, number of rooms, size, and other structural characteristics such as water system, pool, and natural gas are the important variables that affect the house rents.

Ruivo (2010) focused on the determinant factors that contribute to rental pricing at the national level. He chose the cities for his studies based on the population of more than 100,000 and gathered the data provided by the United States Census

Bureau. He found that cities with high income, housing costs, population densities, and poverty rates are associated with higher rental rates, implying that those variables are positively correlated. Cities with more rental units available in the market have lowered rental prices.

Amenyah and Fletcher (2013) used Pearson's chi-square and Cramer's V to compute the relationship between rental values and the proposed determinant variables like the number of bedrooms, availability of toilet and water facilities, and location of the apartment and the strength of such association, respectively, in the metropolitan city of Accra, the capital of Ghana. They found that the number of bedrooms had the strongest correlation with residential rental prices, followed by sharing of facilities, availability of facilities, availability of amenities and location of a rented apartment.

Babalola *et al.* (2013) investigated the factors that determined residential rental values in the university environment of Modibbo Adama University of Technology, Nigeria, using the Hedonic Pricing Model. This study found that age, tenement rate, number of houses built in the university environment and proximity to the university affect the rental values. The house's age and the building's increase in the university environment had a negative relationship. In contrast, the tenement rate and proximity of the university showed positive.

Wickramaarachchi (2016) studied the determinants of rental values of boarding homes through the land owners' perspective in the 500-meter radius buffer zone from the University of Sri Jayewardenepura, Sri Lanka. He distributed sample elements into three: only bed, room and annexe and the multiple regression models were used in the analysis to determine the interrelationships between each factor. The determinants variables of rental values can be categorised into three order factors: distance to the main junction and floor area are the most determinants; amenities services like freely available water, freely available electricity, and attached bathroom and neighbourhoods' characteristics as less congestion/privacy became the second order factors; and others factors like distance to bus route, tiled floor, roof with a ceiling, student tenant are the third factors which determined the rental values.

De and Vupru (2017) analysed the influence of the socioeconomic, locational and neighbourhood factors determining the monthly rent in Dimapur, the capital of Nagaland state, the urban area of northeast India. For the methodology, linear and log-linear regression models were used for the analysis. The analysis reveals that family size, income, education of the head of the family, water availability, security, convenience to access the workplace, road conditions, etc. have significant positive impacts on the monthly rent, while the distance to the workplace, distance to train station and view of green space showed the negative impact. However, the effects of some locational and neighbourhood variables vary across social and economic groups.

Ersoz *et al.* (2018) researched factors affecting real estate values in Karabük City, Turkey using data mining methods like CHAID and C&RT algorithms. In the study, variables like the age of the real estate, distance to the city centre, region's popularity, whether the park and garden, the type of heat protection, interior features, aspects of building, location, landscape, heating, area were significantly affected the real estate values.

Mohammed *et al.* (2019) assessed the factors affecting residential property investment rental values in Minna, Niger state. Using the data of respondents' perception with the methodology of variance, they revealed that the number of bedrooms, quality of construction, electric and water supply, proximity to workplace and CBD (main market), and income of the renters are the variables that influence the rental values. The locational and infrastructure quality of the residents are the most influential factors.

Using a spatial econometric approach like Geographical Weighted Regression (GWR), Dongsung (2020) analysed the determinants of apartment rent in the Seoul Metropolitan Region. He compared the methodology of traditional Ordinary Least Square with GWR with the R-square changes and revealed that GWR was more applicable in his study area. The analysis is based on the variables of structure factors and accessibility factors. He found that Pyoung (area), floor, brand, room, bathroom and distance of the traditional market positively affected the rental values. In contrast,

the age of the building, distance of subway, CBD, subcenter, school and park showed a negative relationship.

Darfo-Oduro (2020) used four regression equations, linear, linear-log, log-linear and log-log, for analysing the effect of neighbourhood characteristics and structural characteristics on residential rental prices in the Accra metropolis of Ghana. By comparing and contrasting the results of the regression models, he concluded that there is a significant relation between house rental prices and neighbourhood characteristics such as distance to market, central business district, park, and mosque, as well as the structural characteristics of residential property like electricity supply, refuse dump, wooded area and urban effect.

Nma (2020) analysed the determinant factors of students' rental values of the different sub-market (single room, single room self-contain and two rooms self-contain) around the immediate environment of the Federal Polytechnic Bida, Niger state. Variables like distance of the university, accessibility, age of the building, number of rooms in a building, availability of gate, fence, water source and dedicated transformer determined the rental values. However, different sub-markets react differently, especially to the attributes of the houses.

Kimani *et al.* (2021) concentrated on spatial (geographical) factors like slope, distance and land values to analyse the factors affecting the rental house prices in the Nyeri constituency, Kenya. The spatial Hedonic Model was used to determine the factors affecting rental prices. They are land values (positive), population density (negative), security (positive), slope (positive), distance of towns (negative), floor size (positive), distance of the international road (negative), distance of the national road (negative), distance of primary school (negative), and distance of secondary school (negative). Furthermore, the Analytic Hierarchy Process (AHP) is used to compute the weightage of each factor that affected the rental prices, and it revealed that floor size, land values and security were the first three most weightage on rental house prices.

Cai *et al.* (2022) considered the impact of the land auction for estimating the influencing factors of the rising private domestic rental prices in Hong Kong. With the Regression Model, he calculated the effect of the variables related to land value

auctions like property market yields, housing price, real GDP, unemployment rate, total loans and government expenditures. The most exciting part is that rental price positively correlates with increasing Housing Price. Surprisingly, due to the outbreak of the pandemic in 2020, Government Expenditures did not significantly correlate with rental prices as unexpectedly.

2.2.2 Literatures on Residential Satisfaction

Based on the dual nature of the environment, the residential environment can be measured in objective and subjective approaches (Galster, 1987; Wiedemann & Anderson, 1985; Francescato, 2002; Kahana *et al.*, 2003; Amole, 2009; Mohit and Nazyddah 2011). Objective measures refer to the actual measurements, such as the presence, the lack of, or quantities of the physical characteristics, facilities, services, and environment, while subjective measures refer to perceptions, emotions, attitudes, and intentions towards the housing attributes (Francescato, Weidemann, and Anderson, 1987; Nurizan & Hashim, 2001; Mohit *et al.*, 2010).

Galster (1987) proposed two main approaches to studying residential satisfaction – the purposive approach and the actual-aspiration gap approach. In the purposive approach, satisfaction is a measure of the degree to which the environment facilitates or inhibits the user's goal; it enables researchers to understand the degree to which different facets and roles of users contribute to their satisfaction (Ibem and Amole, 2012). The actual-aspiration approach indicates that households will cognitively set conditions for their desired housing and neighbourhood features and make a comparison between an individual's actual and expected housing and neighbourhood situations to define residential satisfaction (Amerigo and Aragones, 1997; Galster, 1987; Ibem and Amole, 2012; Tan, 2016). Most of the studies of residential satisfaction utilise these two approaches to improve the understanding of factors that influence satisfaction levels (Ghasrodashti *et al.*, 2017).

Different studies have been carried out in different fields, which provide different dimensions concerning the objectives of the studies. The several chronological developments of the dimensions of residential satisfaction are highlighted in the following table (Table 2.2).

Table 2.2 Chronology of Dimensions of Residential Satisfaction

Researcher	Conceptual Framework
Canter and Rees (1982)	1) the neighbourhood, 2) the house, and 3) the relationship maintained with the neighbours.
Savasdisara *et al.* (1989)	1) Satisfaction with neighbours; 2) satisfaction with public facilities; 3) satisfaction with environmental conditions; 4) satisfaction with the dwelling units; 5) satisfaction with locational aspects.
Amerigo and Aragones (1990)	1) Relationships with neighbours; 2) Residential safety; 3) Basic residential infrastructure; 4) Neighbourhood infrastructure; 5) Deterioration; 6) Urban activity and noise; 7) Open natural spaces; 8) Miscellaneous.
Amerigo and Corraliza (1992)	1) Relationships with neighbours; 2) Urban safety; 3) Overcrowding; 4) Infrastructure: facilities; 5) Health infrastructure
Liu (1999)	1) Psychological; 2) Physiological; 3) Sociological; 4) Economic
Amole (2009)	1) Objective variables (Physical attributes); 2) Subjective variables (subjective measures of physical, social/psychological, and management attributes); 3) Demographic characteristics.
Mohit *et al.* (2010)	1) Dwelling unit features; 2) Dwelling unit support service; 3) Public facilities; 4) Social environment; 5) Neighbourhood facilities; 6) Household characteristics
Ibem and Amole (2012)	1) Housing Unit characteristics; 2) Neighbourhood facilities & Environment; 3) Management of the

	housing estate; 4) Socio-economic characteristics of respondents
Day (2013)	1) Regional access; 2) Housing and environment; 3) Community and social relations; 4) Parking and traffic; 5) Public goods quality and access.
Huang and Du (2015)	1) Housing characteristics; 2) Neigbourhood characteristics; 3) Public facilities; 4) Social environment; 5) Residents' characteristics; 6) Residence comparison; 7) Housing allocation scheme.
Byun and Ha (2016)	1) Dwelling unit features; 2) Neighbourhood satisfaction; 3) Neighbouring; 4) Walkability and safety.
Tucker and Abass (2017)	1) Neighbourhood attachment; 2) Neighbourhood features; 3) Neighbour relationship; 4) Socio-demographic status; 5) Economic status.
Yin *et al.* (2018)	1) Housing physical conditions; 2) Public facilities; 3) Location; 4) Property Service; 5) Value judgement; 6) Corporate Image
Li *et al.* (2019)	1) Housing characteristics; 2) Neighbourhood and Public facilities; 3) Housing operation and facilities; 4) Residential attitude; 5) Socio-demographic characteristics.
Gan *et al.* (2019)	1) Dwelling features; 2) Dwelling facilities; 3) Public facilities; 4) Neighbourhood environment; 5) Housing policies; 6) Socio-demographic characteristics.

From the chronological development of dimensions of satisfaction (Table 2.2), it can be said that the dwelling features and the neighbourhood or locality environment are the most common dimensions. Besides these two dimensions, dwellers' socioeconomic conditions become the most common dimension; though it is not a part

of the residence, many studies found that it significantly impacted dwellers' satisfaction.

Most of the residential satisfaction studies were concentrated on a specific area or case study like public housing (Amerigo and Aragones, 1990; Mohit *et al.*, 2010; Huang and Du, 2015; Byun and Ha, 2016; Ghasrodashti *et al.*, 2017; Gan *et al.*, 2019), students' resident (Amole, 2009; Najib *et al.*, 2011; Muslim *et al.*, 2013), old age centre (Rioux and Werner, 2011; Temelova and Dvorakova, 2012), migrants or reallocate housing (Barcus, 2004; Checa and Arjona, 2010; Day, 2013; Tao *et al.*, 2014; Lin and Li, 2017; Li *et al.*, 2019), gated or non-gated home (Tan, 2016; Shawabkeh *et al.*, 2020), economic status (Aulia and Ismail, 2013; Chen *et al.*, 2013; Li and Wu, 2013), etc. and their objective is mainly to find out the important factors of residents' satisfaction and the factors that determined their residential satisfaction. Only a few studies carried out the analysis of the aerial differentiation of residential satisfaction based on the geographical area (Savasdisara *et al.*, 1989; Tucker and Abass, 2017; Yin, *et al.*, 2018).

Savasdisara *et al.* (1989) attempted to understand which factors of the housing environment contribute to the overall satisfaction of dwellers in private lower-cost housing estates (cost per unit of not more than Baht 400,000) in and around Bangkok (Thailand). The authors used five domains of criteria – satisfaction with neighbours; satisfaction with public facilities; satisfaction with environmental conditions; satisfaction with the dwelling units; and satisfaction with locational aspects. These five domains contain 44 variables of satisfaction which were measured by a scale of 5 points like 1 (= strongly dissatisfied), 2(= dissatisfied), 3 (= undecided), 4 (= satisfied) and 5 (= strongly satisfied). Percentile methods and mean average score of the variables were used to describe the satisfaction level of the estates. Percentile methods defined the proportion of the different scales of each of the variables as well as the domains. The composite index which are calculated by summing up the different average of the variables was used to differentiate the different estate on the level of satisfaction ground. The overall composite index on the average mean score is 3.62 which means that on average, people in the sample were quite satisfied with dwelling units built by the private developers. However, the composite index of the average

score was not a suitable method to extract the underlying factors which determined residential satisfaction.

Ukoha and Beamish (1997) investigated the residential satisfaction with public housing which was provided by the federal government of Nigeria in their capital, Abuja, and examined the relationship between specific housing features and overall housing satisfaction by using the methods of descriptive statistics and correlation analysis for data analysis. Residential satisfaction was measured with a 5-point Likert scale that contained six sections that measured the housing characteristics, and demographic/socioeconomic characteristics. The study revealed that the residents expressed dissatisfaction with their overall housing situation; structure types, building features, housing conditions, and housing management, whereas satisfied with neighbourhood facilities. The residents were dissatisfied with most of the individual housing conditions; the quality of plumbing, lighting, floors, windows, doors and finishing presented problems for many respondents. However, the residents were satisfied with three items; the quality of the exterior construction, the walls, and the pressure of water.

Liu (1999) studied the factors which influence residential satisfaction among the housing estates either private or public rentals in Hong Kong. Liu collected 51 variables in the form of a 5-point Likert scale which was divided into nine categories within the framework of the study i.e., Physiological, Psychological, Sociological and Economic. Liu used factor analysis to reduce the variables of satisfaction. Principal Component Analysis (PCA) with Oblimin rotation is carried out, nine factors being generated from 51 variables with 60% of the variance explained. Among the factors, management and maintenance of the estate consist of six variables had the highest factor loading followed by lightning and ventilation. Multiple regression (stepwise method) was employed to identify the major factors which affect residential satisfaction in Hong Kong real estate. Overall satisfaction with the building was used and the dependent variables and the nine factors were generated from the PCA work as predicting variables. The factors: spatial movement, within the living habitat., the convenience of location, appropriateness of site including privacy, management and

maintenance of the estate and the surroundings had a positive correlation with residential satisfaction.

Amole (2009) used categorical regression with satisfaction as a dependent variable to find out the factors that determined residential satisfaction in student housing in Nigeria. He used the objectives variables of physical attributes; the subjective variables of physical, social/psychological and management attributes by using a 5-point Likert scale; and demographics characteristics as the predicting/independent variables. Amole reduced the 49 subjective variables into 12 factors by using the factor analysis method and the varimax rotation method. Out of the 12 factors, only the first four factors are statistically significant for regression analysis, they are; the social and place qualities of the bedroom; the design of the hall; the social densities in the hall; and storage and furnishing in the bedroom. In general, more than half of the respondent (53.0%) were not satisfied with their housing using the Index of Residential Satisfaction (RSAT). The regression model was used to find out the factor responsible for the satisfaction level of the students. The model found that of all the predicting variables, social and place qualities of the bedroom had a large impact on residential satisfaction among the students, followed by the social densities in the hall. Of all the variables, only the economic status of the students had a negative relationship with satisfaction indicating that the better the economic status of the students, the lesser the satisfaction level.

Mohit *et al.* (2010) assessed residential satisfaction among newly designed public low-cost housing dwellers of Kuala Lumpur, Malaysia, by using the methods of Residential Satisfaction Index (RSI) and Multiple Linear Regression (MLR). The level of housing satisfaction was measured by using a five-point Likert scale containing forty-five variables which were grouped into five components – dwelling unit features, dwelling unit support services, public facilities, social environment and neighbourhood facilities. Among the five components, the residents' satisfaction with dwelling unit support services scored the highest, followed by public and neighbourhood facilities. The components of dwelling unit features and social environment scored low levels in residents' satisfaction. The components of dwelling unit features, social environment, support services and public facilities had high

positive correlations with the Residential Satisfaction Index (RSI), with low positive correlations with neighbourhood facilities. Correlating the residential satisfaction and socio-economic conditions, the study found out that residents' race, employment type, floor level and length of residency are positively correlated with residential satisfaction, while age, family size, working wives, and previous residence are negatively correlated with residential satisfaction. Among the forty-five variables, ten predicting variables in MLR explain 76 per cent of the residential satisfaction in low-cost housing in the study area. The result suggested that the improvement of residential satisfaction can be done by the Local Authority (KLCH) through the development of management of security control, perimeter roads, cleanliness of garbage houses and garbage collection.

Najib *et al.* (2011) investigated the level of residential satisfaction and the relationship between satisfaction and loyalty behaviour among the students who lived in campus student housing facilities (SHF) at Malaysian research universities (RUs). They proposed the student residential satisfaction (SRS) framework to investigate residential satisfaction from the student's viewpoint. The SRS framework consists of two sections, one was Students' actual experience contains five domains which were measured based on perceived satisfaction with a 4-point Likert scale, and the other was loyalty behaviour towards students' residence consisting of three items which was measured by dichotomous answers of yes and no. Descriptive statistics were used to present the students' demographic profiles. The SRS index was computed using the mean score of those four items and found that students are satisfied with the provided SHF with the SRS index of 2.96 or 74 per cent satisfaction level. A correlation (i.e. χ^2-test) was performed to examine the relationship between overall satisfaction and loyalty behaviour of the students towards their resident and found that the relationship was positively significant.

In Finland, Gibler (2014) found that there is a positive relationship between dissatisfaction with housing and mobility, which means that dissatisfaction with housing leads to the intention to move the tenants in Finland cities. He collected twelve objective variables regarding socioeconomic characteristics and physical attributes; and subjective variables related to housing conditions by using 4 points scale system.

Logistic regression was employed to find out the factors responsible for the dissatisfaction of tenants about their housing conditions; and whether the dissatisfaction leads to an intention to move to another house.

Addae-Dapaah and Juan (2014) investigated life satisfaction among poor elderly households in public rental housing in Singapore by using the methods of the binary logit model and factor analysis to find out life satisfaction in the housing and then measures to improve wherever possible. Primary data were collected through a questionnaire which divided into four main components: public rental unit information, quality of life, home modifications and personal information. The degrees of satisfaction level were measured with the scale of 5-point rating Likert scale with 1 being the "least satisfied" and 5 being "most satisfied". In the binary logit model, the response satisfaction level with a 5-point scale was adjusted with two outcomes which enabled it to work as a binary. Thus, the two possible results are defined as: yi/xi = 0 if the response is 1, 2 or 3 on the Likert scale and 1 if the response is 4 or 5 on the Likert scale. The authors used 21 factors as the independent variables (X) and the modified overall satisfaction level worked as a binary dependent variable (Y). The model was used to identify those independent factors that were significant in determining the level of life satisfaction. Among 21 variables, Elderly features in the living unit, Elderly facilities in the vicinity, Social Inclusion, Workmanship of the housing unit and Physical status of the elderly had affected the life satisfaction level of these elderly people with a high significant level, while estate cleanliness and noise are the most insignificant predictors of the level of life satisfaction of the elderly. Factor analysis was carried out in two ways; to measure the current level of life satisfaction among the elderly residents, and their perceived level of life satisfaction if home modifications were made to the public rental housing which were identified from the result of the binary logit model. Six common factors were identified in both analyses with factor loadings of 47.673% and 50.037% respectively. The living environment of the estate comprised of Dwelling atmosphere, Security, Air quality, Estate cleanliness, and Noise level had the highest factor loading implying that the living environment had the largest impact on residential satisfaction among elderly people. As suggested from the analysis results, the factor loading was increased by

2.364% which indicated that there is room for improvement in public rental housing among elderly people.

In the work of Byun and Ha (2016) entitled, “The Factors Influencing Residential Satisfaction by Public Rental Housing Type”, they investigated tenants' residential satisfaction concerning housing type, targeting tenants who reside in public rental housing in Seoul, the capital city of South Korea. The research targeted two different housing types: public rental apartment units and public rental general units. They collected 23 subjective forms of variables related to residential satisfaction by using a Likert 4-point scale system; and divided the variables into two sections, Dwelling Unit Satisfaction (DUS), and Neighbourhood Environment Satisfaction (NES). To find out the environmental factors affecting the residential satisfaction of residents living in the different housing types; and the residential environmental factors that affect the residential satisfaction of "apartment" residents, the authors employed the methods of factor analysis and regression analysis. classified the variables into four classes: the "Safety and Incivility Factor" (SIF), "Physical Factor" (PF), "Facilities Accessibility Factor" (FAF), and "Equipment Factor" (EF). They found out that the "Equipment Factor" (EF) was the most impact factor in determining the residential satisfaction of tenants in public rental apartments, followed by SIF, PF, and FAF. In public rental general housing units, the order of the factors to determine the residential satisfaction of tenants is SIF, EF, PF, and FAF.

Barreira *et al.* (2018) examined the relationship between residential satisfaction and shrinking Portuguese cities. Among the 31 cities which lost population in the 2011 census, 4 cities were selected for case studies. The authors divided the conceptual framework of residential satisfaction into three components; demographic characteristics; attractiveness of the city; and socio-economic status of the respondents. They used the methods of descriptive statistics to find out the satisfaction level of the dwellers; factor analysis to reduce the large number of variables; and logistic regression model to find out which factors were determined for the level of residential satisfaction and having intention to move out from the city. The data showed that 78 per cent of the respondents were satisfied (either satisfied or very satisfied on a 5-point Likert scale), which indicated that residential satisfaction is not

the major factor responsible for the decline of the population in Portuguese cities. In logistic regression, the level of satisfaction worked as a dependent variable, finding that negative relationship between the satisfaction level and intention to leave the city which explains that the higher the satisfaction level, the lower the intention to leave the city and vice versa.

Yin *et al.* (2018) assessed the residential satisfaction and their influence mechanism in the city of Jinan, Shandong Province, East China. The purpose of this paper was to evaluate the degree of satisfaction and explore the influence mechanism of that satisfaction over the new residential community in the recent three years in Jinan City. The authors took numerous objective and subjective variables on the grounds of housing physical condition, location, public facilities, property service, value judgement and corporate image. They employed factorial validity and confirmatory factor analysis to assess the reliability of the questionnaire by using SPSS software; correlation analysis for detecting the impact of real estate group on satisfaction and the factors controlling the degree of satisfaction; multiple linear regression model (MLRM) to found out the influencing mechanism of residential satisfaction. They found out that schools and supermarkets which are from the factor of public facilities are the main factors affecting the residential satisfaction in Jinan city. The MLRM ranked the factors based on their impact on residential satisfaction as; public facilities came first, and followed by property services, housing physical condition, location and, corporate image at last.

Jun and Jeong (2018) analysed residential satisfaction among the different social mixed housing complexes of public housing residents in the Seoul Metropolitan area, Korea. The authors identified five different mixture types which are: independent, complex mix, block mix, line mix, and random mix among the public housing residents. They measured the satisfaction level with a 4-point Likert scale of very dissatisfied (1), dissatisfied (2), satisfied (3), and very satisfied (4) on the grounds of housing attributes, neighbourhood attributes and household characteristics. Order Logit Analysis was used for the analytical method, the five different mixture types of housing complexes were used as dependent variables and, random mixed work as a reference category. The ordinal variables of different satisfaction levels worked as

independent or predicting variables. The result suggested that the independent type which was the lowest level of social mix is more likely to be satisfied than those living in the complex-mix type. And the random-mix type which was the greatest level of social mix, the model suggests that public housing residents living in the random-mix type are more likely to be satisfied than those in the complex-mix type. The authors also ran the t-test analyses and found a statistically significantly greater level of residential satisfaction among public housing residents in the random-mix type than in other social mix types.

Tucker and Abass (2018) examined which factors have the greater impact whether physical built environment characteristics or social factors on residential satisfaction in low-density Australian suburbs neighbourhoods. The survey was conducted in three Australian suburbs area mainly focused only on three dimensions of residential satisfaction - satisfaction with dwelling, neighbourhood and neighbours. The four scales consisted of 37 items that were collected to measure the perceived social and physical qualities of neighbourhoods. Five items from neighbourhood attachment, fourteen items from neighbourhood satisfaction, eleven items from neighbouring, and seven items from walkability and safety. By employing factor analysis, the Exploratory Factor Analysis (EFA) method was used to uncover the underlying structure of the 37 variables. The parallel analysis method was chosen to determine the number of factors than the other methods like the scree plot method or Kaiser criterion because of the more accurate and precise method. Three factors were extracted from 37 items explained 39.3% of the variance – Neighbourhood contentment contributing 24.2%, active socialising contributing 9.2%, and accessibility contributing 6.0%. The study conducted hierarchical multiple regression to avoid multicollinearity problems that can be caused by a high number of variables. Neighbourhood contentment worked as the dependent variable. The physical features of the neighbourhood were divided into five categories – street layout; pedestrian environment; neighbourhood connectivity; public space provision; and dwelling form. Those five categories worked as the predictor separately to predict Neighbourhood Contentment, after controlling for the influence of six socio-demographic variables (length of residency, household tenure, age, income, number of households, and level

of education). Among the five categories of neighbourhood physical features, only the coefficient of pedestrian environment was positively significant. It means that pedestrian environments such as street type, tree coverage, and provision of sidewalks, shared open space and community spaces were significantly positive predictors of Neighbourhood Contentment; indicating that well-planned neighbourhoods are more satisfying places to live for residents.

Gan *et al.* (2019) studied the determinants of residential satisfaction in public rental housing in Chongqing, China. They prepared five domains in the conceptual framework including the issues of housing policy and dwelling facilities which are rarely considered in the study of residential satisfaction, the rest are dwelling features, public facilities and neighbourhood environment. Twenty-three critical factors were incorporated into each of the domains of the framework. The authors used factor analysis to identify the critical factors of residential satisfaction of Public Rental Houses (PRH), One Sample T-Test to identify the source of residential dissatisfaction, and Step-wise Regression to identify the critical determinants of overall residential satisfaction. One-way ANOVA to explore the relationships between residential social-demographic characteristics and their residence. Among the domains, dwelling features, dwelling facilities and housing policies had positive contributions to residential satisfaction, while public facilities and neighbourhood environment had negative contributions. The domains of public facilities, neighbourhood environment and housing policies were the key determinants of overall residential satisfaction by using multiple regression. Specifically, among the critical factors, age, education, family income, residence length and housing type have a significant impact on residential satisfaction in the study of PRH in Chongqing, China.

Li *et al.* (2019) employed a general logistic model to investigate the residential satisfaction among resettled tenants in Public Rental Housing (PRH) especially those who used to live in a shanty town in Wuhan, China. The authors suggested conceptual frameworks to assess the determinants of tenant satisfaction. They are housing characteristics, neighbourhood and public facilities, housing operation and management, residential attitude, and socio-demographic characteristics. The framework was divided into two sections; the first four categories were the subjective

manner and put in the same section; socio-demographic had objective characteristics and put in a different section. The subjective variables were collected through a five-point Likert scale ranging from 1 (very dissatisfied/inadequate) to 5 (very satisfied/adequate), and the objective variables were quantitative. The analysis found that the variables of per capita living space, housing design in housing characteristics; lease management and property services in housing operation and management; and all the variables in neighbourhood and public facilities showed positive and significant impacts on tenants' residential satisfaction. Whereas the level of satisfaction with socio-demographic conditions widely varied in different tenants, and significantly negatively correlated with residential satisfaction. Rental values also showed a negative impact on residential satisfaction.

2.3 National Studies

Mahadevia and Gogoi (2011) studied the informal rental housing in the city of Rajkot in Gujarat and made a comparison between the owners' and renters' socio-economic conditions. The study found that the rental housing supplies in Rajkot are mainly from individual landlords with informal markets. No proper agreements or regulations had been practised in the rental housing markets, which make the rental housing viable and flexible in the city. No distinction had been found in the lifestyle between the owners and occupiers, but the owners are generally engaged in the formal sectors of the economy like regular paid jobs or better self-employment. Nearly half of the tenants can be termed as recent immigrants, staying less than 15 years in the city. Large portions of the tenants are single male migrants who tried to set a foothold in the urban economy, which created a low sex ratio in the city.

Using the Hedonic Pricing Model, Bhargava (2013) analysed the factors influencing property values in Jaipur city with a focus on the various functional characteristics of the city. The analysis is carried out with three levels such as property level, neighbourhood level and city level. The empirical survey revealed that the actual property values are much higher than the property rates given in the Annual Statement of Rates (DLC Rates). The study also found that functional attributes like distance from CBD, SRS Road, distance from hotel, distance from Railway Station and distance

from Airport at the city level; distance from temples, distance from metro stations, distance from recreational zones and distance from main road at the property level have a significant positive relationship up to 83 per cent and 76 per cent, respectively, with the property prices.

Banerjee *et al.* (2014) studied discrimination in the rental housing market based on caste and religion which focused on the Dalit and Muslim community in the National Capital Region (NCR) of Delhi. This paper analysed the spatial variation of the discrimination of rental housing markets across the localities in the Delhi region and the five cities of the NCR, from both the supply and demand sides. Using the telephonic audit method, the study revealed that about 18 and 33 per cent of the Dalits and Muslims, respectively, faced outright refusal from the upper caste landlords to rent out their houses. About 23 and 35 per cent of Dalits and Muslims can rent but with differential terms and conditions such as high rent or other restrictions. The study also found that there is a significant spatial variation of discrimination from locality to locality within the city.

Naik (2015) studied the informal rental housing in Gurgaon, NCT region of India, and focussed on the low-income migrant renters who are generally from West Bengal, Bihar and Uttar Pradesh. Due to the influx of migrants from low-income groups, the landlord provided different types of affordable rental houses like shanties (jhuggis), rooms arranged around a courtyard and multi-storey tenements. The variety of informal rental housing offered different choices of houses for the tenants. It allowed tenants to shift their places close to whenever necessary. However, social networks and migration strategies play a larger role in housing choices than the quality or the prices. The Muslims from Bengal were more likely to choose cheap houses like jhuggis because of prioritizing savings and remittance for their home, while the tenants who are from Bihar and Uttar Pradesh were more likely to live in the pucca houses, the better quality of residence than the previous. Even though, the informal renters have advantages in affordability, flexibility and proximity to livelihoods for migrants The overall quality can be said as poor quality of the housing, poor sanitation, conditions of extreme crowding as well as experiences of exploitation and harassment by landlords.

Tandel *et al.* (2015) examined the drastic decline of rental housing from 1961 – 2011 in India and focused on the decline of affordable rental housing in the formal markets caused by the rent control law in Mumbai. Using the census data, the study found that the share of rental housing for urban India had declined from 54 per cent in 1961 to 31 per cent in 201. The southeastern parts of the country have a higher share of rental housing than the northern and western parts, except for Himachal Pradesh, Uttaranchal and the extreme northeast. In the case of Mumbai, the implication of rigid rental control harmed the landlords in maintaining their properties due to extremely low returns on their profits. This led to the continuing dilapidation of the existing rental housing stock and no investments in new rental housing, which created a shortfall in the rental housing markets in Mumbai.

Kumar (2016) examined the rental housing situation in India during the last decades (i.e., 2001 – 2011) using the data from the Census of India (house listing and housing data) and the National Sample Survey (NSS) (housing condition rounds). The findings suggested that rented houses witnessed a sharp decadal increase with 9.1 million in numbers; of which, almost 90 per cent was contributed by the urban sectors. The rental housing markets are generally formed informal legal and written contracts. The analysis revealed that the substantial increase in mean monthly rent, and the rate are higher in large towns/cities, as compared to those in medium and small towns. The research findings suggested that to provide affordable rental housing and the improvement of housing conditions, the government (principally local government) should take necessary actions and implement the Housing Act and policies.

2.4 Regional Studies on Rental Housing

Not only because rental housing is being neglected in research and remains largely unexplored in India (Banerjee *et al.,* 2014), urban studies have primarily focused on large cities and metropolitan areas and neglected small and medium-sized cities (Porsche, 2019). Cities in hilly cities of northeastern India are usually smaller in terms of geographical area and population. As a result, only a few studies have been conducted on rental housing at a regional level.

Pachuau (1991) analysed the population structure and settlement patterns in Mizoram and found that settlements in Mizoram were originally developed on the hilltop due to its conducive temperature in general, and socio-political security in the past in particular. Besides this, the selection of settlement sites is determined by the slope, water and proximity to arable lands. Settlements located on a hill-top mostly show a compact pattern at the earlier stage, and later deviated into a linear form, consequent upon the later construction of road networks.

Desai and Mahadevia (2013) had a case study of rental housing for the urban poor in Guwahati City. They focussed on the city's rental housing in different housing submarkets, the processes of the settlement and their nature and characteristics. In Guwahati City, eight rental housing markets have been identified and can be categorised into two groups: formal and informal rental housing markets. In the informal sector, 67 per cent of the houses were constructed with bamboo mat walls and tin-sheet roofs, and only 2.4 per cent enjoyed concrete walls and roofs. The majority of the rental house in the informal markets is generally quite poor quality. Only a small portion of the households who are engaged in commercial activities have enjoyed the single water connection, concrete wall and roof and, larger size of the houses.

In the case of formal sectors, even though a large number of rental units are made up of brick walls and concrete, the quality of the construction and the amenities provided by the landlords are not necessarily quite good. Due to the low tenure security and high demand for rental units, the owners neglected the development of the houses. This negligence causes drainage and garbage problems in the housing colony. Only 30 per cent of the household enjoys a single bathroom in the formal sector.

Tuanmuansanga (2016) studied the housing problems of Aizawl City and focused on the poor households. He used the families who belong to the Below Poverty Line (BPL) as the criteria for poor households. Three criteria such as 'good', 'satisfactory' and 'bad' conditions were used to classify the quality of housing, and it found that nearly half of the poor households lived in the 'satisfactory' conditions of

housing and more than one-third of the households achieved ‘good’ quality. Only less than 20 per cent lived in the ‘bad’ housing conditions. About 70 per cent of the poor households could not afford their own house and lived in the rented house. The major problem of housing for poor households is that no agreement has been made between the landlords and the tenants, and no security for the tenants. Tenure agreement, quality and quantity of bathrooms and latrine facilities and supply of water are the significant parameters of housing quality for poor households in Aizawl City. Economically, about 90 per cent are engaged in informal economic sectors mainly daily labour and petty trade with insecure and low-pay jobs.

Kumar De and Vupru (2017) have a micro-study to investigate the structural factors in general and the locational and neighbourhood factors in particular for determining housing choice and rental values in Dimapur City, Nagaland. Using the hedonic pricing method, the household socio-economic characteristics, structural characteristics, and neighbourhood and locational characteristics are taken as factors that determine the rental prices. The analysis reveals that the household characteristics like family size, income, and education of the head of the family; the housing structures like carpet area and age of housing; amenities like water availability and security; the locational characteristics like distance of workplace, railway station, departmental store, road conditions, etc. have significant positive impacts on the monthly rent. However, the impacts of some locational and neighbourhood variables between the Naga and Non-Naga and the economic groups vary across the city.

In his study of urbanisation in Mizoram, Singh (2017) found that Aizawl City was the only city which met the fulfilment of the census criteria as a city in Mizoram. The pattern of the settlement is not only influenced by the morphology of the landscape but the politico-administrative processes. The influx of population caused by urbanisation processes in Aizawl City forced the growth of settlement in the precarious slope and adjoining spurs creating the settlements’ vulnerable and land use patterns against the principle of ecology. In Aizawl City, three distinct categories of city functions such as residential, commercial and administrative have been identified.

In his study of the quality of life in Himalayan cities based on the Aizawl, Saitluanga (2017) found that the quality of life in centrally located areas is relatively better in comparison with peripheral localities. In the case of residency, the residential patterns largely conform to the Hoytian sector model which means that high-class residential was found along the most important route in the city that runs through the main commercial area. Using the factorial ecology approach, the residential differentiation based on socio-economic status is the most prominent factor of segregation in Aizawl City. Other factors like family status, household status, worker status, and ethnic status also have significant contributions to residential segregation. Horizontally, high-class residential is mainly found in the central part of the city while the peripheral regions are dominated by socio-economically less developed. Vertically, the lowest basement of multistorey buildings is generally occupied by the lower income classes while the upper floor level is occupied by the higher income households.

Darrothanga and Colney (2019) evaluated the utilisation of housing complexes created under JNNURM – BSUP in the State of Mizoram and found that Mizoram completed four projects and handed them over to the state government in 2017. All of the projects were taken in Aizawl City in the localities of Lawipui, Edenthar, Durtlang and Rangvamual comprising 1096 dwelling units in total. While BSUP was launched in the years 2005 – 2006, the mission was started in 2013 in Mizoram because different problems had arisen like land acquisition, issues on acceptability by the local communities and most escalation. After the completion of the projects, operation and maintenance are the main problems. The mission provided only the funds for construction, and the maintenance became the responsibility of the state government, which became the burden for small-scale economic states like Mizoram.

Hmangaihzela *et al.* (2023) analysed the level of risk perception of the tenants in their residential environment and the factors that influence their perception in Aizawl City. The study found that the younger generation has a higher risk perception than the older generation because modern education provides better awareness campaigns on disaster management. However, no relationship had been found between the risk perception and landslide susceptibility zones which indicates that the tenants

have a poor level of knowledge on landslide vulnerability. Usually, they measured landslide vulnerability based on the sloop gradient of their housing sites.

CHAPTER – III

METHODOLOGY

3.1 Introduction

The methodology of the present study includes the selection of the study area, preparation of a base map of the study area, determination of sample size and sampling design, preparation of questionnaire, collection of primary and secondary data and application of quantitative and graphical techniques for analysis of collected data. Certain scientific theories and universally accepted theories are also tested wherever possible. The topographic features and the outputs of the analyses were mapped with the use of topographic and choropleth mapping techniques wherever appropriate.

3.2 Selection of Study Area

The study is conducted in Aizawl City, and the entire city is divided into four residential zones based on the Core-periphery, they are – Inner Core (IC), Outer Core (OC), Inner Periphery (IP) and Outer Periphery (OP). However, Core-periphery is a model of development which is not necessarily related to the present context, merely used for demarcating the residential area. Inner core regions are the localities which are located in the central part of the city where the CBD is found. The outer core regions are the localities which are located between the inner core and inner periphery, and then the inner periphery regions are the localities which are located between the outer core and the outer periphery. The outer periphery regions are the localities located in the outer flank of the city.

Administratively, Aizawl City is divided into 19 municipal wards consisting of 82 local councils in total in the 2011 census. Since studies on the intra-urban difference should be more reliable in smaller areas (UN-HABITAT, 2003; Saitluanga, 2017), the local councils, which are the smallest administrative units are taken. Moreover, the presence of a sense of belongingness among the residents, and cohesiveness make them suitable units for spatial analysis. To represent the four residential zones, 17 localities from 4 municipal wards have been taken as shown in Table 3.1. Among them, six localities are from the core regions, out of which two

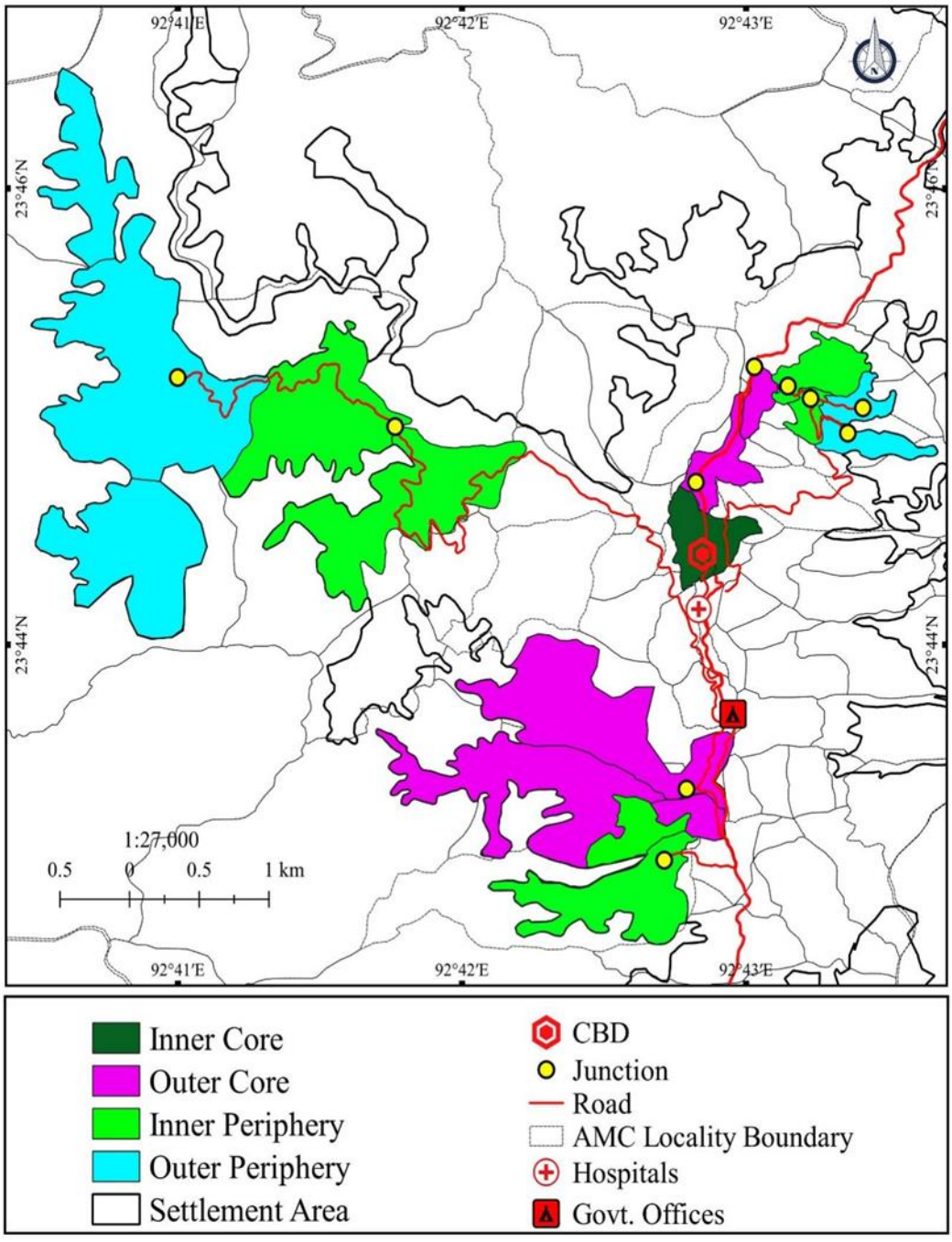


Figure 3.1 Study Area Map

localities are in the inner core. Again, six localities are found in the inner peripheral region, and the rest, five localities are located in the outer peripheral region.

3.3 Sampling and Sample Size

Various literatures were surveyed before collecting samples to determine the sample size and the questionnaire design. Moreover, a pilot survey was undertaken first to determine appropriate variables to be included in the study. The sample size is calculated by using the Cochran Formula of Sample Size with 5 per cent errors, 51.58 proportion and 99 per cent of z-score.

Cochran Formula of Sample Size: $$n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2 N}}$$

Where, z *is the z score*
ε *is the margin of error*
N *is the population size*
$\hat{p}$ *is the population proportion*

A cluster sampling technique with a scheduled method was employed to collect the rental household data. The sample households of each locality are arbitrarily divided into different clusters based on the size, type, floor level and slope gradient of the housing site in proportionate to the total number of houses with the sample size in a locality. The data that are being used in the present study can be divided into two – spatial and non-spatial data. Spatial data are the data related to or containing information about specific geographical locations. In the present study, the spatial data such as the geographical related features like slope degree, elevation, landslide vulnerability of the building sites, the locational or accessibility characteristics like distance of CBD, main hospital, treasury square (a hub of government offices), junction (*kawn*), grocery store, police station are taken. A pocket GPS (Garmin GPS etrex10) is used to collect the coordinates *'xy'* location of the bouse site. With the help of ArcGIS (version 10.4), the appropriate choropleth maps were prepared and then extracted the said spatial data of the building sites by using the coordinates.

Non-spatial data in the present study are the data that are not related to geographical locations like the building characteristics and the household information who reside in the said building. A schedule with a structured questionnaire was employed to collect non-spatial data. The questionnaire is divided into two sections – the first section contains the family information regarding the social, economic and demographic characteristics of the tenants, and the second section deals with the housing characteristics like structural characteristics, quality of housing conditions, quality and quantity of housing amenities etc. The detailed questionnaire can be accessed in Appendix A.

Table 3.1 Sampling and Sample Size

Ward	Localities	Zones	Total Households	No. of Sample
Ward No. V	Zarkawt	IC	398	30
	Electric	IC	1254	63
	Chanmari	OC	1222	61
	Total		**2874**	**154**
Ward No. XIV	Khatla	OC	540	30
	Khatla East	OC	540	30
	Khatla South	IP	1173	59
	Mission Vengthlang	IP	950	48
	Total		**3203**	**167**
Ward No. III	Laipuitlang	OC	394	20
	Ramhlun North	IP	1109	28
	Ramhlun Venglai	IP	559	19
	Ramhlun Vengthar	OP	501	31
	Ramhlun SC	OP	206	20
	Total		**2769**	**118**
Ward No. XI	Luangmual	IP	698	35
	Chawlhhmun	IP	692	30
	Tanhril	OP	673	34
	Sakawrtuichhun	OP	284	30
	Tuivamit	OP	320	30
	Total		**1975**	**159**
	G. Total		**19167**	**598**

3.4 Techniques of Analysis

3.4.1 Correlation

The Pearson product-moment correlation coefficient (or Pearson correlation coefficient) measures the strength of a linear association between the selected variables. The magnitude and direction of association between the variables can be measured. The correlation coefficient's value can range from -1 to +1. A value of 0 indicates that there is no relationship between the variables. A value greater than 0 indicates a positive association, while a value less than 0 indicates a negative association between the variables. The formula can be expressed as:

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

3.4.2 Regression Analysis

Regression analysis is a statistical technique used to analyse the relationship between the dependent variables and one or more independent variables. The model estimated the changes in the dependent variable are associated with changes in one or more of the explanatory variables or independent variables by using the least square methods.

3.4.2.1 Assumption of Linear Regression

Linear regression is based on a parametric approach assuming the data are normally distributed while maintaining the linear relationship between the dependent and independent variables. Due to its nature, violations of the assumptions of linear distribution of data can lead to biased or inefficient estimates, and it is necessary to assess these violations for accurate and reliable regression results. Assumptions of linear regression include linearity and normality of data distribution, multicollinearity, autocorrelation and homoscedasticity.

1) Linearity and normality of data distribution: The linearity of the regression line can be checked by using the scatter plot. A scatter plot is a chart that shows the

relationship between the variables allowing us to understand the trend of that relationship whether linear or non-linear. A bell-shaped curve, also known as a normal distribution or Gaussian distribution, is a symmetrical probability distribution in statistics to show the normality of the data distribution. The shape of the graphic is determined by the mean and standard deviation of the data and the normal distribution forming a symmetrical bell-shaped curve. The mean is normally at the centre of the distribution and the data are symmetrically distributed around the mean. The bell curve shows the symmetrical distribution of data in terms of standard deviation, and approximately, all of the data lies within the 3-standard deviations from the mean. approximately. Generally, 68 per cent of the data lies within one standard deviation of the mean, and 98 per cent lies within two standard deviations in normal distribution.

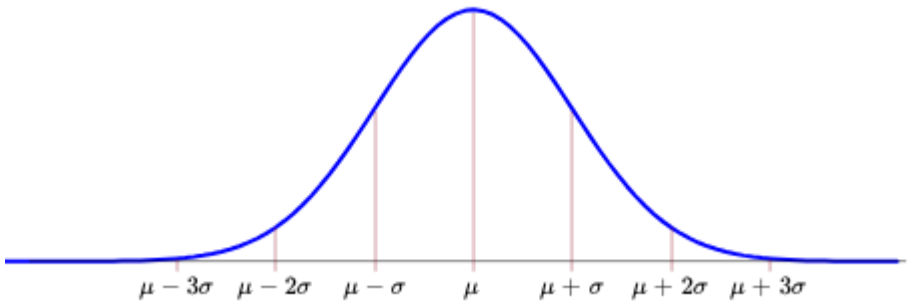


Figure 3.2 Bell-Shape Curve

2) Multicollinearity: Multicollinearity occurs when two or more predicted variables are in perfect linear combination or correlate with one another in a regression model. With multicollinearity, though the regression coefficients are still consistent and the model's predictive power is not reduced, the beta coefficient is untrustworthy (Field, 2018). The coefficient is no longer reliable since the standard errors are inflated when the multicollinearity increases. Also, it limits the size of R; the increase in R-value is insignificant when adding more predicted variables (ibid).

To detect the multicollinearity in the model, the Variance Inflation Factor (VIF) and Tolerance are widely used to measure the degree of multicollinearity of the predicted variables. VIF and Tolerance are closely related statistics, and the relationship is inverse. Since VIF is the inverse of tolerance, a VIF value exceeding

10 (ten) or a tolerance of less than 0.10 certainly indicates a serious collinearity problem (Menard, 1995). The general rule of thumb is that if the VIF value exceeds 4.0 or by tolerance less than 0.2, there is a multicollinearity problem (Hair et al., 2010). Tolerance and VIF can be calculated by the formula below:

$$\text{Tolerance} = 1 - R^2$$

$$\text{VIF} = \frac{1}{Tolerance} \text{ or } \frac{1}{1 - R2}$$

3) Autocorrelation: The existence of autocorrelation severely impacts the model estimation; the standard errors will be invalid (Field, 2018). Autocorrelation or serial correlation occurs when the residuals of the observations are correlated or dependent on each other. The assumption can be tested by using the Durbin–Watson Statistical Test. The null hypothesis of the Durbin–Watson test is that the residuals or errors are not linearly auto-correlated. The value of the test statistics varies between 0 – 4, with values of 2 indicating that the residuals are uncorrelated. A value greater than 2 indicates a negative correlation and a value below 2 indicates a positive correlation between adjacent residuals. The general rule of thumb is that the values of 1.5 to 2.5 can be accepted, which means little or no autocorrelation. However, Field (2018) suggests that values between 1 to 3 are acceptable for the analysis. The formula of the Durbin-Watson Test is given below:

$$d = \frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$$

Where, e_i are the residuals
n = the number of elements in the sample

4) Homoskedasticity/Heteroskedasticity: In a regression model, one of the important assumptions is that the variance of the residual terms should be constant at each level of the predictor variables, which is referred to as homoskedasticity. Violating this assumption can cause the invalidation of the confidence intervals and significance tests (Field, 2018). If the model is not fitted to the assumption of homoskedasticity, then heteroskedasticity exists. Heteroskedasticity refers to situations where the variance of the residuals is not constant or unequal over a range of measured values in a linear equation.

The presence of heteroskedasticity can be detected by creating a graphical plot (scattered diagram) with the least squares residuals against the explanatory variables. Using the Breusch-Pagan test, the hypothesis of homoskedasticity or heteroskedasticity can be tested formally as a mathematical function. The null hypothesis is that homoscedasticity is present, whereas the alternative hypothesis is that heteroscedasticity exists in the model. Suppose the p-value of the test is less than the significance level of .05 (ρ > 0.05); we reject the null hypothesis and accept the alternate hypothesis, which is that heteroscedasticity is present in the model. In this test, Chi-square test ($\chi 2$) computation is involved and compares it with the critical value ($\chi^2_{critical}$) which can be obtained from the statistical tables. If the test value is greater than or equal to the critical value, i.e., (χ^2_{test}) $\geq$ ($\chi^2_{critical}$), heteroskedasticity exists in the model (Murphy, 2010). Fortunately, the Breusch-Pagan test can be quickly done using the SPSS package.

3.4.3 Hedonic Price Model

The hedonic price model was first used by Court (1939) in automobiles, Griliches (1958) in the production of fertilisers and Lancaster (1966) in his theory of consumer demand. However, Rosen progressed Lancaster's theoretical framework in 1974 and provided the foundation of the hedonic pricing model; the hedonic price model has been widely used in analysing residential property prices and rental values (Selim, 2008), particularly useful when there is not enough information, like the property transaction details (Tabales et al., 2013).

A house is a composite commodity comprising different attributes concerning structural, locational and neighbourhood characteristics. Each residence has unique attributes that make them different to one another (Sirmans, 2005). The hedonic pricing model regresses such housing attributes against the price or value to show how the house price or value is affected by the change in each attribute, thereby giving an estimate of the relative monetary contribution of each factor (Liman et al., 2015).

The general form of the Hedonic Price Model is based on a traditional Ordinary Least Square (OLS) estimation, which is a regression between price and its

corresponding characteristics. As a regression specification, the typical hedonic price equation can be written as follows:

$$P\ (y_i) = \beta_o + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip} + \varepsilon_i$$

Where,

y_i *= Price (dependent variables)*
x_i *= independent or explanatory variables*
β_o *= y-intercept (constant)*
β_p *= slope coefficient for each explanatory variable*
ε_i *= errors or residuals*

3.4.4 Log-Linear Regression

Traditionally, the log-linear functional form has been employed in hedonic pricing estimation to reduce heteroscedasticity. Log transformations can be used in regression models by taking the logarithm of the dependent variable, which compresses larger values, reducing the impact of outliers and making the residuals approximately homoscedastic (Vishwesh, 2021). The log transformation has more advantages over the linear specification regarding distance variables (Follain and Malpezzi, 1980). The equation can be written in the following form:

$$lnP\ (y_i) = \beta_o + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip} + \varepsilon_i$$

Where the price is in natural logs, and the independent variables remain unlogged.

3.4.5 Robust Standard Errors

Heteroskedasticity-Consistent Standard Error (HCSE), also known as Robust Standard Errors, is a highly appealing method of reducing the effects of heteroskedasticity in the OLS regression Model (Hayes and Cai, 2007). Among the HCSE estimators, HC3 robust standard errors are the most widely used, and Long and Ervin (2000) recommended it as the best option among the four HC methods because it can keep the test size at the nominal level regardless of the presence or absence of heteroskedasticity. The estimation can be done using the following formula:

$$HC3 = \frac{\mu_i^2}{(1- h_i)^2}$$

Where,

μ_i^2 *are the squared residuals*

h_i *are the hat values which range from 0 to 1*

h_i are also known as leverage values and are the diagonal elements in the "hat" matrix. They can be computed using the formula:

$$h_i = \frac{1}{n} + \frac{(X_i - \bar{x})^2}{\sum_{j=1}^{n}(X_j - \bar{x})^2}$$

3.4.6 Multinomial Logistic Regression

Logistic Regression has been employed to examine the relationship between a nominal dependent variable and independent variables (Boyd et al., 2003). Logistic regression is a predictive analysis similar to linear regression, but the dependent variables are dichotomous or polytomous. Multinomial Logistic Regression is used when the dependent variable is polytomous which means the dependent variable has three or more possible outcomes. The functional equation can be expressed as:

$$P_{ij} = \frac{e^{(\beta_o + \beta_i x)}}{\sum_{j=1}^{k} 1 + e^{(\beta_o + \beta_i x)}}$$

Where,

P_{ij} *= Probability of outcomes (dependent variables)*

j *= Category of dependent variable (j = 1,2…k)*

x_i *= Independent or explanatory variables*

β_o *= y-intercept (constant)*

$\beta_i x$ *= slope coefficient for each explanatory variable*

3.4.7 Principal Components Analysis (PCA)

Principal Components Analysis (PCA) is a statistical technique used to transform an original set of usually higher numbers of variables into a smaller new set of orthogonal (uncorrelated) variables called principal components (Saitluanga, 2017). The principal components or the factor loadings can be represented as:

$$PC_1 = a_{11}x_1, a_{12}x_2, \cdots a_{1p}x_p$$

$$PC_2 = a_{21}x_1, a_{22}x_2, \cdots a_{pp}x_p$$
$$\vdots \quad \vdots \quad \vdots \quad \vdots$$
$$PC_p = a_{p1}x_1, a_{p2}x_2, \cdots a_{pp}x_p$$

Where, PC represents Principal Components or Factor Loadings
a_{ij} represents the loadings of the j^{th} variable of the respected

The principal components are the eigenvectors of the data's covariance matrix which are the linear combinations of the weight of the variables. The eigenvectors are taken from normalised eigenvalues, and eigenvalues are then extracted from the covariance matrix, the process is called eigendecomposition. The following are the steps involved in extracting principal components from the covariance matrix are discussed.

3.4.7.1 Covariance Matrix

Covariance is also the statistical method to measure the dispersion of variables from the mean. Unlike variance, covariance measures how much two or more sets of random variables vary together from the mean. The covariance matrix of the multiple variables can be written as:

$$S = \begin{pmatrix} \text{cov}(x_1, x_1) & \text{cov}(x_1, x_2) & \dots \text{cov}(x_1, x_p) \\ \text{cov}(x_2, x_1) & \text{cov}(x_2, x_2) & \dots \text{cov}(x_2, x_p) \\ \vdots & \vdots & \vdots \\ \text{cov}(x_p, x_1) & \text{cov}(x_p, x_2) & \dots \text{cov}(x_p, x_p) \end{pmatrix}$$

Where Covariance of all order pairs can be written as:

$$Cov_j = \frac{1}{N-1}\sum_{i=1}^{N}(x_{ij} - \mu_j)^2 \dots \text{Variance of the } j^{th} \text{ variable}$$

$$Cov_{jk} = \frac{1}{N-1}\sum_{i=1}^{N}(x_{ij} - \mu_j)(x_{ik} - \mu_k) \dots \text{Variance of the } j^{th} \& \ k^{th} \text{ variables}$$

3.4.7.2 Eigenvalues and Eigenvector

In PCA, eigenvalues and eigenvectors are used to transform the original data space into a new space where the variance is maximized, and such a new space is called the principal component space. Eigenvalues represent the amount of variation in the data that is explained by each principal component and an eigenvector is a vector that represents the direction of maximum variance in the data. The eigenvector of a square matrix is defined as a non-vector in which when a given matrix is multiplied, it is equal to a scalar multiple of that vector. To get the value of the eigenvalue, the equation of eigenvector ($Av = \lambda v$) can be manipulated as:

$$(A - \lambda I) = 0$$

Where,

'A' represents the covariance matrix
'λ' is a scalar value called the eigenvalue
***'v'** is a non-zero vector called the eigenvector*
'I' is an identity matrix of the same order as Matrix A. $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

By manipulating the eigenvector equation, the value of the eigenvectors of the variables can be calculated from the eigenvalue square matrix which can be represented as:

$$(A - \lambda I)\, v = 0$$

$$[(A - \lambda_i I)] \begin{bmatrix} v_{i1} \\ v_{i2} \\ \vdots \\ v_{ij} \end{bmatrix} = 0$$

Where, $\lambda_i = \lambda_1, \lambda_2, \ldots \lambda_p$

v_{ij} *= Eigenvector (i) of the* j^{th} *variables*

Eigenvectors have to be normalised to form a unit length by simply dividing each vector value by the length of the vector (L). The formula is expressed as:

$$e_{ij} = \begin{bmatrix} v_{i1} / \sqrt{v_{i1}^2 + v_{i2}^2 + \cdots + v_{ip}^2} \\ v_{i2} / \sqrt{v_{i1}^2 + v_{i2}^2 + \cdots + v_{ip}^2} \\ \vdots \\ v_{ip} / \sqrt{v_{i1}^2 + v_{i2}^2 + \cdots + v_{ip}^2} \end{bmatrix}$$

Where e_{ij} represents the normalised eigenvector (i) of the j^{th} variables

3.4.8 Factor Analysis

Factor Analysis is a statistical technique that is used to reduce a large number of variables into a smaller number of factors by integrating the variables that share the maximum common variance. It also enables to identification of the underlying patterns or factors in a set of variables. There are two types of factor analysis, Explanatory Factor Analysis (EFA) which is often used when the researchers have no hypotheses about the nature of the underlying pattern of the structure before; and Confirmatory Factor Analysis (CFA) which is mainly used to verify the factor structure of a set of observed variables and allows the researcher to test the hypothesis that a relationship between observed variables and their underlying latent constructs exists. The present study used EFA to identify the underlying factors of tenants' residential satisfaction. In EFA, the most common technique to extract the factors is Principal Components Analysis (PCA). However, while PCA is based simply on linear data combinations, FA is based on a rather special model which 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 (OECD, 2008). The model of Factor Analysis can be expressed as (OECD, 2008):

$$x_1 = a_{11}\mathrm{F}_1 + a_{12}\mathrm{F}_2 + \cdots a_{1m}\mathrm{F}_m + e_1$$

$$x_2 = a_{21}\mathrm{F}_1 + a_{22}\mathrm{F}_2 + \cdots a_{2m}\mathrm{F}_m + e_2$$
$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$
$$x_p = a_{p1}\mathrm{F}_1 + a_{p2}\mathrm{F}_2 + \cdots a_{pm}\mathrm{F}_m + e_p$$

Where, x_i (i = 1, 2,…, p) represents the standardised variables with zero mean and unit variance
a_{ij} represents factor loadings of the j^{th} variable.
F_i represents uncorrelated factors of the j^{th} variable, each with zero mean and unit variance
e_1 are the specific factors supposed independently and identically distributed with zero mean of the j^{th} variable

3.4.8.1 Steps Involves in Explanatory Factor Analysis (EFA)

1. Factorability Tests

Factor analysis is based on the correlation of the measured variables, some variables must be intercorrelated. However, extreme multicollinearity causes difficulties in determining the unique contribution of the variables to a factor (Field, 2000; Saitluanga, 2017), and then it should be avoided. The factorability of correlation can be detected by using correlation and anti-image correlation matrix. A correlation matrix is a rectangular array of numbers that gives the correlation coefficients between a single variable and every other variable in the investigation. If the variables show some sizable correlation (above 0.3), it signifies the data are interrelated and become factorable (Tabachnick & Linda, 2007; Bahati, 2018), but extreme multicollinearity occurs when two or more variables have a very high relationship to each other's. The Anti-image correlation contains the negative of the partial correlation coefficient, which enables the detecting factorability of the data from the diagonal elements and off-diagonal elements. The good factor model shows a high number of diagonal elements and a small value for off-diagonal elements. Tabachnick & Linda (2007) set a cut-off that required 0.6 or more for good factor analysis. However, Brown and Onsman (2012) proposed that it can be acceptable if the diagonal elements of the Anti-Correlation matrix are above 0.5.

2. Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity

The patterns of correlations should be relatively compact enabling to yield of distinct and reliable factors. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a statistic for comparing the value of the sum of the partial correlation and the sum of linear correlation by measuring the compactness of the pattern of correlation. The value of KMO ranges from 0 to 1. Kaiser (1974) recommends 0.5 as a minimum (barely accepted), values between 0.7 and 0.8 are acceptable, and values above 0.9 are superb which indicates the sum of partial correlations is not large relative to the sum of linear correlations. Lower than acceptable indicates the sum of partial correlations is large relative to the sum correlations which is unfactorable. The formula can be expressed as:

$$KMO = \frac{\sum\sum_{j \neq k} r_{jk}^2}{\sum\sum_{j \neq k} r_{jk}^2 + \sum\sum_{j \neq k} p_{jk}^2}$$

Where,

r_{jk} *is the sum of the linear correlation*

p_{jk} *is the sum of the partial correlation*

3. Communality

Communality was extracted from the sum of the square correlations of the variable with the factors (Cattell, 1973) or the sum of the square of the factor loadings of the extracted or retained variable (Child, 2006). The extracted or retained variable is also known as the observed variable. In a standard normal distribution, the mean and variance are assumed as 0 and 1, respectively. It can be considered that the sum of the square of all loadings of the individual variable is the total variance of the said variables and then equals 1. It can be represented as:

$$a_{i1}^2 + a_{i2}^2 \ldots + a_{ip}^2 = 1$$

The total variance of the i^{th} variable is made up of common variance and unique variance. However, PCA assumes that there is no unique variance, so the common variance is equal to the total variance. Communality is a definition of

common variance of the observed variables and is denoted as (h^2). The value of the communality ranges between 0 and 1, and values closer to 1 suggest that extracted factors explain more of the variance of an individual item.

Communality is determined by the variables to be retained in the analysis. Child (2006) suggests that the variable that has communalities less than 0.20 should be eliminated from the analysis since the aim of factor analysis is to try and explain the variance through the common factors. Field (2009) also suggests that the Kaiser Criterion is said to be reliable when the averaged extracted communalities is equal to or above 0.6 in case of sample size is above 250 cases.

4. Variance Explained

The concept of explained variance is useful in assessing how important each component is. Generally, the larger the variance explained by a principal component, the more important that component is. It is simply the proportion of the sum of all the variance of the observed variables or the communality from the total variance and is usually expressed as a percentage. Since the total variance of the individual variables equals 1, the sum of all the total variables is equal to the number of the variables (x_i). Hair et al. (2012) suggested that in social science, the minimum of 60 per cent of the cumulative variance or the percentage of variation explained is quite commonly accepted. Therefore, the total variance explained can be calculated as:

$$\text{Total variance explained (\%)} = \frac{\sum_{i=1}^{k} h_i^2}{N} \text{ x } 100$$

Where, h_i^2 represents the communality of the ith variables
N represents the total number of variables

5. Rotation

Rotation is a procedure in which factors are rotated in an attempt to attain an optimum simple structure that attempts to have each variable load on as few factors as possible, but maximises the number of high loadings on each variable and minimises the rest of the loading being zero close to zero (Rummel, 1970; Yong and Pierce, 2013). Based on the degree of rotation, rotation can be broadly classified into two: orthogonal and oblique. In orthogonal rotation, the factors are rotated 90° from

each other, and it is used when the factors are considered uncorrelated. Contrary, oblique rotation is used when the factors are considered to be correlated; and the factors are not rotated 90° from each other (Yong and Pierce, 2013).

For SPSS users, Tabachnick & Linda (2007) argues that the best way to find the factors that are correlated and uncorrelated to decide between orthogonal and oblique rotation is to request oblique rotation (either direct oblimin or promax from SPSS). In the output of the component correlation matrix, if any of the factors correlated with others exceed 0.32, the factors can be considered as correlated and then oblique rotation is a robust method for rotation. By contrast, if the correlation does not exceed 0.32, the factors are considered to be uncorrelated; and then the robust method should be orthogonal rotation.

6. Cross-Loadings

Cross-loading should be avoided. Cross-loading means the presence of high loading in two or more factors or components in one respective variable matrix. Although high-factor loadings seem to be preferable, factor loads need to be controlled because cross-loading or low-loading can hamper the interpretation of the components. The values of the factor load are important in determining the number of factors to be kept. For cut-off loadings, there are several different suggestions given by different researchers, it can be recommended that the rule of thumb will be set as 0.50 where there are four or fewer variables in the factor and 0.40 where there are more than four variables in the factor depending on the number of variables in the factor.

On the other hand, Stevens (2002) suggests that the significance of factor loading will depend on the sample size. He suggested that for a sample size of less than 100, the loading should be greater than 0.512, but for 100 - 300 it should be greater than 0.298 and for 1000 greater than 0.162. However, he also recommends that the preferable cut-off loading be greater than 0.4 for the interpreting factor loadings (the factor can be explained by around 16% of the variance in the variable).

Comrey and Lee (1992) made the criteria for the quality of the factor loadings. They suggest that loadings over 0.71 (about 50% overlapping variance) are

considered excellent, 0.63 (about 40% overlapping variance) very good, .55 (about 30% overlapping variance) good, 0.45 (about 20% overlapping variance) fair, and .32 (about 10% overlapping variance) poor. They decided that the choice of the cut-off for the size of loading to be interpreted is a matter of researcher preference.

7. Factor Loadings or Principal Component Loadings

Factor loadings are the correlation between the variable (indicators) and the factor (component). Every variable will have loading on every factor or component, which indicates the degree of the relationship of the variables with the components and then looks at the highest loading on the factors. The factor loadings tell us how much the variable has contributed to the factor, representing the strength of the correlation between the variable and the factor (Kline, 1999). The larger the factor loading, the more the variable has contributed to that factor (Harman, 1976). The component loadings can be calculated by the following formula:

$$\mathrm{a}_{ij} = e_{ij}^{T} \begin{bmatrix} x_{1i} & - & \mu_1 \\ x_{2i} & - & \mu_2 \\ \vdots & \vdots & \vdots \\ x_{pi} & - & \mu_p \end{bmatrix}$$

Where, a_{ij} represents the components loading of the vectors
e_{ij}^{T} represents a transpose matrix of eigenvectors of the j^{th} variable
x_{ji} represents individual data of the j^{th} variable
μ_j represents the mean of the j^{th} variable

There are several methods have been developed determining the factors to retained in Principal Components Analysis (PCA) or Explanatory Factor Analysis (EFA) including Kaiser Criteria, Cattell's Scree test, Velicer's Maximum Average Partial (MAP) test, and Horn's Parallel Analysis. The Kaiser Criteria also known as the K1 method proposed by Kaiser (1960) is the most commonly utilized method in practice (Fabrigar et al, 1999). Kaiser's criterion is based on the concept of eigenvalues, which are measures of how much variance each factor accounts for in your data. The higher the eigenvalue, the more important the factor is. Kaiser's criterion suggests that eigenvalues greater than one should be retained in the factors, and discard the rest.

Practically, the extraction of factors can be done from the PCA component table. The first column of the principal component has the highest explained variance, the second becomes the second highest variance explained, and so on. After checking the cross-loading and rotating the matrix, it can be easily identified and separated which variable of the respected principal component has high loading and low loading. The variables which have shown high loading on the respective components share the same variance in that factor and can be taken as one factor. The number of factors taken depends on the component retained.

3.4.9 Construction of Residential Satisfaction Index by Using Factor Score

Factor score is a single score from an individual entity's score on each variable representing their performance on some latent variable (Field, 2018) or simply the aggregation of the factor loading (Hightower, 1978). To compute the factor scores for a given case for a given factor, there are two main classes of computation methods: refined and non-refined. Non-refined methods are easy to compute and interpret, providing information about individuals' placement on the factor distribution, while refined methods provide estimated standardized scores (DiStefano et al., 2009). The regression method, which is one of the refined methods is used to extract the factor scores in this study. Regression factor scores predicted the location of each individual on the factor or component, considering not only the correlation between the factors or between factors and observed variables but also among the observed variables and oblique factors (ibid).

Considering the weight of the variance explained by each of the factor scores of the individual households, a Residential Satisfaction Index of Household (RSI_i) was developed using the formula:

$$RSI_i = (S_{j1}^2/S_N^2)(Factor_1\ Score) + (S_{j2}^2/S_N^2)(Factor_2\ Score) + \ldots + (S_{jm}^2/S_N^2)(Factor_m\ score)$$

Where:

RSI_i *is the Residential Satisfaction Index of the individual observed*
S_{j1}^2 *is variance explain of the first factor*
S_{j2}^2 *is variance explain of the second factor*
S_{jm}^2 *is variance explain of the 'm' factor*
S_N^2 *is total variance explained*

The present study tries to find out the index of the locality to measure the spatial variation of residential satisfaction of renters across the city. For this purpose, the average score of every household in each locality was taken, using the formula:

$$\text{RSI}_l = \frac{Total\ RSI_h\ of\ the\ respected\ locality}{Total\ no.\ of\ households\ of\ the\ respected\ locality}$$

This index measures the residential satisfaction of one locality relative to the other on a linear scale. The value of the index can be positive or negative, making it difficult to interpret. Therefore, the data can be standardised by using the formula:

$$\text{RSI}_l(S) = \frac{\text{RSI}_l j - Min.\ \text{RSI}_l}{Max.\ \text{RSI}_l - Min.\ \text{RSI}_l} \text{ x } 100$$

Where:

$RSI_l SI$ is Residential Satisfaction Index of locality (Standardised)
$RSI_l j$ is Residential Satisfaction Index of the 'j' locality
$Min.\ RSI_l$ is minimum Residential Satisfaction Index of locality
Max. RSI_l is maximum Residential Satisfaction Index of locality

This formula enables to standardised the value of RSI, which can range from 0 to 100. The highest RSI value became 100 and the lowest will be 0.

3.4.10 Kuppuswamy Socioeconomic Status Scale (SES)

Kuppuswamy SES is the most widely used for determining the socio-economic status of an individual or a household especially in urban areas (Bairwa et al., 2012; Saleem, 2020). However, due to the ongoing economic growth and socioeconomic evolution over the years, the Kuppuswamy scale needs regular revisions over time synchronised with the current economic conditions. As a result, the Updated Modified Kuppuswamy SES developed by Saleem (2020) is used in the present research. Using parameters such as the occupation of the head of the family, education of the head of the family, and total monthly income of the family, the socioeconomic status of the family is measured. Each parameter is further divided into subgroups with an ordinal scale and the scores have been allotted based on the order of the subgroups. The detailed parameters and their subgroups are discussed below.

1. Occupation of the Head of the Family

The occupational structure has been divided into ten subgroups from unemployment at the lowest to the legislators, Senior Officials & Managers at the highest. The score of the subgroups ranges from 1 to 10 at one interval, meaning that the lowest groups score 1 point and the highest score 10 points.

Table 3.2 Occupational of the Family Head of the Family

Sl. No.	Occupation	Score
1	Legislators, Senior Officials & Managers	10
2	Professionals	9
3	Technicians and Associate Professionals	8
4	Clerks	7
5	Skilled Workers and Shop & Market Sales Workers	6
6	Skilled Agricultural & Fishery Workers	5
7	Craft & Related Trade Workers	4
8	Plant and machine Operators and Assemblers	3
9	Elementary Occupation	2
10	Unemployed	1

2. Education of the Head of the Family

Levels of educational attainments are categorized into seven classes from the illiterate at the lowest to postgraduate or equivalent at the top. Again, the scores of each level increased from the bottom ‘illiterate’ to the top ‘profession or honours’ with an interval of 1 point.

Table 3.3 Educational Level of the Head of the Family

Sl. No.	Education	Score
1	Profession or Honours	7
2	Graduate	6
3	Intermediate or diploma	5
4	High school certificate	4
5	Middle school certificate	3
6	Primary school certificate	2
7	Illiterate	1

3. Total Monthly Income of the Family

Under the Kuppuswamy scale, the total monthly income of the family, not the head of the family is used for measuring income level. The household income is

divided into seven scales, which are calculated based on the latest base year of the Consumer Price Index (CPI) as projected by the Central Ministry of Statistics and Programme Implementation and the inflation rate (Saleem, 2020). The scores of the subgroups range from 1 to 12 points and the points increase with increasing the level of income. The four lowest levels are increased at the interval of 1 point, while the intervals are shifted by 2 points from the third highest level of income.

Table 3.4 Total Monthly Family Income of the Tenants

Sl. No.	Income	Score
1	≥ 199,862	12
2	99,931–199,861	10
3	74,755 –99,930	6
4	49,962–74,755	4
5	29,973– 49,961	3
6	10,002–29,972	2
7	≤ 10,001	1

The socioeconomic status of the individual or family is measured by using the total score which is taken by adding the score of the three parameters. The total score ranges from 3 to 29 points and is then divided by following the classical division of the society such as upper class, middle class and lower class. However, by dividing the middle class and the lower class into two each, Kuppuswamy's SES have 5 "upper class, upper middle class, lower middle class, upper lower and lower socio-economic class."

Table 3.5 Kuppuswamy's socio-economic status scale 2020

SI. No.	Score	Socio-economic Class
1	26 – 29	Upper (I)
2	16 – 25	Upper Middle (II)
3	11 – 15	Lower Middle (III)
4	5 – 10	Upper Lower (IV)
5	< 5	Lower (V)

3.4.11 Diversity Index

The dissimilarity Index is the most commonly used to measure residential differentiation or segregation and is more reliable even when the region has already clear significant difference or division, it enables to quantification of the level of residential differentiation (Allen et al., 2015; Zhang and Wu, 2023). However, the

dichotomous nature caused its limitation. Even though Křížková and Šimon (2022) developed a threshold for the proportion of the population to handle the multiple variables or social groups, the calculation of the dissimilarity index is quite difficult, and losses the reliability when the regional difference is not well defined before (Zhang and Wu, 2023). At this moment, the diversity index can be used to handle the problems of multiple variables or groups, it is more suitable to describe the even distribution of social groups (ibid). As a result, the present study used the Shannon Diversity Index, Pielou's Evenness Index and the Simpson Diversity Index to identify the region-based residential differences in Aizawl City.

3.4.11.1 Shannon Diversity Index

Shannon Diversity Index, sometimes referred to as Shannon-Wiener Index, was originally used to measure the diversity of species in a community. However, the methods can be applied to measure the residential segregation or differentiation of the intra-city. The formula can be denoted as:

$$H = -\sum_{i=1}^{R} S_i . lnS_i$$

Where H is the Shannon Diversity Index;
*S_i represents the proportion of the **i^{th}** social group of the total population*
ln represents natural log
R is the total number of social groups in a region.

3.4.11.2 Pielou's Evenness Index

The Pielou's Evenness Index or Shannon Equitability Index represents the ratio between the total possible outcome of the value of Shannon's Index and the calculated value of Shannon's Index. It is used to measure the evenness of social groups in a region, and how similar the abundances of different species are in the community and enable to compare the different regions. In simple terms, Pielou's Evenness normalizes the Shannon diversity index to a value between 0 and 1 to measure the evenness or dissimilarity of the different regions on a similar scale. The formula can be represented as:

$$\text{Pielou's J} = \frac{H}{ln\ (S)}$$

Where, H represents the Shannon Diversity Index
ln(S) represents the natural log of the possible outcome of the i^{th} *social group*

3.4.11.3 Simpson Diversity Index

The Simpson Diversity Index has been used to measure the homogeneity level within a region or a community. The index ranges from 0 to 1, where 0 indicates the absence of diversity or absolute segregation (i.e., maximum homogeneity) and 1 indicates maximum heterogeneity or no segregation. The index is one of the most reliable and straightforward to obtain a diversity score (Guajardo, 2015) and can be expressed as:

$$D = 1 - \{\Sigma\ n\ (n - 1)/N\ (N - 1)\}$$

Where, D is the Simpson Diversity Index
n represents the total number of the i^{th} *social group*
N represents the total population of the community or region

Guajardo (2015) provides the guidelines for interpreting Simpson Diversity Index Scores despite there being no cutoff points or rule of thumb for each set of measurements.

Table 3.6 Guidelines for Interpreting Simpson Diversity Index by Guajardo

Simpson Score	Interpretation
0.00	A low degree of diversity/heterogeneity or complete segregation
0.01–0.40	A low degree of diversity/heterogeneity or high degree of segregation
0.41–0.60	A moderate degree of diversity/heterogeneity or a moderate degree of segregation
0.61–0.80	A moderately high degree of diversity/heterogeneity or a moderately low degree of segregation
0.81–0.99	A high degree of diversity/heterogeneity or a low degree of segregation
1.00	Absolute (perfect) diversity/heterogeneity or no segregation

3.5 Choropleth Maps and Topographic Maps

A Choropleth map is a type of thematic map that is used to represent the pattern of the geographic area produced by the statistical data. On the other hand, a topographic map is used to represent the topographic features of the geographical area. Using ArcGIS version 10.4, choropleth maps and different types of topographic maps including elevation maps, slope maps and landslide susceptibility maps were generated. The topographic features like slope map, elevation map and drainage map were extracted from Alos palsar DEM. By using the Weighted Overlay Method, a landslide susceptibility map was generated that included the features of slopes, drainages, roads (bbbike.org), Normalized Difference Vegetation Index (NDVI), and Geological Map (NESAC tiff. file).

3.6 Jenk Natural Breaks Classification Method

There are several methods have been developed for classifying continuous data into categorical or class data, and each method has its advantages as well as limitations. The ‘equal interval’ method is the most common and simplest method, but reliable only on a rectangular frequency distribution (Monmonier, 1972; Saitluanga, 2017). The data are classified at a regular (equal) interval and do not account for data distribution which may cause data values to fall into one or two classes or classes with no values. The quantile method and standard method may solve such problems, but reliable only when data have linear distribution and normal distribution (Gaussian), respectively. To cope with this, the Jenks natural breaks classification method, also called the Jenks optimization method, is designed to determine the best arrangement of values into different classes. Using an algorithm that calculates groupings of data values based on the data distribution, the Jenks natural breaks classification method minimizes the variation within each range, so the areas within each range are as close as possible in value to each other (Jenk, 1967).

CHAPTER – IV

THE STUDY AREA

4.1 Introduction

Aizawl is the primate city and administrative capital of Mizoram. The city is located in the southernmost part of the Patkai Hills which is the southeastern extension of the Himalayas. It is situated on a ridge 1,132 metres (3715 ft) above sea level, with the Tlawng River Valley to its west and the Tuirial River Valley to its east. 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 the Aizawl Municipal Council (AMC). There are 19 municipal wards under the AMC which altogether comprises 83 Local Councils (LCs). These local councils, previously known as Village Councils (VCs) are the lowest administrative units.

A compact pattern of hill-top settlement is traditionally prevalent in Mizoram, primarily due to its conducive temperature in general, and for socio-political security in the past in particular (Pachuau, 1991). The hill crests generally have a cooler climate with good sunshine, while the low-lying valleys are marked by humid, warm and sultry weather, which were infested by the most dreaded diseases in the past like Malaria, and easily the spread of waterborne diseases like cholera and diarrhoea (Pachuau, 1991; Saitluanga, 2017). In due course of time, the population increased and the flat area of the hilltop became limited, settlements grew outward from the flat hilltop to the adjacent convex slopes.

Aizawl, formerly called *'Aijal'* was established in 1890 by the colonial East India Company and was originally a fort with an accommodation of around 200 military personnel only. It was used as a military outpost and developed a residential area for the local staff and the immigrants Gorkhalis from Nepal who came along with the British around the outpost. Gradually, people started migrating from the surrounding regions, and the population of Aizawl increased rapidly from 325 persons at the time of establishment to 2890 during 1901–1911 as per the Census of India. The colonial British created a new form of residential pattern markedly different from the

native settlements (Saitluanga, 2017). Instead of compact settlements around the hilltop, the administrators introduced segregation by forming separate localities along with the main ridge and the surrounding hillocks to reduce the risk of infection from endemic tropical and contagious diseases (ibid). However, the colonial administrators restrained the increasing population by imposing a restriction on the number of houses for each locality with a total of 722 houses and introducing a tax known as the 'Personal Residence Surcharge' (PRS), and the growth rate declined till the Indian independence.

The post-independence witnessed rapid urbanisation in Aizawl City, the decadal population growth rate exceeded 100 per cent during the year 1951 – 1991, reaching 2.93 lakhs population in the 2011 census. With increasing population, settlements were formed along the mountain ridge where the transportation routes developed at first. However, the rapid population explosion put pressure on land for housing, and settlements were developed on the unfavourable hilly slopes towards the low-lying areas of the hill.

4.2 Spatial Evolution of Residential Zones in Aizawl City

The classical urban land-use models suggested that the city initially grows from the centre, then outwards towards the peripheral areas. The city centre became the Central Business District (CBD) and the residential areas developed into the surrounding areas city centre. Based on the patterns of outward expansion of the city, different land-use models have been developed. Burgess (1925) suggested that residential patterns formed a series of concentric zones concerning the core (CBD), while Hoyt (1939) found the patterns of different sectors rather than Burgess concentric, not neglecting the influence of CBD. Harris and Ulmann (1945) accepted the growth had initially started from the CBD, but different nuclei have been developed within the city in due course of time and formed residential areas which are independent of the CBD.

Following Saitluanga's (2017) model, the residential area of Aizawl City area is divided into four zones: Inner Core (IC), Outer Core (OC), Inner Periphery (IP) and Outer Periphery (OP) and each region contain multiple localities. As in Figure 4.2, the

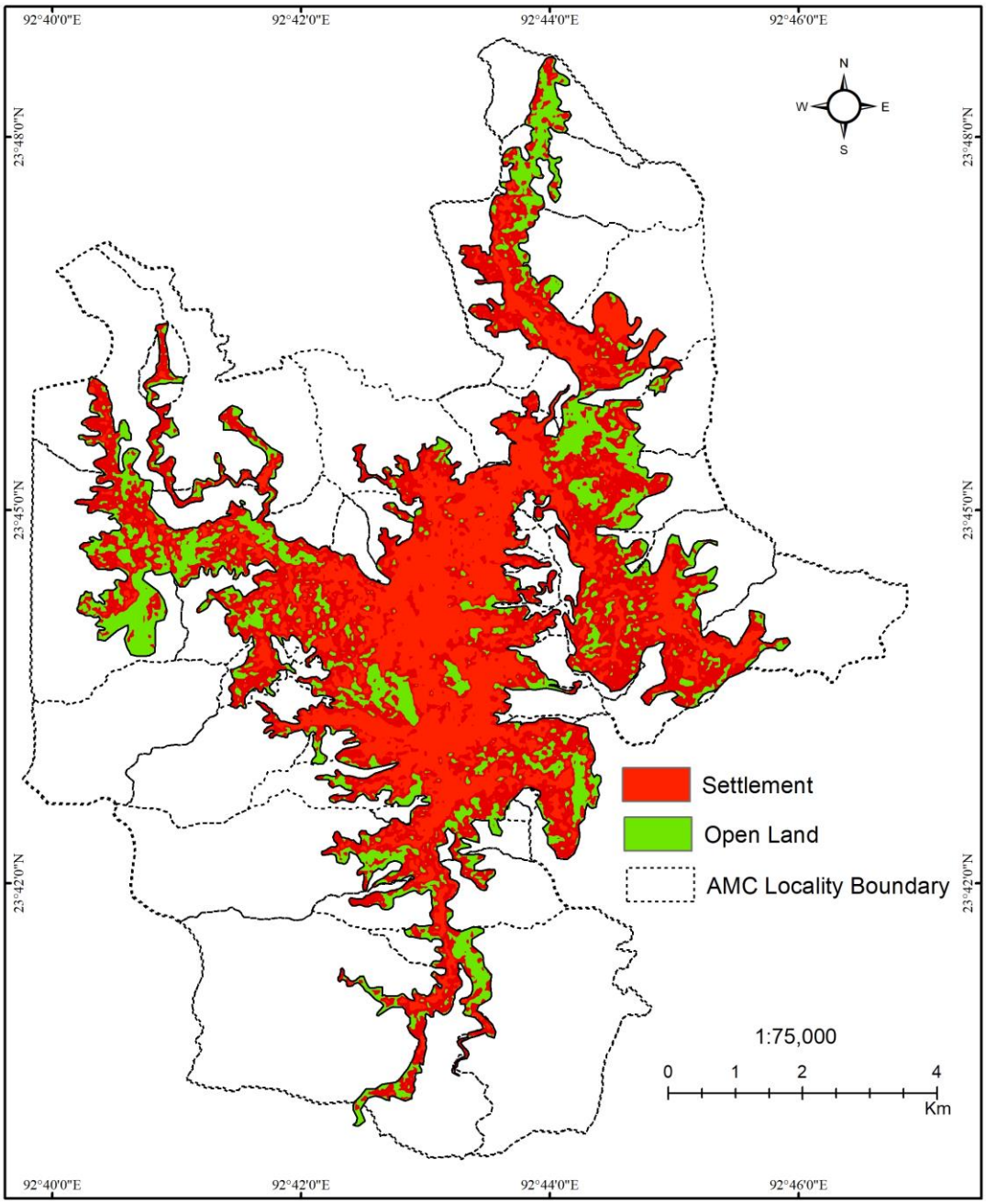


Figure 4.1 Settlement Area Map of Aizawl

inner core is located at the centre of the city surrounded by the outer core region. The outer core is located between the inner core and the inner periphery while the outer periphery region is found at the edge of the city next to the inner peripheral region.

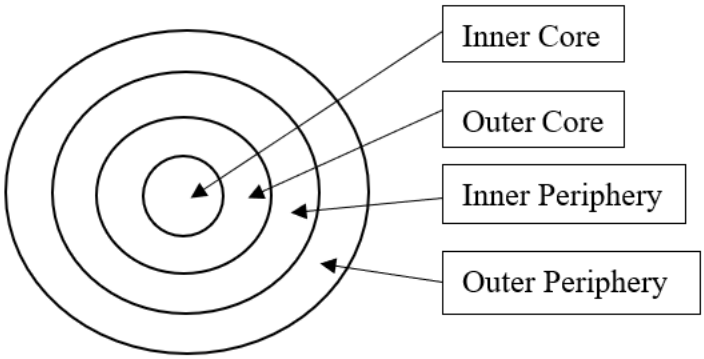


Figure 4.2 A Model of Residential Zones in Aizawl City

It has been mentioned that Aizawl City was originally a hilltop settlement, resting on the elongated north-south trend of the mountain range, and some ridges extend from the main ridge in the eastern and western parts of the city. The horizontal extension of the flat hilltop is the most suitable place for settlement development. Major transportation routes had been developed to run along the north-south direction at the crest of the mountain ridge. Horizontal expansion of the city initially took place along with transportation routes forming a linear pattern of settlement. Localities had been first developed on the crest and trough of the surrounding hillocks because of smoother topography than the limb of the hills. Over time, the increasing population put pressure on land for housing and settlements gradually developed in unfavourable sites on the hilly slope downwardly. As a consequence, the low-lying areas of the hill became the peripheral regions, even if the distances of the city centre are shorter than the hillock settlement area.

As shown in Figure 4.3, the main ridge where the first settlements were established became the central part of the city where the CBD is located. The horizontal expansions of the city led the hillocks A and B which are adjacent to the main ridge to be more inner than the lower-lying areas of the main ridge. For example, the localities of Chaltlang and Mission Veng, which are situated in north and south adjacent hillocks, respectively, are placed within the core zone, while the localities of

the lower part of the main ridge which have a shorter distance to the city centre than the said localities are located in the peripheral areas of the city, for example, Ramhlun Venthar, Ramhlun Sports Complex. However, all hillock settlements or major transport routes could not be placed as inner regions. With growing the city, the city area also expanded, and some localities that were formerly rural villages became part of the city. Even if they are located in the hillock or adjacent to major routes, remain in the peripheral region (hillock C).

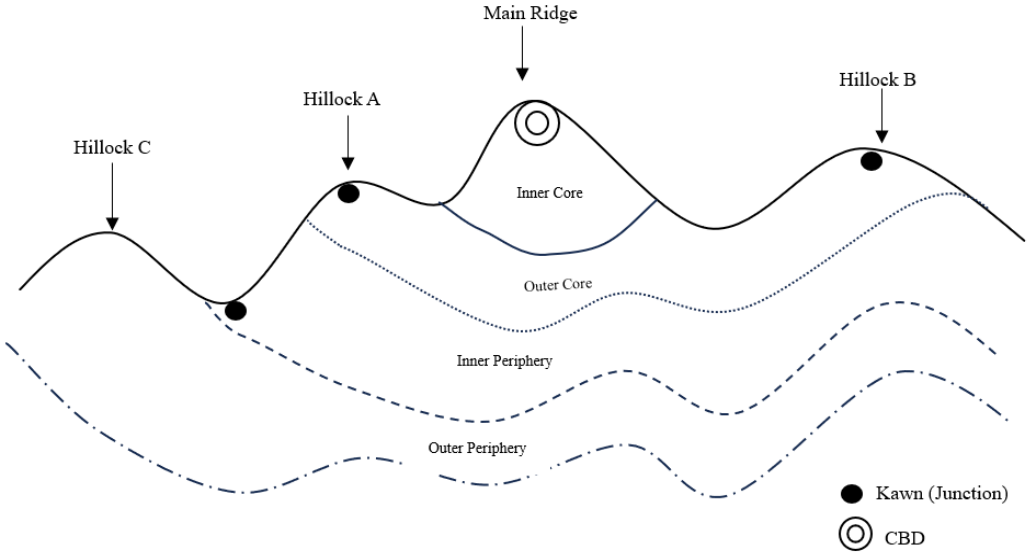


Figure 4.3 Evolution of Residential Zones in Aizawl City

The central part of the city is the most accessible region in the city and functions as a city growth centre where CBD is located. Due to limited extension, one can reach the city centre from the farthest point within 40 minutes (Zarzoenga and Lalhruaia, 2019) and only one growth centre exists in the city as opposed to Harris and Ullman's model of Multiple Nuclei theory. The major public transportation from different parts of the city runs towards the city centre. The functions and services of the city centre are beyond comparable to other parts of the city. As a result, the present study used the services of the core area to represent the city services centres for studying rental housing.

Due to undulated terrain, measuring the horizontal distance by using coordinates like Cartesian Distance measurement is not applicable in hilly areas like Aizawl City because distances on hills are farther than the plain areas when they

presented the same horizontal distance (Tenhundfeld and Witt, 2017). As a result, distances are taken by measuring the transportation routes that are connected between the said service centres and the respective locality. It is more appropriate than the horizontal distance, people usually used to access the city services by using motor vehicles.

4.2.1 Junction or 'Kawn'

Junction, which local people call *'Kawn'* has more meaning than the literary meaning of the meeting point of two or more transportation routes. As mentioned in Figure 4.3, the junctions are usually located at the crest and trough of the hill where the only natural flat surfaces with gentle slopes in the upland are found. It is one of the most suitable places for settlement. When the settlements were dispersed from the centres, *'Kawn'* was usually the first place to build houses and then formed a separate locality. It is located in the most accessible place, mostly at the central place of the respective locality. *'Kawn'* might be considered the initial phase of the nucleus or mini-CBD in the Harris and Ulmann model, the daily needs and necessities like groceries, vegetable markets, stationery, restaurants, hardware stores etc. and public transportation such as buses or taxis can be accessed.

Most localities in Aizawl have some kind of *'Kawn'* but different capacities of functions. The earliest localities generally have large spaces for the '*Kawn'* area and have more *'Kawn'* functions and services. Not all localities have been blessed with the spaces for establishing *'Kawn',* especially newly created or adopted. As a result, several localities shared the services of *'Kawn'* from their former localities. For instance, among the selected localities, Khatla E' and Khatla S' localities were separate from the Khatla locality but still shared the service of Khatla '*Kawn'.* Likewise, Ramhlun Venglai shared Ramhlun N' '*Kawn';* Tuivamit, Sakawtuichhun and Tanhril shared the same *'Kawn'*.

In the present study, the distances between *'Kawn'* and households of the respective locality were considered. Usually, the junction is located in a walkable zone, and then the horizontal distance is used to measure the distance between households and the junction instead of the length of a motorable road. The average distance

between the households and the *'Kawn'* of the selected localities is 391.12 metres, and the range is extended between 9.04 meters and 1.95 kilometres. Generally, the *'Kawn'* and its surrounding areas are the most densely populated area and decrease outwards. As a result, more than two-thirds of the sample households were located at the category 1 and 2, which are the two nearest groups from the junction in a locality (Table 4.1).

Table 4.1 Distance of Households to Junctions

Category	Distance (in meters)	Percentage
1	9.04 – 211.77	40.7
2	211.78 – 437.27	28.8
3	437.28 – 835.61	19.6
4	835.62 – 1363.97	6.6
5	1363.98 – 1955.15	4.4

Source: Primary data collected by the author (2021)

4.3 Neighbourhood Characteristics of Selected Localities

Neighbourhood characteristics refer to the environmental characteristics of a particular locality that have a potential effect on the value of a house (Darfo-Oduro, 2020). The literature review revealed that the most common measures of neighbourhood characteristics are location (Wickramaarachchi, 2016; Kumar De and Vupru, 2017), school quality (Ottensman *et al*., 2008), security (Kumar De and Vupru, 2017, Kimani *et al*., 2021), population density (Kimani *et al*., 2021), green space, water bodies, and air quality (Wiedemann, 2003; Chiesura, 2004). The factors including crime, green space, water bodies and air quality were excluded because the researcher found them irrelevant and make no difference in the study area. The state, Mizoram is the most peaceful state in India, the crime rate is only 262.2, which is far below the national average of 445.9 (National Crime Records Bureau Report, 2021). No neighbourhood found a rough neighbourhood in terms of crime prevalent within the city. And, the state is endowed with rich forest cover and air quality, more than two-thirds (68.52%) of the geographical area is forest-covered areas. Also, due to the absence of heavy manufacturing industries and the abundance of forests, the average Air Quality Index of Aizawl is only 55.25 (Mizoram Pollution Control Board Report

2017-2018) which is one of the best among Indian cities. No significant water body was found in the surrounding areas of the city which became an irrelevant factor.

4.3.1 Topographic Features

An extensive literature review witnessed that the influence of topographic features has been neglected in rental housing studies. It might seem that most studies were done in plain cities where the topographic features are irrelevant. Contrarily, the influence of topographic features on housing cannot be neglected in hilly cities like Aizawl. It had a significant impact on the pattern of settlements, housing development, accessibility and safety assurance etc. The present study focused on the locational features of the selected housing on the grounds of the major topographic features like elevation, slope angle and landslide susceptibility level. The households' elevations from the sea level are measured by using pocket GPS, and the slope gradient and landslide susceptibility level of the building sites are taken from the slope map and landslide susceptibility map by using ArcGIS.

4.3.2 Elevation

The locations of the selected households were extended between the altitude of 777 metres to 1142.5 metres from the sea level, and the average is 989.10 metres. The spatial analysis of the elevation supported the earlier discussion that the city centre is located on the hilly crest and decreases at the immediate hilly slope towards the peripheral areas. However, the main ridge (Aizawl) is extended in the north-south direction, and the highest point is found in the northern part and then gradually declines towards the southern region. As a result, the highest elevations of the selected localities were found in the northern part such as Laipuitlang, Zarkawt and Chanmari with an elevation of 1127.80, 1081.06 and 1070.80 metres, respectively. Five localities, two from the eastern and another three from the western part, were selected to represent the outer peripheral region. The eastern localities were located in the foothill of Aizawl, near the Chite River, while the western localities were located in the separate hillock of Tanhril. Tanhril locality is higher than the eastern localities of the outer periphery, while the other two localities of the western part are lower than the eastern part.

Table 4.2 Average Elevation of the Selected Localities

Locality	Zone	Average Elevation (in Metre)	
Zarkawt	IC	1081.06	1054.27 (Inner Core)
Electric Veng	IC	1027.48	
Chanmari	OC	1070.80	1070.42 (Outer Core)
Laipuitlang	OC	1127.80	
Khatla	OC	1055.71	
Khatla East	OC	1027.38	
Khatla South	IP	981.97	993.13 (Inner Periphery)
Mission Vengthlang	IP	996.89	
Ramhlun North	IP	1000.74	
Ramhlun Venglai	IP	1006.60	
Luangmual	IP	999.68	
Chawlhhmun	IP	972.92	
Ramhlun Vengthar	OP	950.93	911.52 (Outer Periphery)
Ramhlun SC	OP	931.74	
Tuivamit	OP	888.93	
Tanhril	OP	961.69	
Sakawrtuichhun	OP	824.30	
Average Elevation	989.10		

Source: Primary data collected by the author (2021)

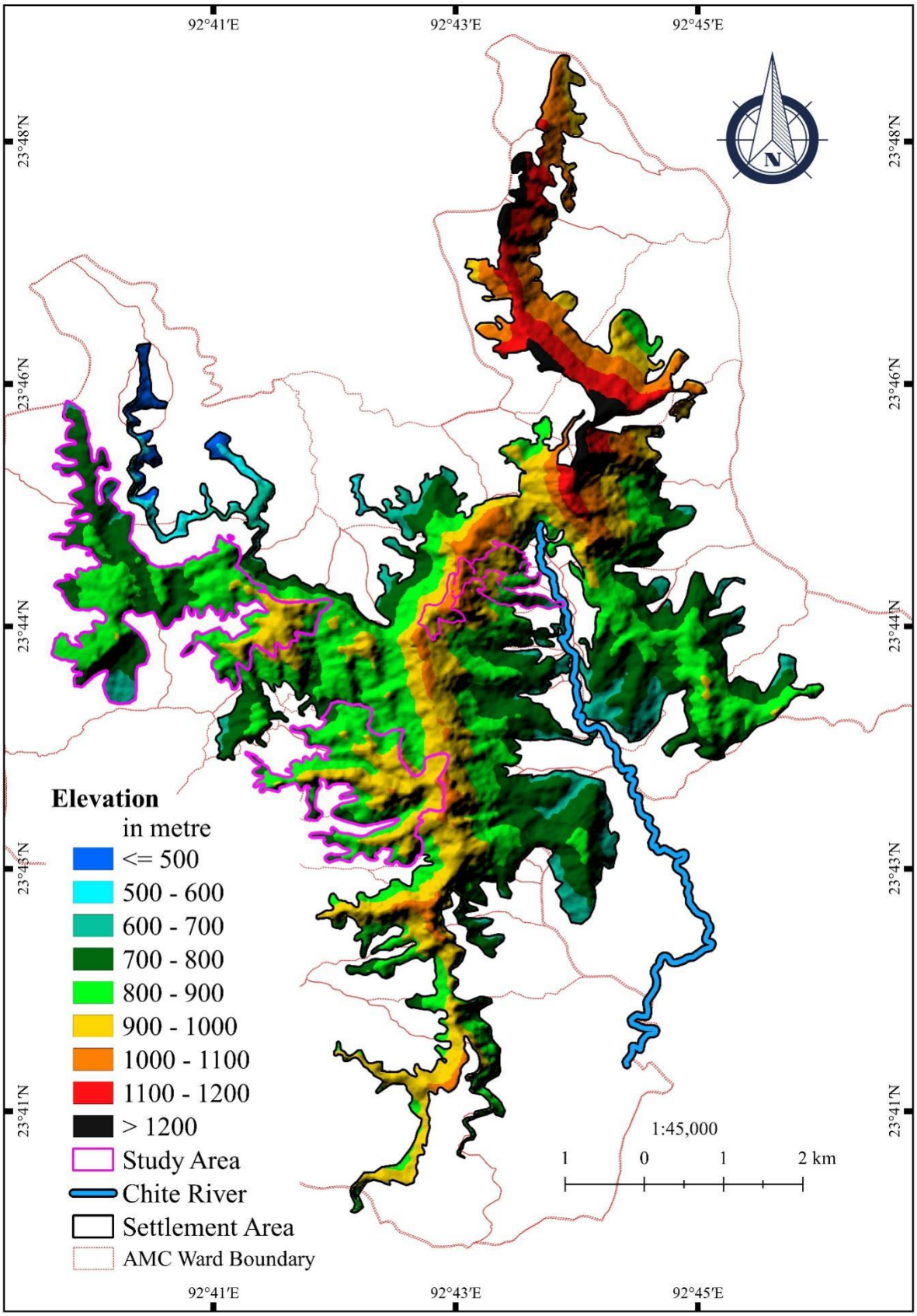


Figure 4.4 Elevation Map of Aizawl Residential Area

4.3.3 Slope Gradient

Slope stability is highly determined by slope angle or gradient which means the higher the angle of a slope, the greater the unstable force or slope failure. The common form of slope failure is landslides. The isostatic imbalance of steep slopes with intensive rainfall causes frequent landslides in the Himalayan region. The hilly city of Aizawl, part of the Himalayas, is prone to landslides, especially during the monsoon season. About 20 per cent of the geographical area is more than 30° slope surface, while 40.58 per cent comes under less than 20° slope (Saitluanga, 2017).

Based on the slope degree of the household sites, the study area is divided into five categories, gentle slope (less than 10^{o}), gradual slope (11^{o} – 20^{o}), moderate slope (21^{o} – 30^{o}), steep slope (31^{o} - 40^{o}) and very steep slope (more than 41^{o}) as shown in figure 4.5. Gradual slope and moderate sloping surface constituted the highest households with 27.50 and 26.40 per cent followed by the steep sloping surface (20.90%). The lowest number of households were found in the very high steep slope counting 9.30 per cent and the gentle slope comes next with the total households of 15.90 per cent.

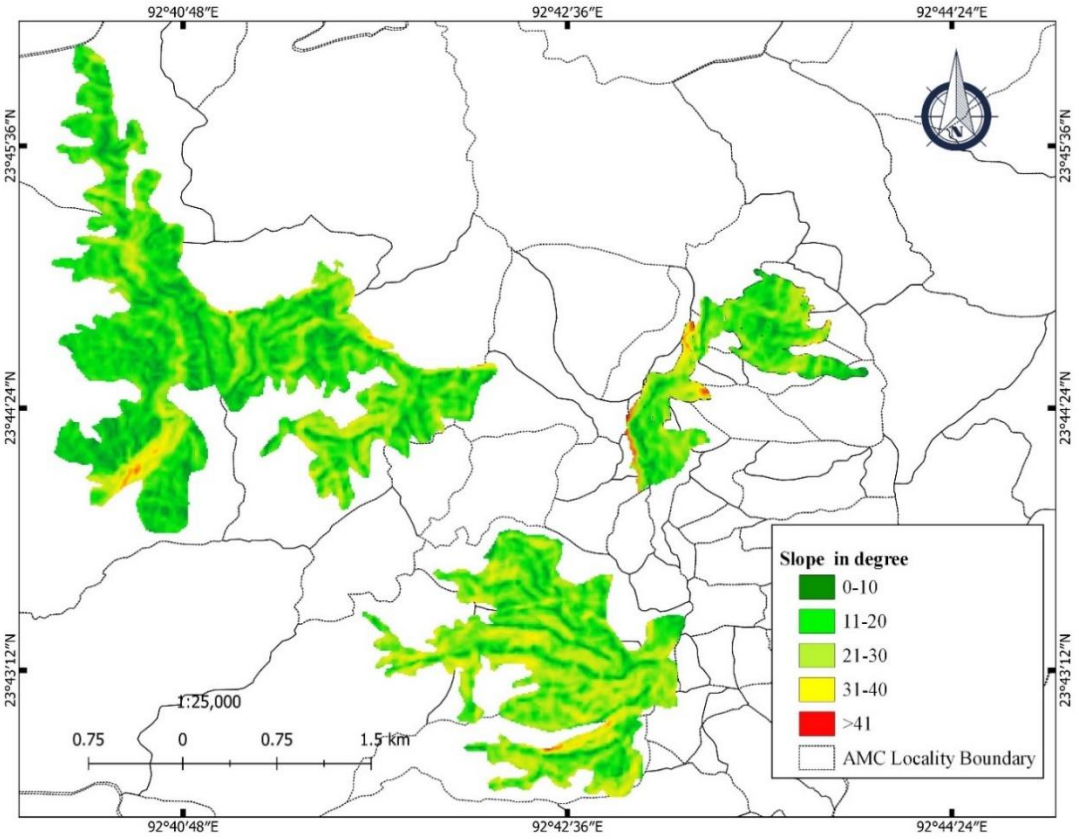


Figure 4.5 Slope Map of the Study Area

As shown in Figure 4.6, more than half of the lowest category of slope degree of household sites are found in the peripheral regions and followed by the inner core region, as expected. The density of built-up land has declined from the centre, and more available spaces for the construction of housing are found in the more peripheral regions. The sloppy areas can be avoided in that area which keeps the slope degrees of the household sites low. Slope degrees increase from the outer peripheral regions and the outer core regions have the highest sloppy sites of households.

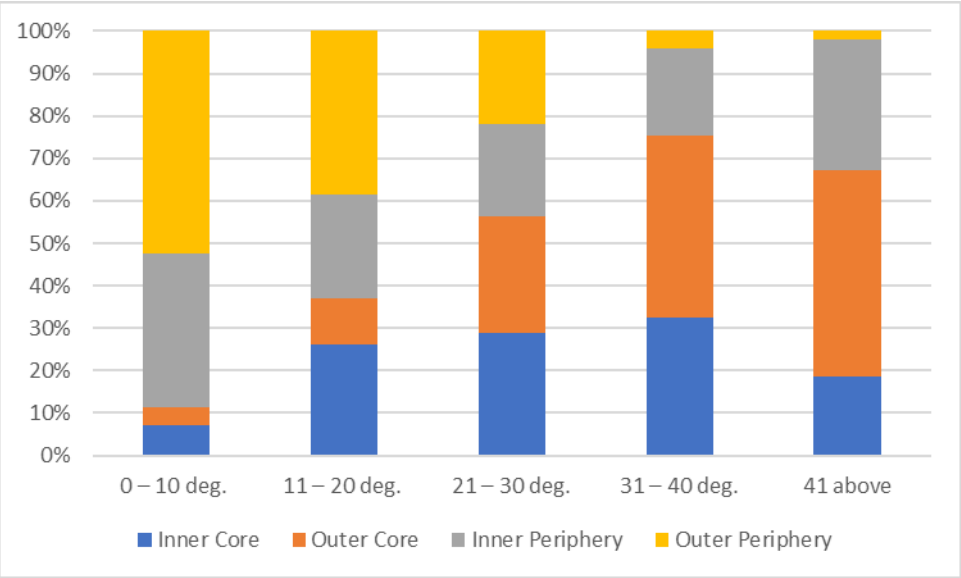


Figure 4.6 Spatial Distribution of Slope Degree of Household Sites

4.3.4 Landslide Susceptibility Zone (LSZ)

By incorporating with Aizawl Landslide Hazard Map prepared by Aizawl Municipal Corporation (AMC), the Landslide Susceptibility Zone of Aizawl City is generated from Weighted Overlay Methods by using ArcGIS Software (Figure 4.7). Table 4.3 shows that four zones of landslide susceptibility were identified in Aizawl City. Among the selected households, 28.40 and 4.80 per cent were located in high and very high zones which have a high chance of occurrence of landslide disaster. The majority of the households (58.10%) are located in the zone with a medium chance of landslide occurrence and 8.80 per cent of households lived in the zone of low chance.

Table 4.3 Landslide Susceptibility Zone

Zone	Overall	Inner Core	Outer Core	Inner Peri.	Outer Peri.
Low	8.80	6.6	10.2	7.7	10.4
Medium	58.10	86.8	49.6	52.6	58.2
High	28.40	6.6	39.4	31.1	26.1
Very High	4.80	0	0.8	8.6	5.2

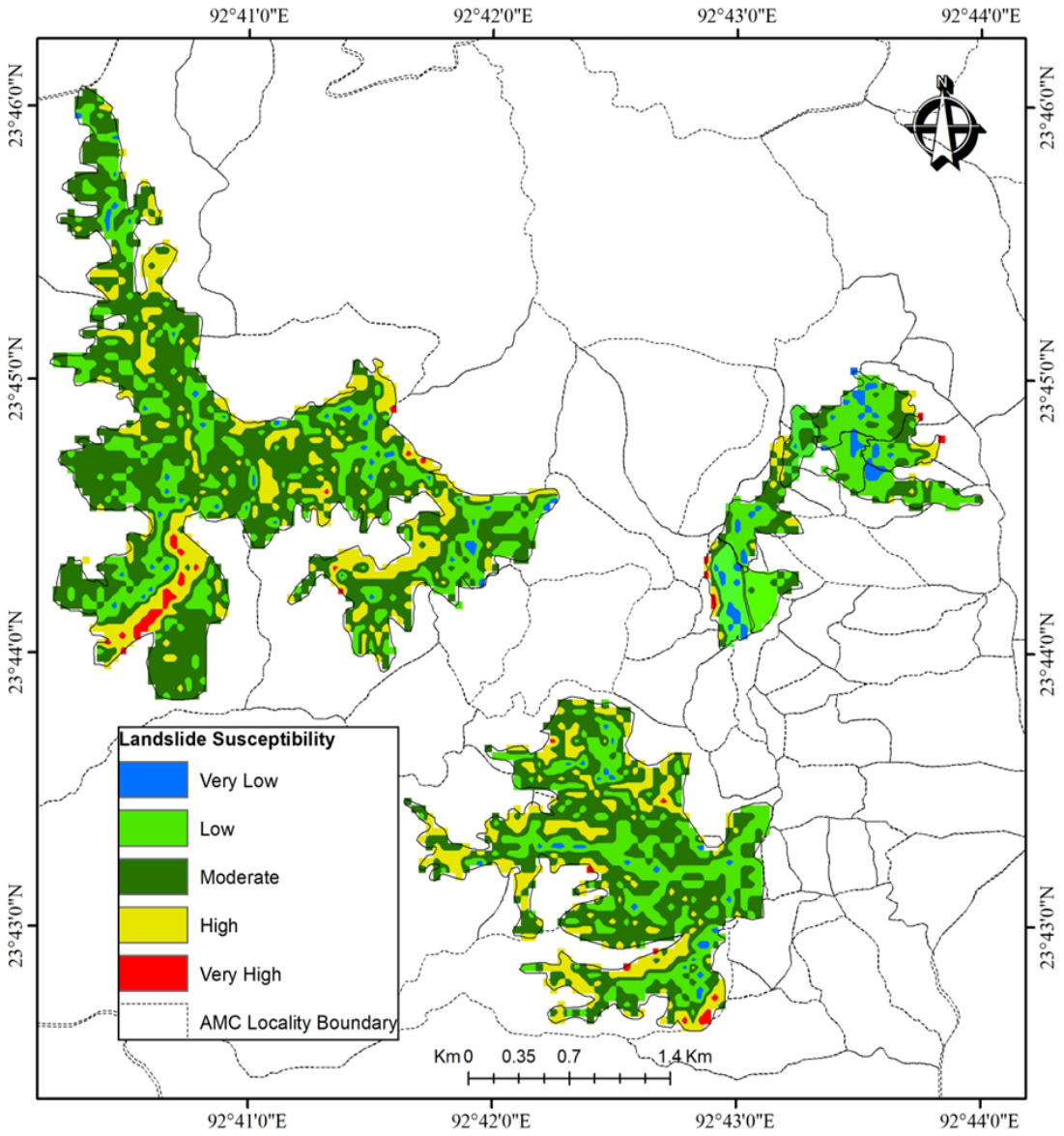


Figure 4.7 Landslide Susceptibility Zones of the Study Area

As shown in Figure 4.8, the regions that have higher slope degrees such as the inner periphery and outer core regions were also found as high in landslide susceptibility zones. Undoubtedly, the hilly crest area such as the inner core region becomes the least risk of a landslide because most of the areas are characterised by flat surfaces. No very high zone of landslide susceptibility is found in the inner core region and 86.80 per cent of households were located in the medium zone. About half of the households of the three zones such as the outer core, inner periphery and outer periphery located in the medium zone of landslide risk. The highest number of households which were located in the high-risk zone found in the outer core zone (39.40%), followed by the outer periphery (31.10%). Both regions have higher sloppy surfaces than the other two regions. Though the outer peripheral regions have the gentlest sloppy surface, some of the areas are in the high-risk zones of landslides. This might be the reason that an extensive area of the slumping zone is found in the Ramhlun Sports Complex locality, one of the eastern parts of the peripheral region.

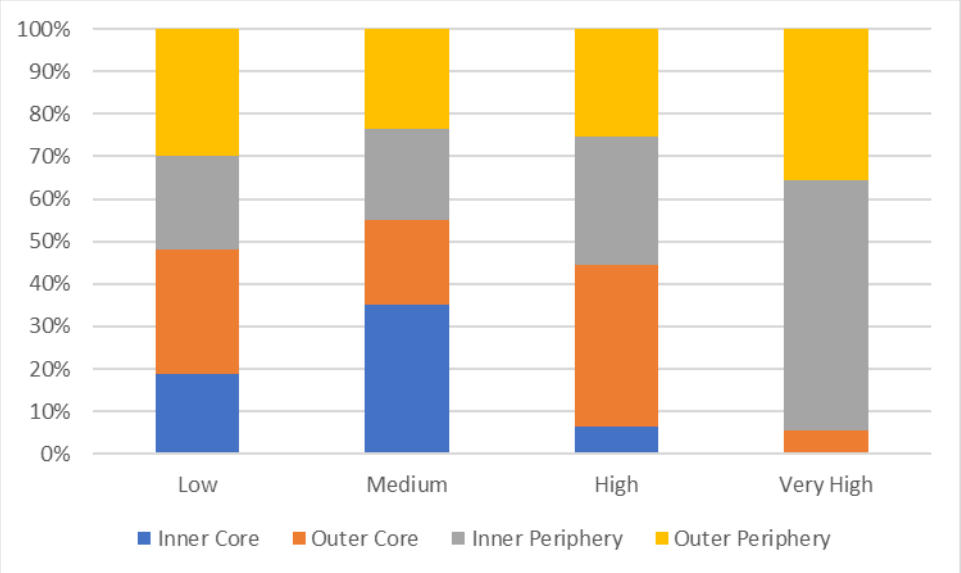


Figure 4.8 Spatial Distribution of Landslide Susceptibility Zones of Household Sites

4.3.5 Population Density

As per the 2011 census, the density of the population of Aizawl City (2,823 per square kilometre) is quite low compared to the top highest density of Indian cities like New Delhi (30339), Chennai (26553) and Kolkata (20980). In Aizawl City, the

neighbourhood that has a high-density population can be regarded as better quality for liveability because the entire city shares the same safe environment for crime and environment. Population density can be categorised into five, and Table 4.4 shows locality-wise population density. Unsurprisingly, the localities of peripheral regions generally have a low-density population, while the more inner localities especially along with the major transport routes have a high population density, except for Khatla South localities.

Table 4.4 Neighbourhoods' Population Density

Density	Locality
Very Low (<4732)	Tuivamit, Khatla, Sakawrtuichhun, Luangmual, Chawlhhmun, Tanhril
Low (4733 – 12861)	Mission Vengthlang, Ramhlun SC, Zarkawt
Medium (12862 – 2752)	Laipuitlang, Ramhlun Vengthar, Khatla East, Ramhlun North
High (2753 – 36412)	Ramhlun Venglai, Chanmari
Very High (>36413)	Electric Veng, Khatla South

In terms of demography, usually, a city with a low density of the population is more desirable than an overcrowded city for liveability. Population density and Quality of Life are negatively correlated which means that an increase in the density of the population decreases the quality of life of the city (Cramer *et al*., 2004). However, regarding the intra-city context, it is difficult to say low density of the neighbourhood's population is preferable to highly populated neighbourhoods. High-density neighbourhoods in a city had better-perceived building aesthetics, better external conditions and transport services compared with low-density neighbourhoods (Walton *et al*., 2008), which makes high-density areas. On the other hand, the higher population density was related to an increase in negative life events including both criminal and noncriminal and a decreasing perception of neighbourhood quality (Cramer *et al*., 2004).

4.3.6 Accessibility

Table 4.5 shows the residential zones of the selected 17 localities and their distance from the selected three service centres. Among them, six localities are from

the core regions, out of which two localities are in the inner core. Again, six localities are found in the inner peripheral region, and the rest, five localities are located in the outer peripheral region.

Table 4.5 Residential Zones and Distance of City Services

Locality	Region	Govt. Offices (in Metre)	Hospital (in Metre)	CBD (in Metre)
Zarkawt	IC	1360	392	-
Electric	IC	1360	392	-
Chanmari	OC	2018	1050	658
Laipuitlang	OC	2955	1987	1595
Khatla	OC	810	1653	2141
Khatla East	OC	810	1653	2141
Khatla South	IP	810	1653	2141
Mission Vengthlang	IP	2030	2873	3361
Ramhlun North	IP	3538	2570	2178
Ramhlun Venglai	IP	3768	2800	2408
Luangmual	IP	3391	2678	4040
Chawlhhmun	IP	6688	6849	7337
Ramhlun Vengthar	OP	4175	3207	2815
Ramhlun SC	OP	4591	3623	3231
Tuivamit	OP	9406	9567	10055
Tanhril	OP	10256	10417	10905
Sakawrtuichhun	OP	11216	11377	11865

Source: Primary data collected by the author (2021)

As mentioned above, all those service centres are taken from the core regions. The main market (Bara Bazaar) and its surrounding areas represent the CBD. Although numerous government offices are spread across different parts of the city, the most frequently visited by the local people like the District Commissioner (DC) Office, assembly annexe, treasury, law office etc. agglomerate in the southern core regions. Civil Hospital run by the government and its surrounding areas is the largest health facility centre in the city. The average distance between the selected localities and the city's services of government offices, hospitals and CBD are 4.07, 3.80 and 3.93 kilometres, respectively. The theoretical statement is that the distance of the city services decreases towards the peripheral regions. However, in some cases, it has been mentioned that some localities of the outer peripheral region such as Ramhlun Vengthar and Ramhlun SC are located at shorter distances than the more inner area of

the Chawlhhmun locality (see Table 4.5). The farthest locality is Sakawrtuichhun which is located on the western fringe of the city at a distance of 11.8 kilometres from the CBD.

4.3.7 Transportation

The sloppy and rugged topography makes it difficult for the construction and development of roads and requires high capital. Roads are usually narrow and congested, and the inadequacy of road networks created transportation is the major issue in hilly cities. A large number of settlements had been unable to access the motorable roads from their doorstep. In the present study, 80 per cent of the households live in apartments that have no access to motorable roads, and only 20 per cent lived adjacent to the said roads. Additionally, the absence of land-use planning and the uncontrolled growth of motor vehicles combined created Aizawl City as one of the least inaccessible cities in the country (Saitluanga, 2017).

Usually, the peripheral regions are often neglected and generally have lower economic and accessibility than the more central ones and then become remote areas. In Aizawl City, the peripheral regions are mostly found in the low-lying areas of the hill, and the local people referred to as *'Veng mawng'* implying the hostile and less developed areas. The quality of life and liveability of the dwellers can be adversely affected by the bad quality of roads (ibid), the people are willing to live near the central place. As a result, the number of rental houses decreased with increasing distance from the centre.

4.3.8 Neighbourhoods' School Quality

In housing studies, there are several criteria have been used for measuring neighbourhoods' school quality. Some researchers used the accessibility of schools, for example, the distances to kindergarten and school (Bhargava 2013; Day *et al*., 2003) and travel times to schools and universities (Des Rosiers *et al*., 2000). While others used the quality of the students of the neighbourhood. For example, Ottensmann *et al*. (2008) used students' Scholastic Aptitude Test (SAT) scores reported for the school district, Kain and Quigley (1970) used the average eight-grade maths

achievement score of the public school, and Hayes and Taylor (1996) took average sixth-grade achievement in mathematics and current expenditures per pupil.

In India, according to the Eighty-sixth Amendment Act, of 2002 inserted Article 21-A in the Constitution, the state must provide free and compulsory education for all children between the age of six to fourteen years. Moreover, the Right of Children to Free and Compulsory Education (RTE) Act, 2009 states that the school should be established within a walking distance of a one-kilometre radius for primary (first to fifth class) and three kilometres for upper primary (sixth to eighth class) of the neighbourhood. As a result, every locality in Aizawl City had at least one or more schools up to upper primary (or middle) free of cost. Furthermore, numerous Mediums of English Schools based on the churches or private corporations had been established in almost all of the localities. Due to this, the primary schools were excluded from this study, and only the secondary schools (high schools and higher secondary) are considered for measuring the quality of neighbourhood schools. Not only due to the fewer in numbers but the state board conducted state-level examinations for tenth and twelfth standards. The local people have paid more attention to such board examinations than all other standards and it would appear that the results of the said examinations are the major criteria to measure the quality of school.

Usually, the schools that have a good reputation in the board examination results automatically have more student enrolment. In this study, neighbourhood school quality is measured by using the number of high schools and higher secondary schools, the number of students enrolment in tenth and twelfth standards, and the result of board examinations. The proximity of the school is excluded because the choice of school is different even in the same neighbourhood. The different range of scores between the localities and the nature of data differences among the variables had been neutralized by using the Z-Score methods. The average scores from the score of each of the variables by the localities were taken and produced the composite score of the school quality of the respected neighbourhood.

Using Jenks Natural Breaker, five categories of school quality zones were identified ranging from very low to very high zones as shown in Table 4.6. The analysis

revealed that the localities that have high-quality schools generally have good transportation networks and are located in a well-accessible region in the city. No high school and higher secondary school are found in the three localities such as Khatla East, Khatla South and Laipuitlang and then placed in the bottom zone. However, they are newly created localities, and as we already discussed they hugely depend on their parents' locality and continually share the same services. Apart from these three localities, it can be said that the best quality of schools is usually found in the middle part of the city, that is the area between the inner core and outer peripheral regions. It can be accepted that the middle parts of the regions have more advantages for the school environment than the inner core regions where the high places for rental values and overcrowded with high noise pollution and the outer peripheral regions of less developed with greater distances.

Table 4.6 Neighbourhoods' School Quality

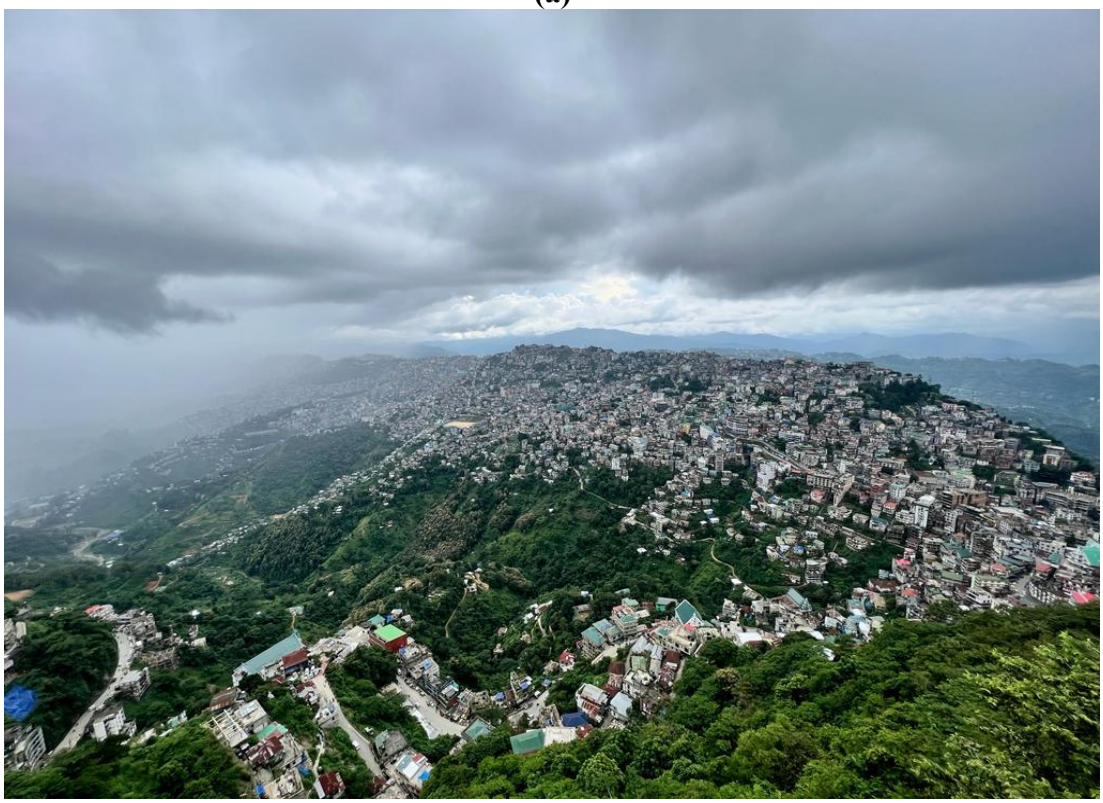
School Quality Zone	Locality
Very Low	Khatla East, Khatla South, Laipuitlang, Ramhlun Sport Complex
Low	Tuivamit, Ramhlun Vengthar, Tanhril
Medium	Chawlhhmun, Electric, Ramhlun Venglai, Luangmual, Sakawrtuichhun
High	Zarkawt, Khatla
Very High	Chanmari, Ramhlun North, Mission Vengthlang

4.4 Conclusion

With the negligence of town planning in the past, the problem created by the topographic features is inevitable for settlement development in the hilly city of Aizawl. The rugged features with shard slopes largely control the evolution of the settlement patterns as well as the accessibility quality. Due to the limited extensive plain area for the built-up area, settlements were first developed alongside the transportation routes which ran along the direction of the mountains and formed the linear pattern of settlement. However, with the rapid increases in urbanisation, the unfavourable sites of the hilly slopes gradually inhabited areas. The topography has a negative impact on the qualities and quantities of the road transport networks, a larger number of settlements cannot access the motorable roads at their doorsteps, and

accessibility is a major issue in the city. On the other hand, the city provides a better quality of the environment in terms of air and noise pollution, clean neighbourhoods and proper sanitation services, abundant natural greenery and scenic beauty of mountains.

(a)



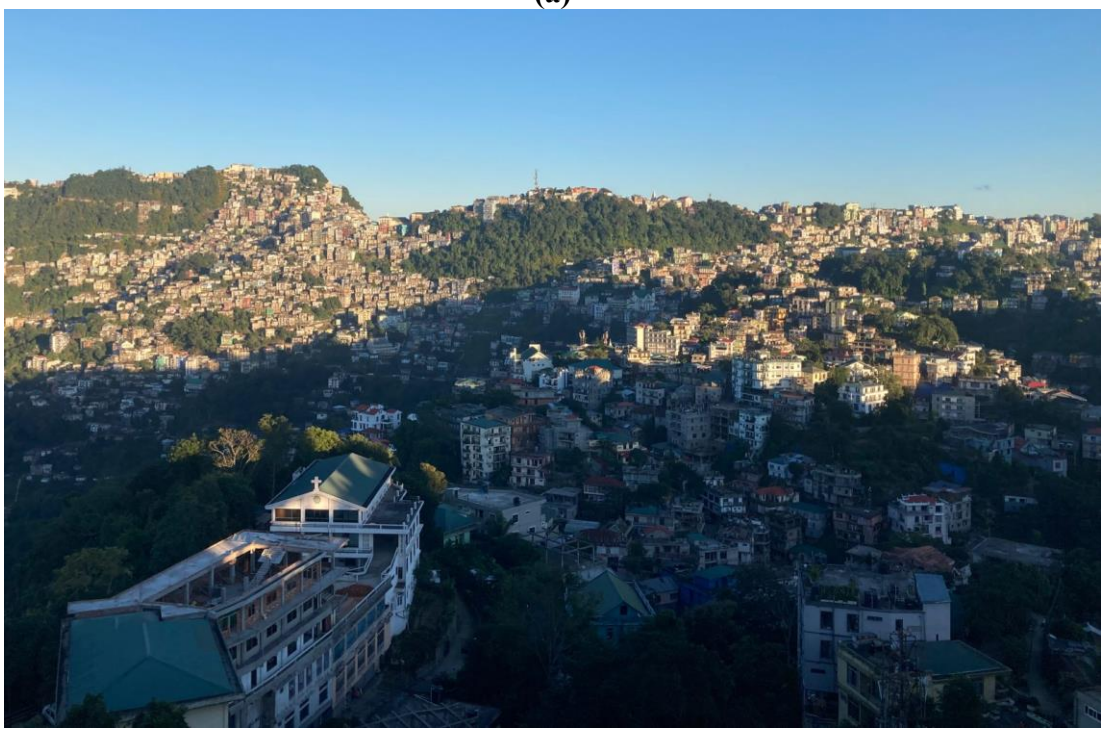
(b)

Figure 4.9 Picturesque showing Landscapes and Residential Patterns of Aizawl City

(a) A view from the northern side of the city

(b) A view from the eastern side of the city

(a)



(b)

Figure 4.10 Picturesque showing Landscapes and Residential Patterns of the Western Part of the Aizawl City

(a) A view from the western side of the city

(b) A view of Western Hillock of Aizawl City

Figure 4.11 Main Market (Bara Bazar) showing the ground floors allotted for commercial services

(a)

(b)

Figure 4.12 Important Services of Aizawl City

(a) Civil hospital and its surrounding medical services centre
(b) Treasury Square – A hub of government offices

(a)

(b)

Figure 4.13 Kawn (Junction) in the Peripheral Residential Zone

(a) Small area of Kawn (junction) and its function
(b) Average area of Kawn (junction) and its functions

(a)

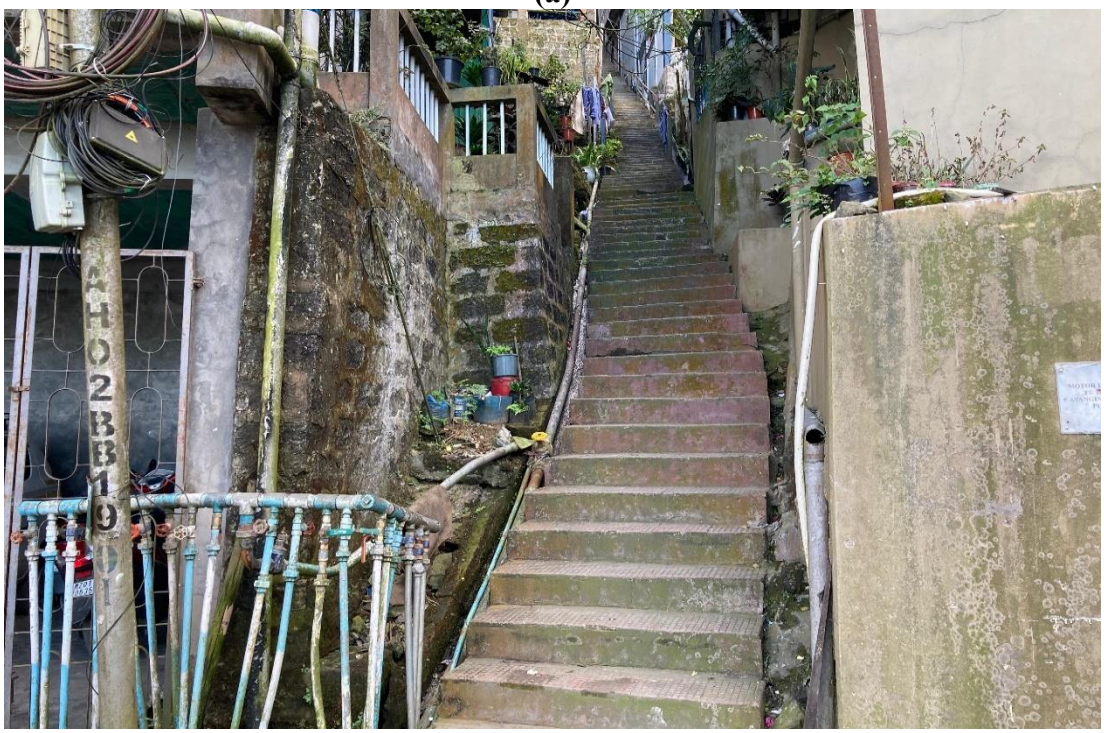
(b)

Figure 4.14 Kawn (Junction) and its Services

(a) Vegetable Sellers

(b) Petty trade

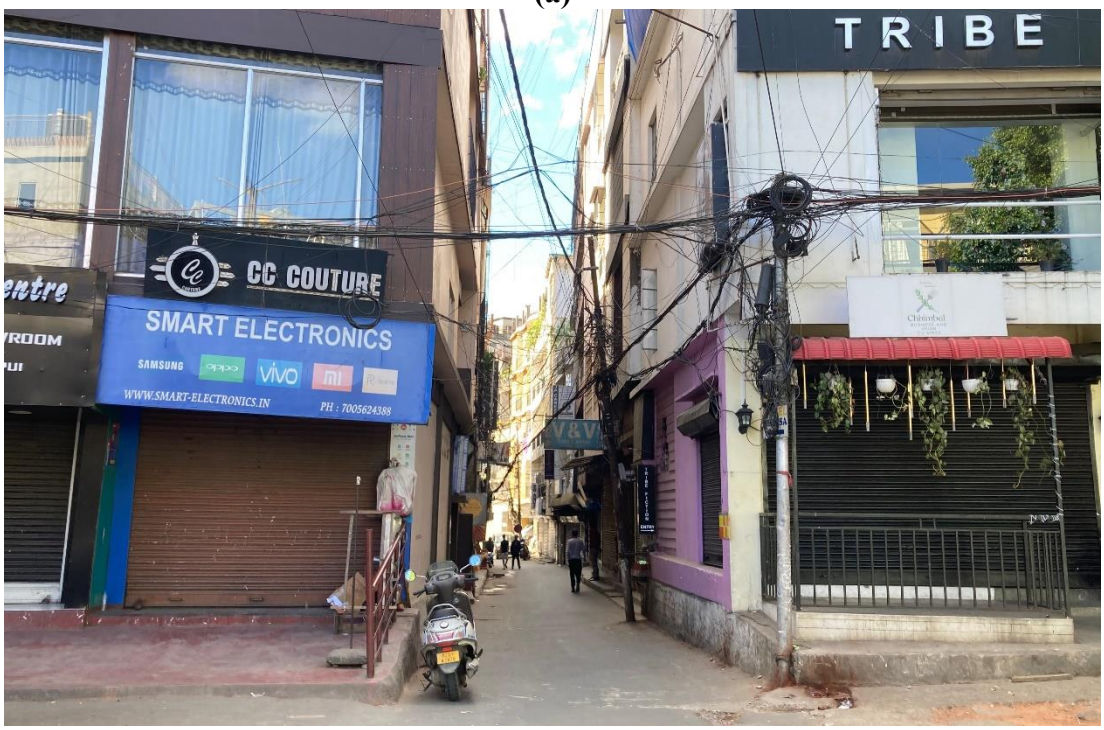
(a)



(b)

Figure 4.15 Picturesque Residential Area located at Unmotorable Road

(a)



(b)

Figure 4.16 Picturesque of Narrow Internal Roads

(a)

(b)

Figure 4.17 Residential Buildings in Highly Steep Slopes

(a) Impact of slopes on the size of the residency
(b) Settlements in highly steep slopes

CHAPTER – V

SOCIO-ECONOMIC CONDITION OF TENANTS IN AIZAWL CITY

5.1 Introduction

Ever since the introduction of urban morphology by the Chicago school during the 1920s, intra-urban spatial differentiation has been widely studied in many cities to understand urban residential spatial structures. The spatial disparity is governed by aerial differentiation of the geographical phenomena such as climate, topography, and natural resources; locational features like core-periphery, agglomeration advantages, and the sociocultural, political and institutional factors (Chepik, 2015; Mikhailova *et al*., 2017) which may eventually lead to segregation, particularly in the intra-urban regions. Spatially, urban social structures have been influenced by industrialisation and modernisation, and several approaches such as human ecological, neoclassical-locational, behavioural, Marxist, and factorial ecology have emerged to study residential differentiation and segregation (Saitluanga, 2017). The basis of segregation or differentiation is not the same in every city. In Western cities, residential differentiation is usually based on race, ethnicity, and religion but class, income, and wealth are more dominant in Asian cities (Sun *et al*., 2017). However, caste is the most profound basis of segregation in India (Vithayathil and Singh,2012)

Among all the states of India, Mizoram has the highest concentration of tribal population constituting 94.43 per cent of the total population in the 2011 census. Mizo forms the ethnic majority and no caste system is found in the society. As a result, segregation based on caste is invalid; and Saitluanga (2017) found that socio-economic status is the most prominent factor of segregation in Aizawl City by using the factorial ecology approach. Socio-economic condition varies from household to household and is used to explain household economic inequality which reflects their class, status and financial position in society and plays an important role in measuring the well-being of the individual household as well as the whole community (Adebayo *et al*., 2022).

Rental housing is increasingly becoming the critical shelter option for the poor and new economic migrants (UN-Habitat, 2003, Kumar, 2011). Studies in different cities showed that low-income households are more likely to live in rental houses

(ElFayoumi *et al*., 2021; Adebayo, 2022). The post-industrial revolution witnessed rapid urbanisation across the world and created a scarcity of urban space for housing in the city (Harvey, 1974). The general consensus is that all households aspire to own housing. However, with the growing land demand for housing, owning a dwelling house becomes more and more difficult for the poor. To cope with such problems, rental housing provides shelter for the people until they can manage to find a stable job and save to invest in ownership housing in the city (Mahadevia, 2011).

The present chapter examines the socio-economic conditions of the tenants and their intra-urban spatial distribution in Aizawl City. The variables such as household size, number of children, occupation, education, migration and income are used to analyse the socioeconomic conditions of renters. The area-based analysis is based on the residential zones by using the appropriate statistical methods. Using the updated Modified Kuppuswamy Socio-economic Status Scale, 2020 (SES), the spatial distribution of the socioeconomic class of the tenants is analysed. The level of housing affordability is calculated by using the monthly income of the households and their rental prices.

5.2 Socio-economic Characteristics of Tenants in Aizawl City

Socio-economic condition of tenants is important in housing studies because the preference for housing quality is highly determined by the household socio-economic conditions (Adebayo *et al*., 2022). Housing quality is measured by not only the quality of the building but also the locational and residential environment. Studies across cities throughout the world revealed that richer households generally tend to live in high-quality housing and vice versa by forming residential segregation based on socio-economic level (Toyobo *et al*., 2011; ElFayoumi *et al*., 2021). The difference in residential quality is one of the major determinants of the morphology of the city (Ogunleye, 2013) and the driving force of urban dynamics (Adebayo *et al*., 2022).

5.2.1 Income of Tenants

The average household income of the tenants is ₹39,459.90 per month. Spatially, the highest is found in the inner core area and declined outward to the peripheral regions (see Table 5.1). The outer core has the second-highest average

household income (₹45,664.00) followed by the inner periphery with ₹36,549.30. The lowest average household income is found in the outer periphery with ₹27,552.24 per month. The per-capita income of the tenants is ₹1,29,863, which is lower than the entire state per-capita income of ₹1,79,503 in the year 2020-21 (Economic Survey of Mizoram, 2022-2023).

5.2.2 Demographic Characteristics

Table 5.1 shows the spatial distribution of the demographic characteristics of the respondents. The average family size of renters is 4.52, and 47.92 per cent of them are male. About 30 per cent of the respondents were below 18 years of age and 5.63 per cent were above 60 years.

The geographical distribution of the age group shows that the peripheral regions have a younger population than the inner regions. The outer peripheral region has the highest proportion of under-18 populations while the over-60 population is highest in the inner core. In addition, the average age of the household head is the highest in the inner core region (53.56%) and decreases towards the outer peripheral regions. Most of the household heads are male (77.91%) as expected.

Table 5.1 Socioeconomic Characteristics of Tenants in Aizawl City

Residential Zone	Average Age of Household Head	Male household head (%)	Average Household size	Male (%)	Under 18 (%)	Above 60 (%)	Average Monthly Income (Rs.)
Inner Core	53.56	72.94	4.56	48.20	25.52	9.28	48074.07
Outer Core	47.44	73.53	4.40	46.10	30.85	4.64	45664.00
Inner Periphery	45.58	89.47	4.72	49.81	30.64	3.60	36549.30
Outer Periphery	45.06	75.71	4.38	47.57	34.95	5.02	27552.24
Overall	47.91	77.91	4.52	47.92	30.49	5.63	39459.90

Source: Primary data collected by the author (2021)

5.2.3 Occupational Structure

Based on the nature of occupation, the economic sector can be categorised into two - the formal sector and the informal sector. The workers who are engaged in formal sectors are entitled to social security benefits and have rules and regulations that are

administered by any form of government. Due to the absence of large industrial units in Aizawl, wholesalers and government employees dominate the formal sector. The formal workers comprised 42.52 per cent of the total workers. Of these, only 11.08 per cent (4.71 per cent of the total workers) were the wholesalers who have a business centre in the core regions. In terms of earnings, the wholesalers were the highest occupational group among the tenants in the city.

Aizawl City is the administrative capital which creates an influx of government employees within the city. As a result, government employees form the highest working population among the tenants with 37.81 per cent of the total workers. Government employees can be categorised into two groups: gazetted with more than level 10 pay scale comprised of 3.33 per cent and non-gazetted with less than level 10 pay scale comprising 34.48 per cent.

More than half of the total workers among the tenants (57.47%) were engaged in informal economic sectors. The informal sectors consist of workers and enterprises that do not come under the regulation of the government and are not entitled to social security benefits. Of the five occupational groups in the informal sector, the workers who engaged in retail shops and petty trade formed the highest proportion followed by unskilled labour and skilled workers. The petty traders were mainly skilled workers like carpenters, and public transport drivers who drove their own vehicles, etc. Unskilled workers, skilled workers and drivers were the hired workers and they formed the lowest occupational groups in terms of earnings.

Table 5.2 shows that the outer peripheral region has more workers who engaged in the informal sector of the economy like agriculture workers, unskilled workers, and drivers while the higher income groups like government employees (Gazetted) and wholesalers were more concentrated in the outer core. Generally, renters of high-level income more afford to rent at better residences, so the outer core can be considered the best residential place in the city.

Table 5.2 Distribution of Tenant Workers in Aizawl City

Occupation	Residential zones				
	Inner Core	Outer Core	Inner Periphery	Outer Periphery	Overall
Agriculture Workers	1.32	0.00	0.99	5.47	1.94
Unskilled Workers	2.63	10.40	8.42	22.66	11.03
Skilled Workers	3.95	10.40	13.37	7.81	8.88
Drivers	7.89	2.40	9.90	13.28	8.37
Business (Retail Shops & Petty Trade)	39.47	28.80	22.77	17.97	27.25
Business (Wholesale)	6.58	8.80	3.47	0.00	4.71
Govt. Services (Non-Gazetted)	36.84	32.00	38.61	30.47	34.48
Govt. Services (Gazetted)	1.32	7.20	2.48	2.34	3.33

Source: Primary data collected by the author (2021)

5.2.4 Educational Level of Household Heads

Different studies suggested that the household heads' educational level has a significant positive relationship with household income and a negative relationship with poverty risk (Okojie, 2002; Javed and Asif, 2011; Bilenkisia *et al*., 2015). The educational level of the household heads of the tenants can be categorised into four - post-graduate, graduate, high school (Class 10 standard) and below Class 10 standard. About three-fourths of the household heads were undergraduates and only 5.14 per cent reached the post-graduate level. Nearly half of the household heads (44.15%) are below high school standards. No illiterate person is found in the present study,

At the micro-regional level, the outer peripheral zone has the highest proportion of the lowest educational level i.e., below Class 10 and the lowest proportion of post-graduate level, which is the highest. More than half of the household heads (57.81%) were below Class 10 standard and only 2.34 per cent were post-graduates in the peripheral region.

The inner core region has the second highest proportion of the lowest educational level as 43.42 per cent of the household heads were found below the class 10 standards. The inner core is usually chosen by migrant economic workers from outside the state of Mizoram due to its nearness to the CBD. Foreign immigrants have a relatively lower level of education than the natives (Dustmann and Frattini, 2011; OECD/European Union, 2018). The highest household heads' educational level is

found in the outer core region with 32.80 per cent of the household heads who are above the graduate level of education (24.80% graduates and 8% post-graduate) and only 32.80 per cent at the lowest level of education.

Table 5.3 Educational Level of the Tenant Household Heads

Edu. Level	Residential Zones				
	Inner Core	Outer Core	Inner Periphery	Outer Periphery	Overall
Below Class X	43.42	32.80	42.57	57.81	44.15
Class X	26.32	34.40	37.62	30.47	32.20
Graduate	25.00	24.80	14.85	9.38	18.51
Post-Graduate	5.26	8.00	4.95	2.34	5.14

Source: Primary data collected by the author (2021)

5.3 Socioeconomic Status of the Tenants

The socio-economic class of the tenants is categorized into three classes - upper middle, lower middle and lower classes against the Kuppuswamy socioeconomic class which includes the upper-class category since no household was found in the said category. Table 5.4 shows the spatial distribution of the socio-economic status of the tenants. The lowest class constituted only 2.66 per cent of the total tenant households. The upper middle was the highest class among the tenants and shared only 11.81 per cent of the total households. The upper lower class, the lowest class in this case, shared the highest household of tenants with 45.51 per cent, followed by the lower middle with 40.02 per cent. Both of the lower classes shared 85.53 per cent of the total household.

Table 5.4 Socio-economic Status of the Tenants

Class	Residential zones				
	Inner Core	Outer Core	Inner Periphery	Outer Periphery	Overall
Upper Middle (II)	15.79	13.60	12.38	5.47	11.81
Lower Middle (III)	46.05	51.20	38.61	24.22	40.02
Upper Lower (IV)	36.84	34.40	47.52	63.28	45.51
Lower (V)	1.32	0.80	1.49	7.03	2.66

Source: Primary data collected by the author (2021)

Figure 5.1 indicates that the spatial distribution of the social classes decreases towards the peripheral regions from the centre which means that the higher classes are

more likely to live in the more inner regions of the city and vice versa. More than 65 per cent of the lowest class are found in the outer peripheral regions and only around 10 per cent of the lowest class of households lived in the inner core and outer core region each.

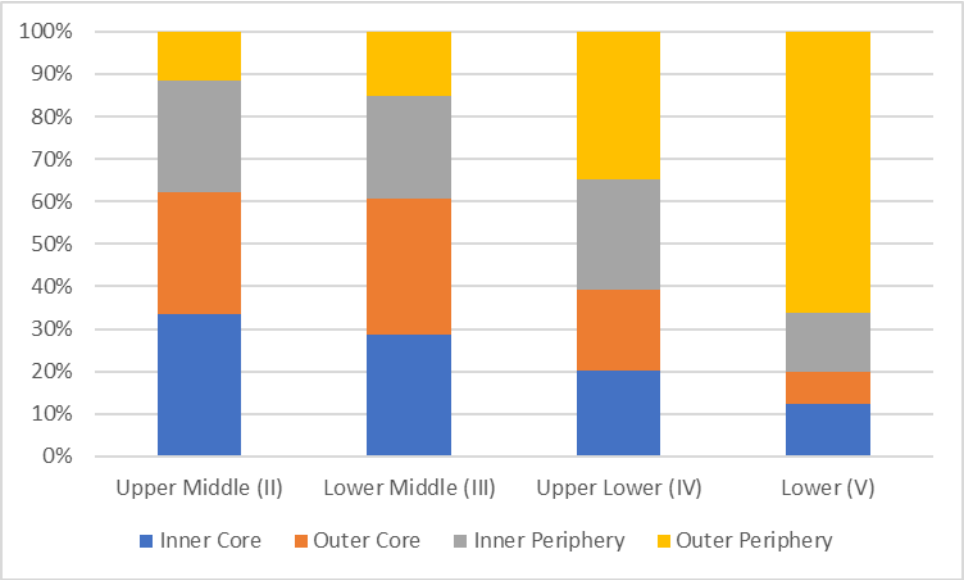


Figure 5.1 Spatial Distribution of Socioeconomic Classes

5.3.1 Tenants' Residential Differentiation

Shannon Diversity Index, Pielou's Evenness Index and Simpson Diversity Index are employed to identify the region-based residential differences in Aizawl City. In all diversity indices, the higher value indicates higher diversity or heterogeneity and vice versa. The regions that have a lower diversity index can be considered as having a higher degree of segregation. Pielou's evenness represents the ratio between the total possible outcome of the value of Shannon's Index and the calculated value of Shannon's Index.

Following Guajardo's (2015) guidelines for interpreting Simpson Diversity Index Scores, the average value of 0.568 indicates a moderate degree of residential differentiation based on the tenants' socioeconomic conditions found in Aizawl City. At a micro level, the highest degree of diversity is found in the inner core regions and then decreases outward towards the peripheral regions. The three more inner regions: inner core, outer core and inner periphery have relatively the same level of diversity and can be considered a highly moderate degree of diversity, the difference can be

negligible. Contrarily, the outer peripheral regions have a distinctive diversity index, a value of 0.447 can be considered as a significant degree of segregation, and then take the region for further study.

Table 5.5 Spatial Analysis of Residential Differentiation

Residential zone	Shannon (H')	Pielou's (j)	Simpson (D)
Inner Core	1.016	0.925	0.626
Outer Core	0.982	0.894	0.600
Inner Periphery	0.976	0.888	0.598
Outer Periphery	0.750	0.683	0.447
Overall	0.931	0.847	0.568

The lower-class tenants' households are the dominant socio-economic class found in the outer peripheral region accounting for more than two-thirds of the households (70.31%) as shown in Table 5.4. As a result, it can be said that the lower-class households were segregated in the outer peripheral regions, the outskirts of the city. The level of segregation is measured by using the simple arithmetic and percentile methods with the lower class as a reference category. As shown in Table 5.6, 34.44 per cent of middle-class and 7.78 per cent of upper-class tenants' households are found in every 100 lower-class households. Otherwise, the lower-class tenants' households are found 2.90 times more than the middle class and 12.86 times more than the upper-class among the tenants' households.

Table 5.6 Level of Segregation in Outer Peripheral Region

Class	Population (%)	C_i*100/L_T	L_T/C_i
Lower	70.31	100.00	1.00
Middle	24.22	34.44	2.90
Upper	5.47	7.78	12.86

Where $\mathbf{C_i}$ is the percentage of the i^{th} Class
$\mathbf{L_T}$ is the total percentage of the Lower Class

5.4 Tenants' Housing Affordability

According to the residual income concept, "Housing is affordable when housing of an acceptable minimum standard can be obtained and retained leaving sufficient income to meet essential non-housing expenditure" (Stephens, 2017). The

term “affordable” is a relative concept that varies from place to place and/or according to a dweller’s circumstances, making it difficult to set the standard of affordability (JLL, 2016). However, the 30-percent income standard is a widely used and accepted measure of housing affordability across countries which means that housing is affordable when the households spend no more than 30 per cent of their pre-tax income on total housing costs (Schwartz *et al*., 2016: Xiaoyu, 2017; Herbert, 2018).

5.4.1 Spatial Analysis of Rental Housing Affordability Index (HAI)

As per the findings of the present study, Aizawl, with its housing affordability index of 19 per cent, might be considered an affordable city to rent a house. As shown in Table 5.7, even though the affordability is found spatially different across the city, no region exceeded the standard criteria of the housing affordability index of a 30 per cent ratio. The highest index is found in the inner core with 21 per cent and decreases outward to peri-urban areas, the lowest is in the outer peripheral region with an 18 per cent ratio. At the household level, 13.22 per cent exceeds the 30 per cent income-to-rent ratio, and the inner core region has the highest percentage of households who rented unaffordable houses with 19.75 per cent, followed by the outer core region (13.60%).

Table 5.7 Distribution of Rental Housing Affordability Index in Aizawl City

Rent-Income Ratio	Inner Core	Outer Core	Inner Periphery	Outer Periphery	Overall
>40.1	8.64	4.80	5.66	2.24	5.07
30.1 - 40	11.11	8.80	5.66	9.70	8.15
20.1 - 30	20.99	23.20	19.81	18.66	20.47
10.1 - 20	35.80	36.80	38.68	34.33	36.78
<10	23.46	26.40	30.19	35.07	29.53
>30% Ratio	19.75	13.60	11.32	11.94	13.22
Average	21	20	19	18	19

Source: Primary data collected by the author (2021)

5.4.2 Rental Housing Affordability Index of the Socio-economic Classes

Since the Housing Affordability Index (HAI) used household income as a benchmark, the lower-income households were expected to encounter more affordability issues than the higher-income groups. Pearson’s Correlation shows a

negative relationship between household income and the Rental Housing Affordability Index. The value of Pearson's r is - 0.468 with a p-value of 0.000, indicating that an increase in household income would increase the value of the affordability index.

Table 5.8 shows the Rental Housing Affordability Index (RHAI) of different socio-economic classes of tenants. The RHAI value of the four socio-economic classes increased from the higher to the lower classes which means lower classes have higher HAI scores. The average HAI of the lower class and the upper lower class are 27 and 23 per cent ratios, while the upper middle and lower middle have average scores of 11 and 17 per cent ratios, respectively. Even though all of the averages of the classes did not exceed the minimum standard of 30 per cent, the lower classes have a significant proportion of unaffordable households. The HAI values show that the low-income population has the highest number of households that have affordability problems, with 25 per cent exceeding the minimum standard of a 30 per cent ratio, followed by the upper middle class with 20.09 per cent. While the upper middle and lower middle classes have only 3.33 and 7 per cent of households that exceeded the minimum standard of HAI.

Multinomial Logistic Regression is employed to measure the probability of the HAI of the four socio-economic classes, using the upper middle class as a reference category, the likelihood ratios of the HAI were calculated. The negative R-value shows the negative relationship between the socio-economic class and the HAI. The significance of the chi-square test suggested that the model is fit for further analysis.

The coefficient of all the dependent variables (socio-economic classes) and the independent variable (HAI score) shows a positive relationship and significance at the level of 0.000. The coefficients of the HAI indicated that the upper middle class (IV) is more likely to afford the rent than the other classes and the odds were increased from the higher class to the lower classes. The odds ratio {Exp. (B)} suggested that the lower middle, upper lower and lower classes were less likely to afford housing than the upper middle class by 1.112, 1.159 and 1.176 times respectively.

Table 5.8 Relationship between Socioeconomic Class and HAI

Class	Coefficient	Sig.	Exp(B)	Average HAI (%)	Unaffordable (%)
Upper Middle[a] (II)	-	-	-	11.00	3.33
Lower Middle (III)	0.162	0.000	1.112	17.11	7.00
Upper Lower (IV)	0.147	0.000	1.159	22.96	20.09
Lower (V)	0.106	0.000	1.176	26.96	25.00
R	-0.324	0.000			
Chi-Square	73.365	0.000			

[a] Reference category: Upper Middle (II)

5.4.3 Socio-economic Class and Housing Location

'Pearson's Correlation analysis was employed to find out the relationship between locational features like distance from the CBD and elevation with the socio-economic classes and the affordability of housing. It suggested that socio-economic class, have a significant relationship with the location of the house, while insignificant relationship with affordability. In the case of distance, the negative relationship indicated that an increase in distance from the CBD would decrease the number of higher classes. The elevation shows a positive relationship which suggests that higher elevations are more likely occupied by higher social classes. However, both of them have weak relationships, even though the relationships were significant at 0.001 level.

Table 5.9 Relationship Between the Housing Location and The Socioeconomic Class and HAI

Variables	Class	Distance	Elevation
Class	1	-.230**	.259**
Affordability	-.324**	-0.075	0.064

** Correlation is significant at the 0.01 level (2-tailed).

In the hilly city of Aizawl, the neighbourhoods that are located near the main market (CBD) and the top of the hill are the most favourable sites for living. The analysis revealed that the higher socio-economic classes are more likely to occupy those areas. The lower classes are more concentrated in the peripheral areas located on the lower fringe or slopes of the city with difficult access to the main market.

5.5 Origin of the Tenants

Studies across the world have theorized rental housing is the first entry point for migrants and is of particular importance to migrants (Mahadevia, 2011). Because of the imposition of an Inner Line Permit (ILP) for non-local people, Mizoram is one of the isolated states of India. Only10 per cent were immigrants from outside Mizoram out of which 9.58 per cent were from other states of India and 0.93 per cent from foreign countries. About 90 per cent (89.49%) are internal migrants from different parts of the state.

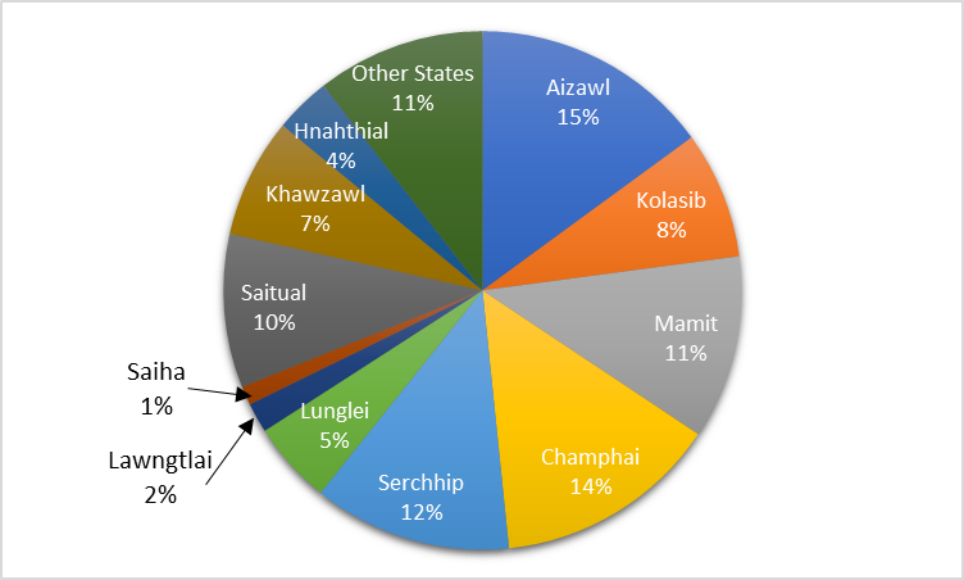


Figure 5.2 District-wise Origin of Tenants in Aizawl City

Economists estimated that around 85 per cent of the migrants could not afford to own a house and lived in rental housing (Condie, 2023). In Aizawl City, more than half of the total households live in a rental house, and the present study found that 77.98 per cent of tenants are immigrants, who are not of local origin. The spatial analysis shows that the outer core region of Aizawl City has the highest proportion (83.94%) of tenants who are immigrants, followed by the inner periphery (76.47%) and inner core (76.47%). Surprisingly, the lowest proportion is found in the outer peripheral regions comprised of 73.38 per cent. The settlement initially started from the centre and radiated outward from it, and peripheral regions are usually subjected to the city's expansion and growing places for the newer settlers. However, the migrants are generally poorer and seek better economic opportunities offered by the

services of the city. Due to the longer distance, it is difficult to access the city centre and its surrounding area from the peripheral regions, so they prefer to stay in the more inner areas of the city. Besides, several localities of the peripheral regions formerly located in rural areas, are newly adapted to the city area by the extension of the municipal regions. Those people cannot be treated as an immigrant.

5.6 Conclusion

The analysis supported the statement that 'lower-income households will tend to live in rental housing" is supported by the fact that the per-capita income of the tenants in Aizawl City is lower than the entire state of Mizoram. No upper class have been found among the tenants, most of them are in the categories of lower middle and upper lower classes. More than two-thirds of the tenants are immigrants, who originated from outside the city. Economically, more than half of the tenants are engaged in the informal economies like retail shops, carpentries, public transport and manual labour. The tenants who are engaged in formal economies are mostly non-gazetted government servants holding lower positions.

The spatial analysis revealed that the lower socio-economic classes are segregated in the peripheral regions. The average household income decreases from the core area towards the peripheral regions. However, the peripheral regions are more likely to afford their residence, and the tenants of the outer peripheral regions spend the least on rent from their income. The housing affordability Index increases from the outer peripheral regions towards the city centre. Horizontally, higher socio-economic classes are more likely to live a shorter distance from the city centre and vice versa. Vertically, higher social classes are more likely to inhabit the higher elevation and vice versa.

(a)

(b)

Figure 5.3 Informal Economic Sector (Street Vendors)

(a) Regular Street Vendors
(b) Local authority allotted road for vegetable sellers on Saturday

(a)

(b)

Figure 5.4 Informal Economic Activities

(a) Public Transportation Network (Two-Wheeler Taxi)

(b) Migrant Workers

CHAPTER – VI

SPATIAL ANALYSIS OF RENTAL HOUSING CONDITIONS IN AIZAWL CITY

6.1 Introduction

Aizawl City has been experiencing unprecedented exponential growth in population since the Independence of India leading to the increasing demand for rental housing. As per the 2011 census, 57.7 per cent of the total population lived in rented houses in Aizawl City. Not only the population pressure, but the topographic features also limit the supply of land for housing, which increases the rates of land and construction of houses. Since Aizawl is the state capital, the agglomeration of the major services in the country like administration, higher education, trade centre, health centre, etc. attracts people from every corner of the state. For such migrant people, rental housing plays an important role, it is their first entry point into the city.

With the heterogeneous nature of the population, the city provided a wide range of options for rental housing in terms of the market system or the housing conditions. Although the housing conditions hugely depend on the economy or the intention of the landlords, the locational aspect, the neighbourhood conditions and the topographic features also play a significant role. The present chapter is a descriptive analysis of the rental housing markets and examines the spatial distribution of the housing conditions in such rental housing markets in Aizawl City.

6.2 Rental Housing Market in Aizawl City

The rental housing market in Aizawl City can be categorised into two groups - private rental housing and public rental housing. The private rental housing market is run by unorganised individuals and is provided mainly for individuals or households who are settled permanently in the city. Public rental housing is an organised institutional housing market run by the government mainly for the economically backward class in the city. Under the mission of Basic Services to the Urban Poor (BSUP), the Government of Mizoram provided 1096 dwelling units free of renting cost. No institutional landlords run by private corporations exist in the city. Public rental housing may include a staff quarter which is constructed by the institution that

provides housing to staff or employees. It is mostly run by the government and provided for individuals or households who are current employees of the government.

Due to the dissimilarity in quantity and nature, the present study excluded other types of rental markets and focused only on the private residential rental housing market. The researcher witnessed that the housing market in Aizawl City is dominated by private rental housing, and when people talk about the rental housing market, they typify private rental housing. The capacity of the public rental housing run by the government is limited, only a few people can enjoy it. As a result, private rental housing became the primary concern in this study.

6.2.1 Formal and Informal Rental Housing

Private rental housing can be categorised into formal and informal rental housing. In formal rental housing, the owner and tenant make a bond with an official agreement and get it registered with the competent authority, which is the government. On the other hand, there is no registered agreement between the landlord and the tenants under informal rental. Generally, the Indian rental housing market can be regarded as informal as the tenurial agreement is made between only two parties - the landlords and the tenants. According to the National Sample Survey (NSS, 2012), only 20.25 per cent of the tenants' households who lived in urban areas had written contact agreements. The rest 79.75 per cent have a verbal agreement with the landlords.

Table 6.1 Tenurial Status of the Rental Housing Market

Agreement	India (Urban)**	Study Area*
Verbal Contract	79.75	91.07
Written Contract	20.25	8.93

**NSS Household Survey, 2012
*Primary data collected by the author (2021)

Since housing is a subject of state government in the Indian Constitution, different states implement different acts or policies for rental housing. In Mizoram, there are no guidelines or restricted laws to follow in the rental house market. The landlords have complete authority over their properties on the tenure and rate of the house in the absence of any acts or regulations. Normally, a verbal agreement is made

between landlords and the tenants in the study area, and only 8.93 per cent bonds with written contracts (see Table 6.1). Normally, the verbal agreement practice in Aizawl City contains only the rate of the houses, not including the duration of the tenure. Among the tenants who have a verbal agreement with the landlords, only 2.37 per cent have a tenure agreement.

6.3 Rental Price in Aizawl City

In Aizawl City, it has been mentioned that landlords have full authority over their rental properties, also the rental price is. Due to the absence of the rental housing act or a framework that guides homeowners towards the pricing criteria, they charged the rental amount by guessing or deciding arbitrarily or asking for charges of comparable adjoining properties without consulting the guideline.

Household rent in Aizawl City is divided into five categories as given in Table 6.2. It can be seen that about half of the households paid less than ₹5000 per month for rent, which is less than the city average. The average monthly rental price in Aizawl city is found to be ₹5334.09.

Table 6.2 Household Rent in Aizawl City

Category	House rent (in Rs.)	Percentage of household
Very high household rent	Above ₹ 10000	7.78
High household rent	₹ 7500 – ₹ 9999	8.97
Medium household rent	₹5000 – ₹7499	32.60
Low household rent	₹3000 – ₹4999	33.88
Very low household rent	Below ₹3000	16.66
Total		100.00

Source: Primary data collected by the author (2021)

Table 6.3 shows the average household rent in various localities and zones of the study area. It is found that the rental values were the highest in the inner core localities which decreased towards the peripheral regions. All six localities in the core regions exceed the average household rent of the city. Unexpectedly, Zarkawt locality in the inner core zone has the highest average household rent, many apartments are

devoted for commercial purposes. However, Electric Veng, one of the inner core localities has the lowest average household rent, only the upper part of this locality can be used for commercial purposes. The lower part is characterised by rugged topography, and most residential areas cannot be accessed by motorable roads. Moreover, the locality might be considered a transition zone where the new immigrants from neighbouring countries who have daily engagement in CBD choose to reside in this area. They are usually temporary migrant workers who can cope with the low quality of houses and single rooms.

Table 6.3 Spatial Variation in Household Rent in Aizawl City

Locality	Zone	Average Rental Price (in Rs.)	
Zarkawt	IC	8452.38	7361.78 (Inner Core)
Electric	IC	6271.19	
Chanmari	OC	7214.29	6632.59 (Outer Core)
Laipuitlang	OC	6463.16	
Khatla	OC	6612.90	
Khatla East	OC	6240.00	
Khatla South	IP	4821.43	5190.49 (Inner Periphery)
Mission Vengthlang	IP	6031.25	
Ramhlun North	IP	5280.77	
Ramhlun Venglai	IP	5510.53	
Luangmual	IP	5065.63	
Chawlhhmun	IP	4433.33	
Ramhlun Vengthar	OP	4916.13	3656.54 (Outer Periphery)
Ramhlun Sport Complex	OP	4100.00	
Tuivamit	OP	4278.26	
Tanhril	OP	2803.13	
Sakawrtuichhun	OP	2185.19	
Aizawl Average	**5334.09**		

Source: Primary data collected by the author (2021)

Except for Mission Vengthlang, all localities in the peripheral zones were found below the overall average household rent. Even though it is located in the peripheral region, Mission Vengthlang is one of the oldest and most mature residential areas with good accessibility and one of the largest schools in the country might be the reason for the high rental values. The two localities that have the lowest household rent are

located in the farthest distance from the CBD. Originally, Tanhril and Sakawrtuichhun villages were located outside the city. Even though they were merged with the city, rural community characteristics can be found in many ways. A combination of distance and less accessibility seems to lower the rental values in these outskirt localities.

6.3.1 Rental Price Change

Since more than 90 per cent of rental houses were occupied by informal renters where the landlord has full authority in his rental property, rental price may be changed by the landlord frequently. Depending on the individual landlords' intention, the frequency of change in rental price varies from one another. Among the tenants in the study area, 44.39 per cent experienced rental price changes in their current residence during their stay. The frequency of price changes is not the same for the tenants. More than half (57.43%) experienced only for the first time and 23.29 per cent had 2 times change. About 20 per cent of the tenants experienced more than 3 times price change. The mean and median of the rate of price increase are ₹ 1120.95 and ₹ 1000, respectively. But, ₹ 500 is the most frequent rate to increase the rental price in the study area.

Table 6.4 Frequency of Change in Rate of Rental Price

Number of changes	Percentage
1 time	57.43
2 times	23.29
3 times	12.05
More than 4 times	7.23

Rate of Change	Rupees
Mean	1120.95
Median	1000
Mode	500

Source: Primary data collected by the author (2021)

Residential rental demand in the major cities of India has risen by at least 10-20% compared with the pre-COVID-19 period in 2019 (Das, 2022). Increasing residential rental demand has led to a 5% increase in prices across the top eight cities during Q2 2022, according to a Colliers-CREDAI report (ibid). No research had been conducted on the rental housing market before, the rate of change in the rental price cannot be measured in Aizawl City. However, this study tried to find how the price of rentals price is changing in the study area.

Pearson's Correlation Method was employed to measure the relationship between the rate of change of the rental price, the year of renting and the frequency of rate change imposed by the landlords. The analysis revealed that the year of renting and the frequency of rental price change are unrelated, but both have a significant relationship with the rate of price changes. The rate of rental price changes and the year of renting showed a positive relationship, which means the year of renting increased, and the rate also increased. However, the relationship is weak, only 19.3 per cent of the tenants are covered. Contrarily, the frequency of the rental price changes and the price of such changes showed a negative relationship, which means the rate of change of rental price is lower for the tenants who experienced more times of rate changes. However, like years of renting, the relationship is not strong, only 22.7 per cent.

Table 6.5 Relationship between Rate Changes, Year of Renting and Frequency of Rate Changes

Correlations	Rate	Year	Frequency
Rate of Price Changes	1		
Year of renting	.193**	1	
Frequency	-.227**	0.12	1
** Correlation is significant at the 0.01 level (2-tailed).			

6.4 Forced Eviction from Rental Housing in Aizawl City

In the present context, forced eviction refers to involuntary mobility, when tenants must leave their residence against their own will by order of the landlords. Due to the absence of a tenurial agreement between tenants and landlords, 16.75 per cent of the tenants in the study area experienced forced eviction by their landlords. There are six reasons tenants experienced forced eviction that were identified in the study area. Nearly half of the tenants (48.31%) of those who experienced forced eviction were evicted due to the need for repair and reconstruction of the house. Another 37.08 per cent were evicted to make room for relatives, friends or acquaintances of the landlord. About 9 per cent of the tenants were forced out due to ownership changes, and natural disasters displaced 3.37 per cent of the tenants. Generally, it can be observed that tenants and landlords try to maintain good relationships since Mizo

society is a close-knit society. Only 2.25 per cent of the tenants were forced because of maintaining an unhealthy relationship with the landlords.

Table 6.6 Reasons for Forced Eviction from Rental House

SI. No.	Reason	Percentage
1	Reconstruction	37.08
2	Replace with other	37.08
3	Repair	11.24
4	Sell the building to other	8.99
5	Natural Disaster	3.37
6	Unhealthy Relationship	2.25

Source: Primary data collected by the author (2021)

6.5 Methods of Finding a Rental House in Aizawl City

In Mizoram, the development of registered real estate is at the beginning stage and only concentrated on purchasing or selling land or houses. Instead, individual brokers or dealers who are unrecognised by the government-run real estate business/property dealership in Mizoram. Usually, any business dealing with letting rental housing is directly done by the owners and the renters with or without brokers. The main responsibility of the broker (locally called 'commission') is to set the arrangement or meeting between the buyers or customers and sellers. They can work for both parties, finding the properties to sell or purchase. Rental house brokers were newly introduced in the year around the 2020s and used social media like Facebook and WhatsApp as their business platforms. They are smaller in number than those who work on selling or purchasing and are mostly hired by the renters. The cost of hiring is different from one person to another but usually ranges from ₹ 500 – ₹ 2000.

In the present study, the tenants' methods of finding their residence can be classified into five modes (Table 6.7). Even though five methods are identified, the first three methods are the most common in Aizawl City. Suppose a person needs a rental house, the first step is to ask his/her relatives, friends or acquaintances whether they have an available residence for rent or not. And the next step is to find randomly by themselves or through their relatives and friends. The analysis result witnessed that

these steps are applicable and useful in the present scenario. Only 2.07 per cent of the tenants found by using pre-booking methods. Usually, the pre-booking method is for the newly constructed building, and the tenants make a prior agreement of renting with the landlords during the construction. Only 0.17 per cent of tenants found their residence through brokers, who are mentioned earlier.

Table 6.7 Methods of Finding a Rental House in Aizawl City

SI. No.	Mode	Percentage
1	Contact by individual	32.99
2	Contact through a relative/friend	32.64
3	Personal relationship with landlord	32.12
4	Pre-booking	2.07
6	Contact through a broker	0.17

Source: Primary data collected by the author (2021)

6.6 Spatial Analysis of Housing Features

Housing features include not only the building characteristics but also the housing amenities and services provided by the landlords. The common indicators of housing characteristics are the type of building, floor area of the building, floor level and age of the building. The literature reviewed suggested that the availabilities of housing amenities and services are diverse across the cities, usually depending on the economic development of the country. In this study, the common household services and amenities found in Aizawl City are water and electric supply; the number of rooms, bathrooms, and availability of balcony, veranda, store room, or garage, respectively, which will be used in the further analysis.

6.6.1 Characteristics of Rented Houses

Buildings in hill areas are different from those in plain areas. Generally, the construction of buildings has to be in tandem with the direction of the hill slope so that one building comprises three levels of floor such as the ground floor, the basements and the upper floors. The ground floor and upper floors are usually of the same size, while the floor size of the basements would decrease by the slope angle. The basement floors were generally allotted to renters, while the ground floor and the upper floor

were occupied by the homeowners. For the entire city of Aizawl, 65 per cent of the ground floors were occupied by the owners (Saitluanga, 2017). The ground floors adjacent to the public road were allotted for commercial purposes in the densely populated neighbourhoods. In the study area, 63.70 per cent of tenants occupied the basement, and only 17.70 and 18.60 per cent of the ground floor and upper floor, respectively, were devoted to rent.

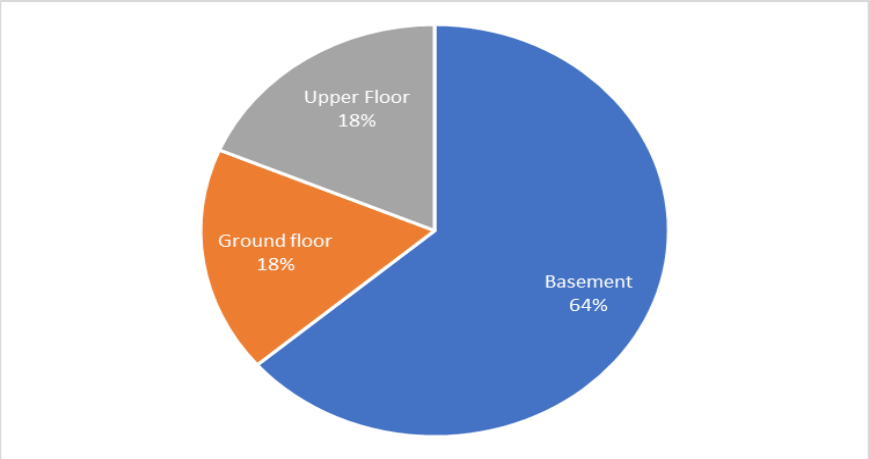


Figure 6.1 Percentage of Households Floor Level

Following the Census of India classification, a building can be categorised into three groups such as Fully concrete, Semi-concrete and Kutcha or Assam-type houses. In the study area, 78.17 per cent of the tenants lived in Fully concrete houses, while only 6.53 and 15.30 per cent of the tenants lived in Semi-concrete and Assam-type houses, respectively. The average total floor area is 713 sq. ft. which is twice larger than the national average of tenants 315.5 sq. ft. (NSSO, 2012), and the mean total floor area per person is 280.95 sq. ft. per person which is again twice larger than the national average of 115 (NSSO, 2012). The range of the area of the houses is 120 – 2880 sq. ft. and divided into five categories by using Jenks Natural Breaker which is mentioned in Table 6.8. Nearly two-thirds of the tenants (63.60%) lived in a floor area of the two smallest categories, which is less than 769 sq. ft. 22.50 per cent of the tenants lived in the medium class category of the total floor area, and only 12.30 and 1.60 per cents of the tenants lived in the category 4 and 5, respectively, which are the two largest floor area.

Table 6.8 Total Floor Area of the Tenants' Apartment

Category	Area (sq. Feet)	Percentage
1	120 – 494	34.10
2	495 – 769	29.50
3	770 – 1079	22.50
4	1080 – 1655	12.30
5	1656 – 2880	1.60

Source: Primary data collected by the author (2021)

Not only the adverse effect of accessibility but also twenty years of insurgency (1966 – 1986) experienced by the states affected the economic development which can be witnessed from the age of the construction of buildings. The majority of the concrete buildings were newly built after the insurgency and only 6.60 per cent of the rented buildings exceeded the age of 40 years. Nearly three-fourths of the rented buildings (72.90%) were less than 20 years of age, and 7.90 per cent of the tenants rented the new buildings.

Table 6.9 Age of Rented Buildings

Age of Building	Percentage
New building	7.90
1 – 10 yrs.	36.10
11 – 20 yrs.	28.90
21 – 30 yrs.	14.10
31 – 40 yrs.	6.40
41 above	6.60

Source: Primary data collected by the author (2021)

The spatial distribution of rented building characteristics is shown in Table 6.10. The average floor size decreases from the inner core towards the peripheral regions. The inner core area is a mixture of residential and commercial places. It has been mentioned that the temporary migrant workers who are mainly engaged in the nearby markets chose to live in this zone. Fully Reinforced Cement Concrete (RCC) is the top-class residential building in Aizawl City, and it can be seen that the numbers have declined outwards from the centre to the peripheral regions. More than 90 per cent of the buildings in the core area are RCC, while the peripheral region only has 59.38 per cent fully-type RCC. It is thus natural that the peripheral regions are the

preferred destinations for poorer new migrants who cannot afford to rent RCC buildings because the land values are relatively lower and available more spaces for construction than in the central areas (Saitluanga, 2017). As a consequence, the highest numbers of newly constructed rental housing are found in the peripheral regions, while the core regions have the highest number of older buildings.

Table 6.10 Characteristics of Rented Buildings across residential zones

Residential Zone	Avg. Size (sq. ft)	Percentage of rented household			
		Full RCC	Having Basement	New Building	Age (>30 yrs)
Inner Core	735.19	94.59	45.90	13.13	34.68
Outer Core	749.44	87.40	64.20	15.82	30.30
Inner Periphery	707.07	78.26	74.40	25.93	16.64
Outer Periphery	566.58	59.38	56.80	45.12	18.39

Source: Primary data collected by the author (2021)

6.6.2 Housing Amenities and Services

Housing amenities are additional features or comfort inside the building or apartments while housing services refer to the essential utility services provided by the landlords. The most common amenities found in Aizawl City are a verandah, balcony, store room and garage. The essential type of rooms found in rental apartments are a single kitchen and adjacent sitting room with or without walls, and a bedroom and bathroom. There are 7.90 and 3.80 per cent of the renters who have no separate bedrooms and single bathrooms, respectively. About half of the households (49.30%) lived in apartments with a single bedroom. Only 15.40 per cent of the renters could afford the apartments that have more than three bedrooms. Similarly, single bathroom house is the most popular and only 1.70 per cent have more than two bathrooms. Other household amenities like balconies and garages were found in only 49.80 and 29.70 per cent of rental households respectively.

Not all rental houses were endowed with equal housing amenities. The main difference is made by the number of bedrooms and bathrooms as well as the additional amenities like balconies, verandas, storerooms and garages. The quality of houses as well as households' quality of life are expected to be reflected by housing amenities.

Since the household amenities were measured by percentage, the spatial distribution of the quality of houses based on housing amenities is measured as the overall average of the said housing amenities like housing attached with two or more bedrooms and bathrooms, verandah, balcony, storeroom and garage. The result indicated that the housing amenities can be considered as equally distributed in the three more inner areas such as the inner core, the outer core and the inner periphery with an average score of 42.55, 44.87 and 42.11 percentages, respectively. However, the outer peripheral region is relatively low as compared with the other regions with an average score of 29.49. It would appear that the outer core area is the most suitable place for renting.

Table 6.11 Spatial Distribution of Housing Amenities and Services

Residential Zone	Percentage of rented households having						Overall Average
	≥ 2 Bedrooms	≥ 2 Bathrooms	Varendah	Balcony	Storeroom	Garage	
Inner Core	60.60	22.40	53.90	68.40	31.60	18.40	**42.55**
Outer Core	59.84	29.10	70.90	53.50	28.30	27.60	**44.87**
Inner Peri.	50.24	28.70	68.90	49.80	22.50	32.50	**42.11**
Outer Peri.	37.40	14.93	54.50	35.80	10.40	23.90	**29.49**

Source: Primary data collected by the author (2021)

In the case of household services, the supply of water and electricity connection for the rented households are the only found common services in rental houses. Most households can enjoy both services, but the difference is whether a single connection or a joint by two or more families. Usually, a single connection is sufficient in the case of electricity service. However, in the case of water supply, a shared connection is less preferable due to a limited supply of water. In the case of joint connection of electricity, although it is a limitless service for residential purposes, the services must be used with the intention of the other households. Less than half of the rental houses (45.40%) accessed a single connection of electricity, while nearly three-fourths of the houses (74.50%) have a single water connection.

Table 6.12 Spatial Distribution of Housing Services

Residential Zone	Percentage of rental households having	
	Single electric connection	Single Water connection
Inner Core	18.40	89.50
Outer Core	44.90	81.90
Inner Periphery	42.10	67.50
Outer Periphery	38.80	70.10

Source: Primary data collected by the author (2021)

6.7 Determining Factors for selection of rental housing in Aizawl City

Housing is heterogeneous in nature consisting of several features which have different capabilities. Depending on their conditions, the tenants were asked about the most important determining housing features for renting and the top ten housing features are mentioned in Table 6.13. Neighbourhood location is found to be the most important factor as given by 38.23 per cent of the tenants, followed by the price of renting with 20.90 per cent. Both of them combine to share more than half of the proportion (59.13%) and it can be said that they are the two most important determining factors in the selection of rental houses. Other housing features are considered less important and they can be grouped into two based on their ranks. The first group contains housing quality, internal setting, sunlight or natural light and water supply, which can be categorised as the third most important housing feature. The other group includes the age of the building, bathroom quality, motorable road distance and relationship with landlords all of which are relatively less important in comparison to other housing features.

Table 6.13 Determining Factors for Selection of Rental Housing in Aizawl City

Rank	Housing Features	Percentage
1	Neighbourhood Location	38.23
2	Rental Price	20.90
3	Housing Quality	6.97
4	Internal Setting	6.97
5	Sunlight or Natural light	6.78
6	Water Supply	6.78
7	Age of building	4.52
8	Bathroom Quantity	3.39
9	Motorable Road Distance	3.20
10	Relationship with Landlord	2.26

Source: Primary data collected by the author (2021)

Besides this, some features like distance of a school, distance of the main market, number of bedrooms and housing types have some significant contributions. Even though those features are collected from the tenants' perspectives, but are not concerned with the tenants' present housing conditions. Several tenants could not afford or achieve their ideal housing for renting.

6.8 Conclusion

An informal rental market is practised in the entire Aizawl City without involving any competing authority. Usually, no written agreement had been made between tenants and landlords regarding the tenure or the price, and landlords have full authority over their rental properties. Compared with the metropolitan cities of India, the rental houses of Aizawl City can be considered more affordable and have reasonable prices. The landlords usually provide decent housing attaching proper bathrooms and amenities like water and electric supplies. No slum area or inadequate housing have been found in the city. However, housing amenities are usually homogenous and limited, no luxurious commodities like swimming pools, heaters, elevators etc. are available in rental houses. The differences in housing quality are mostly determined by the rented prices, location, type of houses, number of bedrooms

and bathrooms, and availability of balconies. The research found that the neighbourhood location and the rented prices are the most determinant factors for the selection of rental housing in Aizawl City.

Spatially, the analysis revealed that the lowest housing quality is found in the peripheral regions of the city. The outer core area, which is adjacent to the inner core area has the highest overall average of housing amenities, followed by the inner core and the inner peripheral region. Vertically, the lower the residence have smaller the size of the area. The basement residences are usually allotted for rent, while the ground floors and the upper floors are occupied by the landlords for commercial purposes or residency.

(a)

(b)

Figure 6.2 Picturesque of House Types in Aizawl City

(a) Assam type and RCC (Reinforced Cement Concrete) Building

(b) Semi-Concrete and Assam type

(a)

(b)

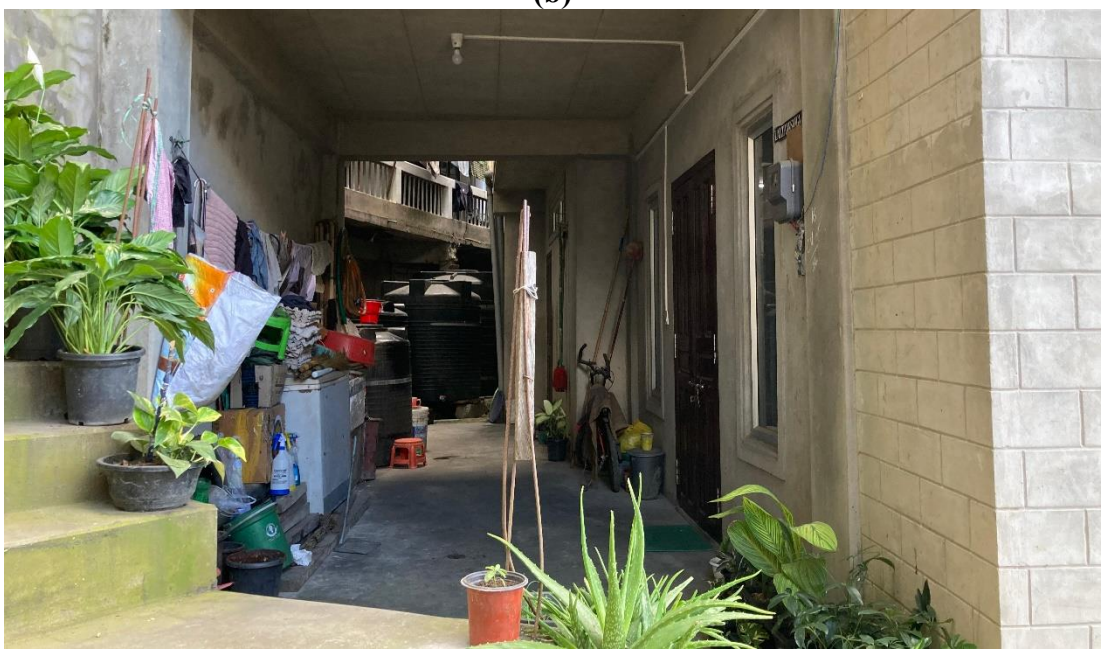


Figure 6.3 Picturesque of a typical Veranda (Housing Amenity)

(a)

(b)

Figure 6.4 Picturesque of Balconies (Housing Amenity)

(a) A standard design of balcony
(b) **Residential Buildings with balconies attached**

CHAPTER – VII

DETERMINANTS OF RENTAL VALUES IN AIZAWL CITY

7.1 Introduction

The present chapter is an analysis of the determinant of rental value in Aizawl City, Mizoram. Pearson's Correlation Coefficient method is employed to find out the relationship between the rental values and the selected determining variables of rental values. The Hedonic Pricing Model with Robust Standard Errors Method is used to estimate and predict rental value. The model takes into account geographic features like slope and elevation which have been relatively neglected in past studies. Unlike other parts of cities, the Himalayan cities are characterised by unplanned rugged topography. The influence of the topographic features cannot be neglected in this region as its impact can be observed from the evolution of settlement patterns, construction of roads and houses, accessibility, and temperature in the city.

7.2 Dimensions and Indicators of Determinants of Rental Values

A number of indicators related to housing were selected to examine the rental values in Aizawl City. The indicators selected to determine rental values are grouped into five dimensions such as structural characteristics, accessibility, topographic features, neighbourhood quality, and socio-economic characteristics. The selected variables and their scale are mentioned in Table 7.1.

Table 7.1 Dimensions and Indicators of the Determinants of Rental Values

Dimensions	Indicators	Definition of indicators	Nature
Structural Characteristics	Size	Floor area	Scale (in square feet)
	Bed R.	Number of bedrooms	Scale
	Bath R.	Number of bathrooms	Scale
	Age B.	Age of building	Categorical
	Type B.	Type of building	Dummy • 1 = Fully concrete • 0 = Otherwise
	Floor	The floor level of the house Basement or Ground floor or Upper floor	Dummy • 1 = Basement • 0 = Otherwise
	Veranda	Availability of Veranda	Dummy • 1 = Veranda

			• 0 = Not available
	Store R.	Availability of Storeroom	Dummy • 1 = Storeroom • 0 = Not available
	Balcony	Availability of Balcony	Dummy • 1 = Veranda • 0 = Not available
	Electric	Single Electric Connection	Dummy • 1 = Single Connection • 0 = Otherwise
	Water	Single Water Connection	Dummy • 1 = Single Connection • 0 = Otherwise
	Garage	Availability of Garage	Dummy • 1 = Garage • 0 = Not available
Locational (Accessibility)	Road	Attached Motorable Road	Dummy • 1 = Attach a motorable road • 0 = Not available
	Junc_10	Distance of Junction	Scale (in 10 meters)
	CBD_100	Distance of CBD	Scale (in 100 meters)
	Office	Distance of Government Offices (Treasury Square)	Scale (in meters)
	Hospital	Distance of Main Hospital	Scale (in meters)
Locational (Topographic)	Slope	Slope degree	Categorical
	Elev.	Elevation from the sea level	Categorical (in meters)
	Landslide	Landslide Susceptibility Zone	Categorical
Neighbourhood Characteristics	Zone	Neighbourhood Location (Residential Zones)	Categorical
	School_Q	Neighbourhood school quality	Categorical
	Density	Neighbourhood Population Density (No. of population/ Area (sq. km.)	Categorical
Socio-economic Characteristics	Income	Household Monthly Income	Categorical
	Migrant	Immigrant or Local people	Dummy • 1 = Immigrant • 0 = Local people
	Permanent	Permanent settlement in the neighbourhood	Dummy • 1 = Permanent • 0 = Temporary
	Fam_Size	Number of members in a family	Scale
	Children	Number of children in a family	Scale
	Motor	Having any motor vehicle	Dummy • 1 = Having vehicle • 0 = Have not
	Duration	Duration of residency	Categorical

For the analysis, three types of data such as scale, categorical and dummy variables are used (Table 7.1). Scale data are continuous data and their values are represented in an orderly manner with a meaningful metric. The categorical data are categorised with class intervals by the Jenks Natural Breaker (as discussed in the previous chapter), except for the variables 'family income' and 'duration of renting'. These two exceptional variables are normally distributed, and the class interval can be naturally done without the help of Jenks Natural Breaker. Both are divided into six categories with an interval of ₹ 20000 and 5 years and the interval ranges are up to ₹100000 above and 26 years above for 'family income' and 'duration of renting', respectively.

The variables such as the distance of junction, the distance of CBD and the elevation are taken as scale data while the neighbourhood school quality, density of the neighbourhood and household income are categorical. Between the categorical and scale data, the ones which have higher correlation have been taken for analysis (see Appendix – C). In dummy variables, the highest frequency is taken as the base category whether the variable is binary or multiple data. For example, the variable 'building type' is multiple data of three, however, the highest frequent type is fully concrete accounting for 78.17 per cent of the total house. The same case goes for the 'floor of the house' in which the basement category with the highest frequency is taken as the base category.

7.3 Descriptive Statistics

Table 7.2 shows the minimum, maximum, mean and standard deviation of the selected variables. Due to the heterogeneous scales of measurement, the variables have different values or quantities of descriptive data. The nature of the data of the selected variables are already mentioned in the above table (see Table 7.1).

Table 7.2 Descriptive Statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
Rental Price	200	15000	5083.15	2692.45
Size	120	2880	704.91	367.83
Bed R.	0	6	1.61	0.91
Bath R.	0	4	1.23	0.56
Age B.	1	6	2.95	1.29
Type B.	0	1	0.79	0.41
Floor	0	1	0.61	0.49
Veranda	0	1	0.64	0.48
Store R.	0	1	0.22	0.42
Balcony	0	1	0.50	0.50
Electric	0	1	0.45	0.50
Water	0	1	0.75	0.44
Garage	0	1	0.30	0.46
Road	0	1	0.20	0.40
Junc_10	9.04	1955.15	391.12	381.39
CBD_100	834.51	11361.15	3920.32	3133.69
Office	427.99	11522.15	3767.02	3246.84
Hospital	35.99	12010.15	3862.70	3494.24
Slope	1	6	2.81	1.22
Elev.	777	1142.5	997.12	67.95
Landslide	1	5	3.01	1.13
Zone	1	4	2.73	0.98
School_Q	1	5	2.97	1.43
Density	1	5	2.92	1.53
Income	1	6	2.41	1.32
Migrant	0	1	0.78	0.42
Permanent	0	1	0.85	0.36
Fam_Size	1	5	2.53	0.93
Children	1	4	1.92	0.74
Motor	0	1	0.69	0.46
Duration	0	6	2.94	1.38

7.4 Determinants of Rental Values in Aizawl City

The Hedonic Pricing Model is used as the base model for analysing the determinants of rental values in Aizawl City. The model has been used in previous studies to regress different housing attributes against the price to show how the change in each attribute affects the house price or rent (see Joseph, 2008). This model stems from the traditional Ordinary Least Squares (OLS) approach and has been utilized extensively in the housing market literature to investigate the factors that control house prices or rent (Selim, 2008). Based on the adopted dimensions of housing attributes (Table 7.1), the typical hedonic price equation can be written as follows:

$$Rental\ Price\ (Y_i) = \beta_o + \beta_1(Structural\ Characteristics) + \beta_2(Locational) + \beta_3(Neighbourhood\ Quality) + \beta_4(Socio-economic) + \varepsilon_i$$

7.4.1 Selection of Variables

The monthly rental price of the individual household is used as the dependent variable to represent the rental values in the study area. Before the analysis, Pearson's Correlation Method was employed to find out the relationships between the dependent variables and the independent variables (Table 7.3). It was found that out of the 30 selected variables, 21 variables were statistically significant at the level of 0.01, and only one variable was significant at the 0.05 level. However, the rest, 8 variables were statistically insignificant and then dropped from the analysis. Usually, the variables that are statistically significant meet the expected relationship with the rental price (positive or negative relationship).

7.4.2 Diagnostic of Linearity

Since linear regression is based on a parametric approach, statistical tests for the assumptions of linearity are necessary for accurate and reliable regression results. The shape of the bell curve and the P-P plot shows the normality of distributed residual (errors) data are acceptable (see Figure 7.1). Durbin-Watson Test is used to measure the autocorrelation in the model and obtained values of 1.5 to 2.5 confirmed that the residuals are uncorrelated and no autocorrelation exists in the model.

Table 7.3 Pearson's Correlation between Rental Price and Variables

Variables	Relationship (Sign)	Level of Significance
Size	Positive	0.01
Bed R.	Positive	0.01
Bath R.	Positive	0.01
Age B.	Negative	Not Significant
Type B.	Positive	0.01
Floor	Negative	0.05
Veranda	Positive	0.01
Store R.	Positive	0.01
Balcony	Positive	0.01
Electric	Positive	0.01
Water	Positive	0.01
Garage	Positive	0.01
Road	Positive	Not Significant
Junc_10	Negative	0.01
CBD_100	Negative	0.01
Office	Negative	0.01
Hospital	Negative	0.01
Slope	Positive	Not Significant
Elev.	Positive	0.01
Landslide	Negative	Not Significant
Zone	Positive	0.01
School_Q	Positive	0.01
Density	Positive	0.01
Income	Positive	0.01
Migrant	Negative	Not Significant
Permanent	Positive	Not Significant
Fam_Size	Positive	0,01
Children	Negative	Not Significant
Motor	Positive	0.01
Duration	Negative	Not Significant

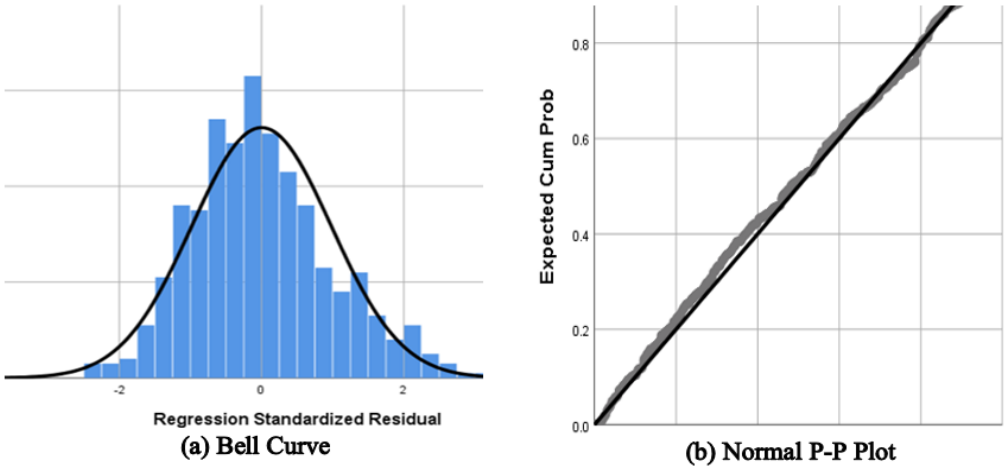


Figure 7.1 Normality of the Residuals (Errors)

Multicollinearity is the occurrence of high intercorrelations among two or more independent or predicted variables in the model. All of the selected service centres like CBD, hospitals and government offices are located in the central part of the city and their correlation exceeds 90 per cent (see Appendix – B). Thus, multicollinearity problems exist in the model which can affect the reliability of the estimate. The three variables that are related to location such as distance of CBD, civil hospital and government offices (treasury square) were not fitted in the model because their tolerance and VIF values are not sufficient enough to be accepted (Table 7.4). Consequently, three models are used to analyse the determinants of the rental price in this study. Of the variables, 18 variables that are acceptable for multicollinearity are fitted to the main model, and the distance of the three service centres and the regions are analysed in the alternate models 2 and 3.

Table 7.4 Collinearity Statistics

SI. No.	Variables	Tolerance	VIF
1	Size	0.634	1.577
2	Bedroom	0.605	1.653
3	Bathroom	0.654	1.529
4	Type of Building	0.746	1.341
5	Floor	0.900	1.111
6	Veranda	0.741	1.349
7	Storeroom	0.826	1.210
8	Balcony	0.741	1.349
9	Electric	0.741	1.350
10	Water	0.767	1.304
11	Garage	0.733	1.364
12	Junction	0.431	2.318
13	DC	0.014	70.104
14	Hospital	0.002	641.836
15	CBD	0.003	356.391
16	Elevation	0.360	2.774
17	Residential Zones	0.284	3.515
18	School quality	0.711	1.407
19	Density	0.401	2.493
20	Income	0.713	1.403
21	Member	0.853	1.172
22	Motor	0.743	1.345

The results of the Breusch-Pagan Test and F-Test for heteroskedasticity indicated that heteroskedasticity exists in the model (Table 7.5). Traditionally, the simplest way to handle heteroskedasticity is the transformation of the dependent variables into a natural logarithm. However, the scattered plot between the residuals of the log-dependent variable and independent variables showed that the log transformation model cannot reduce the heteroskedasticity problem (Figure 7.2).

Table 7.5 Homoskedasticity Test

Breusch-Pagan Test			F Test for Heteroskedasticity			
Chi-Square	**df**	**Sig.**	**F**	**df1**	**df2**	**Sig.**
24.846	1	0.00	25.385	1	512	0.00

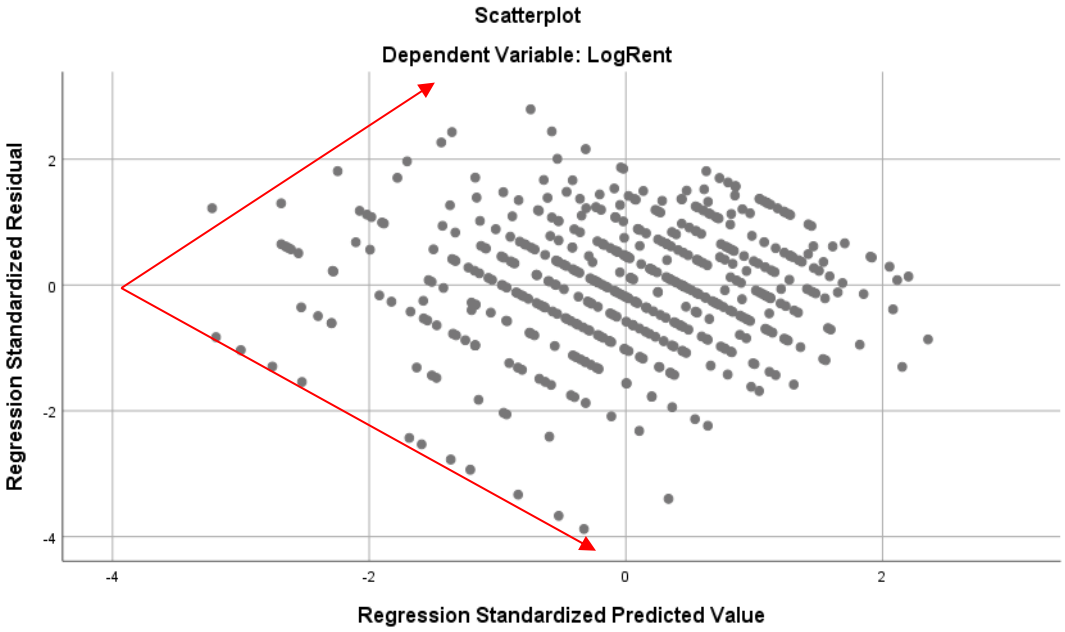


Figure 7.2 Scattered Plot for Heteroskedasticity Test

To cope with heteroskedasticity problems, Heteroskedasticity-consistent Standard Errors (HCSE) or simply Robust Standard Error is the first and most widely used method. Robust Standard Error is used when the OLS no longer produces the best linear unbiased estimators due to incorrect standard errors. It addresses the issue of computing incorrect interval estimates or incorrect values for our test statistics (Yobero, 2016). As a result, it only changed the estimated value of standard errors and the significance of the t-value and p-value, and the value of the coefficient remained the same with OLS.

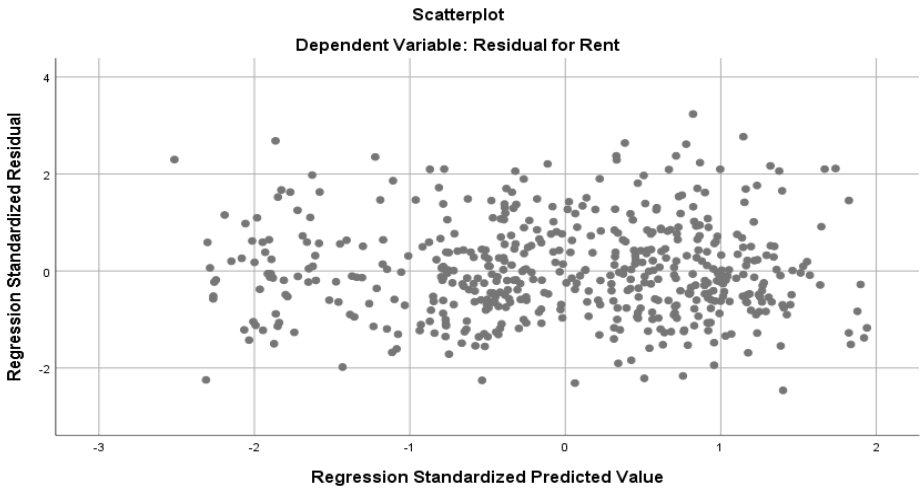


Figure 7.3 Scatter Plot of Residual Using HC3 Robust Standard Errors

After that, the vectors of the selected variables according to their dimensions are specified as follows:

$$Y_i = Rental\ Price$$

$$\text{Structural Characteristics}_i = \begin{bmatrix} \text{Floor area (Size)}_i \\ \text{Number of bedrooms}_i \\ \text{Number of bathrooms}_i \\ \text{Type of building}_i \\ \text{Floor of the house}_i \\ \text{Availability of Veranda}_i \\ \text{Availability of Storeroom}_i \\ \text{Availability of Balcony}_i \\ \text{Single Electric Connection}_i \\ \text{Single Water Connection}_i \\ \text{Availability of Garage}_i \\ \text{Attached Motorable Road}_i \end{bmatrix}$$

$$\text{Locational Characteristics}_i = \begin{bmatrix} \text{Distance of Junction}_i \\ \text{Distance of CBD}_i \\ \text{Elevation from the sea level}_i \end{bmatrix}$$

$$\text{Neighbourhood Characteristics}_i = \begin{bmatrix} \text{Core-periphery Region}_i \\ \text{Neighbourhood school quality}_i \\ \text{Population Density}_i \end{bmatrix}$$

$$\text{Socio-economic Characteristics}_i = \begin{bmatrix} \text{Household Monthly Income}_i \\ \text{Number of members in a family}_i \\ \text{Number of children in a family}_i \\ \text{Having any motor vehicle}_i \end{bmatrix}$$

7.4.3 Model Results

Using the HC3 Robust Standard Errors (HC3RSE) method, the linear and semi-log linear functional forms were employed. The F-test of the linear and log-linear regression are statistically significant at the level of 0.01 which means the two models are acceptable to predict the rental price. HC3 Robust Standard Errors (HC3RSE) was used to handle the problems of heteroskedasticity. This method produced the same coefficients of the independent variables with the traditional OLS for both linear and log-linear models, but differences in the estimated values of standard errors and the resultant ‘t-value’ and ‘p-value’ (see Appendix – D & E). It can be observed that the

standard errors of the predicted variables of the two models are changed by the HC3RSE methods, but no major changes in the significance level of the coefficient in the models. It means that the variables that are statistically significant with OLS were still statistically significant in HC3RSE methods and vice-versa. As a result, it can be said that heteroskedasticity did not cause a serious problem in the models for estimation.

In the case of the variables t-test, only half of the variables in the main model were statistically significant at the level of 0.01 (Table 7.6). The insignificant variables were then dropped from the estimation. The total R square of the linear and the log-linear models were 0.522 and 0.548, respectively, which are acceptable in social science (Ozili, 2023). The R square values show that the log-linear model provides a better explanation of the variance of the rental price than the linear model. Here, it can be seen that 54.80 per cent of the variation in the rental price is explained by the independent variables, which is higher than the linear model of 52.20 per cent.

Table 7.6 Hedonic Pricing Model Result

Predictors	Linear			Log-Linear		
	B	**t-stat**	**Sig.**	**B**	**t-stat**	**Sig.**
Intercept	-5578.46	-4.123	0.000	5.787	18.609	0.000
Size_M2	15.872	5.058	0.000	0.004	6.093	0.000
Bedroom	377.677	3.471	0.001	0.056	2.331	0.020
Bathroom	530.662	3.058	0.002	0.090	2.542	0.011
Type	805.04	4.345	0.000	0.228	4.44	0.000
Floor	-514.721	-3.341	0.001	-0.078	-2.329	0.020
Veranda	118.604	0.725	0.468	0.033	0.887	0.376
Storeroom	-293.509	-1.508	0.132	-0.065	-1.639	0.102
Balcony	27.995	0.181	0.856	0.019	0.574	0.566
Electric	-81.217	-0.527	0.599	-0.033	-0.918	0.359
Water	199.267	1.208	0.228	0.042	1.043	0.297
Garage	144.669	0.800	0.424	0.018	0.456	0.648
Junc10	-7.601	-3.463	0.001	-0.002	-4.222	0.000
Elevation	6.541	4.530	0.000	0.002	5.53	0.000
SchoolCat	233.639	4.407	0.000	0.044	3.614	0.000
DenCat	-1.691	-0.032	0.975	0.001	0.071	0.943
Income	290.66	4.094	0.000	0.056	3.888	0.000
Member	45.224	0.568	0.570	0.006	0.329	0.742
Motor	-41.013	-0.246	0.806	0.022	0.568	0.570
R^2	0.522			0.548		
Adjusted R^2	0.505			0.531		
Durbin-Watson	2.122			2.101		
F-Statistics	30.076			33.302		
F-Significance	0.000			0.000		

[a]HC3 Method

The coefficient is used to measure how much a dependent variable (rental price) changes with a unit change in each of the explanatory variables. The sign of each of the coefficients indicates the direction of the relationship between the predicted variables and the rental price. The coefficient of the size of the house has a positive sign with a value of 15.872 or 0.02 in the linear and log-linear models respectively which suggests that an increase in one unit of the size of the rental house will lead to an increase in rental price by ₹ 15.87 or 0.2 per cent. On the other hand, the floor level of the house has a negative relationship with a coefficient of -514.721 or -0.078 which suggests that the basement of the house is more likely to decrease the rental price by ₹

514.721 or 7.8 per cent than the ground floor or the upper floor. By using the coefficient of the linear model, the equation of the estimation of the rental price can be written as:

Rental Price = –5578.46 (constant) + 1.480 (size) + 377.677 (bed_R) + 530.662 (bath_R) + 805.04 (fully RCC) – 514.721 (basement) – 7.601 (junction/10 metres) + 6.541 (elevation) + 233.639 (school quality) + 290.660 (Income)

The distance of the selected household from the CBD, which is the most common indicator in real estate is taken to represent the service centres in the study area. In social science research, a low R-square is often not a problem and is acceptable, if the coefficient is significant (Ozili, 2022). Although the R-square of the linear and log-linear models are quite low at 0.170 and 0.220 respectively, they are acceptable because both are statistically significant at the level of 0.01 in both F and T statistics (Tables 7.7). The test of Durbin-Watson indicates no autocorrelations exist in the models.

Table 7.7 Coefficient of Rental Price and CBD

Predictors	**Linear**			**Log-Linear**		
	B	**t-stat**	**Sig.**	**B**	**t-stat**	**Sig.**
Intercept	5777.907	43.808	0.000	8.618	317.771	0.000
CBD	-25.45	-12.117	0.000	-0.007	-11.852	0.000
R^2	0.170			0.220		
Adjusted R^2	0.168			0.219		
Durbin-Watson	1.959			1.914		
F-Statistics	104.6			144.757		
F-Significance	0.000			0.000		

[a]HC3 Method

The negative coefficient suggested that the rental price decreases with an increase in the distance of CBD from the households (Table 7.7). The rental price will decrease by ₹ 25.45 or 0.7 per cent at every 100 metres away from the CBD.

Neighbourhood location is considered an important determinant of rental price. The four residential zones such as inner core (IC), outer core (OC), inner periphery (IP) and outer periphery (OP) were regressed with rental values by taking the inner core as a reference category. Table 5.8 shows that the significant predicted variables

had a negative relationship with the rental price which means that the rental price decreases away from the core zone towards the peripheral region of the city. The coefficients suggested that the inner periphery and outer periphery were more likely to have lower rates of rental prices at 24 per cent and 56.30 per cent as compared to the inner core area.

Table 7.8 Coefficient of Rental Price and Residential Zones

Predictors	Linear			Log-Linear		
	B	t-stat	Sig.	B	t-stat	Sig.
Intercept	5739.437	23.615	0.000	8.594	201.263	0.000
Outer Core	73.607	0.237	0.813	0.004	0.069	0.945
Inner Periphery	-1044.99	-3.668	0.000	-0.240	-4.441	0.000
Outer Periphery	-2260.21	-7.824	0.000	-0.563	-9.1	0.000
R^2	0.170			0.220		
Adjusted R^2	0.168			0.219		
Durbin-Watson	1.959			1.914		
F-Statistics	34.08			40.644		
F-Significance	0.000			0.000		

[a]HC3 Method

*Reference Category: Inner Core

7.5 Discussions

Housing is a complex commodity, its value is determined by a combination of different attributes, not only the housing features but the locational and neighbourhood characteristics. When a house is purchased or rented, those various attributes that go with the house are counted on the price, and the hedonic pricing model attempts to find out the effect of such complex attributes on the rental price. Inevitably, housing features are the most determinant factors of housing price, but the impact of locational and neighbourhood characteristics cannot be neglected. For instance, the price of two houses that have the same housing features would not be the same if their locations or neighbourhoods were different.

7.5.1 Structural Characteristics

Among the attributes in the structural features, only the housing features such as the floor area (size), number of bedrooms and bathrooms, type of the house and floor of the house were statistically significant, while the amenities and services

attributes were not fitted in the estimation model. The age of the building, floor area (size), and number of bedrooms and bathrooms are some of the most common variables in explaining rental prices or house values (Sirmans *et al*., 2005). The theoretical statement is that an increase in the floor area (size), and number of bedrooms and bathrooms would lead to an increase in rental prices. The highest purchasing or renting houses are found in the central place of the city where the buildings were built much earlier than the adjacent peripheral area. Due to the perplexity distribution, no significant relationship between the age of the buildings and the rental price was found in Aizawl City.

In the present study, three types of buildings are found, namely, fully RCC-type, semi-concrete and Assam-type. For the analysis, the type of building is represented as a dummy variable and fully RCC-type is used as a reference category.

Of all the variables, the type of house is the most effective variable to explain the rental price in Aizawl City. The coefficient suggests that 22 per cent of the rental price is contributed by the type of buildings, and housing with fully RCC-type houses are more likely to have a higher rental price than other types of buildings like Assam-type and semi-concrete at the rate of ₹ 805.04.

Though the age of the building was found insignificant in Aizawl City, the Assam-type houses are generally older and are of inferior quality as compared to other types of houses. Moreover, Assam-type and semi-concrete houses are constructed with limited resources and are usually owned and constructed by relatively poorer house owners. On the other hand, the newer constructed buildings are fully RCC-type houses that are equipped with modern facilities.

The literature reviewed witnessed that the availabilities of housing amenities and services are diverse across the cities, depending on the economic development of the country. In Aizawl City, the housing features like balconies, veranda, electric and water supply which appear to be ubiquitous in developed countries are the only amenities and services provided by the landlords in general. Furthermore, those amenities and services found insignificance in determining rental prices.

As mentioned in the previous chapter, rental housing can be divided into three categories such as the ground floor, upper floors and basement in Aizawl City. The majority of the rental houses are located in the basements, and the ground floors and upper floors are mainly occupied by the owners. Only 36.30 per cent of tenants occupied the ground floors or upper floors, and the rest, 63.70 per cent rented the basements. This kind of arrangement has not been reported by previous studies. It is mainly due to the topographic difference, most cities that existed in the literature were plain cities where the level of floor started from the ground. Calculating the purchase values of the buildings, the presence of a basement seems to be adding to the price of the house. Almost all of the literatures showed positive relationships between the basement and the house values if it is a significant variable (Sirmans *et al*., 2005). However, in the case of rental housing, the basement apartments were less desirable than the other floors. It is mainly because the basement apartments are relatively smaller in size, have less quality accessibility and one of the four sides is unable to make any windows or doors. The argument is supported by the fact that the basement apartment is more likely to decrease the rental price by 7.8 per cent in the present study.

7.5.2 Locational Characteristics

Different cities have different functions, and the locational effect on rental prices or rental values was mainly measured based on the accessibility or proximity of goods and services provided by the respective city, which means the relative locations are generally taken. Big cities have diverse services in terms of transport, business or market, employment, health, industry, entertainment, etc., and developed multiple growth points or nuclei within the cities. As a result, a number of variables have to be considered which might significantly affect house values or rental prices.

Contrarily, Aizawl City is different in this respect where the city is spread over about only 152 square kilometres. The city services can be accessed within 40 minutes from the farthest point by using public transportation. Due to limited spatial variation in accessibility, the effect of distance-related location could not be as strong as in big cities. For instance, the study by Kumar De and Vupru (2017 in Dimapur (Nagaland), part of the Himalayan city, found that the distance from the market, railway station and

workplace was not significant for determining rental price. Consequently, the locational distances of the service centres are merely found significant in Aizawl city, showing weak relationships (R2 = 0.170). As mentioned earlier, the service centres are concentrated in the core area of the city, and then the locational distance of the CBD is taken to represent the goods and services centre in the city. The coefficient suggested that only 0.7 per cent of the rental price change is affected by a change in the distance of CBD at every 100 metres. The rental price is reduced by ₹ 254.50 for every kilometre away from the city centre.

Besides the CBD, the distance of the junctions in a local area was found significant in different localities. Junction plays an important role, it serves the local people's daily necessities like groceries, vegetables etc. and acts as the public transport station. But it affects only 0.2 per cent of the rental price, and the rental price would decrease by ₹ 76.01 every 100 metres away from the junction.

Accessibility is highly influenced by topographic features. Major cities are generally developed in plain areas where different types of transportation systems can be developed, and consequently, distance-related locations play crucial role than topographic-related locations. On the contrary, the rugged terrain of the Himalayan cities permits limited transport systems pe and become the most inaccessible cities in the country. The cost, size, shape or pattern of construction of road networks hugely depends on the topographic features. Not only in road construction, but the impact of topographic features cannot be negligible in housing studies. It has a tremendous influence on the construction cost, shape and height as well as the safety precaution of the buildings.

Only a few literatures included the influence of topographic features on housing values. Trung and Quan (2019) found that the price of real estate in higher areas with fewer floods during the rainy season or natural disasters is higher than in the low-lying areas in Ho Chi Minh City. Kimani *et al*. (2021) studied the influence of slope gradient on rental prices in Nyeri Town, Kenya, and found that houses constructed on a slope of less than 15% gradient had a higher margin of rental prices than their counterpart builds in areas in relatively sloppy areas by 19 per cent.

In Aizawl City, only elevation is found to have a significant influence on rental prices in the study area as buildings located in higher elevations have higher rental prices. This is mainly because elevated areas have more advantages in terms of terrain, climate, and accessibility than low-lying areas as already discussed in the previous chapter. An increase in one unit of elevation would lead to an increase in the rental price by 6.541 units but only affected 0.2 per cent. The elevation of the selected household ranges from 777 metres to 1142.5 metres and their average is 997.12 metres from the sea level. Undoubtedly, the cost of building construction is one of the important factors for rental prices, and landlords' charges depend on their expenses, not on the slope gradient or landslide susceptibility. As a consequence of this, it appeared that slope and landslide susceptibility are found insignificant in determining rental prices.

7.5.3 Neighbourhood Characteristics

The quality or proximity of schools is expected to have a positive correlation with housing values or rental prices. However, the literature showed that the effect was not strong as compared to other housing features (Ottensmann *et al*., 2008; Bhargava, 2013; Lee, 2020). The present study found a positive relationship between neighbourhood school quality and rental prices. School quality affected rental prices by 4.4 per cent, and of the five categories of school quality, an increase in one unit will lead to an increase of ₹ 233.639 in the rental price.

It has already been discussed that rental prices and neighbourhood density have a perplexing relationship - it can be either positive and negative, or insignificant depending on the nature of cities. A high-density neighbourhood with a higher population is associated with a low quality of life, high crime rate and unemployment rate and has an adverse effect on liveability, the renting prices can be expected to be lower than other neighbourhoods. However, the better accessibility areas have a higher density of population with higher rental prices. In the present context, Aizawl City has one of the lowest population densities (2,823 per square kilometre) among the Indian cities, and population densities are evenly distributed in the city. As a result, the effect of population density on rental prices is negligible and found insignificant.

7.5.4 Socio-economic Characteristics

Many studies have carried out the significant effect of socio-economic characteristics like family size, number of children, income, poverty, number of cars and educational level on rental prices (Ruiva, 2010; Kumar De and Vupru, 2017; Onder and Turgut, 2018). In the present study, only household income is found significantly related to rental prices. Household income shared 5.6 per cent of the rental prices' changes, and households with higher income rented higher rental prices as expected. Kain and Quigley (1970) confirmed that higher-income households tend to reside the better residences. Hypothetically, the family size or the number of children in a household has a negative effect on rental prices. However, the landlords charged the rental prices based on the housing itself, not on tenants in Aizawl City which has an insignificant effect on rental prices. The garage facility was also insignificant in Aizawl rental prices. It would appear that only a small number of landlords (25.60%) provide a garage for their tenants, and most of them have charged separate prices from their rental prices.

7.6 Conclusion

The analysis revealed that structural characteristics are the most determinant factors affecting rental prices in Aizawl City. The variables such as housing types, number of bathrooms, number of bedrooms, floor levels and size have a significant impact on rental values. The locational characteristics such as distance from the services, distance from the junction, and the residential zone are also significant contributors to rental prices. The peripheral regions are more likely to have lower rental prices and vice versa, as expected. However, the influences of locational distance are hardly noticeable because the territorial extension of the city is limited. Vertically, the residences which are located at the higher elevation will tend to have higher rental prices. However, the other topographical characteristics like slope and zones of landslide susceptibility have no impact.

Due to the entire city being characterised by a low population as compared to other Indian cities, population density did not affect the rental price. While the neighbourhoods which have higher quality schools show higher rental prices. Only

household income has a significant impact on the socio-economic variables, expectedly, higher-income households rent higher rental prices.

CHAPTER – VIII

RESIDENTIAL SATISFACTION OF TENANTS IN AIZAWL CITY

8.1 Introduction

Residential satisfaction is a cognitive (behaviour) construct (Rosenberg and Hovland, 1960; Galster, 1985; Li *et al.,* 2019); and objective measurement is not able to examine and explain the psychosocial aspects of individual residential satisfaction (Mohit *et al.,* 2010). Amerigo and Aragones (1997) maintained when the individual objective attributes of the residential environment have been evaluated, they become subjective, giving rise to a certain degree of satisfaction. Thus, the objective measures of housing attributes were considered weaker predictors than the subjective measures (Francescato *et al.,* 1989; Wiedemann and Anderson, 1985). The subjective measurement appears to be more important than the objective measurement of residential satisfaction (Amole, 2009).

Following the behavioural approach, residential satisfaction varies not only in space and time but also from person to person at the same space and time depending on the mental map. Moreover, human behaviour is dynamic, and satisfaction can change through space and time. Usually, individuals or households make judgments or decisions regarding their residential conditions based on their needs and aspirations (Mohit *et al*., 2010). Galster (1987) proposed two main approaches to studying residential satisfaction – the purposive approach and the actual-aspiration gap approach. Following the actual-aspiration approach, residential satisfaction is a dynamic concept and is defined as the measures of the individual's perception of the gap between the actual conditions and their expectation of residential environments (Campbell *et al.,* 1976; Galster, 1987; Ibem and Aduwo, 2013). People subconsciously set "an ideal standard" of the various aspects of their residential condition based on their needs, experience, and aspirations (Li *et al.,* 2019). The individual household's socioeconomic attributes and lifestyle characteristics may help identify housing expectations and preferences (Gibler *et al.*, 2016). In the case of private rental housing, it appears that their rental values largely influence individual household ideal standards for their residence.

Recently, residential satisfaction has been used as one of the significant indicators of modern quality of life that has turned into a popular topic of interest in the field of urban studies and geography (Galster, 1987; Ghafourian and Hesari, 2018). The present chapter aims to analyse the spatial differentiation of residential satisfaction levels of the tenants and to find out the critical factors and the factors that determine satisfaction levels.

8.2 Dimensions and Indicators of Residential Satisfaction

An extensive literature shows studies on residential satisfaction can be categorised into three groups: firstly, residents' perspective on their residence which is mainly used for measuring the level of satisfaction; second, objective assessment of housing attributes that aims to identify the determinant factors of residential satisfaction and, lastly, based on the geographical scale as comparing the micro and macro-regions (Aulia and Ismail, 2013). Residential satisfaction is a multi-dimensional concept (Tucker and Abass, 2017); including not only the housing itself and the environment but also the neighbourhood environment and the services, locational aspect etc., which should be considered. Some studies merely focused on overall satisfaction, while others have considered satisfaction with different housing features including the neighbourhood environment (Etimani-Ghasrodahti *et al.*, 2017). Here, it is considered more appropriate to examine the level of satisfaction on differential dimensions of the residence than overall satisfaction only. Mizo society is a close-knit society; most of the landlords developed a healthy relationship with the renters. It should lead to the renter's indecisive position in rating the house where he lives. For example, when the enumerator asks to rate the level of satisfaction with their residence directly, even if they are unsatisfactory, most of the respondents hesitate to answer the reality conditions concerning their relationship with the landlord. At this moment, measuring the satisfaction level on different housing features is crucial rather than a single or overall aspect to avoid such circumstances.

In the words of Muslim *et al.* (2013), "the term 'dimensions of satisfaction' refer to the aspects, characteristics, and features of the residential environment (such as social, spatial, contextual and functional) to which the users respond concerning

satisfaction." Developing the dimensions is necessary because it would inform researchers about the critical dimensions at different levels of the environment or countries. Studies on residential satisfaction have been carried out in different fields forming different dimensions and variables. Most research focuses on the three dimensions of residential satisfaction – satisfaction with dwelling, neighbourhood, and neighbours (Buys and Miller, 2012; Tucker and Abass, 2017). The chronological development of dimensions of residential satisfaction (see Table 2.2) suggested that the variation of dimensions depends on the researcher's intentions or the study's objective, and found that dwellers' socioeconomic conditions are also commonly used dimension, but different purpose. The hypothesis states that the socioeconomic conditions of the renters can be the factors that influence the tenants' satisfaction with their residence.

The present study adopted the five dimensions including the socio-economic conditions such as dwelling characteristics, neighbourhood environment, public service and geographical attributes (Figure 8.1). Neighbourhood characteristic is divided into neighbourhood environment and public services of the neighbourhood. Studies on residential satisfaction were mostly found in plain cities where the topographic-related features were insignificant. Aizawl City, on the other hand, is characterised by rugged topography and steep slopes and is expected to have an impact on residential satisfaction.

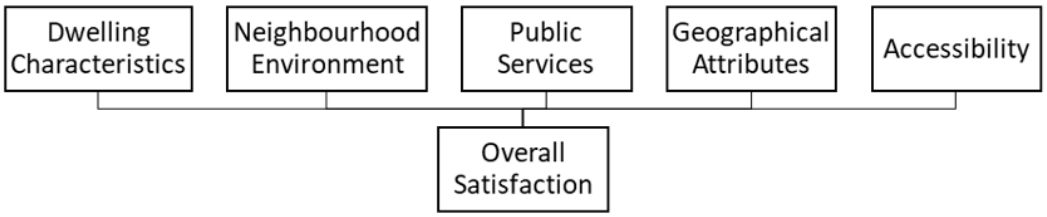


Figure 8.1 Adopted Dimensions on Residential Satisfaction

Each dimension is constituted by several variables. The present study used 27 variables or indicators from the four dimensions as given in Table 8.1. Generally, a study on residential satisfaction can be carried out by qualitative and quantitative methods. The main objective of this chapter is to analyse the spatial differentiation of residential satisfaction by measuring the satisfaction level of the different tenants'

housing features in different areas. Residential satisfaction is subjective (Chen *et al.,* 2019), and households' perceptions of their house determine satisfaction rather than the actual residential conditions (Lu, 1999; Gibler *et al.,* 2016). As a result, the data on residential satisfaction are qualitative and collected through renters' perceptions using a five-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied). The five choices provided the neutral option if the renters were neither satisfied nor dissatisfied.

Table 8.1 Dimensions and Indicators for Tenants' Residential Satisfaction

Dimensions	Code	Indicators
Dwelling characteristics	Area	Satisfaction with size of the residence
	Bed_R	Satisfaction with number of bedrooms
	Bath_R	Satisfaction with number of bathrooms
	Sitting_R	Satisfaction with number of living rooms
	Age_B	Satisfaction with age of the building
	Appr_R	Satisfaction with approach or entry road of the building
Neighbourhood Environment	Elevation	Satisfaction with elevation of house site
	Sunlight	Satisfaction with sunlight availability
	Views	Satisfaction with availability of viewpoint
	Air_Q	Satisfaction with air quality
	Cloth_D	Satisfaction with availability of cloth drying place
Public Services	Dist_Hosp	Satisfaction with accessibility of major hospital
	Dist_Police	Satisfaction with accessibility of police station
	Water_S	Satisfaction with frequency of water supply
	Elect_S	Satisfaction with frequency of electric supply
	Burglary	Satisfaction with safety of burglary
	Night_S	Satisfaction with nighttime safety
Geographical Attributes	Earthquake_S	Satisfaction with safety of house site from earthquake
	Earthquake_B	Satisfaction with safety of building from earthquake
	Landslide_S	Satisfaction with safety of house site from landslide
	Landslide_B	Satisfaction with safety of building from landslide
	Slope	Satisfaction with degree of slope of house site
Accessibility	Dist_M	Satisfaction with distance of motorable road
	Dist_Trans	Satisfaction with distance of public transport station
	Dist_Grocery	Satisfaction with distance of grocery store
	Dist_Junc	Satisfaction with distance of locality junction
	Dist_CBD	Satisfaction with distance of central business district

8.3 Descriptive Analysis

Table 8.2 shows the analysis of the tenants' satisfaction towards their rented houses. It was found that more than two-thirds of the total respondents were satisfied with their residence. Only 16.81 per cent of the tenants were found unsatisfied with

their residence and 4.18 per cent were neither satisfied nor dissatisfied. Among the five components, tenants were most satisfied with accessibility components (83.55%) while they were least satisfied with the neighbourhood environment. (72.83%).

Table 8.2 Tenants' Satisfaction with Residential Dimensions

Dimensions	Percentage of respondents				
	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Overall	5.65	11.16	4.18	49.65	29.35
Dwelling Characteristics	6.61	12.41	2.53	47.77	30.68
Neighbourhood Environment	9.13	15.11	2.94	44.69	28.14
Public Service	5.44	11.14	3.22	52.48	27.72
Geographical Attributes	2.38	7.45	10.20	49.88	30.09
Accessibility	4.70	9.72	2.02	53.45	30.10

As shown in Table 8.3, the average tenant's residential satisfaction level is 3.86 out of the 5-point Likert scale. This implies that the overall satisfaction can be considered as satisfied. Among the 27 variables, the satisfaction level is found the highest in the distance of the grocery store with a score of 4.25 followed by satisfaction with geographical attributes like elevation of house site, safety of the house site from landslide, safety of the building from the landslide with a score of 4.23, 4.16 and 4.15 respectively. Of all the indicators, 8 variables exceeded the satisfaction level of 4 out of 5. No indicators that it is less than the average (3 points) which can be regarded as the tenants' satisfaction in Aizawl City is relatively good.

The variables that are related to landslides became the higher scores among them with exceeding 4 points, which contradicted the actual conditions. The contradicted result might be the reason that tenants measured their satisfaction based on their own perception. Hmangaihzela *et al.* (2023) found that the households measured the safety level of their residence mainly based on the slope of their house site which revealed the poor awareness level of tenants on disaster management.

Meanwhile, 12 variables are placed under the average, and the variable 'satisfaction with viewpoint' scored the lowest with an average score of 3.30. Most of these indicators can be related to the construction of residences on unfavourable

topography without proper planning. The present study found that nearly two-thirds of the tenants inhabited the basement residences. With the absence of proper planning for building permits and regulations in the past, the core regions formed a compact settlement with a high density of buildings and narrow gaps or spaces between buildings which limits the sunlight visibility, viewpoint and cloth drying places for the basement dwellers. Moreover, the floor area of the basement is relatively smaller than the ground floor and upper floors due to the steep slopes resulting the limited spaces for bedrooms and bathrooms. Three indicators of accessibility also have a relationship to poor construction of road networks due to the absence of road planning.

Supply of water in hilltop settlements is difficult and expensive because gravitational force is not applicable. In addition, the unavailability of water wells and ponds creates a scarcity of water, especially during the winter dry season in Aizawl City. As a result, the number of water connections and water storage tanks largely influence the quality of the house as well as the satisfaction of the dwellers.

Table 8.3 Overall Average Score of Residential Satisfaction

Rank	Subjective attributes	Overall
1	Satisfaction with distance of grocery store	4.25
2	Satisfaction with elevation of house site	4.23
3	Satisfaction with safety of house site from landslide	4.16
4	Satisfaction with safety of house site from landslide	4.15
5	Satisfaction with frequency of electric supply	4.14
6	Satisfaction with degree of slope of house site	4.11
7	Satisfaction with distance of locality junction	4.07
8	Satisfaction with distance of motorable road	4.06
9	Satisfaction with nighttime safety	3.98
10	Satisfaction with approach or entry road of the building	3.94
11	Satisfaction with safety of burglary	3.93
12	Satisfaction with size of the residence	3.92
13	Satisfaction with distance of public transport station	3.90
14	Satisfaction with number of sitting rooms	3.89
15	Satisfaction with age of the building	3.86
16	Satisfaction with accessibility of police station	3.85
17	Satisfaction with air quality	3.74
18	Satisfaction with safety of house site from earthquake	3.74
19	Satisfaction with safety of building from earthquake	3.73
20	Satisfaction with number of bathrooms	3.70
21	Satisfaction with number of bedrooms	3.70
22	Satisfaction with frequency water supply	3.68
23	Satisfaction with sunlight availability	3.59
24	Satisfaction with accessibility of major hospital	3.56
25	Satisfaction with availability of cloth drying place	3.52
26	Satisfaction with distance of central business district	3.44
27	Satisfaction with availability of viewpoint	3.30
	Average	**3.86**

8.4 Critical Factors of Tenants' Residential Satisfaction in Aizawl City

The critical factors of tenants' residential satisfaction deal with the fact that the most determinant factors of uneven distribution of tenants' residential satisfaction. The present study employed factor analysis to find out the critical factors of Tenants' Residential Satisfaction in Aizawl City.

8.4.1 Factor Analysis of Residential Satisfaction of Tenants

Explanatory Factor Analysis (EFA) along with Principal Components Analysis (PCA) and the Varimax Rotation Method was used to reduce the variables of residential satisfaction into smaller factors and, explore the critical factors of renters'

residential satisfaction. Descriptive statistics merely measured the level or frequency of the respondents' satisfaction. Meanwhile, Factor Analysis with PCA enables us to identify which factors have a huge impact on respondents' satisfaction and measure the frequencies or degrees of the impact of those factors with the help of variance score. Moreover, it not only explores the critical factors of the respondents' residential satisfaction, but those techniques can be used to reduce the number of attributes of satisfaction into a smaller factor.

8.4.2 Factorability Tests

The computer software Statistical Package for Social Science (SPSS) was employed to run the Principal Component Analysis (PCA). The Correlation matrix (factorability of R) in Table 8.5 shows that most variables were intercorrelated and had no extreme multicollinearity. Besides, it can be identified that there are some sizable correlations (above 0.3) which signify that the data are factorable (Tabachnick and Linda, 2007; Bahati, 2018). The anti-image correlation matrix in Table 8.6 shows that all diagonal elements are high enough and the off-diagonal elements are small enough which indicates the reliability of the data. Tabachnick and Linda (2007) set a cut-off for the acceptable diagonal elements at 0.6 or more, while Brown and Onsman (2012) set it at 0.5. The KMO value of 0.804 indicates a high sampling adequacy for conducting factor analysis. Bartlett's test of sphericity was significant at a 0.05 level of significance indicating that the null hypothesis could be rejected, which means the correlation matrix is not an identity matrix (Table 8.4).

Table 8.4 Sample Adequacy Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.804
Bartlett's Test of Sphericity	Approx. Chi-Square	7557.271
	df	351
	Sig.	0

Table 8.5 Correlation Matrix of Renters' Residential Satisfaction in Aizawl City

Var.	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	X27
X1	1																										
X2	0.72	1																									
X3	0.52	0.53	1																								
X4	0.64	0.67	0.51	1																							
X5	0.32	0.35	0.37	0.37	1																						
X6	0.23	0.26	0.25	0.26	0.24	1																					
X7	0.24	0.20	0.27	0.24	0.32	0.36	1																				
X8	0.13	0.13	0.20	0.14	0.23	0.07	0.12	1																			
X9	0.17	0.15	0.22	0.14	0.27	0.10	0.10	0.88	1																		
X10	0.09	0.05	0.13	0.11	0.23	0.06	0.22	0.37	0.40	1																	
X11	0.07	0.02	0.10	0.09	0.26	0.04	0.22	0.36	0.38	0.91	1																
X12	0.08	0.06	0.11	0.09	0.27	0.01	0.21	0.40	0.36	0.71	0.76	1															
X13	0.12	0.15	0.08	0.10	0.12	0.12	0.08	0.12	0.10	0.12	0.12	0.15	1														
X14	0.19	0.25	0.17	0.14	0.19	0.08	0.11	0.13	0.14	0.08	0.09	0.14	0.40	1													
X15	0.18	0.23	0.18	0.14	0.25	0.15	0.17	0.22	0.26	0.16	0.15	0.14	0.31	0.38	1												
X16	0.17	0.21	0.18	0.17	0.23	0.13	0.18	0.13	0.14	0.16	0.15	0.11	0.43	0.38	0.32	1											
X17	0.10	0.16	0.22	0.18	0.21	0.18	0.19	0.18	0.19	0.16	0.16	0.07	0.08	0.16	0.38	0.21	1										
X18	0.08	0.18	0.19	0.19	0.19	0.10	0.20	0.20	0.16	0.16	0.18	0.17	0.09	0.23	0.27	0.15	0.76	1									
X19	0.17	0.14	0.11	0.17	0.16	0.13	0.28	0.27	0.20	0.36	0.38	0.38	0.07	0.18	0.18	0.08	0.12	0.20	1								
X20	0.16	0.11	0.12	0.21	0.18	0.07	0.21	0.12	0.11	0.21	0.23	0.22	0.01	0.06	0.10	0.12	0.11	0.13	0.32	1							
X21	0.07	0.02	-0.01	0.08	0.01	0.12	0.09	0.07	0.06	0.16	0.18	0.14	-0.07	0.06	-0.01	-0.01	0.06	0.09	0.33	0.33	1						
X22	0.13	0.10	0.06	0.16	0.19	0.20	0.15	0.12	0.11	0.29	0.33	0.26	0.03	0.15	0.11	0.08	0.12	0.16	0.46	0.47	0.58	1					
X23	0.13	0.09	0.01	0.17	0.09	0.10	0.17	0.11	0.07	0.22	0.24	0.20	-0.03	0.07	0.07	0.03	0.07	0.13	0.40	0.36	0.58	0.64	1				
X24	0.05	0.04	0.01	0.05	0.10	0.10	0.10	0.00	-0.03	0.11	0.16	0.13	-0.07	0.10	0.01	0.08	0.00	0.03	0.20	0.20	0.36	0.30	0.39	1			
X25	0.07	0.06	0.05	0.06	0.13	0.17	0.13	-0.04	-0.04	0.12	0.13	0.10	-0.04	0.06	0.01	0.06	0.02	0.03	0.15	0.23	0.25	0.32	0.34	0.67	1		
X26	0.09	0.04	0.04	0.07	0.18	0.13	0.22	0.04	0.06	0.17	0.21	0.14	-0.03	0.01	0.03	0.02	0.01	0.00	0.17	0.31	0.32	0.34	0.38	0.57	0.60	1	
X27	0.21	0.18	0.18	0.26	0.19	0.18	0.21	0.23	0.27	0.31	0.32	0.31	0.11	0.19	0.25	0.14	0.21	0.23	0.36	0.29	0.30	0.38	0.36	0.25	0.24	0.32	1

Var. = Variables, X1 = Area, X2 = Bed_R, X3 = Bath_R, X4 = Sitting_R, X5 = Age_B, X6 = Water_S, X7 = Elect_S, X8 = Earthquake_S, X9 = Earthquake_B, X10 = Landslide_S, X11 = Landslide_B, X12 = Slope, X13 = Sunlight, X14 = View, X15 = Air_Q, X16 = Cloth_D, X17 = Burglary, X18 = Night_S, X19 = Elevation, X20 = Dist_M, X21 = Dist_Trans, X22 = Dist_Grocery, X23 = Dist_Junc, X24 = Dist_CBD, X25 = Dist_Hosp, X26 = Dist_Police, X27 = Appr_R

Table 8.6 Anti-image of Correlation Matrix of Renters' Residential Satisfaction in Aizawl City

Vr.	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	X27
X1	0.84																										
X2	-0.46	0.82																									
X3	-0.17	-0.14	0.92																								
X4	-0.25	-0.33	-0.15	0.87																							
X5	0.00	-0.06	-0.12	-0.13	0.90																						
X6	0.03	-0.08	-0.05	-0.06	-0.06	0.78																					
X7	-0.07	0.07	-0.10	0.01	-0.15	-0.29	0.82																				
X8	0.06	0.02	-0.03	-0.06	0.06	0.02	-0.04	0.67																			
X9	-0.07	-0.02	-0.03	0.08	-0.11	-0.05	0.09	-0.85	0.67																		
X10	0.01	-0.02	-0.05	-0.02	0.07	-0.02	-0.03	0.02	-0.07	0.78																	
X11	-0.01	0.07	0.03	-0.01	-0.05	0.04	-0.01	0.07	-0.07	-0.79	0.75																
X12	0.00	-0.03	0.01	0.05	-0.13	0.06	-0.03	-0.20	0.12	-0.07	-0.36	0.87															
X13	-0.02	-0.01	0.05	-0.01	0.04	-0.10	0.04	-0.06	0.08	-0.01	0.00	-0.08	0.74														
X14	-0.02	-0.09	-0.04	0.06	-0.03	0.07	0.00	0.04	-0.04	0.06	0.00	-0.03	-0.25	0.79													
X15	0.00	-0.08	0.03	0.07	-0.07	-0.01	-0.03	0.06	-0.11	0.00	0.02	-0.01	-0.14	-0.20	0.85												
X16	0.01	-0.02	-0.02	-0.02	-0.08	0.01	-0.08	-0.02	0.01	-0.06	0.00	0.07	-0.31	-0.19	-0.08	0.82											
X17	-0.02	0.06	-0.07	0.01	-0.04	-0.10	0.01	0.01	-0.03	-0.01	-0.08	0.18	0.05	0.11	-0.27	-0.10	0.63										
X18	0.12	-0.10	0.01	-0.06	0.01	0.08	-0.07	-0.07	0.07	0.02	0.03	-0.13	0.00	-0.16	0.10	0.07	-0.74	0.65									
X19	-0.03	-0.04	0.02	0.03	0.04	0.00	-0.16	-0.16	0.12	-0.04	-0.02	-0.07	0.02	-0.06	-0.07	0.06	0.07	-0.06	0.91								
X20	-0.03	0.05	-0.02	-0.10	-0.01	0.11	-0.08	-0.01	0.01	0.00	0.03	-0.07	0.04	0.06	-0.02	-0.10	-0.01	-0.01	-0.08	0.89							
X21	-0.03	0.04	0.01	0.01	0.11	-0.05	0.02	0.03	-0.04	-0.02	0.05	-0.03	0.05	-0.03	0.08	0.02	-0.06	0.03	-0.04	-0.06	0.85						
X22	0.00	0.01	0.03	0.03	-0.12	-0.16	0.13	0.03	0.01	0.03	-0.12	0.06	-0.01	-0.09	0.01	0.02	0.01	-0.03	-0.19	-0.25	-0.29	0.84					
X23	-0.03	-0.02	0.08	-0.07	0.05	0.08	-0.07	-0.07	0.06	-0.01	0.01	0.02	0.02	0.06	-0.03	0.00	0.04	-0.04	-0.08	0.01	-0.27	-0.35	0.88				
X24	0.03	-0.03	0.01	0.02	-0.02	-0.01	0.07	-0.05	0.07	0.09	-0.09	-0.01	0.11	-0.08	0.01	-0.10	0.04	-0.02	-0.06	0.05	-0.17	0.10	-0.10	0.78			
X25	-0.01	-0.01	-0.02	0.03	0.00	-0.10	0.02	0.02	0.03	-0.08	0.08	-0.03	0.02	-0.02	0.03	-0.01	-0.02	0.01	0.04	-0.03	0.12	-0.11	-0.04	-0.48	0.78		
X26	-0.02	0.00	0.02	0.04	-0.09	0.04	-0.15	0.03	-0.05	0.03	-0.07	0.07	-0.06	0.08	0.00	0.08	0.01	0.05	0.08	-0.13	-0.06	-0.01	-0.06	-0.24	-0.33	0.84	-
X27	-0.02	0.05	-0.03	-0.13	0.07	-0.05	0.01	0.09	-0.14	-0.01	0.01	-0.10	-0.03	-0.04	-0.10	0.00	-0.03	-0.04	-0.12	-0.03	-0.05	-0.05	-0.07	-0.03	-0.02	-0.14	0.93

Var. = Variables, X1 = Area, X2 = Bed_R, X3 = Bath_R, X4 = Sitting_R, X5 = Age_B, X6 = Water_S, X7 = Elect_S, X8 = Earthquake_S, X9 = Earthquake_B, X10 = Landslide_S, X11 = Landslide_B, X12 = Slope, X13 = Sunlight, X14 = View, X15 = Air_Q, X16 = Cloth_D, X17 = Burglary, X18 = Night_Safety, X19 = Elevation, X20 = Dist_M, X21 = Dist_Trans, X22 = Dist_Grocery, X23 = Dist_Junc, X24 = Dist_CBD, X25 = Dist_Hosp, X26 = Dist_Police, X27 = Appr_R

As shown in Table 8.8, all the communalities of the selected variables exceed the value of 0.20 which indicates that the variables were fitted for further analysis. The component correlation matrix as shown in Table 8.7 shows that no factor correlation did not exceed 0.32 which suggests that the factors can be considered uncorrelated, and then orthogonal rotation must be used. Following Tabachnick and Linda's (2007) suggestion, the varimax rotation, which is the most common method in orthogonal rotation, has been used in this analysis. Varimax rotation generally tries to maximise the number of variables with high loadings on each factor and works to make small loadings even smaller (Yong and Pierce, 2013).

Table 8.7 Component Correlation Matrix

Component	1	2	3	4	5
1	1	0.143	0.149	0.205	0.17
2	0.143	1	0.018	0.088	0.001
3	0.149	0.018	1	0.118	0.234
4	0.205	0.088	0.118	1	0.105
5	0.17	0.001	0.234	0.105	1
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.					

8.4.3 Factor Loadings

Out of 27 variables, four items such as 'satisfaction with frequency water supply', 'satisfaction with frequency electric supply', 'satisfaction with elevation of house site', and 'satisfaction with approach or entry road of the building' were removed because of insufficient cross-loading (Appendix – F). However, the variable 'air quality' is accepted even though it seems to have cross-loading. Sürücü *et al.* (2022) suggest that even if the variables show cross-loading; the higher load is under the correct or appropriate factor and if there is a difference of 0.1 or more between the cross-loads, the loading can be accepted. After factorability tests, the factor loadings were extracted by running the PCA using SPSS (Table 8.8).

Table 8.8 Rotated factor loadings and communalities of significant variables for residential satisfaction of renters in Aizawl city

Satisfaction Variables	Component					Commun-alities (h^2)
	1	2	3	4	5	
Distance of motorable road	**0.513**	0.171	0.167	-0.02	0.146	0.342
Distance of public transport station	**0.658**	0.075	-0.01	-0.123	0.161	0.479
Distance of grocery store	**0.707**	0.166	0.03	0.017	0.209	0.572
Distance of locality junction	**0.725**	0.092	0.028	-0.054	0.163	0.565
Distance of CBD	**0.742**	-0.024	0.007	0.109	-0.148	0.584
Hospital accessibility	**0.726**	-0.051	0.047	0.112	-0.164	0.571
Police station accessibility	**0.718**	0.064	0.058	0.035	-0.153	0.547
Safety from the earthquake (house site)	-0.077	**0.704**	0.17	0.037	0.188	0.567
Safety from the earthquake (building)	-0.089	**0.708**	0.2	0.05	0.174	0.581
Safety from the Landslide (house site)	0.2	**0.844**	0.01	0.091	-0.003	0.761
Safety from the Landslide (building)	0.245	**0.848**	-0.023	0.098	0	0.789
Slope degree	0.186	**0.797**	0.009	0.118	-0.04	0.686
Size of the residence	0.078	0.033	**0.848**	0.091	-0.037	0.737
No. of bedrooms	0.031	-0.017	**0.852**	0.163	0.054	0.756
No. of bathrooms	-0.025	0.119	**0.735**	0.067	0.115	0.573
No. of sitting rooms	0.099	0.043	**0.828**	0.03	0.091	0.706
Age of the building	0.135	0.275	**0.478**	0.208	0.084	0.372
Sunlight availability	-0.085	0.099	0.032	**0.762**	-0.048	0.601
Viewpoint	0.074	0.029	0.133	**0.717**	0.125	0.554
Air quality	-0.004	0.144	0.141	**0.565**	0.358	0.488
Cloth drying place	0.049	0.089	0.144	**0.717**	0.067	0.550
Burglary	0.045	0.087	0.113	0.157	**0.869**	0.802
Nighttime Safety	0.081	0.11	0.098	0.138	**0.852**	0.773
Explain variance (Eigenvalue)	5.093	3.131	2.492	1.759	1.481	
% of the explained variance	22.145	13.614	10.834	7.647	6.437	
Total Explained Variance	13.956					
% of the total explained variance	60.677					

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
[a] Rotation converged in 5 iterations.

8.4.4 Interpretation of Factor Loadings

Using PCA, five factors were extracted from 23 variables which altogether explained 60.67 per cent of the total variance. There are no rules for naming factors, but it depends on the researcher himself. However, the researcher must consider the best representation of the variables within the factors for naming the factor. The five components were labelled as accessibility, geo-hazards, dwelling characteristics, neighbourhood environment and neighbourhood safety.

1) Factor 1: Accessibility

The first component consists of 7 variables such as 'satisfaction with distance of motorable road', 'satisfaction with distance of public transport station', 'satisfaction with distance of grocery store', 'satisfaction with distance of locality junction', 'satisfaction with distance of Central Business District (CBD)', 'satisfaction with hospital accessibility', 'satisfaction with police station accessibility'. All of these variables are related to the accessibility of crucial locations and 'Accessibility' seems to be the appropriate component name. The component shares 22.14 per cent of the total explained variance and became the most important factor for the tenants' residential satisfaction in Aizawl City.

Accessibility is an important part of urban geography in general and housing studies in particular; and is linked with an array of economic and social opportunities. Access to people, goods, services, and information is the basis of economic and social development in cities. More efficient accessibility results in greater economic benefits through economies of scale, agglomeration effects, and networking advantages.

Urban mobility in hill cities is a major challenge where the solutions become very limited due to its topography and climate (Susngi and Sadhukhan, 2020). The terrain and topography hardly permit transport networks other than roads. Road networks are also winding and narrow due to the steep slope of the terrain. Aizawl City is also one of the least inaccessible cities in the country due to the combination of different factors like the absence of land-use planning, an enormous increase of motor vehicles, narrow roads, and maximum utilisation of space along the prominent transport route (Saitluanga, 2017). Irregular terrain causes intra-urban variation in the

level of accessibility. Usually, the best location is located in the most accessible site. Spatial variation in accessibility makes a variation in the level of residential satisfaction. Consequently, accessibility plays a major crucial factor in the tenants' residential satisfaction. Almost all of the important services are concentrated in the city centre and along the major roads, the neighbourhoods which are located at the centre and its adjacent area, along with the major roads could enjoy more services than the peri-urban area.

2) Factor 2: Geo-Hazards

The second component is named 'geo-hazard' and consists of variables that are related to the vulnerability of geographic-related hazards like 'satisfaction with safety of house site from the earthquake', 'satisfaction with safety of building from the earthquake', 'satisfaction with safety of house site from Landslide', 'satisfaction with safety of building from Landslide', and 'satisfaction with degree of house site'. It is the second most important factor for satisfying the renters about their residence with a total explained variance of 13.614 per cent.

Aizawl City is prone to natural disasters like earthquakes and landslides. It falls under 'seismic zone V', the highest zone for earthquakes. Due to its topographic nature as well as its monsoon climate, the state experience landslide frequently during rainy seasons. As per the Disaster Management and Rehabilitation Report 2013 – 2020, Mizoram lost 1572 houses with 68 lives because of landslides. Poor land use policies and poor construction practices exacerbate the hazard which makes Aizawl city extremely high levels of risk of earthquakes and landslides. So, unlike other plain cities, the safety of the building and building sites from geographical-related hazards and disasters became the second most important factor for the tenants' satisfaction in Aizawl City.

3) Factor 3: Dwelling Characteristics

Unexpectedly, the dwelling characteristics component is placed in the third position with a total explained variables of 10.837 per cent. The variables like 'satisfaction with size of the residence', 'satisfaction with number of bedrooms', 'satisfaction with number of bathrooms', 'satisfaction with number of sitting rooms',

and ‘satisfaction with building age’ signify the quality or characters of the dwelling and are named dwelling characteristics.

Though different landlords provide different quality of houses in terms of size, the number of rooms and bathrooms, location, etc., tenants choose their residents voluntarily depending on their capital. It is obvious that tenants measured their satisfaction level based on the rental price which might be the reasons why it became the third most important component after accessibility and geo-hazards.

4) Factor 4: Neighbourhood Environment

The fourth component is the residents’ environment consists of variables like satisfaction with sunlight availability, ‘satisfaction with availability of viewpoint’, ‘satisfaction with air quality’, and ‘satisfaction with availability of cloth drying place’ with a total variance explained of 7.647 per cent. Residents or neighbourhood environment is one of the most important factors for residential satisfaction in other cities (Muslim *et al.*, 2013; Addae-Dapaah and Juan, 2014; Huang and Du, 2015). However, Aizawl is characterised by one of the best environmental qualities in the country. As per Mizoram Pollution Control Board Report 2017-2018, the average Air Quality Index of Aizawl is only 55.25 which is very good compared to other cities. No heavy industrial places which emit enormous pollution have been found. Moreover, greenery is considered as usual because the state has the highest forest covering area in India in terms of percentage. As a result, most people are not concerned about the environmental quality in their daily lives and never experienced environmental problems. Then, the neighbourhood environment becomes one of the least important components for tenants’ residential satisfaction.

5) Factor 5: Neighbourhood Safety

The fifth component consists of two variables such as ‘satisfaction with safety of burglary’ and ‘satisfaction with nighttime safety’ of the neighbourhood with 6.537 per cent of the total variance explained. Mizoram is one of the most peaceful states in India. As per the National Crime Records Bureau Report 2021, the crime rate of Mizoram is only 262.2 (crime incidence at 100,000 population) which is below the national average of 445.9. There are 3196 times crime incidences happened in

Mizoram which is 0.052 per cent of the total crime incidences in the country. The crime density (crime/100 sq. km.) is only 15.16, far below the national average i.e., 185.45. Combined with strong support from Non-Governmental Organisations (NGOs), the government of Mizoram has enough strength and resources to maintain peace in the state. As per the Ministry of Home Affairs Report 2021, the police population ratio in Mizoram is 674.54 which is higher than the national average i.e., 155.78 police per lakh of population. Moreover, the state government prohibited liquor for citizens, and people in Aizawl City experienced quiet and peaceful nights. As a result, tenants did not care much about neighbourhood safety for their residences.

8.5 Spatial Analysis of Intra-urban Residential Satisfaction of Renters in Aizawl City

Most of the studies on residential satisfaction were conducted to find out the important factors of residents' satisfaction and the factors that determined their residential satisfaction (Amerigo and Aragones, 1990; Amole, 2009; Mohit *et al.,* 2010; Temelova and Dvorakova, 2012; Byun and Ha, 2016; Gan *et al.,* 2019). Only a few studies were carried out to analyse spatial variation of residential satisfaction based on the geographical area (Savasdisara *et al.,* 1989; Tucker and Abass, 2017; Yin, *et al.,* 2018). The present study tries to find out the relationship between the tenants' satisfaction and the spatial distribution of the tenants' residences and measures the area-based satisfaction level based on the selected localities.

8.5.1 Residential Satisfaction Index

Residential satisfaction is a multi-dimensional concept involving different variables. Each variable has different weights on tenants' residential satisfaction which can be witnessed from the PCA analysis. Consideration of the weight of each factor or component is crucial because the same indicator may have different meanings from respondent to respondent. For instance, the indicator 'distance of CBD' has different meanings between those who live near the CBD and in the city's periphery. To avoid such confusion, the present study proposed a residential satisfaction index to produce the individual household's satisfaction score as well as the locality while considering the factors' weights.

The Residential Satisfaction Index of Tenant's Households (RSI_h) was calculated by using the percentage of factor variance explained and the factor score coefficient (the detailed methodology was discussed in Chapter 3, Section 3.4.9). After that, the Residential Satisfaction Index of Locality-based (RSI_l) was extracted by taking the average tenants' RSI_h of the respective locality. The final score of the tenants' satisfaction level is mentioned in the following table (Table 8.9).

Table 8.9 Level of Residential Satisfaction (Locality-wise)

Rank	Locality	RSI_l	$RSI_l(S)$
1	Zarkawt	0.289	100
2	Chanmari	0.256	94.21
3	Electric Veng	0.250	93.13
4	Chawlhhmun	0.086	63.98
5	Ramhlun North	0.060	59.36
6	Ramhlun Venglai	0.053	58.10
7	Luangmual	0.051	57.79
8	Ramhlun Vengthar	0.023	52.81
9	Laipuitlang	-0.054	39.07
10	Khatla East	-0.079	34.64
11	Khatla	-0.120	27.38
12	Mission Vegthlang	-0.126	26.13
13	Tuivamit	-0.138	24.21
14	Khatla South	-0.143	23.15
15	Ramhlun sport complex	-0.153	21.50
16	Sakawrtuichhun	-0.263	2.02
17	Tanhril	-0.273	0

8.5.2. Zoning of Tenants' Residential Satisfaction in Aizawl City

Jenks Natural Break in ArcGIS is employed to divide the study area into five zones - zone of very high satisfaction, zone of high satisfaction, zone of medium satisfaction, zone of low satisfaction and zone of very low satisfaction as shown in Figure 8.3.

The zone of very high satisfaction comprises the neighbourhoods located at the core region around the Central Business District (CBD). Most of the neighbourhoods in this zone are located at the crest of the main ridge of the city where the slopes are

gentle. The most crucial transport route in the city runs through these neighbourhoods north–south direction, and major public transportation routes from different directions run towards the core, which is why the region is the most accessible zone in the city. Like other cities, the CBD is the commercial centre, and essential services like the supermarket (bazaar), hospital, police station, public transportation centre etc., agglomerate in this region. Naturally, the land value declined outward from the CBD as envisaged by distance-decay theory (Alonso, 1964), which makes the CBD area the highest rental value area. However, the quality of accessibility and topographic settings beat the rental values, and the zones became the highest residential satisfaction zones in the city.

The second-highest zone of satisfaction comprised five localities including three localities from the northeastern part such as Ramhlun North, Ramhlun Venglai and Ramhlun Vengthar and two localities from the western part such as Chawlhhmun and Luangmual. All these neighbourhoods except Ramhlun Vengthar are located in the inner-peripheral zone, which lies between the core and outer-periphery. This zone is characterised by middle-class residences and moderate rental prices. Besides this, the researcher observed that this zone has a better advantage in noise pollution, privacy, social environment, road quality, and sparse density of buildings as compared to the other regions.

The third zone is the ‘Zone of moderate satisfaction’ and the localities which located at the outer core residential zones. It comprises two localities from the north and south flanks of the core such as Laipuitlang and Khatla East, respectively. This zone is a transitional zone between the core and the peripheral regions. Because of the transitional place, these two neighbourhoods are neither close enough to enjoy the services of the city centre nor the lower rental prices of the periphery which makes them lower satisfaction level than the other areas. Furthermore, the steepest slopes and the recent experience of landslides might have a significant impact on satisfaction levels in the Laipuitlang locality.

Except for Khatla, all localities belonging to the low satisfaction zone are found in the peripheral region. This zone is the preferred destination for poorer migrants. The

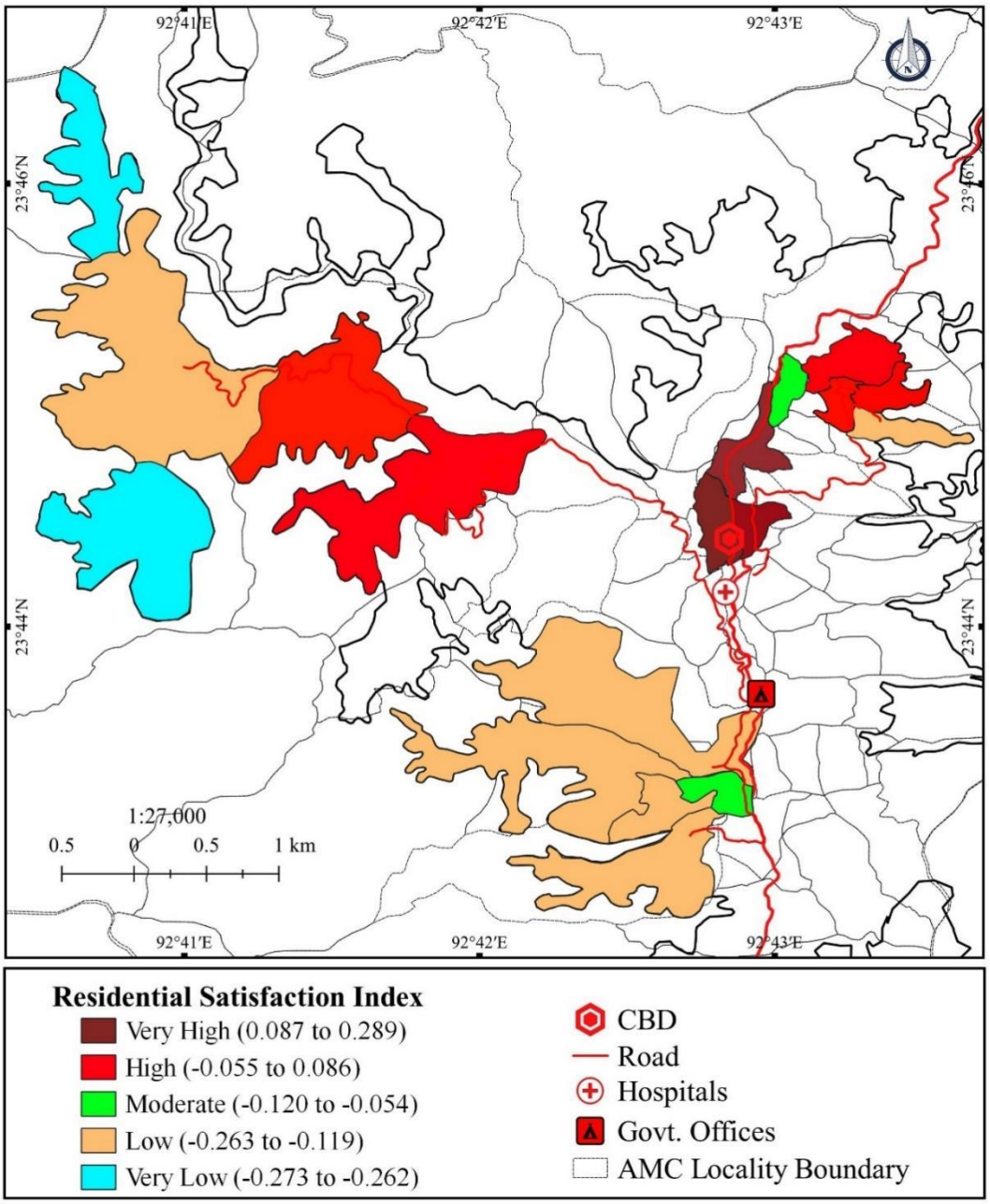


Figure 8.2 Zones of Tenants' Residential Satisfaction Level

land and rent values are relatively low, and the quality of houses is relatively poor. Due to more available spaces for housing construction, the slopes are generally safe compared to other parts of cities. However, a greater distance that makes access to the most important public services might be the reason for lower satisfaction levels.

Unsurprisingly, the farthest localities Sakawrtuichhun and Tanhril are placed in the lowest satisfaction zones. They are newly adopted as municipal areas and still have rural characteristics in social, economic, demographic and even residential.

8.6 Factors that Determined Residential Satisfaction in Aizawl City

Since satisfaction is a subjective concept and depends on the personal perspective environment, the present study employed Pearson's Correlation Method was employed to measure the relationship between the locality satisfaction level and their residential objective attributes such as housing features, neighbourhoods' environment and socioeconomic conditions. The 'RSI_l' was used to represent the locality's residential satisfaction level.

Among the 28 variables, 12 variables have a significant relationship with the neighbourhood tenants' satisfaction level and the sign of all correlations meet the expectation, except rental prices (Table 8.10). The localities which have the following attributes – higher rental prices, availability of single water connection and storerooms have higher tenants' satisfaction levels. Other variables like distance of locality main junctions, government offices, hospitals and CBD have an inverse relationship with satisfaction levels which indicates that the tenant satisfaction level decreases with increasing distance from the said important public points. It is also observed that localities that are located at a higher elevation have higher tenant satisfaction, while those that are located in higher landslide susceptibility areas have lower levels of tenant satisfaction. It is also found that educational level, income and duration of stay have positive relationships with level of satisfaction.

Table 8.10 Factors that Determined Tenants' Residential Satisfaction

Housing Features		Neighbourhood Environment		Socioeconomic Conditions	
Rental Price	.691**	Motorable Road	NS	Age (resp.)	NS
Floor Area	NS	Distance Junction	-.540*	Sex (resp.)	NS
Building Age	NS	Distance of Treasury Square	-.528*	Edu. Qual. (resp.)	.545*
No. of Bedrooms	NS	Distance Hospital	-.629**	Family Income	.594*
No. of Bathrooms	NS	Distance CBD	-.656**	Duration of Staying	.634**
Water Connection	.547*	Slope gradient	NS	Member	NS
Electric Connection	NS	Landslide Suscept.	-.494*	Immigrant	NS
Floor Level	NS	Elevation	.522*		
Availability of Veranda	NS	School Quality	NS		
Availability of Storeroom	.544*	Density	NS		
Availability of Balcony	NS				

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
NS - Correlation is not Significant

8.7 Conclusions

Even though the level of tenants' residential satisfaction in Aizawl City exceeds the average and can be considered as 'satisfied', the score of 3.86 out of 5 cleared that there's still much room for improvement. The indicators that have lower satisfaction levels are associated with the absence of implementing rules and regulations of town planning in the past. The analysis revealed that accessibility is the most critical factor that determines the variation in tenants' satisfaction, followed by geographical hazards.

Spatially, the level of satisfaction was found highest in the central part of the city and the lowest in the outer peripheral zones of residency. Surprisingly, the level of the inner peripheral zone is higher than the outer core zone and becomes the second-highest satisfaction zone.

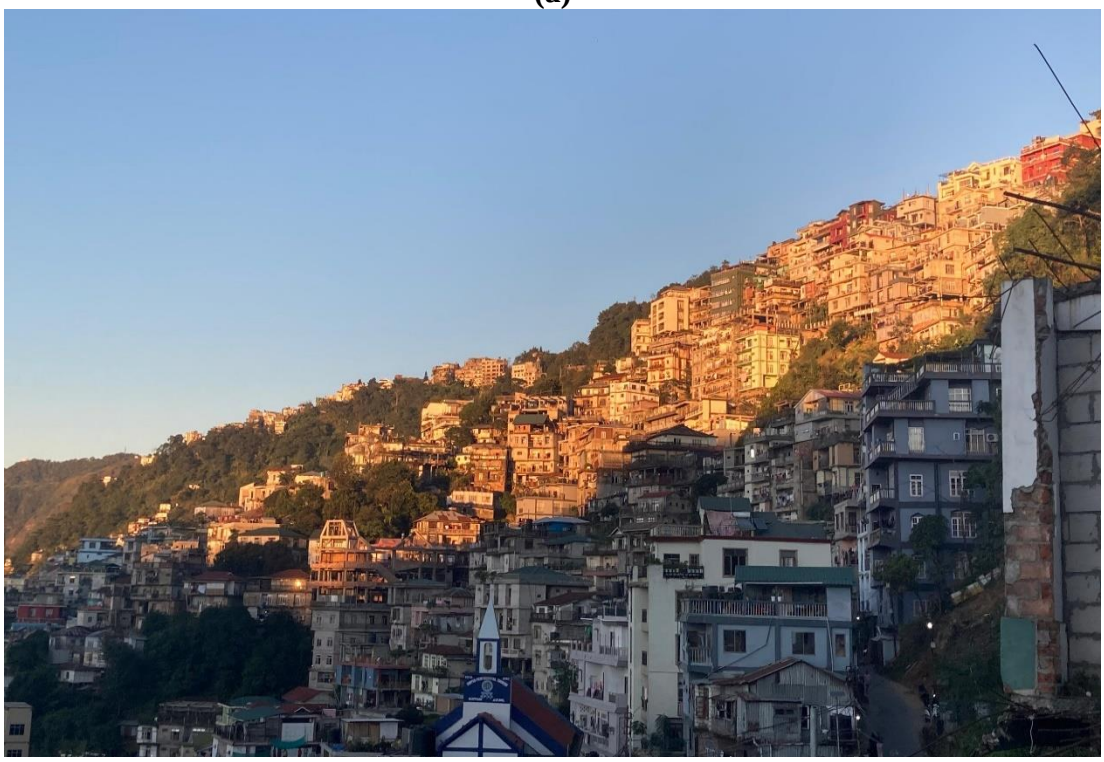
(a)

(b)

Figure 8.3 Picturesque of Accessibility Problems

(a) Traffic Jam during the peak hours
(b) Narrow internal roads

(a)



(b)

Figure 8.4 Picturesque of Geographical-related Disasters (Landslides)

(a) Residential buildings in highly landslide susceptible zone
(b) Landslides during monsoon seasons

(a)

(b)

Figure 8.5 Picturesque of Geographical-related Disasters (Slumping or Sinking)

(a) Building damage cause by slumping

(b) Slumping in the peripheral region

CHAPTER – IX

CONCLUSIONS

Housing improvement and economic development have an asymmetrical relationship which means that economic development would automatically lead to housing improvement (Arku, 2006). Following this proposition, it is clear that developed countries have a higher standard of decent housing than low-developed countries in the real estate market. However, Aizawl City is one of the smallest cities and economically less developed in the country, the rental housing market provides decent housing. Every household, even the lower-class family could afford shelter, no homeless or slum area is found in the city. As compared to the national average, the rental housing in Aizawl City is much better in terms of the total floor area and the mean total floor area per person. Moreover, the good quality of air, abundant green space and low crime rate endowed the quality of rental houses.

However, informal rental market practices in Aizawl City. The landlords have full authority over their properties, and no legal agreements have been made between the two parties. There is no proper implementation of rental housing regulations, the landlords have full authority over their properties, and no legal agreements have been made between the two parties. Due to the absence of a framework for pricing the rental values, the landlords charged the rental amount by guessing or deciding arbitrarily or asking for charges of comparable adjoining properties causing the overcharged or undercharged rental values. Usually, the landlords allot their flats for rented accommodation and live with their tenants under the same roof. Only three housing types such as fully concrete, semi-concrete and assam type have been found, and no luxurious or special amenities found in the rental market.

Aizawl City can be regarded as one of the affordable housing markets in Indian cities. The analysis revealed that the Housing Affordability Index (HAI) is 19 per cent which means that the average household spends 19 per cent of their income for renting indicating that the HAI stays within the acceptable zone of a 30 per cent ratio. Expectedly, lower socio-economic classes have higher HAI than the higher socioeconomic classes, their average index 25 income-to-rent ratio is relatively similar

to the major cities of India like Ahmedabad (23 per cent ratio), Pune (26 per cent ratio), Kolkata (26 per cent ratio) and Bengaluru (28 per cent ratio).

Rental prices largely determined the affordability of the city. The average rental price of Aizawl City which is ₹5334.09 per month, is far lower than the metro-cities average. According to the Mint analysis of rental housing data across India's top six metros (Delhi, Mumbai, Kolkata, Chennai, Hyderabad and Bengaluru), the average monthly rental price is ₹15,600 and the highest is Mumbai with an average of ₹20,000 (Devulapalli, 2019). Undoubtedly, the analysis revealed that the structural characteristics such as the floor area (size), number of bedrooms and bathrooms, type of the house and floor of the house have a major contribution to rental values. On the other hand, housing amenities and services have insignificant relationships with rental values. Among the Socio-economic characteristics, only tenants' household income has a significant impact on rental values, higher-income households were more likely to rent higher-rental houses.

The analysis of residential satisfaction revealed that the majority of the tenants (more than two-thirds) are satisfied with their residence and can be considered as the rental houses in Aizawl City meet satisfactory conditions. However, the tenants measured their satisfaction level based on their personal experience and knowledge, a higher level of satisfaction related to landslides contradicted the actual conditions which indicated the tenants' poor knowledge of disaster awareness. Moreover, the average tenants' satisfaction level i.e., 3.86 out of 5 points Likert Scale, shows that there is some gap for improvement in the quality of residences. The lower-level indicators of satisfaction revealed the negligence of the government authority in the past. The growth of residential buildings without proper planning, the absence of implementing rules and regulations, and the lack of disaster management adversely affected the accessibility, development of road transport networks, and housing quality, especially who live in the basement area. Consequently, accessibility and geographical-related hazards became the critical factors that determined the variation in tenants' satisfaction levels.

The dwelling characteristics, geographical factors and socioeconomic conditions of the tenants have an impact on residential satisfaction. In dwelling characteristics, tenant households who lived in higher rental prices with the availability of single water connection and storerooms have higher satisfaction levels. The geographical factors like distance of main junctions, government offices, hospitals and CBD have an inverse relationship with satisfaction levels which indicates that the tenant satisfaction level decreases with increasing distance from the said public services. It is also observed that localities that are located at a higher elevation have higher tenant satisfaction, while those that are located in higher landslide susceptibility areas have lower levels of tenant satisfaction. It is also found that educational level, income and duration of stay have positive relationships with level of satisfaction.

The spatial analysis witnessed that the geographical factors have an impact on the intra-urban variation in residential rental housing in Aizawl City. The quality of housing conditions in the peripheral regions is poorer than in the central regions in terms of housing types, size, number of bathrooms and bedrooms (those housing features are the significant factors that determine the rental values).

The central part of the city is the most accessible region in the city, the important city services are agglomerated around the central part of the city. As expected, the peripheral regions become the least accessible regions in the city. Unlike in other countries, locational distance is not the main problem in accessibility. The city spans only 152 square kilometres and the city services can be accessed within 40 minutes from the farthest point by using public transportation. Instead, poor quality and quantity of roads, narrow roads and congested traffic made the peripheral regions the least accessible regions.

The analysis revealed that the tenants can be categorised into two socioeconomic classes – middle class and lower class, and no upper class had been found among the tenants in Aizawl City. Lower socio-economic classes are segregated in the outer peripheral regions because the regions provide cheap and affordable rental prices. About 70 per cent of the households living in the outer-peripheral regions are categorised as the lower socio-economic class. The outer peripheral region shares the

highest proportion of workers who are engaged in the informal sector of the economy like agriculture workers, unskilled workers, and drivers. Higher-income groups tend to live in the higher elevations area near the central part of the city but not close to the CBD area.

Also, geographical-related factors like accessibility, elevation, neighbourhood location and quality of neighbourhood have a significant impact on rental values. The rental prices are found highest in the core regions and then decrease towards the peripheral regions. The rental price is reduced by ₹ 254.50 for every kilometre away from the city centre (CBD) and by ₹ 76.01 for every 100 metres away from the junction. As compared with the core area, the inner periphery and outer periphery were more likely to have lower rates of rental prices at 24 per cent and 56.30 per cent. Buildings which are located in higher elevations have higher rental prices due to higher areas having more advantages in terms of terrain, climate, and accessibility in the hilly city of Aizawl. An increase in one unit of elevation would lead to an increase in the rental price by 6.541 units but only affected 0.2 per cent.

The level of residential satisfaction of renters decreases towards the peripheral region. Access to CBD or the main market is difficult from the peripheral areas because of the poor transportation network. Besides the rampant growth of motor vehicles with narrow roads, traffic jams have become a serious problem for commuters.

In the case of the core regions of the residential zone – the inner core and the outer core, CBD is located within the inner core regions and all the major city services are concentrated in the central part of the city. The higher social classes tend to inhabit the core regions of the residential zone of the city. However, to avoid transportation problems and save time and money, a number of people especially migrant workers or labourers who are daily engaged in business usually pay high rent to stay near the city centre, which is the inner core, making the region become more congested and overcrowding and active, filled with inhabiting unstable social groups other than settled families. To avoid such a residential environment, the higher-income groups who are engaged in the formal economic sector tend to live in the outer core zone,

which is adjacent to the inner core zone. The localities in the outer core zone have more advantages than the inner core as well as the other two peripheral regions. Not only located in the vicinity of a variety of services, but the region also provides better housing quality and school quality making it the most favourable region for inhabitation. As a result, the outer core residential zone can be regarded as the best residential zone in the city.

Like Hoyte's sector theory of urban land use, high rental price residential areas are found along the major transportation routes. The ground-floor residents were normally allotted as mini-business centres. The rural settlement areas that previously surrounded the city area have now become the jurisdiction of the municipality area due to the expansion of the city area. However, those newly recruited villages as city areas still have rural characteristics in many ways. As a result, lower socio-economic classes with poorer housing quality are found in the peripheral regions of the city as opposed to Burgees's theory of concentric zones.

India's Directive Principles of State Policy encourages the State government to secure a decent standard of living for all citizens. A decent standard of living cannot be achieved without providing adequate shelter (Jha, 2020). The government implemented a number of housing schemes, but all the interventions mostly focused on the ownership of housing for the vulnerable population. However, due to the unprecedented increase in population in the urban areas, the housing schemes are unable to cover the whole population sections. Moreover, due to the limited space in the city, the recent construction of public houses usually takes place in the peripheral areas which are far from the city centre. It might seem that public housing schemes have failed to solve the housing shortage problems, but rental housing has become a far more viable option, especially for the immediate needs of shelter.

Since housing is a state subject, the Government of Mizoram enacted the Mizoram Urban Areas Rent Control Act, 1974 (amended in 1976), which was fully inherited from the former state, Assam. Recently, the Mizoram Urban Areas Rent Control Bill, 2017 was put up in the state legislation, but not regulated yet. Even though the state government still regulate the Rental Control Act or Law, there is no

practical implementation on the ground. The Mizoram Urban Areas Rent Control Act, of 1974 (section 3(1)) set the standard rent for the landlord, and no landlord shall be entitled to charge rent for any house at a figure higher than the standard rent. However, the researcher witnessed that no landlords or tenants were familiar with the standard rent or anything related to the Rental Control Act. The rental markets are run by the private authority without involving the competing authority. The landlords have complete authority over their rental properties, they made the terms and conditions of the rental agreement in favour of themselves. Tenants do not have any choice but to accept the agreement offered by the landlords.

Following the standard rent proposed by the Rental Act is seemingly impracticable to reality. The standard rent is calculated from the amount of the estimated cost of construction and the market price of the land. However, the land values hugely depend on the location, not the nature of the land itself, and always changing. Also, the cost of construction is not static, the materials and labour costs increasing day by day. Due to these perplexity conditions, implementing rigid laws of standard rent may cause different ranges of the rental price of the same quality of houses.

Nevertheless, the study revealed that the rental price is not the major problem in Aizawl rental housing markets. As compared with other cities, the rental price seems affordable, and the landlords provide a decent standard quality of houses. The analysis of residential satisfaction suggests that accessibility and safety from geographical-related hazards are the most critical factors of tenant satisfaction. Those two factors are the consequence of the hilly topographic features of the city.

As already mentioned, Aizawl City is characterised by a rugged topography with steep slopes. The problems of geological and topographic features are inevitable in housing development. Geologically, Aizawl Hill is relatively young and immature, landslides frequently occur in the steep slope area during the rainy season. Tectonically, the geology is highly unstable due to the convergence zone of the Indian plate and the Eurasian plate. The Indian National Disaster Management Authority (NDMA) put the entire region as seismic zone V, the most high-risk zone for

earthquakes. Uncontrolled migration caused a rapid expansion, land became a scarce resource. Houses were constructed without following proper rules and regulations. Undesirable sloping surfaces have been utilised to construct residential buildings creating a highly vulnerable zone of landslide and other hazards.

The development of transportation networks in hilly regions is more challenging than in plain areas. Furthermore, roads have been constructed without proper planning, and most of the internal roads are constructed after sufficient houses have already been constructed which makes it difficult for the construction of roads. The roads are usually narrow and irregular, and a larger number of residents cannot access motorable roads on their doorsteps.

Moreover, the uncontrolled growth of motor vehicles caused heavy traffic problems in urban mobility. The average peak hour speed is only 3.3 kilometres per hour, and the average speed in a normal period is 11.65 kilometres per hour (Zarzoenga and Lalhruaia, 2019). Almost all of the city services are concentrated in the CBD and its surrounding areas. All the major transportation routes run through or towards the city centre creating difficulty to commute or enjoy the services, especially for the peripheral regions. Taxi fare in Aizawl City is ₹ 40 per kilometre, which is one of the highest in Indian cities. Due to the high transportation cost and longer time spent, accessibility became a major problem for the renters who live in the peripheral areas.

From the above discussion, the three major problems such as accessibility, safety from topographic-related disasters and fixing the rate of rental price cannot be done by the landlords or the tenants, but it is the responsibility of the state government. The present study introduced suggestions for the improvement of rental housing conditions in Aizawl City. Firstly, the government should take necessary action to regulate and implement the framework of the unbiased standard rate of rental price for the renters and the tenants. Secondly, since it is impossible to construct the new road network line that connects the city centres, the government should introduce the ropeway networks as an alternative to improve accessibility, especially for the people who live in remote areas. The rate of accessing the services of the city centres can be reduced by strengthening the growth centres in the peripheral regions. Urban outward

extensions usually take place along the transportation networks. The congestion and overcrowding of the city can be reduced by encouraging the landowner of the vacant land to build residential buildings by providing roads, electricity and water supply. Urban high-vulnerability zones can be reduced by developing urban extension areas in the vacant land and resettling the people who live in the high-vulnerability areas. Because improving accessibility not only affects the quality of rental housing but also the quality of life of the people (Saitluanga, 2017), the government should consider taking the necessary action.

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APPENDICES

APPENDIX – A: SCHEDULED FOR HOUSEHOLD SURVEY

The survey is about spatial analysis of the rental housing in Aizawl City and is purely intended for research purposes. The responses will be kept confidential.

Respondent: _____ Age _____ Edu. Qual._____

Locality: _____ House No. _____

A. SOCIO-ECONOMIC CHARACTERISTICS

Head of the Family

1. Age: _____ Sex: Male/Female Edu. Qual._____

2. Occupation: _____

3. Originality (Local or immigrant) _____ (if immigrant, since) _____ From _____ Nature: Permanent/Temporary

Family

1. Number of Members _____ Male _____ Female _____

2. Under 18 years _____ Over 60 years _____

3. Family Main Occupation _____ Family Income (Monthly) _____

B. DWELLING CHARACTERISTICS

1. Methods of Finding a Rental House _____

2. Rental price: _____ 3. Duration _____

4. Agreement: Verbal/Written 5. Tenure Agreement: _____

6. Mode of Payment: Pre-monthly/Post-monthly/Occasionally

7. Experience of rental price change _____ (If yes, how much?) _____

8. Carpet Area of the house (Consult with landlord) _____

9. Age of building _____

10. Water Connection: Single / not 11. Electric Connection: Single / not

12. Experience of Force Displacement: Yes/No If yes, reason _____

13. Important Housing Features for Renting (Opinion) _____

C. SATISFACTION LEVEL

1= Very Dissatisfied 2= Dissatisfied 3= Neutral 4= Satisfied 5= Very Satisfied

SI.	Indicators	Level				
1.	Satisfaction with size of the residence	1	2	3	4	5
2.	Satisfaction with number of bedrooms	1	2	3	4	5
3.	Satisfaction with number of bathrooms	1	2	3	4	5
4.	Satisfaction with number of living rooms	1	2	3	4	5
5.	Satisfaction with age of the building	1	2	3	4	5
6.	Satisfaction with approach or entry road of the building	1	2	3	4	5
7.	Satisfaction with neighbourhood location (elevation)	1	2	3	4	5
8.	Satisfaction with sunlight availability	1	2	3	4	5
9.	Satisfaction with viewpoint	1	2	3	4	5
10.	Satisfaction with air quality	1	2	3	4	5
11.	Satisfaction with availability of cloth drying place	1	2	3	4	5
12.	Satisfaction with accessibility of major hospital	1	2	3	4	5
13.	Satisfaction with accessibility of police station	1	2	3	4	5
14.	Satisfaction with frequency of water supply	1	2	3	4	5
15.	Satisfaction with frequency of electric supply	1	2	3	4	5
16.	Satisfaction with safety of burglary	1	2	3	4	5
17	Satisfaction with nighttime safety	1	2	3	4	5
18	Satisfaction with safety of house site from earthquake	1	2	3	4	5
19	Satisfaction with safety of building from earthquake	1	2	3	4	5
20	Satisfaction with safety of house site from landslide	1	2	3	4	5
21	Satisfaction with safety of building from landslide	1	2	3	4	5
22	Satisfaction with degree of slope of house site	1	2	3	4	5
23	Satisfaction with distance of motorable road	1	2	3	4	5
24	Satisfaction with distance of public transport station	1	2	3	4	5
25	Satisfaction with distance of grocery store	1	2	3	4	5
26	Satisfaction with distance of locality junction	1	2	3	4	5
27	Satisfaction with distance of central business district	1	2	3	4	5

APPENDIX – B: MULTI-COLLINEARITY PROBLEMS

Correlations

		Rent	DC	Hospital	CBD	Region
Rent	Pearson Correlation	1	-.348**	-.371**	-.374**	-.356**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	546	546	546	546	546
Treasury Square	Pearson Correlation	-.348**	1	.970**	.940**	.702**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	546	546	546	546	546
Hospital	Pearson Correlation	-.371**	.970**	1	.993**	.743**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	546	546	546	546	546
CBD	Pearson Correlation	-.374**	.940**	.993**	1	.742**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	546	546	546	546	546
Region	Pearson Correlation	-.356**	.702**	.743**	.742**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	546	546	546	546	546

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix – C: SCALE Vs CATEGORICAL

Comparison of Scale vs Categorical Variables of Spatial data in relation to Rental Value

Variables	Junc_10	CBD_100	Elevation	School Q.	Density	Income
Scale	-.306**	-.374**	.406**	.251**	.120**	.406**
Category	-.255**	-.315**	.401**	.286**	.131**	.481**

** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX – D: TRADITIONAL OLS METHOD (LINEAR MODEL)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-5578.463	1292.344		-4.317	.000
	Size_M2	15.872	2.930	.203	5.417	.000
	Bedroom	377.677	99.827	.142	3.783	.000
	Bathroom	530.662	158.593	.124	3.346	.001
	Type	805.040	191.302	.151	4.208	.000
	Floor	-514.721	146.630	-.114	-3.510	.000
	Veranda	118.604	157.754	.026	.752	.453
	Storeroom	-293.509	180.120	-.054	-1.630	.104
	Balcony	27.995	147.161	.006	.190	.849
	Electric	-81.217	158.109	-.018	-.514	.608
	Water	199.267	173.525	.040	1.148	.251
	Garrage	144.669	173.797	.030	.832	.406
	Junc 10	-7.601	2.101	-.135	-3.618	.000
	Elevation	6.541	1.375	.203	4.756	.000
	SchoolCat	233.639	56.626	.148	4.126	.000
	Den Cat	-1.691	51.296	-.001	-.033	.974
	Income	290.660	61.906	.169	4.695	.000
	Member	45.224	78.620	.019	.575	.565
	Motor	-41.013	167.078	-.009	-.245	.806

a. Dependent Variable: Rent

APPENDIX – E: TRADITIONAL OLS METHOD (LOG-LINEAR MODEL)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	5.787	.286		20.225	.000
	Size_M2	.004	.001	.224	6.154	.000
	Bedroom	.056	.022	.093	2.542	.011
	Bathroom	.090	.035	.093	2.572	.010
	Type	.228	.042	.187	5.377	.000
	Floor	-.078	.032	-.076	-2.416	.016
	Veranda	.033	.035	.033	.958	.338
	Storeroom	-.065	.040	-.053	-1.642	.101
	Balcony	.019	.033	.019	.589	.556
	Electric	-.033	.035	-.033	-.948	.344
	Water	.042	.038	.038	1.099	.272
	Garrage	.018	.038	.016	.457	.648
	Junc 10	-.002	.000	-.182	-5.002	.000
	Elevation	.002	.000	.241	5.809	.000
	SchoolCat	.044	.013	.121	3.487	.001
	Den Cat	.001	.011	.003	.072	.943
	Income	.056	.014	.142	4.065	.000
	Member	.006	.017	.011	.350	.726
	Motor	.022	.037	.021	.598	.550

a. Dependent Variable: logrent

APPENDIX – F: CROSS-LOADING PROBLEMS

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
Size	.044	.039	.831	.052	-.042
Bed_Room	-.006	-.013	.835	.130	.037
Bathroom	-.051	.125	.739	.056	.076
Sitting_Room	.068	.048	.820	.001	.075
Age	.117	.272	.501	.203	.045
Water_Supply	.191	-.038	.412	.131	.101
Electric_Supply	.220	.163	.370	.140	.109
Elevation	.387	.072	-.061	-.014	.343
Earthquake_Locality	-.074	.702	.166	.039	.183
Earthquake_House	-.083	.706	.195	.051	.171
Landslide_Locality	.204	.842	.023	.088	-.009
Landslide_House	.248	.845	-.009	.098	-.011
Slopeness	.197	.797	.008	.108	-.023
Sunlight	-.077	.096	.039	.736	-.007
View	.063	.035	.139	.705	.113
Air_Quality	.002	.143	.166	.571	.341
Cloth_Drying	.043	.089	.160	.703	.064
Burglary	.039	.084	.169	.212	.761
Night_Safety	.076	.110	.143	.186	.756
Dist_Motorable	.498	.167	.179	-.036	.140
Dist_Public_Trans	.642	.063	.016	-.130	.148
Dist_Grocery	.734	.134	.039	-.022	.306
Dist_Junction	.749	.068	.030	-.089	.249
Dist_CBD	.713	-.017	.037	.141	-.265
Dist_Hospital	.697	-.047	.088	.148	-.290
Dist_Police_St	.698	.072	.102	.067	-.261
Approach_house	.446	.292	.222	.149	.180

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

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M.Sc	Mizoram University	2017	Distinction
NET	UGC	2017 & 2018	
NET-JRF	UGC	2018	
PGC Geoinformatics	IGNOU	2022	

PRESENTATIONS AND PUBLICATIONS OF RESEARCH PAPER

A. Presentation of Research Papers

1. "*Spatial Analysis of Residential Satisfaction of Renters in Aizawl City"* in National Seminar on 'Climate Change, Environment & development: Indian Perspectives' organized by Department of Geography & RM, Mizoram University, 25th and 26th April 2023.

2. *"Risk Perception of Natural Hazards in Residential Environment: A Case Study of Rental Housing in Aizawl City"* in National Seminar on 'Earthquake Prediction – Forecast in Northeast India' organized by the Centre for Disaster Management, Mizoram University, 27th to 28th April 2023.

3. *"Determinants of rental Values in Serchhip Town: The Agro-town of Mizoram"* in International Conference on 'Management of Natural Resources & Sustainable Livelihoods through IWM for North-east India: Evidences, Gap and Future Strategies' organized by Department of Geography, Pachhunga University College, 4th to 5th May 2023.

B. Publication of Research Papers

Journal Publication

1. Social Well-being, Ethnicity and Regional Development in Mizoram, Northeast India, *GeoJournal*, May 2021, Vol. 87, pp. 3277-3289. ISSN No: 1572-9893 (Web)

2. Transport Mode Choice among Off-Campus Students in a Hilly Environment: The Case of Aizawl, India, *Transport Problems*, 2022, Vol. 17(3), pp. 163-172. ISSN No. 1896-0596.

3. Risk Perception and Satisfaction Towards Residential Environment of Tenants: A Case Study of Aizawl City, *Geographic*, July 2023, Vol. 18, pp. 107-117, ISSN 0975-4121.

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DEGREE : DOCTOR OF PHILOSOPHY

DEPARTMENT : GEOGRAPHY AND RESOURCE MANAGEMENT

TITLE OF THESIS : SPATIAL ANALYSIS OF RENTAL HOUSING IN AIZAWL CITY, MIZORAM

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2. BOS : 3rd APRIL 2019
3. SCHOOL BOARD : 26th APRIL 2019

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Ph.D. REGISTRATION NO. & DATE : MZU/Ph.D./1205 of 24.08.2018

EXTENSION : NIL

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ABSTRACT

SPATIAL ANALYSIS OF RENTAL HOUSING IN AIZAWL CITY, MIZORAM

AN ABSTRACT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

LALHMANGAIHZELA

MZU REGISTRATION NO.: 4460 OF 2012

Ph.D. REGISTRATION NO: MZU/Ph.D./1205 of 24.08.2018

DEPARTMENT OF GEOGRAPHY AND RESOURCE MANAGEMENT

SCHOOL OF EARTH SCIENCES AND NATURAL RESOURCES MANAGEMENT

APRIL, 2024

ABSTRACT

The post-industrial revolution witnessed rapid urbanisation across the world and created a scarcity of urban space for housing in the city. Millions of people migrated to the cities to access the accumulation of urban resources by taking up informal jobs for livelihood. Despite the aspiration for ownership, housing in urban areas is not ubiquitous for everyone due to constraints of affordability and a limited supply of land. Rental housing is the first entry point for migrant people in the city. Rental housing, therefore, plays a crucial role by providing the much-needed 'room for manoeuvre' to lessen the burden of migrants, and becomes important in the 'poverty-risk period' It is an integral part of cities and plays a crucial role in urban functionalities.

It is a fact that most households aspire to own their housing, and homeownership has become the cornerstone of government housing policy in most countries in the Third World. The government's approach to urban poor housing has been focused on providing them with ownership of housing and land titles. This has led to neglect of the importance of rental housing, and uninterested in rental housing markets, except to convert the tenants into homeowners during policy-making. As a consequence, India has given little attention to the rental housing segment and the study of rental housing markets has remained largely unexplored.

The term 'rental housing' is used to denote the totality of the process of the letting of accommodation by landlords and the payment of rent for rights over the use of the accommodation that is rented by tenants. Rental housing can be broadly categorised into two based on the form of provision – public rental housing and private rental housing. Public rental housing is typically non-profit and supplied by non-profit organisations or government-sponsored programs at all levels of society from the local to the national. On the other hand, private rental housing is supplied by households who can afford to build more than they require, and the allocation process of private rental housing supply is largely determined by market forces like demand conditions.

The study of rental housing encompassed a wide range of topics, not only the architecture or the design or the conditions of housing itself but also the livelihood and

the quality of life, sustainability, environment, economy, demography, politics and even psychology. The literature review suggested that the majority of the research related to rental housing is taken from economics and focuses on economic-related matters. Traditionally, social theorists put more emphasis on sociological and historical explanations and neglected spatial context for studying social processes in general and urban housing systems in particular. However, the social geographers stressed that every social process takes place in space and the intra-urban social differentiation is the product of dissimilarities of social spaces, and then the residential pattern is the manifestation of intra-urban social differentiation. The territory is unjust, some regions have more advantages than others. The uneven distribution of resources causes social differentiation. Therefore, the spatial perspective cannot be neglected in the analysis of intra-urban rental housing.

The present study is about rental housing in Aizawl City. It is the primate city and administrative capital of Mizoram, located in the northeastern region of India. Mizoram is one of the most urbanized states in India, and Aizawl City comprises 26.89 per cent of the entire population of the state. Aizawl City is a part of the Himalayas, characterised by rugged topography with steep slopes. Unlike plain areas, the topography, altitude, relief and slope have an immense impact on residential environments in the way of construction of buildings, building safety, building characteristics, accessibility and even the local climate. Consequently, the study puts more emphasis on the geographical perspective of space, analysing the influence of intra-city spatial differentiation on rental housing, without neglecting the traditional approaches of sociological, economic and historical explanation.

There has been no proper study on account of rental housing in Mizoram. Although the government had been making acts and regulations regarding rental housing, most of the people had not been familiar with the rules and regulations. So, the tentative study may be the pioneer work and it would have a good contribution to Mizo society; it is useful for the people who have been involved in rental housing and the government for drafting the policies and programmes. The main objectives of the study are:

1. To study the residential rental housing markets and rental housing pattern in Aizawl City
2. To study the socio-economic characteristics of tenants in Aizawl City
3. To investigate the spatial variation of rental housing affordability in Aizawl City
4. To find out the factors that determine rental values in Aizawl City
5. To examine the intra-urban variation of residential satisfaction of tenants in Aizawl City.

The entire city is divided into four residential zones based on the Core-periphery, they are – Inner Core (IC), Outer Core (OC), Inner Periphery (IP) and Outer Periphery (OP). However, Core-periphery is a model of development which is not necessarily related to the present context, merely used for demarcating the residential area. Out of 82 local councils in Aizawl City, 17 localities from 4 municipal wards have been taken to represent the four residential zones. The sample size i.e., 598 samples, is calculated by using the Cochran Formula of Sample Size. A cluster sampling technique with a scheduled method was employed to collect the rental household data.

The data that are being used in the present study can be divided into two – spatial and non-spatial data. The spatial data are the quantitative data regarding rental houses having a relationship with the geographical location while non-spatial data are the physical characteristics of the buildings and dwellers' characteristics. For the analysis of data, different statistical techniques including descriptive and inferential statistics are employed. Graphical representations like choropleths, bar graphs and pie charts are used. Different topographical maps are prepared by using ArcGIS version 10.4, and the Statistical Package for Social Science (SPSS) software tool was used for data calculations.

Even though, Aizawl City is one of the smallest cities and economically less developed in the country, the rental housing market provides affordable and decent housing. Every household, even the lower-class family could afford shelter, no homeless or slum area is found in the city. As compared to the national average, the

rental housing in Aizawl City is much better in terms of the total floor area and the mean total floor area per person. Moreover, the good quality of air, abundant green space and low crime rate endowed the quality of rental houses. However, informal rental market practices in Aizawl City. There is no proper implementation of rental housing regulations, the landlords have full authority over their properties, and no legal agreements have been made between the two parties. Due to the absence of a framework for pricing the rental values, the landlords charged the rental amount by guessing or deciding arbitrarily or asking for charges of comparable adjoining properties causing the overcharged or undercharged rental values.

Using the updated Modified Kuppuswamy Socio-economic Status Scale, 2020 (SES), tenants can be categorised into two socioeconomic classes – middle class and lower class, no upper class had been found among the tenants in Aizawl City. The higher socioeconomic households were decreased with increasing distance from the city centre. Using the Shannon Diversity Index, Pielou's Evenness Index and Simpson Diversity Index for measuring residential segregation found that the lower socioeconomic were segregated in the outer peripheral regions of the city.

The Housing Affordability Index (HAI) was employed to measure tenants' housing affordability conditions and found that the HAI is 19 per cent which means that the average household spends 19 per cent of their income on renting indicating that the HAI stays within the acceptable zone of a 30 per cent ratio. Expectedly, lower socio-economic classes have higher HAI than the higher socioeconomic classes, their average index 25 income-to-rent ratio is relatively similar to the major cities of India.

Usually, the landlords allot their flats for rented accommodation and live with their tenants under the same roof. Only three housing types such as fully concrete, semi-concrete and assam type have been found, and no luxurious or special amenities found in the rental market. The quality of housing conditions in the peripheral regions is poorer than in the central regions in terms of housing types, size, number of bathrooms and bedrooms.

The average rental price of Aizawl City which is ₹5334.09 per month, is far lower than the metro-cities average. The rental prices are found highest in the core

residential zones and then decrease towards the peripheral regions. The hedonic Pricing Model (HPM) is used to find out the factors that determine rental prices and estimate the rental price. The HPM is widely used in housing studies and the technique is similar to the Ordinary Least Square (OLS) method. The Robust Standard Errors (RBE), also known as the Heteroskedasticity-Consistent Standard Errors (HCSE) method was employed to avoid heteroskedasticity problems. Undoubtedly, the analysis revealed that the structural characteristics such as the floor area (size), number of bedrooms and bathrooms, type of the house and floor of the house have a major contribution to rental values. On the other hand, housing amenities and services have insignificant relationships with rental values. Among the Socio-economic characteristics, only tenants' household income has a significant impact on rental values, higher-income households were more likely to rent higher-rental houses.

The geographical-related factors like accessibility, elevation, neighbourhood location and quality of neighbourhood have a significant impact on rental values. The rental prices are found highest in the core regions and then decrease towards the peripheral regions. The rental price is reduced by ₹ 254.50 for every kilometre away from the city centre (CBD) and by ₹ 76.01 for every 100 metres away from the junction. As compared with the core area, the inner periphery and outer periphery were more likely to have lower rates of rental prices at 24 per cent and 56.30 per cent. Buildings which are located in higher elevations have higher rental prices due to higher areas having more advantages in terms of terrain, climate, and accessibility in the hilly city of Aizawl. An increase in one unit of elevation would lead to an increase in the rental price by 6.541 units but only affected 0.2 per cent.

The analysis of residential satisfaction revealed that the majority of the tenants (more than two-thirds) are satisfied with their residence and can be considered as the rental houses in Aizawl City meet satisfactory conditions. However, the tenants measured their satisfaction level based on their personal experience and knowledge, a higher level of satisfaction related to landslides contradicted the actual conditions which indicated the tenants' poor knowledge of disaster awareness. Moreover, the average tenants' satisfaction level i.e., 3.86 out of 5 points Likert Scale, shows that there is some gap for improvement in the quality of residences. The lower-level

indicators of satisfaction revealed the negligence of the government authority in the past. The growth of residential buildings without proper planning, the absence of implementing rules and regulations, and the lack of disaster management adversely affected the accessibility, development of road transport networks, and housing quality, especially who live in the basement area.

Explanatory Factor Analysis (EFA) was used to find out the critical factors that determined the variation in tenants' residential satisfaction in Aizawl City. By employing the Principal Component Analysis (PCA), the selected 27 indicators of residential satisfaction were reduced into five dimensions with 60.677 per cent of the variance explained. The analysis found that accessibility and geographical-related hazards with a total variance of 22.145 and 13.614 per cent became the critical factors that determined the variation in tenants' satisfaction levels.

Pearson's Correlation Method was used to find out the factor that determined the tenants' satisfaction with their residences. In dwelling characteristics, tenant households who lived in higher rental prices with the availability of single water connection and storerooms have higher satisfaction levels. The geographical factors like distance of main junctions, government offices, hospitals and CBD have an inverse relationship with satisfaction levels which indicates that the tenant satisfaction level decreases with increasing distance from the said public services. It is also observed that localities that are located at a higher elevation have higher tenant satisfaction, while those that are located in higher landslide susceptibility areas have lower levels of tenant satisfaction. It is also found that educational level, income and duration of stay have positive relationships with level of satisfaction.

The present study developed the Residential Satisfaction Index (RSI) by considering the weights of the factors or components of residential satisfaction provided by PCA. Considering the weight of the components was crucial because each variable has different weights on tenants' residential satisfaction and the same indicator might have different meanings from respondent to respondent which can be witnessed from the PCA analysis. The Residential Satisfaction Index of Tenant's Households (RSI_h) was calculated by using the percentage of factor variance explained

and the factor score coefficient. The analysis of intra-urban residential satisfaction was done by using RSI. From RSI_h, the Residential Satisfaction Index of Locality-based (RSI_l) was calculated by taking the average tenants' RSI_h of the respective locality. Then, the map of the Tenants' Residential Satisfaction zone was prepared by using the index of RSI_l. The level of residential satisfaction of renters decreases towards the peripheral region.

The higher social classes tend to inhabit the core regions of the residential zone of the city. However, to avoid transportation problems and save time and money, a number of people especially migrant workers or labourers who are daily engaged in business usually pay high rent to stay near the city centre, which is the inner core, making the region become more congested and overcrowding and active, filled with inhabiting unstable social groups other than settled families. To avoid such a residential environment, the higher-income groups who are engaged in the formal economic sector tend to live in the outer core zone, which is adjacent to the inner core zone. The localities in the outer core zone have more advantages than the inner core as well as the other two peripheral regions. Not only located in the vicinity of a variety of services, but the region also provides better housing quality and school quality making it the most favourable region for inhabitation. As a result, the outer core residential zone can be regarded as the best residential zone in the city.

Like Hoyte's sector theory of urban land use, high rental price residential areas are found along the major transportation routes. The ground-floor residents were normally allotted as mini-business centres. The rural settlement areas that previously surrounded the city area have now become the jurisdiction of the municipality area due to the expansion of the city area. However, those newly recruited villages as city areas still have rural characteristics in many ways. As a result, lower socio-economic classes with poorer housing quality are found in the peripheral regions of the city as opposed to Burgees's theory of concentric zones.

The study revealed that the rental price is not the major problem in Aizawl rental housing markets. As compared with other cities, the rental price seems affordable, and the landlords provide a decent standard quality of houses. The analysis

of residential satisfaction suggests that accessibility and safety from geographical-related hazards are the most critical factors of tenant satisfaction. Those two factors are the consequence of the hilly topographic features of the city.

The central part of the city is the most accessible region in the city, the important city services are agglomerated around the central part of the city. As expected, the peripheral regions become the least accessible regions in the city. Unlike in other countries, locational distance is not the main problem in accessibility. The city spans only 152 square kilometres and the city services can be accessed within 40 minutes from the farthest point by using public transportation. Instead, poor quality and quantity of roads, the rampant growth of motor vehicles with narrow roads, and traffic jams made the peripheral regions the least accessible regions, and become a serious problem for commuters.

The development of transportation networks in hilly regions is more challenging than in plain areas. Furthermore, roads have been constructed without proper planning, and most of the internal roads are constructed after sufficient houses have already been constructed which makes it difficult for the construction of roads.

The problems of geological and topographic features are inevitable in housing development. Geologically, Aizawl Hill is relatively young and immature, landslides frequently occur in the steep slope area during the rainy season. Tectonically, the geology is highly unstable due to the convergence zone of the Indian plate and the Eurasian plate. The Indian National Disaster Management Authority (NDMA) put the entire region as seismic zone V, the most high-risk zone for earthquakes. Uncontrolled migration caused a rapid expansion, land became a scarce resource. Houses were constructed without following proper rules and regulations. Undesirable sloping surfaces have been utilised to construct residential buildings creating a highly vulnerable zone of landslide and other hazards.

Poor quality of accessibility, lack of proper safety measurement from topographic-related disasters and absence of implementing the Rental Housing Act are the major problems of rental housing in Aizawl City. It was obvious that the problems cannot be solved by the landlords or the tenants, but it is the responsibility of the state

government. The present study introduced suggestions for the improvement of rental housing conditions in Aizawl City. Firstly, the government should take necessary action to regulate and implement the framework of the unbiased standard rate of rental price for the renters and the tenants. Secondly, since it is impossible to construct the new road network line that connects the city centres, the government should introduce the ropeway networks as an alternative to improve accessibility, especially for the people who live in remote areas. The rate of accessing the services of the city centres can be reduced by strengthening the growth centres in the peripheral regions. Urban outward extensions usually take place along the transportation networks. The congestion and overcrowding of the city can be reduced by encouraging the landowner of the vacant land to build residential buildings by providing roads, electricity and water supply. Finally, Urban high-vulnerability zones can be reduced by developing urban extension areas in the vacant land and resettling the people who live in the high-vulnerability areas.