TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

1.1 BACKGROUND

During the last decades of the eighteenth century, the Industrial Revolution began in Great Britain. None of Europe's cities was prepared for what lay ahead: an avalanche of changes that ripped the fabric of urban life. Around 1800, Western Europe was still overwhelmingly rural. As thousands migrated to the cities with industrialization, cities had to adapt to the mushrooming population, the proliferation of factories and supply facilities, the expansion of transport systems, and the construction of tenements for the growing labor force. The effects of industrialization and urbanization in Great Britain were indirectly linked with the political & economic policies of British Government in Subcontinent i.e. India & Pakistan (Fouberg, Murphy, & De Blij, 2009).

Before 19th century, agriculture, mining, livestock and fishing etc. was the primary sector for basic needs for human settlements. With the industrial revolution in beginning of 1800, manufacturing sector took the place as secondary sector for urban settlements. It has evolved business centers and central markets around industrial estates which creates jobs for people in service sector. Cities have created due to transformation of secondary sector into service sector which attracts labor and working class to reside in big urban settlements. With the increase in the Industrial

production and consumption of resources, cities have been expended with the increase in the urban population.

It has been observed that cities which have roads in its periphery expends more and quickly. Some cities expends beyond its limit due to its road connectivity in all direction. Landuse and transportation are interconnected to each other. Peripheral and territorial roads attract population due to road connectivity and infrastructure. It creates urban sprawl and leapfrog development but provides affordable housing and urban expansion corridors. The roads diverging from the center of the city have potential of outwards development of the city.

City managers require accurate and up to date information on growth rate and directions to work out the solution of uncontrolled expansion. In this regard, recent advances in Geographic Information System (GIS) and remote sensing technologies provide useful tool to undertake analysis of spatial expansion. Remote sensing techniques have already shown their worth as data sources for urban mapping, urban growth analysis, modeling and land use change. Monitoring urban expansion and detection of urban change are major application aspects of GIS and remote sensing technology (Adeel, 2010b).

1.2 EVOLUTION OF CITIES AND PROCESS OF URBAN GROWTH

Urban growth monitoring and spatio-temporal changes in Land use / Land cover (LULC) can identify physical expansion of the city. Generally, the organic urban growth is not in the smooth and regular manner rather it expands randomly in

unplanned manner and in irregular shaped. The planned urban growth like in Islamabad can be called as smooth and regular growth as it expands in rectangular shaped sectors. Spatial clustering, roughly distributed settlements or dispersed built-up area are the ways of urban expansion. The Land owners divided the land parcels as per inheritance law keeping the access path for each land shareholder which is further connected to main arterial roads. It means that street pattern evolved from informal land sub-division which decides the layout pattern of each settlement.

With the increase in the population and passage of time, the villages are connected with the urban areas through farm to market roads. Agricultural surplus of food production is one of the reasons of creation of these types of markets. The infrastructural facilities like electricity, gas, sewerage and drainage system, water etc. have been laid down along farm to market roads for the surrounding settlements which attract the population to reside along it. Public buildings like schools, post offices, hospitals etc. have been constructed with suitable site selection in those rural settlements which have comparatively more population. This increase connectivity and demand for mobility. The transportation cost on the product decides its market value in the nearby vicinity. The daily travelling of commuters attract them to live close to the city which evolves peri-urban areas which have both rural and urban characteristics.

As the demand for housing has increased in the peri urban area, the agriculture land has been converted into built area as it gives more profit to the land owner with less effort then cultivation. This increases the demand for construction material like

cement, sand, steel, brick and crush for building. Construction material agencies have been established for the provision of building material. Earth kilns already existing in rural and peri-urban area, increase the labors and earth digging which changes the topology, natural terrain and physical environment. This also increases the demand for other accessories for houses like, wood and glass work, marble & tiles, water and electricity fittings, furniture & fixtures etc. as well.

To meet the daily demands and necessary items, commercial sector boosts in the cities and shops have been constructed along peripheral roads and the residential area along major roads have been converted into commercialized road in core city area. It demands for more industrial production and the supply to the market which creates jobs for people in informal sector. Others pull and push factors increases the population of the cities and converted into big urban centers. Urban land values have been increased due to boost in the market of formal and informal sector in the cities.

The urban growth and expansion of city is due to three major factors. Firstly, due natural increase in the population, the household size increases in the densely populated area which increases the occupancy rate of the residential area. This intensification demand for more housing and few family members have to shift to other places. If they afford for purchasing house then they reside as per their affording capacity otherwise they have to live on rent in suburban area. The people have the vacant plots for land speculation; they construct houses for rent purpose. This increases the urban built-up area and jobs for contractors, masons and labor class. Secondly, the migrants coming from others cities also live in rental houses or

they purchase houses in the outskirts of the city. It also increases the population of the city and urban residential land use. Thirdly, the conversion of rural area into urban area, revision of the city growth and service boundary and enhancement of municipal services encourage the villagers in peri-urban area to live close to cities. This provides growth poles and expansion corridors along peripheral roads and territories.

1.3 MAGNITUDE AND INTENSITY OF URBAN GROWTH

Cities and urban settlements have all dimensions of life like social, economic, physical and cultural etc. The urbanization is the proportional increase in the population of the city. It is a demographical term and measures the quantity of population in numeric figures. Urban growth deals with physical expansion of urban area. It is the measure of area expansion of the city. Urbanism is the social term and it is study of attitude transformation and behavioral change in the people through urban society. Urban economies deal with the market of the city due to high demand for consumption of resources and products with respect to its supply from industry, transportation cost and all four dimension of economics i.e. land, labor, capital and machinery. Cultural exchange and interfaith harmony is one of big aspect of multi ethnic society and cities have become the socially integrated place for all type of communities.

Urban expansion took place both in forward and reverse order. Cities expand outwards from the center to the outskirts and towards inwards from peri-urban area to urban periphery. Comparatively, outward urban expansion is greater than inward growth. The linear expansion of the city in the form of ribbon development took place

along the roads which are connected between the cities with the surrounding towns. The radial and peripheral roads are further connected with each other through link and connector roads. Neighborhood streets play the role of collector roads and the city expands in the form of parts, sectors, blocks and parcels etc.

1.4 RAWALPINDI DISTRICT

1.4.1 Area and Location

The district of Rawalpindi lies between 33°.04´ - 34°.01´ North Latitudes and 72°.38´ and 73°.37´ East longitudes. The area district Rawalpindi is 5,286 square kilometers, grading it the 42nd position (area wise) among urban areas of Pakistan.

1.4.2 Boundaries

Islamabad Capital Territory is on the North of Rawalpindi District including Abbottabad and Haripur Districts of Khyber Pakhtunkhwa, Attock District is on the West, Chakwal and Jehlum Districts are on the South and River Jhelum across, which lies Rawalakot and Kotli Districts of Azad Jammu and Kashmir are on the East.

1.4.3 General Description

According to 6th Pakistan Housing & Population Census 2017, the total population of the District is 5405633 with an inter-censual percentage increase of 60.6 since 1998. During this period, 2.52 percent is the average annual growth rate (Statistics, 2017).

Between 1970 and 2010 the population of Lahore has become doubled and area increased four times. It means that population growth rate is half of the percentage increase in area of the city. After partition, the residential colonies in

transition zones of Lahore was in the 1 kilometer circle of the walled city and now the southern last stop Gajumata of metro bus service is almost 20 km away from the walled city. According to 1998 census the Population of Rawalpindi city is 1,409,768 persons (Statistics, 1998). The population density of the District was 1146 persons per square kilometers. The percentage of urban share in District Rawalpindi population in 1998 was 73.1 percent. It means that the urban density of Rawalpindi city in 1998 was 844 persons per square kilometers.

1.5 FEDERAL JOBS, GOVERNMENT AND ARM FORCES EMPLOYEES HOUSING COLONIES

As Islamabad is the capital city of Pakistan, all the public offices, secretariats, regularity bodies and cooperative sector offices are in Islamabad. Rawalpindi is the general headquarter of Pakistan Army and has all regional offices for northern part of Punjab province. More than 50 percent people are working in formal sector i.e. Government, semi government jobs as well as Arm Forces. These employees live in Government servant quarters, organizational townships, flat and apartments and on rent in private housing schemes. Maximum of these employees built own house in developed schemes or in suburban area after retirement. This has also increased the future growth potential of Rawalpindi.

Housing schemes and society's concept emerge in cities to deal with housing backlog through informal sub-division of land and development. The size of the city and magnitude of urban expansion increases with these housing schemes but it provide developed plots with public spaces and recreational areas. It have emerged

the concept of gated community living but also increases the leap frog development in cites leaving vacant parcels and agriculture fields. As the housing schemes took the connections of infrastructural facilities like electricity, gas, sewerage & drainage system, water etc. from Water and Power Development Authority (WAPDA), Sui Northern Gas Pipe Line (SNGPL) and Water and Sanitation Agency (WASA) etc. respectively, people make investments in land around these housing schemes. People ensured that the plots they have purchased will be developed in future or its value will be increased due to surrounding housing schemes.

1.6 FORM AND TREND OF URBAN EXPANSION

The physical patterns of low-density expansion lies with the principal lines of urban growth and means small or no control of land subdivision. As the results, these development is un-continuous, patchy, scattered and strung out, leaving agricultural enclaves with the urban limits (STAN, 2013).

1.7 TEMPORARY RESIDENTS

Arif, 1998 indicated that urban enumeration is very difficult and has not been conducted exhaustively. In big cities of Pakistan like Lahore, large segments of population earning their livelihood leaving their dependents or partially dependents in their original residents' towns/villages, remit money and send material goods at original residences, and visit their dependent family members to support financially weekly or on monthly basis in spite of settled since years at their working cities. At the time of enumeration they avoid to include themselves as urban citizens of these cities on any status because the majority don’t own a house, consequently,

enumerated proportion of urban population seems as lower side in Lahore, where as the facts are contradicted (Zaman, 2012).

Rawalpindi has very less population from the pioneer of its inhabitants which belongs from the same city. The major community is from northern & central Punjab, pothohar region, Murree, Kashmiris, phustuns and from the surrounding cities like Chakwal, Abbottabad, Attock, etc. In the winter seasons, the people belong from the cold areas especially Murree, came to Rawalpindi temporarily but they keep their residents empty through their relatives. This also increases empty homes. The maximum population of Islamabad is also from the outer side and sometimes called as the city of passengers who come back to their native towns on public holidays. In the beginning, the population of the small villages in Islamabad was shifted to Rawalpindi which becomes permanent residents of city. The people come from the outside of Islamabad and Rawalpindi, have sold their properties in their native towns and purchased land and permanently settled in the twin cities with their family members. This has increased the population growth and urban expansion.

1.7.1 Influx of People to Rawalpindi due to Immigration, Disaster and Emigration

In the recent times, the structural and social transformations in this region are responsible for the phenomena of rural to urban migration. The educated and resourceful migrants prefer to shift in Islamabad for better opportunities and peaceful urban social life. While the economic, environmental and social migrants with less financial support find an abode in urban centers such as Rawalpindi. Resultantly, the

density of human population in both urban centers is rapidly increasing (Adeel, 2010b).

During the 1980s Soviet-Afghan War, Peshawar was a center for Afghans refugees. Peshawar assimilated many Pashtun Afghans with relative ease, since the city shares historic and cultural ties with Afghans, and the city became home to many Afghan people. These Afghans further shifted to Islamabad & Rawalpindi in search of jobs, labor and business etc. In Rawalpindi, Afghans are found primarily in Pashtun-dominated suburbs. Before 2006 about 25,000 Afghans lived in refugee camp in Islamabad. The camp was closed, its refugees relocated and 7335 Afghans were reportedly living in Rawalpindi. In 2009, it was reported that the United Nations High Commission of Refugees (UNHCR) helped about 3000 refugees move from the slums of Islamabad to an undeveloped plot of land in a green belt on the edge of Rawalpindi city. It increases more haphazard urban expansion (UNHCR, 2017).

People migrated to Rawalpindi after 2005 earth quake in the northern areas and Kashmir i.e. from Muzaffarabad, Bagh etc. Due to flood in KPK and southern Punjab, people also migrated to Rawalpindi to live in save places and get job. This has also increase urban population in Rawalpindi.

Since the 1990s, a large number of Pakistanis who settled in Europe have been returning to Pakistan. Those who were born in Europe have also maintained close links to Pakistani culture. Those returning from northern England (Bradford), majority can be found in northern Punjab (Jhelum, Chakwal & Attock) especially in Rawalpindi. Since the September 11, 2001 terrorist attacks and financial crisis of

2007-2010 in United States, a large number of Pakistani Americans & Canadians have begun to return. Those returning from North America have tended to find jobs easier in Pakistan due to their abroad experience especially in Rawalpindi/Islamabad and resided with their family here. This has also increased the urban population growth (Department for Communities and Local Government, 2009).

Some people of Rawalpindi and Islamabad are working in foreign ministry and embassies and other multinational companies. For better future, they are looking for abroad visa for them and for their family, relatives and friends. This has increased people to live in twin city. The remittances send by the overseas Pakistanis are invested in the land and property in Rawalpindi & Islamabad. Many Land & property marketing companies provides online services for purchasing plot, house, shop etc. These marketing companies have their offices in Islamabad & Rawalpindi. People prefer to live in Islamabad & Rawalpindi to pay the monthly installment & collect rent of house and shop. This has increases urban growth potential in Rawalpindi.

The highest property value in Pakistan is in Islamabad after Karachi and Lahore. In Islamabad the price of the plot is depending upon it size, location and government policies about the vicinity. For instance, the private developer takes Rs. 1 million development charges per 1 kanal plot in an area or housing schemes and Capital Development Authority (CDA) takes Rs. 5 million development charges per 1 kanal plot in an area or sector. The Development Charges of CDA includes the high infrastructure of Islamabad. The rich people want to live in Islamabad and the rest of

the people prefer to live in Rawalpindi with low infrastructural cost. This has also increased the population living in Rawalpindi, those are working in Islamabad.

1.8 POLITICAL INFLUENCE IN RAWALPINDI

The development and growth of the city has very much belonged to the political parties and their influence in the area. The national and provincial assembly constituencies like NA-63, PP-12, PP-13 and PP-19 are the peripheral and suburban area of Rawalpindi. A paved street is one of the prime concerns of the people who have land and plots. Pavement of streets along with sewerage & drainage system is one of the priorities of the Member of National Assemblies (MNA) and Member of Provincial Assemblies (MPA) to meet the demand of their voter. Ex interior Minister Chaudary Nisar Ali Khan has completed many development projects in Rawalpindi city and its suburbs. Everyone will find the sign boards of his name and the estimates of the development projects in every street corner in the outskirts of the Rawalpindi city. This has increase street pattern of the edge of the city. Future growth potential of Rawalpindi city can be assessed from the layout and morphological pattern of the settlements along peripheral roads.

1.9 FACTORS OF URBAN SPRAWL

Six major factors promoted urban sprawl in the United States and some other countries. First, ample land is available for most cities to spread outward. Second, house building loans from the governments stimulated the development of suburbs. Third, less fuel price then monthly house rent promoted car use and the construction of highways, bypasses, ring roads and outlying tracts of land. Fourth, tax laws

encouraged home ownership and property taxes and utility charges are less in suburban and peri-urban areas. Fifth, most federal and provincial zoning laws favored large housing plots and separation of residential and commercial areas. And sixth, most cities areas are the combination of federal and provincial assembly constituencies and these public representatives rarely work together to develop an overall plan for managing urban growth.

On the other hand, many people prefer living in suburbs and exurbs. Compared to central cities, these areas provide lower density living and access to larger lot sizes and single-family homes. Often they also have newer public schools and lower crime rates. As they grow outward, separate urban areas sometimes merge to form a megalopolis. For example, the remaining open spaces between Lahore and surrounding cities like Narang Mandi, Muridke, Sheikhupura, Bhai Pheru, Raiwind and Kasur are rapidly urbanizing and coalescing. The result is an almost 200 kilometer-long (100 km radius) urban area that contains about 20 million people and sometimes may be called as Greater Lahore region.

1.10 DRIVING FORCES AND MORPHO-MECHANISMS OF SPRAWL

The most common mechanism by which specific spatial forms appear sprawl phenomenon is the fragmentation. This means, in a first instance, successive sub-division of agricultural parcels, reducing street hierarchy, jumps in the street connectivity (lack of collector roads), consequently leading to a discontinuity throughout the peripheral tissue.

Poor land fragmentation is often accompanied, in functional terms by another mechanism, that of juxtaposition: joining incompatible functions (housing/ industry or housing/infrastructure), overlap of adverse interest (public/private), jumps in scale of the urban fabric, cultural "colonization" (urban values colonizes the rural world).

The third mechanism identified (illustrative for Bucharest) is the intercalation, characterized by joining of mutually dependent functions (agriculture - housing, storage - housing), lack of communication between different entities, passive co-existence between segregated communities, completely disjoint between very different architecture and lifestyles (McKee e t al., 2004).

Both juxtaposition, and intercalation bring with them another phenomenon, that of parasitization, regarding the urban image and the relationship between morphology and environmental factors. On the one hand, it refers to that aggressive development to an item (often natural) that it smothers; on the other hand, it means a completely alien inoculation into an existing context. In both cases there are significant risks of pollution and there is an alteration of the landscape on its natural qualities.

The last among machanisms and one with the strongest imprint (also the hardest metabolized) is the randomisation. It may include all the other mechanisms that parts of it, but its meaning is one of total fracture from the city and the creation of enclaves or points with weak further connectivity opportunities. Known as the "leap frog" (Heim, 2001) development, it is an uncontrolled development on totally unprepared for urbanization land (Jenks et al., 2000) it tends to a particular

"vernacularization" through successive adaptations to an unfavorable context (STAN, 2013).

1.11 STATEMENT OF THE PROBLEM

Rawalpindi is the third city in Pakistan with highest urban growth rate. More than 1 million urban population is increased and 10 percent urban land is converted into built up area in last 10 years. Rawalpindi and its suburbs are facing number of problems due to uncontrolled expansion such as inappropriate land use growth and haphazard development. For this thesis, the study area was restricted to peripheral area of Rawalpindi along outwards roads, so that the pattern, potential and policies of urban growth can be explored in sufficient detail and completeness. Uncontrolled spatial growth of Rawalpindi can be summarized in the following points:

i. Expansion of existing settlements is being carried out in violation to urban land use and development control standards, thus uncontrolled and haphazardly since long. This is an urban sprawl (i.e. expansion of buildings at the expense of the suburban land) in Rawalpindi which is using up green fields irrespective of the street pattern. Unchecked spatial growth in patches and clusters is constantly depleting the morphological layout of Rawalpindi. People are encroaching the "right-of-ways" of peripheral roads through informal land subdivision. Major haphazard expansion is evident along *Adyala, Chakri* and *Girja* Raods, mostly in settlements of *Kalyal, Ranial* and *Dhoke Girja*. A number of settlements

have been expended along peripheral roads in *Dhamial* and *Chakra* as well.

ii. Peri-urban settelments are facing continous deterioration in their physical appearance. Uncontrolled development has converted green and barren land into built up area in patches, clusters, randomly distributed, dispersed and linear form. The land use conversion is at alarming rate espaecially along peripheral roads due to infrastuctural facilities. This has increase the urban growth potential in peripheral area as the land value is cheaper than core city area. i.e. Rs. 1 million per kannal.

iii. It is observed that Development authorities have no legal power through Landuse & building control policies on land acquition and utilization for the implementation of Master Plan. Only housing schemes approval process for Non Objection Certificates (NOC) and commercialized roads are the prime authority of Development Authorities (DA). Rest of area is expanding haphazardly.

Cities are living organism. Urban growth is directly proportion to it's population. Development required road for connectivity and roads attracts development also. Urban density and land values is high in Central Business District (CBD) and it decreases as the distance is increasing from the center. People who has less purchasing power to buy a piece of land near to CBD or can't afford housing prefer to live in outskirts. Therefore urban expension is must for accomodating the growing population of the city.

Apart from this, cities have physical and economic constraints in expension. Small right of ways of outward roads, narrow streets due to encroachments, high volume of traffic on outward roads have reduce the potential urban development in the outskirts. Unavailability of municipal services and low level of utility services are also physical constraints in the urban expension. Urban sprawl and leapfroag development has reduce the intrest of local authority to provide infrastructure and public transport. Delays in the development of housing soceities has reduce the intrest of the people to invest in these schemes.

1.12 RESEARCH QUESTIONS

- What are the urban growth patterns which may be identified along these peripheral roads?
- What are potentials and constraints of these major urban growth corridors for urban expansion?
- What are the recommendations of urban growth policies and strategies about future growth of the city?

1.13 OBJECTIVES

- To explore the patterns of urban growth/expansion along five major corridors of the Rawalpindi city
- To measure the potential of each road in terms of attracting the urban development.
- To identify the urban policies which are related to the future growth of the city.

1.14 SCOPE

The major concern of this study is to explore the pattern of urban expansion along the growth corridors of Rawalpindi. In this context, it also underlies the issues of physical and socio-economic aspects of urban expansion of growth corridors.

Pattern of urban settlements includes linear, circular and settlements in cluster form etc. the pattern of urban settlements of the case study area are exclusively explained. The layout and street pattern of existing settlements in the periphery of the city is also included. The factors which attracts development along peripheral roads specially those which make urban development accessible to different target groups are also discussed. The study is based on reconnaissance and wind screen surveys of the peripheral settlements and urban growth corridors. The overall physical and socio-economic aspects of these two types of peripheral roads and settlements and their relationship with each other are also explored.

The results of the study will be very beneficial for concerned planning authority in adopting appropriate measures to resolve the problems regarding expansion along peripheral roads and managing urban growth. Recommendations will also be helpful for planning authorities working in other cities of Pakistan and catering the same problems concerning landuse allocation and building control.

1.15 RATIONALE

The physical aspect of the urban growth like morphological and layout pattern of the settlements is studied but it is not incorporated with urban growth policies. Similarly the economic aspect of roads in terms of attracting development is well

known but it is not controlled by planning authorities rather it is declared commercialized roads which allow city to expend in linear form. Contrary to this, people who did not afford housing they willing to live in outskirts. This social feature is not included in policy making for future growth of the city. This required comprehensive research to determine the problems related to these physical and socio-economic aspects of urban development and to ensure the satisfactory planning policies for the future growth of the city.

1.16 LIMITATIONS

Research work every where is subject to certain restrictions and limitations. Similarly, in the completion of this research work, the researcher encountered a number of hindrances. The foremost amongst these were:

- Due to lack of proper and complete data of housing and population census data, the current landuse cannot be calculated.
- Sampling cannot be done up to the mark as the census units and settlements data is not available on paper.
- The data regarding governing body decisions was to be extracted from files maintained by RDA proved to be very laborious process.
- Cost analysis on the extraction of data and analysis is not calculated.

1.17 THESIS STRUCTURE

This thesis consists of seven chapters. The brief description of each chapter is as under in sequential manner:

Chapter 1 discusses the statement of the problem and background of the issue. Moreover, to support the base of the subject matter, the justifications of the thesis are given. Also the scope and factors affecting this research are presented. Limitations that have affected formation of thesis or in collection of data are also shown. Overall, procedures carried out to achieve the objectives through a clear research methodology involving a comprehensive account of all the actions and are given.

Chapter 2 introduces the case study. Data regarding layout pattern of peripheral settlements are discussed in this sector. Moreover, potential of urban growth corridors in terms attracting development is also explored. Population of each settlement, area of attraction etc is also emphasized here. The reviewing of previous as well as up to date data pertaining to urban polices, landuse, building control housing and factors which affecting urban growth and development was another main physical, economic and social aspect of this research thesis. Potential and constraints of these urban growth corridors are discussed. Pros and cons of low density and urban sprawl are also presented.

Chapter 3 deals with review of literature on topic in hand. It is one of the most important aspects of the research. This chapter presents a summary of literature closely related to the research topic.

Chapter 4 gives the hierarchy of the peripheral settlement. The physical, economic and social aspects of such type of settlements and how settlements generate grow and expending while population increases.

Chapter 5 shows the potential of five major urban growth corridors of Rawalpindi and population density of settlements which comes in the catchment area of each road.

Chapter 6 provides overview of urban polices. The physical, economic and social aspects of policies while growing of the city.

Chapter 7 includes the conclusions and the recommendations.

Chapter 2

LITERATURE REVIEW

2.1 URBAN EXPANSION

Cities have transformed to interconnected centers of physical, social and economic activities from isolated locations in the last century. It is a natural and inevitable phenomenon that spatial expansion of human settlements either vertical or horizontal, is considered in this regard (Adeel, 2010c). Built-up environment containing buildings and related physical structures will gradually take the place of the un-built land, as a result (Adeel, 2010b). People who has less purchasing power to buy a piece of land near to CBD or can't afford housing prefer to live in outskirts. Therefore urban expension is must for accomodating the growing population of the city.

2.2 EFFECT OF IMMIGRATION ON URBAN GROWTH OF RAWALPINDI

The first major wave of immigration was influx of Afghan refugees that entered in Pakistan following the soviet invasion. At least one million Afghans are estimated to have reached Pakistan by 1979, with a total of 3.3 million having fled to Pakistan and Iran by 1980. In 2001, after 9/11 the US begins attacks on militant targets in Afghanistan, promoting a fresh wave of migration to Pakistan. Around five million Afghans have crossed into Pakistan since 1979. These Afghans were resided into official 334 refugees camps and then spread all over Pakistan especially in big

urban centers like Peshawar, Islamabad, Rawalpindi, Quetta and Karachi etc. That increase more dynamic pressure and burden on cities with influx of these Afghan's population and create slums, squatter settlements and Katchi Abadis (UNHCR, 2017).

2.3 EFFECT OF EMIGRATION ON URBAN GROWTH OF RAWALPINDI

About 7.6 million Pakistani live abroad, with the vast majority, over 4 million, residing in the Middle East. The second largest community, at around 1.5 million, lives in the United Kingdom. In 2017, overseas Pakistanis sent remittances back to their families amounting to Rs 2137 billion (US 15 billion dollar) which is highest ever. Overseas Pakistanis are the second largest source of foreign exchange remittances to Pakistan after exports over the last several years. The first mass migration of Pakistanis began in 1965 during the construction of Mangla Dam in Azad Jammu & Kashmir. Over 280 villages around Mirpur and Dadyal were submerge, which lead to the displacement of over 110,000 people from the region. During the same period, the British government was activity seeking from abroad to work in industrial towns in north-west England who were suffering from worker shortages. Thus many worker permits for Britain were awarded to the displaced populations of Mirpur who were eligible for work. Close to 50,000 Pakistanis from Mirpur emigrated to Northern England between 1965 to 1970. Rest of the people shifted to the surrounding towns and cities including Rawalpindi & Islamabad (Department for Communities and Local Government, 2009).

2.4 URBAN LAND

In rural areas, people have big parcels of agriculture land from their forefathers. These agriculture fields are normally divided into 1 acre parcels which are separated through narrow walking footpath little bit rise from ground. This sub-division is necessary for irrigation purpose and estimation of crop production. For the access of crop machinery, a lane is separated between adjacent crop fields so that animal carts, tractors, leveling and thrashing machinery can be used for the transporting purpose for the produced items. The farmers and tenants used to live in jointly shared small settlements in which they keep their cattle also and left the agriculture land for cultivation so that each parcel of land may not be used by respected land owner for living purpose separately. When the land property is further distributed to the next generation, they keep the same owned land for cultivation and increase the habitual dwellings for their family in the same jointly shared living settlements. It has evolved the concept of shared ownership of land for both agriculture and living purpose. The farmers, tenants, milkmen and labors etc joins these settlements with their family which make it a village. These villages make clusters around urban centers. District Hafizabad is one example of this type of clusters, which have 128 villages around Hafizabad, Jalalpur bahttian etc.

2.5 SLUMS

If someone visits a poor area of a typical city in a developing country, his senses may be overwhelmed by a chaotic but vibrant crush of people, vehicles of all types, congestion, noise, traffic jams, and smells, including smoke from burning trash

and wood and coal cooking fires and raw sewage. Many people sleep on the streets or live in crowded, unsanitary, rickety, and unsafe slums and shantytowns with little or no access to safe drinking water or modern sanitation facilities (Fouberg et al., 2009).

2.6 TRANSITION ZONE & MIX LAND USE

The transition zone of the city is the area where public building and commercial area have merged with the residential sectors. Retail business like general stores and light manufacturing industries like auto-mechanic shops & service stations etc. have surrounded around residential blocks. Mosques, Schools, beauty parlor, guest house, tuition center etc. are found within the residential area. Mix land use development have made along the roads which connect these transition zones and residential sectors. Commercial Banks, Government office like post office, Town Committee office, offices of utility services, support complex, marriage halls etc. are the prominent features of these roads. The residential area in transition zone is consist of family quarters of Government employees, high and middle income people houses, bachelors hostels and dwelling units of mostly people working in CBD and public buildings of transition zone. These transition zones are further divided into industrial zone, educational zone and commercial zone etc. Industrial zone doesn't mean that the whole zone has consisted of industries, rather it has residential area but the dominating area is industrial area. Sindh Industrial & Trading Estate (SITE), Karachi is one of the examples of these types of industrial zones. In public building zones and industrial zones, public housing colonies have occupied closely spaced homes for labor force and middle class residences for Government employees. The residential

colonies for industrial workers are usually separated with buffer zone which has converted into Neighborhood Park. The outer ring of the city consists of land marks and nodes at cross junctions and road intersections. Land fill site, sewerage treatment plant, sports ground & stadium, heavy machinery markets, nurseries, regional transport terminals, grid station; wood tolls etc. are the prominent land uses of the outer ring of the city. The small urban settlements scattered around the outer belt indicated the city entry and exit points.

2.7 HOUSING

Housing or shelter is essential for human survival. Without a right to housing, many other basic human rights will be compromised. The factors like the right to family life and privacy will be disturbed. Also freedom of movement will be affected. The right to assembly and association will be hindered. Fundamental social factors such as health and development will be stalled.

The right to housing is plainly supported by international laws. The very foundation of these international human rights systems is the Universal Declaration of Human Rights. This Declaration is adopted by the United Nations in 1948. It establishes an internationally recognized set of standards for all human beings.

In the article 11 of the International Covenant on Economic, Social and Cultural Rights recognizes the right of all people to adequate housing and commits state parties to take appropriate steps to ensure the realization of that right. Article 11 recognizes, ".... the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing..." and that "States

Parties will take appropriate steps to ensure the realization of this right" (Hasan, 2011).

2.8 URBAN SPRAWL

Nelson et al. (1997) describes urban sprawl as " …unplanned, uncontrolled and uncoordinated single use development that does not provide for an active and functional mix of uses and/or is not functionally related to surrounding land uses and which variously appears as low density, ribbon or strip scattered, leapfrog or isolated development" (Nelson et al., 1997). Urban sprawl refers to a specific form of urban development characterized by low-density, leapfrog, commercial strip development and discontinuity (Downs, 1999; Ewing, 1997; Galster et al., 2001). Urban sprawl is an inevitable consequence of the spontaneous development of cities. Sprawl occurs when the rate of land use conversion and consumption for urban uses exceeds the rate of population growth for a given area over a specified period (Aksoylu, 2015).

2.9 TRAJECTORY OF URBAN GROWTH IN RAWALPINDI

2.9.1 Pre 1890 AD

An ancient city existed on the site now occupied by the cantonments. It was known as 'Gajipur' or 'Gajnipur' and was of considerable size. A small village existed about 3 miles to the north of Rawalpindi, named Ghaznj, on the banks of the same stream as the cantonments, it most probably preserved the old name of the city.

Within historical times the old name of the place was Fatehpur Boari, but the town which bore this name was completely destroyed by one of the Mughal invasions of the fourteenth century. It remained deserted till Jhanda Khan, a Gakhar chief,

restored it, giving it the name of 'Pind' or 'Rawalpindi' from the name of 'Rawal', which was at one time a flourishing place, a few miles to the north of the Town on the road to Murree. The Town, however, was of no importance until after 1765, when it was occupied by Sardar Milka Singh. He invited traders from Bhera, Miani, Pind Dadan Khan and Chakwal, flourishing towns of then, Jhelum and Shahpur Districts, to settle in Rawalpindi. Due to this incentive, the town rapidly grew in importance.

In 1849, the area came under the British Empire and development started taking place rapidly. The British immediately established cantonments on the strategic places. Rawalpindi was an obvious choice, being on the route leading to Khyber Pass and Kashmir. It also helped to keep a check on the tribal people in the North-West, who were never subjugated to the British.

The establishment of the Cantonment brought first official recognition to this small town. The Cantonment was also the first planned effort in Rawalpindi. The Cantonment was established on the western side of the Town, using Nullah Lai as a physical barrier to keep the military installations away from the civilian population for security reasons. It was more significant to the colonial rulers who always maintained a certain distance with the local population. However, the Cantonment became an instrument, in bringing economic activity to the City.

Murree was selected as summer headquarters of British Governor of the Punjab. Rawalpindi gained significance, as passage to Murree had to be through Rawalpindi. The municipality of Rawalpindi was first constituted in 1867. It had a

population of 28,586 in 1868, which increased to 52,975 in 1881 and subsequently to 73,795 in 1891.

The next major step was the Railway line which was extended to reach the City in 1879. It was much needed for the movement of the troops, which became another major factor contributing to the development of the City. The Railway line divided the Cantonment and the City thereby creating another barrier between the two parts. As the City and the Cantonment started growing Lei Nullah and Railway line caused obstruction to compact City growth. However, interdependence was bound to make the trend of the development in each other's direction. Commercially Rawalpindi acted as the feeder of the cantonments, and for this purpose all kinds of articles were collected here. A considerable portion of the trade of then province with Kashmir passed through the City. There were however, no manufactures or industries of importance situated here.

The principal buildings of Rawalpindi were the Tehsil building, Police Thana, Municipal Hall and City Hospital, which were situated at the place, where the road from cantonments, an extension of Sadar Bazaar, entered the City. The Map of the Trajectory of Urban Growth indicates that up to the year 1900, the City grew up with the establishment of Cantonment, but there was little development to the areas on western side of Lei Nullah, known as Sarai Beli Ram.

2.9.2 1901- 1947 Period

According to 1901 census, the City had a population of 87,688 persons, which reflects that it had grown to a considerable size by that time. The period from 1901 to

1947 does not indicate any major economic incentive, which would have boosted City's growth substantially. However, it is clear that the cantonment was extended and City developed at a normal pace, mainly in the eastern and southern directions. The Chaklala Cantonment is said to have been established during this period, thus pulling the development trend on the eastern side. The city also grew to fill in the gap up to the Asghar Mall Road on Sarai Beli Ram side. The population stood at 185,042 persons in 1941.

2.9.3 1948 - 1967 Period

At the time of independence in 1947, a large number of people migrated from other side of the border, thereby increasing the population of the City. Rawalpindi also gained special significance as it was declared the Headquarters of Pakistan Army. This meant increase in the military personnel, which brought in more economic activities. The City had population of 237,219 persons in 1951.

'The Trajectory of Urban Growth' reflects that the major development of the city started in 1948, due to influx of migrants from India. To solve the problems of refugees, Satellite Town Scheme was planned by the Punjab Government in 1953, thereby extending the City to the north.

In 1960, the development of Islamabad, as Federal Capital commenced. Rawalpindi was however, declared as an Interim Capital. This was indeed a great honor for the City, but the decision brought an impact of great consequences on City development. The economic activities increased but at the same time serious housing shortage for the residents was witnessed. However, this brought in huge investments

by public-and private sector. To meet the requirements, the development was rapid, but without any systematic plan thereby creating slums beyond the Satellite Town, up to Islamabad Highway and beyond Lei Nullah up to Pirwadhai Road.

The City grew tremendously but infrastructure and services could not keep pace with population growth. Resultantly, these were taxed to choking point. The federal offices eventually moved out of Rawalpindi, in a phased programme, but infrastructure remained constantly in the state of overpressure, due to rapid urbanization.

2.9.4 1968- 1996 Period

The Development of City got maximum momentum during this period. However, it became relatively compact, as large tracts of land were utilized as infill development, in almost all directions. In this period, major growth trend remained towards western and southern sides. However, some developments on other sides also took place.

In the northern side, Satellite Town was completely colonized. This structural change had physically linked up the City with Islamabad, up till I-J Principal Road, a boundary of the twin cities. Similarly in the western side Area Development Scheme named Khayaban-e-Sir Syed, developed by Housing and Physical Planning, Punjab, also appeared as an important residential area that linked the City with Islamabad.

Due to population pressure, the development had crossed the barriers and had over-spilled into the built up areas, of the Cantonment. At that time, attractive areas were along Chaklala Road, Chakri Road and Adiala Road, where numerous private

housing schemes were under stages of development. Since the government could not keep balance in the supply and demand of residential plots therefore, katchi abadies also appeared, at different locations on City's landscape.

As per Master Plan 1968, the commercial activities were concentrated in the central parts of the City. However, from 1976 to 1996, Murree Road appeared as a major commercial area, where commercial activity took place in ribbon form.

Till 1996 more than 20 commercial centres had appeared in this longitudinal commercial strip, extending over 10 Kilometer length. At that time important commercial centers were near Shamsabad, Chandni Chowk and Committee Chowk, along this road. Although it helped in strengthening the economic base of the City yet numerous traffic problems arose, due to on street parking and lack of development control. In addition, two other commercial centers were developed in Satellite Town i.e. Commercial Market and Katarian Market.

The land use conversion, particularly from residential to commercial, rapidly took place during this period. The residential areas along Circular Road, Jamia Masjid Road, Iqbal Road, Asghar Mall Road, Saidpur Road and Raja Bazaar were converted into commercial use.

At that time the existing bus-stand was creating traffic problems for the inter-city and intra-city traffic. A new bus-stand was therefore, developed at Pir Wadhai in 1976. This solved many inter-city traffic problems to an extent. In the same year, the Satellite Town telephone exchange was also constructed. Al-Shifa Eye Trust Hospital was constructed in the year 1980. Similarly, Rawalpindi Medical College and Barani

College were also built in the same period. Municipal Park on Murree Road, Satellite Town and Government Girls College, Government College for boys, Murree Road was also constructed during 1991-92. In addition, a new road, namely, Shahrah-e-Stadium was constructed to link the City with the stadium in 1991-92.

A considerable number of built-up areas were added to the City landscape during 1968-1996, as the total area increased from 23,134 acre in 1968 to 23,687 acre in 1996, including the Cantonment areas.

The City developed along G.T. Road on north-western side, whereas the areas like Allahabad, Naseerabad, Dhok Mustqueem and Afshan Colony etc. were established during 1970-1996. New abadies i.e. Dhok Kala Khan, Dhok Paracha, Dhok Kashmirian, on the east of Murree Road, were also developed during this period. Gulistan colony and Jhanda colony, were developed on the south-eastern side of the City, during 1970-1996. Mahmood colony also developed in the southern part, during this period. Another visible structural change was the construction of over-head water tanks, in different parts of the City. Similarly, widening and extension of existing grid stations and telephone exchanges were carried out, to meet growing needs of the population.

The City, being a divisional headquarters, had a very strong economic base that had its regional influence. Islamabad had also a very strong multiplier effect on Rawalpindi's economy, as substantial population gets job opportunities at Islamabad. This factor also contributed a lot towards physical development of the City (NESPAK, 2010).

Chapter 3

MATERIAL & METHODS

3.1 METHODS OF RESEARCH

Rawalpindi is continuously facing urban expansion from the last three decades due to uncontrolled growth and haphazard development of settlements in the outskirts of the city. The ever increasing population pressures and growing settlements in the area point out to a totally opposite picture to what had been foreseen and planned through Rawalpindi Master Plan 1996. This study analyses the pattern, potential and policies of urban growth and expansion in Rawalpindi, which essential part of planning process, in order to ensure sustainable growth of Rawalpindi.

This study explores historical nature and past trends of spatial growth in Rawalpindi. The study identifies 'spatial growth trends' in terms of magnitude, intensity, location, form, size, shape, pattern and direction of nature as well as extent of urban growth over time. It draws a methodology to identify the future growth potential based on the parameters of population density, built up area, existing LULC, distances to major road. Urban growth management policies, land use allocation, and building and development control measurements have been discussed in this research.

3.2 DATA & MATERIAL USED

Primary as well as secondary data have been used in the study. Primary data included satellite imageries, census population, peripheral road network and results from unstructured reconnaissance & wind screen survey. Secondary data included

published maps with administrative boundaries and a number of published documents related to the problems of uncontrolled growth in the study area.

Population of each settlement (Mouza) was obtained from District Census Report of Rawalpindi for year 2017. Future population of each settlement (Mouza) has been estimated for year 2037 using 2017 population rates.

Landsat satellite imageries of Rawalpindi were obtained from United States Geological Survey (USGS) website for the study. Table 3.1 shows the detail of the temporal, spatial resolution and bands of the two landsat images used in this research.

Table 3.1: Landsat 7 and 8 imageries

Image	Temporal	Spatial	No. of Bands
Landsat 7	2009	30 m	8
Landsat 8	2019	30 m	11

ArGIS 10.3 online imagery is used as based map for demarcation of administrative and settlements (Mouzas) boundary. Google Earth Pro software was used for updated information. Google Maps from internet was used for the names of the location and respective coordinates.

The following paper maps (Table 3.2) have been used either as base map or as primary data source for the study.

Table 3.2: Paper maps

Sr. No.	Name	Source
1	Administrative Boundary Map	Rawalpindi Development Authority
2	Census Map	Pakistan Bureau Statistics
3	Master Plan of Rawalpindi 1969 & 1996	Rawalpindi Development Authority
4	Union Council Map	Urban Unit, Lahore
5	Rawalpindi Tehsil Map	Survey of Pakistan

Related official documents from RDA provided complementary information regarding metropolitan planning, land use zoning, development control, Master plan implementation and the problems of spatial growth in the study area.

3.3 RESEARCH METHODOLOGY

Every project has some simple set of methods or procedures. Research methodology is nothing more or less than the systematic study of methods that are, can be, or have been applied within a discipline. Methodology can be defined as a plan or strategy to guide the work in particular right direction. Therefore every project has some stipulated time, which forms from the objectives of the study. The objective of the study is to explore the patterns of urban growth/expansion along five major corridors of the Rawalpindi city. To measure the potential of each road in terms of

attracting the urban development and to identify the urban policies which are related to the future growth of the city.

Three major datasets used in the study including satellite imageries, settlements population and review of official document regarding major reasons for uncontrolled urban expansion.

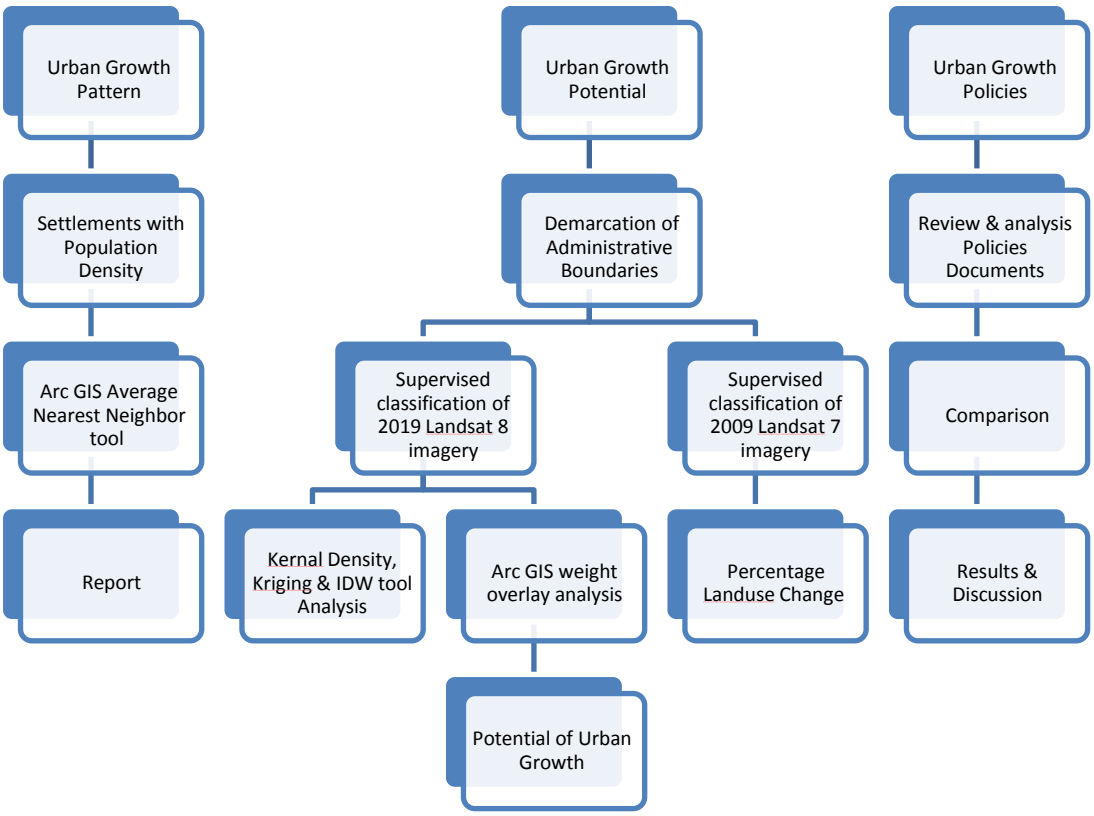

Figure 3.1: Research methodology

3.4 SECONDARY DATA COLLECTION

All the secondary data was collected pertaining to population density, land cover and boundary of Rawalpindi etc. which was a very important task to firstly initiate. Rawalpindi Development Authority gives me all the much needed data. RDA

provides me the shape files of settlements of the case study which include union councils & mouzas with area and number of union councils & mouzas comes under the jurisdiction of the RDA. The base of thesis was data collection. The secondary data collected had a direct relevance to the objectives and topic at hand.

3.5 PRIMARY DATA COLLECTION

In formation of this research thesis, reconnaissance and wind screen surveys of the peripheral settlements and urban growth corridors respectively are the key factors. In section-wise manner, the findings of all of these surveys have been presented. About physical and social aspects, expert's views are discussed. Potentials formed by both roads and development are noted and compared. Opinions and views of representatives of district council and RDA have been obtained.

3.6 SAMPLING FRAME

The descriptive approach was used in this research. Primary data has been collected through field surveys. The reconnaissance survey has been conducted to look at the layout pattern of each settlement along five major urban expansion corridors of Rawalpindi. Wind screen survey has been conducted to see the potential of each road in attracting the urban development. Secondary data has been collected through Government department. Population of each mouza of Rawalpindi and its area has been taken from the website of Pakistan Bureau of Statistics. Rawalpindi urban area has been marked on the map through the assistance of Rawalpindi Development Authority. All the mouzas falling beyond the Cantonment limits (Rawalpindi urban area limits in 1998 population census) till the jurisdiction of

Rawalpindi Development Authority have been marked through the assistance of Revenue Clerk (Patwari) of each mouza. Urban Policies have been studied through government official documents.

3.7 INDICATOR USED

Indicator is defined as a measurable entity related to specific information needed, or progress toward an objective. To explore the patterns of urban growth/expansion along five major corridors of the Rawalpindi city, all the mouzas falling beyond the Cantonment limits (Rawalpindi urban area limits in 1998 population census) till the jurisdiction of Rawalpindi Development Authority have been marked on the map. The settlements (mouzas) which are depending on each road have been separated. The pattern of growth of each settlement has been identified through its morphological structure. Population density of each settlement (mouza) has been measured through its area and population, which incorporating in the growth along each corridor. The potential of each road in terms of attracting the urban development has been measured by dividing the sum of population of the settlements which incorporating in the growth along each corridor by its density. It will provide the future area which will be expand in the form of urban development due to each road. Rawalpindi Master Plan, Rawalpindi peri urban structure plan and other local government plans will suggest the future growth of the city. Spatio-temporal growth of Rawalpindi has been measured through LULC.

3.8 DATA ANALYSIS

Analysis on primary data as well as secondary data was done with use of Geographical information System and ERDAS Imagine software. In Arc GIS, Settlements have been marked on base map through point shapefile. 1998 Population of each settlement has been attributed in attribute table and shown through "label features". Urban Union Councils beyond the limits of Rawalpindi city in 1998 census have been marked using polygon shapefile and 2009 population of each UC has been attributed in attribute table. Symbology tool was used in properties and shown through "label features".

Temporal data of satellite images was used to identify the extents of spatial growth which was obtained through the analysis of historic LULC change, urban built up area clustering and urban expansion. The month of data acquisition was preferred to be same to have similar climate impact on all datasets. LULC mapping of the study area was carried out through visual interpretation of satellite imageries. For this purpose maps and images are visually enhanced and projected with good spatial resolution for accurate digitization. The process started with the preparation of base map from Landsat satellite imagery showing physical features of Rawalpindi e.g. major road network and water channels. Rawalpindi Master Plan 1996 was overlain on the base map to identify the locations of existing settlements as marked in 1998 census and the boundaries of administrative units and urban settlements (mouzas). A suitable LULC schemes was developed for visual image interpretation. LULC classes

were finalized keeping in view objectives of the study and personal knowledge of the study area.

In ERDAS Imagine, unsupervised image classification and indices tools were used for identification of physical features. 2009 landsat 7 and 2019 landsat 8 imageries with same spatial resolution of Rawalpindi have been classified using supervised classification tool in raster drop down menu. Four feature classes i.e. water, vegetation, built up area and barren land have been classified through spectral sample (training sites) in signature editor separately for each image. Maximum likelihood rule has been used for classified image output. Area of each feature class has been calculated in acres from attribute table. Accuracy assessment has been performed to check the accuracy of each image. The area of feature classes in both images has assessed and percentage of Land use / Land cover (LULC) change has been calculated.

The boundary of each settlement (mouza) of Rawalpindi beyond the cantonment limit has been digitized as polygon on LULC of Rawalpindi. To measure built up density, built up area has been calculated by multiplying number of pixels of built up feature class with area of each pixel. Remaining study area was digitized as polygons of corresponding LULC class. Principles of visual interpretation (location, size, shape, pattern, texture, local knowledge of interpreter etc.) were used for LULC mapping. Resulting LULC classes were improved by cross verification and correction after overlaying published maps of Rawalpindi Master Plan 1996, RDA governing area and hosing schemes acquired area.

Supervised and unsupervised classification recognized the LULC in the images which was very useful for manual delineation of dominant LULC in the study area. Nature of spatial growth was determined through settlement, union council and mouzas population data of year 1998, 2009 and 2019 respectively. It was explored in terms of changing population densities, growth pattern and percentage of land use change. The pattern of growth is determined by nearest neighbor technique in which location of each settlement and its population is imported in to Arc GIS. It tells the nature of spatial growth i.e. cluster, random or dispersed.

Future growth potential of the study area was identified through weighted overlay analysis of the nature and extents of spatial growth. Parameters used to identify the varying future growth potential in the study area included (1) LULC type; (2) population density; (3) built up density and (4) distance of built area along the periphery of the study area. Each parameter was given equal weightage for the analysis. The output raster was reclassified into 3 classes i.e. High, Medium and low growth potentials. This technique is useful for identifying growth potential of an area through its land cover, road network and population concentration. This method identifies the relative growth potential of the area only. The method proposed in this study area can be adopted for other areas with necessary modifications. For example, other parameters can be added to improve the accuracy of results; weights of parameters can be varied, overall influence of the parameter can be changed, etc.

Causes in the wake of uncontrolled urban growth were explored through informal meetings and group discussion with RDA employers. Review of literature of

urban expansion in Rawalpindi and survey of the research area were also conducted for this function. Four Organizations of Rawalpindi (RDA, Municipal Corporation, District Council, and Cantonments Boards) directly deal with physical development of the city. To explore the causes of uncontrolled urban growth, quires were asked from these organizations. Summary of the discussion outcomes, regarding major reasons behind the uncontrolled growth in the study area, has been given in the Chapter 6.

Chapter 4

URBAN MORPHOLOGICAL GROWTH PATTERN

4.1 URBAN LAYOUT

The urban morphology of a city is the layout of the city, its physical form and structure. When purpose or use of buildings is added to the map of the morphology of a city, it reveals the functional zoning of the city. The functional zoning reveals how different areas or segments of a city serve different purposes or functions within the city. The cities layout is conceptualized through models that illustrate the structures of cities (Fouberg et al., 2009).

The city takes the shape of its morphological pattern. If the city has circular layout pattern it will spread in all directions until or unless there is no physical barrier in each direction. However, if the city is built on gridiron pattern it will expend in the linear direction. Moreover, if the city is built on spider net pattern, its core area will be concentrated on the central business district, it transition zone will be populated around the neighborhood centers and suburban area will expend along peripheral roads. The future growth of the city will depended upon the layout pattern of the settlements on the periphery of the city. If the settlements are circular, then these settlements will expend in circular form. Ribbon development will occur if the settlement expends in the linear way along peripheral roads. If the suburbanization increases in patches or in leap frog development like housing schemes it will form clusters and merge together in future.

4.2 RAWALPINDI CITY- URBAN PROFILE

4.2.1 Demography

Rawalpindi City, the largest urban centre of Northern Punjab and the twin city of Federal Capital Islamabad, is ranked fourth among the big cities of the country. According to the Population Census 2017 the total population of the city is 2098231 and area is 686 square kilometers. The average House Hold Size for the city is 6.1. The average population growth rate of the city is 2.1 per cent. Cantonment & municipality (Rawal Town) comprises a combined area of approximately 97 sq km as per the boundaries provided by Population Census Organization, Rawalpindi Cantonment Board and Chaklala Cantonment Board. Rawalpindi Tehsil area is 1616 sq. km and density is 2016 persons per sq. km in 2017 census. The total population of Rawalpindi Tehsil is 3258547 in 2017 census. Urban share is 64.4 per cent and rural share is 35.6 per cent.

Rawalpindi is the District as well as Tehsil Headquarter and perhaps owing to this reason most populated (with population of 1,927,612 in 1998), and most developed in the district. Other most populated Tehsils are Gujar Khan, with population of 494,010, followed by Taxila with population of 371,140. Kahuta has population of 313,200 persons, and then comes the most popular family tourist resort Murree, with the population of 176,426. Kotli Sattian is least populated Tehsil in the district, with population of 81,523. Taxila has growth rate competitive to Rawalpindi, whereas remaining tehsils did not match the figures of these two. The industrial base

at Taxila, Wah and nearby areas can be one of the reasons for this increase that must have triggered urbanization in this Tehsil (Statistics, 1998).

Greater Islamabad Rawalpindi Area Transportation Study (GIRATS) 1994 reveals that the road network of Rawalpindi is spider net pattern. Its CBD is raja bazaar and the population of the core area is surrounding around raja bazaar. The rest of the settlements like satellite town, cantonments and residential area populated around neighborhood centers sadder, commercial market and panorama shopping center. The settlements at the edge of the city are extended along linear outwards commercialized roads like tanch bata and form a ribbon development. Rawalpindi city has five major urban corridors diverging from the city center towards the outskirts of the city. These roads have shopping centers, public buildings and attract population from the catchment area of its vicinity (C. D. Authority, 1994).

The objective of this study is to explore the layout pattern of the settlements in outskirts of the city, as in spider net road network the future growth of the city is depend upon suburban settlements. First of all Rawalpindi Development Authority limits has been marked on the map. The boundary of city up to which it expends till 1998 has been laid town on the map with the help of Rawalpindi Master Plan 1996. To explore the patterns of urban growth/expansion along five major corridors of the Rawalpindi city, all the union councils falling within jurisdiction of RDA limits and five major urban growth corridors starting from the city limits in 1998 have been marked on the map. The settlements (urban union councils) which are depending on each road have been separated. The pattern of growth of each settlement has been

identified through its morphological structure. Population of these union councils has taken from housing and population census report 1998 & 2017, Pakistan Bureau of statistics. Population density of the settlements has calculated by dividing the 1998 population of each settlement by its area. 2017 population of each settlement is divided by this 1998 population density to get the required future growth of this settlement. The different between the form and shape of each settlement during inter census period is taken as its future morphological pattern which incorporating in the growth along each corridor. This all work has been done through buffering technique in GIS software.

4.2.2 Administrative Units

During the Population Census of 1998 the city was divided into two major administrative units;

i. Rawalpindi Cantonment
ii. Rawalpindi Municipal Corporation

The rest of the area was under the administrative control of the District Council.

With the introduction of the Local Government System in 2001, the City's administrative units were dissolved into Towns. The tehsil is functioning under the following administrative units;

i. Rawalpindi Cantonment & Chaklala Cantonment
ii. Rawal Town
iii. Potohar Town
iv. Rawalpindi Development Authority

The landuse and building control within the jurisdiction of Rawalpindi City was given to Rawalpindi Development authority and infrastructural Municipal Services was provided by TMA Rawal town and Potohar Town. Rawalpindi Cantonment and Chaklala Cantonment worked separately as autonomous body.
The respective TMAs administratively control the rest of areas.

Under the local Government system 2013, all the urban union councils falling under the jurisdiction of town municipal administration of metropolitan cities have been declared as Municipal Corporation separately and all the rural union councils of the district of metropolitan cities have been declared District Council.

4.2.3 Existing Population

The population of Rawalpindi city at the start of the century was in mere thousands. After making of Pakistan in 1947, the population grew at a constant rate of about 3.7 per cent till sixties. However, after the establishment of Islamabad as the Federal Capital, a mega influx was received in this region, resulting in boost of the population growth rate of 5.1 per cent almost doubling the population of the city in seventies. The growth rate then reduced as recorded in 1981 census that slightly increased, according to the population census of 1998. According to the Population Census 2017 the total population of the Rawalpindi city is 2098231. The average House Hold Size for the city is 6.1. The average population growth rate of the city is 2.1 per cent. The reason behind the decrease in the growth rate of Rawalpindi is that the people live in ICT limits Zone-IV. According to the Population Census 2017 the total population of the Islamabad Capital Territory is 2006572 with average growth

rate of 4.91 percent and the population of Islamabad Metropolitan Corporation is 1014825 with average growth rate of 3.48 per cent (Statistics, 2017).

Table 4.1: Past population trend of Rawalpindi

Population & Growth Rate Data Rawalpindi		
YEAR	**POPULATION**	**GROWTH RATE**
1901	87,688	
1951	237,219	
1961	340,175	3.7
1972	614,809	5.1
1981	704,843	3.1
1998	1,409,768	3.4
2017	2,098,231	2.1

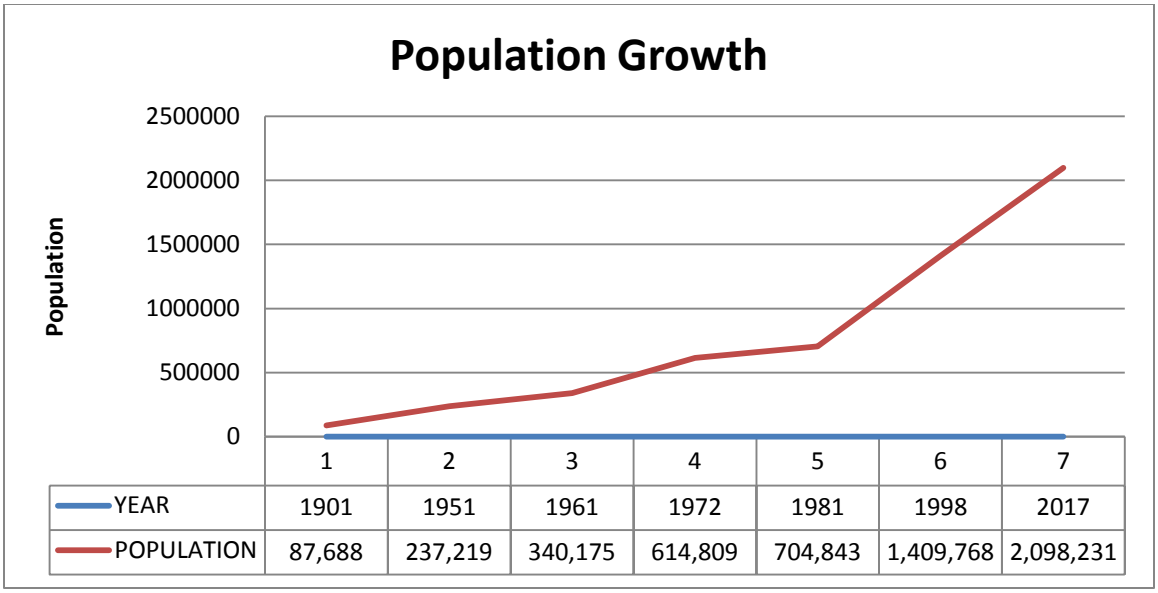

Figure 4.1: Graph of population growth of Rawalpindi 1901-2017

4.3 MIGRATION

4.3.1 At District Level

According to 1998 Census 21 per cent of total district population comprise of Life–Time In-Migrants. Statistics reveal that 89 per cent of the above total Life–Time In-Migrants settled in Towns (Urban/Semi Urban Areas) of the district. It shows tremendous tendency of urbanization in the population influx.

4.3.2 At City Level

The observations of the 1998 Census Survey showed that 27 percent of the Total City Population constitutes of Life–Time in-migrants. Almost 50 percent of these moved in from Punjab Province, 26.4per cent from KPK, 7.2 percent from AJ&K and 4.3 percent from Sindh. Moreover 56per cent in-migrants are residing at Rawalpindi City for more than ten years.

Statistics of 1998 census show that a huge quantum of migration into the district was attracted towards the city of Rawalpindi. However, due to lack of data relating to in and out migration (net migration), birth and mortality rates in the past years, the element of net migration in the years to come, cannot be estimated under this study (Statistics, 1998).

4.4 NATURE OF SPATIAL GROWTH

4.4.1 Pattern of Population Densities

Population density is a useful measure to describe the spatial growth in term of population concentration. It shows the nature of spatial growth in term of number of occupants per unit area. Settlements (mouzas) population data was used to identify spatial and temporal patterns of changing population densities in Rawalpindi in order to explore the magnitude, shape, size and direction of the nature of the urban expansion over time.

In Rawalpindi, there are no specific guidelines of declaring an area urban or rural settlement by population density. In 1989, H&PP Department, Punjab has defined the settlements (mouzas) which come under the jurisdiction Rawalpindi Development Authority (R. D. Authority, 1989). In 1998 census, the area beyond the cantonment limits has taken as rural union council (Table 4.2). As per Local Government Act 2001, the union councils falling within the urban limits are declared as urban UCs which is now the part of Municipal Corporation Rawalpindi as per Local Government Act 2013.

Table 4.2: 1998 and 2009 population of union councils of Rawalpindi

UC No.	Union Council	Census 1998	Area (arces)	2009 Population	PD 2009
UC 82	Morgah	16143	2220	17901	8.063514
UC 83	Adiala	19681	8234	21824	2.650474
UC 85	Dhamian Syedan	12399	2413	13749	5.697886
UC 86	Dhmaial	19597	3255	21731	6.67619
UC 87 & 88	Lakhan	12199	1491	13527	9.072435
UC 89 & 90	Chak Jalal Din	17783	2576	19719	7.654891
UC 91	Garja	9327	6136	10343	1.685626
UC 92	Bijnial	12740	4130	14127	3.420581
UC 93	Ranial	11571	16218	12831	0.791158

(Bureau of Statistics, 2010)

To create population density surface for Rawalpindi, Kernal density function has been applied in Arc GIS spatial analyst. The resultant surface of population density was classified into 9 classes. The trends of rapid increase of densities along peripheral roads resulting in continuous densification are around the middle of settlements, highlights by population density surface analysis. Of the various interpolation options allowed by ArcGIS, the methods used to interpolate population density, is Kriging and Inverse Distance Weighted (IDW) which shows the pattern of urban expansion by averaging the population of the settlements.

Results of analysis highlights that population density of urban settlements ranges from 1000 to 2000 persons per square kilometer' increases from 4per cent to 16per cent in built up area. Cumulatively, 20 square kilometers built up area has been increased in last 10 years in Rawalpindi and it extent spread from entire western cantonment boundary to western corners of peripheral roads. The figure highlights that the shape and temporal direction of population density concentration. The areas around *Chakri* road experienced highest population densities. The areas with higher densities presently are increasing more rapidly, thus creating the process of densification.

Higher densities elongated shift are towards *Chakri* road and *Adyala* road displays by historic density clustering. The high densities oval shaped area stretched from the middle of the cantonments to Chakri Road (at Ranial) on southwest and towards Adyala road on south. Higher density contours did not meet ICT limits (I-series) on northwest because a number of private housing schemes (Kohsar View, Up Country Enclosure etc.), institutional allotments (FOECHS, CBRCHS phase-II, WNCHS etc.) and villages (Sheikhpur, Noon, Bajnial etc. having farmland, Cattles and earth kilns) control the densities of population of this high accessible spatial site. The bow waves like densification effects weaken out slowly but surely towards the southwest due to Rakh Dhamial forest as spatial growth barrier.

The measures give an insight to the changing order and relative strengthening and weakening of population growth. It allows for an easy comparison of city dynamics within metropolitan area. The output is useful for decision making

regarding urban planning issues. When it is applied at a relative growth of the settlement's population, it explains location and process of population growth is moving up and down in order of urban expansion. Interpolation is very useful in studying the dominance urban expansion and it identifies the areas and sectors of rapid decline and boost of city's population growth. To identify spatial statistical variations in settlements growth, population interpolation tool was carried out through GIS analysis. Settlements population for year 2017 was used to create interpolation surface of Rawalpindi along peripheral roads.

Kriging technique in spatial analyst tools in ArcGIS has been applied that generates an estimated surface from a scattered set of settlements. Kriging tool is applied when there is a spatially correlated distance or directional bias in the data. Kriging assumes that the distance or direction between sample points reflects a spatial correlation that can be used to explain variation in the surface. It creates spatial surface by taking the lowest and highest value and distribute it on average base. Figure 4.3 shows that the direction of spatial growth trend is from cantonment limits in east to west periphery towards M2 motorway. Resultantly, the urban expansion is between Rakh Dhamial forest and Thalian interchange at M2 i.e. Chakri Road and between Rakh Dhamial forest and Sowan River i.e. Adyala Road.

Another tool IDW has been applied to check the multiple growth patterns. IDW interpolation determines cell values using a linearly weighted combination of a set of sample points. This method assumes that the variable being mapped decreases in influence with distance from its sampled location. For example, when interpolating

a surface of consumer purchasing power for a retail site analysis, the purchasing power of a more distant location will have less influence because people are more likely to shop closer to home. Attached figure shows that settlements which are far from the city have less influence in urban expansion. These settlements show the growth pattern in radial, circular and cluster form which merge in city after few years.

Spatial patterns of urban expansion are shown in the attached figures. In the first phase, the areas of increasing population growth were located towards cantonment limits covering the population centers of Rawalpindi along peripheral roads and reaching north-south boundaries of the research area. In the second phase, the trend of increasing population growth is shifted towards the connector roads between peripheral roads. The high increase areas were spread around along peripheral roads in semicircular form.

Decreases in population growth in last phases are experienced in the settlements away from peripheral roads. In Figure 4.4 highlights the IDW surface during third last phase, which somewhat resembles IDW surface of previous phases, increasing and spread to the areas around to M1-M2 interchange, Lakhu road and the first section of Chakra road. In spatial context, the population growth of settlements has shifted from mobility to constancy that shows in the interpolation surface analysis. Increasing population growth area expands from north-south oriented central part of the study area to the south-west oriented western part during the last twenty years. Areas of increasing population growth expands urban periphery. Population growth in the area located closer to peripheral roads shows the trends of relatively

faster than furthest settlements. The effect of rapid urbanization has predicted by the analysis in the area located between Chakri and Adyala road.

4.4.2 Spatial Clustering

To test whether the development is occurring in the form of spatial clusters or not, cluster analysis technique of Arc GIS Nearest Neighbor toolset was used. It measured the extents of spatial clustering, random or dispersion of built up area in Rawalpindi statistically. Principally the toolset measures the distance between each feature centroid and its neighbor centroid. It then averages all of these nearest neighbor distances for both present and the hypothetical random distribution of same dataset. Then it calculates the ratio of the observed distance divided by the expected distance (hypothetical distribution).

The ratio identifies the extent of clustering, random or dispersion of dataset. If the index is less than 1, the pattern exhibit clustering; if the index is greater than 1, the trend is towards dispersion/competition. Test result is given on five unit scale of dispersed to clustered pattern. On applying this test, corresponding unit of graphical scale is highlighted with a z-score which indicates whether the outcome could be the result of random chance or is statistically significant. The results of analysis (Table 4.3) confirmed that built up area of Rawalpindi exists in random form.

Table 4.3: Results of Nearest Neighbour Analysis

Observed Mean Distance	2585.467296
Expected Mean Distance	1919.689419
Nearest Neighbor Ratio	**1.346815**
z-score	3.112007
p-value	0.001858

The results of spatial clustering shows that randomly distributed behavior of built up area. The test was applied to the built areas of 1998, 2009 and newly added built up areas till 2017. The table shows that the ratio of observed to expected distance of nearest neighbor was differ and greater than 1, showing a different random pattern of development in years till 2017. Results of spatial clustering also highlighted that the newly built up area were slightly more random than overall development in Rawalpindi as it seems that their ratios were slightly higher than the overall development.

Chapter 5

URBAN GROWTH POTENTIAL

5.1 URBAN EXPANSION CORRIDORS

The expansion of the city is depended upon the road network of the city. If the road pattern of the city is grid iron it will expend in its rectangular sectors. If the city is built on concentric zones, it will expend along circular road. In the same way if the city is planned on the radial ring pattern it will expends along those peripheral roads which will generate from the center of the city.

The road network of Rawalpindi shows the sketch of spider net pattern which is similar to radial ring pattern. In radial ring pattern the city expend to some extend in a circular direction and then it generates outward roads. As there is a physical barrier at north and east of the Rawalpindi due to Islamabad, the city of Rawalpindi looks like a quarter of circle. Apparently, it looks like a hand, as a palm is showing the hub of the city and the fingers are showing the radial outward roads. Rawalpindi has five major urban corridors like fingers of right hand. The little finger is indication the misriyal road, the ring finger is advancing towards girja road, the middle finger is showing as chakri road, the index finger is identifying dhamyal road and the thumb is displaying adyala road.

Roads are the main attracting land use for development. As public infrastructure facilities is provided along roads, so all the development carried on along the roads. The peripheral roads of Rawalpindi have the same attraction of

population due to its municipal services. The areas along the roads are expanding in linear direction which shows the growth potential of these roads. As misriyal, girja, chakri, dhamiyal and adayala road is advancing towards the peri urban area; these roads have connected the small villages with periphery of the city.

The objective of this section is to explore the potential of each road in terms of attracting the urban development. It has been measured by dividing the area which is dependent on each road. The area has calculated by tracing the boundary of the area. The population of each settlement has been divided by its area to get population density. It will provide the future area which will expand in the form of urban development which incorporating in the growth along each corridor. The length of each road has been taken from the 1998 census boundary.

5.2 URBAN EXPANSION DURING 1997 – 2010

The late 90's and early 2000 experienced a boom in real estate business in the region. Resultantly numerous housing societies propped up nearly along all the major arterials. The development extended towards the south-eastern side of the city beyond Chaklala Airport and along Islamabad Highway and Grand Trunk (GT) Road. Development of prominent housing schemes like Fizaia Housing Scheme, Bahria Town, Safari Valley, Rabia Bungalows, Rabia Residencia etc. were initiated during this period along Islamabad Highway and G.T. Road. Adiala Road also became a major axis of development and attracted private housing establishments like Garden Villas, Askari Housing, Gulshan-e-Abad etc. Owing to the construction of Motorway (M2), the attention of private developers was directed towards the major links of

Chakri Road, Dhamiyal Road and Girja Road as all the three have the potential of linking to the Motorway (M2), where already a link is provided at Chakri interchange. The private housing schemes establishments in the region in various time spans. It is evident that the major developments have been carried out from 2000 till date. A list of housing schemes has been provided at Table given below showing the mouza in which it has existed /surfaced.

5.3 FUTURE PROJECTS

5.3.1 Mega Residential Projects

The boom of real estate in and around Rawalpindi City, to a large extent owes to mega residential projects proposed in the region, by epic developers. According to satellite image based calculations in 2009, the total existing built up area of Rawalpindi City, is around 150 sq. km. Information provided by the stake holders reveals that around 200 sq. km. of area has been proposed to be developed as residential establishments under these mega projects, owned by a couple of developers. Defense Housing Authority and Bahria Town have land commitments that may not develop completely even in next 20 years.

These housing projects have contributed great deal towards the housing sector, as they offer well planned housing, good environment, sufficient infrastructure, good education and leisure facilities. Despite all this these aspects, these developers may not be able to contribute toward the housing shortage, being experienced in the city, as they are aimed at serving the upper middle and upper classes of the populace.

These developers have chosen land that lies on eastern and south-eastern part of the city. Two criteria seems to be dominating the selection of land, first is the accessibility as the land is linked with main city routes of Islamabad Express Way and G. T. Road. Second is availability of water, as both developers have taken the land along rivers of Islamabad and Rawalpindi. The approach of these developers seem very positive, as accessibility would be crucial for people living in these areas and the city may be confronted with acute water shortage in coming years.

The construction of Motorway (M2) in 1998 also offered an incentive to the real estate developers in future, thereby attracting private developers to this avenue. Another mega residential project in the making is the Qartaba Housing Project near Chakri Interchange on Motorway (M2), it has land commitment of about 14 sq. km. Besides accessibility through Motorway (M2), Chakri road and Chak Belli road, the developer has chosen land between Sil River and Soan River that would help them to secure water resources for the potential population (NESPAK, 2010).

5.4 MASTER PLAN OF RAWALPINDI 1996 – 2016

The Plan of Rawalpindi City has been prepared for a period of 20 years (1996-2016). It gives an overall picture of land use and road net-work, to guide existing and future physical growth, keeping in view past and present development trends of the City. The projected population of the area was estimated to be 3,826,356 persons, by the end of plan period i.e. 2016. A total urban area of 65,692 acre, including the existing urban area, was proposed to be utilized, till the end of the plan

period. As such the gross density of the City was proposed to be 58 persons/acre (R. D. Authority, 1996).

The growth of the City restricted on the north side by Khyaban-e-Sir Syed and Islamabad Highway. Similarly on the north-eastern side, Islamabad Highway and National Park are the physical barriers. As such, trend of the city at that time was towards south and south - western directions. Adiala road, Dhamial road, Chakri road and Girja road were the main corridors for the future growth, where development had already started in the form of private housing schemes etc. . In addition, nearness of Lahore - Islamabad Section of the Motorway with interchanges at Chakri and Kashmir road, further opened up this area for development. The future growth of the City has therefore, been proposed in the said directions (Adeel, 2010a).

Even at present the inter city traffic is passing through the City, due to which numerous problems are being created by intermixture of highway traffic and the local traffic. In order to have an uninterrupted movement of highway traffic, a By-pass was proposed in the Master Plan for the City. It was planned to take off from GT Road opposite to Radio Pakistan premises, connecting the Ring Road that was proposed by RDA (R-l) Capital Highway and other Islamabad road net-work, and it was also proposed to ultimately join GT Road at Tarnol. The right of way of this road was proposed to be 300 feet. It was planned to have limited access highway, having grade separation at various crossings. It was versioned in Master Plan that the inner area of the City would be relieved of traffic load, to considerable extent, with the construction of this highway.

Two parallel roads, one taking off from GT Road near Rawat with right of way of 250 feet and other taking off in close vicinity of the Grid Station, having right of way of 200 feet along existing high tension line, were also proposed. The roads were proposed to be extended up to I-J principal Road, providing link with road network of Islamabad. The existing high tension lines, local roads/ring roads proposed by RDA in the 'Guided Development Plan', were utilized to provide missing links.

Some major and minor linkages were also proposed for the city and the alignments of the same, was left for decision by the Local Planning Authorities. Improvement and remodeling of junctions including Marrir Chowk, Asghar Mall Chowk, Pindora Chowk, Kamalabad Chowk and Committee Chowk were also proposed.

An Industrial Estate comprising 250 acres for Chamber of Commerce and Industry was proposed in Master Plan that could be extended further to 500 acres in order to cater future requirements of the City. Moreover, High Tech. Industrial activity was recommended along the RDA Ring Road, and Markaz of the planning Zones, in addition, sites for service industries measuring 50 acres each was proposed to be provided in the Zonal Centers, as well (NESPAK, 2010).

5.5 RDA PROPOSALS

To relieve, Rawalpindi city from various urban problems Rawalpindi Development Authority (RDA) has given a range of proposals, regarding road network, housing and economic activities. To assist in Rawalpindi’s traffic problems

the RDA proposed different City Boulevard Options for the future developments. The city boulevards are aimed at serving as Ring Roads for the city limits. One of the *'City Boulevard Option'* launches from G. T. Road near Chhanni Bridge moves through the proposed Economic Zone, crosses Chak Beli Road at Kali Koth Harakk, another option of City Boulevard starts from G.T. Road where Islamabad Express Way Terminates (near Dhok Kashmirian) and terminates into former City Boulevard Option at Dhok Ashiq Khan. The former option then continues to cross Soan River and Adiala Road near Adiala Jail and circles around Rakh Dhamial Forest. At crosses Dhamial Road near Banda Nagial and it again disperse into two corridors. One moves to cross Chakri Road, at Malakpur and Girja Road at Kashmir Colony, to terminate at proposed alignment of Khayaban-e-Sir Syed, between Islamabad Sectors of I-15 and I-16. Other corridor takes-off from Dhamial Road at Banda Nagial and crosses Chakri Road near Dhok Chattian Wali and proposed site of Fatima Jinnah University. Later it crosses Motorway (M2) and Girja Road near Thalian and travels further to terminate at Fateh Jang Road, near Dhok Dhumnian. Numerous housing schemes are already planned for future development near the proposed Islamabad International Airport. This alignment will not only cater for accessibility requirements of these projects, but would also provide incentive for potential future projects.

RDA has also proposed a housing project named as RDA Vista. This project would be a public private partnership, where government would play its role as facilitator and private sector would come up with land and its development. This may also help to offer quality housing near the city. This project is proposed to be sited at

proposed alignment of Khayaban-e-Sir Syed near I-16 and I-17 sector of Islamabad. This may also boost the already started trend of housing schemes in the vicinity of proposed Islamabad Airport.

An economic zone is also proposed near Rawat and is planned to be connected to both the G.T. Road and proposed City Boulevard. This way it would facilitate business men of the city through G. T. Road and Islamabad Express Way, whereas users not intending to avoid city traffic would have option to use City Boulevard.

This *Economic Zone* would mainly comprise of dry port, show rooms, ware houses, display centers, marble factory, workers colony, furniture zone, auto mobile zone, steel works zone and truck stand. These activities when shifted out of city to site at Economic Zone would relieve center city from lot of unwanted traffic and may make land available to be used for more compatible uses.

5.6 SURROUNDING GROWTH POLES

Rawalpindi City is surrounded by various growth poles like Islamabad City, Taxila and Wah Cantonment being major towns, whereas Murree Town, Gujar Khan, Kotli Sattian and Kahuta being smaller towns.

The growth rate of Taxila and Rawalpindi are somewhat comparable, remaining do not match with them. Growth rate and population of Islamabad has also been presented, although it is not part of the District. The reason being is that Islamabad as growth pole and capital, has lot of influence on growth of Rawalpindi and this influence can be expected to increase on Taxila and Kahuta, provided

communication network is improved, to increase the accessibility. Many people working at the Capital commute daily to Rawalpindi, Taxila and Kahuta. In migration to these locations has a share of being nearer to the Capital.

Besides the influence of Islamabad, Rawalpindi has, Taxila, another growth pole that is growing with similar pace. The reason mostly understood is industries and job opportunity located at Wah, Taxila and nearby areas. People of Taxila have linkage with Rawalpindi for health, education, recreation and socio-economic needs. It is also observing that trend of developments along G. T. Road in direction of Taxila and vice versa, showing the attraction of both growth poles.

Kahuta and Gujar Khan have relatively low growth rate owing to relatively less economic base in the area. Murree surprisingly being the leading and most popular tourist resort has very low growth rate. This may be indicator in decline of tourism in Pakistan that may be owing to the reason of inadequate facilities in the area. Kotli Sattian has the least growth rate of -0.12 that shows out migration in the area that may be towards Rawalpindi, contributing to its growth.

Proper and planned developments of the surrounding growth poles, of all major urban centers in Punjab, can reduce urbanization towards these centers, therefore, incentives should be given and developments should be made in small urban centers.

5.7 IDENTIFYING DIRECTION OF GROWTH

Rawalpindi city is physically bounded, on north by Islamabad and Kahuta Tehsil, on west by Islamabad and District Attock, on east. Therefore, it has very few

expansion options, as city. Cities are living organisms and take their form and shape as per their needs. However, sometimes decision makers and developers take certain vital decisions that affect the pace and direction of growth of a city.

Most of the cities of Pakistan developed in form of ribbon development, along some regional route; therefore, the natural direction of growth is mostly dominated by some communication route or at least proximity to regional route.

In most of the cities in Pakistan development plans made are rarely implemented. One of the disadvantages of this drift is that the communication routes proposed in Master/development plans, in harmonization with upcoming or proposed development of public and private sectors, are also wasted. This situation leave no choice for private sector developers, to develop their projects along existing communication routes, as accessibility is one of the fundamental needs of suburban population.

In case of Rawalpindi, if we go through various eras of development of the city, since year 1900 till 1995, it is observe that the city has taken its form by expanding almost on all sided instead of some particular direction. Now as the city has already reached its administrative boundaries adjacent to Islamabad, Kahuta tehsil and Fateh Jang Tehsil, it has spilled in the administrative jurisdiction of these cities. By looking at the city map, it can be clearly seen as spill over of Rawalpindi, rather than these cities, as the center of these cities are far from those boundaries, to merge with this spill over.

In 1995 private sector started to play its role in housing sector and since then many projects surfaced in Rawalpindi and Islamabad including some Mega projects like Bahria, Qartaba and Defense Housing projects. The boom of real estate housing from private sector prevailed from 2000 to 2005 and then the trend subsided, except from serious minded investors/developers. If we take a closer look at the projects and development pattern, we observe that most of the developers have chosen location adjacent to a main road or regional road. If the proposed ring roads have been timely connected the scenario would have been different, developers might have thought differently, as in that case the entire city, even Islamabad would have been well connected and the site selection priorities would have been different.

Second priority that seems to be considered was water sources. It can be clearly seen that land along Korang and Soan River has been purchased by developers. This land may have included 'shamlat land' that might have been comparatively easier to purchase, availability of large chunk of vacant land, was not possible, near to main urban area.

Owing to all above factors it is noted that Rawalpindi has varied from its natural pattern of growth that prevailed for over fifty years. Now Rawalpindi is expanding along eastern direction on Islamabad Expressway and G. T. Road and is touching Rawat already. In Western part owing to proximity to Motorway (M1 & M2) and anticipation of upcoming Islamabad Airport it is expanding along G. T. Road, land between G. T. Road and land reserved for airport. However some mushroom and ribbon development has also taken place along G. T. Road owing to

push and pull factors of Taxila City, another upcoming growth pole in the vicinity. These two directions of growth have been shown in the map.

Rawalpindi Development Authority has proposed two options for Main City Boulevard shown in map, these express ways if build could trigger growth in south-eastern and south-western direction of the city. This can be done rather easily if the existing Roads, emitting from the Rawalpindi Cantonment are linked at various places with the proposed City Boulevard or some other higher order road that can be connected to the City Boulevard.

5.8 ISSUES AND LIMITATIONS

It may not be the case in other urban areas of Punjab, but in Rawalpindi the administrative boundaries of various development agencies are not clear, resulting in disputes related to revenue collection and approval of various level development plans.

Islamabad was declared capital, depending on work force and other resources of Rawalpindi, but the load Rawalpindi would have to bear regarding urbanization on account of capital being its twin city, was not thoroughly worked out. Besides Islamabad was equipped in all respects, not only to become capital, but the first relatively well planned city of Pakistan. The plans made for Islamabad were never coordinated with the plans that were made at Rawalpindi development agencies, resulting in sharp contrast in pattern of spreading out of development in both cities. In Zone-I of Islamabad we observe sectors planned on Grid Iron pattern proposed by C.

A. Dioxides, whereas in Rawalpindi we notice with great concern complete urban sprawl.

This difference of pattern of development between both cities, has contributed to land speculation at Islamabad. Land values and rents relatively low at Rawalpindi, have resulted in receipt of lot of migrating population that manage to find jobs at Islamabad, but cannot afford to own or rent house at the Capital. Therefore, besides its own migrating population Rawalpindi has to put up with the load of Islamabad. It is evident from the fact that lot of people travel to place of work situated at Islamabad from Rawalpindi, creates chaos on the roads of Rawalpindi, with again Rawalpindi being left alone to cope with this traffic directing towards the Capital. Plans and implementation of various traffic mitigation measures is done for capital, but not even half effort is being made to control/regulate traffic that is in fact foreign to Rawalpindi.

Rawalpindi Master Plan was prepared in 1996 for next 20 years, since then no effort has been made to implement the proposals of Rawalpindi Master Plan. However, owing to the natural trend and limited expansion options Rawalpindi city has, the growth took place more or less in the directions indicated by Master Plan. Irony of the fact is that the growth has taken place without any planning and the area has developed as peri-urban area. This study is aimed at providing support for regulated and organized implementation of Master Plan by assessing the urban expansion of the city that would cater for the needs of at least next 20 years.

Owing to lot of investment in housing sector during 1996-2005 and land speculation by investors, none of these housing projects can serve the masses and housing short fall would not change significantly. However, lot of urban land has been booked in these housing projects that do not offer city level amenities; therefore, there is need that the area declared as city boundary for next 20 years should cater for the city level needs of Rawalpindi. Similarly preservation of forest, catchment areas of rivers, nullahs and upcoming dams must be ensured.

In Rawalpindi most of the development works are under taken by Rawalpindi Development Authority and therefore, it takes major share in revenue collection, whereas Rawal Town (Now Municipal Corporation) and Potohar Town (Now Rawalpindi District Council) are only left with responsibility to maintain the developed works, with negligible development fund.

All development agencies are planning and administering areas falling in their jurisdiction and there is no Authority to coordinate the overall picture of city needs. Similarly, monitoring of scarce resources like water is not being taken care of. Owing to missing clarity in jurisdiction of various development agencies, responsibilities of each Authority is not clearly understood. If planning is done it is in isolation to the overall regional context, fragmented and demand driven.

Updated, reliable and accurate data base is deficient in all aspects of urban profile. This is resulting in impediments in planning and decision making. The data available is neither as per requirement nor is it on some uniform format that can be shared by various linked/concerned departments. Likewise lot of relevant and

important data is lying with various departments and no effort has been made to organize it. Data gathering departments like Pakistan Census Organization do not conduct consultation meetings with most of the end-users, prior to conduction of surveys, to ensure collection of data in format that can be helpful to the end users. Category of *'Classified Data/Information'* should also be reviewed, to make data available to public that is not classified any more, owing to availability of free information like imagery/maps on the web. All maps of revenue department should be computerized and printed on useable scale to facilitate all concerned departments (NESPAK, 2010).

5.9 URBAN GROWTH CORRIDORS

Rawalpindi City has five major urban growth corridors:

- Adyala road
- Dhamyal road
- Chakri Road
- Girja road
- Chakra road

Table 5.1: Detail of segments of peripheral roads of Rawalpindi

Sr. No.	**Name of Road**	**Existing ROW**	**Section**	**Start Point**	**End Point**
1	Adiala Road	115 feet	I	Start of RDA Limits (Jarahi	Gulshan-e-Abad

				mouza	
		150 feet	II	Gulshan-e-Abad	Adiala Jail
		200 feet	III	Adiala Jail	End of RDA Limit
2	Chakri Road	150 feet	I	Start of RDA Limits	Shagaf ki Kassi
		200 feet	II	Shagaf ki Kassi	End of RDA Limits
3	Dhamyal Road	105 feet	I	Banaras Market	Up to Jorian
		130 feet	II	Mouza Jorian	Mouza Barrian
		150 feet	III	Moza Barrian onward upto RDA limit	
4	Girja Road	105 feet	I	RDA limits	Dhoke Girja
		150 feet	II	Dhoke Girja	Onward
5	Chakra Road	80 feet	I	Noona Chowk	Army Fort

5.10 EXTENTS OF SPATIAL GROWTH

5.10.1 Existing land Use / Land Cover

Presently, Agricultural land spreads nearly 70 sq. km, covering one third of the study area, built up area covers nearly 16 percent of the study area while the forest

area covers approximately 5 sq. km of land spreading to nearly 1.6 percent of land of study area. Barren land covers half of the study area which is approximately 160 sq. km due to undeveloped housing schemes. Remaining area falls under the 'Others' category which may be water bodies etc. Attached figure shows LULC map prepared using Landsat 8 imagery for the year 2019.

An overview of satellite image and LULC map shows that vegetation, built up area and barren land are the three major land cover of the study area. Agriculture and vegetation cover one third of the study area. Vegetation extended to Rakh Dhamial forest on south western side and the middle portion of the study area. Attached figure shows that the natural vegetation and agricultural area stretch across the central landscape and along Soan River whereas the barren land is located along the western side at undulating topography and higher elevations. Both spatial features are somewhere mixed together also.

5.10.2 Historic Land Use / Land Cover

LULC maps for the year 2009 (Figure attached) and 2019 (Figure attached) were obtained through supervised classification of Landsat imageries. Table 5.2 shows area under each LULC class.

Table 5.2: Land use / Land Cover Change of Rawalpindi 2009-2019

Land cover	Area 2009 (arces)	Area 2019 (arces)	percentage land cover change
Vegetation	29364.6	17507.8	-14.31479624
Builtup	**15664.8**	**25436.9**	**11.79792358**

Barren Land	37610.1	39306.5	2.048075395
Water	189.481	577.782	0.46879847

The table highlights that, since 2009, all the classes increased at the expense of vegetation and 'others' category. A view of LULC map of 2009 and 2019 reveals that since 2009, the green area has been reduced and the land has been utilized for development activities form the central areas to the peripheral roads on the western side. Till 2009, 'Others' category land use class was included in the category of vegetation. Figure 5.2 highlights that the agricultural land experienced a continuous and highest decrease of 14per cent while built area increased by 11 percent. Although the barren land has experienced some increase since 2009, but as a whole, it the conversion of green land into private housing schemes during development phase.

5.10.3 Pattern of Built up Area Expansion

Overview of the satellite imageries shows that although the area appears predominately vegetation and barren land, built up area spreads along the peripheral roads in random form of small and large clusters of urban development. First large cluster of built up area is located around Chakri road and Adyala road due to its proximity to the Rawalpindi and Chaklala Cantonment. Higher population densities and the population center of urban expansion are also located in this area. Second major location of built up is found southern boundary of the study area. This area has highest population growth rates in the study area. Third major clusters of built up area is found along Chakri road in ribbon foam of development. Built area density

decreases towards the western side. Remaining built up area is found in small patches of scattered unplanned housing mainly along Girja and misrial road.

5.10.4 Future Growth Potential

Future growth potential of the study area was determined overlying land use / land cover, population density and built up density. Each layer was considered to exert proportional influence on future growth but feature weights varied within each layer due to varying suitability of its classes for future growth. Table 5.3 highlights the weights assign to each class of all parameters for weighted overlay analysis.

To identify the spatial variation in growth potential, the output was organized into five classes, using natural breaks of dataset values ranging from 'Very Low' to 'Very High' growth potential. Table 5.4 shows the resultant future growth potential and area covered by each class.

Table 5.3: Weighted Overlay Analysis table

Raster	**Influence**	**Weight**
Land cover	40	
Vegetation		4
Barren Land		2
Water body		1
Built up		0
Others		No data
Population Density	30	

1 to 15 persons/acres		1
16 to 35 persons/acres		2
36 to 50 persons/acres		3
51 to 70 persons/acres		4
71 to 85 persons/acres		5
Built up Density	30	
1 to 45 persons/acres		5
46 to 90 persons/acres		4
91 to 135 persons/acres		3
136 to 180 persons/acres		2
181 to 225 persons/acres		1

Table 5.4: Area of future growth potential of Rawalpindi

Sr. No.	Growth Potential	Area (acres)	Percentage
1	Very Low	1589.232145	19.0924
2	Low	88.73546404	1.066032
3	Moderate	1817.409053	21.83362
4	High	4766.806858	57.26651
5	Very High	79.61728352	0.95649

Results of future growth potential analysis (Fig.) show that the growth potential increases with the areas between peripheral roads. Most of the land of Study area (Nearly 60per cent) carries 'High to 'Very High' potential for future growth. Areas of 'High' potential are located along peripheral roads in linear form of development spreading 2 kilometers westwards into agricultural land of the study area. Another piece of 'Very High' growth potential area is located as 2.5 kilometers wide strip eastwards of Rakh Dhamial forest.

Chapter 6

URBAN LAND-USE POLICIES FOR FUTURE GROWTH

6.1 URBAN POLICIES

Urban polices have strong impact on the growth of the city. Urban growth increases where policies encourage developing or investing in different landuses. In the same way development reduces where certain landuse activities are restricted by growth policies. Human psychology must be incorporated while implementing different regulations and bye laws. For instance, if an area is allocated for the health facility then medical laboratories and pharmacies cannot be restricted in the vicinity of hospital. Similarly residential area cannot be provided adjacent to industrial area without buffer zone as it will be harmful for health of the people living in the surroundings.

Rawalpindi has four different administrative controlling bodies but the dominating area is under the jurisdiction of Rawalpindi Development Authority under Punjab Development of cities Act 1976. As being old military town, the core area of the city is under cantonments under the administrative control of Rawalpindi and Chaklala cantonment Boards. RDA was established in 1983, it was Rawalpindi Improvement Trust before. Under Local Government Act 2013, the provision of infrastructural facilities responsibilities has given to Municipal Corporation (Urban Union Councils) and District Council (Rural Union Councils).

Land uses allocation and development control measurements are the major concerns of Development Authorities. This is done by the implementation of Master plan and landuse & Building control laws. Although landuse standards and location criterion has been defined by the concerned authorities but the same has not been implemented with true letter and spirit. For instance, Approval of Housing schemes and commercialization of roads is under the RDA at district level but the same is violated beyond city limits. Similarly industries and other public amenities are under the control of district council but the same are constructed without completing the prerequisites. This creates conflict of interest in policies and the city is expending haphazardly.

According to RDA notification issued in 1998, the authority controls both sides of Adyala road khawaja cooperation chowk to adyala village, Dhamial road to kotha village to dhamial village, Chakri road from lakkan more to morah chappar village and girja road from girja village to noon village on the border with Islamabad. Some area on fateh jang road also comes under RDA. It is investigated that development along these peripheral roads did not follow the landuse and building control bye laws and expending without any prior NOC to lunch different project. Official documents of Urban Policies like Rawalpindi Master Plan, Rawalpindi peri urban structure plan and other local government plans have been studied which will suggest the future growth of the city.

6.2 REASONS BEHIND UNCONTROLLED GROWTH

Major reasons behind uncontrolled growth in Rawalpindi are as follows:

6.2.1 Absence of Comprehensive Plan of Development

This is probably one of the main causes for the uncontrolled spatial growth in Rawalpindi. A strict land use development plan was not available for the area. The concept of 'Guided Development Plan' could not be interpreted into a detailed land use plan as well. Rather the plans like action plans were designed and implemented as and when required. Such approaches lead to piecemeal development of the area. For example, RDA permitted educational buildings in its limits and approved public housing schemes, creating a mix-up of land use in peri-urban area.

6.2.2 Poor Implementation of Master Plan 1996-2016

Another main cause following uncontrolled urban expansion in the research area is poor implementation of Master Plan. RDA could not follow the land use allocation and development control measures. Sluggish land use alteration and building control procedures slow down the pace of Master Plan implementation. RDA regularized land form and local resident develops it as per zoning and building bye laws guidelines. Other than development and infrastructural projects like remodeling of Murree Road, Metro bus transit etc., RDA could not acquired land and afterwards this land is occupied by private developers significantly. Now more than half of agricultural land other than forests is privately owned where RDA cannot impose master plan provision. Rawalpindi city faced a comparatively overemphasized which almost neglected implementation in suburban area.

RDA has prepared Guided Development Plan providing a network of Ring Roads and Arterial roads connecting city’s urban and peripheral areas up to Motor

Way. Six numbers of Ring Roads and seven numbers of Arterial Roads make complete network of the proposed future 'Guided Development'. RDA has proposed 400' ROW width for Arterial Roads and 800' ROW width for Ring Roads. The reserved 'right of way' area of these thirteen proposed roads is not development yet and the period of Master Plan has expired (Adeel, 2010a).

6.2.3 Master Plan and Real Estate Market

The major mistake in the Master Planning process in the past has been that the Master Plan is not related with the sale – purchase of properties. In real estate market, the investors keep on selling and purchasing lands and buildings without any consideration to the Master Plan. Investors always keep on searching properties. Politicians are also involved in this business and the bureaucracy also receives benefits by using discretionary powers by making changes in the Master Plans. It is proposed to strongly link the Master Plan with sale – purchase process of property so that the buyers and sellers are well aware of the land use before transaction. Definitely, both will adjust the value according to proposed land use. For materializing this concept, few modifications will be required in the acts related to Title Deeds, Revenue Acts & Clause 23 & 24 of the constitution (Anwar, 2018).

6.2.4 Failure of Master Planning

If modifications indicated in the above mentioned Para are not done, it will be impossible to exercise Town Planning in our urban and regional areas. The main cause is that our Municipal Agencies and Development Authorities always need land acquisition in public interest because land belongs to public and funds are not

available, so Master Plans fails. Example is that in year 1996, Master Plans of 13 cities of Punjab were prepared. Unfortunately, all these Master Plans failed and problem still exists. Heavy loans were taken by the Country from Asian Development Bank and World Bank for these projects and today we can see that all these cities are facing serious urban problems (Anwar, 2018).

6.2.5 Master Plan & Importance of Land Ownership

Experience has revealed that when a Town Planner picks up his pen for Master Planning, the question arises regarding ownership of land. The planner when draw a line, the land belongs to somebody else. The constitution protects his right of ownership whereas the planner is interested to place public land use on his land such as school, parks, university, hospital & road etc. No consideration is given to the value of land and the transaction process. Because, the purchaser pays the price of the land according to his mental picture of land use, he fights back with the government to use the land according to his will because he has paid for it. He approaches the Development Control Authority for approved of his plan after purchase. If he is stopped at this stage, he fights back and tries to offer bribe for approval of his plan because he has already invested. He was required to be educated at transfer stage that his ownership rights falls in land use category mentioned in Master Plan. There is need to control the situation at land / property transaction stage by making stronger legislation (Anwar, 2018).

6.2.6 Town Planning & Patwar System

Town Planning & Patwar System are very closely knitted. According to the Patwar System, the land in Pakistan is divided into Khasras, Khewats & Khatonis. Basically, this system was for agriculture lands. In this system, the agriculture lands were divided in grids and it was ensured that every piece of land is served by 15 to 20 feet wide access roads (Rastas) for moving carts and water channels (Khalaas) were also provided. Where there were villages, Shamlaats (Public Uses) were provided. Because, this system was for agriculture areas where the scale of ownership was in Acres but when the areas got urbanized, the scale converted form Acres to Kanals, Marlas and Sfts. Ownership disputes arise when the Patwari distribute the land / property. In this process, Town Planning is not seen anywhere. This is the reason that in spite of computerizing the land record system, corruption could not be controlled in urban areas. Hence, it is very important to make the Land Revenue System subordinate of Town Planning System in urban areas (Anwar, 2018).

Since 2009, the area did not meet any major construction activity. Settlements and institutions cover 10per cent land of study area and more than 50per cent land is reserved for forest and farming or left un-built. Master plan implementation on 10per cent built-up area is in adequate to preserve its entire urban character. To date, one third of RDA regularized land is not developed and left vacant. Despite external pressures like the institutional allotments, high demand for farm housing and trend of constructing luxurious guest houses and residential bungalows at farmlands, RDA wishes to implement Master Plan in Suburban area. However, the adopted approach

cannot be continuing at required pace. As a result, poor plan implementation has triggered uncontrolled growth in the study area.

6.2.7 Poor Development Control by RDA

In the research area, to exercise proper development control, RDA has become failed. Due to poor development control, settlements are expanding without any intervention. Without site development, expansion and construction is taking place. Huge problem for research area has been created due to haphazard buildings and uncontrolled expansion. The study area contained twenty thousand households in 1998 and now it has reached around more than seventy thousand by 2017.

6.2.8 Duality of Control

With the introduction of Local Government System 2001, the area beyond the cantonment limits was dissolved into Town Municipal Administration potohar town and now rural Union Councils of TMA potohar town is now being administrated by District Council through Punjab Local Government Act 2013. RDA has either less or no concern in rural development activities. RDA can implement its power at land regularization for housing schemes only. Rural Union Councils are liable for specified land use development and building control of privately owned rural land as per given schedules. RDA follows The Punjab Development of Cities Act 1976 for development control in its entire limits. But the restriction impose on private land by RDA are not observed by District Council and local elected bodies. Thus study area is being ruled by two different authorities under two different policies.

Duality of control has resulted in an unsynchronized growth and inconsistency of functions. Governmental policies with different kinds of influencing development make it virtually impossible to plan and manage land with one vision. It has been observed that people take administrative approval from UCs authorities when they decide to build against RDA building bye laws. As RDA approved development is economically high valued in Rawalpindi, so consent from RDA has become only a matter of prestige.

In Rawalpindi Master Plan 1996, study area was planned to provide economic base zones to Rawalpindi, as well as to hold industrial zone with supporting markets and housing with infrastructural facilities and road network. To preserve some of the planned land uses, it is still not too late. Proper land management is needed, in this regard, for study area. It is proposed to implement the divided sub zones with minor changes where applicable for proper land use allocation in future. The zones should be proposed to follow natural boundaries like roads and water channels and they are recommended keeping in view LULC of the study area.

6.3 DUALITY OF FUNCTIONS

The Functions of RDA, Municipal Corporation and District Council Rawalpindi is as under:

6.3.1 Functions of Development Authority

(xiv) Issue interim development order for the area for which a scheme is under preparation and restrict or regulate by general or special order, any change in the use of land and alteration in building structure and installation (Punjab, 1976).

6.3.2 Functions of Municipal Corporation

a. Approve spatial plans, master plans, zoning, land use plans, including classification and reclassification of land, environment control, urban design, urban renewal and ecological balances;

6.3.3 Functions of District Council

Control over land-use, spatial planning, land-subdivision, land development and zoning by public and private sectors for any purpose, including for agriculture, industry, commerce markets, shopping and other employment centers, residential, recreation, parks, entertainment, passenger and transport freight and transit stations (Local Government & Community Development Department, 2013).

Duality of function has resulted mismanagement in urban policies and overlapping of jurisdiction has created wastage of useful resources. It is observed that both government authorities collect taxes on prescribed land uses as per their rules and regulations which created confusion in the mind of the people to pay. Both authorities perform both functions at the same time for each land use or refused to accept their responsibilities. For Instance, the record of verification of shops along commercialization roads in belongs to RDA but the same is performing by District Council for Adyala road. As per Devolution plan 2001 & Punjab local Government Act 2013, District Planning & Design Committee has constituted for scrutiny of planning map, district map and peri-urban structure plans etc. through Punjab land use (classification, reclassification and redevelopment) rules 2013, which is the responsibility of Municipal Corporation. RDA is also consulting the land use

allocation, alteration cases as well as development and building control issues in the same committee.

It is highlighted that RDA has its own governing body duly notified by government. It approves budget, development and action plans as well as recommends policies for urban growth management. The housing schemes at district level are under RDA and it is approved through Punjab Private Housing Schemes and Land Subdivision Rules 2010 from District Planning and Design Committee in Lahore as half of the committee members is same from Governing Body. Similarly, the Industrial area is managed by District Council through Industrial area scrutiny committee under the Punjab land use (classification, reclassification and redevelopment) rules 2013 which is the prime responsibility of RDA for the implementation of Rawalpindi Master Plan 1996-2016.

As per Punjab Private Housing Schemes and Land Subdivision Rules 2010, other than approved housing schemes, less than 100 kanal land parcels can be sub-divided subject to condition that land is:

a. not prone to flooding,
b. not notified by the Government for acquisition for any public purpose,
c. locked because it is;
    i. Surrounded by an approved housing scheme or an existing built up area and
    ii. Separated from the built up area by physical barriers.

d. Maximum size of residential plot one thousand square yards; approach road in other Districts is not less than forty feet; and approach road in five City Districts is not less than sixty feet

e. internal roads: minimum right of way of thirty feet; (Punjab, 2010)

These provisions of land sub-division, shall not apply to the inherited property to be divided among the legal heirs of a deceased for construction of houses for personal use. It is observed that the private land owners sub-divided their land informally. For Instance, 1 kanal plot measures approximately 5450 square feet in the old scale (1 inch = 30 karam) of revenue department. The landowner sold or inherited plot leaving 20 feet wide accessing path and converted the plot into the size of 50 x 90 square feet which is equal to 4500 square feet. This informal land sub-division creates irregular street pattern and have an effect on the layout and morphological structure of the growth of the city which increases urban expansion.

6.4 SUB PLANS

A brief Discussion on recommended sub plans is as fallow:

6.4.1 Land Use Classification Map

A City District Government or a Tehsil Municipal Administration shall prepare the land use classification map for an established built up area by dividing an established built up area, falling outside an approved scheme:

(a) Into urban blocks by adopting the following criteria:

(i) An urban block shall not cross boundary of a Union Council;

(ii) Area of a Union Council shall be divided into urban blocks in such a way that the block area falls within range of 25[twenty five acres] to three hundred acres of predominantly residential area;

(iii) An existing compact commercial or industrial area shall be considered as an urban block;

(iv) An urban block shall be bounded by existing road network, natural or manmade barriers;

(v) Data on various land uses and size of plots for an urban block shall be collected and compiled as prescribed in rules.

(vi) Urban blocks shall be redefined on the basis of predominant land use and plot size;

(vii) Land use survey and the latest population census blocks shall be taken into consideration;

(viii) An urban block shall not be bisected by railway line, primary road or irrigation channels such as canal, river and storm water drains more than forty feet wide;

(ix) An existing mohalla may not be divided; and

(x) Notwithstanding clause (viii), a notified Katchi Abadi shall be treated as a single urban block:

To fulfill these requirements, the same type of methodology can be adopted through this research study. Built up area has been taken as mouza which are not crossing boundary of union council. The built up area is within the range of 25-300

acres. The latest Housing & Population Census 2017 has been taken into consideration. The muoza has not been bisected by natural features more than forty feet wide. An existing mohalla and Katchi Abadi has not been divided.

6.4.2 Peri Urban Structure Plan

The definition of peri urban area in Punjab land use (classification, reclassification and redevelopment) rules 2013 is given as: " the area that spans the landscape between contiguous urban development and rural countryside is likely to be urbanized in the next twenty years and is predominantly being used for agricultural activity with low population density, a City District Government or a Tehsil Municipal Administration shall ensure that and is notified as peri-urban area". No private housing scheme or land sub-division shall be allowed outside peri-urban area as per Punjab Private Housing Schemes and Land Subdivision Rules 2010.

External boundary of the peri-urban area shall mark by City District Government or a Tehsil Municipal Administration on the following basis of:

(a) Urban sprawl trend and direction;

(b) Population growth rate; and

(c) Next twenty years requirements for urban development.

The peri-urban structure plan shall include:

(a) Proposed road networks;

(b) Block wise division of area; and

(c) The proposed land uses for various blocks;

The District Coordination Officer may constitute a joint committee of the Town or Tehsil Municipal Administrations If the built up area of two or more adjoining Towns or Tehsils is contiguous, to prepare a consolidated peri-urban structure plan. The peri urban structure of Rawalpindi is approved but not notified by RDA yet. After informal discussion with the RDA officials, it is concluded that these specifications of peri urban structure plan have not been included efficiently as in this research study. For instance, private housing scheme on Chakri Road or land sub-division like on Adyala road has been allowed outside peri-urban area. The Tehsil Fateh Jang, District Attock boundary is adjoining to Tehsil Rawalpindi limits at mouza Kohlian Par which may be converted into built up area in next 20 years but RDA has not prepared consolidated peri-urban structure plan.

6.4.3 Preparation of a Planning Map

Planning map shall prepare and approve by City District Government or a Tehsil Municipal Administration by combining:

(a) The notified land use classification map;

(b) The notified peri-urban structure plan; and

6.4.4 Preparation of a District Planning Map

A district planning map shall prepare by City District Government or a District Government by combining the notified planning maps of the Towns or Tehsils of the district.

6.4.5 Land Use Re-classification

A land use reclassification scheme for an area, to be known as a project area, may prepare by City District Government or a Tehsil Municipal Administration, after the notification of land use classification map.

6.4.6 Selection of Project Area

Identifying and prioritizing an urban block or group of urban blocks shall proposed for reclassification for the selection of the project area by City District Government or a Tehsil Municipal Administration in accordance with the following criteria:

(a) Trend of existing land uses changes;

(b) The change of land use in the area as per Market demand;

(c) Compatibility with adjoining uses;

(d) Potential for up-gradation of serving road network; and

(e) Prospects for redevelopment.

The trend of changes in the existing land uses can be calculated through spatial clustering technique using this research study. Market demand for the change of land use in the area can be measured through Interpolation methods. Compatibility with adjoining uses can be seen through classification maps. Potential for up-gradation of serving road network has been measured in this study. Prospects for redevelopment can be calculated.

6.4.7 Master Plan

A master plan or zoning plan shall prepare in accordance with these rules by City District Government or a Tehsil Municipal Administration and shall treat the area outside the following limits as agricultural areas:

(a) 2-3 kilometers in case of Chief Officer Units of the Tehsil Municipal Administration;

(b) 3-4 kilometers in case of the Tehsil Headquarters; and

(c) 4-6 kilometers in case of the District Headquarter (Punjab, 2013).

As the Master Plan of Rawalpindi (1996-2016) has expired in 2016 so it can revised using methodology of this research study for preserving the agriculture area.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The study concludes the excessive population growth is one of the most important driving forces for land use and land cover change in study area of Rawalpindi. The study explores rapid population densification around Adyala road touching Chakri road and Girja road. Population density spread in the shape like 'bow waves' whose strength gradually increase towards western boundary. Historic growth of study area's population densities shows that the area has attained sub-urban densities and it is moving speedily towards built up densities due to urban expansion in the sub-urban area. Since 2009, the population density of study area and the increasing built up area along peripheral roads gradually shifted the trend of urban expansion towards sub-urban area showing the attraction of population towards Motorway and north western part of Sown River. Analysis shows that the built up density has reached a state of variation in spatial context and the area closer to peripheral roads have been gaining population more rapidly than other areas of Rawalpindi.

As calculated from the Land sat imageries of year 2009 and 2019 for the study area, the vegetation and forest land has been reduced by 14 percent area from 45 percent to 31 percent. 10 percent land has been converted into built area, barren land has been increased by 4 percent from 50 percent to 54 percent due to development of

private housing schemes while others LULC class like water contains 1per cent land. So far 20 sq. km of productive land has been to uncontrolled and unplanned expansion on the expanse of vegetation and forest. Rate of expansion has increased by 220 percent since 2009. Expansion during year 2009 to 2019 is characterized by expansion near Adyala road and Chakri road, expansion and ribbon development around peripheral road and relatively scattered development around Dhamial road, Girja road and Misrial road.

GIS analysis found out 57 percent land of study area carries high growth potential due to accessibility, lower land prices and official problems. Surveys have found that the existing settlements are expanding into the agricultural and barren land due to the absence of an appropriate policy and poor development control. There is an urgent need to control the outward expansion of settlements along peripheral roads, before it gets unmanageable to implement master plan in sub-urban areas according to new scenarios.

7.2 RECOMMENDATIONS

This study is an effort to draw RDA's attention to control the haphazard conversion of agricultural and barren lands against uncontrolled expansion and mushrooming built up of the study area. Built up area expansion is on the rise due to the prime location and accessibility through peripheral roads. It is proposed that the methods employed in this research be applied to the other areas country wide to assess the rate of urban expansion and future growth potential. The study points out following recommendations to manage the uncontrolled expansion in the study area.

In fact, land is the raw material of Master Planning industry and if there is no land, planning cannot be exercised in air. On the other hand, in Pakistan most of the land is in private ownership. If the Master Plan is prepared for 20 years, the need arises to acquire land for public uses. In the proposed Automated Town Planning System, a land bank will be created where public funding will be pooled for acquisition of land for public uses. In the proposed Master Plan, all land parcels of the city will be explicitly marked at appropriate scale for different land uses such as, primary roads, parks, commercial centers, schools, universities, bus stands, fruit & vegetable markets etc. These land uses will be recorded in the Revenue Record and the category of land use will be locked at the time of approval of the Master Plan. Within the Master Plan time period (20 years), the compensation will be given to the owner according to the category as mentioned in the Master Plan. For example, a person owns a piece of agriculture land in year 2018 and the Master Plan proposes a commercial center in 2035 at his agriculture land and physical possession of land is required in 2030. The owner will be allowed to continue agriculture activities up to 2030 and in the acquisition year, he will be given compensation at the rate (as in year 2030) of agriculture lands. If he does not want to sell the land, he must pay value addition to the government and will be bound to develop as per Master Plan. An example is illustrated as under:

Table 7.1: Example for land use categorization, acquisition and compensation criteria

Owner of Property	**Land Use in 2018** (One Month Before Approval of Master Plan)	**Land Use identified in the Master Plan (2038)**	**Acquisition Year**	**Compensation Criteria** (At the time of acquisition)
Owner-A	Agriculture	Recreational / Park	2030	In year 2030, the owner will be given compensation @ agriculture rates prevailing in 2030.
Owner-B	Commercial	Educational	2025	In year 2025, the owner will be given compensation @ commercial rates prevailing in 2025.
Owner-C	Agriculture	Commercial	2028	In year 2028, the owner will be given compensation @ agriculture rates prevailing in 2028.
Owner-D	Residential	Health Facility (Hospital)	2035	In year 2035, the owner will be given compensation @ residential rates prevailing in 2035.
Owner-E	Agriculture	Primary Road	2030	In year 2030, the owner will be given compensation @ agriculture rates prevailing in 2030.

It is also proposed that the Revenue Department should be declared subordinate of the comprehensive Town Planning Act. In this way, land use rights of all types of lands will be converted according to the Master Plan. Owners of properties, while approaching to Patwar Khanas will receive the Fard-e-Malkiat in which the proposed land use of the Master Plan will be explicitly written.

Revenue Department will be bound to take into consideration the land uses proposed in the Master Plan and instructions will be passed on to Patwari level that while issuing the Fard, the existing and proposed land use must be mentioned. In this way, sellers and purchasers will conceive the value of property as per Master Plan which will accelerate the process of Master Plan implementation.

Every citizen when buying and selling the property should be bound to refer to the Master Plan without which transaction will not be possible. In this way, buyers and sellers of the property will mutually adjust the value of the property according to the land use given in the Master Plan. The proposed land use in the Master Plan should make part of the ownership documents. In this way, the land use control will not only be easy but the habit of using discretionary powers with malafide aims will be reduced.

Sale – Purchase of the property and Master Planning check in the transaction process. For sellers and buyers of the property it should be made impossible while negotiation the deal that they could ignore the Master Plan. In our country, there are few laws related to Title Deed of Properties.

After approval of Master Plan, the data will be transferred in the Revenue Record available with area Patwari and he will be responsible to write in the Fard the land use proposed in the Master Plan. A special column will be needed to be introduced in the Fard for writing the land use proposed in Master Plan. With this system, the purchaser and sellers of the land will start considering the proposed land use while making deals.

After making above mentioned changes in the laws, there will be change in the sale – purchase process in the market. The process is shown in Figure no. 7.1. In this process, Patwari will be bound to mention the Master Plan proposed land use in the Fard and the Registrar will also be bound that while approving the sale deed, he will be legally bound to enter the planning conditions given in the Master Plan. In this way, at transaction stage, the ownership rights of property will be transferred to the next owner along with future land use along with other planning condition. In this way, the next owner will be legally bound to obey the provision of Master Plan.

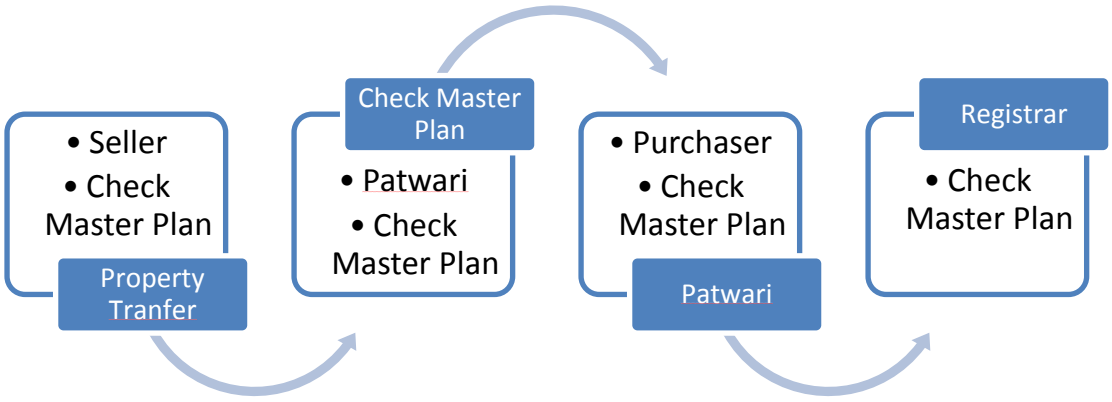

Figure 7.1: Proposed sale purchase process for effective implementation of Master Plan

It is also mentioned that devolution moment is diverting powers to local level but for plan making purpose, it is not recommended to transfer the powers to local level for first Master Plan (20 years). Because local investors, politicians and other pressure groups are in the habit of interfering in the planning process for personal gains. This activity should either be done at Federal level or Provincial level. The approved plan should be filter down to the local level for implementation.

Experience reveal that 40 years ago, road bypasses were constructed in many cities but now these bypasses have again been congested due to haphazard investment of investors along edges of these bypasses. When the Master Planning will be attached with the sale-purchase of properties, the buyers of properties will be bound to keep the require set-backs.

In our towns, it is very difficult to exercise development control because public normally resists. Every day when the Sun rises, there are changes in the town. One property require transfer due to inheritance, other owner desires to make commercial building and somebody want to make new house. Normally, public rush towards development authorities and there is need to depute sufficient staff transport, police force etc. unfortunately, institution capacity of Municipal authorities has not been upgraded for many decades. For example, in year 1975 when the population of Islamabad was one hundred thousand, there were ten Town Planners working day and night. On the other hand at that the population of Lahore was 1 million and there was only one Town Planner, maybe other two were added for next 30 years. The Lahore continued expanding haphazardly and now we are facing all sorts of problems.

When implementation power will be inducted in the Master Plans through amendments in legislations related to title deeds and support will be available through amendment in the article no. 23 & 24 of the constitution, the discretionary powers of politicians and bureaucrats will be minimized. This will reduce corruption. In ownership documents of each property, the present and proposed land use will be explicitly written. The map will be displayed on the website. Every buyer and seller will be able to see it clearly. The land market will start transforming according to the land uses given in the Master Plan.

In the Master Plan operational system, further legislation will be required for organizations providing services to the public (e.g. electricity, gas, water supply, sewerage) not to give the connection to any property which violates the Master Plan. After improvement in the Master Plan implementation system, the standard of development will be improved and cost will be reduced because presently there is practice to redo the developed work repeatedly in the absence of planning.

REFERENCES

Adeel, M. (2010a). *Assessing the implementation of Rawalpindi's Guided Development Plan through GIS and Remote Sensing*: na.

Adeel, M. (2010b). Methodology for identifying urban growth potential using land use and population data: A case study of Islamabad Zone IV. *Procedia Environmental Sciences, 2*, 32-41.

Adeel, M. (2010c). *The role of Land Use Policy behind unauthorized spatial expansion in rural areas of Islamabad.* Paper presented at the 46th ISOCARP Congress.

Aksoylu, S. (2015). Development of the urban periphery and issues related to urban landscape due to gated communities. *Journalism And Mass Communication, 5*, 415-427.

Anwar, V. (2018). An innovative and revolutionary proposal for implementing Town Planning in cities of Pakistan.

Authority, C. D. (1994). Greater Islamabad Rawalpindi Area Transportation Study.

Authority, R. D. (1989). *Housing & Physical Planning Department, Punjab*.

Authority, R. D. (1996). *Rawalpindi Development and Strategic Plan*

Bureau of Statistics, G. o. P. (2010). *Punjab Development Statistics*.

Department for Communities and Local Government, L. (2009). The Pakistani Muslim Community in England.

Fouberg, E. H., Murphy, A. B., & De Blij, H. J. (2009). *Human geography: people, place, and culture*: John Wiley & Sons.

Hasan, A. (2011). Task Force Report on Urban Development (February 2011 ed., pp. 36).

Local Government & Community Development Department, G. o. P. (2013). *Punjab Local Governement Act*.

NESPAK, U. U. (2010). Comprehensive City Boundary of Rawalpindi.

Punjab, G. o. (1976). *The Punjab Development of Cities Act*.

Punjab Private Housing Schemes and Land Sub-Division Rules (2010).

The Punjab Landuse Rules (2013).

STAN, A. I. (2013). Morphological patterns of urban sprawl territories. *Urbanism. Arhitectură. Construcţii, 4*(4), 11-24.

Statistics, P. B. o. (1998). Housing & Population Census.

Statistics, P. B. o. (2017). *Housing & Population Census*.

UNHCR. (2017). Refugee Affected and Hosting Areas Programme.

Zaman, K. U. (2012). Urbanization of arable land in lahore city in Pakistan; a case-study. *European Journal of Sustainable Development, 1*(1), 69-83.