CHAPTER 3: Urban and Regional Morphometrics

Abstract

The chapter explores the evolution and change in the understanding of the city and regional forms overtime. Social, economic and political dynamics that affect the characterisation of city and regional forms are highlighted. The chapter explores how city and region forms have adapted to current rapid urbanisation, urban poverty and principles of sustainability and resilience. It is suggested that the forms of cities and regions in the contemporary era are the key to the achievement of sustainability. Hence it is imperative to fuse traditional factors determining different forms of cities and regions as influenced by social, economic and political dynamics with modern sustainable design concepts such as compactness, sustainable transport, density, mixed land uses, diversity and greening, among others. These concepts have a great potential in creating sustainable urban forms such as the compact city and the eco-city and these are measurable through sustainable development indices and matrixes.

INTRODUCTION

The chapter focuses on aspects of urban and regional forms with a core understanding that cities and regions evolve through different forms. The development of cities and regions throughout the world has followed well laid fundamental theories and factors influencing different forms. Current cities are fascinating and regional forms were influenced by the forms of the past. It is, therefore, imperative to track city and region form, to their origins and explore some social, economic and political dynamics that affect the characterisation of these forms. With the changing urban landscape and the crafting of fundamental concepts like sustainability and resilience, forms of cities and regions have also changed and this study interrogates the adaptation of city and region forms. This research is important in bolstering a city in history, understanding of the reader and informing possible work on urban and regional morphometric in the wake of rapid urbanisation, urban poverty and principles of sustainability and resilience. Cities and regions have been crafted into three major functional categories, that are central places, break-of-bulk and specialised function. Most cities and regions represent a mixture of

these types, with each factor assuming varying relative importance for each city.

BACKGROUND AND CONTEXT

Urban form is a fundamental aspect of the built environment. Barke (2018) regards the townscape as the 'objectivation' of the human spirit. This means the urban environment carries with it the efforts and aspirations of residents in the past and present and this is reflected in its physical form. The term 'urban form' is used to describe a city's physical characteristics. As observed by Živković (2019), this refers to the size, shape and configuration of an urban area or its parts. Barke (2018) highlights form including street layout, buildings and the use of the space and the physical form that encapsulates the spirit of place. This chapter realises that these aspects of city and region form develop over time and the present city and region forms owe much to the historical events and work on cities and regions. Thus, this chapter pays attention to the development of cities and regions, factors influencing, theories and the adaptation of cities considering the contemporary urban planning dynamics that include rapid urbanisation, urban poverty and principles of sustainability and resilience.

The history of cities and regions as important centres of human activity, extends back thousands of years to the dawn of civilised life. Throughout the world, cities and towns or regions, differing in size and character are found and in regions known presently as China, Egypt, Israel, Iraq, Pakistan, Greece and Turkey where we find some fundamental aspects of the background of cities and towns. The origins of these places in those ancient times are understood largely as religious and administrative centres or defensive sites. The Multnomah County Planning Commission (1967) also provides that the development of urban societies is determined by the socio-cultural organisation, climate, topography and economic development. The early civilisation of Indus (Mohenjodaro, Harappa), Tigris-Euphrates (Lagas ur, Uruk), Nile (Memphis, Thebes) and Hwang Ho (Chen-Chan An Yang) are examples of the earliest cities of the world that originated near river valleys.

These early developments of urban settlements evolved with changing technology and human needs. The Multnomah County Planning Commission (*ibid.*) further attributes such evolution to trade and commercial activities and settled agriculture as major facilitators.

Present cities are shaped by some of these fundamental activities and are viewed as places where markets, governments, religious and cultural centres exist. King (2020) also provides that other cities in these same regions and other parts of the world in Europe, Asia, the Americas and Africa began as important locations for trade and commerce and in this role, they grew and flourished over the centuries.

Barke (2018) observes a brief description of the three types of cites. Central place cities are described as cities that serve as trade centres and social foci for a surrounding tributary area whose shape has been demonstrated to approach that of a hexagon, under ideal conditions. These central places approach a uniform distribution in hexagonal patterns and a hierarchy of size and functions performed when such factors as the physical base, climate, transport network and socio-political considerations are constant. Then, the break-of-bulk cities develop at transportation junctions or where goods in transit must be transferred from one means of conveyance to another. The last category is the specialised function cities that locate near sites of natural resources or amenities and they develop specialised commercial or industrial functions that serve extremely large tributary areas. From this background information, cities had complex spatial layouts reflecting the multiplicity of human exchanges. These historical cities have been alive with the richness of patterns and symbols that fulfil many psychological and spiritual needs. One good example is the sense of enclosure and spatial definition provided by medieval walls that satisfied more than a need for defensive protection.

As observed by Lozano (1990), features of historical cities such as medieval walls also provided psychological stimulation and physical comfort. However, in present times, it is imperative to talk about the changing form of the city that has seen cities and regions transform from relatively contained to widespread urban sprawl. This has been a worldwide phenomenon. Jenks and Dempsey (2005) observe that the strengthening of international capital has led to the concentration of economic power in many global centres of finance and highly specialised services such as London, Frankfurt and New York.

DEFINITION OF KEYWORDS

Morphology can be used in the study of urban areas to create what is known as ‘urban morphology’. Urban morphology is the study of the built form of cities and it seeks to explain the layout and spatial

composition of urban structures and open spaces, their material character and symbolic meaning, in light of the forces that have created, expanded, diversified and transformed them' (Conzen, 2012).
Morphometrics refers to the study of shape variation of organs and organisms and its covariation with other variables (Pares-Casanova, 2017). In respect of human settlements, morphometrics means a process of characterising urban form through utilising a vector of measures that quantify individual aspects of its constituent elements and their relationships in space. The elements of urban form thus include the street, the block and the natural area.

Urban Morphometrics is the study of the measurements of urban form. The urban form describes a city's physical characteristics. The main aim of urban morphometrics is to extract indicators and rules from urban morphology principles and theories. Dibble (2017) observes the indicators as density and built volumes, permeability and urban coverage, urban block descriptors, urban form descriptors: surface to volume ratio, compactness index, urban canyon ratios, the prevailing orientation of facades, and sky view factor.

Regional Morphometrics is the study of the measurement of regions form and structures. The concept of regions is linked with space and it has spatial dimensions. In urban planning, regions may mean a part of a district, a village, a district, a state or a group of states. Mukhopadhyay (2010) defines a region as the total of its physical and human elements. Regional morphometrics measures the dimensions of regional morphological elements, their parts and aggregated structures, quantifying shapes of geometries representing a wide range of morphological features, capturing the spatial distribution of elements of regions, density, diversity of various aspects of regional form, connectivity of urban street networks and generating relational elements of regional form.

THEORIES UNDERPINNING THE STUDY

As observed by the Multnomah County Planning Commission (1967), there are three basic theories of urban pattern or form of cities or regions, the concentric zones, sectors and multiple nuclei. These theories buttress this study and assume that the arrangement of the use of the land within a city or region is fashioned largely by market forces and as all theories must, minimise or ignore the influences of other factors that are considered to be of less significance.

The *concentric zone model* was propounded by Ernest Burgess in 1923 to explain the structure and growth of the city. This theory hypothesises that cities grow and develop outwardly in concentric zones. The theory suggests that cities grow by expanding radically from their centres to different concentric circles or zones. As observed by McDonagh (1997), the development of the concentric model was a development of Von Thunen's explanation of rural land uses and values, put forward in the early part of the last century and based on the concept of a medieval village design. This theory was developed using Chicago as an example as Burgess viewed that as cities expand outwards, the interaction among people relating to economic, social and political organisations also creates radical expansion outward and form a series of concentric zones. Multnomah County Planning Commission (1967) understands the concentric theory as based on a process of invasion and succession. Invasion is a process that necessitates the continual expansion of inner zones into outer zones, due to the natural aggression of the migrant into the city, while succession occurs when an area becomes dominated by the activity invading that zone. It is important to note that there is competition in the city among people for limited space and only those who can afford to pay get the desired location for their businesses and homes. Therefore, the concentric zone theory reflects the ongoing conflict between city dwellers and periphery villages.

The *concentric zone theory* has five major zones, i.e. the commercial centre, the zone of transition, the working-class residence, middle/higher class residence and the commuter zone. The following is a brief description of the five major zones of the concentric zone theory:

Commercial centre: this is also called the Central Business District (CBD). This zone is characterised by high intensity of commercial, social and civic amenities. This is the heart of the city, including departmental stores, office buildings, shops, banks, clubs, hotels, theatres and many other civic buildings. The morphological structure of this commercial centre includes buildings, roads and infrastructure and, as observed by Burgess, this structure is always changing rapidly with the changing people's needs.

Zone of transition: this zone houses light industries and slums and is visible in American cities. This is also the home of

numerous first-generation immigrants who usually live in low-income houses, retrogressing neighbourhood conditions, among other poor conditions. This zone is largely believed to be the chief breeder for crime, gambling, sexual vice and other social deviances. It is also characterised by physical deterioration and social disorganisation that leads to concentration of poor housing, poverty, juvenile delinquency, family disintegration, physical and mental diseases.

Working-class residence: this is a planned residential area, close to places of economic activity that often shift and move to the outward rings. This is a residential area with all the modern amenities of civic society. The houses are spacious in a pollution-free zone. Sanitation, health facilities and all other requirements of a good quality of life are found here. There is proper transportation, communication and parking facilities.

Commuter zone: it is located in the uttermost concentric zone, beyond the area of higher-class residence. This is a ring of encircling small cities, towns and hamlets that constitute the commuter zone. People from these areas commute daily towards the CBD or commercial centre for employment and business purposes but live in their small cities, towns and hamlets. These places are largely low-density, isolated and located in suburbs and satellite towns.

The *concentric zone theory* was based on a study carried on in Chicago in the US. Thus, this may not be a reflection of all cities form and structure in the world. The theory is unable to explain the structural pattern and growth of cities in developing countries. Scholars, such as Hoyt, refute this concentric model and argue that the growth of cities does not always form a circle completely. It is often rather distorted by major transport and topographical features.

The *sector theory* incorporates the effect of a radial street pattern into the system. Under this theory, similar types of land uses are located in certain wedge-shaped sectors that radiate from the CBD. The various activities move progressively outwards along access corridors as urban growth takes place. The sector theory represents an improvement over the concentric zone theory as it provides a more satisfactory explanation of the influence of improved access and residential growth

dynamics. However, the model has been criticised because it is ambiguous and oversimplified.

The third theory is known as the *multiple nuclei concept* that recognises many land uses located and around several nuclei in the city. The primary focus is the CBD, but other economic activities are located in nucleated patterns because of mutual profitability of agglomeration, or the attracting or repelling force of land rents, or mutual disaffinity, whereby activities attempt to locate away from other activities whose actions are detrimental to their own. The multiple nuclei theory illustrates the effect of the manifold locational factors on the urban area and how these factors acting independently, and together cause the particular pattern of land uses that may be observed in and around all cities within the country.

APPROACHES TO UNDERSTANDING THE SUBJECT

Cities all over the world evolve in a process developing over centuries that needs to be read and analysed to be able to assess the scope of future possibilities, that at best could lie beyond our current dependencies. It is on this background note that Malfroy and Caniggia (2020) argue that a prerequisite to understanding the subject of urban morphometrics is a certain curiosity for urban history and willingness to deal with those grown structures. This also come hand in hand with a proper education system where literature and theoretical underpinnings of urban development and planning are well explained and delivered.

GLOBAL CASES IN THE STUDY

The world has entered an age of urbanisation, a metropolitan century that is one-third complete. This influences the dynamics in cities as far as urban and regional morphometrics are concerned. Europe has not always been so urban. In the past 50 years, there have been far-reaching changes to the way the European urban system is organised. Europe shifted from an industrial and primarily rural continent to an urban and metropolitan continent. Nabielek *et al*. (2016), provides that the continent's 828 cities accounted for 37% of the population in 1961, growing to 40% in 1981 and remaining constant from thereon, until more recent growth in the urban cores.

The urban and regional landscape of Europe is characterised by a large diversity of small, medium-sized and large cities. Compared to

other parts of the world, many urban regions in Europe have a polycentric structure. This is where multiple towns and cities are near one another. In some cases, there are situations where a single large city may typically be a country's capital, dominates its surrounding region resulting in a more monocentric pattern. There are also other regions with a linear urbanisation pattern, such as areas bordering the Mediterranean Sea and Italy's Adriatic coast. The urban form of Europe is a result of many underlying factors. As observed by Nabielek *et al*. (*ibid.*), some settlements date back to the Roman Empire, where they functioned as administrative centres. Other towns and cities developed during the Middle Ages as regional marketplaces at strategic locations along trade routes often close to a river or harbour. Because of political, demographic and economic developments, towns and cities flourished and, therefore, expanded in some periods, whereas other periods were characterised by a decline (Benevolo, 1995; Rutte and Abrahamse, 2016). Nabielek *et al*. (2016) indicate that over the course of the 20th century, cities spilt over into their surrounding regions. Some of the examples highlighted by Nabielek *et al*. (2016) include Milton Keynes in the United Kingdom, Almere in the Netherlands and Nowa in Portland. These city expansions are said to have injected new and highly planned urban and suburban centres into the historical European urban structure.

In the contemporary world, Europe's city and regional forms can be characterised into four main types: monocentric urban regions, dispersed urban regions, linear urban regions and polycentric urban regions. Monocentric urban regions are found in France, Spain, Portugal and countries in the northern and eastern parts of Europe where cities are distributed over relatively wide areas. In terms of the dispersed urban patterns, these are formed by scattered or sprawling cities, towns and suburbs with relatively low densities. Nabielek *et al*. (*ibid.*) observe that these can be found in parts of Belgium, in northern Italy and the south of Poland. Cities and regions that follow the linear patterns emerged mostly along some of European's coastlines, for instance, in Portugal, in the southern parts of Spain and France and the east of Italy. Linear urban regions are also present in mountain valleys in Switzerland Austria. Polycentric urban regions have multiple cities lying near one another. These kinds of regions can be found in the Netherlands, the western part of Germany and the southern half of the United Kingdom.

From the 11th to the 15th centuries, there emerged different categories of medieval European towns. Some of the outstanding urban regions in Europe followed the concentric-ring type of urban form development. Morris (1994) observes an example of Florence as an example of the concentric-ring type of city development. Sun (2013) further provides that in Europe, medieval towns had similar determinants in social, economic and political contexts. Both the planned new towns formal gridirons and the informal uncontrolled layouts were made up of the local vernacular buildings and the medieval towns were composed of the wall, streets, marketplace, church and town buildings. Another example of a different city form was Nijmegen, that remains important in urban form discourse for its historic development of multi-nuclear origins and successive fortification systems.

The coming in of the renaissance period was taken from Italy and the new architectural style spread quickly from Florence. At this time, the population and extent of European cities were remarkably increasing. Five broad areas for urban planning during the renaissance period were the fortification systems, partial regeneration of the cities, reconstruction of existing cities, extensive addition of new districts and the layout of some new towns (Morris, 1994). Sun (2013) observes that the primary straight streets could determine the existing city's growth. It is important to note that during this time, the main factor determining urban form was a fortification. This is the reason some towns boast of a purely strategic military origin and some examples include Naarden in the Netherlands, Neuf Brisach in France and Palmanova in Italy. These towns had geometric layouts for military reasons.

Sun (*ibid.*) observes that European countries have different forms of urban settlements. Cities have their characteristic patterns. For modernisation, this city is developed with their history, culture, population and many other aspects.

REGIONAL CASES IN THE STUDY

Africa today is labelled as a chief beneficiary of other continents' urban planning theories. Cities and regions in Africa are largely seen and discussed in the context of European, American and even Chinese concepts. However, it is of paramount significance to highlight that although largely destroyed by war and plunder, ancient Africa had cities of grand scale that were extensively planned. Some of the oldest urban settlements in Africa include the El-Lahum that is also known as

Kahun or Ro-hent in Egypt, perhaps the oldest master-planned urban settlement currently known in Africa. Its walls, as observed by archaeologist's reports have date up to 1897 BC (Mazzone, 2017).

Some of the outstanding urban forms in ancient cities and regions in Africa showed a high level of gridded street patterns that suggest authoritative planning, rather than a spontaneous generation and also pre-colonial Senegalese cities including Diakhao, Kahne and Maka are organised along orthogonal grids (Ross, 2015). There are also medieval planned African cities such as Songo Mnara, Tanzania, a 15th-century Swahili stone town, that had highly developed social welfare systems, craftsmanship and political organisations (Patel, 2014). Archaeologists continue to discover remnants of African cities designed with geometric and programmatic spatial divisions that suggest coordinated planning such as Harlaa, Ethiopia, a 9th century cosmopolitan trading city identified in 2017 (Gaffey, 2017). As far as archaeology is concerned, these identifications highlight rapid construction and massive investments of coordinated planning efforts in Africa.

The colonial period (starting in the 1880s up to the 1980s) is one such important period in the life of African cities that saw cities and regions taking different shapes and also being established for different reasons. As observed by Keeton and Nijhuis (2019), the colonial period, understood as the period between the Berlin Conference of 1884 and 1960, largely inverted the concept of urban life in Africa. Africa had centuries of old trading cities that dominated inland Africa and this all changed with the coming in of colonisation when the colonial occupiers replaced (and often destroyed) these centres of commerce with coastal port cities that facilitated the export of natural resources (Coquery-Vidrovitch, 2005: 25). This entails a change or transition of urban forms in Africa. However, this change was not uniform as the colonial models differed or varied greatly among the respective colonial occupiers. Keeton and Nijhuis (2019) observe that each colonial occupier government brought in its design theories, planners trained in specific academic traditions and underlying goals with specific spatial implications. Other scholars, like Njoh (2009), however, argue that regardless of the diverse urban forms created in African cities and regions, all these colonial governments that engaged in urban planning used it as a tool to enforce racial segregationist policies.

Keeton and Nijhuis (2019) further highlight that as colonial planning in Africa was gaining ground, influential people like Howard Ebenezer were proving to be profoundly influential on contemporary European town planning. With their success stories in the European contexts, the garden city model was subsequently reinterpreted around the world in master-planned new towns that linked spatial design to social motives (Galantay, 1975). Thus, in the period between 1898 and 1960, the European occupiers introduced new town planning ideas influenced by Howard Ebenezer Garden city model in British, French and Portuguese colonies, among others. Some of the outstanding examples as described by Myers (2003) and Bigon (2013) include S.D. Adshead's plan for Lusaka, Zambia, from 1931 and A.J Thompson's 1920s plan for Pinelands, South Africa.

As observed by Njoh (2007), the Adshead's plan or the land use plan for Lusaka was designed to accommodate 13 000 people comprising 8 000 Europeans and 5,000 Africans. The plan provided for a shopping and business district, semi-official buildings, clubs and hotels. It had a colonial government house designed about 2.4 to 3.2 km from the government centre. The government house was surrounded by residencies of senior colonial government officials. Adshead also envisaged that the town would develop in the direction of the railway line and station with factories developing in the area bordering the railway. The plan also had a major street of 37m wide, linking the new capital and the old village of Lusaka. There was also a 122m wide avenue designed to run along the ridge, forming the backbone of the new capital city. Keeton and Nijhuis (2019) further indicate that other European colonising powers employed similar design principles, like the radial or grid compositions, low-density residential areas, monumental public buildings and functional zoning, but these were not called garden cities. The most prolific and common planning practise during this period was the planning of racially exclusive spaces that divided cities into areas for colonial residents and areas for indigenous populations (Silva, 2015).

When African countries started to gain independence even in the 1960s, there was a new move to build new towns and new capitals. As observed by Keeton and Nijhuis (2019), these were mainly spatial assertions of nationalism and identity. Some of the described examples of the 1960s include Dodoma in Tanzania that is said to have been built on the African socialism ideology of President Julius

Nyerere, while Abuja, Nigeria, was envisioned as a democratic capital that could help move Nigeria towards a national consciousness. In terms of urban form, these cities and regions were largely central places, especially Abuja, that was located in the geographic centre of the country to provide a message of perceived ethnic and religious neutrality. Gaborone, Botswana, was located because of her environmental advantages and lack of tribal affiliation. Keeton and Nijhuis (*ibid.*) argue that most of the new towns built during this period were state-led and embedded in prevailing political movements, such as unity, nationalism and identity and these were also central tenets of their design and development.

DAR ES SALAAM, TANZANIA

Dar es Salaam is a rapidly growing city in sub-Saharan Africa and has been experiencing substantial changes in its spatial pattern and land cover over the years. As observed by Mkalawa (2016), these changes have been driven by many factors, including transport and communication, internal and international migration, high natural growth rates of urban populations, public policies and agglomeration economies. Mkalawa (*ibid.*) further indicates that unluckily, urban expansion has taken the form of "peripheralisation" that is characterised by large peri-urban areas with an informal or illegal pattern of land use, combined with lack of infrastructure, public facilities, lack of services and often accompanied by lack of public transport and adequate access roads. He) further indicates that this process is leading to new urban forms as the countryside began to urbanise.

The city of Dar es Salaam is clustered from the city centre and unevenly dispersed following the four major roads. The clustering of settlements and economic activities along the major roads radiating from and connecting separate metropolitan areas leads to gradual building-up of the urban fabric along the metropolitan core, arranged in a linear fashion making a four-fingers pattern. This shows that the city of Dar es Salaam urban cover and spatial pattern has been shaped by transport networks. Mkalawa (*ibid.*) indicates that from the colonial era to the current, the city has been extending following these four major arterial roads. There is an increased intensity of city growth from 1981 to 2009. Mkalawa (*ibid.*) also provides that this ribbon-shaped four-fingers pattern structure, has stretched for a long distance mainly in four major roads of Morogoro, Bagamoyo, Kilwa and Pugu. Urban

growth in Dar es Salaam is extending in perpendicular directions. There are new nodes in areas where highways are intersecting such as Mwenge, Ubungo, Buguruni and Tabata. Mkalawa (*bid*) argues that these developments of the city are dominated by a fragmented pattern that is characterised by high-density residential areas that are single-use and result in patches of mono-functional, dense built-up areas.

The urban form of Dar es Salaam is influenced by the networks of transportation since economic activities require high levels of accessibility to the cluster along main roads or nodes close to major intersections of highway systems. Residential developments also seek accessibility, therefore the developments of new routes and transport system provided important ways of structuring the city in the long term.

NAIROBI, KENYA

Nairobi is home to more than 3.14 million people, making it the second-largest city by population in the African Great Lakes Region, after Dar es Salaam. Nairobi is a centrally located capital and a major hub for commerce, transport and regional development. As observed by Antos *et al*. (2016), roughly 60% of its population lives in slums and these slums are strategically situated close to the CBD to provide cheap and local labour. There is a high proportion of unplanned and crowded housing units in areas close to the CBD. In terms of the general layout of the city, there is a mixture of highly irregular and regular residential developments and commercial/industrial land throughout the city. The city is dominated by land covered with commercial, industrial and transportation structures. The irregular neighbourhoods are predominantly found around 3-8 kilometres from the city centre and the closest identified near Kariokor in the northeast (Pumwani, Mjengo estate and Kitui Village). This is in sync with the provisions of the concentric theory that places zones of transitions out of the city centre. These zones are characterised largely by urban decay and occupation by some of the poorest urban people.

The development of the City of Nairobi is described by Kingoriah (1983) and one of the important points is that no settlement of any kind existed in the area occupied by the City of Nairobi before its formation. Thus, the development of the City of Nairobi, together with its urban form, is a result of railway construction and encampment. This city has, however, developed to be a modern metropolis and one of the biggest in eastern Africa. Kingoriah (*ibid.*) goes on to argue that the land use

pattern or, rather, an urban form of Nairobi or the city structure, has not been so much the result of economic variables operating over the distribution of land resources, but has been mainly the result of government policy since the city was founded. Kingoriah (1983) describes models of city structure and tries to fit Nairobi and the general agreement is that not only does Nairobi resemble some of the modes like the concentric zone model, but also does resemble developments that fit into other models of city structures. As highlighted above, most residential developments in Nairobi are outside the city centre and they also follow some irregular patterns that show a mixed urban form as far as the theories of urban form are concerned.

ADDIS ABABA, ETHIOPIA

Addis Ababa is one of the oldest and largest cities in Africa and it has an estimated population of about 2.7 million people and this number has been doubling every decade since 1984 (Antos *et al*., 2016). As observed by the UN-Habitat, it is estimated that the rapid growth of the population will continue and reach 12 million people by 2024. Population growth in Addis Ababa has triggered a boom in construction, especially of condominiums, office buildings and infrastructure projects breaking ground almost simultaneously throughout the city. Antos *et al*. (2016), however, provides that these developments have not always followed government regulations and this has resulted in some projects cut off and creating an ill-functioning urban form where major road intersections are built without pedestrian considerations and lacking coordination and support of a strong transport system. Because of such misnomers, neighbourhoods are mostly medium density and possesses an urban village type environment, where residents are within walking distance to all their amenities.

Like most African cities and urban regions, residential settlements are highly concentrated in and around the city centre. Addis Ababa is prone to irregular settlements as well. Antos *et al*. (*ibid.*) indicate that there is a significant portion of land in the city centre that is occupied by irregular residential developments. Within the first four kilometres from the city centre, about 26% of the built-up land is residential and irregular, with this number dropping off dramatically around 8% and 6 kilometres outside of the city centre. There are pockets of irregular residential developments that continue to appear towards the city's

periphery. One outstanding difference with cities and regions Dar es Salaam and Nairobi is that Addis Ababa's industrial and commercial land is found in small pockets throughout the city, rather than concentrated in large zones as in the mentioned cities. As observed by Antos *et al*. (*ibid.*), this pattern of small pockets of land cover might be indicative of the 'urban village' environment that is a localised type of development in Ethiopia.

DAKAR, SENEGAL

Dakar is located on the Cap-Vert peninsula and is home to about one-third of Senegal's population. The majority of Dakar's economic activity is concentrated in the huge industrial zone that stretches from the Port of Dakar to Rufisque, along Hann Bay. Antos *et al*. (*ibid.*) indicate that the population of Dakar has tripled since the 1970s with much of this growth occurring near the periphery of the city. The urban structure of the City of Dakar is different from other cities in Africa. Due to land constraints from its geographical location, the spatial distribution of the land cover in Dakar is decidedly different from the African cities discussed in this chapter. Mainly, commercial and industrial uses are primarily concentrated directly at the core and along the south coast of the peninsula. Regular residential land is located north of the city centre and extends west. There are also irregular residential developments. These are found in small pockets scattered throughout the city, particularly near the airport and near Rufisque.

LOCAL CASES IN THE STUDY

Urban development in Zimbabwe is directly related to or influenced by colonialism. There were human settlements in Zimbabwe before colonialism and these remain important in the study of human settlements in Zimbabwe. However, they lived long before any urban development commenced in Zimbabwe. These human settlements were entirely scattered and sparsely populated rural settlements and of notable significance are the states of great Zimbabwe, Khami and Dlodlo states. The development of the urban atmosphere in Zimbabwe, like many sub-Saharan countries, is attributed to colonialism and its impacts. As observed by Munzwa and Jonga (2010), colonialism brought with it a new social-political and economic dispensation. He further describes that the mission of the settler was to take occupation of the land and make it his home by exploiting all the available resources to the best advantage. This, in terms of the subject of the matter, best explains the overall assertion that colonial cities and

regions, especially in Africa do resemble urban forms or rather urban characters of their host colonisers.

In Zimbabwe, urban development first came through the development of military forts that were established along the route of entry followed by an expeditionary force called the Pioneer Column that was under the British South Africa Company. Some of these urban areas include Fort Tuli (near present-day Beitbridge), Fort Victoria (now Masvingo), Fort Charter (now Chivhu) and Fort Salisbury (now Harare). At first, the settlers were not interested in staying permanently as their main focus was on the exploration and mining of various minerals. However, since there was an agenda to colonise, the settlers had to consolidate their power or the colonisation process through the establishment of supportive infrastructures, including roads, railway lines and telegram lines and urban and mining towns. This is the period between 1890 and 1939 that centres such as Kwekwe, Redcliff, Kadoma, Chegutu, Chinhoyi, Bindura, Shamva and Marondera, were developed.

The second stage of urban development, as indicated by Wekwete (1994), is between 1940 and 1952 where urban development transformed to high levels of building and construction, especially because of the boom in exportation or primary products and the manufacturing sector. Kwekwe and Redcliff were transformed in that era into industrial towns as the iron and steel industry received immense investment improvement. It is important to note that some urban and regional centres of that time were developed out of a direct response to the core-periphery connectivity. During that time, urban expansion was highly notable and concepts such as the garden city and the Redburn were adopted in Zimbabwe through the establishment of settlements. These stages were later followed by urban development during the Federation epoch of 1953 to 1965. It is in this era that Zimbabwe witnessed major urban development.

As highlighted above, Zimbabwe owes much of its current urban form to the colonial period. The spatial form and structure of Zimbabwe's towns and cities as they appear today were, by and large, created by the inception designers (Munzwa and Jonga, 2010). Munzwa and Jonga argue that more than 95% of central business districts (CBD) of these centres was laid out on a gridiron pattern. The alignment of roads had streets and avenues running in a north to south and east to west direction respectively. These urban forms, especially found in

cities such as Harare and Bulawayo, were adapted to the respective site conditions and topography they have. Most industrial cities and regions are located to the south-west of the CBD, with low-density (high income) areas to the north and high density (low income) areas to the west. Munzwa and Jonga (*ibid.*) argue that this type of urban form complied with the prevailing south-easterly winds.

EMERGING DEBATES IN THEORY, POLICY AND PRACTICES

The study of urban morphology has evolved and many professions and schools of thought have treated the field differently. What remains valid and essential is a new movement calling for the integration of different, often isolated, urban form research and teaching approaches through pedagogic innovation and information and communication technology. This movement comes from the realisation that the field of urban morphology has disintegrated through multiple numbers of professionals who argue through the history of urban development the world over and the changing situations of urban areas and the emergency of interested and relevant professions to be involved at the current period. Thus, debates emerging in terms of theory, policy and practice point to the need to develop an innovative, open and inclusive system of teaching and training in urban form from a multidisciplinary perspective. This should be capable of enabling the current and future generation of planning and design professionals to address comprehensively and effectively the variety of issues and challenges faced by contemporary cities.

It is on this background note that contemporary cities require different handling of the whole urban morphology issue. Krieger (2009) indicates that contemporary cities are characterised by a variety of forms of socio-spatial patterns and increasing social, economic and political fragmentation strongly related to their urban form. In this regard, urban municipal authorities, policymakers, urban designers and scholars are called to respond to such challenges and a variety of approaches on understanding urban form in terms of theory and how it operates are being developed. However, there seem to be few aspects of convergence between separate schools of thought as each tends to focus on its dimensions and belief systems over urban morphology. One of the outstanding challenges over the years is the shaping of cities and regions in the mid-20th century that focused on the sprawling of cities and decay in ageing central places.

As observed by Elrahman and Asaad (2020), the goal was to find common ground among the design disciplines, namely architecture and urban planning, for dealing with the kinds of exasperating problems that are beyond the mastery of any single design discipline. However, most agree— some enthusiastically and others with reservations — that urban form has been largely the domain of architects interested in urbanism.

Proponents of the above school of thought argue that since giving shape to urban space and settlement is an essential task of urban design, it requires an architect's training. The planning profession, on the other hand, increasingly reengages physical planning and it argues that urban form is their prerogative as they claim an urban design grow in their professional practice. The central argument from the physical planner's side is that urban form carries spatial implications that are not, at heart, architectural, so an architecture dominated approach to urban design is limiting. Krieger (2009) also provides a counter-argument from the emerging generation of designers calling themselves landscape urbanists who questions the supposition that urban design insight is the prerogative or architecture form-making sensibilities alone and probe the question, "Isn't the landscape the real glue of the modern metropolis?" While these schools of thoughts are still growing and grabbing their share on the table, it is important to note that the promise of landscape urbanism in urban morphology is powerful since it promotes logical integration of land use, environmental stewardship and place-making.

In light of the above, it is of importance to pursue any city, regional or neighbourhood development through a highly collaborative mind of a myriad of actors beyond professional circles. Urban form is a critical aspect of the urban fabric and can be greatly improved from the initial tactics of the Mohenjodaro developments to new urbanism and the current modern planning and design phases. Some of the key factors include, among others, public agencies, investors, financial institutions, regulators, built environment professionals and residents. Krieger (*ibid.*) underscores that navigating the shoals created by cadres of stakeholders is perhaps the greatest challenge to pursuing sophisticated ideas about goals for urbanism. The morphometrics of cities and regions of today may greatly benefit through processes and forms of urbanisation than we acknowledge or deploy from our memory bank of good cities.

LESSONS DRAWN

The first fundamental lesson drawn is that the field of urban and regional morphometrics is a dimensional field that provides rich information and knowledge on the evolution, structure and future of urban areas. The gateway to the understanding of the field of urban and regional morphometrics is looking through the past and histories of the grown cities. These provide fundamental information concerning theories regarding urban form and factors that led to varying urban forms throughout the world. In this chapter, it has been highlighted that different urban and regional forms formed the basis of current and past urban forms in the world.

Three categories of urban forms, cities and regions as central places, break-of-bulk and specialised function, are discussed. It is understood that cities and regions do not necessarily follow one of these categories but may have traits of all of these urban forms. Some of the theories that support this subject matter are the concentric zone theory, the sector theory and the multi-nuclei theory. These theories do not determine the spatial structure of every individual city but, rather, they can be generalised to explain the arrangement of activities, land uses and structures that would result from the actions of factors responsible for the establishment of the cities or urban regions.

Another important take away from the chapter is that urban and regions are created out of a process of 'human objectivation'. This is when the aspirations and needs of certain people are responsible for the type of urban area they establish and its urban form. From the chapter, it has been highlighted that from Europe to Africa, urban areas started as a small collection of human settlements that grew over time to become some of the outstanding metropolitans of the world. In the past, especially in the 19th and 20th centuries, most urban regions had fewer people that determined the level of development in cities and their urban forms. Early civilisation of Mohenjodaro or Harappa originated near river valleys because of the needs and locational advantages that suited the people of that time. However, urban areas are dynamic and they transform over time. This is also one of the lessons that even urban form transforms over time and sometimes it transforms due to physical factors or due to other man-made factors.

The subject of urban and regional morphometrics remains under the purview of professionals who can explain the transformations of urban

regions from the early civilisation cities. However, it has been seen that there is a born of contention over the schools of thought that consider themselves creators and protectors of various urban forms. Professions such as urban planning, architecture and urban designing have shown great motive over the subject matter and sometimes their effort has gone to waste due to lack of coordination and collaboration over urban and regional morphometrics.

CROSS-CUTTING THEMES

The study of urban and regional morphometrics has been discussed in this chapter and it remains important to note that many cities of today are because of the processes of planning that happened in the past. Studying this subject in the contemporary era requires an understanding of cross-cutting themes of urban and regional morphometrics to ensure the relevance of the subject matter. Some of the fundamental cross-cutting themes of this chapter include the following:

URBAN MORPHOLOGY

In terms of urban morphology, the major focus is on the science that is used to assess the generation process of ideas and tendencies that base the form of cities to focus on the tangible impacts of social, economic and environmental forces. With time, the elements of urban morphology such as buildings, gardens, streets, parks and statues change and evolve but they remain the key elements of morphological analyses. It is on this background that Fathi *et al*. (2020) argue that the physics of the city reflects the impact and footprint of human tendencies and activities and that form can be related to a specific historical period or can be caused by their designed events. This makes urban morphology an important theme in this chapter or the subject of urban and regional morphometrics. Studying the physical aspect of urban and regional spaces is the most proper basis for delineating the overall image of character since the physical nature and organisation of cities and regions are the most tangible and sustainable aspects.

The main elements of urban morphology thus include:

- Form, city structure, proportions and deformation of objects and their components;
- Economic and social structures, time and its effect on city form;
- Use of buildings and human activities and interactions;

- Form, cultural factors and urban components and landscape;
- Historical and social factors, form and spatial factors;
- Physical for of the city, form and space;
- Form and time: implementation, extension and spatial interaction.

These concepts of urban morphology emphasise the physical-functional aspects of the city, such as street and building patterns and the social, economic and political factors and the passing of time that significantly affect the formation of the artefact texture of the city. Urban morphometrics describes urban form via the systematic and comprehensive measurement of its morphological characters. The morphological characteristics of urban areas include their physical characteristics such as the street, the block and the natural area. In terms of measurement, the main focus of urban morphometrics is on indicators of urban morphology such as density and built volumes, permeability and urban coverage, urban blocks descriptors, urban form descriptors: surface to volume ratio, compactness index, urban canyon ratios, the prevailing orientation of facades, and sky view factor.

SPACE SYNTAX MEASURE

The space syntax measure is an important theme in the study of urban and regional morphometrics. This is an indicator of street connectivity and is done through an analysis of the configuration of a city, that is, the pattern and order, among others, to analyse the potent relationship between form, space and social forces. Fathi *et al*. (*ibid.*) indicate that space syntax measure entails dividing the city into a discrete system, including the longest visual-motor channels where audiences move in and perceive city structure. The intersection of these lines is evaluated based on graph and mathematical analyses and the intersection of two lines represents their relationship and a line having more intersections with other lines is related with higher elements in the network and is more accessible. As observed by Fathi *et al*. (*ibid.*), this method of space syntax measure allows researchers to analyse the relationship between spatial configurations and the social and behavioural structure of space and recognise and analyse the effect of changes in urban networks on citizen mentality and behaviour. Space syntax is considered an attempt at how a spatial configuration situation expresses a social or cultural meaning, and predicting the amount of space used and its linkage with the daily life of people is possibly

based on this method. Fathi *et al*. (*ibid.*) further highlight that space syntax aims at describing how human-made places such as buildings and urban space networks, were formed, especially how they are articulated and aligned.

Some of the basic concepts related to space syntax measure include integration or interconnection. This is a principal concept in the space syntax approach. The integration index interprets an axial map, i.e. the spatial arrangement image of a city. The integration of a point in the map shows its relation with the overall structure. If space can be reached by travelling shorter spaces, that space is said to have more integration and vice versa. Another dimension or concept is connectivity. This refers to the number of paths and ways that are directly linked to the path being analysed. There is also depth distance, that is the minimum spatial distance, that must be travelled from one node or path to any other node or path. The lower the depth is, the higher the integration and connectivity would be.

CONCLUSION AND FUTURE DIRECTION

The chapter explored different forms of cities and regions across the world. It has been described that cities and regions have various forms that develop and transform over time due to various factors. Some of the described factors can be grouped into the physical such as topography; economic i.e. the availability of natural resources or raw materials and political reasons. These factors have been discussed in the context of urban forms of cities such as Addis Ababa, Nairobi, Dar es Salaam, Dakar and some European and American cities. The wake of rapid urbanisation has also been elaborated on, especially on how African cities have evolved and adapted to high rates of informal settlement development in their cities.

The following are some of the options to consider when trying to build a desirable urban and regional form:

- Respect the experience, identity and character of the surrounding context;
- Ensure the sustainability of natural systems and urban living;
- Protect the quality of life of residents, employees and visitors;
- Ensure the connectivity and integration of surrounding uses; and
- Require properties to develop in a manner that contributes to the overall vision of the city