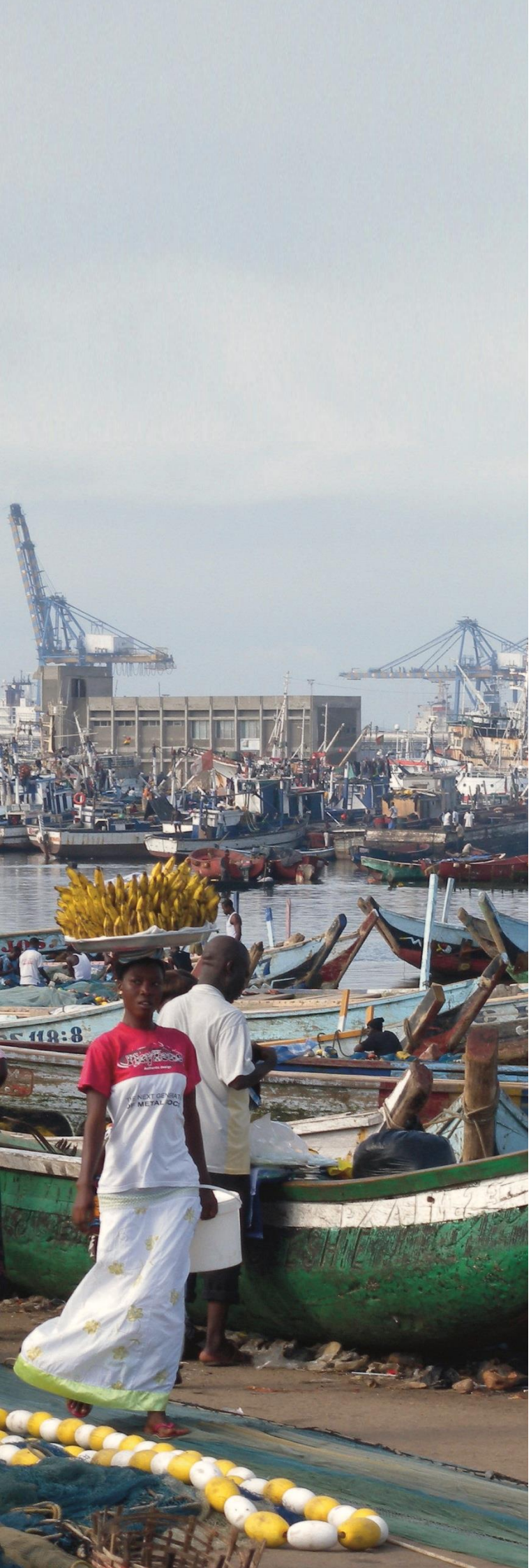

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Abstract

The impacts of intense urbanization and associated urban land-use change along coastlines is vast and unprecedented. Several coasts of the world have been be subjected to human-induced coastal changes and it is imperative to monitor, assess and quantify them. This paper provides the state-of-the-art discourses on the changing dynamics of urban land-use driven by the forces of urbanization. Drawing on extant literature mainly from Web of Science and Google scholar, the status quo of the spatio-temporal dynamics of urbanization and urban change processes were explored with specific focus on global, Africa, Ghana and an actual case of Accra coast. Findings show whilst urbanization continues to increase exponentially, urban land also continue to change markedly. Current trends and patterns shows that changing urban dynamics exhibit are distinctly different from that of the past. Particularly, the rate, magnitude, geographic location, urban forms and functions are changing. In the specific case of Accra coast, there is general trend of urbanization moving outwards, i.e. from the core city centre towards the peripheral areas. Additionally, spatial urban pattern is dominated by urban sprawl, characterized by the cyclical process of diffusion and coalescence. The processes of urbanization are further exacerbated within coastal areas with a new and unique spatial urban form, “tourism urbanization” emerging. This new urban form is largely driven by rapid expansion of tourist infrastructure, developing at the instance of government policy to develop coastal tourism. In addition, the coastal conurbation of Accra-Tema is a powerful hub for industrial and commercial activities, which is drawing huge “humanline” towards the coastline. The literature illustrates that contemporary approaches and conceptualizations for urbanization and urban land-use change analysis be extended particularly from the mere focus on statistical classifications of cities in different size categories. With the urban fringe spreading outwardly, it should be kept in mind that new forms of urban settlements are emerging along with varying sizes. Considering the multiple scales, magnitude and rates involved as well as the geospatial patterns of urban change processes, experimental case studies that include coastal cities, Peri-urban fringes and interconnections with rural areas across a range of urbanization processes is essential and very urgent.

Coastal Urbanization and Urban Land-Use Change in the Greater Accra Metropolitan Area

John Edem Akubia

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1 Introduction

Human impact on Earth has been vast and unprecedented. Consequently, the dynamics of an urbanizing world coupled with constant changes in land-use/cover has been recognized as being an important aspect of human imprints over time and space (Scheuer, Haase, & Volk, 2016). These processes are a significant cause, or forcing function of global change, and the medium through which many human responses to global change will occur; this makes both phenomena an essential component in all considerations of sustainability (Seto, Reenberg *et al.*, 2012). Reports show that the world's population is rapidly increasing and this is projected to reach some 9 billion by 2050 (UN-DESA, 2015; UN-HABITAT, 2016; US Census Bureau, 2015). As of 2015 54 percent (4 billion) of the world's population lived in urban areas and this urban population had multiplied more than ten times in the past century from 224 million in 1900 to 2.9 billion in 1999 (UN-HABITAT, 2016). As the urban population increases, urbanization-driven land-use change in cities have equally increased with even higher rapidity (ibid).

Subsequently, the spatial organization1 of many urban areas are undergoing unprecedented and extraordinary processes of change and transformations. The sizes (in terms of population and extent), spatial processes, spatial structures, functions and roles of cities are changing (Sana, 2013). Urbanization-driven land-use/cover change (LUCC) dynamics (Clement, Chi, & Ho, 2015; Seto, Guneralp, & Hutyra, 2012; Seto & Reenberg, 2014) is thus the primary agents of change of city processes. Substantial studies have buttressed these points arguing that the rapid growth in urbanites have triggered irreversible changes, especially in Peri-urban fringes of cities (Clement *et al.*, 2015; McGranahan & Satterthwaite, 2014; Weeks, Hill, & Stoler, 2013), characterized by land-use/cover changes (Delphin, Escobedo, Abd-Elrahman, & Cropper, 2016; Lambin & Geist, 2006).

Ever-increasing economic development including land reform, construction of roads and infrastructure, real estate development, industrial and commercial development has accelerated the process of urbanization in many regions (Sayed & Haruyama, 2015). Current observations show that urbanization-driven land-use change has been widely impelled by housing and resi-

[1] The term spatial organization herein connotes the configuration of space relative to spatial processes and spatial structures, which depict the spatial pattern of population and settlement distribution, interrelated locations of things and activities within a built up area. Spatial structures are the patterns, layout, distribution or arrangement of physical phenomena relative to each other in space whilst spatial processes are the mechanisms which produce the spatial structures of the distributions Klapka, Frantál, Halás, and Kunc (2010); Sana (2013)

dential development, commercial and industrial zones in the urban prefecture to promote urban development (ibid). In effect, urbanization processes and the rapidly changing patterns of land-use/cover are considered to be two co-evolving phenomena in the current urban era (Santhiya, Lakshumanan, & Muthukumar, 2010).

Much of the growing urban population growth are concentrated along coastlines, which have a good number of mega-cities linked to global or core cities. Findings from extant studies indicate that urbanization-driven land-use change within many coastal locations have shown to be advancing rapidly across a global scale (Scherner *et al.,* 2013). Coastal zones[2] and locations are probably more than any other part of the ecosystem have been exposed to increasing population growth and processes of change (Sesli, 2010). with the growing upsurge in coastal population, many of the world's coast are increasingly becoming urbanized (Pelling & Blackburn, 2013; UNU-IHDP, 2015). According to a report of the world's first global assessment of the effects of urbanization on biodiversity and ecosystem services, Elmqvist *et al.* (2013) reported that current trends of urbanization processes (urban population growth) and associated land-use expansion are rather growing faster in low-elevation, biodiversity-rich coastal zones than in other areas. This affirms Seto's (2009) argument that urban population growth, urbanizing landscapes and the most densely populated parts of human settlements are predominantly coastal[3]. Inferred from this, the pressures mounted on "coastal urban" areas around the world has increased dramatically over the last 50 years (Campbell, Whittingham, & Townsley, 2006; Santhiya *et al.,* 2010).

As coastal cities continue to attract the bulk of the world's urban population, the increase in urbanization is likely to continue and become unprecedented (Pelling & Blackburn, 2013). The physical expansion of cities, the rise of new urban forms and the transformation of new urban spaces most especially at the urban fringe and the geographic edge of many cities and metropolitan regions have materialized (Nilsson, Pauleit, Bell, Aalbers, & Nielson, 2013; Winther, 2015). Overall, the Peri-urban area is characterized by increased in-

[2] Coastal zone is composed of about 200 nautical miles seaward and 5 km–10 km landward. A coastal zone is a transitional region between the terrestrial and marine environment with features, which makes it one of the most productive ecosystems in the world (Olaniyi, Abdullah, Ramli, and Alias, 2012). In these regions, almost half a billion urban residents already live in coastal areas, which are increasingly vulnerable to rising sea levels and the unprecedented frequency and intensity of storms which may render many of these cities uninhabitable in our lifetime.

[3] Globally, approximately 400 million people live within 20 meters of sea level and within 20 km of a coast. Many large cities occupy coastal locations (Seto, 2009). Presently, from the indicator "*Percentage of total population living in coastal areas*" it is estimated that about 3 billion people (constituting about 40 percent of the world's population lives within 100 kilometers of coastal landscapes (CIESIN, 2013).

teractions between urbanization-land-use change with high, and often increasing, population density, small landholdings, rich countryside homes, contested land tenure rights, uncoordinated conversion of agricultural land to housing, intensified resource exploitation and a considerable economic dynamism (Nilsson *et al.,* 2013).

In recent years, some progress has been made in understanding the spatial, temporal and functional elements of urban change. Particularly, recent literature has seen growing efforts devoted to investigating the spatial processes and patterns of urbanization in order to understand the possible links between urban change land-use change processes (See for example, *Seto et al.,* 2014). Following, several new international initiatives and urban research networks have been established to explore the relationship between urbanization and urban land-use change. In a recent assessment of global change trends, Seto & Reenberg (2014) identified three important trends that are concurrently reshaping land-use both locally and globally namely: urbanization; the growing integration of economies and markets (globalization); and the emergence of new land-use agents (rising competition for land resources). These are the hallmark of current patterns and trends of global urbanization and land-use change.

It is imperative to state that the current patterns and trends of urbanization and urban land-use change stand out as especially timely and are particularly promising frontiers for environmental change research that need attention. To be able to generate and contribute knowledge to these emerging trends, it is important to conduct a comprehensive research study that hinges on the interplay between urbanization and land-use change over time and space. As a point of departure, the main thrust of this working paper is to present state-of-the-art discourse spatial patterns and dynamics of urbanization-driven land-use change processes. This report provides the status quo of the rate, magnitude and nature of spatial urban dynamics in terms of urban population growth and urban land-use change as well as the interconnections between them.

Following the introduction, this report is divided into four major parts. The first part elucidates current definitions, conceptual and theoretical perspectives of urbanization and land-use change. The second part provides the major contemporary patterns, trends, processes and changes discourses on urbanization and urban land-use change processes, from the global perspectives relative to African, Ghana and finally Accra situations. The third part provides some empirical evidence of previous studies, drawing on the interlinkages between urbanization and land-use change. Finally, the report outlines some critical knowledge gaps need to be bridge relative to urbanization and land-use change. This this followed by conclusions drawn from the review.

2 Current Definitions, Conceptualizations and Theories of Urbanization and Land-use Change

2.1 Urbanization

2.1.1 Definitional and Conceptual Aspects

Generally speaking, urbanization can be conceptually and practically analysed from several perspectives, viz: the historical (temporal) perspective, the spatial perspective, the network and power hierarchies' perspective and the land-use change perspective (Scheuer *et al.,* 2016). In principle, the process of urbanization can be studied using any of approaches stated either on a case-by-case basis or on a combination of two or more perspectives. Current approaches in studying urbanization, however, adopt a combination of the spatial and temporal perspectives have been intensely used to examine urbanization and the dynamics of its change by geographers, economists and also social scientists for many decades (Scheuer *et al.,* 2016). For the present purposes, the spatial and temporal perspectives as well the land-use change perspective shall be the focus of this working paper.

In defining the term urbanization, it is imperative to note an absolute definition of urbanization is elusive because of variations in the form, shape, function and history of urbanization around the world. What is certain is that, over time, traditional conceptualization of urbanization have revolved around percentage of total urban population, population density; functions performed by the urban areas in question, extent of built-up areas and authorized local units of national or state government. More recently, urbanization as per (Seto *et al.,* 2014), has been conceptualized to connote a process that involves simultaneous transitions and transformations across multiple dimensions, including demographic, economic, and physical changes in the landscape and each of these dimensions presents different indicators and definitions of urbanization.

Firstly, urbanization involves an array of interactive processes involving four multi-dimensional indices: demographic, social, and economic dimensions and manifest as spatial morphological changes (Mulligan, 2013; You, 2016). Demographic urbanization, being the widely accepted connotation involves the increase in urban population proportion relative to the total population. Social urbanization involves employment rate and other aspects related to quality of life, cultural and lifestyle adjustments of the urban economy. Economic urbanization on the other hand covers aspects of economic growth with specific focus on steady growth in Gross Domestic Product (GDP). Lastly, spatial urbanization involves the conversion of land being it agricultural pastures, and forests to urban uses in terms of extent of built-up area, population density. Although these aspects are used to describe the urbanization patterns from particular aspects, they can be case-specific, and do not really reflect the actual dynamic, integrated process (Gamba & Herold, 2009; You, 2016). Therefore, to address this caveat, multi-dimensional definitions have

been construed to comprehensively reflect the demographic, social, economic, and spatial characteristics of urbanization (see for example: Guo, Wang, Nijkamp, & Xu, 2015; Li, Zhou, Shi, & Zhu, 2012; Wang *et al.,* 2013). It is however, important to emphasize that these conceptualizations are generally used to characterize the interactions between urbanization and environment, rather than the process of urbanization itself (You, 2016).

According to McGranahan & Satterthwaite (2014), a country or region maybe be said to be urbanising if more of the economically active population are becoming more urban. Demographers have interpreted this to mean that a growing share of the population lives in urban settlements, with the level of urbanization being the urban share, and the rate of urbanization being the annual growth rate of this urban share (UN-HABITAT, 2016). (Friedmann, 2006) simply defined urbanization as a dynamic, multi-dimensional, interactive and a distinct set of socio-spatial processes taking place within urban regions. Karrar & Qadeer (2013) defined urbanization from a spatial and ecological perspective, which refers to an area undergoing large urban population growth, high density, non-agricultural economy, and often some form of municipal organization so that the proportion of a country's population that lives in such habitats is a measure of its urbanization. The UN-HABITAT (2014) defined urbanization as a multifaceted concept, that refers not only to the growth of population in towns and cities (i.e. the share of the national population in towns and cities), but also, the extent to which population growth is accompanied by structural shifts in an economy, employment, and socio-political changes that occur when people live in large, nucleated settlements.

Perhaps, the most important and comprehensive definition of urbanization for the purposes of this report the definition put forward by Elmqvist *et al.,* (2013). To them, urbanization is a multidimensional process that manifests itself through rapidly changing human populations and changing land-use/cover, with urban growth resulting from a combination of four major forces namely natural growth, rural to urban migration, massive (migration due to extreme events), and redefinitions (reclassification) of administrative boundaries. In this report, I use a working definition of urbanization, as a complex, dynamic, multi-dimensional and spatial process that manifests itself through rapidly changing human population and the simultaneous temporal, spatial and sectoral changes in the demographic, social, economic, technological and biophysical, land-use/cover and environmental aspect of life in a given urban region.

Inferring from definitions above, this paper comprehensively identifies five (5) key characteristics of urbanization namely: human ecology aspects, natural increase, net migration, population density, urban county, and percent urban population. Natural increase and net migration represent changes in population size, and urban county and percent urban population are two alternative measures of socio-spatial organization (Clement *et al.,* 2015). In addition to this, Seto & Reenberg (2014) identified six salient features that has historically characterized urbanization and often noted in extant literature have been identified. These features include: (a) density of population (b)

compact built environment (c) governance (d) specialized economy (e) infrastructures and (f) rural hinterlands. Whilst some of these features are associated with the character of urban settlements (density, durable built environment and urban infrastructures), others refer to processes that enable urbanization (specialized economies and governance).

Furthermore, Scheuer *et al.* (2016) draws attention to four (4) stages of urban processes goes through. The first stage known as urbanization comprises absolute population growth in the core city and thus the agglomeration as a whole. Second, suburbanization stage is when there is absolute population growth in the agglomeration, with growth being relatively concentrated on the suburban space and the core city stagnates. Third stage is where we have desurbanization, which indicates absolute population decline in the core city, its periphery and thus the urban agglomeration in total; and finally, the re-urbanization stage, which is the recurring population growth in the agglomeration's core city (Scheuer *et al.,* 2016). Keeping this in mind, one must be careful not to overemphasize the growing rate of the urban population proportion and economy, but instead focus primarily on the synchronous development of the involved multiple interactive processes.

2.1.2 Theoretical Perspectives

Various theories, focusing on the causes and effects of urbanization have been put forward to theoretically conceptualize urbanization globally. Among the many theories that have been propounded are four (4) key theories of urbanization, which covers different era are worth noting in this working paper. These include; the theories of self-generated or endogenous urbanization, the modernization theory, the dependency theory/world system perspective and the global city perspectives (Peng, Chen, & Cheng, 2011). In addition to the four, the urban bias theory is also discussed in passing. These theoretical perspectives, focusing on the causes and effects of urbanization are considered relevant for the purposes of this report.

To begin with, the self-generated or endogenous urbanization theory suggests that urbanization is predicated on two separate prerequisites − the generation of surplus products that sustain people in non-agricultural actives and the achievement of a level of social development that allows large communities to be socially viable and stable. In a demographic sense, this theory focuses on the rural-urban population shift as the foundation of urbanization but it identifies industrialization as the basic driver behind the movement of rural population to urban areas for factory or industrial jobs. The historical development of urbanization is evidential of this theory in that most western countries first undertook accelerated industrialization and then urbanization followed. In view of this, if we focus on cities instead of urbanization, this theory accounts for the endogenous conditions that facilitated the transition from pre-industrial to industrial cities, first in the West and then in the rest of the world, in an uneven manner. A point to note here is that the trends of urbanization in cities today has not necessarily been industrialization-driven

or accompanied by industrial expansion. Critical voices argue that urbanization today is demographic driven rather than economic because it has not propelled by radical transformations in agricultural productivity and industrialization (Songsore, 2009). Inspite of this concerns the self-generated or endogenous theoretical perspective of urbanization, perhaps, remains relevant today in light of the close relationship between industrialization and urbanization even in contemporary developing economies, however, the theory suffers from the drawback of focusing narrowly on the rural-urban shift within countries as the key to urbanization (Peng *et al.,* 2011).

The urban bias theory was first put forward by Michael Lipton (1977) in his seminal work on urbanization in developing countries holds that urbanization is the product of government policies that systematically channel most valuable national resources to metropolitan areas. The urban bias theory puts forth two propositions why urbanization occurs: (i) that the development processes of cities in the global south is systematically biased against the rural countryside (ii) that this bias is deeply embedded in the political decisions making, dominated by actors who are in the urban groups. The theory holds that urbanization occurs for the simple reason that public resources are often skewed in favor of urban areas, despite the fact that urban residents make up only a small fraction of the total population. It adds that a bias in public good provision also has implications for individual migration decisions (Majumdar, Mani, & Mukand, 2004). Given that, citizens concerned with the quality of public services are often influenced to change their residence from rural places to the urban so that migration rates and levels of urbanization are likely to increase concurrently. The urban bias theory has been criticized on certain grounds. First, the urban bias theory neglects political institutions. The urban bias outcome argument is not true across political systems or across ideological orientations of the ruling elite (pro-rural or pro-industrial). Second, the urban bias theory did not anticipate how technical change over time could begin to make the rural sector powerful. For instance, cities are largely supported by resources originating from primarily rural regions, so that the expansion of the urban front increases demand for rural resources such as land, water, air and rural space to accommodate growing population and growing levels of economic activity (Seitzinger *et al.,* 2012). The reliance of urban areas on rural resources and their communities over time emphasizes how strong the rural front has become. Inspite of this, the conception of how rural interests are expressed in the political realm is simply limited in the urban bias theory to the strictly economic issues. To this end, the urban-rural boundaries have become so blurred in recent times and may at times be hard to detect (Majumdar *et al.,* 2004). Although urbanisation continues to be critically important, it is also important to recognize that in some ways the rural-urban dichotomy is losing its salience. The boundary between rural and urban fronts is increasingly blurred, and many of the traditional distinctions between urban and rural cultures, lifestyles and enterprises are eroding or reforming (McGranahan & Satterthwaite, 2014)

Modernization theory has long been strongly linked with urbanisation and the growth of industrial capitalism, principally through spatial diffusion of

modernity (Maxwell *et al.,* 2000; Potter, Binns, Elliott, & Smith, 2008). Modernizationists perceive urbanization as part of a natural process through which, a traditional or agrarian society passes to become a modern or industrialized nation (Bradshaw & Noonan, 1997). Generally, the theory holds that existing state of urbanization in any given society is predated on modernization. The intellectual underpinning of the modernization view on urbanization in developing countries can be linked to an even earlier theoretical paradigm such human ecology, which is based on the interactive role of population dynamics, market competition, material technology (e.g., transport infrastructure), and the built environment in making and remaking urban way of life (Bradshaw & Noonan, 1997). The populist revision of Modernization theories reverses the view that cities are engines of growth and development, noting for example that urbanisation has not necessarily been associated with industrialization, but is an extractive – even 'parasitic' – process that undermines agriculture and rural development (Maxwell *et al.,* 2000; Potter *et al.,* 2008). This view was very developmentalist in heralding the more positive outcomes of accelerated urbanization in the global south, but only to be challenged by the more depressing reality of economic and spatial inequalities, as well as other social problems from urbanization (Bradshaw & Noonan, 1997).

The dependency theory or world-system perspective on urbanization largely relates the effect of urbanization on the availability of land and other vital resources for farmers and other rural-based entities. The notion contend that urbanization has the tendency of dispossessing rural dwellers of their land and consequently forcing them to migrate to cities (Njoh, 2003). It links recent changes in the roles and organizations of the economies of developing countries to the growth and extension of capitalism in the capitalism world system. From this world-systemic perspective, urbanization is regarded as an internal locational response to global economy dynamics. In relation to this, dependency theorists assume that a uniquely capitalist development pattern exists, asserting that capitalism is a unique form of social organization. Second, capitalism requires a certain social structure, which is characterized by unequal exchange, uneven development, individual social inequality, core-periphery hierarchies, and dominance structure. In addition, dependency theory models social organization, technology and population dynamics as endogenous factors in development and urbanization that are constrained by exogenous forces (e.g. globalization) and also suggests that underdevelopment is a result of the plunder and exploitation of peripheral economies by economic and political groups in core areas. The view from the dependency or world-system notion, urbanization in developing countries, to the extent it occurs and at what speed, is a major spatial outcome of global capitalism and its own spatial organization (Peng *et al.,* 2011). This is an inherently uneven process leading to geographic disparities between urban and rural areas and between cities, particularly so if taking into account the unequal conditions at the start of urbanization. Empirical studies, whether explicitly from this theoretical perspective or not, have borne out the serious undesir-

able consequences of rapid urbanization in developing countries such as rural-urban imbalance, lopsided city hierarchy, housing segregation, and income inequality both within and across nations (Peng *et al.,* 2011).

The Global City theoretical perspective, triggered by the globalization of urbanization. The notion brought into being a definitive touch to the study of the global city through a sharp conceptualization and a systematic comparison of three such cities (Sassen, 2005). According to Sassen's (2005), Global City theory, in the current era of globalization, the activities of production are scattered on a global basis. These complex, globalized production networks require new forms of financial and producer services to manage them. These services are often complex and require highly specialized skills. Thus, they are subject to agglomeration economics, and tend to cluster in a limited number of cities. Relative to this, global cities function as 1) highly concentrated command points in the organization of the world economy; 2) key locations for finance and specialized services, which have replaced manufacturing as the leading industries; 3) innovative sites of production in these leading industries; and 4) markets for the products and innovations of these industries. The notion dwells on the growth and extent of its producer services, which include accounting, banking, financial services, legal services, insurance, real estate, computer and information processing, etc. While not a strict theory on urbanization in the same sense as the earlier mentioned theories, the global city theoretical perspective has moved the theorizing of urbanization both backward and forward to explicating the historical and contemporary relationship between industrialization, urbanization, and globalization (Peng *et al.,* 2011)

In sum, each of the theories appraised above offers a distinctive perspective on urbanization during different times. Each of the theories indicated may have transcended these times in either sustaining or losing its applicability to specific cases that have experienced urbanization differently. While the so-called theory on self-generated or endogenous urbanization uncovered its important general conditions, it does little to account for the recent urbanization of developing countries. Besides failing on the same score, modernization theory does not stress class relations or capitalism per se, but rather the inevitable tensions created by the shifts in social organization encouraged by industrialism. Dependency/world-system theory is stronger in suggesting the association rather than proving a causal relationship between urbanization and capitalist development. It has also fallen short in explaining the large scope and powerful ways of the state in creating and sustaining rapid urbanization in for example, China and the rise of Shanghai as a new global city (Peng *et al.,* 2011).

2.2 Land use Change

2.2.1 Definitional and Conceptual Aspects

The first point to note is that land-use change (LUC) is different from land-cover change (LUC). Changes in land-use (human use of land e.g. settlement, cultivation, rangeland, and recreation) and land-cover (biophysical state: natural and human-made coverings of the earth's surface) are the most sensitive indicators of environmental change (Weng, 2010). Whilst land-use, is abstract and not always directly observable, land cover is concrete and therefore subject to direct observation (ibid. Land-use (LU) and land-cover (LC) are therefore, linked by the proximate sources of change, the human actions that directly alter the physical environment (ibid). Globally, the most important land-uses, spatially and economically are related to urbanization. This and other land-uses have altered the properties of the earth's land surface by transforming the biophysical states of land cover (Weng, 2010). Among various types of land-use and land-cover, changes in urban land-use (often referred to as built-up area) has arguably been the most significant visible imprint of environment in contemporary times (Zhou & Sun, 2010). For the purposes of this working paper, land-use change shall be the principal focus.

Considering its dynamic nature, land-use (change) is far broader and harder to define. The views of land change scholars such Turner II, Briassoulis and Lambin suggest that definitions and descriptions of land-use and land-use change vary with the purpose of the application and the context within which they are used. It is, thus, necessary to look at alternative definitions and descriptions of the term ((Briassoulis, 2000).

Firstly, (Meyer & Turner II, 1996) conceptualized land-use as the end result of multiple processes that act over different scales. At each scale, different processes have a dominant influence on land-use. Land-use can be defined as the human use of the land (Weng, 2010). In other words, "land-use involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation i.e. the purpose for which the land is used" (Turner II *et al.,* 1995). The description of land-use, at a given spatial level and for a given area, usually involves specifying the mix of land-use types, the particular pattern of these land-use types, the areal extent and intensity of use associated with each type including the land tenure status. Land-use change thus, comes about under the influence of many macro and micro factors, acting and interacting within varying time frames and geographical space (Briassoulis, 2000).

In the analysis of land-use/cover change, it is first necessary to indicate the meaning of change to detect it in real world situations. At a very elementary level, land-use and land-cover change means (quantitative) changes in the areal extent (increases or decreases) of a given type of land-use or land-cover, respectively. It is therefore, important to note that, the detection and measurement of change depends on the spatial scale; the higher the spatial level of detail, the larger the changes in the areal extent of land use and land

cover which can be detected and recorded (Briassoulis, 2000). In the case of land-cover two types of changes are notable i.e. change in terms conversion and modification (Skole, 1994; Turner II *et al.,* 1995). Land cover conversion involves a change from one cover type to another whilst land cover modification involves alterations of structure or function without a wholesale change from one type to another; it could involve changes in productivity, biomass, or phenology (Skole, 1994).

Land-cover changes on the other hand are the outcome of not only natural processes such as climatic variations, volcanic eruptions, changes in river channels or the sea level, etc. but also human actions and activities, i.e. the uses of land for production or settlement (Turner II *et al.*, 1995). It is important to note that "land-use change (both deliberately and inadvertently) alters land cover in three ways: converting the land cover, or changing it to a qualitatively different state; modifying it, or quantitatively changing its condition without full conversion; and maintaining it in its condition against natural agents of change" (Meyer & Turner II, 1996, p. 238). This corroborate (Briassoulis, 2000) argument that land-use change may involve either (a) conversion from one type of use to another – i.e. changes in the mix and pattern of land-uses in an area or (b) modification of a certain type of land-use. Thus, modification of a particular land-use may involve changes in the intensity of this use as well as alterations of its characteristic qualities/attributes – such as changes from low-income to high-income residential areas (the buildings remaining physically and quantitatively unaltered), changes of suburban forests from their natural state to recreation uses (the area of land staying unchanged) (Briassoulis, 2000).

The physical process of urban land-use change as per (Seto, 2009, p. 7) is most commonly described as either a change in the absolute area of urban space (a measure of extent) or the pace at which nonurban land is converted to urban uses (a measure of rate). In the views of Seto (2009), the extent and rate of urban growth provide indications of the aggregate size of cities and the rate at which other land uses such as agriculture are converted to urban uses. However, aggregate growth rates give limited information regarding spatial patterns of urbanization or the underlying processes that shape human settlements (ibid). The spatial configuration of urban landscapes is as much a reflection of past as it is an indicator of current socio-economic processes and interactions.

Essentially, the analysis of land-use change revolves around two central and interrelated questions: "what drives or causes land-use change?" and "what are the (environmental and socio-economic) impacts of land-use change? (Briassoulis, 2000). More often, certain driving forces are emphasized over some others. In view of this, two major distinctions can be made. First is the origin of the driving forces behind land-use change; i.e. either biophysical or socio-economic drivers (Briassoulis, 2000). The biophysical drivers the characteristics and processes found in natural environment such as: weather and climate variations, landforms, topography, and geomorphic processes, volcanic eruptions, plant succession, soil types and processes, drainage patterns, availability of natural resources. The socio-economic drivers comprise

demographic, social, economic, political and institutional factors and processes such as population and population change, industrial structure and change, technology and technological change, the family, the market, various public sector bodies and the related policies and rules, values, community organization and norms, property regime (Briassoulis, 2000; Lambin & Geist, 2006). At this point, it is important to emphasize that the biophysical drivers usually do not cause land use change directly; mostly, they trigger change(s) in land-cover which then influences land-use decisions made by change agents such land owners or managers (e.g. no farming on marginal lands). Conversely, change in land-use changes enforces changes to land-cover. The feedback on land-use decisions leads to new rounds of land use change(s) (Briassoulis, 2000).

2.2.2 Theories of Land Use Change

Several theories of land-use change has been formulated to guide analytical thinking about land-use change, to provide conceptual and operational expressions of change, its determinants and the relations between them, and further suggest explanatory schemata for making sense of available empirical evidence. By definition, theories of land-use change are a set of propositions used to comprehend the "what" of land-use change and the "why" of this change. In other words, they describe the structure of the changes in terms of the uses of land from one type to another – and explains why these changes occur, what causes these changes, what are the mechanisms of change (Briassoulis, 2000).

It is imperative to note that majority of land-use change theories are formulated from general theoretical frameworks of disciplines such as economics, environmental and spatial change or transformation (Briassoulis, 2000). For the present purposes a broad set of theories, which deals specifically with the dynamics of urban and regional spatial structure are underscored in this report because these theories mostly treat land and land-use as geographic features in space and their significance lies in the fact that they analyze the interactions between spatial processes and structures that trigger changes land-use. Most of these theories mainly deduce changes in spatial structures starting from the behavior of the individual household or firm. Significantly too, these theories support the building of spatially explicit models, which focus on the level of the individual decision making unit (farm, firm, household) (Briassoulis, 2000).

According to Briassoulis (2000), the theoretical literature on land-use change contains a considerable variety of theories where land-use is treated explicitly and is the direct object of theoretical inquiry. Generally, six interrelated variations of theories can be distinguished based on the following criteria: the purpose of the theoretical project; the approach to theorization; the spatial scale and level of spatial aggregation adopted; the types of land-use considered as principal objects of analysis; the types of land-use change and how temporal dimension is treated. These theories can further be classified into

three main categories: (a) the urban and regional economics theorization tradition; (b) the sociological (and political economy) theorization tradition, and (c) the nature-society (or, human nature) theorization tradition (See Briassoulis, 2000). Overall, the complexity of causes, processes, scales and outcomes in land system change makes it quite challenging to establish a comprehensive theory of land-use change (Lambin & Geist, 2006). One can argue that the list of theories governing land-use change is quite long. At the risk of being subjective and circumventive, five key theories of land-use change, which has been prominent in the literature over the last decade, are discussed in the ongoing paragraphs.

To begin with, the notion of land-use transitions, which has recently become prominent in the land change literature, is based on classical land intensification theory (Seto, Reenberg *et al.,* 2012). This theory accounts for a stylized vision of a sequential transformation of land-uses from pre-settlement extensive use to highly industrial intensive use of land (DeFries, Foley, & Asner, 2004; Foley *et al.,* 2005). It holds the idea that land-use change is a non-linear process, which occurs alongside other societal and biophysical systemic changes. This implies that a transition in a particular land-use cannot be depicted in a fixed pattern, nor in a deterministic fashion. In relation to that, one can argue that, land-use transitions can be caused by negative socio-ecological feedbacks that arise from a depletion of key resources or from socio-economic change and innovation that take place rather independently from the ecological system. This notion has been very useful in pointing out the various stages of land-use transformations that regions are expected to go through in the development from a predominantly agrarian to an industrial or even post-industrial society (Friis & Nielsen, 2014). As such, land-use transitions are linked to both historical and ongoing biophysical and societal changes that may be experienced within a given region over time and space (Lambin & Meyfroidt, 2010). A counter argument is that the land-use transition notion portrays land-use change as a linear process that does not really take into account the potential for non-linear developments including feedbacks, loops and thresholds into account (Seto, Reenberg *et al.,* 2012; Turner, Lambin, & Reenberg, 2007). It is therefore arguable that the notion is essentially a representation of a modernist vision of change that does not account sufficiently for cultural and historical differences (Friis & Nielsen, 2014).

The notion of proximate causes and underlying driving forces, originally proposed in a study on tropical deforestation by (Geist & Lambin, 2002), has largely been acclaimed as a useful way of framing the analysis of the forces behind land-use change. The proximate causes are generally viewed as direct and immediate influences on land-use, e.g. agricultural expansion, while underlying driving forces are seen as the as large-scale, distant processes operating at longer temporal scales, e.g. population growth or international trade agreements etc. As such, the framework has helped to point out cause and effect patterns of land use change, as well as highlighting the complexity of drivers working together to create single or multiple outcomes of land change (Geist & Lambin, 2002; Lambin & Geist, 2006). The notion remains highly influential within the land system scientific community. It is however,

arguable that the complexity of the processes involved in shaping current land changes challenge the distinction between proximate and underlying drivers, as they interact across spatial, institutional and temporal scales (Friis & Nielsen, 2014).

The nature-society theorization perspective is another principal theory of land-use change. The importance of this theory is that, it embeds the analysis of land-use change within the broader discourse on global environmental change and this discourse is informed by a variety of theoretical approaches which are named, inter alia "nature-society", "human-nature" and "man-environment" theories (Bruckmeier, 2011). These set of theories seek to address the question "how does man relate to nature?" This is commonly related to the more popular question of "what is man's role in causing environmental change?" or "what are the human causes of global environmental change" (Briassoulis, 2000). A common characteristic of this theory is that it deals with the totality of the interactions between nature (or, environment), economy, society (including politics and institutions), and culture. Given that the environment is explicitly considered in this tradition, they are more relevant for the analysis of land-use and land-use change. This does not mean that all theories in this group treat land-use change explicitly and concretely (Briassoulis, 2000).

In addition to the above, the nature-society theories are categorised into (a) humanities-based theories, (b) natural sciences-based theories and (c) social-sciences-based theories (Briassoulis, 2000; Bruckmeier, 2011). The humanities-based theories reveals a wealth of theoretical approaches and outlooks, which deal with nature-society relationship at various spatial levels from the global to the very local and the personal level. They focus deeply on the social and personal determinants of land-use change although in most of them, the direct connection to land-use and its change is not always made. Depending on the level of analysis, this theoretical perspective is used to inform the analysis of land-use change and offer alternative explanatory frameworks. Natural sciences-based theories on the other hand tend to treat the environment, land and land-use change concretely and comprehensively – as material entities with characteristic properties and particular ways of relating to one another and to the socio-economic forces that impinge on them. The most comprehensive and widely publicized theory within this cohort has been environmental determinism i.e. the doctrine that human activities are controlled by the environment (Briassoulis, 2000). According to Turner (2002), environmental determinism explains cultural development and, indirectly, environmental transformation, in terms of the physical geography of a place or a region. Several studies show how environmental and land-use changes reflect or adopt outright an environmental deterministic stance considering that land-use change patterns are determined solely – at least on large, regional scales – by natural factors (climate, geology and soils) primarily (see, for example, Briassoulis, 2000). Added to this, natural sciences-based theories adopt definitions of land and land-use, which address their material and intrinsic characteristics and attributes, and they get into the physical pro-

cesses, which account for the observed transformations. Although these theories address the important linkages between the uses of land to serve human needs, purposes and the environment, they tend to place excessive emphasis on the environmental factors, thereby, ignoring or assigning a secondary role to a host of other factors, which condition the use of land such as institutional, political, and economic factors. Their relevance to the analysis of land-use change has to be explored further as they may be more applicable to particular societies and historical periods than in others (Briassoulis, 2000).

The generalized Core-Periphery theory represents another theoretical perspective. In principle, the Core-Periphery theory assumes that as general prosperity grows worldwide, the majority of that growth is enjoyed by a 'core' region of wealthy countries despite being severely outnumbered in population by those in a 'periphery' that are ignored. The theory describes and explains the spatial organization (structures and processes) of human activities premised on the idea of unequal distribution of power in socio-economic and political affairs. In this way, it provides a general level of theorization schemata about the uses of land and changes of land-use resulting from the relations of dependence, which develop between the core (a developed – but not necessarily spatially defined – region) and the periphery (underdeveloped regions). There are several variants of the basic core-periphery theoretical formulation. Its origins can be traced to earlier modernization theories (Cooke, 1983) as well as in (Rostow, 1960) “the stages theory of economic growth”. More generally, it can be embedded within a broad diffusion theoretic framework since the central idea is that development spreads out (diffuses) from a core region which contains the most modern economic sectors towards the periphery – regions which are at the first or pre-industrial stage of development (Cooke, 1983). Friedmann (1966) defined the core-periphery relations as the second of a four-stage sequence of the development of the space economy. These stages include: (a) pre-industrial society with localized economies; (b) core-periphery; (c) dispersion of economic activity and (d) spatial integration. Corollary to that, a more general, global version of the core-periphery dualism is the world system theory (Wallerstein, 2011), a theorization of how core, industrialized regions relate to the underdeveloped periphery on a world scale. They can be used to frame questions and answers about the determinants of land-use change at higher spatial scales as well as to be combined with analyses of land-use change at these scales (See Briassoulis, 2000).

Lastly, the notion of ecological equilibrium is particularly applicable for a regional analysis of dynamics and changes in land-use (Coccossis, 1991). The notion holds that a region has four interacting factors; population, resources, technology and institutions. Regional changes in the spatial organization of the region such as land-use change are the result of changes in the equilibrium between these factors so that a change in one of these factors engenders changes in the others and the state of dynamic equilibrium shifts towards a new level (Coccossis, 1991). This implies that changes in land-use

may be due to changes in the size and the distribution of population, technological innovation and economic restructuring, social organization and policy. The notion has been found to be too descriptive and its value only lies in considering the role of resources and environmental constraints as limiting factors on development and, consequently, on land-use change. The notion failed to delve into the mechanisms of change and the dynamic interactions between these natural constraints and the socio-economic and institutional regimes governing their utilization (Briassoulis, 2000). To prove useful as analytical devices of land-use change, they need to be synthesized with elements from other theories to produce explicit theoretical propositions of the processes by which and the conditions under which land-use is transformed from one type to the other at particular spatial levels and within specific time frames and historical contexts (Briassoulis, 2000).

3 Linkages between Urbanization and Land-use Change: Current Discourses and Empirical Case Studies

This section provides the current discourses relative to the patterns and trends of urbanization and urban land-use change processes. A close assessment of current debates on linkages between the two phenomena is presented by drawing on empirical case studies.

To begin with, I provide a generalized outline of the linkages between urbanization and land-use change. Human-induced land use changes are considered the prime agents of the global environmental changes. Here, urbanization is the physical expression of human relationship with land. Current trends show that urbanization is reshaping land-use locally and globally (Seto & Reenberg, 2014). Urbanisation and associated growth patterns (urban sprawl) are physical characteristic of any spatial temporal changes in landscape (Ramachandra, Aithal, & Sreekantha, 2012). According to Seto & Reenberg (2014), urbanization is a type of land-cover in the form of built-up or paved-over areas. Urban land-cover grows on average at more than double the rate of growth of urban population (Angel, Parent, Civco, Blei, & Potere, 2011). One major consequence is that human processes transform the landscapes so that the construction of settlements (cities to villages), impervious surface infrastructure such as roads, and waste deposits among others creates changes in land-cover (ibid). It is through proximate sources that human goals of land-use are translated into changed physical states of land cover (Meyer & Turner II, 1996). The change in land-use is therefore the result of urbanization because land-use change is a direct manifestation of the changes in the state of urban environment. Regardless of where it occurs, urbanization involves a significant increase in the expected material standard of living which in tend leads to massive increases and multiple demand for land-based products and resources (Seto & Reenberg, 2014). For this reason, as humanity continues to urbanize, there will be a requirement to develop land and for that, land-use change would result in significant ways−both direct and indirect (ibid). In my opinion, the 'growth trend' in urban spatial

structures and processes gives an indication that every vacant land would be urbanized over a period of time. There is therefore a direct relationship between urbanization and land use change so that the higher the rate and magnitude of urbanization processes the more changes in spatial or physical structures–land-use.

3.1 Urbanization on a Global Level

An ongoing debate in the literature differentiates between current trends and patterns of urbanization across and within countries from that of the past. Contemporary processes of urbanization are different from urban transformations and transitions of the past in significant ways (Seto, 2016). At first sight, three most important and significant trends of urban change and transition are stated. Globally, the scale/magnitude; rate and geographic location of urbanization (Seto, 2009; Seto, Parnell, & Elmqvist, 2013) are changing. In drawing from the literature, I provide generalized outline of the changes in the ongoing paragraphs.

First, Seto *et al.* (2013), suggest that the scale and magnitude of urbanization processes in progress extraordinary. The scale of urbanization today is simply beyond compare to that of the past in terms of urban population size, urban extent, and the sheer number of large urban areas. The size of urban areas (cities) are simply larger than those at any other time in history in terms of their populations (Seto & Reenberg, 2014). Whilst there were no cities with an urban population up to ten million at least several decades ago, there are as much as 19 urban agglomerations with populations of over ten million today and still counting (Seto *et al.,* 2013). Neoliberal reforms, demographic transitions, and economic growth and development have created new cities and megapolitan regions of extraordinary size. For example, the urban extent of Tokyo-Yokohama covers of 13,500 km2 has a population of nearly 40 million urban areas, which have become extraordinarily large in physical extent (ibid). In addition, at the start of the 1800s when the world population was around one billion, Beijing for example was the only city with a population of one million. Today, there are approximately 400 cities with populations of well over one million and the trend continues unabated (Seto, 2009; Seto *et al.,* 2013; Seto & Reenberg, 2014).

Second, the rate of urbanization is a major characteristic of this century and not the past. The rapidity with which landscapes and populations are urbanizing is simply faster compared to other periods in history. It was not until 1960s that the world experienced an urban population of at least one billion; however, it has taken only 26 additional years to reach an urban population of two billion (Seto *et al.*, 2013). Within several cities and towns across the developing world, the growth of urban population translates into everyday challenges for city managers and residents as they seek to ensure the physical infrastructure and resource supplies on which new urban residents' livelihoods will depend (ibid). For example, Brazil's urban population reached 36 % in 1950; whereas India's urban population is currently at 31 %. In the next

two decades, China is expected to have nearly 30 new cities of 1 million inhabitants whilst India would have 26 cities of this size during the same period (ibid). This implies that China and India together will potentially have almost one-third of the world's population dwelling in urban areas by 2030 (ibid). This points to the fact that rates and periods of urbanization, cultural patterns of land-use and the biophysical conditions urban regions will continue to vary tremendously (Seto, 2009; Seto *et al.*, 2013).

Global trends also show that the geographic location of urbanization processes are shifting (Seto *et al.*, 2013). Predictions from the United Nations showed that urbans transition underway today was to take place primarily in Africa and Asia. This is occurring if not occurred as the world's 20 most fastest-growing urban regions i.e., younger, and more dynamic hotspots of urbanization are now located primarily in the "Global South", i.e., are in Asia (China and India in particular) and in Africa (especially Nigeria) (Scheuer *et al.*, 2016). It is also important to note that whereas the urbanization levels in the Americas and Europe are already high—80 % in South America and 75–78 % in Europe and North America–the urban populations on the continents of Africa and Asia are less than 40% of total population. Over the next two decades, while the rural population will also rise, the urban populations of both continents are expected to reach 50% and beyond. By this, many parts of Asia and Africa will have urban growth rates of more than 5%. The location of urban land change will parallel with the expected changes in population growth. China and India will experience significant expansion of urban built-up area, as will Nigeria (Seto, 2009; Seto *et al.*, 2013)

According to the global assessment of urbanization processes by Seto *et al.* (2013), the overall trajectory of urban transition shows that the physical extents of urban areas are expanding faster than urban populations, implying that the world will require increasingly more land to build cities and supply urban consumption as urban populations continue to increase. In some urban areas that are shrinking in population or economic activity, new and emerging challenges are associated with vacant or abandoned land and buildings (ibid).

Per the observations of Seto *et al.* (2013), cities have traditionally been compact and concentrated populations; however, this status quo has changed because today, cities have rather become increasingly expansive. Indeed, across the world, many urban areas are growing on average twice as fast as urban populations (Angel *et al.*, 2011; Seto, Fragkias, Güneralp, & Reilly, 2011). In addition to being increasingly physically expansive, current urban land change processes is also predominantly characterized by peri-urbanization–the process whereby rural areas both close to and distant from city centers become enveloped by, or transformed into, extended metropolitan regions (Seto *et al.*, 2013). This has resulted in a tight mosaic of traditional and agricultural juxtaposed with modern and industrial land-uses and governance systems. As a physical phenomenon, peri-urbanization involves the conversion of agricultural land, pastures, and forests to urban areas. As a social phenomenon, peri-urbanization involves cultural and lifestyle adjustments

of agrarian communities as they become absorbed into the sphere of the urban economy. In developing countries, current trends especially in Asia and Africa show that, peri-urbanization is the most prominent form of urban growth and urbanization, with different characteristics across countries and regions. As a result, emerging urbanizing regions represent probably the most complex mosaic of land-cover and multiple land-uses of any landscape (Seto *et al.*, 2013). In view of this, recent urban developments, which is indicative of on-going urbanization, suburbanization, or spread, are characterized by a higher relative variability of the urban area extent (Scheuer *et al.*, 2016).

On a global scale, the processes of urbanization pose a significant impact in terms of urban land-use change (Scheuer *et al.*, 2016). Land-use change has increased markedly in the last couple of decades both in terms of extent and intensity (Lambin & Geist, 2006). Current trends shows a rapid and widespread – but spatially uneven change in land-use. In fact, the pace of such change today is simply unprecedented (Seto & Reenberg, 2014). In addition to the increased intensity of land change, current patterns and trends appears to be unique in terms of the scale of changes in land-use. Land-use change often thought of as a local problem, have now accumulated to become a global problem, i.e. globalization of land-use is pronounced (Seto & Reenberg, 2014). Today's urban areas are estimated to comprise approximately 5% of the global land surface (Scheuer *et al.*, 2016).

Patterns and processes of urbanization are the factors influencing contemporary land-use change trends. Several aspects of current land-use transition, influenced by changes in the global urbanization processes have triggered interrelated changes in the rapidity, direction, location, and timing of land-use change (Ramachandra *et al.*, 2012; Seto & Reenberg, 2014). Changes in rapidity are reflected in urban land-use change globally. The rapidity of change in land-use refers to the amount of time it takes for a particular land area to undergo a transition or change the land-use system. Contemporary speeds of land-use changes are different from those in the past. Typically, the speeds of transition are faster, but they could also be slower (Seto & Reenberg, 2014). Conceptually, the change in speed relates to the increase in the ability of urbanites to move into any geographic location (ibid). According to Angel *et al.* (2011), medium projections for the future suggest that urban land change in developing countries will more than double over a thirty-year period from 300,000 km2 in 2000 to 770,000 km2 in 2030, and then increase by another 64% by 2050 to reach 1.2 million km2. The direction of land-use change refers to the level (share amount) and intensity of any given land-use in an area. For instance, there is ample evidence showing that global trade flows in agricultural product have increased land under agricultural production as well as increased the intensification of agricultural production at the global level (Seto & Reenberg, 2014). The direction of land-use change in this regard includes changes in expected patterns of development as urbanization grows steadily (Lambin & Meyfroidt, 2011). The location of land-use driven by urbanization are also changing. Land-use change around the world is increasingly being driven by new agents and driv-

ing forces, which emanate from distant locations, through forces such as urbanization, globalization, trade, migration and transnational land deals (Seto, Reenberg *et al.*, 2012). More particularly, the distal flows and connections between people, economic goods and services are driving land-use change processes in multiple locations rather than local (Seto, Reenberg *et al.*, 2012; Seto & Reenberg, 2014). Lastly, the timing of land-use change refers to the sequence of change a well as the point at which change occurs during the urbanization process (Seto & Reenberg, 2014). Subsequently, two aspects of the timing of land-use changes have emerged. First, land-use transitions is known to occur at different times in the urbanization process, as measured by the rapidity of urban change. Second, land-use transition and urban change are occurring more simultaneously than in the past. For example, the land-use transition model, as described by Foley *et al.* (2005) suggested that, while the developed world experienced land-use transitions in a sequential manner i.e. moving from “presettlement” ," to "frontier," to" subsistence,'' to "intensifying," to the “intensive” stages–those in the global south are not experiencing similar patterns. Contemporary trends of land-use change are rather found along the line of frontier and subsistence stages (Seto & Reenberg, 2014).

Müller & Munroe (2014) argue that a major trend in land-use change is driven by rapid urbanization of the Earth (i.e. urbanization-driven land-use change). Recent estimates suggest that rising from urbanization processes an additional 1.5 million km2 may be transformed to urban land uses by 2030 (Seto *et al.*, 2011; Seto & Reenberg, 2014). This process of urbanization has enforced fundamental changes in land-use and landscape pattern around the globe (Deng, Wang, Hong, & Qi, 2009). There is mounting evidence to show that the process of urbanization has profoundly transformed and change natural and human landscapes throughout the world, which inevitably has resulted in various effects on the structure, function, and dynamics of ecological systems at a wide range of scales (APN, 2008).

According to Santhiya *et al.* (2010), noted that rapid urbanization has greatly transformed and changed the trends and patterns of uses of land in many urban regions of the world in the recent past and it is arguably the most dramatic and prevalent form of irreversible land transformation (land-use change). The linkages between urbanization and land-use change is now at the forefront of scientific enquiry. In the recent extant literature, studies show that urban population growth and for that matter, urbanization is a dominant and a primary driving force of landscape changes throughout the world (Jain, Dawa, Mehta, Dimri, & Pandit, 2016). For instance, in their recent global assessment, Elmqvist *et al.* (2013) observed that the most obvious and direct impact of urbanization on biodiversity is land-use/cover change which they attribute to the growth of urban areas, habitat loss, clearing of natural vegetation and transformation (conversion and modification of existing land-use type) which leads to the physical expansion of urban areas. In addition, in 2008, the Asia-Pacific Network (APN) for Global Change Research conducted a study to quantify the level of urbanization from the aspect of land-use change pattern in three biggest cities (China, Philippines and Vietnam).

Their results confirmed urbanization as the predominant driver of land-use change and landscape pattern alterations, which coincided with the phases of urbanization in the study cities. (Hahs, 2016) concur, arguing that urbanization is itself a process tightly associated with the physical transformation of specific geographic locations. Santhiya *et al.* (2010) assessed and mapped land-use/land-cover changes and related issues within the coastal environment of Chennai coast, India. Among other things, they found that the Chennai coastal zone had undergone major changes over a period of 10 years mainly due to urban population growth and increase in commercial and industrial activities. More specifically, they observed considerable changes in coastal landforms i.e. increase in settlement and built-up areas, industries, disappearance of cropland, decreased coastal forest (mangroves) areas and waterlogged areas due to anthropogenic activities. Similarly, Jain *et al.* (2016) studied land-use/cover change and drivers in Delhi, India using multi-temporal satellite data; their findings show that growing pressures from rapid population growth and changing economy have led to unprecedented rates of urbanization, enforced extensive changes land-use.

3.2 Urbanization in Africa

Consistent with observed trends across the world, Africa is urbanizing fast. The process of urban population growth keeps increasing and as a result of that urbanization – driven by population growth in both urban and rural areas is very rapid (Anderson & Erbach, 2000). Several recent reports have identified urbanization (Cobbinah, Erdiaw-Kwasie, & Amoateng, 2015; Elmqvist *et al.*, 2013; Lwasa, 2014; Opoko & Oluwatayo, 2014; Seto, Sánchez-Rodríguez, & Fragkias, 2010) and associated land-use/cover change (Tran, Tran, & Kervyn, 2015) as the key factors influencing Africa's urban development. Indeed, Africa's urbanization rate has increased steadily over the past three decades and is reported to be faster than in any other region in the world (Jedwab, 2013; Lwasa, 2014).

Currently, Africa has a growth rate of nearly 3.4 % per annum and nearly 40 % of Africa's inhabitants live in urban areas which is expected to more than double from 395 million people to 1 billion in 2040 (Elmqvist *et al.*, 2013). Pelling & Blackburn (2013) concur, arguing that this situation is expected to aggravate, as urban population grow more rapidly, spreading beyond geographic boundary of cities. Whilst urban populations grow, observations show that growing urban population in largely concentrated primarily in coastal areas (Ngoran, Xue, & Ngoran, 2015). According to the UN-HABITAT (2014), more than a quarter of Africa's population lives within 100 km of the coast and more than half of Africa's total population living in low elevation coastal zones is urban, accounting for 11.5 percent of the total urban population on the African continent. In view of this, coastal African cities are said to be physically spreading at 4% a year, as their populations grow rapidly (The Economist, 2012).

As discussed already, although urbanization in Africa cities is still very high, some studies have increasingly showed that the rate and level of urbanization in the African region is rather slowing down (Cobbinah *et al.*, 2015; Freire, Lall, & Leipziger, 2014; Nielsen & D'haen, 2015; Njoh, 2003; Ruhiiga, 2013). The driving forces behind contemporary urbanization in Africa are a combination of rural-urban migration, reclassification of rural areas, natural increase within towns and cities themselves (Nielsen & D'haen, 2015; Potts, 2012; Songsore, 2003, 2009). These are aggravated in some regions by forced migrations triggered by various stresses including ethnic conflicts, wars, drought and famine (Potts, 2012; Songsore, 2009). One striking thing is that current urbanization trends in Africa is demographic bias rather than economic because urbanization in Africa has not been driven by industrial development as the developed world experienced (Songsore, 2009).

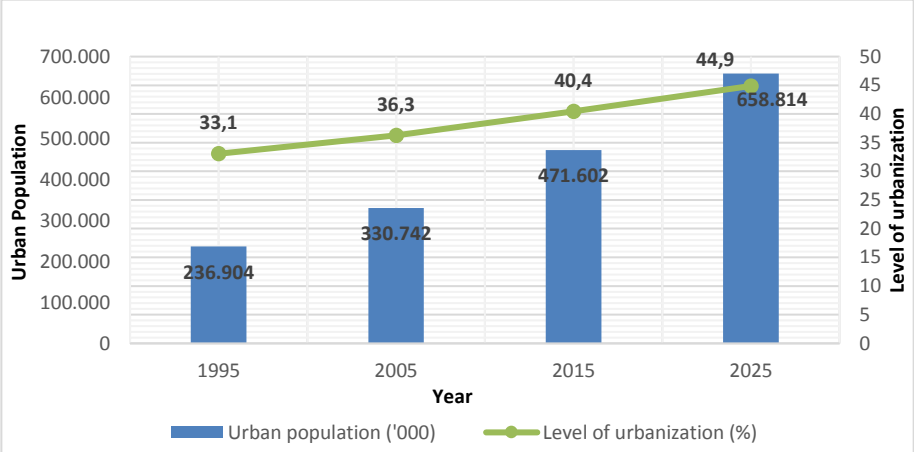

Figure 1: Urban population vs. level of urbanization in Africa

Data Source: United Nations, Department of Economic and Social Affairs, Population Division (2014)

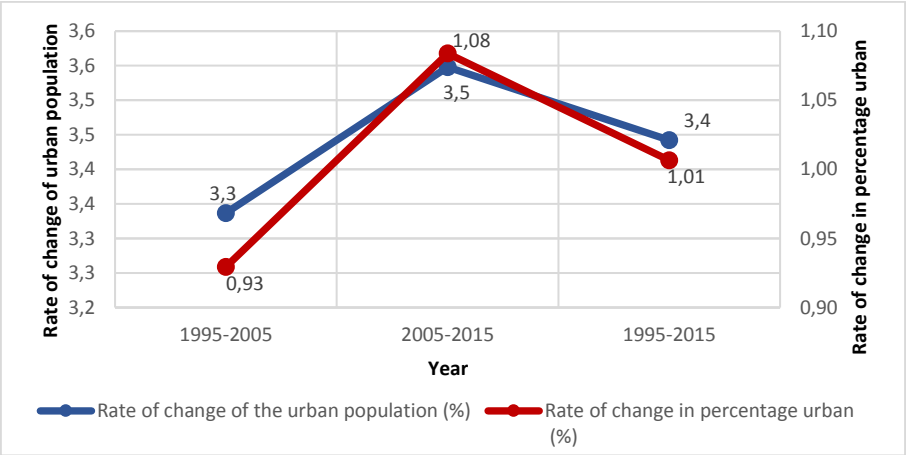

Figure 2: Rate of Change: Urban population and Percentage urban in Africa 1995 – 2015

Data Source: United Nations, Department of Economic and Social Affairs, Population Division (2014)

In Figure 1 and 2, urban population size and rate of change are presented respectively; as depicted in Figure 1, population for urban areas and the level of urbanization in Africa has been rising consistently from 1995 to 2015. The statistics in Figure 2, however, shows that the rate of change of the urban population and the percentage urban are decreasing. This downward trend of the rate of urbanization, no matter how consistent it will be will relatively one of the highest in the world indicating that a stabilization in growth rates should occur after some number of years (Ruhiiga, 2013). As population growth continues, urbanization and development needs exerts a great deal of pressure on landscapes, including coastal lands. as a result of increasing human activities and increased demand and consumption for land and further intensified by natural processes (Neumann, Vafeidis, Zimmermann, & Nicholls, 2015), clearing tropical forests, practicing subsistence agriculture, intensifying farmland production, or expanding urban centers, human actions are changing the landscapes in pervasive ways (Foley *et al.,* 2005).

3.3 Urbanization in Ghana

Ghana has urbanized rapidly over the past couple of years, outpacing the West African average and even considerably faster than the global average (World Bank, 2015). The country, is urbanizing rapidly although most part of its spatial organization is still predominantly rural (Reed, Andrzejewski, & White, 2010). Current population of Ghana as of 2015 is estimated to be 27 million, up from the official 2010 census figure of 24.2 million (United Nations, 2016). Compared to previous census observations, Ghana's population is increasingly becoming urbanized (Ghana Statistical Service, 2014). Today, about four out of every ten Ghanaians live in a city or town of more than 5,000 people – the census or statistical definition of an urban centre in Ghana (Songsore, 2009).

Over the last three decades, Ghana's urban population has more than tripled, rising from 4 million to nearly 14 million people, and outpacing rural population growth (World Bank Group, 2015). Countrywide Urbanization trends has been steady and uniform given that all ten regions have experienced urban population growth (ibid). This urban growth trend has been faster in smaller cities as compared to larger ones (ibid). Perhaps, this faster growth in small cities, towns and rural areas is because these are the areas creeping up the political agenda of most successive governments and many international agencies in an attempt to bridge the rural–urban divide (Songsore, 2009).

The rising trend in urbanization is being driven by following demographic processes are: rural-urban migration; natural increase in towns and cities; and re-classification as villages grow into towns (Potts, 2012; Songsore, 2009; Yankson & Bertrand, 2012). In addition to this, certain socio-economic and environmental factors also drive urbanization especially on the coast (Awumbila, 2014). The coastal zone of Ghana has serves as home to a large populace of urbanites (Appeaning-Addo, 2013). The presence of industrial installations and associated employment opportunities plus a rich diversity of natural resources pulls people of different social backgrounds and strata to the coastal areas of Ghana. As a result, population in the coastal urban areas of Ghana are growing much faster than those in non-coastal areas (Appeaning-Addo, 2013; Curran, Kumar, Lutz, & Williams, 2002). (Adank *et al.*, 2011) concur, arguing that the most densely populated parts of the country are the coastal areas.

To put the process of coastal urbanization in Ghana into proper perspective; the coastal zone covers about 7 percent of the total land area of Ghana yet, it is inhabited by 25 percent of the nation's population (Ghana Statistical Service, 2014; Hewawasam, 1998). A World Bank report in 2006 estimated that by the year 2020, about 75 percent of the population would be living along the coast of Ghana (World Bank, n.d). Expectedly, the growth in the proportion of population within coastal urban areas of Ghana's has increased remarkably over years (Appeaning-Addo, 2014; Yankson & Bertrand, 2012). The urban transformation of coastal areas in Ghana has been momentous, relying mainly on industrial development, but this is not unique. About 75 per cent of Ghana's industrial installations can be found in the coastal zone, supporting export and import activities (Songsore, 2009). For example, two large coastal mega-cities, Accra-Tema and Takoradi as port cities have attracted a lot of industrial development. As a result, increased economic activities have led to a high concentration of urbanites within a short distance from the coastline (Appeaning-Addo, 2014).

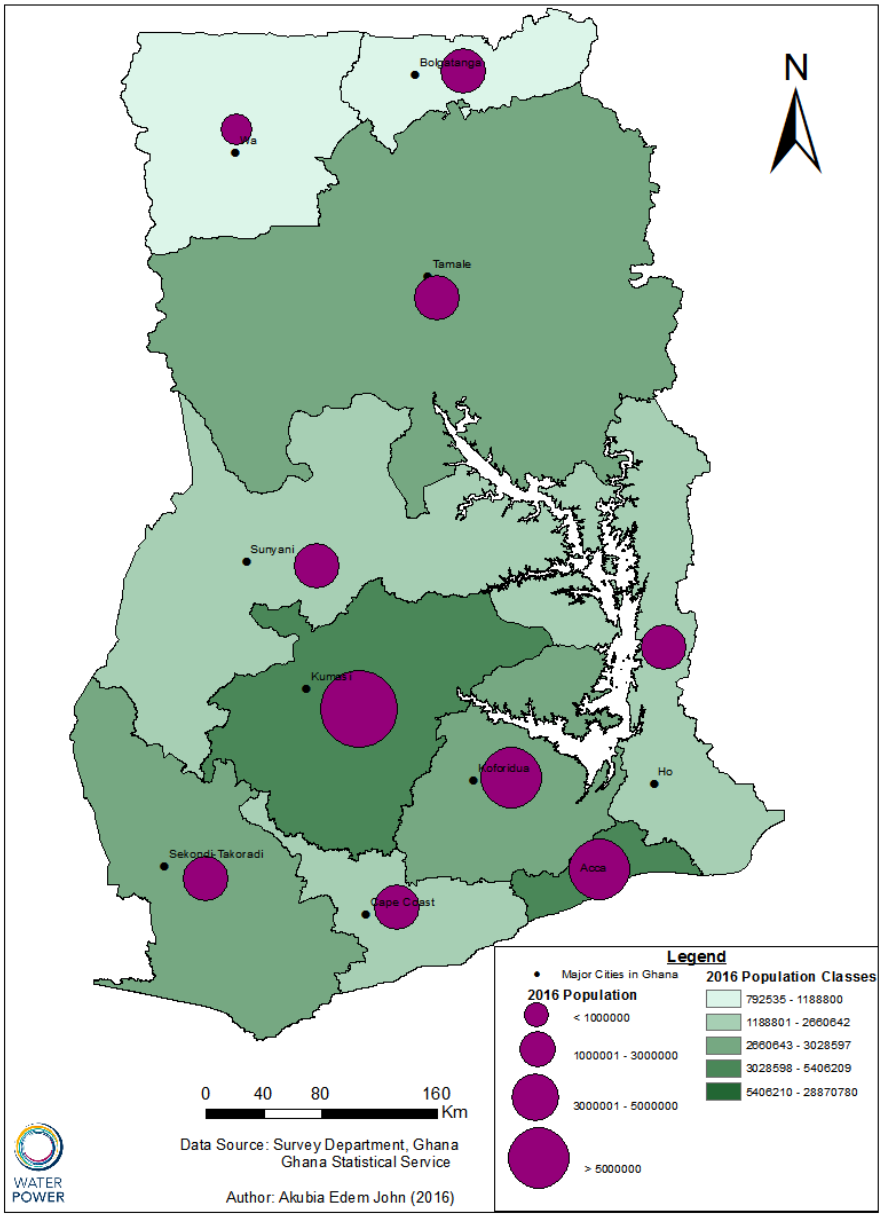

Figure 3: Map of Ghana showing major cities and 2016 population size per region.

According to Weeks *et al.* (2013), Ghana has one of the highest urbanization rates in the Sub Saharan Africa, with 51 % of the country's 24 million people living in urban areas. Current trends shows that Ghana's urban population growth or level of urbanization is growing steadily with an average urbanization rate of 3.4% (Weeks *et al.*, 2013). This is confirmed by a close study of urban population size and rate of change compiled by (United Nations, Department of Economic and Social Affairs, Population Division, 2014). As depicted in Figure 2 and 3 below, Ghana's urban population has been increasing steadily since 1995, depicting the country's strong numerical increase in population. In Figure 2, it is apparent that the margin of growth between urban population and the level of urbanization (the proportion of Ghana's population living in urban areas) are directly related. There is however some notable variations in the rate of change in urban population and the rate of change of percentage urban. Between 1995 and 2005, there was a general increase

in both cases but beyond, 2005; the trend began to rise again so therefore the current rate of urbanization which stands at 3.4% is a true reflection that urbanization is on the increase.

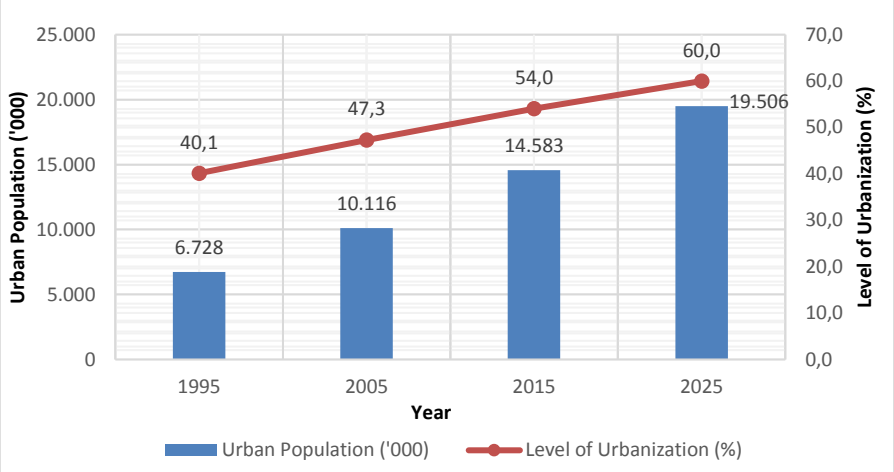

Figure 4: Urban population & level of urbanization in Ghana, 1995 – 2025

Data Source: (United Nations, Department of Economic and Social Affairs, Population Division, 2014)

Table 1: Urbanization trends in Ghana, 1960–2010

Year	Country Population	Urban Population	Proportion (%)	Population Growth Rate		Urban Growth Rate
				Period	(%)	
1960	6,726,815	1,551,174	23.3	1960–1970	2.4	4.7
1970	8,559,313	2,472,456	28.9	1970–1984	2.6	3.3
1984	12,296,081	3,938,614	32.0	1984–2000	2.7	4.6
2000	18,192,079	8,274,270	43.8			
2010	24,658823	12,549,229	50.9	2000–2010	2.5	4.2

Source: (Tetteh, 2016): Compiled from 2000 and 2010 PHC Reports, Ghana Statistical Service

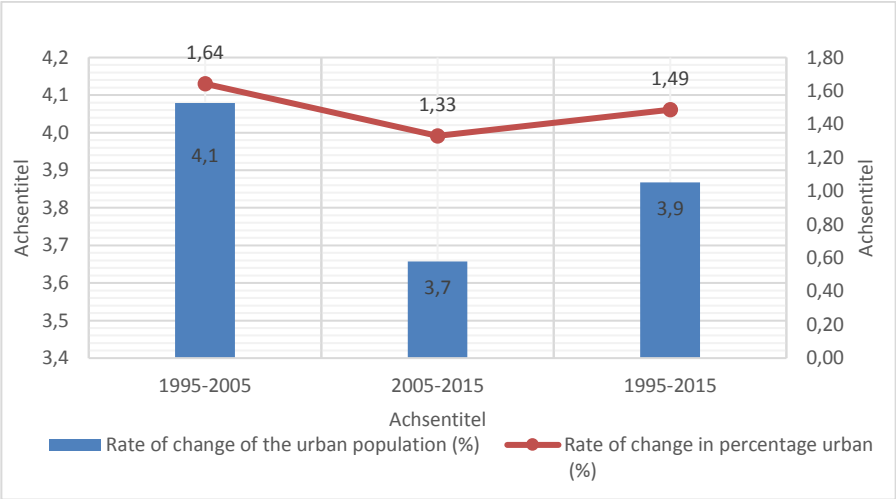

Figure 5: Rate of change in urban population and percentage urban
Data Source: United Nations, Department of Economic and Social Affairs, Population Division (2014)

Apart from the statistical evidence of urban growth in Ghana, several empirical studies have confirmed that Ghana is experiencing rapid population growth and very rapid urbanization, from the socio-economic and spatial (physical) perspectives (Awumbila, 2014; Tetteh, 2016; Yankson & Bertrand, 2012). According to Yankson (2012), the rapid increase in urban population growth is the changing structure of the economy so that increase in economic and commercial activities, all combine to exert severe pressure on available land resources in urban areas. Urban land expansion and change is one of the most direct representation of this form of urbanization. In particular, Reed *et al.* (2010) observed that the coastal region of Ghana is urbanizing especially rapidly with expanding and growing number of old and new settlements (Adu-Kumi, Adu-Kumi, & Apraku, 2015; Appeaning-Addo, 2013; Jonah & Adu-Boahen, 2016; Reed *et al.,* 2010).

3.4 Urbanization on the Coast – the case of Accra

Within Ghana, the capital city Accra[4] is considered to be the most urbanized agglomeration in the country (Ghana Statistical Service, 2014). According to the recent report provided by United Nations (2016), Accra is the largest and primate city of Ghana with 4 million inhabitants (making it the 11th largest metropolitan area in Africa), up from 2.7 million in year 2000 and 3.2 million in 2005 (Angel *et al.,* 2011) . Given this rapid population growth, GAMA, unsurprisingly, accounts for nearly 17 % of the country's population (Weeks *et al.,* 2013).

[4] For the purposes of this study, the choice of the descriptor, 'Accra', is used in a generic sense to imply the 'urban area' of the Greater Accra Metropolitan Area (GAMA), it also connotes the Metropolitan area to the coast, unless otherwise specified.

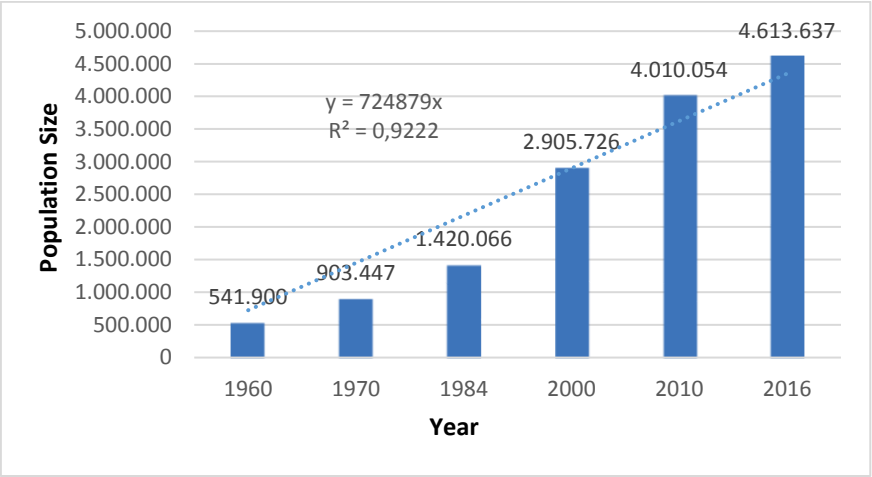

Figure 6: Population growth in Accra 1960 – 2016

Data Source: Data Production Unit, Ghana Statistical Service (16.09.2016)

As can be observed in Figure 6, the population of Accra is growing very fast. This suggests that Accra has experienced rapid urban growth for the last four and half decades. Urbanization in Accra is thus mainly due to the rapid increase in population. The reasons for this are obvious. Accra is the capital city of Ghana. Its strategic location as the main coastal city of Ghana and as a nodal city with major arterial routes connecting other parts of the country as well as its huge industrial development engineered its role as a transit point and a strong commercial hub for migrants from both the northern and southern parts of the country and beyond. In addition to that, urban population growth of Accra is increasing fast because of urban development factors including; concentration of industrial activities and as the most administrative and commercialized centre in the country, better employment, health, transportation and education facilities. Due to this uncontrollably increasing urban population growth in Accra, many of the peripheral villages and towns have been engulfed (Yankson & Bertrand, 2012).

Currently, the most prominent form of urban growth and urbanization in Accra is peri-urbanization characterized by the conversion of agricultural land, pastures, and forests to urban land-uses (Doan & Oduro, 2012). The massive growth and expansion of the Accra metropolitan areas have entailed both intensification of densities and sprawling into Peri-urban areas (Simon, McGregor, Nsiah-Gyabaah, & Thompson, 2003; Tagoe, 2005; Yankson & Bertrand, 2012). The Peri-urban (sometimes also called the urban fringe) may be the dominant urban form and spatial planning challenge of the twenty-first century. According to (Nilsson *et al.*, 2013), Peri-urban could be understood as an area where the urban structure transitions into the rural landscape so that it can be a significant territory in area terms that must be looked at in the context of the wider transitioning between dense urban cores and rural hinterland. In simple terms, Peri-urban change is a direct result of urban expansion i.e. the Peri-urban area spreading outwards into rural areas (Nilsson *et al.*, 2013). It is the area where the most chaotic form of urbanization in Accra is occurring, with urban population and economic growth, resulting in increasing demand for housing and commercial areas.

The Peri-urban areas of Accra are expanding spatially and numerically in a largely spontaneous manner without any rational urban growth planning strategy, even to a geographic extent that rivals most other cities in the global south (Weeks *et al.*, 2013). For example, the size of some present towns (i.e., Ofankor, Pokuase, and Amasaman), which were fringe villages some time ago, have expanded about 10 times since 1965 (Tagoe, 2005). This is evident by the increasingly massive physical and spatial development, including luxury housing, office and recreational infrastructure by the new middle classes, who are moving away from the urban core areas due to congestions among others (Tetteh, 2016).

An important driving force behind urban expansion of Accra, the growth of the urban population has created a situation where the spatial extent of Peri-urban areas around the city have been transcended, causing rural to urban conversion of large areas. This rapid urban growth has created a chaotic mixture of urban and rural land-use (Doan & Oduro, 2012). Urban processes and activities have transform layout and human activities of Peri-urban areas (including the coastal urban zone) in terms of urban land-use, physical outlook, spatial development and general well-being (ibid).

Beyond that, the coastal stretch of Accra is the most vulnerable area undergoing rapid urban population growth–urbanization (Campbell *et al.*, 2006). Population increase along the Accra coast has resulted in urbanisation rate of 52% per annum (Appeaning-Addo & Lamptey, 2013). Opportunities for employment has attracted migration of people from inland and other towns and cities to the coast and the population density of 3,388 persons per Km2 gives a clear indication that substantial portions of the coastal zone are habited (ibid). This has imposed more stress on the coastal lands as natural habitats have been altered to accommodate the increased urban population. With the coastal population increasing, irrational and uncontrolled land-use development coupled with unwise management practices by both the local urban population and city authorities (Appeaning-Addo & Lamptey, 2013).

Numerous studies have been conducted to assess the spatial and temporal patterns of urbanization and land-use change along the Accra coast (Angel *et al.*, 2011; Boafo, Asiedu, Appeaning-Addo, Antwi, & Boakye-Danquah, 2014; Doan & Oduro, 2012; Stow *et al.*, 2016). Angel *et al.* (2011) examined the growth rates of the urban population and the urban land-cover in a global sample of 120 cities between 1990 and 2000 including Accra, detecting a significant change in land-cover with increased built-up area in Accra. Urban land-cover expanded from 13,000 to 33,000 hectares, comprising 153 percent increase more than twice as fast as population growth (Ibid). The study found and increasing concentration of infrastructural development to be replacing coastal vegetation. Doan & Oduro (2012) assessed urban population growth of the Peri-urban fringe in Accra between 1970 and 2000, finding rapid urbanization as the major driving force of changes in the form and shape of Peri-urban land. Boafo *et al.* (2014) assessed land-use/cover change implications of coastal tourism development along the coast of Accra. Their findings revealed the coastal tourism developments activities are changing

the spatial patterns of land-use. In particular, tourism development has become the major source of income for the coast but, at present, tourism-related infrastructure causes significant change to coastal land cover. Further, Weeks *et al.* (2013) evaluated the level and degree of urbanization trends in Accra, discovering that Accra's urban population growth is intense and unprecedented, rapidly expanding extent of built-up areas into urban fringe areas. Stow *et al.* (2016) analyzed the amounts and spatial patterns of land-use/cover in Accra, identifying that new urban areas are forming at an accelerating rate within Peri-urban areas of Accra, commonly with widely spaced residential land-use composed of large houses with minimal or no urban infrastructure.

The accumulated empirical evidence provided above gives an indication that urbanization-driven land-use change cannot be overstated. A thorough assessment of the changing patterns of urban population growth has become very critical, given that urbanization will continue to be one of the major global environmental changes in the foreseeable future (Seto & Fragkias, 2005). As the trend and processes of urbanization and urban land-use change does not provide any hint of ending anytime soon, providing an insight into the evolutionary trends and spatial patterns of the actual case study in Accra, Ghana, would greatly improve understanding into the dynamics of urbanization and land-use change.

4 Urban Land Teleconnections: Introducing a Concept for Accra Case Study

The purpose of this section is to introduce a conceptual framework proposed by Seto, Reenberg *et al.* (2012) which, explicitly captures the linkages between land change and underlying urbanization dynamics. According to Seto, Reenberg *et al.* (2012), the economic complexities and dynamic interrelations among local, regional, and global processes and commodity flows mean that there are important linkages between urban areas and nonurban places, which in turn have land use implications. In the same piece, transboundary and nonlocal impacts on land changes enforced by urbanization processes can occur in multiple and distant locations. Conversely, urbanization processes in multiple locations can drive land change in one place, because numerous cities can simultaneously draw on resources in the same setting, such as rare earth elements that are geographically limited to a few locations. Additionally, it is important to emphasize that populations and economies of many urban areas rely heavily on hinterlands for resources, but then there is a disconnect between using resources for urban areas and preserving or conserving ecosystem services that are outside of urban areas (Seto & Reenberg, 2014).

As indicated earlier, urbanization and land change are two global processes with far-reaching consequences and although the two are highly intertwined and causally related, their literatures and analytical frameworks have been largely developed separately (Seto, Reenberg *et al.*, 2012). Land-use science

has historically focused on rural and frontier landscapes, with relatively little attention on urbanization or the rural-urban connections across time and space. Many of the current analytical frameworks also take a negative view of urbanization and its impact in terms of land change. However, urbanization can also present opportunities for increased efficiency of land and resource use, and yet there is no conceptual framework that fully addresses the linkages and bi-directionalities between urban and non-urban uses of land (Fragkias *et al.*, 2012). Thus, recent research has underscored the dynamics of increasingly globalized land systems arguing that that the underlying causes of land-use change in one location, which are often, located in distant places needs to be re-examined (Meyfroidt, Lambin, Erb, & Hertel, 2013; Müller & Munroe, 2014; Seto, Reenberg *et al.*, 2012).

In relation to the above, the concept of Urban Land Teleconnections (ULT) was developed taking into account the growing linkages between urbanization and urban land change processes (Müller & Munroe, 2014); the two are interconnected, their drivers and effects cross many space and time scales, and encompass environmental and socio-economic dimensions (Seitzinger *et al.*, 2012). First, the concept of teleconnections was adopted from climate science and have been defined as the correlation between specific planetary processes in one region of the world to distant and seemingly unconnected regions elsewhere (Steffen, 2006 cited in Nielsen & D'haen, 2015). Inferring from the prefix 'tele', the teleconnection concept implicitly invokes a sense of geographical and spatial distance between interacting systems that produce a connection (Nielsen & D'haen, 2015). In land change science, (Seto, Reenberg *et al.*, 2012, p. 7689) broadly defined "urban land teleconnections" as "a process-based conceptualization that intertwines land use and urbanization by linking places through their processes". In otherwords, urban land teleconnections as a process-based framework is used for integrating urbanization and land change dynamics, for revealing their linkages and pathways over time and space and, for identifying potential intervention points for sustainability (Seto, Reenberg *et al.*, 2012).

Furthermore, the ULT framework is a theoretical and a mythological response to the need to advance current conceptualizations of urbanization and land-use change that are increasingly inadequate to understand how changes in urban places affect distant non-urban places and vice versa (Seto, Reenberg *et al.*, 2012). One of the central tenets of the ULT framework is to understand how changes in urban locations are linked to distant, and sometimes, multiple places through a complex set of processes (ibid). In this context, the conceptual framework re-examines three themes in the current land change literature: the traditional system of land categorization, place-based relationships, and implicit assumptions about deterministic progression of land change (Güneralp, Seto, & Ramachandran, 2013).

It is important to note that the concept builds on theoretical elements drawn from different but related concepts in the land change science literature. Key among these include the theoretical perspectives on urban systems, world system theories commodity and production value chains, and agglomeration economies, among others. Based on these notions, four major types of urban

land teleconnections have been hypothesized. The first type of teleconnection (1) occurs when decisions in multiple urban places (e.g., manufacturing demand for mobile phone production) lead to land change in a limited number of distal sites (e.g., coltan mining in the Congo). The second type of teleconnection occurs when processes within a single urban place (e.g., one city's switch to hydropower) lead to land change in many distal areas (e.g., flooding in multiple downstream communities). A third type of teleconnection occurs when urbanization processes in a single place (e.g., increase in urban population) leads to land change in one or more urban or Peri-urban regions (e.g., land conversion for residential development). The last (fourth) major type is when urbanization processes in multiple locations (e.g., increase urban demand for energy) lead to multiple land impacts in distal and nearby places (e.g., CO2 uptake, appropriation of ecosystem services) (Seto, Reenberg *et al.*, 2012, p. 7689).

In recent years, the ULT concept has slowly gained prominence in the more socio-economic orientated land system studies to account for distal environmental changes, as well as their socioeconomic linkages (Nielsen & D'haen, 2015). More specifically, the concept has gained prominence in studies on urban dynamics and land use changes. With currently over half the world's population, cities are supported by resources originating from primarily rural regions often located around the world far distant from the urban loci of use. The sustainability of a city can no longer be considered in isolation from the sustainability of human and natural resources it uses from proximal or distant regions (Seitzinger *et al.*, 2012). Urban areas are supported by human and natural resources often drawn from far distant regions (Seitzinger *et al.*, 2012). Therefore, increasing and urban population growth, coupled with changing urban lifestyles and consumption patterns, have led to unprecedented resource, which inevitably influence land change outcomes in distant locations around the world (Nielsen & D'haen, 2015; Seitzinger *et al.*, 2012).

Güneralp *et al.* (2013) provide four fitting examples to depict the urban land teleconnection idea and illustrate the linkages between the urban processes and the implications for land change in the hinterlands. The first examples is the perceptions people have about places they have never or rarely been to (willingness to pay for ecosystem services in distant locations). Second is the physical movement of materials (mining of raw materials to construct the built environment). Thirst involves people (migration, tourism and lifestyle mobility), and the last example focuses on money (remittances) between urban and nonurban places (ibid). For the purposes of this report, only the last three examples are briefly outlined and discussed.

The first important example to consider is the physical movement of materials (mining of raw materials to construct the built environment). According to Güneralp *et al.* (2013), mining activities for construction materials are a major driver of land change in many rural places. As areas urbanize, there is a growing requirement for an increasing amounts of raw materials and energy to construct the built environment. Some of these construction materials (e.g. cement, steel, and timber) may be available locally at first, but as urban areas expand and the demand for materials exceeds the quantity or

quality of the local supply, the source of these materials shifts to increasingly distant places.

One fitting example of linkages between specific urban places and specific extraction sites is in Perote Valley, Mexico, in a study by Fry (2011) where the demand for pumice (tepetzil) initially came from the nearby city of Xalapa, the capital of Veracruz State. Eventually, demand came from the more distant metropolitan areas such as Mexico City and Monterrey. In this study, (Fry, 2011) show that urbanization processes and rural "deagriculturalization" are intimately linked processes. Using a case study from the Perote Valley, Mexico, the study assessed how urban driven concrete aggregate mining affected rural agricultural lands and livelihoods in distant rural areas. Numerous factors resulting from urbanization processes including increased prices for aggregates, consumerist desires for new homes to accommodate growing numbers, and declining returns to agriculture persuaded farmers to convert their agricultural lands to mines (ibid). The study demonstrates that urbanization-driven demand for construction materials simply played a significant role in shaping rural land-use decisions and livelihoods in the Perote Valley. In the long term, diminished agricultural potential resulting from widespread mine abandonment might drive farmers to migrate to cities for employment, creating a positive feedback between urban demand for construction aggregates and mining of agricultural fields (Fry, 2011).

The example illustrated is also fitting for the actual case study of Accra because the Ga districts of Accra (now Ga East, Ga Central and Ga West) has for the past decades served as a major source of earth materials for the construction industry both within and outside the district (Owusu & Albert, 2002; Tagoe, 2005). There is ample evidence to show that urbanization and growing population pressure in and around Accra is leading to significant changes in land-use elsewhere (see for example: Doan & Oduro, 2012; Owusu & Albert, 2002; Tagoe, 2005). A key challenge of the urbanization process is the rapid conversion of large amount of prime agricultural land at the urban periphery to urban land-use (mainly residential construction) (Grant, 2005; Owusu & Albert, 2002). According to Tagoe (2005) (Tagoe,È, construction has become one of the fastest growing industries in the districts. Given the enormous deposits of natural building material such as high quality sand and stone coupled with its large undeveloped tracts of land at the peripheral areas of the Ga districts, makes it suitable place for estate development targets. A wide variety of housing units are being developed in and around Pokuase-ACP Estates, Ashongman Parekuo Estates, Adenta, Pantang, Ashaley Botwe, Abokobi and Weija. Construction in these areas are widespread due availability of localized building materials in such distal places away from the city core of Accra. Specifically, these areas are noted for huge and good deposits of quality stone and sand including other raw construction materials, which are extracted for use in the building industry in the core areas of the Accra Metropolis and elsewhere. The case presented here can best be described as a local teleconnection in and around the Greater Accra Metropolitan Area.

Extraction of stone and sand mining activities have spread throughout the entire coastal area and Peri-urban fringes of Accra (Appeaning-Addo & Lamptey, 2013). Sand mining is a term generally used to describe the practice of sand collection from open landscapes for sale to people in the construction industry for estate development and other construction purposes (Tagoe, 2005). Sand mining and extraction of other earth materials for housing and infrastructure development to accommodate the growing number of people in and around Accra have resulted in the destruction of large tracts of vegetation and land degradation leading to land-use change. This makes it a two-way process whereby sand mining enables urbanization-driven land-use change both in-situ and in distant places. Owusu & Albert (2002) attributed the intensified activities of sand mining and stone quarrying in the Ga District to high demand for sand and gravels by the construction industry in Accra and its surrounding areas. Large tracts of hitherto fertile agricultural lands found in and around locations as such Manhean, Ablekuma, Ashiaman, Dodowa, Oblogo, Nsakina Doblo-gonno, Kwabenya, Mallam Gbawe and Ayikai-Doblo have undergone massive changes (Owusu & Albert, 2002; Tagoe, 2005). In times past, both migrant and indigenous farmers cultivating food crops like cassava, garden eggs, pepper, tomatoes etc occupied most of the lands in the areas mentioned. These lands have been lost to sand mining and extraction of earth materials for building purposes; so therefore, affected people move to new areas and the cycle continues. The increasing demand for construction materials to meet the housing with the emergence of new communities continuously results in widespread land-use changes. Within this context, I argue that sand mining and extraction of earth materials can contribute to deforestation and removal of vegetative cover, which by all standards is considered a change in land-use.

In addition, it noted that migrants create connections between their places of origin and destination, while affecting land changes in both places. Migration to urban centers in search of employment require shelter and this lead to land-use changes due to construction of formal and informal housing. The land change implications of rural–urban migration in places of origin tend to be more context specific depending on such factors as existing land use practices, economic incentives, personal preferences of migrants as well as of those they leave behind, and the local and national institutional frameworks (Güneralp *et al.*, 2013).

The last example relates to the situation where tourists become residents (permanent or seasonal) in their destination region. Tourists usually create unique patterns of residential development and land-uses (Güneralp *et al.*, 2013). This is what has been termed “tourism urbanization”, an urbanization formed from the rapid expansion of resort areas (Mullins, 1992). It is a new and unique type of urbanization that has emerged over the last thirty years; evident along many coastlines (ibid). (Güneralp *et al.*, 2013) aver that tourism urbanization has been the key determinant of the spatial patterns of development along the Gold Coast of Australia. In this, “Cities for pleasure”, were first developed for Australians, which was later expanded to accommodate

the growing number of international visitors (Mullins, 1992). This action triggered changes in urban land-use and infrastructure patterns that promote consumption different from other Australian cities (ibid). By focusing on tourism urbanization, this paper makes a case for the urban development of the Accra coast. Advanced by government of Ghana's policy to develop coastal tourism (Appeaning-Addo, 2013), Accra's coast is epitomizing this new spatial urban form. Being a tourist city, Accra's coast represent this new and extraordinary form of urbanization because of the huge presence of resorts which offer a range of goods and services for fun, pleasure, recreation, relaxation etc.

The examples illustrated about highlights the importance of process-based conceptualizations of urbanization and land change. Collectively, they demonstrate how diverse and versatile the concept of ULT is. Indeed, ULT approach thus captures the importance of recognizing the possibility of simultaneous and multi-directional streams of flows when analyzing transitions and pathways in land use systems. In this respect, it moves beyond the "classical" land transition notion and its emphasis on sequential stages of transformation, highlighting instead the possibility of feedbacks and multi-directional processes in contemporary land change (Nielsen & D'haen, 2015).

One of the advantages of the ULT conceptual framework is that, it comes as tool, which offers solutions towards improving on classical theories and the need to advance knowledge on current conceptualizations of urbanization and land change interconnections. In particular, it moves away from the placed-based conceptualizations of land-use, which assume sharp and distinguishable boundaries between urban and nonurban and do not permit multiple classifications of the same physical space. These conceptualizations have increasingly become inadequate in trying to understand how changes in urban places affect non-urban places and vice versa. In relation to this, ULT gives explicit attention to the actors, processes and networks involved in creating the teleconnections further apart. Also, one of the central underpinnings of ULT is that contemporary urbanization and globalization processes make the identification of distinct urban versus hinterland areas nearly impossible, therefore the ULT framework can help us to understand how changes in urban locations are linked to distant, and sometimes, multiple places through a complex set of processes. Another key strength of the ULT framework is its relative flexibility with regards to the analytical entry point in terms of methodological and theoretical approaches. According to (Güneralp *et al.*, 2013), there are several useful methodological approaches such as material flow analysis (MFA), spatially explicit Life-Cycle Assessment (LCA), Commodity Chains Analysis (CCA), Multilevel and Multiagent modelling approaches (Seto, Reenberg *et al.*, 2012) that can be employed concurrently with ULT. This flexibility of the ULT framework lending itself to disparate methodological and analytical approaches presents scholars with ample opportunities to engage with urban and land change system change from their disciplinary vantage points, while simultaneously presenting a relatively open and integrative platform for urban land change scientists to work inter-

disciplinary, when addressing the various aspects of teleconnection processes. Overall, the ULT framework presents a heuristic device for analyzing new causal relations in land system change over distances that can prove very useful for future urban and land change research (Güneralp *et al.*, 2013; Seto, Reenberg *et al.*, 2012).

Despite all the strengths of the ULT conceptual framework, there are a few weaknesses as well. The first of these weaknesses relates to the fact that the ULT framework does not come as a stand-alone tool of analysis because of its dependence on other methodological approach. This is quite argumentative because even though this could present major challenges, it can also be a good approach for example, interdisciplinary research projects. It is therefore relevant to raise the question: in how far does assorted methodological approaches lend themselves flexibly to the ULT framework? It is common knowledge methodologies are usually derived to be variable-oriented or case-based (see for example P.6 & Bellamy, 2012). It can be argued that trade-offs could emerge in terms of methodology, inferences, and interpretations as far as the ULT framework relies on other methodological approaches to be able to work. Arguing along the same line, (Güneralp *et al.*, 2013) contend that in order for the ULT framework to be fully implemented for specific studies, more research is required to identify appropriate methodological approaches. Additionally, the concept failed to define a scale of analysis. As it stands, the concept does not provide for how and where to draw the line in terms of geographical scope and define the temporal and spatial scale of analysis. One would agree that scale-issues are a central aspect of teleconnection analysis and researchers need to explicitly account for and be aware of the consequences of their scale-choices.

There are a number of challenges related to this. For instance, the framework emphasized the importance of feedback processes between urban land changes as a prerequisite for the creation of a teleconnection. This then creates potential inertia in some processes and interactions because, for example, spatial processes are unpredictable since humans-driven. While a 'trigger of change' might set in motion rapid responses and feedbacks between systems, some processes change more gradually and only manifest themselves after longer time spans. Additionally, the inertia of some processes and feedbacks can only be ascertained retrospectively. This affects the identification of analytical entry points, especially if the take off point for analysis depends on land-use transformation. Based on this premise, the framework needs to overcome the challenge of dealing with rapid changes taking place now, but only manifesting themselves as feedbacks in the future. Lastly, as the case may be for other kinds of research on dynamic systems, ULT research is equally expected have some inherent challenges most especially for depicting linkages and interactions between the systems as a static 'temporal snapshot'. This underscores the need for adopting the framework in a continuous and iterative research process (Müller & Munroe, 2014).

All things considered, the Urban Land Teleconnections concept comes as an advanced and suitable conceptual framework for an actual case study in Accra. As a result of the interactions between rural and urban areas (Nilsson *et*

al., 2013). The complexities of changing patterns and trends of new and diverse spatial urban forms occur mostly within a Peri-urban interface, characterized by distal heterogeneous mosaic of natural ecosystems, productive or agro-ecosystems, and urban ecosystems affected by rural material flows demanded by the urban core and beyond (Doan & Oduro, 2012; Owusu & Albert, 2002).

5 Urbanization and Land-use Change Study: Identified Research Gaps

Despite the growing importance of urbanization and urban land-use change as a defining trend in the twenty-first century, there is lack of some critical information and data about significant trends and patterns of urban areas and urbanization processes (Elmqvist *et al.*, 2013). Lack of reliable geospatial data hinders effective scientific investigations into the rapidly changing urban trends (McPhearson *et al.*, 2016). To date, substantial studies explored the proximate land changes brought about by urbanization, but the more distant land-use implications of urbanization remain under examined (Seto, Reenberg *et al.*, 2012). This concerns are buttressed by (Seitzinger *et al.*, 2012) who aver that sustainability of a city can no longer be considered in isolation from the sustainability of human and natural resources it uses from proximal or distant regions, or the combined resource use and impacts of cities globally. Thus, current conceptualizations of urbanization and its relationship with global change through land-use does not provide us with an integrated understanding that moves us towards urban sustainability solutions (Fragkias *et al.*, 2012).

Judging from what is available in the peer reviewed literature; several researchers who have studied the dynamics of urbanization have only conceptualized urbanization in terms of growth in urban population and mapped the physical expansion (spatial extent) of urban areas. Moreso, given the intermittent and delayed nature of population census data, it is no longer appropriate to rely solely on estimates of long past census to determine current urban populations. When current estimates are based on long past censuses, as is particularly the case in many countries, it is easy to draw unwarranted conclusions when estimates do not respond to changing conditions (McGranahan & Satterthwaite, 2014). For instance, LeGates & Stout (2011) had noted that in time past, the population of cities and towns (urban areas) has usually been given as the number of people living within politically demarcated boundaries but this practice no longer provides a true reflection of urban populations particularly because in many urbanizing countries, urban populations have been spilling over the narrow political boundaries at a tremendous rate and as a result of the outward spread of urbanites, counts made on the basis of existing political boundaries alone underestimate the city populations and exaggerate that of rural populations (LeGates & Stout, 2011).

Beyond this, Qin & Zhang (2014) argue that considering current trends and patterns, urbanization is more than the physical growth of urbanized areas. They aver that in addition to real estate development and land-use expansion, urbanization also includes the transition of people's working and living-modes. Therefore, to describe and understand urbanization, there is a need an indicator. The most widely used measurement is the urbanization level, which is the share of urban population within the total population. However, the problem with the measurement of the urbanization level is how to define urban population (ibid). Arguing along the same line, Karrar & Qadeer (2013) contended that not only does urbanization involve the growth in urban population and outward expansion of urban built-up area but also ongoing social and economic transformative process of urban regions, must equally be considered. Current urban dynamics go far beyond urban population size and the physical form of settlement spread. Corollary to this, Elmqvist *et al.* (2013) make a case that mapping the physical expansion of urban areas is no longer sufficient to calculate the full range of effects of urbanization on for instance; biodiversity, ecosystem services and human well-being. They aver that there are many indirect effects of urbanization resulting from resource demands of residential, commercial, and industrial activities as they relate to changing land-use in urban areas. These aspects need to be considered strongly.

While the United Nations World Urbanization Prospects publications provide country-level information on the percentage of populations in urban areas per annum, they do not supply intra-country or intra-city variations of urban population distribution, the location of urban areas, or changes in urban spatial patterns. In view of this, there is limited knowledge of the spatial extent and spatial patterns of urbanization, i.e. we simply do not know the spatial configuration of new urban areas (Seto, 2016). This is challenging because urban population growth rates often vary greatly among cities that make up large cities or urban regions (McGranahan & Satterthwaite, 2014). Furthermore, information about quality of life and basic socio-economic variables such as education, income and equity relative to urbanization processes are not readily available or collected across cities in a systematic fashion. Although there have been some efforts recently to develop comparable city and urban indicators that measure a range of urban services (e.g., Global City Indicators Facility, UN Global Urban Indicators), these efforts are only now underway and developing time series will take years in the making of these a reality. Addressing these biases through empirical research can contribute to bridging the current knowledge gaps in research (Elmqvist *et al.*, 2013).

It is important to emphasize that urban development is occurring so rapidly that existing management and governance systems are often unable to cope with the challenges of urban transformation, thus there is now the need to build upon and complement previous and ongoing research that seeks to understand the dynamism of urbanization and its relationships with the wider landscape changes. Ongoing debates differentiates between two distinct matters in need of urgent and critical research. The first is the location of emerging urban development – whether in low-lying coastal zones, or near

existing urban centres. The second is the way in which urban development occurs – whether expansive or compact, with multi-family or single family homes, with mixed-use or single-use zoning. The focus is to determine how for example, these infrastructure needs, housing types and energy consumption, and shape the entire urban social fabric (Fragkias, Güneralp, Seto, & Goodness, 2013).

Additionally, over the last twenty years, land change science has made significant progress in advancing our understanding of land-use change dynamics at various temporal and spatial scales. Most importantly, the land-use change community has increasingly acknowledged the complexity of human-environmental systems, improved the conceptual platform for land change studies, examined and documented the drivers of land-use change with of course urbanization as one of the major driving forces (Müller & Munroe, 2014; Seto *et al.*, 2010; Seto & Reenberg, 2014). Overall, the global overview of land-use development has significantly improved and has benefited from Remote Sensing and modelling advancements. However, absent from current land-change discussions is a framework that examines explicitly the trade-offs between land-uses and agents of change (for this study, urbanization) at the global scale – such a new conceptualization would need to be formed to provide methods to measure the linkages between land-use and its agents of change across geographic space and across time (Seto & Reenberg, 2014).

Another important knowledge gap relates to the scale and spatial configuration of urban land-use change (Elmqvist *et al.*, 2013; Letourneau, Verburg, & Stehfest, 2012). Information on land-use change due to urbanization in this regard is not available over long a period. Considerable scholarly attempts have been made to document and examine the interlinkages between urbanization and land-use change processes; however, while the relationship between urbanization and land-use change appears to be self-evident throughout these studies, the interrelationship between these two processes remains vague (Xie, Fang, Lin, Gong, & Qiao, 2007). Alongside the challenges of understanding and forecasting the patterns of land-use change and urbanization, there are also gaps in knowledge regarding the extent to which urbanization affects land use change and the ways in which they interact to yield various spatial forms and intensities in different political and geographic contexts (Elmqvist *et al.*, 2013; Xie *et al.*, 2007). Additional insights are urgently needed in order to develop for example, urban land-use change models that better reflect the complexity, diversity, and intensity of human influence on land systems (Letourneau *et al.*, 2012). Also, the feedback mechanisms that are needed to more completely account for the effects of urbanization on land-use change (Seto *et al.*, 2010), through interactions among social systems, ecological dynamics, and actors, such as households whose behaviour is the proximate cause of land-use change.

Another important knowledge gap as far as this study is concern relates to the lack of integration between changes in urban spatial patterns and coastal research. Yet, we know much less about the interaction of coastal and large

urban systems than we do for the constituent parts. Knowledge of the dynamic two-way interactions between megacities and the coast is quite a large gap in our collective knowledge of coastal urbanization and associated changes; there is an urgent need to understand how these interplay in and around coastal cities (Pelling & Blackburn, 2013).

While all human settlements in Ghana especially Accra are experiencing changes in their populations, layout and physical outlook; however, aggregate growth rates give limited information regarding spatial patterns of urbanization or the underlying processes that shape human settlements well as their implications for urban planning and management (Adarkwa, 2012). It has been observed that urbanization and growing population pressure in and around the Greater Accra Metropolitan Area (GAMA) is enforcing significant changes in land (Doan & Oduro, 2012). The evidence for urbanization and widespread changes in land-use change is given within the cohort of urban transformation relative to the steady growth in urban population as well as expansion of spatial processes and spatial structures within the city core and its "geographic edges" have not been adequately documented.

There has also been widespread challenges in capturing a vivid picture about urban changes because of strict reliance on population census data. While such population census data do not always capture precise urban population numbers due to undercounts of migrant and temporary populations, they represent the best available picture of the extent of urbanization in the capital region of Ghana (Doan & Oduro, 2012). This calls for scientific analysis for the way forward on how to capture population census data without widespread incongruities. Several recent research findings have demonstrated limited level of knowledge relative to the emerging trends, patterns and processes of urbanization and information on the rates and distribution of land being converted to urban built-up, and other land-use/cover change in GAMA (Stow *et al.*, 2016).

To address these problems, further research and spatial information is critically needed to complete our understanding of the emerging trends and patterns of urbanization and associated spatial patterns of urban land-use change (Weeks *et al.*, 2013). To bridge the knowledge gap on some of the issues highlighted above, the study would build on and extend knowledge on what has been done so far. A study underway to investigate the spatial and temporal dynamics of Peri-urban change, with specific focus on variations of urban population distribution, the location of new urban areas and the changes in spatial urban patterns as an actual case study in Accra, Ghana.

6 Conclusion

The paper presented the "state-of-the-art" discourses on the spatio-temporal dynamics of urbanization and urban land-use change from the global level, Africa, Ghana and the case of Accra. Evidence adduced from extant literature shows that there is an increasing size and urban concentration of

world's population. Contemporary urbanization simply differs from the past in its rate, scale, location and form. In addition to this, the level, pace, spatial patterns and trend of urbanization vary widely across the world. Findings of empirical analysis affirmed that there is a direct relationship between urbanization and land-use change. Clearly, urban activities drive much of the global changes we see today, whether in energy use, resource depletion, land-use change etc. Particularly, urbanization related activities, whether converting natural landscapes for human use or changing management practices on human-dominated lands have transformed a large proportion of the planet's land surface. Consequently, current trends indicate that urbanization is a pervasive and rapidly growing form of land-use change. With increasing urbanization, materials and resources are drawn in great quantities primarily from distant regions or hinterlands to support resource requirements of urban regions. This emphasizes the dependence on rural land and communities in urbanizing regions. The distal flows and connections between urban and non-urban regions are an important driver of land-use change. Urbanization of agricultural land is the predominant land-use change in this case.

Accra, the actual case study is in a period of rapid population growth and very rapid urbanization. The report provides evidence of increasing trend of urbanization in Accra, which does not exhibit any sharp distinctive features compared to global trends. The rapidity, magnitude, location, and direction of urban development processes in Accra are comparable to observed trends in other urbanizing coastal urban cities across the world. The overall trend of urbanization processes along the coast of Accra is moving outwards, i.e. from the core city centre towards more of the peripheral areas and the general spatial urban pattern is dominated by urban sprawl. The location and direction of new spatial urban forms per the literature can mostly be found at the Peri-urban areas, making peri-urbanization the predominant form of urbanization in Accra. Significantly too, recent trends and patterns of spatial urban development processes in and around Accra essentially manifests a two-step cyclical process of diffusion and coalescence. First, large tracts of new lands are developed in a scattered, patchy form at the fringes of the city. As the process continues, infilling among the patches begins to occur leading to the coalescing of the city into a more contiguous urban fabric. The major forces which produce, structure and fractionate the urban space includes increased urban population growth, rural-urban migration, fast growth of frontier conurbations and other socio-economic and environmental factors. Residential areas at the outskirts of the Accra metropolis are now growing at the fastest rates due to these interacting forces. The processes of urbanization are further exacerbated on along the Accra coast because the coastal areas of Accra, merging with the Tema region exist as a powerful central hub for industrial and commercial activities for migrants from both the northern and southern part of the country. This is the result of the huge presence of the "humanline" along the coastline. Additionally, coastal population in Accra is on the increase due to "tourism urbanization", a new and unique spatial urban form driven by rapid expansion of tourist infrastructure such as holiday resorts, hotels, lodges and restaurants, emerging at the instance government

policy to develop coastal tourism. While of crucial importance, these new spatial forms of coastal urbanization do not appear to be the most dramatic representation of new urban development in Accra.

The preliminary findings in the literature illustrate that contemporary approaches to the analysis of urbanization and urban land-use change be extended particularly from traditional interpretation of statistics on the cities in different size categories. With the urban fringe spreading outwardly, it should be kept in mind that new forms of urban settlements are emerging along with the sizes. Peri-urban growth, stable urban densities and the increasing prevalence of polycentric urban regions have become part of the new urban transformation. Consequently, it is imperative that the process of urbanization together with land-use change be studied holistically from a regional to local scale in order to highlight particularities that might be have been overlooked in global assessments that have taken place. The interconnected nature of problems, the multiple scales, magnitude and rates involved, and the geopolitical patterns make the need for an integrated approach very urgent. Experimental case studies that include cities and interconnections with rural areas across a range of geographic, development and cultural setting is an essential first step. The pursuit of this is very crucial, keeping in mind that it would propel us into the realm of having an appropriate understanding of the changing trends and patterns of urban land-use driven by the forces of urbanization.

7 References

Adank, M., Darteh, B., Moriarty, P., Osei-Tutu, H., Assan, D., & van Rooijen, D. (2011). Towards integrated urban water management in the Greater Accra Metropolitan Area. SWITCH (Ed.), Accra, Ghana.

Adarkwa, K. K. (2012). The changing face of Ghanaian towns. African Review of Economics and Finance, 4(1), 1–29.

Adu-Kumi, J., Adu-Kumi, M., & Apraku, A. (2015). Threats to the Conservation of Wetlands in Ghana: The Case of Songor Ramsar Site. Journal of Scientific Research and Reports, 6(1), 13–25. doi:10.9734/JSRR/2015/13906

Anderson, G. D. & Erbach, J. (2000). Urbanization & Environment: Opportunities for Refocusing USAID Assistance in Sub-Saharan Africa (Final Report for USAID Africa Bureau Office of Sustainable Development No. 25).

Angel, S., Parent, J., Civco, D. L., Blei, A., & Potere, D. (2011). : The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050, 75(2),. Progress in Planning, 75(2), 53–107.

APN. (2008). Quantification of Land Use Urbanisation Level in Three Developing Asia Countries based on the Analysis of Scale Effects in Landscape Pattern (No. Final report for APN project: ARCP2008-06CMY-Li. Asia-Pacific Network for Global Change Research).

Appeaning-Addo, K. (2013). Shoreline morphological changes and the human factor. Case study of Accra Ghana. Journal of Coastal Conservation, 17(1), 85–91. doi:10.1007/s11852-012-0220-5

Appeaning-Addo, K. (2014). Coastal Vulnerability Index to Sea Level Rise in Ghana. Coastal and Marine Research, 2(1), 1. doi:10.12966/cmr.01.01.2014

Appeaning-Addo, K., & Lamptey, E. (2013). Innovative Technique of Predicting Shoreline Change in Developing Countries: Case of Accra Erosion and Causal Factors. In C. W. Finkl (Ed.), Coastal Hazards. Dordrecht: Sringer Science.

Awumbila, M. (2014). Linkages between Urbanization, Rural-Urban Migration and Poverty Outcomes in Africa: World Migration Report 2015 (International Organization for Migration (IOM)).

Boafo, Y. A., Asiedu, A. B., Appeaning-Addo, K., Antwi, K. E., & Boakye-Danquah, J. (2014). Assessing Land-cover Changes from Coastal Tourism Development in Ghana: Evidence from the Kokrobite-Bortianor Coastline, Accra. Civil and Environmental Research, 6(6), 9–19.

Bradshaw, Y. W., & Noonan, R. (1997). Urbanization, Economic Growth, and Women's Labor-force participation: A Theoretical and Empirical Reassessment: Oxford England Oxford University Press.

Briassoulis, H. (2000). Analysis of Land Use Change: Theoretical and Modeling Approaches (The Web Book of Regional Science, Regional Research Institute, West Virginia University). Retrieved from http://www.rri.wvu.edu/WebBook/

Bruckmeier, K. (2011). Towards interdisciplinary rural research – theorizing nature-society relations. Natures Sciences Sociétés, 19(1), 3–13. doi:10.1051/nss/2011111

Campbell, J., Whittingham, E., & Townsley, P. (2006). 21 Responding to Coastal Poverty: Should we be Doing Things Differently or Doing Different Things? Environment and livelihoods in tropical coastal zones, 274.

CIESIN. (2013). Percentage of Total Population Living in Coastal Areas (Environmental Treaties and Resource Indicators (ENTRI) Query Service). Center for International Earth Science Information Network, Columbia University.

Clement, M. T., Chi, G., & Ho, H. C. (2015). Urbanization and Land-Use Change: A Human Ecology of Deforestation across the United States, 2001-2006. Sociological Inquiry, 85(4), 628–653.

Cobbinah, P. B., Erdiaw-Kwasie, M. O., & Amoateng, P. (2015). Africa's urbanisation: Implications for sustainable development. Cities, 47, 62–72.

Coccossis, H. N. (1991). Historical land use changes: Mediterranean regions of Europe. Land Use Changes in Europe, Springer Netherlands., 441–461.

Cooke, P. (1983). Theories of Planning and Spatial Development: Hutchinson: London.

Curran, S., Kumar, A., Lutz, W., & Williams, M. (2002). Interactions between Coastal and Marine Ecosystems and Human Population Systems: Perspectives on How Consumption Mediates this Interaction. AMBIO: A Journal of the Human Environment, 31(4), 264–268. doi:10.1579/0044-7447-31.4.264

DeFries, R. S., Foley, J. A., & Asner, G. P. (2004). Land-use Choices: Balancing Human Needs and Ecosystem Function. Frontiers in Ecology and the Environment, 2(5), 249–257.

Delphin, S., Escobedo, F. J., Abd-Elrahman, A., & Cropper, W. P. (2016). Urbanization as a land use change driver of forest ecosystem services. Land Use Policy, 54, 188–199. doi:10.1016/j.landusepol.2016.02.006

Deng, J. S., Wang, K., Hong, Y., & Qi, J. G. (2009). Spatio-temporal dynamics and evolution of land use change and landscape pattern in response to rapid urbanization. Landscape and Urban Planning, 92(3-4), 187–198. doi:10.1016/j.landurbplan.2009.05.001

Doan, P., & Oduro, C. Y. (2012). Patterns of Population Growth in Peri-Urban Accra, Ghana. International journal of urban and regional research, 36(6), 1306–1325. doi:10.1111/j.1468-2427.2011.01075.x

Elmqvist, T., Fragkias, M., Goodness, J., Güneralp, B., Marcotullio, P. J., McDonald, R. I.,. . . Wilkinson, C. (2013). Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment. Dordrecht: Springer Netherlands, DOI 10.1007/978-94-007-7088-1.

Foley, J. A., DeFries, R., Asner, G. P., Barford, C., Bonan, G., Carpenter, S. R.,. . . Snyder, P. K. (2005). Global Consequences of Land Use. Science, 309(5734), 570–574.

Fragkias, M., Güneralp, B., Seto, K. C., & Goodness, J. (2013). A Synthesis of Global Urbanization Projections. In K. C. Seto, S. Parnell, & T. Elmqvist (Eds.), A global outlook on urbanization. In Urbanization, biodiversity and ecosystem services: Challenges and opportunities (pp. 1-12). Springer Netherlands. (pp. 409–435). doi:10.1007/978-94-007-7088-1_21

Fragkias, M., Langanke, T., Boone, C. G., Haase, D., Marcotullio, P. J., Munroe, D., & Simon, D. (2012). Land Teleconnections in an Urbanizing World. A workshop Report. GLP-IPO/UGEC-IPO, Copenhagen.

Freire, M. E., Lall, S., & Leipziger, D. (2014). Africa's urbanization: Challenges and opportunities. The growth dialogue. Washington, DC., Pg 1-30.

Friedmann, J. (1966). Poor Regions and Poor Nations: Perspectives on the Problem of Appalachia. Southern Economic Journal, 465-473.

Friedmann, J. (2006). Four Theses in the Study of China's Urbanization. International journal of urban and regional research, 30(2), 440–451.

Friis, C., & Nielsen, J. Ø. (2014). Exploring the potential of the telecoupling framework for understanding land change: THESys Discussion Paper No. 2014-1. Humboldt-Universität zu Berlin, Berlin, Germany., Pp. 1-29. Retrieved from edoc.hu-berlin.de/series/thesysdiscpapers

Fry, M. (2011). From Crops to Concrete: Urbanization, Deagriculturalization, and Construction Material Mining in Central Mexico. Annals of the Association of American Geographers, 101(6), 1285–1306. doi:10.1080/00045608.2011.584289

Gamba, P., & Herold, M. (. (Eds.). (2009). Global Mapping of Human Settlement: Experiences, Datasets, and Prospects: Taylor and Francis Group, USA.

Geist, H. J., & Lambin, E. F. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation. BioScience, 52(2), 143. doi:10.1641/0006-3568(2002)052[0143:PCAUDF]2.0.CO;2

Ghana Statistical Service. (2014). 2010 Population and Housing Census (District Analytical Report: Accra Metropolitan). Accra, Ghana.

Grant, R. (2005). The Emergence of Gated Communities in a West African Context: Evidence from Greater Accra, Ghana. Urban Geography, 26(6), 661–683.

Güneralp, B., Seto, K. C., & Ramachandran, M. (2013). Evidence of urban land teleconnections and impacts on hinterlands. Current Opinion in Environmental Sustainability, 5(5), 445–451. doi:10.1016/j.cosust.2013.08.003

Guo, Y., Wang, H., Nijkamp, P., & Xu, J. (2015). Space – time indicators in interdependent urban – environmental systems: A study on the Huai River Basin in China. Habitat International, 45, 135–146.

Hahs, A. K. (2016). Urban megaregions and the continuum of urbanity—embracing new frameworks or extending the old?. Ecosystem Health and Sustainability, 2(1).

Hewawasam, I. (1998). World Bank Document: Integrated Coastal Zone Management Strategy for Ghana. Africa Region Findings & Good Practice Infobriefs; No. 113. World Bank, Washington, DC. © World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/9894 License: CC BY 3.0 Unported.

Jain, M., Dawa, D., Mehta, R., Dimri, A. P., & Pandit, M. K. (2016). Monitoring land use change and its drivers in Delhi, India using multi-temporal satellite data. Modeling Earth Systems and Environment, 2(1), 1–14.

Jedwab, R. (2013). Urbanization without structural transformation: Evidence from consumption cities in Africa. George Washington University, Washington, DC. Processed.

Jonah, F. E., & Adu-Boahen, K. (2016). Coastal Environmental Injustice in Ghana: The activities of coastal sediment miners in the Elmina, Cape Coast and Moree area. GeoJournal, 81(2), 185–196. doi:10.1007/s10708-014-9612-4

Karrar, H. H., & Qadeer, M. A. (2013). Urbanization of Everybody and Social Sustainability. Retrieved from International Growth Centre website: http://www.theigc.org/wp-content/uploads/2014/11/Karrar-Qadeer-2013-Working-Paper.pdf.

Klapka, P., Frantál, B., Halás, M., & Kunc, J. (2010). Spatial Organisation: Development, Structure and Approximation of Geographical Systems. Moravian Geographical Reports, 18(3), 53–65.

Lambin, E. F., & Geist, H. J. (Eds.). (2006). Land-use and land-cover change: local Processes and Global Impacts: Springer Berlin Heidelberg New York.

Lambin, E. F., & Meyfroidt, P. (2010). Land use transitions: Socio-ecological feedback versus socio-economic change. Land Use Policy, 27(2), 108-118.

Lambin, E. F., & Meyfroidt, P. (2011). Global land use change, economic globalization, and the looming land scarcity. Proceedings of the National Academy of Sciences of the United States of America, 108(9), 3465–3472. doi:10.1073/pnas.1100480108

LeGates, R. T., & Stout, F. (2011). The City Reader (Fifth edition). Routledge urban reader series. Topical urban anthologies. London, New York: Routledge/Taylor & Francis Group.

Letourneau, A., Verburg, P. H., & Stehfest, E. (2012). A land-use systems approach to represent land-use dynamics at continental and global scales. Environmental Modelling & Software, 33, 61–79. doi:10.1016/j.envsoft.2012.01.007

Li, Y., Zhou, Y., Shi, Y., & Zhu, X. (2012). Investigation of a coupling model of coordination between urbanization and the environment. Journal of environmental management, 98, 127–133. doi:10.1016/j.jenvman.2011.12.025

Lwasa, S. (2014). Managing African Urbanization in the Context of Environmental Change.

Majumdar, S., Mani, A., & Mukand, S. W. (2004). Politics, Information and the Urban Bias. Journal of Development Economics, 57(1), 137–165.

Maxwell, D., Levin, C., Armar-Klemesu, M., Ruel, M., Morris, S., & Ahiadeke, C. (2000). Urban Livelihoods and Food and Nutrition Security in Greater Accra, Ghana: International Food Policy Research Institute.

McGranahan, G. & Satterthwaite, D. (2014). Urbanisation concepts and trends.: IIED Working Paper. IIED, London.

McPhearson, T., Parnell, S., Simon, D., Gaffney, O., Elmqvist, T., Bai, X.,. . . Revi, A. (2016). Scientists ust have a say in the Future of Cities. Nature, 538(7624), 165–166. doi:10.1038/538165a

Meyer, W. B., & Turner II, B. L. (1996). Land-use/land-cover Change: Challenges for Geographers. GeoJournal, 39(3), 237–240.

Meyfroidt, P., Lambin, E. F., Erb, K.-H., & Hertel, T. W. (2013). Globalization of Land Use: Distant Drivers of Land Change and Geographic Displacement of Land Use. Current Opinion in Environmental Sustainability, 5(5), 438–444. doi:10.1016/j.cosust.2013.04.003

Müller, D., & Munroe, D. K. (2014). Current and future challenges in land-use science. Journal of Land Use Science, 9(2), 133–142. doi:10.1080/1747423X.2014.883731

Mulligan, G. F. (2013). Revisiting the Urbanization Curve. Cities, 32, 113–122. doi:10.1016/j.cities.2013.03.014

Mullins, P. (1992). Cities for Pleasure: The Emergence of Tourism Urbanization in Australia. Built Environment (1978-), 18(3), 187–198.

Neumann, B., Vafeidis, A. T., Zimmermann, J., & Nicholls, R. J. (2015). Future coastal population growth and exposure to sea-level rise and coastal flooding--a global assessment. PloS one, 10(3), e0118571. doi:10.1371/journal.pone.0118571

Ngoran, S. D., Xue, X., & Ngoran, B. S. (2015). The Dynamism between Urbanization, Coastal Water Resources and Human Health: A Case Study of Douala,

Cameroon. Journal of Economics and Sustainable Development, 6(3), 167–181.

Nielsen, J. Ø., & D'haen, S. A. L. (2015). Discussing rural-to-urban migration reversal in contemporary sub Saharan Africa: The case of Ouagadougou, Burkina Faso. THESys Discussion Paper No. 2015-1. Humboldt- Universität zu Berlin, Berlin, Germany, Pp. 1-21. Retrieved from edoc.hu-berlin.de/series/thesysdiscpapers

Nilsson, K., Pauleit, S., Bell, S., Aalbers, C., & Nielson, T. S. (Eds.). (2013). Peri-urban futures: Scenarios and Models for Land use Change in Europe. New York Dordrecht London: Springer Heidelberg.

Njoh, A. J. (2003). Urbanization and Development in Sub-Saharan Africa. Cities, 20(3), 167–174. doi:10.1016/S0264-2751(03)00010-6

Olaniyi, A. O., Abdullah, A. M., Ramli, M. F., & Alias, M. S. (2012). Assessment of drivers of coastal land use change in Malaysia. Ocean & Coastal Management, 67, 113–123. doi:10.1016/j.ocecoaman.2012.05.029

Opoko, A. P., & Oluwatayo, A. (2014). Trends in Urbanisation: Implication for Planning and Low-Income Housing Delivery in Lagos, Nigeria. Architecture Research, 4(1A), 15–26.

Owusu, E. A., & Albert, O. G. (2002). Application of Geoinformation Techniques in Identifying and Mapping Land Degradation Problems within Amasaman-Pokuase (Northeast of Accra) and its Surrounding Areas. American Association of Petroleum Geologists, 90007(2002).

Pelling, M., & Blackburn, S. (2013). Megacities and the coast: Risk, resilience, and transformation. London, New York: Routledge/Taylor & Francis Group.

Peng, X., Chen, X., & Cheng, Y. (2011). Urbanization and its consequences. Paris, France: Eolss Publishers.

Potter, R. B., Binns, T., Elliott, J. A., & Smith, D. (2008). Geographies of Development: An Introduction to Development Studies (Third Edition). Harlow, England: Pearson Education Limited.

Potts, D. (2012). Challenging the myths of urban dynamics in sub-Saharan Africa: The evidence from Nigeria. World Development, 40(7), 1382-1393.

Qin, B., & Zhang, Y. (2014). Note on urbanization in China: Urban definitions and census data. China Economic Review, 30, 495–502. doi:10.1016/j.chieco.2014.07.008

Ramachandra, T. V., Aithal, B. H., & Sreekantha, S. (2012). Spatial Metrics based Landscape Structure and Dynamics Assessment for an emerging Indian Megalopolis. International Journal of Advanced Research in Artificial Intelligence, 1(1). doi:10.14569/IJARAI.2012.010109

Reed, H. E., Andrzejewski, C. S., & White, M. J. (2010). Men's and women's migration in coastal Ghana: An event history analysis. Demographic research, 22(25), 771–812. doi:10.4054/DemRes.2010.22.25

Rostow, W. W. (1960). The Stages of Economic Growth: A Non - Communist Manifesto. Cambridge: Cambridge University Press.

Ruhiiga, T. M. (2013). Managing explosive urbanisation in Africa. Journal of Human Ecology, 42(1), 43–52.

Sana, A. A. (2013). Spatial Organization of Settlements: A Case Study of Hathras District, Uttar Pradesh, India. International Journal of Scientific Research, 2(10).

Santhiya, G., Lakshumanan, C., & Muthukumar, S. (2010). Mapping of landuse/landcover changes of Chennai coast and issues related to coastal environment using remote sensing and GIS. International Journal of Geomatics and geosciences, 1(3), 563–576.

Sassen, S. (2005). The Global City: Introducing a Concept. The brown journal of world affairs, 11(2), 27–43.

Sayed, M. B., & Haruyama, S. (2015). Dynamics of Land Use/Cover Change in Manikganj District, Bangladesh: A Case Study of Manikganj Sadar Upazila. Journal of Geographic Information System, 07(06), 579–587. doi:10.4236/jgis.2015.76046

Scherner, F., Horta, P. A., Oliveira, E. C. de, Simonassi, J. C., Hall-Spencer, J. M., Chow, F.,. . . Pereira, S. M. B. (2013). Coastal urbanization leads to remarkable seaweed species loss and community shifts along the SW Atlantic. Marine pollution bulletin, 76(1-2), 106–115. doi:10.1016/j.marpolbul.2013.09.019

Scheuer, S., Haase, D., & Volk, M. (2016). On the Nexus of the Spatial Dynamics of Global Urbanization and the Age of the City. PloS one, 11(8), e0160471. doi:10.1371/journal.pone.0160471

Seitzinger, S. P., Svedin, U., Crumley, C. L., Steffen, W., Abdullah, S. A., Alfsen, C.,. . . Sugar, L. (2012). Planetary Stewardship in an Urbanizing World: Beyond City Limits. Ambio, 41(8), 787–794. doi:10.1007/s13280-012-0353-7

Sesli, F. A. (2010). Mapping and monitoring temporal changes for coastline and coastal area by using aerial data images and digital photogrammetry:: A case study from Samsun, Turkey. International Journal of Physical Sciences, 5(10), 1567–1575.

Seto, K. C. (2009). Global Urban Issues: A Primer. In: Gamba, P., & Herold, M. (Eds.) Global mapping of human settlement: experiences, datasets, and prospects. Boca Raton, FL: CRC Press, 3-9.

Seto, K. C. (2016). Immersion Lecture: Rethinking Urbanization in the 21st Century. National Socio-Environmental ynthesis Center (SESYNC), USA.,

Seto, K. C., Dhakal, S., Bigio, A., Blanco, H., Delgado, G. C., Dewar, D.,. . . McMahon, J. (2014). Human Settlements, Infrastructure and Spatial Planning. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Seto, K. C., & Fragkias, M. (2005). Quantifying Spatiotemporal Patterns of Urban Land-use Change in Four Cities of China with Time Series Landscape Metrics. Landscape Ecology, 20(7), 871–888. doi:10.1007/s10980-005-5238-8

Seto, K. C., Fragkias, M., Güneralp, B., & Reilly, M. K. (2011). Meta-Analysis of Global Urban Land Expansion. PloS one, 6(8), e23777. doi:10.1371/journal.pone.0023777.g001

Seto, K. C., Parnell, S., & Elmqvist, T. (Eds.). (2013). A global outlook on urbanization. In Urbanization, biodiversity and ecosystem services: Challenges and opportunities (pp. 1-12). Springer Netherlands.

Seto, K. C., & Reenberg, A. (Eds.). (2014). Rethinking Global Land Use in an Urban Era. Cambridge Massaschusetts, London-England: MIT Press Ltd.

Seto, K. C., Reenberg, A., Boone, C. G., Fragkias, M., Haase, D., Langanke, T.,. . . Simon, D. (2012). Urban land teleconnections and sustainability. Proceedings of the National Academy of Sciences of the United States of America, 109(20), 7687–7692. doi:10.1073/pnas.1117622109

Seto, K. C., Sánchez-Rodríguez, R., & Fragkias, M. (2010). The New Geography of Contemporary Urbanization and the Environment. Annual Review of Environment and Resources, 35(1), 167–194.

Seto, K. C., Guneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. Proceedings of the National Academy of Sciences of the United States of America, 109(40), 16083–16088. doi:10.1073/pnas.1211658109

Simon, D., McGregor, D., Nsiah-Gyabaah, K., & Thompson, D. (2003). Poverty Elimination, North-South Research Collaboration, and the Politics of Participatory Development. Development in Practice, 13(1), 40–56.

Skole, D. L. (1994). Data on Global Land-Cover Change: Acquisition, Assessment, and Analysis: In Changes in Land Use and Land Cover: A Global Perspective, eds. W.B. Meyer and B.L. Turner II, 437-471. Cambridge: Cambridge University Press.

Songsore, J. (2003). Towards a better understanding of urban change: Urbanization, national development and inequality in Ghana. Accra: Ghana Universities Press.

Songsore, J. (2009). The Urban Transition in Ghana: Urbanization, National Developmentand Poverty Reduction (Study Prepared for the IIED as part of its Eight Country Case Studies on Urbanization). University of Ghana, Legon-Accra.

Stow, D. A., Weeks, J. R., Shih, H.-c., Coulter, L. L., Johnson, H., Tsai, Y.-H.,. . . Mensah, F. (2016). Inter-regional pattern of urbanization in southern Ghana in the first decade of the new millennium. Applied Geography, 71, 32–43. doi:10.1016/j.apgeog.2016.04.006

Tagoe, T. (2005). The Socio-Economic Impact of Sand Winning in the Ga Districts (A Dissertation Submitted to the Institute of Statistical Social and Economic Research (ISSER) in Partial Fulfilment for the Award of M.A. Development Studies Degree). University of Ghana, Legon, Accra. Retrieved from http://ugspace.ug.edu.gh

Tetteh, K. (2016). The new middle class and urban transformation in Africa : A case study of Accra, Ghana (Master of Science in Planning). University of

British Columbia, Vancouver. Retrieved from http://hdl.handle.net/2429/57950

The Economist. (2012). A sea of riches: Coastal waters could feed many more Africans, but need better protection. Feb 18. Retrieved from http://www.economist.com/node/21547867

Tran, H., Tran, T., & Kervyn, M. (2015). Dynamics of Land Cover/Land Use Changes in the Mekong Delta, 1973–2011: A Remote Sensing Analysis of the Tran Van Thoi District, Ca Mau Province, Vietnam. Remote Sensing, 7(3), 2899–2925. doi:10.3390/rs70302899

Turner, B. L. (2002). Contested Identities: Human-Environment Geography and Disciplinary Implications in a Restructuring Academy. Annals of the Association of American Geographers, 92(1), 52–74. doi:10.1111/1467-8306.00279

Turner, B. L., Lambin, E. F., & Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. Proceedings of the National Academy of Sciences, 104(52), 20666–20671.

Turner II, B., Skole, D., Sanderson, S., Fischer, G., Fresco, L., & Leemans, R. (1995). Land-Use and Land-Cover Change: Science/Research Plan. IGBP Report No.35, HDP Report No.7. IGBP and HDP, Stockholm and Geneva.

UN-DESA. (2015). World Population Prospects: The 2015 Revision, Methodology of the United Nations Population Estimates and Projections (Working Paper No. ESA/P/WP.242). New York. Retrieved from United Nations, Department of Economic and Social Affairs, Population Division website: www.unpopulation.org

UN-HABITAT. (2014). The State of African Cities 2014: Re-imagining Sustainable Urban Transitions (State of Cities - Regional Reports). Nairobi, Kenya.

UN-HABITAT. (2016). Urbanization and Development: Emerging Futures: World Cities Report 2016 (No. ISBN Number: 978-92-1-133395-4). Nairobi, Kenya. Retrieved from United Nations Human Settlements Programme (UN-Habitat) website: www.unhabitat.org

United Nations. (2016). Ghana Population 2016 - World Population Review. Retrieved from Ghana%20Population%202016%20-%20World%20Population%20Review.htm#

United Nations, Department of Economic and Social Affairs, Population Division. (2014). World Urbanization Prospects: The 2014 Revision.

UNU-IHDP. (2015). Coastal Zones and Urbanization: Summary for Decision-Makers. Bonn: UNU-IHDP.

US Census Bureau. (2015). International Programs, International Data Base: World Population: 1950-2050. Retrieved from http://www.census.gov/population/international/data/idb/worldpopgraph.php

Wallerstein, I. (2011). The Modern World-System IV. Capitalist agriculture and the origins of the European world-economy in the sixteenth century, with a new prologue (Vol. 1). California, USA: University of California Press.

Wang, Q., Yuan, X., Zhang, J., Mu, R., Yang, H., & Ma, C. (2013). Key evaluation framework for the impacts of urbanization on air environment-A case study. Ecological Indicators, 24, 266–272.

Weeks, J. R., Hill, A. G., & Stoler, J. (Eds.). (2013). Spatial Inequalities: health, poverty, and place in Accra, Ghana. Springer Dordrecht Heidelberg New York London: Springer Science & Business Media.

Weng, Q. (2010). Remote sensing and GIS integration: Theories, methods, and applications. New York: McGraw-Hill.

Winther, L. (2015). Editorial – transformation of cities. Geografisk Tidsskrift-Danish Journal of Geography, 115(2), 67–72.

World Bank. (2015). Rising through Cities in Ghana: Ghana Urbanization Review Overview Report. Washington, DC, USA.

World Bank Group. (2015). Urbanization in Ghana: Challenges and Strengths. Ghana in Brief;. World Bank, Washington, DC. © World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/22761 License: CC BY 3.0 IGO.

Xie, Y., Fang, C., Lin, G. C., Gong, H., & Qiao, B. (2007). Tempo-Spatial Patterns of Land Use Changes and Urban Development in Globalizing China: A Study of Beijing. Sensors, 7(11), 2881–2906. doi:10.3390/S7112881

Yankson, P. W. (2012). Landlordism and Housing Production in Greater Accra Metropolitan Area. E. Schandorf, P. Yankson, & M. Bertrand, The Mobile City of Accra: Urban Families, Housing and Residential Practices, 163–182.

Yankson, P. W., & Bertrand, M. (2012). Challenges of Urbanization in Ghana. The Mobile City of Accra, 25.

You, H. (2016). Quantifying the coordinated degree of urbanization in Shanghai, China. Quality & Quantity, 50(3), 1273–1283. doi:10.1007/s11135-015-0204-2

Zhou, Q., & Sun, B. (2010). Analysis of spatio-temporal pattern and driving force of land cover change using multi-temporal remote sensing images. Science China Technological Sciences, 53(1), 111–119.

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