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Peri-urbanisation and loss of arable land in Kumasi Metropolis in three decades: Evidence from remote sensing image analysis

Kabila Abass[a,*], Selase Kofi Adanu[b], Seth Agyemang[a]

[a] Department of Geography and Rural Development, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[b] Centre for Remote Sensing and Geographic Information Services (CERGIS), University of Ghana, Legon, Ghana

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ABSTRACT

This paper examined the effects of peri-urbanisation on arable land in Kumasi Metropolis. The study involved classification of Landsat Thematic Mapper (TM) 1986 imagery and images from Enhanced Thematic Mapper Plus (ETM+) 2004 and Landsat 8 Operational Land Image and Thermal Infrared Sensor (OLI/TIRS) image for 2016 to show land use and cover changes in the Metropolis. The results show that the Metropolis has undergone significant land use and land cover changes in thirty years with negative repercussions for food crop production. While urban land use increased by 54.6% between 1986 and 2016, arable land declined by 15.6% over the same period. The results show a strong positive correlation between the size of arable land and crop output over a fifteen-year period. The paper calls for legislative enforcement as well as standards on urban land use and development as enshrined in the 2016 Land Use and Spatial Planning Act to ensure that land use in the city is consistent with sustainable principles.

1. Introduction

About 50% of the world's population lives in urban centres and it is projected that future population growth will occur in cities (Cohen, 2003; McGranahan and Satterthwaite, 2003; Satterthwaite et al., 2010). It is projected that, the population of the world will reach 6.29 billion, which is 69% of the total world population by 2030 (United Nations, 2010). By the year 2050, it is expected that the world's urban population will increase by more than two thirds, with about 90% of the increase taking place in the urban centres of Africa and Asia (United Nations Population Division, 2015). The urban population of developing countries is especially projected to grow at an average annual rate of 2.4%, which is twice the 1.2% urban growth rate in the developed world (Golden, 2004). The current rates of population growth and urbanisation in Sub-Saharan Africa are and will be the highest in the world, providing impulsion for monitoring of land cover and land use change based on remote sensing (Toure et al., 2016). In view of the fact that a huge proportion of urban population resides in peri-urban areas, the question of how peri-urbanisation is to be managed has become one of the topical issues in spatial planning and sustainable urban development in the 21st century (Watson, 2009). Peri-urbanisation is a 'process by which rural areas located on the outskirts of established cities become more urban in character, in physical, economic, and social terms, often in piecemeal fashion' (Webster, 2002, 5). In countries of the developing world, peri-urbanisation is becoming increasingly an important issue because of continuous and rapid urbanisation (United Nations, 2001; Cohen, 2006).

Urbanisation is one of the key processes affecting human societies, especially over the last century. It has brought a lot of benefits economically to a lot of countries with tremendous improvements in the provision of social services to communities (Raddad et al., 2010). If not properly managed, however, urbanisation can create adverse consequences (GOG, 2012). A major challenge is farmland decline as rapid urban expansion eats up available peri-urban and rural lands compelling farmers living in urban fringes with huge population to migrate to new locations where they can find farming space. It is estimated for example that every year, 1.5 million farmers in China lost their farmlands since the last decade due to urban expansion (Lu et al., 2003). Due to urbanisation, communities are rapidly going through a transition from the natural rural vegetation to man-made urban engineered infrastructure (Golden, 2004) with negative implications for the environment. The process of urbanisation has been associated with different environmental and resource problems worldwide, including habitat loss, land cover change, species extinction and alteration of hydrological systems (Chen et al., 2014). Rapid urbanisation (Weeks, 2015), and urban sprawl (Bruegmann, 2005) are key factors for extensive land cover and land use change.

Peri-urbanisation, a process by which hitherto rural and non-urban

* Corresponding author.
E-mail addresses: kabass.cass@knust.edu.gh (K. Abass), sadanu@ug.edu.gh (S.K. Adanu), sagyemang.cass@knust.edu.gh (S. Agyemang).

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areas become urbanised, presents challenges to peri-urban dwellers. As Ode and Fry (2006) note, traditional farming activities come into conflict with alternative economic, residential and recreational interests within the peri-urban zone. Conversion of agricultural lands to urban use causes scarcity of productive land as non-farm activities increase land values leading to high competition for land, landscape fragmentation, neighbour conflicts and environmental pollution (Clark et al., 2007). As a result, urban expansion into urban fringes increases pressure on the agricultural land, which could impact negatively on socio-economic conditions of communities (e.g. Mandere et al., 2010). Between 1982 and 2003, the total area devoted to cropland, rangeland and pastureland in the United States dwindled by 76 million acres in the lower 48 states, while the total area of urban land increased by 36 million acres (Wu, 2008). Similarly, when urban sprawl invaded farmlands in China, farmers lost the most valuable resource on which they have lived for generations (Sui and Zeng, 2001; Xiao et al., 2006; Liu et al., 2010). Between 1996 and 2002, for example, arable land dwindled from about 130.03 million hectares to about 125.93 million hectares (Lu et al., 2005). The expansion of urban areas in China has resulted in over 40 million farmers losing their farmland at a rate of 2 million acres per year (Elhadary et al., 2013). Another clear example is that of Hanoi, Vietnam, where rural communities have lost their main sources of livelihood, in the form of production of fresh food such as fish, pork, and vegetables for urban residents as a result of rapid increase of residential and commercial developments (Tacoli, 2003).

Although urbanisation is a challenge to the survival of rural agricultural economies, it is also an opportunity for creating urban market for farm products and creation of alternative jobs for off-farm employment, emergence of new markets for higher value goods and income from recreational activities (Levi and Sperry, 2007). Depending on the challenges and opportunities, farmers in peri-urban areas tend to develop several strategies such as intensification, on and off-farm diversification and having multiple income portfolios to secure their livelihood in such a dynamic environment (Clark et al., 2007; Sharp et al., 2007; Wilson, 2007; Zasada et al., 2011, Afriyie et al., 2014). These dynamics imply that farmers would respond differently to the forces that cause change within the peri-urban spaces.

Ghana is urbanising rapidly. With well over 70% of the total population in rural areas at independence in 1957, the country now has about 51% of its total population living in urban centres, thus crossing the urban divide (GOG, 2012). The urban population growth rates of 4.7%, 3.3%, 4.6% and 4.3% were recorded for the periods 1960–1970, 1970–1980, 1984–2000 and 2000–2010 respectively. Compared to the national population growth rate of 2.4%, 2.6%, 2.7% and 2.5% for 1960–1970, 1970–1980, 1980–1984, 1984–2000 and 2000–2010 respectively (sum of urban and rural), it is clear that the urban growth rate is higher. By 2030, the country's urban share of the national population is projected to hit 65% (GOG, 2012).

As cities expand, housing deficits continue to increase amidst the generally low levels of income of the Ghanaian working population, land tenure insecurity and escalating high cost of building materials. The limited supply of public sector housing should have provided the opportunities for private sector housing to do business. This has not materialized fully due to the challenges of high bank interest rates on loans which is a disincentive for housing development. As a result, housing provision is principally through self-help initiatives (Obeng-Odoom, 2009). To meet accommodation needs for residential purposes, peri-urban lands are particularly attractive. This is because land value diminishes away from the city centre. The outward growth of such housing developments, often uncontrolled and unregulated, give rise to the sprawling city (Farooq and Ahmad, 2008). Uncontrolled and scattered sub-urban development increases problems of traffic, destroys open spaces and depletes local resources (Peiser, 2001).

In the last two decades, in the Kumasi Metropolis, rapid urbanisation has affected agriculture in a dramatic fashion (GSS, 2014). The increased demand for land for residential, industrial and commercial uses has occurred at the expense of agricultural land use. According to the Ghana Statistical Service estimate, about 95% of the cultivable lands have undergone conversion through housing construction and other forms of physical infrastructure (GSS, 2014).

The effects of urban expansion into rural areas have been documented by Afriyie et al. (2014) and Cobbinah and Amoako (2012). However, the effect of peri-urbanisation on arable land in the Ghanaian context is under researched. This paper therefore examines peri-urbanism and its effects on arable lands in Metropolitan Kumasi. This will contribute to the small but growing body of scientific discourse in this area.

2. The growth of kumasi and the peri-urban development

Kumasi has seen a tremendous growth in terms of population and infrastructural expansion. It grew at 5.2% annually between the 1984 and 2000 inter-censal years but grew at an unprecedented growth rate of 5.4% from 2000 to 2010. Compared to the 2.7% and 2.4% annual national growth rates for the periods 1984–2000 and 2000–2010 respectively, the Metropolis has grown about twice the national growth figures (Afrane and Amoako, 2011). This is attributed to Kumasi being the Asante State capital and currently Ashanti regional capital. Being a nodal city coupled with its rich and varied natural resource endowments make it not only a transit location but also an important commercial centre for a large number of migrants from across different parts of the country and beyond. Since 1960, migrants from other parts of the country to Kumasi and foreigners accounted for 63% and 13% respectively of the total population (Korboe, 2001 cited in Quagraine, 2011).

The rapid growth of the population of the city has necessitated a substantial demand for housing resulting in an annual housing growth rate of 8.6% between 1984 and 2000 (Afrane and Amoako, 2011). This development has a significant effect on the physical structure of the Kumasi Metropolis, with expanding peri-urban settlements. The development of peri-urban Kumasi does not strictly follow formal urban planning and development processes and is influenced largely by factors that are beyond the control of the city authorities (Afrane and Amoako, 2011; Afriyie et al., 2014). A complex mix factors are at play and include among other things individual housing preferences, desire for new lifestyles outside the inner city, improvement in transportation links, demographic trends, price of land, traditions and constraints at the metropolitan level (Afriyie et al., 2014).

The Kumasi Peri-urban Interface (KPUI) falls within an area that spans 9 and 20 km from the City centre (Owusu-Ansah and O'Connor, 2010). Its width has been estimated to range from 20 to 40 kilometers. This has however changed over time because of its fluidity and it is almost certain to continue doing so with future urban growth (Brook and Dávila, 2000). The width of the peri-urban zone around the City is also not uniform (Afrane and Amoako, 2011). This area has over the years experienced massive changes in terms of land use as well as social and economic activities. This has culminated in a rural-urban mix of residents, haphazard distribution of buildings which are either fully completed or at different levels of construction (Owusu-Ansah and O'Connor, 2010).

As Kumasi grows outward, it absorbs previous peri-urban lands and many other villages which hitherto were in rural locations. Their rural characteristics are gradually changing due to the influence of urban way of life which is changing the hitherto agriculturally dominated economy to a multiple use landscape (Busck et al., 2006). Simon et al. (2004) are of the opinion that these changes are as a result of in-migration, growth and changes in population composition that result in land use and economic diversifications. With the increased urbanisation, land within the urban centres become relatively scarce. Consequently, the price (value) of a parcel of land goes up beyond the reach of an average Ghanaian. Land values decrease however, with distance from the city centre. These dynamics and the increased proximity and