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Land use/cover change in Ghana's oil city: Assessing the impact of neoliberal economic policies and implications for sustainable fevelopment goal number one – A remote sensing and GIS approach

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ABSTRACT

Increasing levels of urbanization around the globe has contributed to the loss of agricultural lands in many exurban zones. Loss of agricultural lands, in many cases, worsens poverty levels of smallholder farmers who depend on subsistence farming – an issue that Sustainable Development Goal number one seeks to address. Land use and land cover (LULC) change studies are widely used to monitor human-induced changes in the environment. This study used multi-temporal satellite images and geographic information systems (GIS) to assess the spatio-temporal dynamics of land use/cover changes in Sekondi-Takoradi, over a 30-year period (1986–2016), to understand how recent historical events and economic policies may have contributed to such changes. Our results suggest that the size of urban land area has nearly doubled through the study period to accommodate the constantly increasing population in the metropolis. This has led to a significant reduction in agricultural lands and an almost complete obliteration of standing forest. Policies enacted during the era of structural adjustment program and the current oil industry seem to have been the main drivers of LULC changes in Sekondi-Takoradi. With the prevailing antagonism between urban expansion and agricultural land use activities, our study asserts the need to control urban sprawl. This will be important to prevent loss of lands dedicated to subsistence farming, if complete eradication of poverty as stipulated by Sustainable Development Goal (SDG) number one will be a realistic goal for the people of Sekondi-Takoradi.

1. Introduction

Land use/land cover change (LULCC) is one of the leading factors responsible for global change, and has therefore emerged a subject of significant global importance in recent decades. Globally, the growth of urban populations has become an everyday phenomenon. In Africa, the rate of urbanization has surpassed all forecasts (Hegazy and Kaloop, 2015; Reis, 2008). Once considered a rural continent, the rate of urbanization in Africa currently surpasses that of North America (Kalnay and Cai, 2003; Satterthwaite, 2008). However, the type of urbanization in Africa and other developing regions is characterized by unorganized expansion and increased immigration (Hegazy and Kaloop, 2015). Particularly for migration, discovery of natural resources in local areas have the tendency to spur an influx of people to nearby towns and cities: a leading contributor to the phenomenon of urban sprawl (Gougha and Yankson, 2012). In most countries, the expansion of exurban zones can lead to land degradation, which can have deleterious impacts on the environment such as interfering and distorting local biogeochemical cycles, ecosystem processes, and climate (Foley et al., 2005; Pullanikkatil et al., 2016). Additionally, the movements of commercial and residential activities into rural areas that exist at the periphery of metropolitan areas have led to massive losses of agricultural lands in many countries (Belal and Moghanm, 2011; Hegazy and Kaloop, 2015; Reis, 2008).

Loss of agricultural lands threatens livelihoods and increases poverty of people who live in exurban zones in many areas around the world. For this reason, conflicts are common in such areas and many other indigenous communities, where natural resource exploitation activities encroach on pre-existing activities (Akabzaa, 2000; Arago and Rud, 2011; Beine et al., 2012; Cuba et al., 2014; Gougha and Yankson, 2012; Palazuelos and Fernandez, 2012; Parker and Jacobsen, 2012; Obeng-Odoom, 2013; Okpanachi and Andrews, 2012). The Sustainable Development Goals (SDGs) have acknowledged the importance of recognizing the inextricable link between poverty reduction and the ability to safeguard access of the poor and vulnerable to land resources for food production. The SDGs is the new framework by nations to improve human conditions by the year 2030. Specifically, the overarching objective of goal number one is to eradicate all forms of poverty

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on the planet, and the target number four states the following:

> "By 2030, ensure that all men and women, *in particular the poor and the vulnerable, have equal rights to* economic resources, as well as access to basic services, *ownership and control over land* and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance" (UN, 2016).

Like most African countries, Ghana's urban population has steadily increased over the past decades. It rose from about 31% in 1984 through 44% in 2000, and 54% at the current level, with an annual rate of change of about 3.4% (CIA, 2016). Sekondi-Takoradi in the western region of the country has been one of the most rapidly urbanized areas in the country over the past three decades (Songsore, 2009). A string of pivotal moments in the country's recent history seems to have influenced the drastic increase in urban population in the metropolis. One such moment was in the 1980's, during the era of the neoliberal Structural Adjustment Program (SAP). In 1983, the Ghanaian government, under the guidance of the World Bank and the International Monetary Fund (IMF), launched its own version of the SAP: the Economic Recovery Program (ERP). The main purpose of the ERP was to stimulate growth of Ghana's economy. One of the most prominent policies implemented under the ERP was to enhance conditions for the production and export of goods through infrastructural rehabilitation (Benhin and Barbier, 2004; Berry, 1994; Owusu, 1998). The Takoradi harbor was one of the most important facilities earmarked for expansion to support exports. This expansion stimulated a wave of urbanization into the Sekondi-Takoradi metropolis. Another monumental event that has further increased expansion of urban activities in the Sekondi-Takoradi metropolis is the discovery of oil resources in Ghana. In 2007, during the golden jubilee celebration of the country's independence from British colonial rule, Ghana discovered oil deposits in commercial quantities. This discovery thrust Sekondi-Takoradi metropolis into the global spotlight spurring a renewed wave of urbanization resulting in massive changes in local land uses (Obeng-Odoom, 2012).

Obeng-Odoom (2013) reported that between 2007 and 2013, the value and price of lands almost doubled, contributing to the increasing conversion of farmlands to urban activities. This undermines the survival of poor traditional farmers who are the majority of the population, and can be a major obstacle to achieving SDG number one when livelihoods are undermined. For this reason, there is a pressing need for knowledge about the extent of land use change in Sekondi-Takoradi due to urban expansion and possible implications on pursuing the goal of absolute eradication of poverty.

The advent of remote sensing techniques, Geographical Information Systems (GIS) and related applications has presented useful and detailed mechanisms through which such land use/cover change can be monitored. The basic premise in the remote sensing application is that it is a cost-effective approach towards identifying changes in land use and land cover occurring over a given period. This approach achieves a better accuracy in quantification, which may otherwise be difficult (Balakeristanan and Said, 2012; Belal and Moghanm, 2011; Butt et al., 2015; Hegazy and Kaloop, 2015; Rawat and Kumar, 2015; Reis, 2008; Serra et al., 2008; Weng, 2002; Xiao et al., 2006; Yin et al., 2011).

The main objective of this study was to describe the trend and magnitude of land use/land cover change in the Sekondi-Takoradi during the period 1986 and 2016. We also assessed how much of the change occurred within the two halves of the 30-year study period (i.e. 1986–2001; 2001–2016). Additionally, we sought to assess how much of the change has occurred since 2009 when oil production officially commenced. Finally, it discusses the implications of associated changes in agroecosystems on the pursuit of SDG number one.

2. Description and brief history of study area

The Western Region is Ghana's oil region and covers about 2390 km^2, approximately a tenth of Ghana's total land area. Within this region is the Sekondi-Takoradi Metropolitan Area (Fig. 1) which contains the second most important port city in Ghana, Sekondi-Takoradi.

Sekondi-Takoradi Metropolitan Area is the third largest city in terms of population size (about 560,000). It encompasses an area of about 211 km^2 and it is geographically located between latitude 4.95° N and longitude 1.73° W. Sekondi-Takoradi is an area of strategic importance both in the colonial and post-colonial history of Ghana. "Takoradi" and "Sekondi" were the names of two settlements in the Gold Coast before their merger into a single metropolis. While Sekondi-Takoradi has recently grown in its reputation around the world as a new oil city in Africa, attracting such levels of international attention is not new to the city. In 1928, in order to facilitate cargo from the Gold Coast (currently Ghana), the Takoradi harbor was built and became the first harbor in West Africa. This harbor contributed immensely to the importance of the Sekondi-Takoradi in international circles (GSS, 2014; Obeng-Odoom, 2012).

In the 1986, Takoradi harbor saw a revamp as part of the ERP to increase exports in a bid to resuscitate the ailing economy. The massive facelift, in addition to a government policy to reduce income tax by 25% if businesses established entities in the city, spurred a new wave of development and urban expansion (Obeng-Odoom, 2012). Due to this expansion of urban areas, the Sekondi-Takoradi metropolis saw a steep rise in population from the mid-1980s, even though its population had been on a downward spiral in the previous decade (Fig. 2). As a matter of fact, the annual growth rate of the metropolis between 1984 and 2000 increased to 7.1%, higher than the 4.6% and 6.7% recorded for Greater Accra Metropolitan Area and Kumasi Metropolitan Area, respectively (Songsore, 2009). In this same period, according to the Ghana Statistical Service, Sekondi-Takoradi saw the highest average annual percentage increase in number of houses among all regional capitals in Ghana between 1984 and 2000, greater than that of Accra and Kumasi (Table 1) (GSS, 2005).

With its population size and port, Sekondi-Takoradi is a vibrant and bustling metropolis in terms of business and commerce (Amoasah, 2010; Obeng-Odoom, 2013). Having been established as the main business area within the Western Region, many changes resulting from the oil and gas industry in terms of population, housing, and facility installations occur within this metropolis. This coupled with the fact that about 75 percent of the population are directly or indirectly engaged in agriculture, fishing and forestry makes it even more relevant understand the consequences of land use change on agricultural lands (GSS, 2014).

3. Data and methodology

3.1. Remote sensing data

This study utilized imagery from Landsat Thematic Mapper (TM), Landsat Enhanced Thematic Mapper (ETM +) and Landsat Operational Land Imager (OLI-8) (path 194 and row 57) acquired on 5th April 2016. The data covered the period of 1986–2016 and included imagery collected primarily in the dry season when cloud presence is minimal (December, 1986; January, 2001; January, 2009; and January, 2016). Between these years, we collected image for halfway the entire period to assess the magnitude of change for both halves. In order to assess the amount of change that has occurred since the oil exploitation in Ghana, a Landsat ETM+ image was collected for the period just after oil discovery to determine the amount of change that has occurred since the operations began. All images considered in the study had spatial resolution of 30 m. With the exception of the thermal band, all visible and infrared bands were included in the analysis.

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