

# **Quantifying Urban Growth in Accra Metropolitan Area (Ama), Ghana and Exploring Causal Mechanisms**

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**Key words:** Remotely Sensed Images, Geographical Information System (GIS), Urban Growth and Management, Land Administration.

## **SUMMARY**

This paper quantifies the spatial pattern of urban growth in Accra from 1985 to the present using a time-series of geometrically corrected remotely sensed imagery. Change detection techniques were applied to identify areas that had undergone rapid transformation as a result of urban encroachment. The next phase of the research involved a field survey using questionnaires, formal and informal interviews, and focus group discussions to explore and understand the nature of the spatial growth processes in these areas and how best to manage them. Consequently, it was identified that the demand for and access to land is the main cause of urban growth within these areas. In addition, the pluralistic system of land tenure coupled with the overlapping and duplication of roles by Government institutions has also created a cumbersome process to land title registration. Subsequently, people bypass these registration processes and develop their land. However, education, land reform and legal amendment to existing land laws are suggested as ways to address the present problems identified.

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## 1. INTRODUCTION

Rapid urban growth is a global phenomenon. Like other human-induced land cover changes, urbanisation represents a response to socio-economic, political, demographic or environmental conditions, characterised by an unprecedented concentration of humans into cities (Masek *et. al*, 2000). Cities are engines of economic and social development in most developing countries, which provides the basis for which cities build infrastructure. Conversely, in the absence of a healthy urban economy, it is rarely possible to provide these services on sustainable basis.

Ghana is rapidly urbanising and is no different from other countries in Sub-Sahara Africa. Recent statistics indicates 43.8% urban dwellers in 2000, as against 9% in 1931. At the current growth rate of 2.6% per annum, the urban population is expected to double in 17 years (GSS, 2000). Accra Metropolitan Area (AMA) alone according to 2000 census represents 25% of all urban dwellers in Ghana, increasing at 4.2% per annum. It is generally characterised by fragmented economic and residential geographies, which represent a complex, dynamic system responding to competing forces. In most cases, this process occurs so fast that it overtakes the capacity of planning authorities to deal with the situation, and to control urban growth. Monitoring this growth and planning for its control have been made more difficult by the expanse of time involved in producing reliable and up-to-date maps. Existing maps are usually old, out dated and, therefore difficult to use as an effective information base for planning. This, if left unchecked, will undermine sustainable urban development, hence the need for enhanced planning of urban growth and development and the better management of existing urban centres.

Consequently, the use of Remote Sensing (RS) and Geographical Information Systems (GIS) provides an alternative for urban growth to be effectively mapped and monitored. Such technologies offer an important approach to spatial problem solving, and has played a very significant role in urban growth and management. With these technologies, urban growth patterns and rates can be determined and quantified, and planned for alternative future scenarios.

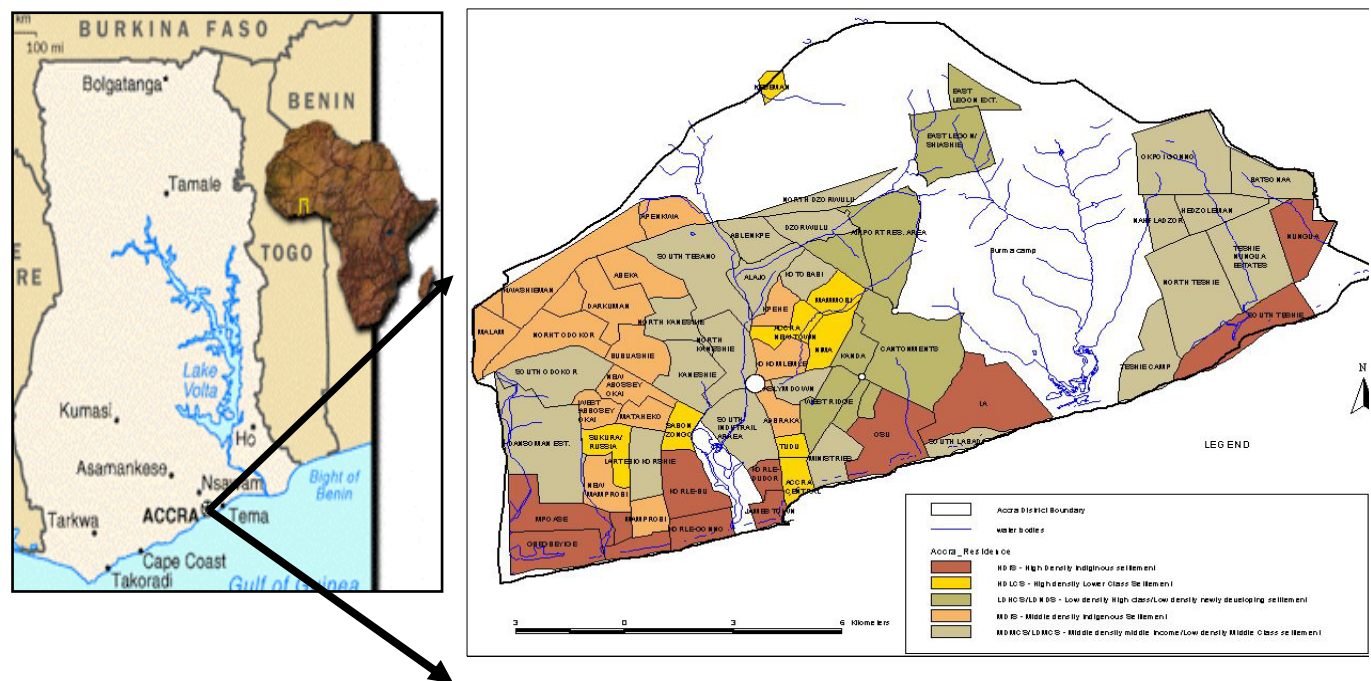
Recent studies in Accra (Yankson 1997; Konadu-Agyemang 1998; Tipple et al 1998; and Tipple 2000) focused on urban growth, infrastructural development and housing. Konadu-Agyemang (1998) maintains that the rapid growth of Accra's urban population has created the situation in which a wide gap exists between the needs for, and the provision of, housing and related infrastructure. A situation he concluded needs consideration and review. Yankson (1997) assessed land cover change in Accra and tested the adequacy of Landsat TM images

for urban change detection. Analysis based on these studies does not address the complex processes and implication of urban growth. These perspectives do not provide sufficient insight on the processes and nature arising from the competing interests in the development and management of urban growth. However, the underlying processes of this growth have not been fully understood or documented especially within the local area due to specific characteristics. Yet such studies are necessary both for comprehending local patterns of urban growth and their links to broader patterns of human activities.

To address the loopholes in previous research, the study aims to contribute to the understanding of the causal mechanisms of urban growth, which is vital in an attempt to effectively and efficiently monitor, and manage urban areas in Accra. Without such knowledge, formulating urban growth development and management strategies, as well as policies are likely to be unsuccessful.

## 2. RESEARCH SETTINGS

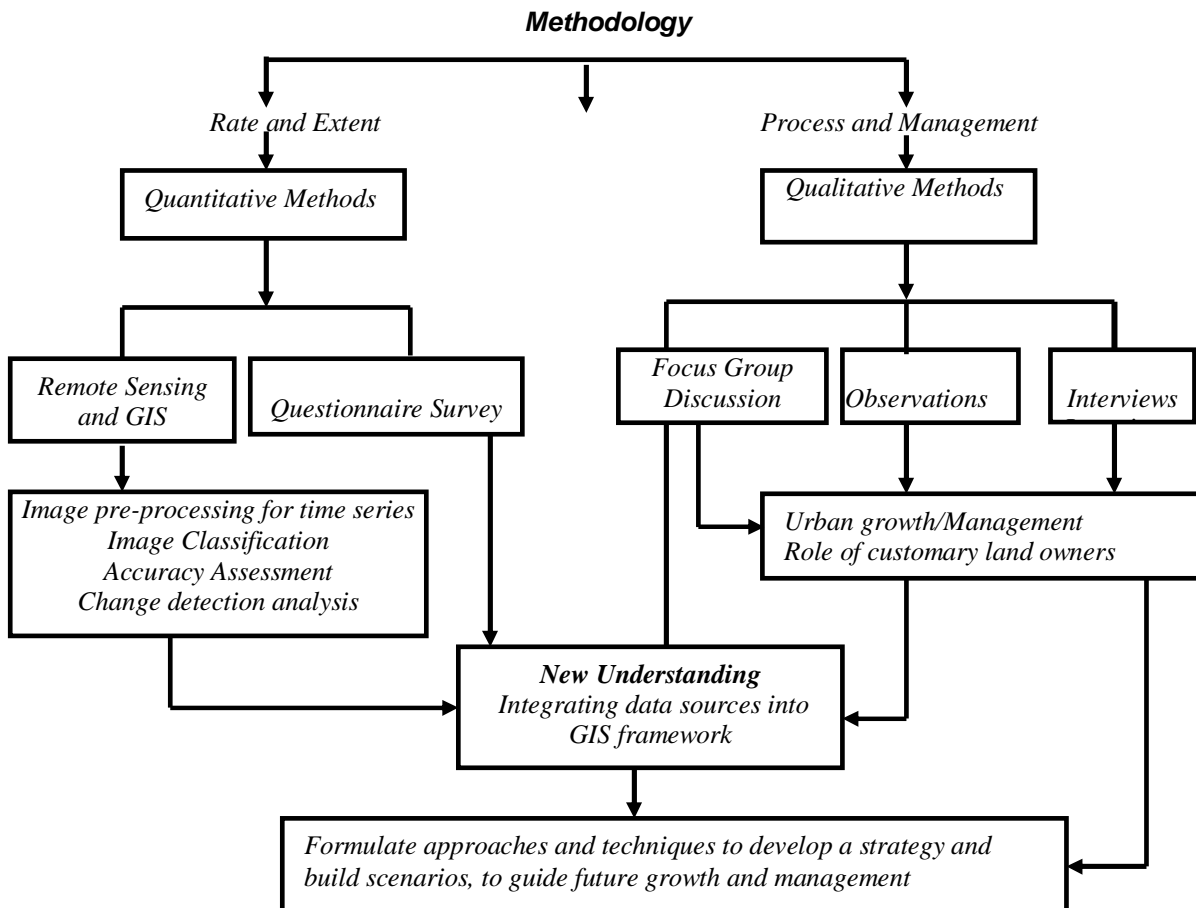
Accra Metropolitan Area currently covers 300km<sup>2</sup> (Grant and Yankson, 2002). Considering the size of the study area, time and financial limitations, and land ownership issues, there was the need to narrow down the focus of the research to specific study sites for an in depth analysis. Three study sites (*East Legon, Naapladzor and Okpoi Gonno*) were selected on the basis of the change detection results which showed areas of significant change in urban development. Other criterion used included visual inspection of urbanised areas on the time series of remotely sensed images, land ownership, access to land, formation of community association and census figures were also used as for the selection.



**Figure 1:** Map of Ghana, showing the localities in Accra Metropolitan Area

### 3. METHODOLOGY

Understanding existing mechanisms for urban growth and management within a specific context is important as the causes differ from place to place. With the research objectives in mind, an interdisciplinary methodology (Figure 2) was designed to quantify and identify areas of urban encroachment for data collection, analysis and interpretation.



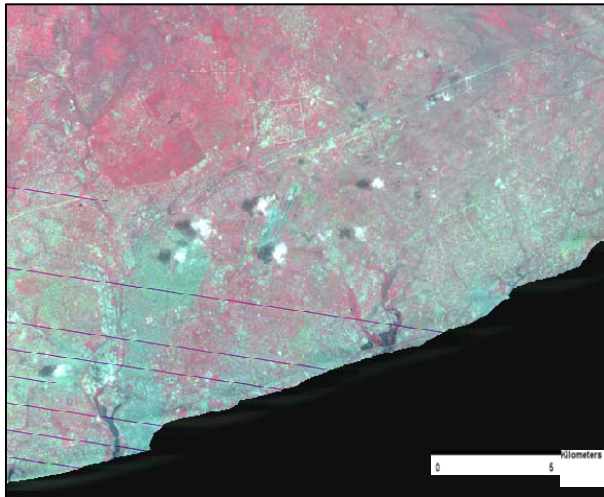
**Figure 2:** Schematic representation of research framework

The first stage of the methodology determined the rate and extent of urban growth using a time series of remotely sensed images. This next phase involved field survey in an attempt to understand the causal mechanisms, by collecting training sites to assess the accuracy of the classification performed. In addition, ground observation was undertaken to verify the spatial distribution and extent of the categorised class, as well as collection of both qualitative and quantitative data through interviews, focus group discussion and questionnaire survey. Integrating these approaches provided an alternative understanding to guide and control future growth patterns.

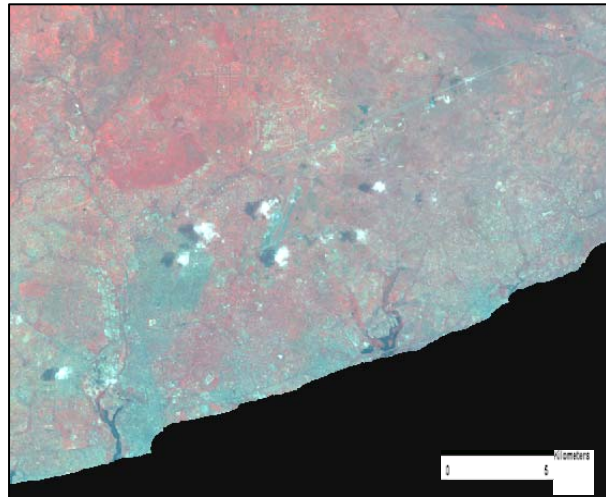
### 3.1 Remote Sensing Analysis

Landsat TM and ETM Images acquired (1985, 1991, 1998 and 2003) were rectified (Figure 3a and 3b) and geo-referenced pixel by pixel using Nearest-neighbour interpolation procedure to the Ghana War Office spheroid. The root mean square (RMS) error for the ground control points (GCPs) was approximately 0.4 pixels on the average of a pixel, corresponding to a spatial accuracy of about 11.5m on the ground.

**Figure 3a:** Scan lines before rectification



**Figure 3b:** Image after rectification



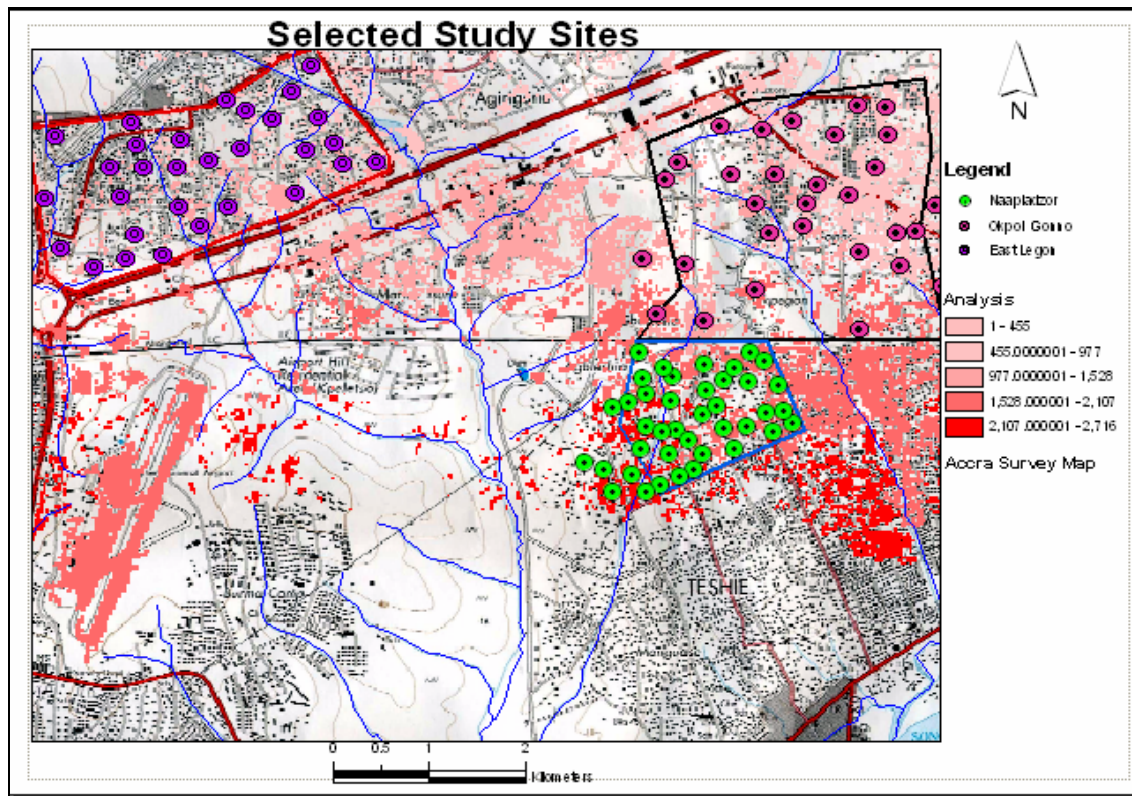
The basic premise is that changes in urban areas results in changes in radiance values or local texture that are separable from changes caused by factors such as differences in atmospheric conditions, illumination and viewing angle, soil moisture and others (Singh, 1989). However, in order to explore the causal mechanisms responsible for the encroachment, classified images were used in association with socio-economic data in a Geographical Information System (GIS) environment in order to identify a range of sites for further analysis. Accuracy assessment was performed and the classified images to determine the land cover map “*fitness for use*” for their application. This included details on the database’s spatial, thematic, and temporal characteristics and their accuracy (Goodchild 1989). Post classification, Image differencing, Principal Component Analysis and Normalised Vegetation Index (NDVI) were the change detection techniques used to ascertain which method best fits. The Post Classification, Principal Component Analysis, and the NDVI methods were chosen for the analysis, as the objective of the study was not only to detect rapid urban transformation but also to identify and classify land cover types. Figure 4 shows areas of urban development between 1985 and 2003, which revealed 35% of urban change within the Metropolis.



**Figure 4:** Areas of urban growth between 1985 and 2003

### 3.2 Process and Management

Following the study sites selection (Figure 4), questionnaires were administered using simple random sampling in areas that the time series analysis of remotely sensed imagery revealed significant growth through time (1985-2004). Individual households selected within these areas had their locations captured and registered using a global positioning system (GPS). With the registered co-ordinates the selected households were identified during the pilot study. However, some of the urban developments identified through the remote sensing analysis could not be located in the field. As a result, households nearest to the selected GPS co-ordinates were taken as a replacement of the initial identified urban change on the images. In all 100 questionnaires, 27 formal and informal interviews, and 6 focus group discussions were conducted.



**Figure 4:** Selected sites from the study area

In addition, purposive sampling technique was used to target, seek clarification and opinions in the form of informal interviews from key respondents in the questionnaire survey. Formal interviews were also conducted with the district assemblies, key personalities of the lands agencies and planning authorities, who threw more light on their roles and challenges they faced within their institutions.

#### 4. RESULTS AND DISCUSSION

From the remotely sensed analysis, the PCA and the Post Classification techniques provided the best results. Overall accuracy of the Post Classification for 1985 and 2003 were determined to be 85.4% and 92% respectively, with kappa indices of 0.8905 and 0.8317 respectively for 1985 and 2003. Thus, Lillesand *et al.*, (2004) asserted that the completeness of classification depended on its accuracy assessment, and its ability to meaningfully quantify and retrieve the required information from the classification accuracy.

Findings from the selected study sites suggested that the demand for and access to land for residential purposes were the main drivers for the spatial growth of the sites. In addition, indiscipline in the urban land market and compulsory acquisition of land by the Government without compensation were also identified as contributory factors. Others issues of concern includes the contradiction and conflict between and within the various stakeholder groups.

Such instances therefore undermine sustainable land management and economic development. Furthermore, the institutional bottlenecks in the duplication and overlapping roles calls for, a strong co-ordination and co-operation between these government

institutions. This will reduce the cumbersome administrative procedures currently associated with land administration in Accra Metropolitan Area and Ghana as a whole.

## 5. CONCLUSION

This research identified land as crucial resource, to be utilised efficiently in the planning and development of urban space in Accra. However, the complexities in marrying both the customary and State land tenure, coupled with the general indiscipline in the land market, have had enduring consequences on the economic, social and cultural functioning of the city.

Considering the cumbersome procedure of land title acquisition, over 60% of the residents had no titles to their properties. This research recommends a well formulated land reform, education, better land administration system, and good governance as key steps towards formulating sustainable urban development and management strategies in Accra Metropolitan Area, Ghana. In addition, it would enable decision makers and urban planners to forecast and manage future occurrences of urban growth and how best to meet those challenges. It must be emphasised that the success of the policies and strategies recommended depends on the knowledge, attitudes and perceptions of AMA residents with regards to urban growth and sustainable urban management.

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## BIOGRAPHICAL NOTES

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