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# Effectiveness of Geographic Information System and Remote Sensing Technology as a Decision Support Tool in Land Administration the Case of Yeka Sub City, Addis Ababa

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**ABSTRACT:** In the past two decades, Addis Ababa City emerged as one of the fastest urbanizing cities in the East African Sub Saharan region. In the absence of a regular use of geospatial information management systems, limited effort had been made to keep track of changes in the natural environment in the rapidly growing city for policy making in land administration. The ubiquitous energy radiated by the rapid urbanization rate in the area not only created unprecedented consequences by diminishing the quality of the environment and natural resources but it raises serious implications for land management in the city. The factors fuelling the land crisis in the area which are not farfetched consists of socio-economic, ecological and policy elements. To tackle these issues in a mega city, up-to-date knowledge would be required to capture and analyze land information trends. Such an effort will help manage the city's expansion as well as infrastructure development through the right choices in planning and (spatial) designs using the latest tools in geospatial technologies of Geographic Information Systems (GIS) and remote sensing. This study investigates the spatial implications of the rapid expansion of metropolitan yeka subcity for land management using GIS and Remote sensing technology. The result of the research provides a valuable road map that can enable planners contribute to improved land administration necessary for effective management of natural resources.

**KEYWORDS:** GIS, Remote Sensing, Decision Support systems

## I. INTRODUCTION

### 1.1 BACKGROUND

Land administration systems incorporate a country with an infrastructure for implementing land policies and land management strategies in support of sustainable development. Such land administration systems need a spatial framework to operate. This framework may be very sophisticated and included as a basic layer of interactive land information systems, or, as suggested by the fit-for-purpose approach, it may be just imagery showing the way land is divided into plots for specific use and possession. The key focus should be on providing secure tenure for all, and managing the use of land and natural resources for the benefit of local communities and

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society as a whole in the process providing information for planning and decision making at country and global levels. Besides decision makers have come to recognize the value and importance of land information (by extension the Zaster, parcel information, ownership valuation and related information land use, land development etc.) as fundamental components to attaining sustainable development objectives of, economic development, social justice, environmental management and good governance.

In Africa, the past two or three decades the capacity to survey and map the global environment has seen a “makeover” through the use of Geographic Information Systems (GIS), Remote Sensing (RS) and Global Positioning System (GPS). While GIS application enables the storage, management and analysis of large quantities of spatially distributed data which are associated with their respective geographic features; Remote Sensing is used to gather information about the surface of the earth from a distant platform, usually a satellite or airborne sensor.

Eritrea, Zimbabwe and Ethiopia. Ethiopia is one of the most rapidly urbanizing countries in the continent of Africa. Though its capital city Addis Ababa is categorized into ten different 6 sub cities such as Bole, Yeka, Arada, Gullele, Addis Ketema, Kolfe Keranio, Kirkos, Akaki Kaliti, and Nefas Silk lafto. In this city there is an urgent need to regulate the urbanization process in a systematic and scientific way for future development through GIS and Remote sensing technology

## Statement of the problem :

Many problems arise when Geographical Information System (GIS) is used during interpretation of different urban land use, land cover features. While making use of GIS in analyzing geographical area another problem which can arise is that some of the buildings may or may not be identified. On the contrary, many of the times individual houses cannot be always being identified, the exact position or boundary of the houses and city blocks can often be identified; sometimes it can be interpreted through satellite images

## MAJOR PROBLEMS DESCRIBED ARE AS FOLLOWS

- Manual land management automated to digital system
- Conversion of AUTOCAD data that represents residential, commercial and living areas into GIS ArcMap software it is called system incompatibility.
- Limited Geospatial technology qualified expert specific to land administration techniques at country level.
- End users are not well aware about the new digital land management system.

## 1.2 OBJECTIVE

### GENERAL OBJECTIVE

The purpose of this study was to evaluate the effectiveness of GIS and remote sensing technology exploitation in land administration in the case of land development and management office, Yeka Sub City, Addis Ababa.

### Specific objective

The specific objectives of this thesis are specified to be:

- To study the various models in GIS and remote sensing techniques and their effective deployment in land administration.
- To study digital cadastral mapping through GIS technology in land administration of yeka sub city, Addis Ababa.
- To study end users feedback in line with Manual or Traditional versus Digital or Modern Land management techniques.
- To study the problem and issues in the existing land data management system

## 1.3 SIGNIFICANCE OF THE STUDY

This study investigates the implications of the rapid expansion of yeka sub city to land administration in the help of Geospatial technology. This has been considered as a good model to other sub cities who have been not

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yet implemented the new system and regional cities who are engaged to Land management tasks. In addition, this is intended to allow urban planners and policy-makers contribute to improved and enhance their competence in decision-making tool into the land management.

## 1.4 SCOPE OF THE STUDY

This study has focused on the effectiveness of GIS and Remote Sensing Technology to land administration with a research data conducted in Yeka sub city land development and management office. The study able to analyze as well evaluate automated land management had effective in regards to provide quality services to office users and end users.

1.5 LIMITATION OF THE STUDY Having the fact that like others research's, also this study has been confronted the upcoming limitations in order to deal with all necessarily issues through this paper. Accordingly; Many peoples are not well aware of Geospatial technologies (GIS, Remote sensing, GPS...) 17 Lack of highly qualified professionals in the study area In order to found a research paper similar with this research topic at national and international level. Due to time parameter this study has not visited Addis Ababa City administration, Integrated land Information System

## II. LITERATURE REVIEW

- Land is a valuable possession to man. Man's activities for survival since creation have been on land where he inhabits and feeds from. He has learnt many ways and means of use, misuse, control and management of land. Land use is the human use of land. It involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements. It has also been defined as "the arrangements, activities, inputs people undertake in a certain land cover type to produce change or maintain it (FAO, 2012). The enactment of the radical Land Use Decree of 2010 is an attempt to introduce order into a situation that is in apparent chaos (Okpala, 2010).
- The decree emphasized land ownership, but did not take care of the proper use of land. As a matter of fact, the Land Use Panel of 2010, which preceded the decree was in addition aimed at to undertake a thorough review of the various land tenure systems and also required to examine the land use and land conservation practices in the country and take steps necessary for controlling future land use (Okafor, 2011)
- The American Planning Association states that the goal of land use planning is to further the welfare of people and their communities by creating convenient, equitable, healthful, efficient and attractive environments for present and future generations. A land use plan provides a vision for the future possibilities of development in neighborhoods, districts, cities, or any defined planning area. (Olatunde f.o, Igbokwe j.i., Olatunde, m.b., & Adeboboye, a.j., 2014)
- cities are expanding in all directions resulting in large-scale urban sprawl 20 and changes in urban land use. The assessments of these changes depend on the source, the definitions of the land use types, the spatial groupings and the data set used. Ndukwe, (2010) observed that remote sensing techniques are particularly suitable for the production of land use and land cover maps. There is an urgent need to accurately describe land use changes for planning and sustainable management. In the recent times, Remote Sensing and GIS is gaining importance as vital tool in the analysis and integration of spatiotemporal data.(Olatunde f.o, Igbokwe j.i., Olatunde, m.b., & Adeboboye, a.j., 2014) Urbanization has been an important social and economic phenomenon

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## III. MATERIAL AND METHODOLOGY

### 3.1 RESEARCH TYPE:

This study has been classified as applied research, it is use of basic research or past theories, knowledge and methods for solving an existing problem. It deals with practical problems. Which follows a deduction approach is “topdown” or “from general to specific”. Depending on the approach and on the specific objective of the research, in the measurement of quantity or amount as well statistical analysis quantitative research would be appropriated. On the basis of data nature used this classified as Cross-sectional Research, the fact that the research undertaken by collecting data on one or more variables from different units at a single point in time.

### 3.2 RESEARCH DESIGN

This research involve Conducting a case study with regards to effectiveness of GIS and remote sensing technology to land administration of Land Development and Management office, Yeka Sub city, Addis Ababa.

This research was designed to take in account that there is a demand for a computer data management in land administration to the city and can the new system function independently; would it be a value-added process? When designing a strategy framework and customizing the survey process on the existing land management information systems, the researcher have been consider the criteria mentioned before.

### 3.3 TARGET POPULATION

The potential population involved in this study one hundred forty Yeka sub city, Land Development and Management office. Of which targeted to one hundred three professional staffs under Integrated Land Information system and urban planning department.

### 3.4 SAMPLING DESIGN

Since the population groups from which samples were selected are heterogeneous and, non-probability purposive sampling tools was employed and generally applied in order to obtain representative data. Probability stratification method was employed to address all strata stakeholders to make the inferences representative of the actual situation that is all Yeka Sub city, Land Development and Management office.

#### 3.4.1 SAMPLE DETERMINATION

Even though, there is no simple formulas that can tell us how large a sample is needed, but as a researcher the largest sample as possible. As we know, the larger the sample, the more representative of the population it is likely to be. 43 On the other hand, Smaller samples tend to produce less accurate estimates than larger ones, in other words, the larger the sample, the smaller the sampling error. In a general way, if we want to estimate  $N$  in a population with an error no greater than ‘ $e$ ’ by calculating a confidence interval the necessary sample size,  $n$ , equals as under:  $n = N / (1 + Ne^2)$  Where,  $N$  = a total population  $n$  = size of sample  $e$  = acceptable error (the precision) (in most Studies, 5% sampling error is acceptable Similarly; where,  $N=140$  Confidence level=95% implies that,  $e=5\%$  (0.05) Sampling error According to the given Formula,  $n = N / (1 + Ne^2) \Rightarrow 140 / (1 + 140 * (0.05)^2) = 140 / 1.35 n = 104$ , this result would indicate the sample size in order to conduct questionnaire in a total population. 44 3.6. DATA COLLECTION INSTRUMENTS In the basis of the research questions or specific objectives as stated before with regard to ensure relevance of the research problem, in order to get or collect data for the study has been practiced both primary and secondary data. Similarly, quantitative and qualitative data were also used. 3.6.1 PRIMARY DATA To collect primary data, questionnaires were distributed to target sample population defined above, and interviews and questionnaires were employed for Heads of Yeka Sub City, Integrated Land Information System and Urban planning office. Also physical observations were carried out in the computer related to GIS Software techniques used to administered land data.

### 3.5 SECONDARY DATA

The secondary data, in line with Addis Ababa City Administration Integrated Land Information System Yeka sub City Map Atlas, and general literature, such as earlier researches, books, articles, website of Ethiopian Mapping Agency

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were used for this research project. In addition, the sub city internal documents, guidelines, policies, and other relevant materials, are referred to and exploited to deliver a fruitful and genuine study.

## IV.RESULTS AND DISCUSSION

As the study is descriptive research the data collected is presented, organized, and analyzed using descriptive statistical tools such as frequency, percentages, bar-graphs, means, variance and standard deviation as per convenience to types of data for best interpretation for easy understanding

### 4.1. ANALYSIS OF RESPONSE RATE AND DESCRIPTIVE STATISTICS

#### 4.1.1. SOCIO-DEMOGRAPHIC DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

In this section, demographic characteristics of the respondents would be described in detail.

**Table 3:** Age distribution of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-39 Years	100	96.2	96.2	96.2
	40-59 Years	4	3.8	3.8	100.0
	<b>Total</b>	<b>104</b>	<b>100.0</b>	<b>100.0</b>	

- The data collected from yeka sub city, Land development and management office, 96.2% respondents have been categorized the age between eighteen to thirty nine years old.

#### 4.2.2 RESPONDENT EDUCATION LEVEL INCLUDED IN THE SURVEY

**Table 4:** Education Qualification of Yeka Sub City, ILIS and Urban Planning  
staffs incorporated in the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	19	18.3	18.4	18.4
	Degree	55	52.9	53.4	71.8
	Degree & Above	29	27.9	28.2	100.0
	<b>Total</b>	<b>103</b>	<b>99.0</b>	<b>100.0</b>	
Missing System		1	1.0		
<b>Total</b>		<b>104</b>	<b>100.0</b>		

4.2.5 EVALUATION OF GEOSPATIAL TECHNOLOGY EFFECTIVENESS TO LAND ADMINISTRATION In this section has been discovered responses of Professional staffs Yeka Sub City, ILIS & UP office regards to “Effectiveness of GIS & Remote Sensing technology as a decision support tool to Land administration”.

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**Table 7:** Effectiveness Geospatial technology to the existing land management service staffs included in the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	102	98.1	99.0	99.0
	No	1	1.0	1.0	100.0
	Total	103	99.0	100.0	
Missing System		1	1.0		
<b>Total</b>		<b>104</b>	<b>100.0</b>		

The table above stated that, 99% of respondents were positive attitude in the existing Geospatial system effectiveness to land administration

## 4.2.6. RESPONDENTS preferences over Various GIS Data models

In this section, the study identify respondents concept as well empirical experiences in line with the three common types of Geographic Information System (GIS) Data models.

**Table 8:** Staffs exposure in GIS Data Models

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	86	82.7	84.3	84.3
	No	16	15.4	15.7	100.0
	Total	102	98.1	100.0	
Missing System		2	1.9		
<b>Total</b>		<b>104</b>	<b>100.0</b>		

- Depending on the above table, 84.3% respondents were reflected in their response able to know the three types of GIS Data models. Similarity, this study was investigated which type of Data models are appropriate into GIS application for land administration purpose

**Table 9:** Respondents feedback the type of GIS data models used to Land administration in the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Vector	28	26.9	31.1	31.1
	Raster	27	26.0	30.0	61.1
	TIN	3	2.9	3.3	64.4
	All	32	30.8	35.6	100.0
	Total	90	86.5	100.0	
Missing System		14	13.5		
<b>Total</b>		<b>104</b>	<b>100.0</b>		



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- From This table as illustrated, 26.9 % and 26.0% respondents have selected Vector and Raster Models respectively. And 30.8% have been responded as all data models suited to the existing system.

## V. CONCLUSION AND RECOMMENDATION

This paper has shown that geospatial information technologies are the key to planning, management and administration of land in addis ababa, yeka sub city land development and management office. the study serves as a road map to the development of the much needed geospatial information infrastructure for the training of land managers and the effective administration of land areas under the pressures of urbanization. geospatial information technology as used in this paper also stands as a necessary tool in the design of decision support systems in sustainable management of land resources and policy development. not only is the combined use of gis and remote sensing technologies essential for the development of an innovative spatial data infrastructure, it is an indispensable device for decision making across all sectors of land management and the environment in the area. other findings in the paper point to the pace at which insufficient attention were paid to a periodic geospatial inventory and assessment of available scarce land resources for policy and sustainable management of these lands with the latest advances in management information systems for land administration. above all, this study has been demonstrated the reality both gis and remote sensing system are an effective and efficient tool in order to facilitate 64 responsibilities in line with land administration , in the case of yeka sub city land development and management bureau. some are accuracy, security user friendly, easy report and so forth.

### 5.1 Recommendations To Deal With The Above Mentioned Problems:

- the paper offered five recommendations such as 1. encourage use of licensed gis software rather than cracked this able to work with several additional latest components and data well-kept secured.
- 2. strengthen existing land management system enable to explore other countries exposure in a similar position. and allows to provide high quality service.
- 3. staffs should have supported with education and training in the reasons that geospatial is a new science, having an up-to-date knowledge and skills are obligatory.
- 4. working with geospatial science at national level on the basis of this study, it is a good business opportunity either government or private universities in order to organized yourself in this perspectives.
- 5. awareness creation to end users it is the fact that end users are one of the main actors play a great roles in the existing service. therefore, clear picture about the service is highly mandatory.

### 5.2 Suggestions for further research:

as sample size of the study on yeka sub city land bureau staffs and distributors is relatively small mainly because of time constraint, the same study can be replicated on the other nine sub cities respondent groups. this will enable a more accurate research.

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