CHAPTER I

INTRODUCTION

1.1 Background and Motivation

Land is limited, non renewable resource; it is the location of most human activity and in many parts of the world is over utilized and corrupted by urbanization and industrialization. Every activity of every society both impacts land and depends on it as its base. The ownership of land and its resources has been the basis of all material wealth for most societies since the beginning of civilization. Land has been treated as a measure of wealth, status and power all over the world. As Simpson, (1976) mentioned, from land we get everything that we use or value, whether it be food, clothing, fuel, shelter, metal or precious stones. We live on the land and from the land, and to the land our bodies are committed when we die. The availability of land is the key to human existence; the land's distribution and use are of vital importance. Owing to the above mentioned facts, land has been the source of many wars and bloody disputes not only between the nations and kings who wanted to establish their supremacy over each other but also between common people.

All facts previously stated establish the importance of land and also the importance of the existence of an efficient system to manage land resources. The question now is: Do we have such an efficient system in place? The answer is self-evident; certainly, we do not have an efficient Land Management System in place. In many countries all over the world, they are still dependent on the age-old methods of creating and maintaining the Land records.

It is evident that, without accurate information about land and water, and without an up-to-date inventory of the country's resources, the government and the people of a nation will find it very difficult to control and manage their land resources. It is also very difficult to efficiently use of the land and its natural wealth or to minimize its misuse, without a system that provides up to date information about the country's land resources. The development of this system should be part of the basic infrastructure of any country.

Information about land resources must be recognized as a resource which requires explicit management strategies. Information management requires a Land Information System (LIS) capable of assembling information base about land. The operation of such LIS includes; data acquisition, data processing, storage, maintenance, analysis and retrieval. The next chapter provides details related to the concept, definition and components of LIS, as well as exploring the relevant terms and systems such as Geographic Information System (GIS) and Cadastre.

It is worth emphasizing here that from a surveying point of view, the cadastral data base is the core of LIS. In recent years there has been successful efforts and universal consensus regarding the importance of building cadastral systems in many countries all over the world. However, Konecny (2006) stated that only about 50 countries of the over 190 countries in the world have cadastral systems, with some of these systems still exists in old analogue hardcopy (paper) form. Furthermore, Konecny (2006) also mentioned that around 70 other countries are in the process of establishing cadastral systems utilizing modern information techniques. The International Federation of Surveyors (FIG) has been promoting the "Cadastre 2014" for world wide implementation for cadastre. Statements regarding "Cadastre 2014" are highlighted in this research.

Egypt has a cadastral system that extends long time ago. The system is in analogue hardcopy form. Since two decades, there have been continuous efforts towards building a digital cadastral system. Towards the development of LIS in Egypt, this research provides a methodology for building the digital rural cadastre using existing documents. It should be noted that this research considers many of the recent development and advancement that occurred in the fields of GIS, LIS and cadastre. Naturally, and due to the researcher's scientific and professional interests in Cadastre and LIS, this research is a continuation to push the limits of a previous research done by the same author (Abdel-Fattah, 1992) in an effort to present significant new contributions in the field of LIS and cadastre to benefit Egypt. Some of the technical, economic and institutional issues discussed in the 1992 research are re-examined in this research, as these issues constitute some of the basic knowledge that needs to be presented to the reader to build on top of it. Also, the LIS model proposed in the 1992 research is re-examined in this research; implementation steps as well as committees and groups to be established and their assigned

roles are enhanced. However, in such cases, every possible effort has been made in this research to avoid duplication or unnecessary repetition.

1.2 Literature Review:

1) Gurney, (1997) demonstrated the establishment of the Immovable Property Registration System (IPRS) in Albania; IPRS unifies land information including forest and urban cadastres as well as urban deed registration. This system is based on land parcels and has two main objectives:

- To set up a unique, comprehensive, and cost-effective system. This system will register, update, and legally protect the public and private rights over the immovable property.
- To develop options to consolidate land markets and encourage sustainable land use.

The small size of land parcels and the fragmented nature of land holdings make time and cost very important issues. Gurney showed that Global Positioning System (GPS) was used in the Albania's IPRS and proved a quick and cost-effective parcel determination. The GPS methodology tested and implemented in Albania utilizes the differential pseudo-range positioning to do surveying and mapping of individual parcels.

2) Cichocinski, (1999) demonstrated the shortcomings of available cadastral system in Poland. The first cadastre in Poland was established in the nineteenth century; the modern Polish cadastre was created in the 1960s. The system is based on the land register which contains a list of owners and all the parcels they possess. The cadastral map only serves in an auxiliary role showing spatial structure of objects that consists of parcel boundaries, ground use boundaries and class boundaries. Each object is described by an identifier. Cichocinski shows that data stored in traditional cadastral systems fail to meet requirements of supervision, management, decision-making, forecasting and development planning. The most significant problems are:

- Low precision of geometric data;
- Low Quality and speed of data access;
- Divergence between the map and the register;
- Lack of supervisory tools.

Cichocinski (1999) emphasized that the existing cadastre, consisting of paper maps and land registers, is now becoming insufficient. Cichocinski proposed the creation of a Land Information System with the digital cadastral map is the main component of this system; such digital cadastral map can be the basis for additional thematic layers within the LIS framework. Cichocinski presented the structure and information content of the digital cadastral map, its differences from analogue maps, and the process of map creation. Some examples of the additional thematic layers to be added based on the digital cadastral map are also presented.

3) Williamson, (1996) shows that one of the main reasons for the growth in the use of LIS and GIS in Australia has been the availability of digital spatial data. Williamson mentioned that it is accepted in Australia that the most important core data set is the cadastral parcel framework or digital cadastral data. Williamson provided an overview for the growth of Digital Cadastral Data Base (DCDB) and highlighted how it is created through digitizing of available hard copy maps. Williamson reviewed the development of cadastral systems in Australian jurisdictions and examined the trends to establish coordinated cadastres. He described a future conceptual model for an Australian state wide LIS and GIS based on a legal cadastre. He also discussed the institutional, political and technical concerns related to the development of LIS and GIS in Australia.

4) Panaguiton, (1998) illustrated the use of GIS as a tool in land use mapping in the Philippines**.** Panaguiton showed how GIS enhances the mapping function of the local government in displaying the wealth of its land resources and the potential to efficiently utilize it for future use; GIS also further helps the local government units to enhance decision-making capability in enforcing laws that would influence the basic services which directly affect the lives of the local population.

Panaguiton reviewed the (Parcel-Based) process that has been successfully applied by various Local Government Units in exercising land use mapping. Though tedious and time-consuming process, it addressed the permanent problem of defining administrative boundaries and individual parcel definition in preparing land use plans. The use of GIS helped in validating and updating the land information status of the locality faster; while it takes the manual mapping days and weeks to do the same task.

1.3 Objective and Scope of the Research:

1) The main objective of this research is to present a new and practical approach to create the digital agricultural cadastre in Egypt (rural cadastre). The approach focuses on areas without digital cadastre (around 60 - 70% of total agricultural area in Egypt). The proposed approach is based on the use of the following already existing data sources:

- Existing cadastral paper map sheets
- Registered lengths of parcel' sides that define the correct and legally recognized parcel shape and area.

Towards developing and testing this approach, a pilot area covers around 250 Feddans was used; it includes two Hods; Al Wastania Hod, No. 12 (Kism Awal, Al Fakhri) and Al Wastania Hod, No. 12 (Kism Than, Al Morror). These two Hods belong to Meet Rahina Village of Al Badracheen District, Giza Governorate. Real data was used; the 1:1000 and 1:2500 scale map sheets of the pilot area were used. A full application is developed using Visual Basic for Applications (VBA) to implement such approach utilizing the ArcGIS 9.2 The required manpower, time frame, hardware, software and cost for implementing such approach to build the digital rural cadastre in Egypt are identified. Parcel related tabular data available in the Mutation Form is added to the created database through the developed application; digitized parcel is connected to its relevent tabular data through the parcel ID. The connection between the database to be created utilizing the proposed approach and Sigelo Al Aini database as well as the update mechanism are discussed in this research.

It is important to note here that ESRI software (ArcGIS) is used in this research since it was the available resources for me as well as being the software package I am having experience with it. Meanwhile, the work can be done using any other GIS software and I am not recommending a specific software.

2) The second main objective of this research is a proposal for an LIS model to be implemented in Egypt and provides a balance between centralization and decentralization:

- The approach to be followed for implementing such a model is discussed.
- Different committees, subcommittees and groups required for implementing the proposed LIS are established.
- Duties of such recommended committees and groups are identified.

3) The scope of the research also focuses on several aspects. The following presents the specifics for each aspect:

3.1) The research handles technical aspects related to the survey control and geodetic reference framework for LIS. Among this; three main subjects are focused in this research due to their fundamental role in the development of LIS:

- The establishment of a Geodetic Reference Framework (GRF) that provides the spatial framework to which different data will be geographically referenced and consequently different data layers will be registered to each other.
- Approaches of creating the cadastral layer that represents the base framework for any LIS.
- Opportunities provided by GPS for the development of GRF and Cadastral layer.

3.2) The research provides an overview of the educational and institutional concerns of the design and implementation of LIS due to their fundamental role in LIS development. The research illustrates the importance of educational and institutional issues as two major factors that should be taken into account so that LIS can be implemented successfully in the long term; otherwise the development of LIS will be more a dream than reality. The research illustrates how appropriate institutional arrangements can be achieved to properly coordinate and manage a successful LIS implementation. It also illustrates the importance of the existence of a strong educational base to provide the academic foundation for the LIS initiatives.

3.3) The research analyzes the LIS economics since the implementation of LIS requires substantial expenditures of time and money which require an economic justification. The benefits and costs of LIS are analyzed within this research.

3.4) The research provides a conceptual overview for handling the available cadastre data of different rural areas in Egypt towards the building of a national digital cadastral data base as a framework for LIS in Egypt; some areas having old cadastre (non digital format), others having new cadastre (in digital format) and others have no cadastre.

3.5) The research addresses the different steps and activities that provide general guidelines to LIS design and implementation in Egypt as well as other countries.

3.6) The research focuses on surveying and mapping activities in Egypt. Land registration activities in Egypt as well as the involved agencies and their role are discussed. Shortcomings of existing cadastral system are highlighted.

3.7) The research also handles the LIS and GIS concepts through the following:

- Addressing the history of LIS and GIS development
- Providing different definitions of LIS and GIS as well as definitions of cadastre and other LIS/GIS related terms.
- Presenting the characteristics of LIS and GIS as an integrating technology.
- Defining the components of LIS and GIS.
- Illustrating different application areas of both LIS and GIS.

1.4 Significance of the Research:

The Egyptian government has had a high priority goal for creating up to date and digital rural cadastre for Egypt. Massive efforts and significant budget were invested by Egyptian Government. A lengthy period of time has elapsed and the digital cadastre is not accomplished yet. Many international projects in cooperation with different other countries were implemented; the outcome was creating digital cadastre for limited areas in Egypt; still there are 5 million Feddan were not covered by pervious recent projects and still have paper maps. This research aims to create up to date and consistent digital cadastre for this remaining 5 million Feddan. The National Project for Automating the Rural Cadastre that started at 2006 (after this research was finished) and to be finished by mid of 2008 aims also to build the digital cadastre for this remaining 5 million Feddan; but will not solve the data inconsistency; the parcel data (area and dimensions) as resulted from the digitized map sheets will be different from that available in the Mutation Form and Deed.

This research provides a scientific, cost effective and practical approach to create the digital rural cadastre in Egypt and will solve the data inconsistency between the cadastral map and the Mutation

Form. Moreover, the proposed approach can be implemented with local/national resources without the need for any international projects or involvement.

In the mean time, the high trend towards building digital and up to date cadastre in many countries all over the world especially the Arab countries (Qatar finished, Libya and Saudi Arabia are about to start, Egypt already started) makes this research more significant.

LIS is needed for Egypt to integrate up-to-date land related data in order to provide information needed for natural resources management, better planning and effective decision-making. Handling different subjects related to the design and implementation of LIS in Egypt makes this research very significant. The research proposes an LIS model to be implemented in Egypt. The proposed model provides a balance between centralization and decentralization. In terms of being practically significant, the approach and steps recommended to be followed for implementing such a model are discussed. Different committees, subcommittees and groups required for the implementation of the proposed LIS are established.

1.5 Organization of the Dissertation:

To fulfill different objectives of the research that were previously mentioned; this thesis contains six chapters and two appendices; a list of used references is also included.

This chapter I is an introduction; it shows the need for LIS and discuss the objectives and significance of the research as well as the dissertation organization and contents.

Chapter II addresses the history of LIS and GIS and provides the definitions of LIS, GIS, cadastre and other related terms. Differences between LIS and GIS as well as between LIS, GIS and other related concepts and terms are highlighted. The characteristics of LIS and GIS as an integrating technology are discussed. Components of LIS and GIS are identified and different application areas are highlighted.

Chapter III deals with the educational, institutional, economical and technical concerns related to the development and implementation of LIS. Benefits and costs of LIS are analyzed. The importance of

efficient and effective institutional cooperation for the development of LIS is explained; achieving such cooperation in both individual organization and in joint effort between organizations is discussed. The need for a strong educational base to provide the academic foundation for the LIS and GIS initiatives is addressed.

The chapter also handles technical aspects related to the survey control and geodetic reference framework for LIS. Among this; three main subjects are focused in this research due to their fundamental role in the development of LIS: 1) The establishment of a Geodetic Reference Framework (GRF) 2) The creation of the cadastral layer 3) Opportunities provided by the Global Positioning System (GPS) for the development of GRF and cadastre.

Chapter IV elaborates on achieving the main objective of the research. A detailed proposal for creating the digital rural cadastral is introduced; this proposal based on the use of existing 1:1000 and 1:2500 scale cadastral map sheets and the registered geometrical data of the parcel included in the land registry (parcel dimensions and area). To test this approach, real data is used and in-house application is developed using Visual Basic for Application (VBA) and utilizing the ESRI ArcGIS 9.2 Manpower and time frame as well as required hardware, software and cost for implementing such proposal are identified. This chapter also highlights the surveying and mapping activities in Egypt; Land registration activities in Egypt and the involved agencies are discussed. Shortcomings of existing cadastral system are highlighted.

Chapter V handles the second main objective of this research. It discusses the approach to be followed for implementing LIS in Egypt. The LIS model proposed for Egypt by Abdel-Fattah (1992) is re-examined and necessary changes are made. The approach and steps to be followed for implementing such model and the committees to be established are enhanced to reflect changes in Egypt as well as new developments in the LIS and GIS fields since 1992.

Chapter VI provides conclusions and recommendations for building the rural digital cadastre as well as for the LIS development and implementation in Egypt.