

Developing GIS Based Property Tax Information System:

A case of Tsedecha Arara Kebele, Adama, Ethiopia

By

Yisahak Abraham



A Thesis Submitted to

The department of Geomatics Engineering

School of civil Engineering and Architecture

Presented in Partial fulfillment for the Degree of Master's in Geo-Informatics

Office of Graduate Studies

Adama Science and Technology University

Adama, Ethiopia

November, 2020

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We, the undersigned, members of the Board of Examiners of the final open defense Yisahak Abraham have read and evaluated his thesis entitled: Developing GIS Based Property Tax Information System: A case of Tsedecha Arara Kebele, Adama, Ethiopia and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirement of the Degree of Master of Science in Geoinformatics.

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CANDIDATE'S DECLARATION

I, Yisahak Abraham hereby declare that this MSc Thesis is my original work and has not been presented for a degree in any other university and all sources of material used for this thesis have been properly acknowledged.

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This MSc Thesis has been submitted for examination with our approval as thesis advisor/co-advisor.

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LIST OF ACRONYMS

API	Application Programming Interface
CAD	Computer Aided Design
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
GBPTIS	GIS Based Property Tax Information Syste
GISBRETIS	GIS-Based Real Estste Tax Information System
GUI	Graphical User Interface
GDP	Gross Domestic Product
MPL	Mozilla Public License
OLE DB	Object Linking and Embedding, Database
PID	Property Identification
RS	Remote Sensing
TIN	Tax Identification Number
VB	Visual Basic

ABSTRACT

Almost all local governments worldwide rely, at least to some extent, on property taxation to pay for local services. The main problem of Adama revenue authority in property tax collection is unavailability of system; that identifies the tax paid from unpaid and unable to enforce defaulters to pay taxes. The goal of this thesis is to develop GIS Based Property Tax Information System (GBPTIS) that comprises searching and addressing of tax defaulters through tax bill. These is done by integrating the GIS software MapWindow GIS for the map graphics and the database driven software Visual Basic.NET for the tax application with access database, these two components will be linked to get the GIS tax system. The system was accessed with different authorization levels of administrator, tax agent and user. The modules in GBPTIS are tax map, data entry and tax bill. Besides, GBPTIS is the system developed for storing, retriving, displaying and manuplating spatial and non-spatial information of property taxation including the required owner information, parcel information, building information and tax information so as to adress defaulters and create tax bill. The system improves tax collection and becomes more helpful when the system upgrades to web based GIS, this will give property owners in order to access their property details everywhere and pay the tax due electronically. Finally, this research recommends that other researchers should look at integrating the GBPTIS with street addressing in order to facilitate the billing system.

Keywords: property taxation, GIS, MapWindowGIS, database, VB, GBPTIS

CHAPTER I. INTRODUCTION

1.1 Background of the Study

The earliest known tax records, dating from approximately six thousand years B.C., are in the form of clay tablets found in the ancient city-state of Lagash in modern day Iraq, just northwest of the Tigris and Euphrates Rivers. The king used a tax system called *bala*, which meant “rotation.” The assessors would focus on one area of the city state, assessing and taxing one area each month, thereby breaking down the arduous task into more manageable components. Property taxes were used in Egypt, Babylon, Persia, and China and throughout the ancient world. The most common taxpayers were the farmers, from whom assessors coerced collection. If a taxpayer did not or was not able to pay, he was brought before courts that immediately dispensed justice. A typical tax rate was ten percent of all production. Tax assessors were highly valued people because of their skills with hieroglyphics and their ability to collect revenue. Often when a king died, the assessor was the only staff person not killed and buried along with the king, so valued was his service (Carlson, September 2004).

Almost all local governments worldwide rely, at least to some extent, on property taxation to pay for local services. Economists have long argued that the property tax is a good tax for local government because it is fair (in relation to the benefits received from local services), it is difficult to evade, and it promotes local autonomy and accountability (Slack, September 2010).

Property tax rises on average revenues of less than 1% of GDP in developing countries. In many African countries it contributes far less than 0.5%. Following such low contribution, there is a growing eagerness among policy makers to increase its share in GDP. This policy brief provides a theoretical rationale behind such enthusiasm by discussing the reasons for considering property tax as a ‘good’ tax compared to other forms of taxes such as income and consumption tax (Merima Ali, March 2017).

The International Monetary Fund (IMF), which is the standard source for comparative fiscal data, takes a broader view. It defines the term property tax for statistical purposes to refer to “taxes payable on the use, ownership, or transfer of wealth” (IMF 2014, 417).

Land and property taxes are the largest untapped source of municipal revenues for many cities. For instance, It is estimated that a 1% tax on land and property in Kigali, could generate over USD\$60 million per year under full tax compliance. In the same way in Lagos, reforms to property taxes under governors of cities Tinubu and Fashola that have been implemented since 1999 have helped the state to increase public revenues from taxes five-fold to over \$1 billion in 2011. This provided the government with much needed funds to provide the public services and infrastructure being demanded of them by the public (Paul Collier E. G., Land and property taxes for municipal finance, March 2018).

Today the assessor is constantly challenged to improve the quality of the results of the assessment process. With better informed taxpayers, a cadre of elected officials demanding more accurate and current information, and a media quick to criticize the assessment values, the assessor regularly faces demands to justify assessment valuation results. Often the assessor must produce analyses for specific properties or geographic areas (V. Gopi Krishna Kasyap, 2015).

Property tax isn't being acknowledged to its maximum capacity because of poor evaluation rates of properties and weaker effectiveness in revenue collections. The biggest challenge faced by municipalities and local civic bodies today is to define better methods for property valuation, keeping a regular track on revenue collections and record losses on account of exemptions (Pareta, 2017).

Manual tax assessment systems maintain property records in hardcopy archives like vellum maps, cards, forms, and lists placed in files and cabinets. Striving to attain efficiencies in such systems where traditional survey methods are used to collect and store property information is challenging.

As today's communities are in constant state of change and growth, authorities need to continuously monitor new developments to keep the property records up-to-date. Effectuating such change in manual system takes a great deal of time and requires creating new tax map to reflect all new improvements from scratch. As result the updating process will labor intensive, costly and time consuming (Zoneh, August, 2013).

Because of these drawbacks, it is often difficult for authorities to conduct regular updates, track tax defaulters and trace out unauthorized and under taxed properties. Correspondingly, it will result to poor coverage of properties under tax net, high accumulation of arrears and low revenue (Zoneh, August, 2013).

As information from Adama revenue authority, one of the problems may be the main one in property tax collection is unavailability of system; that identifies the tax paid from unpaid and enforcing defaulters to pay taxes. In Adama city, annual municipal revenue increased by 272.7 million birr from 2004 E.C to 2011 E.C and within the same year 632.06 million birr increment was revealed for state revenue. This shows that due to unavailability of system for municipal revenue, Adama city revenue authority felt in collection of property tax timely from all land holders and this results in low property tax collection performance and high accumulation of arrears.

The gap was filled by developing GIS Based Property Tax Information System was developed. It's a system that integrates land properties geographically and their descriptive information using database tables. GBPTIS has main interface with tax map, data entry and tax bill of customized buttons. The system was accessed with different authorization levels authorization levels of administrator, tax agent and user.

The modules in GBPTIS are tax map mainly for display tax maps and track defaulters; data entry has tables of owner detail, parcel information, tax table and building detail.

The main goal of this thesis is to develop GIS based property tax information system that comprises searching and addressing of tax defaulters through tax bill. These is done by integrating the GIS software MapWinGIS for the map graphics and the database driven software Visual Basic for the tax application, these two components will be linked to get the GIS tax system. The database software was used for the application development while the GIS software provides the functionality for the spatial analysis.

Property tax information system is a key in collection of property tax for local governments, according to (Saviour Mantey, May 2012), The geo-property tax information system will improve revenue collection and promote operations of businesses in general.

GIS based tax information system has to potential for regular re-inspection of properties and thus improves the efficiency with which the tax map and database are updated (Zoneh, August, 2013). Therefore, GIS could help in efficiently monitoring this process and thereby stop the loss of revenue through effective enforcement of property tax practices (Pareta, 2017).

GIS Based Property tax Information System (GBPTIS) is the system developed for storing, retriving, displaying and manuplating spatial and non-spatial information of property taxation.

1.2. Statement of the Problem

In this research, the problem statement is “unavailability of GIS based property tax information system makes property tax collection and revenue mobilization inefficient”.

As information from Adama revenue authority, the main problem in property tax collection is unavailability of system; that identifies the tax paid from unpaid and enforcing defaulters to pay taxes. To do this the locational information of the properties should be known which is handled by GIS application. Moreover Google Earth will be used to visualize the property and as means of addressing, Google Earth is lunched from map window GIS.

The data from Adama Revenue Authority shows that in 2004 E.C annual municipal revenue collected is birr 87.92 million and annual state revenue collected is birr 151.62 million, whereas in 2011 E.C yearly municipal revenue and state revenue collected are birr 360.62million and birr 783.68 million respectively. In these 8 years municipal revenue increased in birr 272.7 million and state revenue increased by birr 632.06 million.

State tax payers go and pay their taxes in order to renew their business license; i.e. if they fail to renew they will terminate their business. And also to open another business one should clear the previous unpaid tax one because one tax payer has only one TIN No. Whereas in property tax the revenue authority didn't know where the property is and there is no means to enforce the defaulters to pay property taxes. Sometimes when a tax payer goes to the municipality to pay tax files may lose, as a result the tax payer to expose for penalty and interest.

Most Local Authorities face a number of challenges in realizing their mandate. The challenges include: delivery of infrastructure and services, financial management, institutional and legal framework, human resource capacity and managing rapid growth. Some of these challenges they have faced and still do are:

- Poor record keeping and management of information. Most Local Authorities rely on the old file based information storage and dissemination system which has got a lot of errors and omissions and pose major challenge while retrieving of information.
- Increasing land rates defaulters in many authorities in Kenya due to general poor revenue collection and information management.
- General poor provision and management of the services i.e. sustainable environment, health, water and sewerage, education facilities, social amenities, housing, road, town development plan, which highly relies on administration and revenue collection.
- Inadequate geospatial and non-geospatial data that are also not being updated as per ongoing land development (land subdivision). This is true as most of the authorities' information is geo-referenced, from infrastructure to utilities.

There is no visual link between the location of a property and its corresponding data, rendering all forms of visual analysis impossible. GIS application helps establish a complete inventory and identify ownership of every piece of real property.

These challenges have resulted in poor service provision and general management of Local Authorities activities. Many analysts have criticized the Local Authorities, and questioned their role in the newly formed devolved county governments (Jepkemboi C. , May, 2013). Moreover, effectuating such change in manual system takes a great deal of time and requires creating new tax map to reflect all new improvements from scratch thus, making the updating process labor intensive, costly and time consuming. As a result of these drawbacks, it is often difficult for Adama revenue authority to conduct regular updates, track tax defaulters. Correspondingly, it will result to poor coverage of properties under tax net, high accumulation of arrears and low revenue (Zoneh, August, 2013).

1.3. Research Questions

- i. What components are required to make property tax system efficient?
- ii. How to create tax billing system?
- iii. How to test system prototype workability?

1.4. Significance of the Study

An efficient Property Tax System has the potential to generate enough revenues to sustain government's social programs such as the school feeding program, capitation grant and the livelihood empowerment against poverty (Saviour Mantey, May 2012).

This project will attempted to contribute to the existing knowledge, or helps to solve the existing some problems by suggesting possible solutions. The importance of this research will be for the government, tax payers and researchers/institutions.

Government

Give insight for local administrators to look in to the application of GIS technology on property tax administration for efficient property tax collection; in minimizing the work load and save time of their customers and penalize for those who do not pay taxes on their properties. Besides, it creates means to the collection of tax from the inhabitants. Moreover, it replaces the customary method of data handling to modern and computerized ways.

Tax payer

On time registration on tax network, the property owners or tax payers will be discharged from high accumulation of arrears in paying their taxes on time and protected from file loss.

Researchers

Give way to other researchers and institutions who work in land administration to apply and implement their own methods of handling information's. Furthermore, forthcoming researchers may interest in creating interacting web GIS application for online property tax payment.

1.5. Objectives

1.5.1. General objective

General objective of the research is to develop a GIS based property tax information system to improve tax collection and revenue mobilization for Adama municipality.

1.5.2. Specific objectives

- i. To conduct requirement analysis for property tax system development.
- ii. To create property tax bill for tax payment.
- iii. To test the developed prototype.

1.6. Scope of the study

This research encompasses a very few blocks of the study area Tsedecha Arara Kebele, and focus on property tax information system development as a pilot study on desktop application level.

It is not an easy task to integrate the tax payer information from Adama city revenue authority and its corresponding spatial and attribute data from Adama municipality; for the reason that, the city revenue authority didn't know where one's property is located, as a result of this, the study is limited on some of the parcels and buildings in the study area.

CHAPTER II. LITERATURE REVIEW

2.1 Introduction

Developing countries everywhere are undertaking fiscal decentralization and local government reforms to improve economic efficiency and accountability. These reforms involve rationalizing expenditure and revenue responsibilities along with establishing intergovernmental transfer programs to enable governments to better fulfill their stabilization, distribution, and allocation functions (Minassian, 1997).

The International Monetary Fund (IMF), which is the standard source for comparative fiscal data, takes a broader view. It defines the term *property tax* for statistical purposes to refer to “taxes payable on the use, ownership, or transfer of wealth” (IMF, 2014).

One critical prerequisite for sustainable local government reform is adequate financial resources. Thus, in addition to supplementing local resources through establishing central local revenue transfers, governments are searching for ways to mobilize and improve existing local own-source revenue sources. Virtually all countries seem to be focusing on strengthening the property tax, the most common revenue source for local governments throughout the world (Dillinger, 1993).

Property taxes are made by owners on the addition of houses, additions of floors in houses, change of ownership etc. As a result, municipalities are seemingly in loss of large amounts of revenue. Property tax isn't being acknowledged to its maximum capacity because of poor evaluation rates of properties and weaker effectiveness in revenue collections. The biggest challenge faced by municipalities and local civic bodies today is to define better methods for property valuation, keeping a regular track on revenue collections and record losses on account of exemptions (Pareta, 2017).

2.2 Property Tax Management System

In many countries real property taxation revenue is one of the most important sources of revenue of local governments. Today, the existing real property assessment and tax collection system is under pressure to increase its efficiency.

Traditional manual workflows of partially redundant working steps cause delay and inconveniences for the tax paying public; as a fact that certainly does not increase the

willingness of property owner to pay their taxes regularly and on time. National governments are usually very interested that local governments increase their real property tax collection efficiency, hoping to reduce their dependency on national transfers and grants. In order to streamline the efficiency and lessen administrative costs, the computerization of the local real property tax administration system has gained high priority. Usually two connected elements or modules are at the core of the automation of a real property taxation system. A digital data management system for the storage of all taxation relevant records and automation of routine function, such as printing of tax collection and other reports (Pareta, 2017).

Tax management by local authorities has become more challenging due to robust developments. Property tax revenue is the main income for local authorities which are used to pay for services and maintenance in the local authority administrative areas. However, the amount of revenue collected is decreasing due to the serious problem of property tax arrears that affects the administrative system and as a corollary, the delivery of services by local authorities (Zahari, January 2011).

National governments often provide financial and technical assistance to modernize and increase the efficiency of the local government revenue generation system. However, computerization also requires the simultaneous redesign and adjustment of workflow processes otherwise the cost of data collection will increase (Pareta, 2017).

Even modest investments in reform to Land and Property Tax systems can help dramatically expand municipal revenues to enhance public service and infrastructure provision (Paul Collier E. G., Land and property taxes for municipal finance, March 2018).

In order to streamline the efficiency and lessen administrative costs, the computerization of the local real property tax administration system has gained high priority. Usually two connected elements or modules are at the core of the automation of a real property taxation system.

A digital data management system for the storage of all taxation relevant records and automation of routine function, such as printing of tax collection and other reports (Pareta, 2017).

2.3 Benefits of Property Tax

Taxing land, or land and property together, is often fairer than other forms of tax. When local governments invest in building a road or a school near a property, the price of this asset significantly increase. At the same time, the value of land in a city is increasing all the time due to urban population growth that places higher demand on land. These increases are not small Kigali, for example, peri-urban land has appreciated 1000-fold in the last ten years. Taxing land and properties allows governments to capture some of these increases in land and property prices that result from forces outside of the owner's control and are in part the direct result of public investment. If designed appropriately those individuals who gain more from public services and population growth can be taxed for the benefit of the wider community (Paul Collier E. G., July, 2018).

Property tax is *efficient* compared to other forms of taxes such as consumption and income tax because its imposition does not affect resource allocation by distorting the decision to supply and invest in the form of human and physical capital. Because it is a tax on wealth, rather than productive activities, it does not undermine productive incentives – and can also encourage more productive use of land and property. This advantage holds because of the ‘immobile’ nature of the tax base. It is also considered as *Equitable* tax because land and capital, in general, are owned by relatively wealthy individuals. As a result, the burden of the tax is likely to be borne by middle and high income earners (Merima Ali, March 2017).

Property tax an ideal source of local government revenue because the tax base is geographically delimited and paid by local residents with limited mobility, it is generally regarded as a stable and predictable revenue source for local authorities. Because properties are physically immovable, it is in principle relatively straightforward for governments to identify and tax properties, even where administrative capacity is limited.

And this requires the creation of systematic record keeping and organization, and involves the collection of detailed data on land and properties, thus potentially spurring broader administrative improvements.

Moreover property tax is highly visible to taxpayers and, in principle, linked to improved local services. As a result, it holds unique potential to act as a foundation for bargaining between taxpayers and governments over revenue and public spending, hence, making policy makers and local officials more accountable (Merima Ali, March 2017).

Property Tax is one of the most important and effective revenues and need to have a Geo-Property Tax Information System for efficient revenue mobilization (Saviour Mantey, May 2012).

The property tax is a compulsory contribution to be paid by the taxpayer, where the taxpayer in return will receive benefits from the local authorities in the form of tangible and intangible services, community facilities, infrastructures and development projects for their enjoyment. Government and economists elucidate that economic development can grow rapidly with the establishment of the tax system as a channel and method for raising national income. Property tax in local authorities will be identified to help local authorities play their role effectively so that the objectives of achieving administrative efficiency can be attained successfully and effectively (David Martin, January 2011).

Land and property taxes can allow governments to obtain returns on their investments into public services and infrastructure that raise the value of nearby land, or land and property. In cities in Brazil, providing an adequate water supply to plots increases land prices by up to 10 times the cost of investment. This means that implementing these taxes provides governments with higher projected future income streams, on the basis of which it may be possible to finance current projects through capital markets. Because land and the properties on this land, are immovable and highly visible assets, it is easier to identify and monitor them for the purposes of taxation. People who do not pay tax on their land or property can more easily be identified and penalized than those who do not pay tax on their incomes (Paul Collier E. G., July, 2018).

2.4 Property Tax Policies in Ethiopia

Policies required legitimacy through legislation or provided in legal code. The statutory process of the tax system sets out policy choices clearly by setting the tax rate. The lines between “related” taxes and “undesignated” taxes are not well defined in the Ethiopian Constitution.

Nonetheless, both the Federal Government and Regional States have in practice continued to levy and collect taxes that are not expressly stated in the Constitution as theirs. The Regional States, for example, have authorized the levying and collection of municipal or property taxes although these taxes are not expressly mentioned in the Constitution as regional government taxes (Lencho, 2013).

This type of tax is imposed on a piece of land which is used for non- agricultural purposes like constructing a residential building or erecting an industrial plant as the owner of the land gets an unearned increment because of the extra- ordinary increase in the value of land particularly with in or in the vicinity of growing towns and cities.

The assessment of non-agricultural land has assumed special importance with increasing urban development the urban land use and house tax are thus imposed on urban dwellers. Ethiopia had Pro. NO 80/1976 and pro. NO 161/1979 according to which families, persons, organization or cooperative societies are required to pay tax to municipalities or in their absences to town administrations (Bogale, 2009).

Property tax has been a relatively under-utilised source of urban finance in developing countries. This is especially pronounced in rapidly urbanising regions such as Africa and Asia. The United Nations Economic Commission for Africa reports that Africa's urban population has reached 40 percent of the total in 2014 and is expected to reach 56 percent in 2050. This presents an opportunity to raise bigger urban revenue along with the responsibility to provide urban services to an increasing urban population. Ethiopia's urbanisation has also been rapid in the past few years. Between 2000 and 2010 Addis Ababa has expanded by more than 9000 hectares according to the Atlas of Urban Expansion. In addition, the value added in construction has increased from 3 percent of the GDP in 2003 to 16 percent in 2017 according to the Ministry of Finance and Economic Cooperation figures. This has meant a rapid expansion in the building of infrastructure, residential and commercial buildings. Both the quality and the stock of buildings has rapidly increased. This presents a big opportunity to modernise property tax systems as a potential to raise revenue and deliver better urban services. This can be used as a sustainable source of finance in a country where land is owned by the government and property accounts for a large investment.

The current property tax system, known as ‘roof tax’ or ‘city house tax’, is outdated with very low unitary rates and poor enforcement mechanisms. The Ministry of Urban Development and Construction established a project office to modernise property taxes. With a lack of empirical research in this area, there is interest from this office in a research project on different valuation methods and rates (Kiflu Molla, August 2019).

Tax base refers to the reference used for the determination of the annual property tax. Here, the Ethiopian law recognizes that only property owners not lessees, public or private, are required to pay property tax. Thus, the tax base considers the size of the plot under possession and the annual rental value of the privately owned property. (Urban Land Rent and Urban Houses Tax Proclamation No. 80/1976). According to Article 5 of the Proclamation, a legal possessor of urban land is required to pay annual land rent that is to be assessed on the basis of the size of the plot and location of the plot in the concerned city, to be categorized as Grade 1, 2, or 3. The Proclamation clearly indicates that the plot used for the construction of residential or commercial purposes would be treated differently. With respect to the property tax payable on urban houses, the Proclamation stipulates that the percentage of the annual rental value of the concerned house will be used as a basis for determination. The schedule attached to the Proclamation specifically indicates that for the annual rental value of up to ETB 600; 1% tax rate applies. It defines the rate progressively with the increase in the annual rental value and recognizes 4.5% rate for values that exceed ETB 6,000.00 (Alemayehu Negash Soressa, 2009).

According to (McCluskey, 2017), Ethiopia has different Legislation in different times:

- Government Ownership of Urban Lands and Extra Houses Proclamation No. 47/1975. Public Ownership of Rural Lands Proclamation No. 31/1975.
- Urban Land Rent and Urban Houses Tax Proclamation No. 80/1976. Urban Lands.
- Constitution of the Federal Democratic Republic of Ethiopia, 1995.
- Stamp Duty Proclamation No. 110/1998.
- Lease Holding Proclamation No. 272/2002.
- Condominium Proclamation No. 370/2003.

The lack of an integrated approach and the absence of assertive management to maximize revenue from property taxes are major problems in Ethiopia.

The table below shows revenue statistics taken from Finance and Economic Development Bureau of Addis Ababa (McCluskey, 2017).

Table 2. 1 Revenue statistics for Addis Ababa, 2000 - 2004

Fiscal year	Total Revenue (ETB Millions)	Revenue from Property Tax (ETB Millions)	Property Tax as A Percentage of Total Revenue
2000	729.47	14.12	1.92
2001	830.50	13.76	1.68
2002	879.02	13.69	1.59
2003	905.53	12.06	1.32
2004	1,642.94	16.17	0.97

Source: Adapted from (McCluskey, 2017); original data provided by the Finance and Economic Development Bureau of Addis Ababa.

2.5 Global Comparisons

Though it can have many forms, property tax is generally levied as an annual tax on the value of real property such as land and buildings. There are exceptions to this definition as capital invested on land in general, and non-residential activities like businesses in particular, could be mobile. While property tax as a share of GDP can reach as high as 2% or more in high-income countries, it accounts for less than 1% in developing countries. Western European countries, United States, Canada and Australia on average collect PT that is close to 2% of their GDP. Some upper middle-income countries such as Brazil and Argentina also have a share similar to most developed countries. Transition countries in Central and Eastern Europe and former Soviet Republics revenues from PT represents close to 1% of their GDP.

For most low-income African countries where data is available, property tax contributes to less than 0.1% of their GDP (Merima Ali, March 2017). Property rights to land play a fundamental role in governing the patterns of its use, management, and taxation. The way in which land is owned or occupied in African countries often limits the revenue potential of the property tax.

In many countries, land belongs to the state and cannot be privately owned (Ethiopia, Lesotho, Mozambique, Swaziland, Tanzania), or private ownership is greatly limited

(Cameroon, Rwanda, Sierra Leone, and Zambia). However, state ownership of the land does not preclude levying a property tax (McCluskey, 2017).

The growth of Africa's towns and cities has outpaced local governments' capacity for service delivery in terms of management, infrastructure, and financing. As a result, many African towns and cities are now faced with a governance crisis. The restructuring of governmental functions and finances has entered the core of the development debate. Policy makers are increasingly aware of the potential and need to mobilize domestic revenues through broad based property taxation. Property tax appears to emerge as a potential cornerstone for the efforts to strengthen broad based direct taxation in urban Africa. (Odd-Helge Fjeldstad, March 2017).

Even if one takes these data problems and definitional issues into account, the observation that the property tax produces little budget revenue seems valid. Research by (Bahl R.W. and J.Martinez-Vazquez, 2008) and (Norrgaard, 2013) highlights the poor revenue performance of the property tax in developing countries.

The best comparable data on the revenue yield of the property tax in developing and transition countries as sourced by the IMF over various years suggest an average yield of only about 0.6 percent of gross domestic product (GDP), versus 2.2 percent for industrial countries (Bahl R.W. and J.Martinez-Vazquez, 2008).

The true average for developing countries is probably even lower than this estimated amount because many countries with negligible property tax revenues do not report data and are not counted in this average. Bahl and Bird (forthcoming) have assembled a comparison of property tax revenues relative to GDP for 25 countries, drawn from various sources.

The results show a concentration of countries in which property tax revenues are below 0.5 percent of GDP, reinforcing the conclusion that the property tax is normally an inconsequential source of revenue. By comparison, the average ratio of total tax revenue to GDP is about 16 percent for developing countries (Bahl, 2014). In general, rich countries make more use of property taxes than poor countries. Property taxation is a kind of luxury good that wealthier places can afford and manage better. But there is much more to the story about the demand for more property taxation.

(Bahl R.W. and J.Martinez-Vazquez, 2008) Conducted an econometric analysis of the determinants of variations in the property tax share of GDP using panel data for 70 developed and developing countries and treating the property tax share as endogenous in the model, they found that higher levels of expenditure decentralization increase the use of property taxation. The implication of this for fiscal planners, and for those who would provide assistance to them, is that the demand for property tax financing will increase with the demand that local governments play a larger role in service delivery.

Table 2.2 property tax as a percentage of GDP in selected rich countries

Country	Year	All Property Taxes as % of GDP	Recurrent Property Taxes as % of GDP
Australia	2009	2.48	1.45
Belgium	2010	3.00	1.24
Canada	2010	3.49	3.04
France	2010	3.65	2.46
Germany	2010	0.85	0.46
Greece	2009	1.24	0.17
Ireland	2010	1.56	0.88
Israel	2010	3.12	2.32
Japan	2010	2.70	2.14
Luxembourg	2010	2.65	0.07
Mexico	2009	0.30	0.19
New Zealand	2010	2.16	2.11
Switzerland	2010	2.22	0.09
United Kingdom	2010	4.23	3.42
United States	2010	3.21	3.07

Source: Adapted from (McCluskey, 2017); original data provided by OECD Revenue Statistics (2011) as reported by Norregaard (2013).

Fiscal decentralization could provide an incentive for increased revenue mobilization from property taxation. History and practice have shown that central governments have been willing to devolve the property tax. (Bahl R.W. and J.Martinez-Vazquez, 2008) Provide empirical evidence that is consistent with the argument that the demand for property taxation is driven by the level of decentralization. This supports the notion that increased reliance on property taxation should ideally be part of a properly formulated strategy for strengthened decentralization (Norregaard, 2013).

Table 2.3 Total tax revenue and property taxes as a percentage of GDP in African countries

Country	Total Taxes as % of GDP (2012)	Fiscal Year	Property Taxes as % of GDP	GDP per Capita in USD (2012)	Income Level (2016)
Algeria	37.4	2011	0.00	5,584	Upper-middle
Angola	43.8	2012	0.15	5,532	Upper-middle
Benin	15.5	2012	0.24	808	Low
Botswana	26.9	2011	0.06	6,936	Upper-middle
Burkina Faso	15.6	2012	0.10	673	Low
Burundi	13.6	-	No data	244	Low
Cabo Verde	18.3	-	No data	3,498	Lower-middle
Central African Republic	9.9	2012	0.10	470	Low
Comoros	11.8	-	No data	750	Low
Congo	9.5	2008	0.32	391	Lower-middle
Cote d'Ivoire	16.0	2013	0.07	3,191	Lower-middle
Democratic Republic of the Congo	10.2	-	No data	1,281	Low
Djibouti	18.5	-	No data	1,587	Lower-middle
Egypt	13.2	2012	0.83	3,226	Lower-middle
Equatorial Guinea	11.9	2009	0.03	23,278	Upper-middle
Ethiopia	9.7	-	No data	470	Low
Gabon	15.1	-	No data	10,642	Upper-middle
The Gambia	14.5	2008	0.53	505	Low
Ghana	15.4	-	No data	1,642	Lower-middle
Guinea	19.2	-	No data	487	Low
Guinea- Bissau	7.9	-	No data	559	Low
Kenya	15.6	2012	0.01	1,185	Lower-middle
Lesotho	54.8	2011	0.70	1,159	Lower-middle
Liberia	21.1	2012	0.15	414	Low
Libya	1.2	-	No data	13,035	Upper-middle
Madagascar	9.1	2010	0.06	445	low
Malawi	21.4	-	No data	270	Low
Mali	14.2	2011	0.70	642	Low
Mauritania	17.4	-	No data	1,283	Lower-middle
Mauritius	18.9	2012	1.39	9,114	Upper-middle
Morocco	24.5	2010	1.75	2,931	Lower-middle
Mozambique	19.1	2011	0.70	565	Low
Namibia	31.0	2012	0.15	5,680	Upper-middle

Source: Adapted from (McCluskey, 2017); original data provided by IMF (2015, 2016); Jibao (chapter 25); <http://data.worldbank.org/about/country-and-lending-groups>.

In the above table 2.3 the property tax as a percentage of total taxes, the picture is still bleak. The property tax exceeds 1 percent of total tax revenues in only nine African countries. The conclusion is clear: property tax revenues in Africa are well below the average in other low-income countries.

2.6 GIS for Property Tax

Introduction of modern technology for mass valuation of properties has proved effective in some countries. In 2014, Arusha City Council in Tanzania changed from a manually administered own-source revenue system to a modern Local Government Revenue Collection Information System (LGRCIS) integrated with a geographic information system (or a GIS platform). The new system allows the local government to use satellite data to identify taxpayers' properties and includes an electronic invoicing system that notifies and tracks payments. This new method identified more than 102,000 buildings, a huge increase from the 23,000 of the old system. In the first 15 months after the introduction of the new system, the number of eligible taxpayers more than tripled, from 31,160 to 104,629. Within one year, the city council boosted annual revenues by 75 percent (Odd-Helge Fjeldstad, March 2017).

GIS is a computer-assisted system for capture, storage, retrieval, analysis and display of spatial and non-spatial attribute data. This tool helps convert property tax complexities and challenges into opportunities for property tax administrators and improve assessor's judgment (URISA and IAAO, 1999). It also enhances access and accuracy of data and brings about change, a change in the way humans work with records. However, while GIS is the fundamental analytical platform for spatial planning that provides an environment for better decision-making, remote sensing, of all the various data sources used in GIS, plays a fundamental role (Leeuw, 2010).

A GIS linked with a Computer Assisted Mass Appraisal (CAMA) system can provide an efficient technique for first locating potential assessment value problem areas, and then identifying the properties in question. Graphic displays of where property sales are occurring and where price/value ratio disparities exist can allow the assessor to respond quickly to changing conditions and concentrate on problem areas.

A GIS can be used to simplify the data gathering necessary to identify where the factors that affect values are located (V. Gopi Krishna Kasyap, 2015).

Because a tax cadastre needs to record only such information about boundaries, ownership and improvements, and regularly update those records as well, the need for the integration of remote sensing techniques into such practice is extremely worthwhile.

The integration is mainly useful for supplying baseline information for land-use and other forms of spatial planning in areas where maps are not available, such as in developing countries (Bocco, 2001).

Because a tax cadastre needs to record only such information about boundaries, ownership and improvements, and regularly update those records as well, the need for the integration of remote sensing techniques into such practice is extremely worthwhile.

The integration is mainly useful for supplying baseline information for land-use and other forms of spatial planning in areas where maps are not available, such as in developing countries (Bocco, 2001). Moreover, it fills the gap in areas with old-fashioned mapping record by providing the data to update those maps (Leeuw, 2010). As a result of such technological evolvement, the traditional approaches and techniques used for creating base maps for rate blocks now prove to be costly, labor intensive, time consuming and inefficient. Because of such extreme importance of remote sensing as a data input to GIS, it has become incumbent upon GIS analysts; particularly those involved in property tax administration, to gain a strong familiarity with this technology to enable them enhance the tax assessment function with spatial data that is relevant to property assessment.

GIS-based tax assessment and management system the city government is able to: check the total tax collected for a defined area like a ward; compare this against what would be expected to be collected from the ward; re-plan tax amount based on changing urban development plan and new construction; and develop more detailed system focusing on new development areas to improve tax collection (Pareta, 2017)

It is evident from the above functionalities that these spatial tools convert all property tax complexities into opportunities for revenue authorities. These tools further provide the capabilities to view, query, and analyze spatial data, which enhances the assessment functions.

They improve work efficiency through spatial task management and enable assessors to provide a better picture and service to the communities they serve. Since property taxation mainly relies on commodities (land and buildings) that are geographically fixed within jurisdictional boundaries, bringing RS and GIS that take account of location into the property tax infrastructure is paramount.

This provides decision makers with the base for strategic planning and streamlining the workflow of the property tax infrastructure. Unlike any type of information handling tool, GIS can understand the concept of location with ease and as such enhances cost efficient decision-makings (Zoneh, August, 2013).

Generally, GIS enables assessor respond quickly and appropriately to requests for information by elected officials, other agencies, the media and citizens. Hence, promoting transparency and openness of the tax administration and improving taxpayers' compliance.

2.7 Experiences in GIS Based Tax Information System

Whether governance is unitary or federal, and whether it features strong third-tier local governments, can affect the implementation of a strong and well-founded property tax. Normally, we would expect more decentralized countries to be more aggressive about reliance on the property tax. In this regard, there is great variation in Africa. Botswana, The Gambia, Ghana, Kenya, Lesotho, Liberia, Malawi, Mauritius, Namibia, Sierra Leone, Swaziland, and Tanzania have only two levels of government. Nigeria, South Africa, Zambia, and Zimbabwe have three levels. (The Comoros, Ethiopia, Nigeria, and Sudan are the only federal countries in Africa.) Uganda has a unique and intricate system of local government consisting of five tiers, but the Seychelles has only a central government with local administration on some of the individual islands. In North and Northeast Africa, countries differ greatly in how the property tax is levied.

The imposition and administration of the real property tax and the agricultural land tax in Egypt are centralized within the Real Estate Tax Authority. To the extent that it still exists, the property tax is also administered centrally in Libya. In Ethiopia, Somalia, and Sudan, however, the tax, or at least its administration, has been devolved to the local level (McCluskey, 2017).

Urban local governments in Ethiopia are not sufficiently assertive in identifying taxpayers and serving tax notices. Land rent, which is calculated on the basis of plot size and location grade, is directly linked to property market values. However, the assessed annual rental values of properties bear little relationship to current market values. Informality in the property market is also a huge challenge.

As suggested earlier, high transfer taxes and outdated laws pertaining to land and buildings play an important role in this regard (McCluskey, 2017).

The lack of an integrated approach and the absence of assertive management to maximize revenue from property taxes are major problems in Ethiopia.

2.7.1 Accra, Ghana

According to (Saviour Mantey, May 2012), the officials in Ghana are unable to collect the Property Tax efficiently and hence fall short of the budget estimate year after year. This is mainly Property Tax details are without geo-spatial information in the TNMA. If the tax details are maintained electronically and geo-spatially, the efficiency of tax collection can be improved. Also to achieve total transparency, spatial dimensions of all the structures can effectively be maintained in a GIS environment. With the advent of geo-information systems and availability of computers the Property Tax Department is not an exception where tax records are maintained electronically (in the form of database tables with a front-end application) but there is no geographical reference made in such application. The above limitation can be overcome by integrating the applications with a Geographical Information System.

More recently, an arrangement between the UK Valuation Office and the Ghana Valuation Division led to revaluation of all properties in Accra.

The exercise led to an increase in the number of properties under valuation from 46,000 to 250,000, thereby increasing the tax base 800-fold.

The Geo-Property tax system were built using This is the tool for developing applications that targets the .Net Framework and MapObjects is the mapping component software components that lets developers add dynamic mapping and geographic information system

(GIS) capabilities to existing Windows applications or to build custom mapping and GIS solutions. MapObject created by Environmental Systems Research Institute, Inc. (ESRI).

2.7.2 Monrovia, Liberia

According to (Zoneh, August, 2013), One of the main problems in property taxation, particularly in developing countries, is the manner in which the taxes are valued. In these countries, most often, valuations are done manually.

Manual tax assessment systems maintain property records in hardcopy archives like vellum maps, cards, forms, and lists placed in files and cabinets. Striving to attain efficiencies in such systems where traditional survey methods are used to collect and store property information is challenging. As today's communities are in constant state of change and growth, authorities need to continuously monitor new developments to keep the property records up-to-date. Effectuating such change in manual system takes a great deal of time and requires creating new tax map to reflect all new improvements from scratch. Thus, making the updating process labor intensive, costly and time consuming. As a result of these drawbacks, it is often difficult for authorities to conduct regular updates, track tax defaulters and trace out unauthorized and under taxed properties. Correspondingly, resulting to poor coverage of properties under tax net, high accumulation of arrears and low revenue. A new system is desirable for these areas. For example, taxes are Liberia's main source of government revenue. Evasions and withholdings of taxes present serious challenges to the government because administrative processes are manual and depend solely on the integrity of civil servants (Fallah, 2011).

To persuade people to pay taxes, the Ministry of Finance has embarked on a vigorous tax awareness campaign. It has organized public programs for people from the business community, mounted giant-sized billboards on main streets, carrying messages like "taxes bring development" or "good taxpayers are nation-builders".

The need for decision-makers to institute an effective and reliable property tax administration to ensure all taxable properties are brought to the tax net cannot be undervalued. It is strongly believed that, vast amount of potential resources can still be generated if structural and administrative changes are brought about with regard to this tax (Raghuram, 2011).

These administrative changes demand a dedicated information technology system for both the assessment and the financial accounting systems for the billing, collection, and enforcement procedures. Hence, the importance of incorporating remote sensing and GIS (spatial techniques) into the property tax infrastructure is paramount, especially the need to capture, store, update, retrieve and display large amounts of data. Today, with the use of large storage servers and reliable database management systems, information communication technology (ICT) empowers the authorities to make informed decisions and much more so easily.

2.7.3 Bangalore, India

Greater Bangalore Municipal Corporation was recently awarded by the World eGovernments Organisation of Cities and Local Governments (WeGO) for its GIS-based property identification (PID) number system. While municipalities across are increasingly adopting GIS technologies for various e-governance initiatives, the award for BBMP is just an example how the technology can be used to achieve error-free tax collections (Kumar, 2012).

Proper assessment of properties and efficient collection of tax is vital for municipal corporations as property tax is the primary source of income for these authorities. In a bid to improve their functioning, not only Bangalore but several municipalities across India have introduced innovative practices in property tax assessment and administration. Reform of the property tax systems is also one of the mandatory reforms under the Jawaharlal Nehru Urban Renewal Mission (JNNURM).

Illegal constructions, un-assessed properties, administrative inadequacies, among others, have eroded the property tax base of most Indian cities. A significant number of properties are not included in the tax base, while those that are included are often inaccurately assessed, leading to inefficient tax collection. Also, legal disputes over property ownership result in poor tax assessment (Kumar, 2012).

Moreover, in many parts of India, property tax details are still maintained in paper format, which makes it difficult for the municipal authorities to track the tax defaulters and trace the un-authorized and under-taxed properties. This results in poor coverage of properties, low revenue and inefficient tax management system (Kumar, 2012).

CHAPTER III. METHODOLOGY

3.1. Study Area Description

Adama City is located at some 100 kilometers from Addis Abeba, on the southeast along the main road to Harar. Its grid references point that the City stretches between $8^{\circ} 33'$ to $8^{\circ} 36'$ North latitude and $39^{\circ} 11' 57''$ to $39^{\circ} 21' 15''$ East longitude. Adama lies in somewhat warm and lower climate. Hence, it enjoys hot and dry weather for the greater part of the winter and warm and sunny climate in summer. Thus, the area is generally, known for its attractive weekends and summer resort release. References to its temperature points that Adama has a minimum annual temperature falling between 19°C and 22°C . Its yearly minimum rainfall is reported to be 760 mm (Wikipedia t. f., 2012).

The study area is a single block containing twenty parcels, the extent is in between $8^{\circ} 33' 44''$ to $8^{\circ} 33' 47''$ North latitude and $39^{\circ} 17' 01''$ to $39^{\circ} 17' 04''$ East longitude.

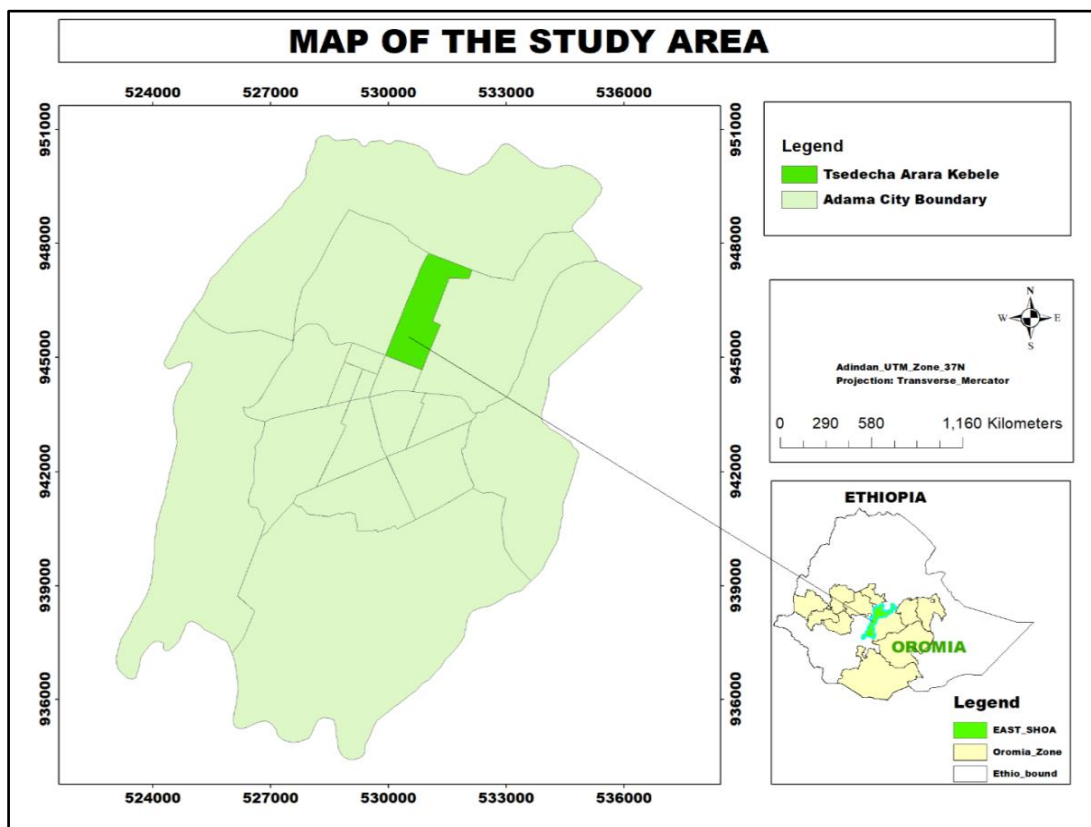


Figure 3.1 map of study area

3.2. Data Collection and Data Sources

For the research both primary and secondary data were used. The primary data were collected on site visiting by taking pictures of buildings. Secondary data were collected from different sources. By digitizing available Quick Bird satellite image block, parcels and building footprints were obtained.

The following table 3.1 the different data and their sources with corresponding data format.

Table 3. 1 Data source and its format

Data	Original format	Final format	Source
Quick Bird satellite image spatial resolution of 2.4 Meter	Image format(.tif)	Image format(.tif)	Available
Block, Parcel and Buildings	shapefil.(shp)	shape file	Digitized from satellite image
Property tax classification tax rate information	Paper/ hard copy	Tabular information	AdamaCity Revenue Authority

3.3 Software Used

ESRI product ArcGIS 10.4 were used for georeferancing and digitizing block, parcels and buildings from the satellite image and MapWindow GIS which is an Open source GIS mapping application adopted by the United States Environmental Protection Agency, used display, editing, query tax map. Visual studio the visual basic .Net framework were used build the system by integrating access database using Microsoft Access database file OLE DB and active x control tools.

Table 3. 2 Softwares and Equipments

Item	Version/Model	Purpose
Arc GIS	10.4	For georeferancing of parcel, building and road network using Quick bird satellite image and editing
MapWindow GIS	5.6	For mapping
Visual Basic (VB.Net)	2010	For system development
Microsoft Access	2010	For database development

3.4 System Development

There are two components, the GIS software MapWinGIS for the map graphics and the database driven software Visual Basic for the tax application, these two components will be linked to get the GIS tax system. The database software was used for the application development while the GIS software provides the functionality for the spatial analysis. The application offers better table functionality in handling attribute data and thus serves as the databank or centralized data repository for the entire system.

Considering the conceptual design, the software components considered were Microsoft Visual Basic the .Net Framework provides developers with wide range of tools such as compilers, debuggers, programming languages and execution engines. It feature's many programming languages such as Visual Basic (VB), C++, J#, C# etc. making VISUAL STUDIO an all in one programming package for developers (Saviour Mantey, May 2012).

It is compatible with COM and ActiveX controls and provides unlimited extensions for applications developed with VB.Net for the application development with MapWindow.

MapWindow is an open source geographic information system (GIS) and an application programming interface (API) distributed under the Mozilla Public License (MPL), built upon the Microsoft Dot Net Framework (Daniel P. Ames, July 2007).

And also includes a complete ActiveX component which may be used to instantly add GIS capabilities to the user's existing software product. Additional geoprocessing components are available for .NET-compatible languages (Gary Watry, 2006)

Using the GIS and the database software, the described data (spatial and non-spatial) was then transformed into the model of the software using the development environment. The two components will be integrated or linked in the development environment by adding the MapWinGIS to Visual Basic 2010.

MapWindow GIS is an open-source GIS mapping application and set of programmable mapping components. It has been adopted by the United States Environmental Protection Agency as the primary GIS platform for its BASINS (WikiPedia, 24 March 2020).

MapWindow GIS can be reprogrammed to perform different or more specialized tasks. There is also plug-ins available to expand compatibility and functionality. The application is built upon Microsoft .NET technology (WikiPedia, 24 March 2020).

In MapWindow Map display properties will be using datum World Geodetic System (WGS) 1984 and coordinate system, Universal Transverse Mercator (UTM) zone37 north.

The study's research methodology is based on the use of an intrinsic case study – an undertaking understanding of the case; to develop a strategy for designing and implementing the prototype that could be adapted for institutional development of GIS based tax information system tax system.

The figure 3.2 below illustrates application architecture of the research. The steps were approached below the technical scheme.

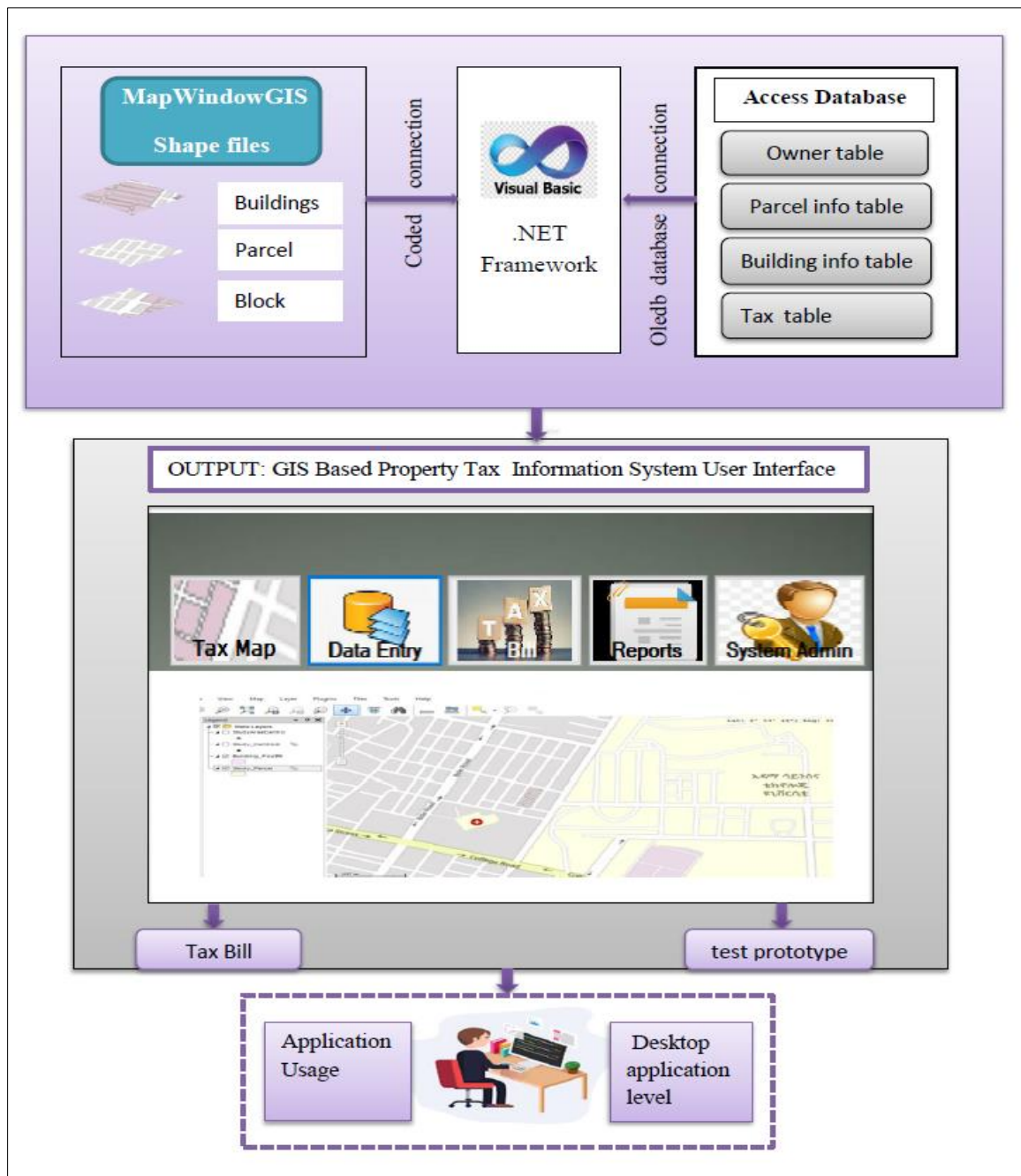


Figure 3. 2 Technological schemes

Steps used in the system design

- i. Required components: selected for system development these are data entry form (owner data entry, parcel data entry, building data entry and tax data entry) and tax map.
- ii. Selection of software: the system was built using MapWindowGIS 5.6 for tax map manipulation, Microsoft Access for data base development (creating tables, relationships) and Visual Basic (VB.NET) for system development with customized buttons.
- iii. The third step is to create the four tables (owner table, parcel info table, building info table and tax table) and the relationships between them.
- iv. From the georeferenced satellite image parcel, building and block were digitized and tax map were created in order to search defaulters through query and manipulating tax map.
- v. The fifth step is building the GBPTIS interface using the active x controls and customized buttons.
- vi. Tax bill were created for tax payment.
- vii. Finally the developed system proto type was tested.

3.4.1. Database Design

In the database tables are constructed as ***owner table*** with fields (PID, owner first name, middle name, last name, sex, date of birth, Kebele, phone number and email), ***parcel table*** (PID, land use, legal area, land grade, block), ***tax table*** (PID, tax amount, tax paid date), ***building table*** (PID, house number, building area, number of floors, building photo, building status, construction year).

In Adama revenue authority there is no distinctive property tax calculation; for example, for lease land holders the computation is depends on the agreement between the lessor and lessee, this implies that valuation of tax in the database is being contingent on the lease agreement. As a result, the assessed tax value for each and individual plot of land and its corresponding building should be evaluated and recorded in the database tables. When the annual tax value will be changed, the current assessed value becomes updated in the new field.

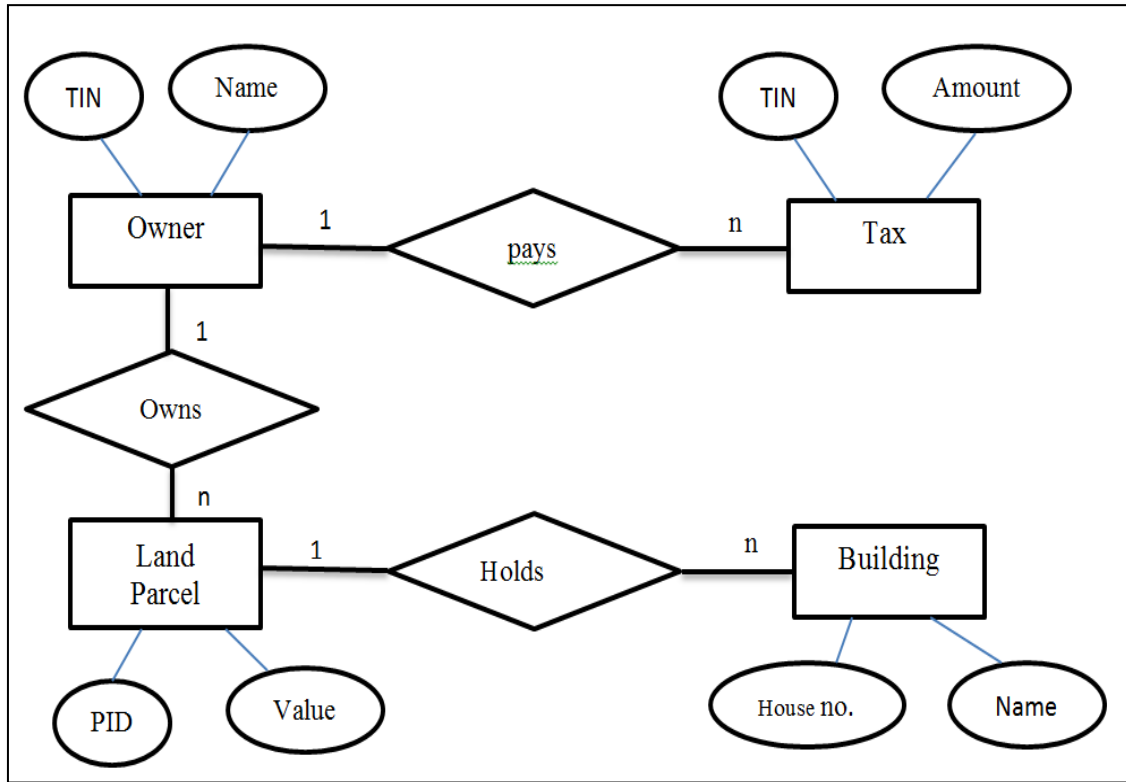


Figure 3. 3 Entity relationship diagram

Physical Modeling

A physical data model is equally important during the data mapping process and it gives information about entities that have rolled up from the logical data model, primary indexes, data types of attributes, partitioning, referential integrity, update related fields, and so on. The representation was about organizing the data to create a blueprint of how the database will be constructed - dividing the logical data model into database tables.

The relationship in the following diagram shows the weighty part of designing a relational database is dividing the data elements into related tables. Once we are ready to start working with the data, we rely on relationships between the tables to pull the data together in meaningful ways. For instance, one land holder may have more than one parcel as a result he/she will pay property taxes as per the number of their property. That is why on the relationship from owner to parcel, owner to tax table and parcel to building becomes one-to-many.

The figure below 3.4 shows how database tables are organized in the Microsoft access database and their relationships.

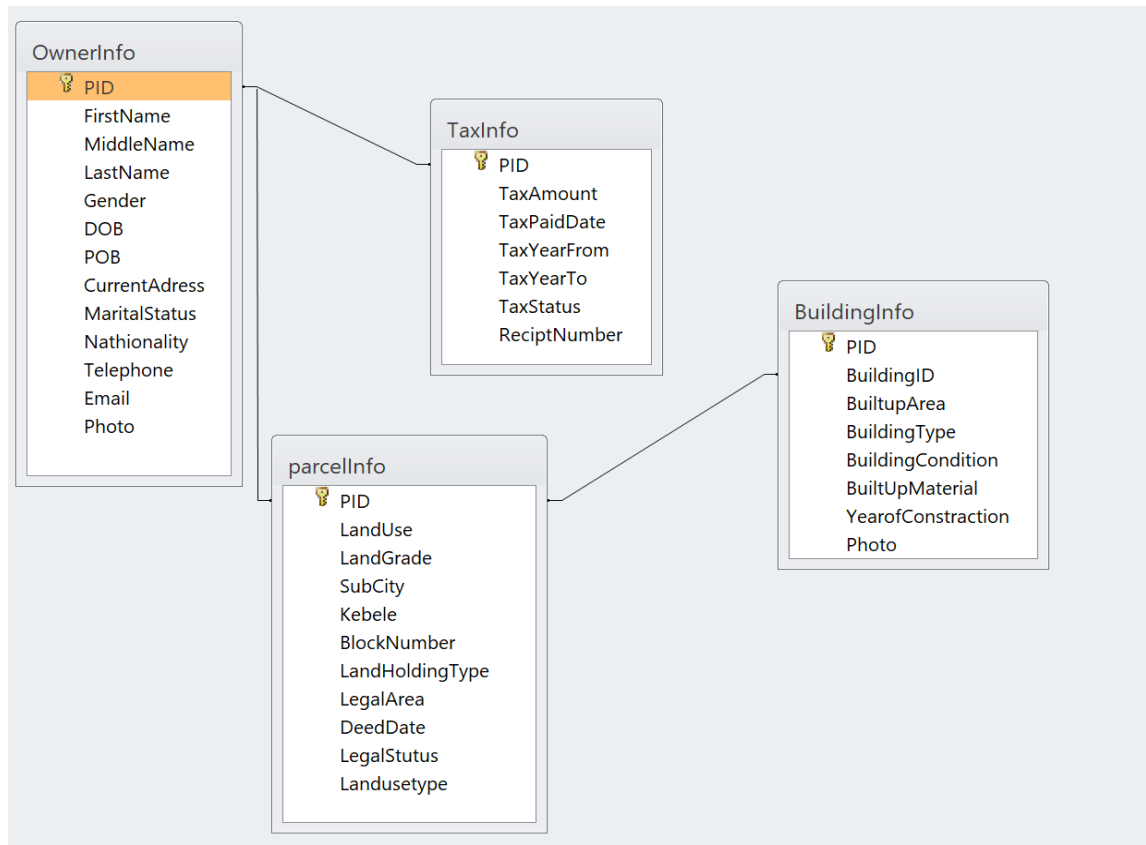


Figure 3.4 Physical modeling

CHAPTER IV. RESULT AND DISCUSSION

4.1 Introduction

The research found the tax map, data entry form and tax bill as the main required components for GIS based property tax information system development. From the details of owner information, parcel information, Building information and tax information, tax bill were created. Tax map was created for storage, visualization, editing and manipulation of spatial and attribute data. Defaulters were searched using tax map by attribute query and addressed through created tax bill. Besides tax map, the system generates report in order to identify tax paid and not paid.

Finally, the system were developed successfully and tested by entering the data as required.

4.2 User Interface

GIS Based Property tax Information System (GBPTIS) is the system developed for storing, retring, displaying and manuplating spatial and non-spatial information of property taxation. The GBPTIS has tax map, data entry form, tax bill, reports, system adminstration and login customized buttuns.



Figure 4. 1 GIS based property tax information system main interface

System Login

In computer security, logging in (or logging on, signing in, or signing on) is the process by which an individual gains access to a computer system. The user credentials are typically some form of "username" and a matching "password" (Wikipedia, 2020).

The system administrator in GBPTIS application there are three authorization levels; administrator, tax agent and guest with different access privileges. The tax administrator has full right to the entire system such as updating, deleting, entering data printing the tax bill. Tax agent and guest have rights for visualization.

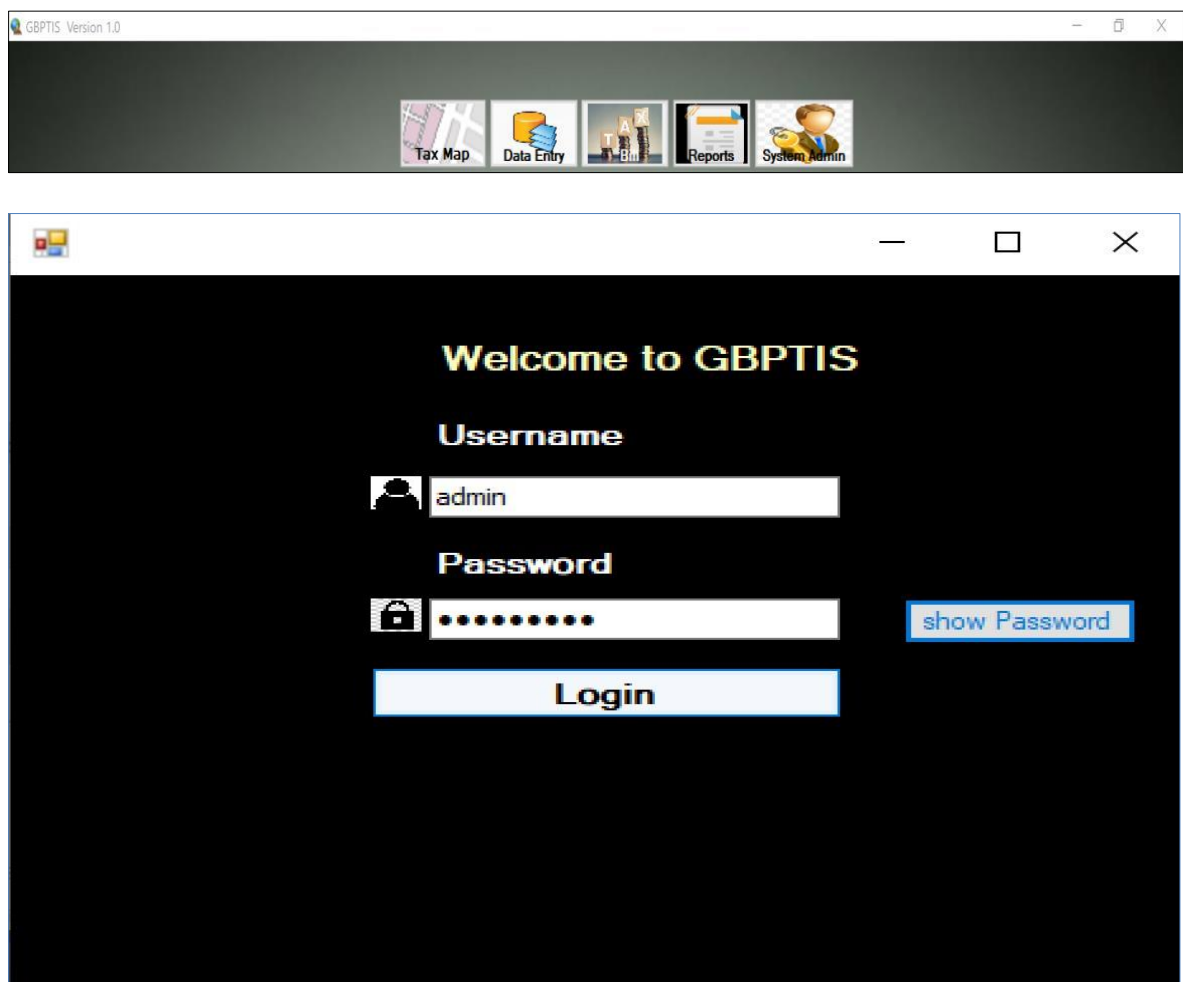


Figure 4. 2 System login interface

Tax Map

In GIS based tax information system MapWindow GIS were used to display blocks, parcels and buildings with the functionalities editing spatial and non-spatial data, save, print, zoom in, zoom out, pan, identify, select feature, full extent, add data, display attribute table, query etc. Google earth, Street Map, Bing Map, also overlaid below the tax map in order to visualize current condition of the building for example, to look for new construction. Besides, Google map street map used to identify defaulters location for addressing tax bill.

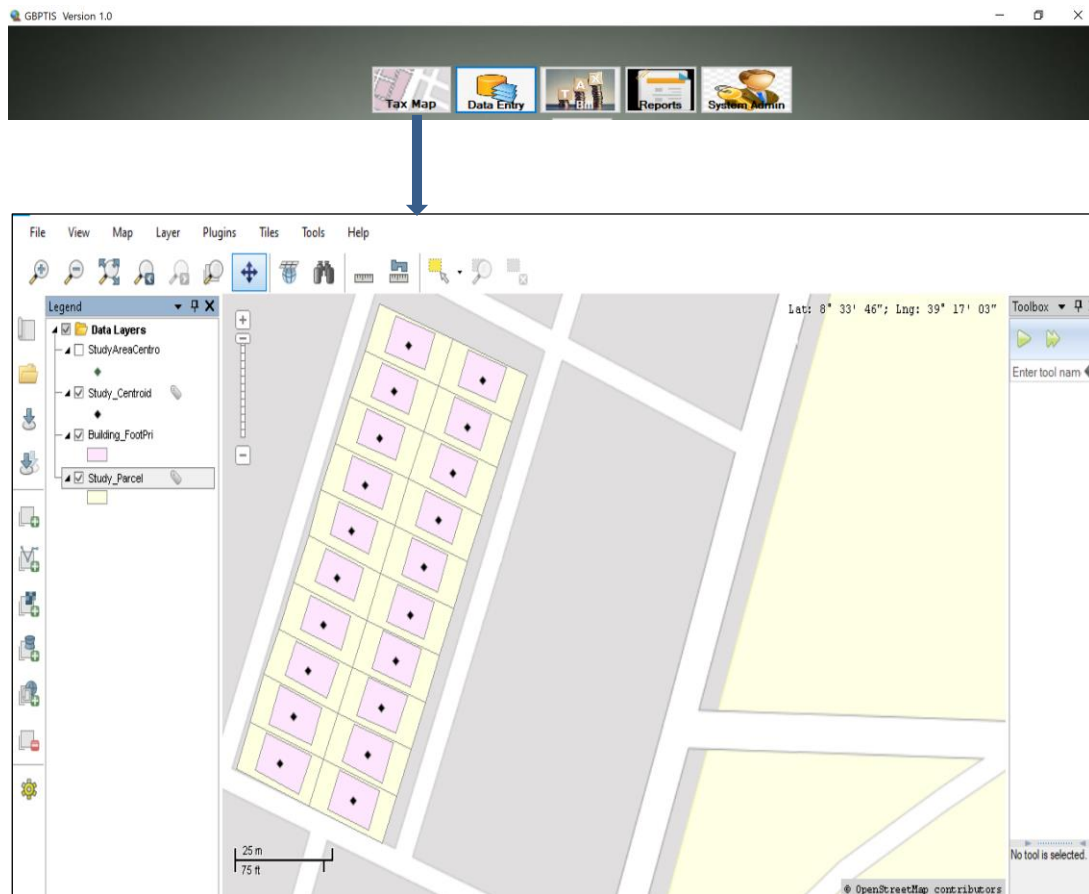


Figure 4. 3 Tax map window displaying parcels and buildings

Attribute tables

Attribute information is tabular information is the basis of geographic features, allowing you to visualize, query, and analyze your data. In the simplest terms, tables are made up of rows (records) and columns (fields), and all rows have the same columns.

The tax map window also displays the descriptive information of tax parcel and contained buildings. And from this table its possible to select parcels that property tax was paid or not, that is mainly to assess defaulters. Different attribute queries can be performed using parcels or buildings.

In the figure 4.4 below the yellow color shows the selection of a given parcel using its PID.

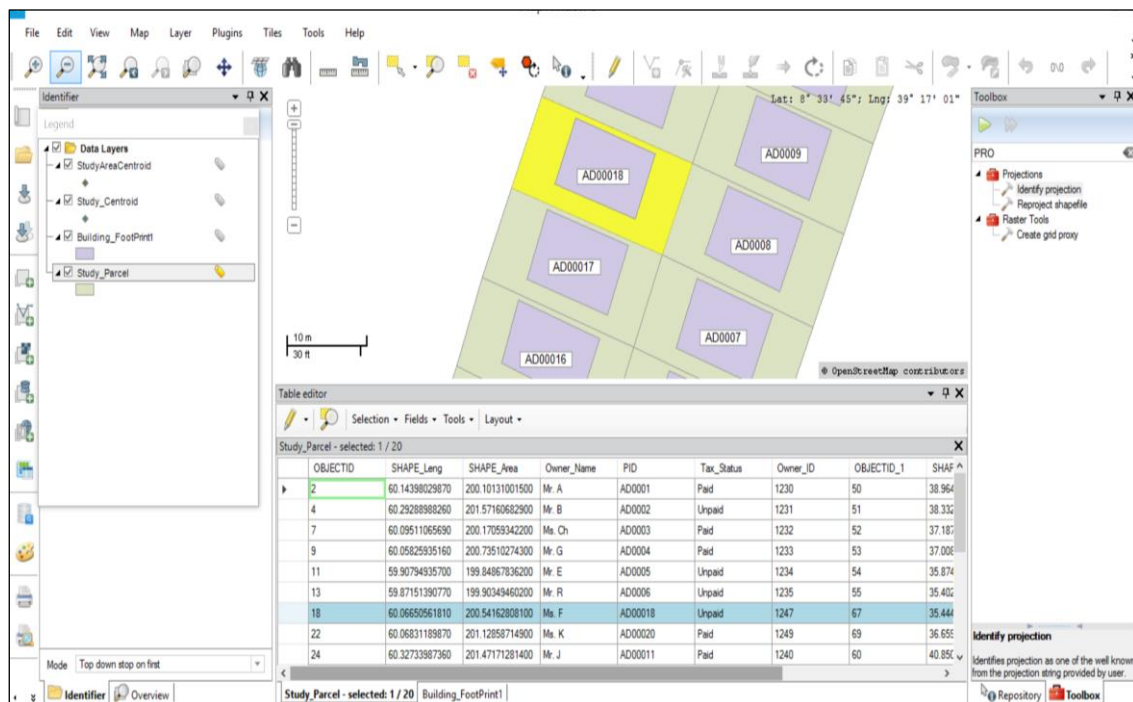


Figure 4. 4 Attribute table of corresponding parcel

4.3 Data Entry Form

4.3.1 Introduction

Data entry form was developed using Microsoft Access Database File OLE DB (Object Linking and Embedding, Database) and VB.NET framework.

The data entry form include owners table with fields (PID, first name, middle name, last name, gender, date of birth, place of birth, current address, marital status, nationality, telephone and email, owners photo), parcel table (PID, land use, land grade, sub city, kebele, block number, land holding type, legal area, deed date, legal status), tax table (PID, tax amount, tax paid date, tax year from, tax year to, tax status), building table (built up area, building ID, building type, building condition, built up material, year of construction).

While data entered on the left of the form and click the save button the data will displayed on the right side of the data entry form table and stored in the database.

The data entry forms had search button used for searching a single record using names or PID. In addition, the print button was used to print the selected records in the datagridview or the whole records.

The data entry forms also had background color and selection color choosing combo boxes for table records and its used for better visualization while selection.

Owner data entry

In the figure 4.5 below during data entry owners photo added to the database by clicking choose photo button and searching the photo saved with PID. In the data entry form its also possible to search and print records. Owner data entry had ten fields (PID, first name, middle name, last name, gender, date of birth, place of birth, current address, marital status, nationality, telephone email and owners photo). while selecting a single record the corresponding owners photo automatically displayed on the picture box.

Data_Entry

Owner Info Parcel Info Building Info Tax Table

Owner Data Entry



Clear

Choose Photo

PID: AD00004

First Name: Aberash

Middle Name: Bogale

Last Name: Hunde

Gender: Female

DOB: Sunday, January 5, 196

Nationality: Ethiopian

Telephone: 0913896544

Email: abera@gmail.com

Search

Update Save Add New Delete Print

PID	First Name	Middle Name	Last Name	Gender	DOB	Nationality	Telephone	Email	Photo
AD00001	Aberash	Waako	Gumu	Female	3/5/1980	Ethiopian	0912431189	aberaah@gmail...	
AD00002	kebede	Belay	Kefie	Male	3/15/1973	Ethiopian	0923875612	kebede@gmail...	
AD00003	Chaltu	Gutu	Tufa	Female	3/4/1971	Ethiopian	0976567743	chaltu@gmail.c...	
AD00004	Aberash	Bogale	Hunde	Female	1/5/1969	Ethiopian	0913896544	abera@gmail.c...	
AD00005	Afaw	Gebeyehu	Alemu	Male	2/3/1970	Ethiopian	09341567	afaw@gmail.c...	
AD00006	Kedir	Husen	Kemal	Male	1/29/1964	Ethiopian	0911232155	husenk@gmail...	
AD00007	Fozia	Mohamed	Ali	Female	6/15/1983	Ethiopian	09236785	mohamed@gm...	
AD00008	Alemu	Sime	Kemal	Male	6/13/1979	Ethiopian	0912453288	alemu@gmail.c...	
AD00009	Alemayehu	Yifu	G/Hiwot	Male	6/14/1962	Ethiopian	0935762899	alemayehu@g...	
AD00010	Sisay	Kifu	Gudeta	Male	7/16/2065	Ethiopian	0988675432	sisay23@gmail...	
AD00011	Almaz	Fikru	G/Mariam	Female	1/10/1976	Ethiopian	0911768896	almaz1@gmail...	
AD00012	Lemma	Fkadu	Gudina	Male	5/14/1973	Ethiopian	0932145633	fkadu@gmail...	
AD00013	Aselef	Gima	Kebede	Female	6/21/1969	Ethiopian	0915790054	aselef@gmail.c...	

Back Color: Alternate Fill

Reset Me

Figure 4. 5 Owner data entry form

Parcel data entry

In the figure 4.6 below land use, land grade, sub city, kebele, land holding type and legal status were created using combo box, these made the data entry easy and proper words were used during data entry. For example, for land use (residential, commercial, mixed use, industrial and agricultural), for sub city (Bole, Aba Geda, Bokku, Dabe, Lugo), for kebele (Tsedeche Arara, Goro, Migira, Gara Lugo, Degaga, Gurmu, Bedhatu, Oda, Irecha, Biqa, Berecha, Geda, Chefe, Hangatu, Boku Shenen, Malka Adama) and for land holding type (Lease, Life Time) were used by choosing from drop down list.

The screenshot shows the 'Data_Entry' application window. The 'Parcel Info' tab is active, displaying a 'Parcel Data Entry' form on the left and a table of parcel data on the right. The form includes dropdown menus for Land Use, Land Grade, Sub City, Kebele, and Land Holding Type, and text input fields for PID, Block No., Legal Area, and Legal Status. A 'Search' button is located below the form. The table lists 13 parcels with columns for PID, Land Use, Land Grade, Sub City, Kebele, Block Number, Land Holding Type, Legal Area, and Legal Status. A 'Data Saved' dialog box with an 'OK' button is overlaid on the table. At the bottom of the window, there is a map view with 'Back Color' and 'Alternate Fill' dropdowns, and a 'Reset Me' button.

PID	Land Use	Land Grade	Sub City	Kebele	Block Number	Land Holding Type	Legal Area	Legal Status
AD00002	Residential	Second	Bole	Tsedeche Arara	B12	lease	200	have site plan
AD00011	Residential	Third	Bole	Tsedeche Arara	B22	Lease	200	Legal
AD00008	Residential	Third	Bole	Tsedeche Arara	B22	Life Time	200	Legal
AD00004	Commercial	First	Bole	Tsedeche Arara	B12	Life Time	400	Legal
AD00007	Residential	Third	Bole	Tsedeche Arara	B22	Lease	250	Legal
AD00009	Residential	Third	Bole	Tsedeche Arara	B12	Life Time	200	Legal
AD00006	Commercial	Fourth	Bole	Tsedeche Arara	B22	Lease	200	Legal
AD00001	Commercial	Second	Bole	Tsedeche Arara	B22	Lease	200	Legal
AD00003	Residential	Third	Bole	Tsedeche Arara	B12	Lease	250	Legal
AD00005	Residential	Third	Bole	Tsedeche Arara	B12	Lease	200	Legal
AD00010	Residential	Third	Bole	Tsedeche Arara	B22	Lease	200	Legal
AD00012	Mixed Use	Second	Bole	Tsedeche Arara	B22	Lease	200	Legal
AD00013	Mixed Use	Third	Bole	Tsedeche Arara	B12	Lease	180	Legal

Figure 4. 6 Parcel data entry form

Tax table data entry

Figure 4.7 below shows tax table data entry with fields PID, tax amount, tax paid date, tax date from, tax date to, tax status and receipt number. Tax report also generated from the tax table. Tax table data entry has seven fields (PID, Tax amount, tax paid date, tax year from, tax year to, tax status and receipt number).

The screenshot shows a software interface titled 'Data_Entry'. It has a menu bar with 'Owner Info', 'Parcel Info', 'Building Info', and 'Tax Table'. The 'Tax Table' menu is active, displaying a 'Tax Table Data Entry' form on the left and a 'Tax Info' table on the right.

Tax Table Data Entry Form:

- PID: AD00013
- Tax Amount: 3100
- Tax Paid Date: Thursday, October 8, 202
- Tax Year From: Sunday, September 1, 201
- Tax Year To: Sunday, August 30, 202
- Tax Status: unpaid
- Receipt No.: -

Tax Info Table:

PID	TaxAmount	TaxPaidDate	TaxYearFrom	TaxYearTo	TaxStatus	ReceiptNumber
AD00001	2200	6/18/2020	9/1/2019	8/30/2021	paid	FS000001
AD00002	2200	6/11/2021	8/25/2019	8/30/2020	paid	FS000002
AD00003	2500	7/13/2020	9/1/2019	8/30/2020	paid	FS000003
AD00004	2360	6/25/2020	9/1/2019	8/30/2020	paid	FS000004
AD00005	2800		9/1/2019	8/30/2020	unpaid	-
AD00006	3100	7/6/2020	9/1/2019	8/30/2020	paid	FS000005
AD00007	2750	6/25/2020	9/1/2019	8/30/2020	paid	FS000008
AD00008	2900		9/1/2019	8/30/2020	unpaid	-
AD00009	3200	6/10/2020	8/25/2019	8/30/2020	paid	FS000011
AD00010	2450	9/1/2019		8/30/2020	paid	FS000009
AD00011	3250		9/1/2019	8/30/2020	unpaid	-
AD00012	2750		9/1/2019	8/30/2020	unpaid	-
AD00013	3100		9/1/2019	8/30/2020	unpaid	-

The table has a search bar and buttons for 'Update', 'Save', 'Add New', 'Delete', and 'Print'. The last row (AD00013) is highlighted in blue.

Figure 4. 7 Tax table data entry form

Building data entry

The forth data entry was building data entry. As showed in the figure 4.8 below the building type (L-shape, villa, condo, apartment, G+1, G+2,...), building condition (completed/under construction), built up material (stone, concrete block, wood, mud) were entered using combo box. Building photo also included in the database it could be used to assess the fairness of the tax paid as per the standard of the building.

The screenshot shows a software application titled 'Data_Entry'. It has a menu bar with 'Owner Info', 'Parcel Info', 'Building Info', and 'Tax Table'. The 'Building Info' menu is active, displaying a 'Building Data Entry' form on the left and a 'Building Info' table on the right.

Building Data Entry Form:

- Photo:** A thumbnail image of a building with a 'Clear' button and a 'Choose Photo' button.
- Fields:**
 - PID:
 - Building ID:
 - Built Up Area:
 - Building Type: - Building Condition: - Built Up Material:
- Buttons:** Search, Update, Save, Add New, Delete, Print.

Building Info Table:

PID	Building ID	Built up Area	Building Type	Building Condition	Built Up Material	Photo
AD00001	BG2312	120	L-Shape	Completed	concrete Block	
AD00002	BG2314	140	L-Shape	Completed	Concrete	
AD00003	BG1454	180	Villa	Completed	Concrete	
AD00004	BG1533	160	G+3	Completed	Concrete	
AD00005	BG3412	130	G+1	Completed	concrete Block	
AD00006	BG2265	180	G+1	Completed	concrete Block	
AD00007	BG2354	180	Villa	Completed	Concrete	
AD00008	BG1243	140	L-Shape	Under Construction	Concrete	
AD00009	BG1244	160	L-Shape	Completed	Concrete	
AD00010	BG1266	150	L-Shape	Completed	Concrete	
AD00011	BG2341	180	G+2	Completed	Concrete	
AD00012	BG2355	160	Villa	Completed	Concrete	
AD00013	BG1287	120	L-Shape	Completed	Concrete	

At the bottom of the application, there is a map view with a 'Back Color:' dropdown, an 'Alternate Fill' dropdown, and a 'Reset Me' button.

Figure 4. 8 Buildings detail data entry form

4.4 Collection and enforcement

Tax Bill

The actual tax bill should target the person or legal entity who is obliged to pay and it should also clearly formulate the tax liability. Local property taxation does not necessarily mean that all the administrative burdens of property tax billing, collection and enforcement are assigned to municipal level. The first step of tax collection is to identify and to reach the taxpayers with a clearly formulated tax statement. The register of property owners and users can be collected from the general population registry or other information bases, such as list of utility service users. Most of the time tax bills should reach the taxpayers two-three weeks before the payment deadline. Delivery of local property tax bills could be done using post office or local government property tax agents (NALAS, March, 2009).

In the tax bill below total tax amount is assessed tax value of parcel and buildings which is obtained from the database interest and penalty will be calculated as per the revenue authority rules and regulations for property tax. Total tax due is the sum of total tax amount, interest and penalty.

The screenshot displays the 'GBPTIS Tax Bill' interface. At the top, there is a header with the Ethiopian flag and the text 'Ministry of Revenue Adama Revenue Authority Municipal Tax Bill'. Below this is a form with various input fields for property details and tax calculations. The form includes fields for Date, Bill Number, PID, First Name, Middle Name, Last Name, Location of Property (SubCity, Kebele), Land Holding Type, Legal Area, Land Use Type, Tax Year (From, To), Total Tax Amount (Birr), Interest (Birr), Penalty (Birr), and Current Payment (Birr). There are also buttons for 'Search', 'Print', 'Choose Printer', 'Calculate', and 'Clear'. Below the form is a table with columns: PID, SubCity, Kebele, LandHoldingType, LegalArea, LandUseType, and Tax. The table contains one row of data for PID AD00003, SubCity Bole, Kebele TsedechaArara, LandHoldingType lease, LegalArea 250, LandUseType Residential, and Tax 9/1/2. At the bottom, there are dropdown menus for 'Back Color' (MistyRose) and 'Alternate Fill' (Gold), and a 'Reset Me' button.

PID	SubCity	Kebele	LandHoldingType	LegalArea	LandUseType	Tax
AD00003	Bole	TsedechaArara	lease	250	Residential	9/1/2

Figure 4. 9 GIS Based Property Tax Information System tax bill

Searching for Defaulters

Tax map opened from GIS based property tax Information System and query were performed to track defaulters i.e owners who do not pay their tax on time. It's possible to query all the defaulters ones using the expression "PID = unpaid" or we can search a unique tax payer using PID, like "PID = AD00006." Query for defaulters is helpful in geographically visualizing the location of properties that do not pay taxes and enforcing the them to pay their taxes by addressing tax bill. In this time, the revenue authority may add the perdim cost of the tax agent to the tax payer on the amount of the tax paid with different receipt.

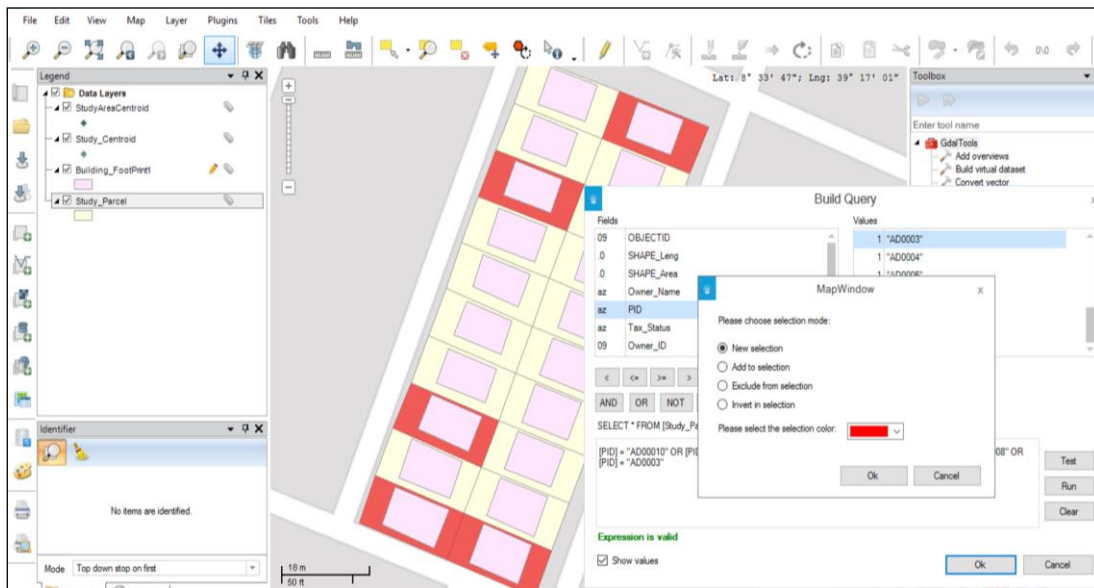


Figure 4.10 Searching defaulters

Tax Report

Tax report was generated using different parameters it could be by date or by tax status or other parameter. The generated report could be printed and the information on the report used for searching defaulters using the tax map attribute query.

Tax Report						
PID	Tax Paid Date	Tax Amount	Tax Year From	Tax Year To	Receipt Number	Tax Status
AD00001	6/18/2020 12:00:00 AM	2200	9/1/2019 12:00:00 AM	8/30/2021 12:00:00 AM	FS000001	paid
AD00002	6/11/2021 12:00:00 AM	2200	8/25/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000002	paid
AD00003	7/13/2020 12:00:00 AM	2500	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000003	paid
AD00004	6/25/2020 12:00:00 AM	2360	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000004	paid
AD00005		2800	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	-	unpaid
AD00006	7/6/2020 12:00:00 AM	3100	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000005	paid
AD00007	6/25/2020 12:00:00 AM	2750	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000008	paid
AD00008		2900	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	-	unpaid
AD00009	6/10/2020 12:00:00 AM	3200	8/25/2019 12:00:00 AM	8/30/2020 12:00:00 AM	FS000011	paid
AD00010	9/1/2019 12:00:00 AM	2450		8/30/2020 12:00:00 AM	FS000009	paid
AD00011		3250	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	-	unpaid
AD00012		2750	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	-	unpaid
AD00013		3100	9/1/2019 12:00:00 AM	8/30/2020 12:00:00 AM	-	unpaid

Figure 4.11 Tax report

CHAPTER V. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This research tries to show the application of GIS based property tax information system for effective property tax collection, identification of property location and property related attributes, details of property owners and more importantly tax billing system. Tax map, data entry and tax bill are the main modules of the GIS based property tax information system.

The GIS Based Property Tax Information System (GBPTIS) were developed using customized buttons in VB.NET by integrating MapWindow GIS (mapping software) and Microsoft Access (database tables).

With detailed tax payer information or land holder information, location and details of the land parcel, details of contained buildings including photo and the assessed tax value of parcels and buildings, the property tax system works efficiently. Moreover, from tax table tax report will be created and attribute query will be performed so as to track tax defaulters.

The system prototype were tested by entering the data using the four (owner, parcel, building and tax) data entry forms and it was found successful.

5.2 RECOMMENDATIONS

The system improves tax collection and becomes more helpful when the system upgrades to web based GIS, this will give property owners in order to access their property details everywhere through their PID/TIN and to pay the tax due electronically without coming to the tax center. It's recommended that other researchers should look at integrating the GBPTIS with street addressing in order to facilitate the billing system.

Moreover, its suggested that the extention of the system for building rent revenue collection would make the revenue authority systematically and in efficient way.

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