International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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Securing Bank Loans and Mortgages Using Real Estate Information Aided by Geospatial Technologies

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ARTICLEINFO

Article history:
Received 10 November 2012
Received in revised form 25 January 2013
Accepted 28 January 2013
Available online 29 January 2013

Keywords:
Banking;
GIS;
Loan appraisal;
Information technology;
Mortgage.

ABSTRACT

Due to liberalization within the financial market, there has been increased cash flow in banks. This has resulted in increased competition among banks to secure and increase their customer base, in an effort to remain profitable. Banks are foregoing the multitude of checks that used to be conducted before granting any mortgage facility to customers, in an effort to remain competitive. This has led to a drastic increase in the number of credit card and loan defaulters, leading to increased operation costs and reduction in profit margins.

This research proposes an integrated GIS approach enabling banks locate defaulting real estate properties used as collateral. Using data provided by Kenya Commercial Bank (KCB) for a locality in Kenya, a geodatabase was developed and a custom application developed for the bank loan appraiser to use. This application retrieves property information about a client based on his/her bank account information. Based on a series of spatially driven queries embedded in the solution, the appraiser can prepare a detailed appraisal for the client in a very short time, thereby satisfying the client, while not prejudicing the banks position.

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1 Introduction

Geographic Information Systems (GIS) have been defined and conceptualized in a number of different but related ways. de Man (1988), Goodchild (1992), and Burrough (1986) argue that GIS is a special type of information system that handles spatial data. Dickinson and Calkins (1988) take a component view of GIS, arguing that a GIS has three elements: technology (hardware and software), a database, and infrastructure (staff, facilities, etc.). GIS technology has a great deal to offer the mortgage finance industry because geographic location and spatial relationships have a central role in housing and mortgage market outcomes. Housing is fixed in its location and is durable. As a result, a home's location relative to employment opportunities, mortgage finance and housing market intermediaries, public services, and amenities exerts a strong influence on its price. The location of a home influences the choices and opportunities of its residents and of those seeking to own it and location is thus a strong influence on mortgage markets. The location of mortgage suppliers defines the availability of mortgage credit. The segregation of residential space into discrete geographic submarkets influences the pattern and nature of mortgage product demand.

The highly segregated nature of residential space demands that mortgage lenders target their products, services, and marketing efforts to the specific character of different demographic groups that occupy different market areas Because the nature of the competition faced by participants in the mortgage finance process varies across different areas, they must develop different competitive strategies to suit the character of their competition in different areas. GIS technology has the potential to support a wide range of business applications in mortgage finance (Alberts and Douglas, 1992). At the most elemental level, it can provide mapping capabilities to help decision makers visualize the spatial distribution of variables that affect their business. At a higher level, it can be used to combine multiple variables such as the racial and income composition of neighborhoods with the location of recent mortgage originations. It can be used, for example, to select the optimal number, location, and size of branch offices to service a market area given some decision rules about how far any share of potential borrowers can be from a branch office (Birkin and Clarke 1998).

In Kenya, the use of GIS is rather limited but growing steadily with the mainstreaming of GIS in many curricula in the Universities. Acquisition of georeferenced data is also an expansive undertaking including the data management and dissemination. Another limitation is poor consumer awareness which means less demand for the products and services of GIS. Regardless of these limitations, GIS has been used in Kenya for several projects with good result, for instance, in compiling the National Water master plan (Republic of Kenya, 1992). The Kenya Wildlife Services (Kariuki, 1992) used GIS for managing the large volumes of data they acquire relating to wildlife census, vegetation and land use dynamics, infrastructure, security and planning of operations. The department of resource surveys and remote sensing makes use of GIS and Remote Sensing in the mapping of natural resources (Ottichilo, 1986). An integrated GIS and remote sensing system has been developed for water resources management in Kitui county (Kuria, et al, 2012), while Mulaku and Nyadimo (2010) used GIS in the mapping of schools. Kuria, et al (2011) developed a GIS tool for enhancing efficiency in distribution of national examinations. GIS has also been used to prepare the National Environment Action Plan (Ministry of Environment and Natural Resources, 1994) and to monitor a development programmed in Laikpia District (Hoesli, 1995).

In recent years, the banking industry in Kenya has been undergoing drastic changes reflecting a number of underlying developments. Significant advancement in surveying, architectural and information technology (IT) has accelerated and broadened the dissemination of real property information and financial services and also increased the complexity. Another key impetus for change has been the increasing competition among a broad range of domestic and foreign institutions in providing bank loans, mortgages and other related services. Regulations and computer technology advancement are forcing mortgage institutions to adopt better operational strategies and upgrade their skills, throwing more challenges to banking sector.

One of the most tedious tasks in banking is providing mortgage services for their clients. Banks offer this service to enhance their accessibility to the customers. To cushion themselves, banks need collateral such as tangible (fixed) property or business assets etc. In order for a bank to sanction a mortgage, the property is analyzed. Some of these analyses include distance from the main road or size of the plot, verification of the actual owner of the plot, current land valuation etc. Currently in Kenya, banks accomplish these analyses manually by going to the sites or contacting third party to do the tasks. This process at the least takes 30 days to complete and involves a substantial expenditure in funds while following this due diligence. In case the same plot is being used by a client to request for other loans to the same bank or different banks

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the analyses have to be done for each application cascading the problem.

A GIS simplifies the process by easily accomplishing the following: (i) does the spatial analysis easily on the computer from the office, (ii) calculates the area or distance from main road or other features of interest without having to visit the site/plot, (iii) calculates the land value of the area by analyzing the surrounding area, (iv) creating a centralized or distributed database system that can be used to detect and prevent multiple loan applications utilizing the same plots, and (v) perform auction procedures and instructions without much difficulty.

The objective of this study is to develop a pilot database for real property information within parts of Kilimani, Lavington and Kileleshwa estates that can be used to secure bank loans and mortgages. To accomplish this objective a geodatabase is developed with capabilities of analyses, and modeling of (i) present land use (ii) present land value (iii) information of the plot e.g. past owner, case, previous loan taking condition etc (iv) distance from the main road and (v) adjacent road width

2 The study area

The area chosen for study (Figure 1) covers extensive parts of Kileleshwa, Kilimani and Lavington estates. It lies between (9857500m N, 242000m E) and (9859000m N, 254000m E). It covers an area approximately 3,000,000 m^2. The area has approximately 1500 plots and over 1800 permanent buildings. Semi-permanent buildings were however not considered.

Lavington is a suburb green haven lying halfway between the busier areas of Hurlingham and Westlands. Here the few modern apartment blocks are unobtrusive and the lanes linking busier roads are lined with large houses and bungalows set in an acre or less of well-tended land. Many have swimming pools. Some roads are gated with security staff screening all visitors. Lavington is popular with expatriate families. Kilimani is bounded to the north by Dennis Pritt Road and to the south by Ngong Road, bisected by Argwings Kodhek Road. T hese busy areas host many of Nairobi’s newly built apartment blocks. These are replacing the expansive 1950s and 1960s bungalows which once sat back from the wide streets bordered by high green hedges. Few of the new blocks are taller than five story and many enjoy balconies, communal swimming pools and 24-hour security staff. Kileleshwa is quieter and greener than Kilimani, Hurlingham or Ngong Road and more of the 1950s and 1960s bungalows, set in large mature gardens, have survived the property developers. However, there are some apartments blocks here too.

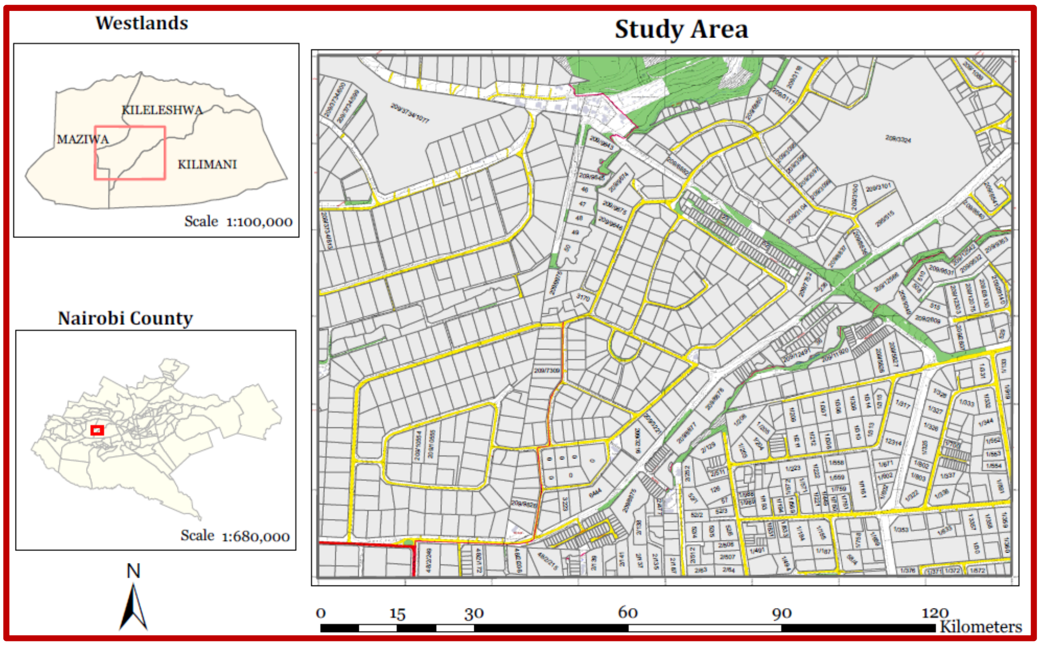

Figure 1: The study area.

2.1 Mortgage financing

The term mortgage refers to the process by which an individual or a business can purchase either a residential or a commercial property without having to pay the total value upfront. Mortgage is defined as a loan to an individual or a business for purchasing a real estate. In this case the real estate also acts as collateral for the loan. The mortgage contains two parts: (i) mortgage that is also the pledge and (ii) the promissory note which is the promise for repayment.

Virtually all mortgage financing arrangements require one to put in some equity, with the financing institution funding a portion of the value of one's new home. Most will require that one saves up for the required down payment with them, which is usually 15% to 30% of the purchase price. Paying more up-front works better in the long run, reducing the costs of the mortgage. One may also pay term deposits and various statutory fees for any transfers, charges and/or registrations to take place. As a rule of thumb, the combined legal and stamp duties work out to about 10% of the purchase price of the new home. Monthly repayments will also typically include the cost of insurance policies on the property offered as security for the loan and on mortgagor's life.

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3 Methodology

The study area was chosen on the basis that it has undergone drastic development changes for the past few years due to changing zoning ordinances and building regulations. Emergence of apartments clearly indicates that many people are buying residential houses in this area. The prices of such apartments range from Ksh. 6,000,000 and some even over Ksh. 10,000,000. It is thus obvious that mortgage market will continue to be of great concern in this region. The banking sector thus needs to collect and maintain a spatial database of all spatially referenced information about the buildings that are on mortgage and all land parcels that acting as collaterals.

3.1 Data collection

In order to have a clear view of the study area some aerial photographs were used. These had the advantage of depicting the land uses as they appear and brought about clarity.

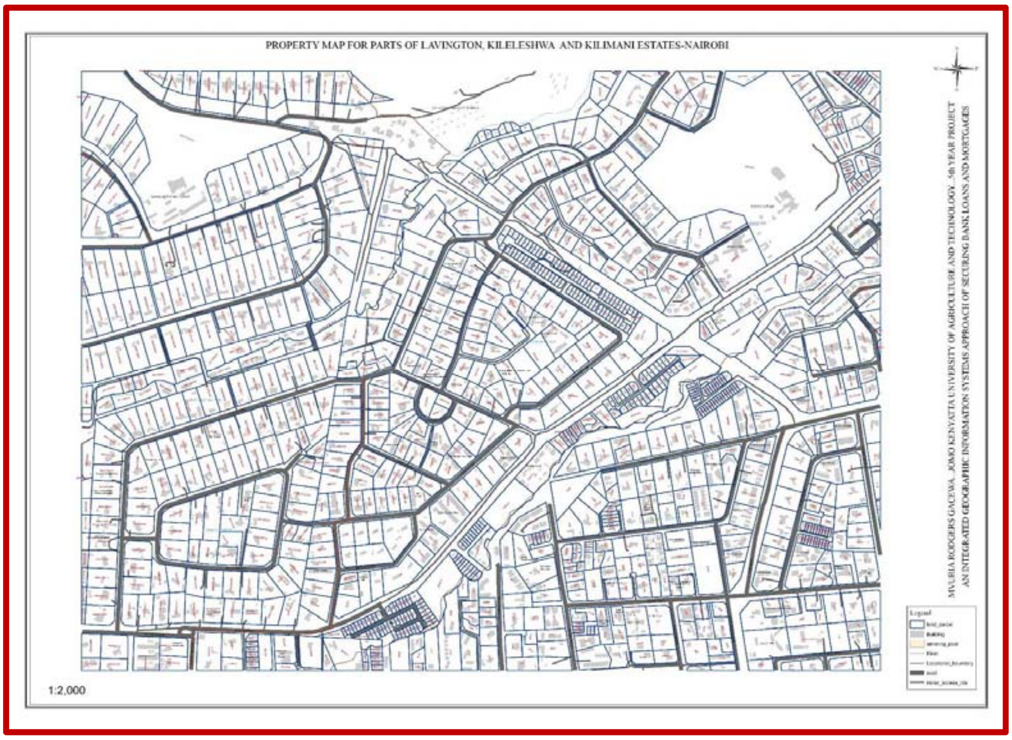

Figure 2: Digitized property map.

A topo-cadastral map (map showing land subdivisions and the topography) of the area was scanned at a resolution of 600 dpi (dots per inch) and saved. The target areas of Kilimani, Lavington and Kileleshwa estates acted as the sample size of the project. The features considered are (i) transport network, (ii) cadastral subdivision, (iii) existing buildings, and (iv) land use. Figure 2 shows the land parcels in the study area, which can serve as collateral for mortgages.

Data capture was carried out in the following ways: (i) digitizing by scanning hardcopy maps(ii) onscreen digitizing and (iii) attribute entries. The topographic maps, survey plans and building plans were scanned using a flatbed scanner. The resulting images are a digital copy of the original paper based map or plan. Onscreen digitizing was done with great care since a deviation in parcel areas would mean a lot in the final analysis. This involved digitization of line, point or area features. Once all the required features had been digitized and stored in their corresponding layers, attribute entry was done. Buildings' photographs and where possible floor layout plans were incorporated into the database in order to provide as much information as possible. In the following diagram, one can that the selected building is cut through by the boundary on the right. From visualization alone several conclusions can be drawn; number of floors, boundary case, building type, value, floor area, nearest road etc.

3.2 The conceptual system

A customer-centric business model can help address these challenges. A mortgage institution's primary function is to deliver financial services and products to their customers. In the modern world they need to be market driven and market responsive. The success of such an institution depends on its approach to data management, customer relation management. Such institutions manage a bulk of information about customers, customer profiles and much more. By incorporating 'geographical location information of real property' into their database, long range planning mixed with geographical modeling will yield tangible benefits to the mortgage finance institutions community.

Figure 3 shows the mortgage decision making process as conceptualized in this work. A GIS plays a central role tying the bank's non-spatial data to spatial data. Utilizing the bank's non-spatial data, the financial health of a client's account can be easily obtained. Using the spatial data, property information can be retrieved and analyzed based on various attributes and spatial relationships with other features. From these analyses, the mortgage or loan value can be determined. Information about encumbrances and other restrictions on a property can also be retrieved. Since all these bits of information have been stored in a single centralized or distributed database, a quick decision (in a matter of minutes) can be arrived at on whether to grant or deny the application. To aid in this decision making process, the logic captured in Figure 3 has been coded into an extension that calls up the geodabase and based on the parameters of interest (such as particular parcel, client, mortgage remaining, transaction histories) a set of decision pathways are proposed and presented to the appraiser using the system.

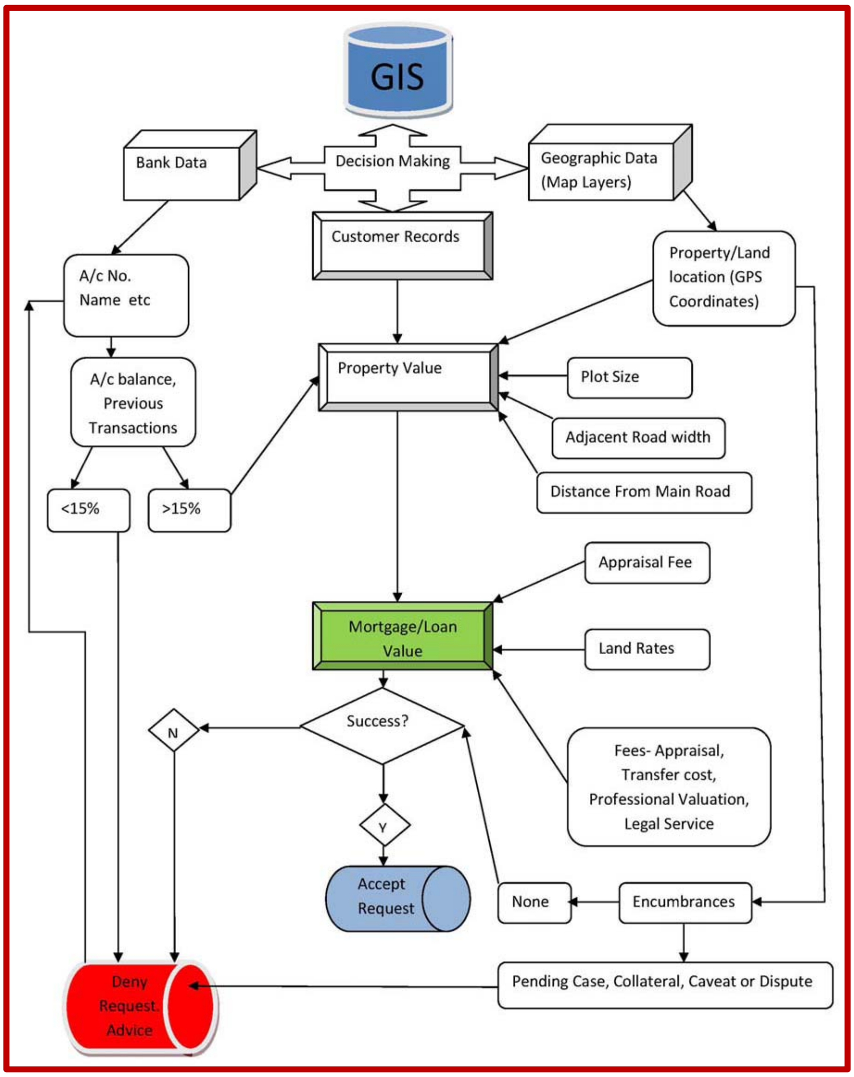

Figure 3: Conceptual model of the mortgage decision making process.

4 Results and Discussion

A pilot GIS database for real property information in Kileleshwa, Kilimani and Lavington has been developed. The database contains information on plots, plot numbers, plot sizes, plot values. Layers of related geographic features e.g. buildings, access roads and rivers are also incorporated in this database. Figure 4 shows an example of information retrieved for one land parcel and the building it contains. Managing such a bulk of geographical data including customer's bank records is hectic and cumbersome. Prior to the incorporation of the GIS, decision making required some time and even a third party consultation. Now with the GIS in place, some of the checks and decisions can be made quite easily and in a cost effective fashion.

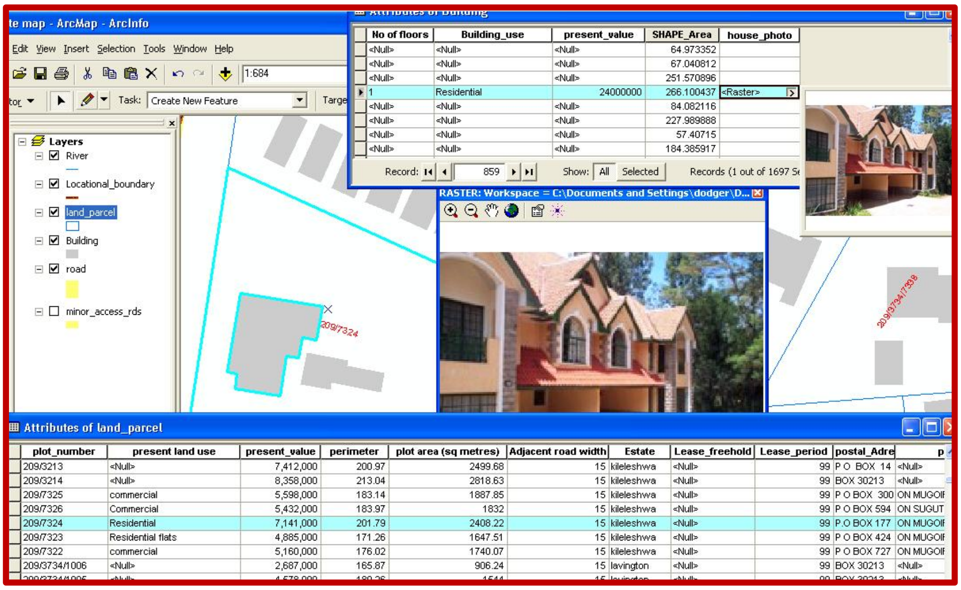

Figure 4: Retrieved geodatabase results for parcel and contained building.

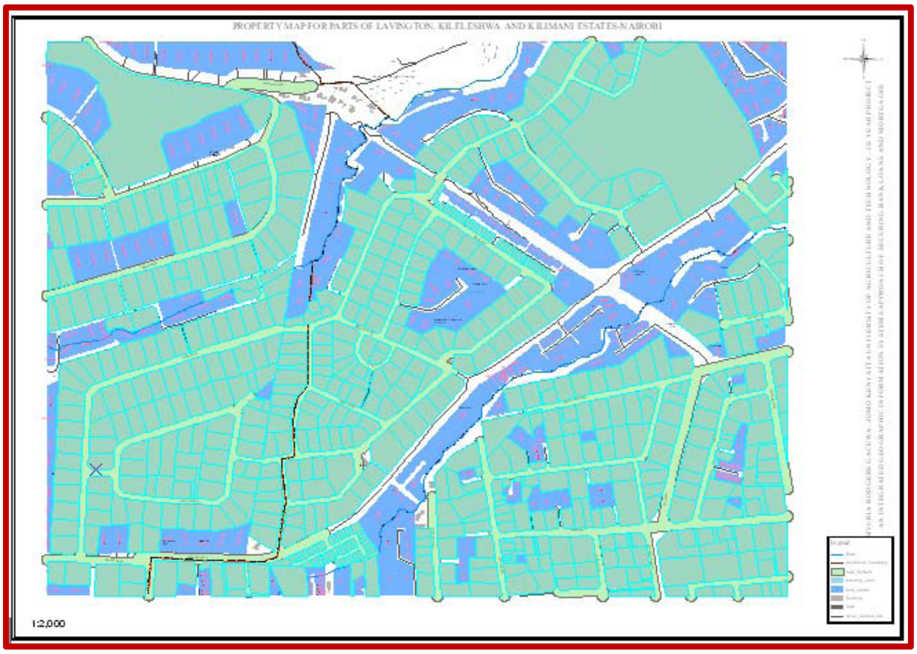

Figure 5: Accessibility levels.

In Figure 4, parcels with boundary disputes can be easily identified from the database, encroaching parcels, existing encumbrances, e.g. court orders, caveat, pending cases and other restrictions can also be effortlessly retrieved. It is evident that the distance from the main road affects the value of any property; the further the property is from a main road, the lesser the value.

Figure 5 shows the accessibility levels. These levels were determined through a 15m buffering on either side of the road. Parcels in light green color had a high proximity to tarmac road, other parcels in light blue had a lower proximity to the road. They however had minor access roads linking to the tarmac roads. For land value computations purposes, the study area was assumed to have a high accessibility level in the interest of simplicity. Eighteen properties were sold out recently in the area; these were used to make buffers at distances of 5 km.

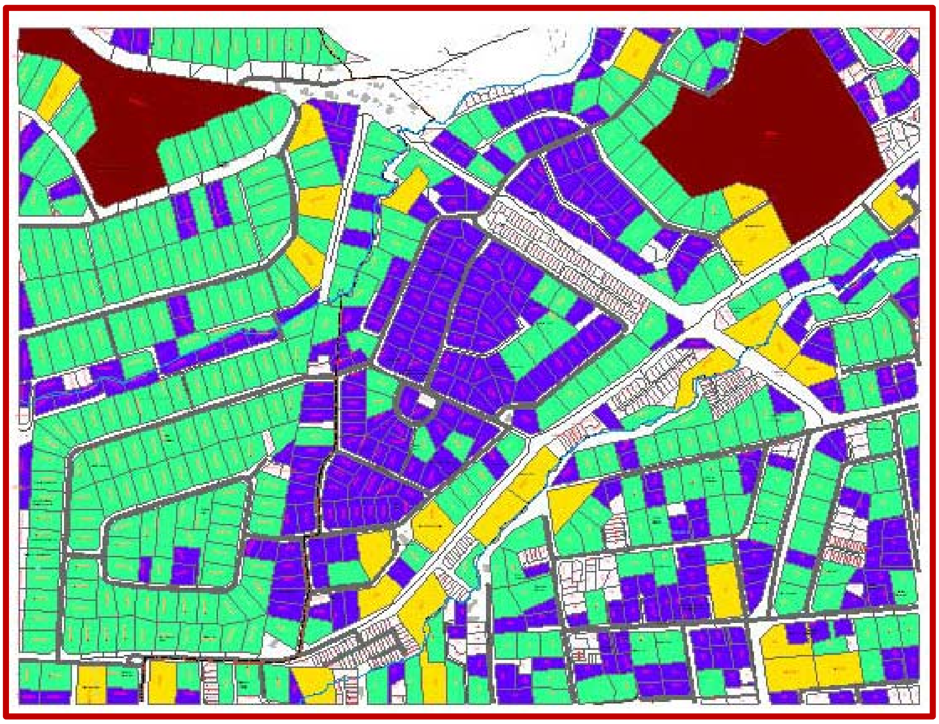

Figure 6: Property value distribution.

Buffers are rings drawn around features at specified distance from the features. These buffers were meant to determine the value of all land parcels in the study area. It was concluded that the land values were homogeneous throughout the study area. The statistics of these plot values in shillings and areas in square meters were generated. From frequency distribution analysis of these recently sold out properties, a mean value of approximately KShs. 14,790,000.00 per acre was obtained. A similarly obtained mean area of the properties was found as 4990 m^2. The following formulation (eq. 1) was used to obtain the prevailing value for a property.

$$C = \frac{\overline{C}}{\overline{A}} \times 4047 \times Ac \tag{1}$$

Where Ac = property area (in acres) A = property area (m^2) and C = value of property with the over-bar referring to mean value, with the value 4047 being the conversion factor (from acres to m^2). It is worth mentioning that in the study area, errors in area computation can have serious value implications since 1 m^2 costs KShs. 3,000.00. Based on these computations, a property value distribution map was prepared (Figure 6). It gives a clear view of prevailing land values. It is therefore easy to predict the range of any plot value at a glance. The most expensive parcels belong to Lavington Primary school and Kenton College – dark brown. The value depends on the size of the property, the larger the size the more expensive.

Figure 7 provides insight to the bank on the distribution of property that the bank needs to subject to auction – in red. The plots in purple show mortgaged property. Tracking such property with the use of Global Position System (GPS) is easy and cost effective since their positional information can be obtained from the map and imported into the GPS devices for field crews.

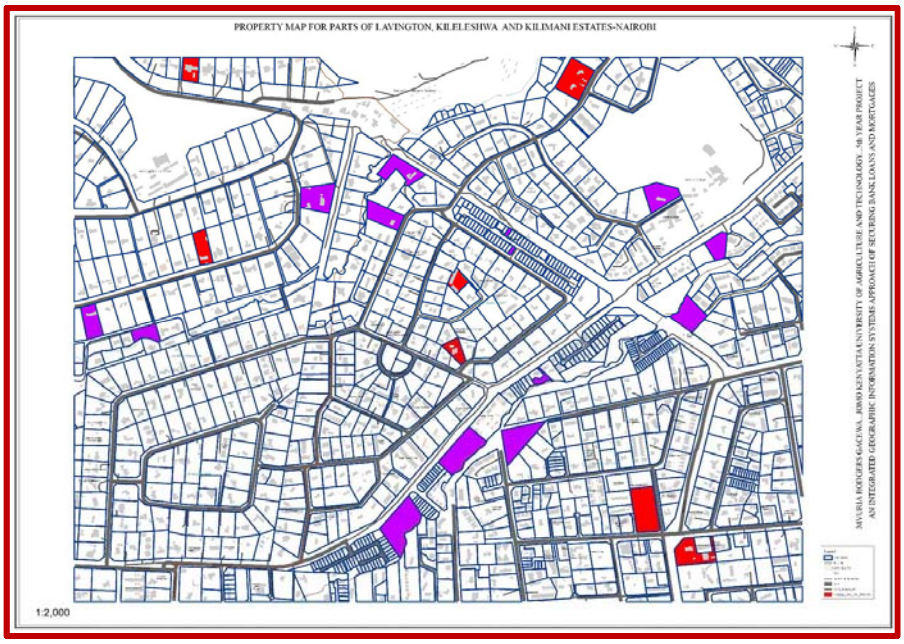

Figure 7: Mortgages approved and defaulted.

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An ArcGIS extension was developed that can be used to bring out a user interface to non-GIS appraisers. This was programmed in Visual basic and linked to the GIS database. The extension generated the interface shown in Figure 8. An account number input generated all other information related to that parcel. The database end user (bank employee) is only expected to input the account number for any customer and the program automatically retrieves all other parcel related information. All this is achieved within a GIS environment with the map of attributes in the background.

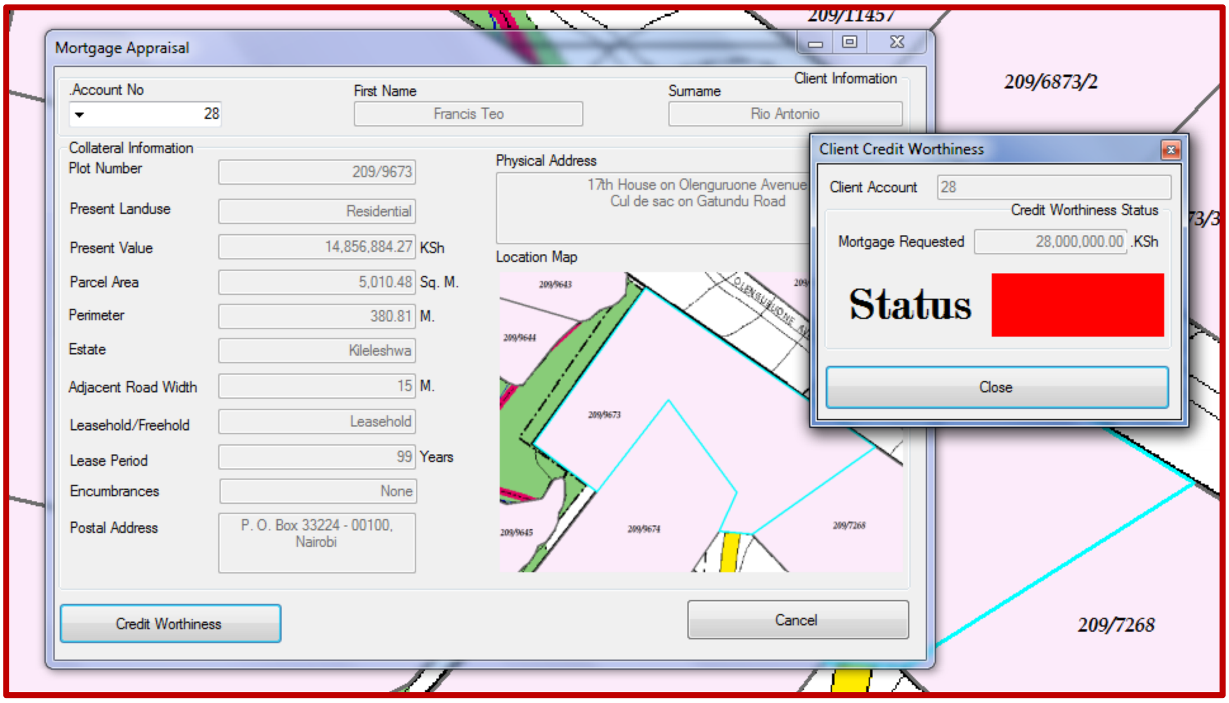

Figure 8: User interface for querying database.

Based on the amount of mortgage applied for and the credit history of a client, the application is able to flag the credit worthiness of the applicant. A healthy client is flagged with a green status, while one who either has encumbrances on the property or whose value of collateral is insufficient to guarantee the mortgage is flagged with a red status. In the case of one whose case needs further clarification an orange status is presented.

5 Conclusion

A GIS database for real property information within the study area has been developed. Attributes related to real estate were input from existing maps, with some being generated by the software such as areas and prices of land parcels. The geodatabase retrieves geospatial information from the mortgage appraiser. Performance of analysis, statistics and updating yielded the desired results. Storage and retrieval of spatial data was convenient, without a large storage capacity demands. Using the proposed system, a bank can effortlessly and efficiently manage the administration its financial products touching on spatial elements. This system has demonstrated capability of identification and tracking of defaulters, multiple loan or mortgage applications tied to the same property. It is able to process the credit worthiness of any client applying for a mortgage.

While this study has demonstrated the potential of GIS in the banking industry, banks still need to decide on the utility of GIS with respect to simplifying their loan and mortgage processing. The rapid emergence of apartments in high residential areas shows that mortgage market will continue to thrive and hence handle more geographic data. Such data needs a central storage with fast digital map retrieval capability; which is accompanied by any other related non-spatial data. This work considered data from one bank which was not linked to any other bank's data and it is imperative that a centralized system for the banking sector can help deal with rogue defaulters from other banks. Sharing of these or any spatial data among bank branches can improve efficiency and thus reduce costs.

6 Acknowledgement

The authors would like to acknowledge the Kenya Commercial Bank for providing valuable information on the loan procurement procedures and data used in this work.

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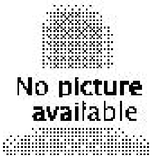

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Peer Review: This article has been internationally peer-reviewed and accepted for publication according to the guidelines given at the journal’s website.