SITE SELECTION FOR MICROFINANCE FACILITIES USING GIS
CASE STUDY: KIBERA SLUMS, NAIROBI COUNTY

BY

Eunice Akinyi Odhiambo

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A Project submitted in partial fulfillment for the Degree of Master of Science in Geospatial Information Systems, in the Department of Geospatial Space and Technology of the University of Nairobi
DECLARATION

I, (Eunice Akinyi Odhiambo), hereby declare that this Project is my original work. To the best of my knowledge, the work presented here has not been presented for a degree in any other Institution of Higher Learning.

…………………………………………     …………………
Name of student          Date

This Project has been submitted for examination with our approval as university supervisor(s).

…………………………………………     …………………
Name of Supervisor        Date
DEDICATION

This project is dedicated to my lovely Family.
ACKNOWLEDGEMENTS

I would like to thank the staff at University of Nairobi, My Professors and Lecturers at the Department of Geospatial Space and Technology for their knowledge, guidance and support throughout the course. I would like to extend my sincere gratitude to my supervisor Mr. J. Mwenda for his invaluable time, knowledge, guidance, encouragement and support in all the time of research and writing of this project. In all I have learnt and acquired many technical and analytical skills that will advance my GIS career.
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ABSTRACT

There are many Microfinance Institutions (MFIs) operating in Kenya; both licensed and unlicensed by the Central Bank of Kenya to serve the Small Micro Enterprises (SMEs) such as small retail shops, street vending, artisan manufacture, service provision, drug stores and so on. With arising need and availability of resources, it is not difficult to open a new MFI branch or agent, but to find a suitable location for the MFIs might be essential and challenging. For example opening a branch in areas with low population density may only increase administration cost without realizing benefits. On the other hand, opening a new branch in an area where there are many MFIs providing same service is also a tough business for the owners. However, to investigate a suitable site for Microfinance takes a lot of time and money. The technology of Geographical Information Systems (GIS) can help people to view, understand, interpret, and visualize spatial data in many ways that reveal relationships, patterns, and trends.

This project identifies criteria for analysis of potential site for Microfinance facilities in Kibera Slum as security, high population density, existing financial Institutions in the study area and proximity to the main roads. It applies features of GIS to create baseline information; criterion maps and analyzes these spatial data using GIS and Multi Criteria Evaluation (MCE) to efficiently choose a suitable site for new Microfinance facilities in Kibera slum, the study has demonstrated that similar techniques can be used elsewhere with good results.
LIST OF ABBREVIATIONS USED

CBK-Central Bank of Kenya
CBD-Central Business District
CDF-County Development Funds
D.O-District Officer
DTMs-Deposit Taking Microfinance
GIS-Geographical Information Systems
IFRA-French Institute for Research in Africa
KNBS-Kenya National Bureau of Statistics
MCE-Multi-Criteria Evaluation
MF-Microfinance
MFI-Microfinance Institutions
NBFIs-Non Bank Financial Institutions
NGOs-Non Governmental Organizations
PAR-Portfolio at Risk
ROA-Return on Assets
SMEs-Small Micro Enterprises
CHAPTER 1: INTRODUCTION

1.1 Background

There has been tremendous growth in the Microfinance sector over the past years, With the Kenyan Government and the Central Bank of Kenya (CBK) emphasizing financial access as a key to modernizing the economy, the sector has been strengthened by progressive policies and innovative approaches to delivering financial services (Mixmarket, 2014). Microfinance is a source of financial services for entrepreneurs and small businesses lacking access to banking and related services; it is a way to promote economic development, employment and growth through the support of micro-entrepreneurs and small businesses. Microfinance institutions commonly tend to use new methods developed over the last thirty years to deliver very small loans to unsalaried borrowers, taking little or no collateral (Wikipedia, 2014). The two main mechanisms for the delivery of financial services to such clients are: relationship-based banking for individual entrepreneurs and small businesses and group-based models, where several entrepreneurs come together to apply for loans and other services as a group. These methods include group lending and liability, pre-loan savings requirements, gradually increasing loan sizes, and an implicit guarantee of ready access to future loans if present loans are repaid fully and promptly. More broadly, microfinance refers to a movement that envisions a world in which low-income households have permanent access to a range of high quality and affordable financial services offered by a range of retail providers to finance income-producing activities, build assets, stabilize consumption, and protect against risks. These services include savings, credit, insurance, remittances, and payments (Microfinancegateway, 2014).

Microfinance institutions (MFIs) in Kenya have mainly been using their own intuitive expert knowledge for identification of potential sites for their facilities and Central Bank of Kenya prudential guidelines for Microfinance institutions (CBK, 2014). Identification of suitable areas/location for expansion and development is one of the critical issues that determine the future of these businesses in terms of growth and revenue. This project shows an automated way used to identify potential locations for MFIs in Kibera and details necessary steps taken using Geographic Information Systems (GIS) and Multi-Criteria Evaluation (MCE). GPS receiver was used to collect point related data; the data collected were layers that defined the criteria for
MFIs location purposes. Overlay analysis was done in data preparation and produced the required data; criterion maps. Finally the weighted overlay analysis was performed and the end result was suitability map with the most suitable sites.

**Study Area**

Kibera is a division, within Langata Constituency in Nairobi County in Kenya. Located at 36.40° E and 1.25° S and has an area of approximately 2.5 square kilometers (Wikipedia, 2014). It has three locations; Kibera, Laini Saba and Serangombe, the neighborhood is divided into a number of sublocations, including Kianda, Soweto East, Soweto west, Gatwekera, Kisumu Ndogo, Raila, Lindi, Kambimuru, Laini Saba, Siranga, Makina and Mashimon. The D.O.s camp in Kibera acts as the administrative centre for the whole constituency with several police camps/posts distributed within the sub locations. Kibera has a very high population density; the upper and middle class areas of Kibera have informal settlements with permanent housing along Kibera road, Karanja road, Olympic estate, Ayany estate and Fort Jesus Estate. Kibera slum has the low income end earners and the settlements are informal and semi permanent in nature, the informal settlements include Makina, Kisumu Ndogo, Lindi and Silanga villages (Wikipedia, 2014).
<table>
<thead>
<tr>
<th>Village</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Households</th>
<th>Area (Sq.Km)</th>
<th>Density</th>
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<tr>
<td>Karen</td>
<td>7,450</td>
<td>6,338</td>
<td>13,788</td>
<td>4,223</td>
<td>39.6</td>
<td>348</td>
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<tr>
<td>Kibera</td>
<td>48,001</td>
<td>39,548</td>
<td>87,549</td>
<td>28,878</td>
<td>1.6</td>
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<tr>
<td>Laini Saba</td>
<td>28,547</td>
<td>23,826</td>
<td>52,373</td>
<td>18,341</td>
<td>0.8</td>
<td>68,785</td>
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<td>Langata</td>
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<td>8,648</td>
<td>19,515</td>
<td>5,434</td>
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<td>Mugumo-Ini</td>
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<tr>
<td><strong>Totals</strong></td>
<td>185,836</td>
<td>169,352</td>
<td>355,188</td>
<td>108,477</td>
<td>223.2</td>
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**Table 1.1 Populations by Sex, Number of Households & Density**

**Source:** KNBS, 2009 Kenya Population & Housing Census
Fig 1.1 Map of Kibera
1.2 Problem Statement

In Kibera slum, the unemployment rate is above 55% with those who are employed having temporary employment in various industries in Industrial area, the remaining workers are self-employed within various small trade businesses in the area. This high unemployment mainly affects the youth of the area leading to unlawful activities which contributes to insecurity in the area (Wikipedia, 2014). Crime is rampant especially in areas with poor lighting such as along the railway line and the river banks. Crime has been reported in areas near shops, kiosks, bars and drinking clubs, these areas are among crime hotspots in Kibera slum. Mapping of the police camps, security groups, crime hotspots and security lights assists in identifying the distribution of police camps and other security groups which are responsible for provision of security in the area.

Secondly, it is difficult to operate in highly competitive areas and finding suitable location is essential and challenging. Identifying the exact locations of all the banking institutions in an area such as Kibera is time consuming. Mapping of these financial institutions by showing point data overlaid in a base map is a solution which gives exact location of these financial institutions. This facilitates the understanding of the distribution of financial facilities and possible competition among the banks in the area. Thus GIS can accurately, effectively and efficiently assist in solving the above site problems with accurate spatial data and correct analysis.

Population distribution/density is a major criterion in site analysis for banking institutions, locating microfinance facilities in areas with low population density only increases the administration and operation costs. It is easier to visualize and analyze population data in a population distribution/density map as compared to the same data in statistical/table form. The map assists in identifying population relationship, trends and distribution patterns such as densely populated areas and the area coverage in square kilometers. This information is useful in making informed decisions in location of financial facility.
1.3 Objectives

General objective of the project is to carry out site suitability analysis for microfinance facilities using Multi-Criteria Evaluation (MCE) and GIS approach. Specific objectives of the study include the following:

1. Identifying criteria for analysis of potential site for microfinance facilities
2. Develop baseline information and spatial data for the research and future use. (create criterion map)
3. Identify the potential sites for locating microfinance facilities.

1.4 Justification for the Study

The research results can be used by the microfinance institutions in Kenya to improve customer service (by bringing their services closer to the clients) and also create new market areas especially in the slum areas where there is high population and many business opportunities. The success of this study will be a significant basis for application and replication in other areas with the same characteristics and variables/criteria. Future research can utilize the methodology and tools that have been used in this study.

1.5 Methodology

This study was done to select suitable areas in Kibera slum for locating Microfinance facilities. Geographic Information Systems and Multi-Criteria Evaluation were used; GPS receiver was used to collect point related data such as Police Camps, Security Lights, Security groups, Crime hotspots, location of Commercial banks, Bank Agents, Safaricom MPESA agents, Cooperative Societies and Credit Associations. Building and Infrastructure data was acquired from Ramani Company in Nairobi, Kenya. 2009 Kenya Population and Housing Census statistical data was acquired from Kenya National Bureau of Statistics (KNBS). These data were prepared and transferred to GIS environment for overlay analysis to produce criterion maps (Security, Population Distribution, Building and Infrastructure, Current location of financial institutions and facilities). Criterion maps were used in the weighted overlay analysis to show suitable areas for location of Microfinance facilities.
1.6 Scope and Limitations

This research was conducted in Kibera slum and its environs on an area measuring approximately 2.5 square kilometers. The research dealt with spatial analysis of criteria for selecting suitable sites for MF facilities in Kibera slum; population distribution, security and existing financial institution data, and finally showed the areas that were suitable for locating a banking institution. This project does not show a building or land parcel for location of the financial facility.
2.1 What is Microfinance?

Microfinance is often defined as financial services for poor and low-income clients offered by different types of service providers. In practice, the term is often used more narrowly to refer to loans and other services from providers that identify themselves as “Microfinance institutions” (MFIs). These institutions commonly tend to use new methods developed over the past years to deliver very small loans to unsalaried borrowers, taking little or no collateral. These methods include group lending and liability, pre-loan savings requirements, gradually increasing loan sizes, and an implicit guarantee of ready access to future loans if present loans are repaid fully and promptly (Wikipedia, 2014). More broadly, Microfinance refers to a movement that envisions a world in which low-income households have permanent access to a range of high quality and affordable financial services offered by a range of retail providers to finance income-producing activities, build assets, stabilize consumption, and protect against risks. These services include savings, credit, insurance, remittances, payments, and others.

2.2 Difference between microcredit and microfinance

Microcredit is a form of microfinance that gives very small loans to a group of small traders or group of workers/individuals who have come together for financial gains and who do not depend on salaries and have little or no collateral. Microcredit focuses on encouraging better repayment discipline using a group model and charging interest rates that cover the costs of credit delivery, both of which support development of these businesses and individuals to continue to expand their services in the future (Wikipedia, 2014). Microfinance on the other hand refers to a range of financial services including credit, savings, insurance, money transfers, and other financial
products provided by different service providers, targeted at poor and low-income people.

2.3 History of the microfinance

Over the last thirty years microfinance has been recognized as one of the main innovations in the fight against global poverty. The reasoning is that, for low-income individuals, lack of capital is a critical barrier to enhancing returns from income generating activities. By easing capital constraints microfinance empowers low-income individuals to make profitable investments. It is estimated that there are over three billion people worldwide without access to mainstream financial services (Microfinancegateway, 2014). Microcredit attempts to overcome this barrier through the provision of small loans to groups of individuals who have come together to provide mutually binding loan guarantees. In working to alleviate poverty, microcredit recognizes two basic points:

- The poor live complex financial lives and is perhaps most in need of access to financial services for support.
- Individuals can be the best judge on how to improve their own situation.

The history of micro financing can be traced back as far as the middle of the 1800s, when the theorist Lysander Spooner was writing about the benefits of small credits to entrepreneurs and farmers as a way of getting the people out of poverty. Independently of Spooner, Friedrich Wilhelm Raiffeisen founded the first cooperative lending banks to support farmers in rural Germany (Wikipedia, 2014). The idea was popularized by Grameen Bank of Bangladesh with the microfinance pioneer Muhammad Yunus, who won the 2006 Nobel Peace prize for his work in the area (Wikipedia, 2014). It began nearly 40 years ago when Professor Yunus lent $27 to a group of women in Bangladesh making bamboo furniture. Formal banks were unwilling to lend to such people, who were deemed too much of a risk. Grameen Bank, on the other hand, worked on the assumption that even the poorest of the poor can manage their own financial affairs and development given suitable conditions. The instrument was microcredit: small long-term loans on easy terms, economists came to realize that the returns were good and most paid back their loans quickly. By establishing Grameen Bank in 1983, Muhammad Yunus sought to realize his vision of self-support for the very poorest people by means of loans on easy terms. The bank
has since been a source of inspiration for similar microcredit institutions in over one hundred countries.

In Bangladesh today, Grameen Bank has 2,564 branches, with 19,800 staff serving 8.29 million borrowers in 81,367 villages. On any working day Grameen Bank collects an average of $1.5 million in weekly installments. Of the borrowers, 97% are women and over 97% of the loans are paid back, a recovery rate higher than any other banking system. Grameen Bank methods are applied in projects in 58 countries, including the US, Canada, France, Netherlands and Norway. By providing financial services to those on low-incomes who lack access to formal banking, microcredit has come to fill a vital requirement in developing economies. “Many of us see the millions of impoverished people in the world as a seemingly unsolvable ‘problem’. However, we should see them as the world’s largest untapped source of entrepreneurs and consumers.” – Muhammed Yunus (Wikipedia, 2014).

2.4 Microfinance clients
A good number of microfinance clients are poor and low-income people who do not have access to other formal financial institutions; most of them lack the requirements by the formal institutions and are deemed as too much of risk. Most of these people are often self-employed, household-based entrepreneurs; their diverse microenterprises include small retail shops, street vending, artisanal manufacture, and service provision. Women often comprise the majority of clients. In rural areas, microentrepreneurs often have small income-generating activities such as food processing and trade, with many of them being farmers. Hard data on the poverty status of clients is limited (Microfinancegateway, 2014) but tends to suggest that most microfinance clients fall near the poverty line, both above and below. Households in the poorest 10% of the population, including the destitute, are not traditional microcredit clients because they lack stable cash flows to repay loans. Most clients below the poverty line are in the upper half of the poor population. It is clear, however, that some MFIs can serve clients at the higher end of the bottom half.

Over the past decade, some financial institutions have started developing a range of products to meet the needs of other clients, including pensioners and salaried workers.
Although little is known about the universe of potential clients, the number of households without effective access to financial services is enormous.

2.5 Kinds of institutions that deliver microfinance
Most MFIs started as not-for-profit organizations such as NGOs (non-governmental organizations), credit unions and other financial cooperatives, and state-owned development and postal savings banks. An increasing number of MFIs are now organized as for-profit entities, often because it is a requirement to obtaining a license from banking authorities to offer savings services. In Kenya, licensing for MFIs is done by the Central Bank of Kenya (CBK, 2014) under the prudential guidelines for institutions licensed under the Microfinance Act (Chapter 12 Part 7: 231-CBK of the Laws of Kenya) (Kaplan, 2014). The prudential guidelines, mainly provides operation/administrative guidelines for licensed banking institutions. These Guidelines includes Agent banking; licensing new institutions; the opening, relocation and closure of marketing offices and agencies of Deposit-Taking Microfinance (DTM). Generally the legislation empowers the Central Bank of Kenya to issue guidelines to be adhered to by institutions in order to maintain a stable and efficient deposit taking microfinance system.

In Kenya, there are over 60 registered MFIs (Nkugi, 2014) with only 9 registered as licensed Deposit Taking Microfinance (DTMs), these includes in order of licensing: Faulu DTM Ltd, Kenya Women Fund Trust DTM Ltd, Small Micro Enterprise Program DTM Ltd, Remu DTM Ltd, Rafiki DTM Ltd, Uwezo DTM Ltd, Century DTM Ltd, SUMAC DTM Ltd, and U and I DTM Ltd.
2.6 How does microfinance help the poor?

The microfinance sector has continued to play vital role in both developed and developing economies through provision of affordable products and services. The impact of microcredit has been studied more than the impact of other forms of microfinance (Microfinancegateway, 2014). Microcredit can provide a range of benefits that poor households highly value including long-term increases in income and consumption. A greater understanding of the underlying demand for credit and other financial products has come from recent research using financial diaries of poor families Collins and Daryl (2009). Poverty is characterized by irregular and undependable income; therefore provision of credit helps the poor to alleviate poverty by building and developing their businesses. The result is that the poor can meet their primary needs by having access to food, clothing, shelter and education.

Also Credit can make it easier to manage shocks like sickness of a wage earner, theft, or natural disasters, the poor use credit to build assets such as buying land, which gives them future security. Women participants in microcredit programs often experience important self-empowerment, there is a strong indication from borrowers that microcredit improves their lives, they faithfully repay their loans even when the only compelling reason is to ensure continued access to the service in the future.

Other microfinance services such as savings, insurance, and money transfers have developed more recently, and there is less empirical research on their impact. Client demand indicates that poor people value such services. MFIs that offer good voluntary savings services typically attract far more savers than borrowers (Microfinancegateway, 2014).
2.7 MFIs interest rates

There are concerns as to why MFIs charge high interest rates than the bank interest rates that wealthier people pay. (Microfinancegateway, 2014). Generally the reasons are:

1) Administrative cost: the cost of making small loans is much higher in percentage terms than the cost of making a larger one.

2) Loan size: it takes less staff time to make a single loan of larger amount to one person than the same amount divided to a group of individuals’ (e.g. giving KES 200,000 to one person is easier and takes less time and effort than the same amount of loan of 20,000 each for ten group members).

3) Collateral: in MFIs arrangement, loan officers are responsible for assessing the risk of each loan to be given to the borrowers who have neither collateral nor a salary, these officers normally carries out site visits to study the sustainability of the enterprises or meet with these groups of individuals in need of loans at designated places, this raises the operational cost especially where the borrowers reside far away from the MFI.

4) MFIs may operate in areas that are remote or have low population density, making lending more expensive. This is often why traditional banks tend to stay away from such areas.

Thus if an MFI wants to operate sustainably, it has to price its loans high enough to cover all its costs. Although microcredit interest rates can be legitimately high, inefficient operations can make them higher than necessary. As the microcredit market matures in a given country, administrative costs usually drop as managers learn from experience and in some cases because competition forces lower pricing and greater efficiency.
2.8 Kenyan Microfinance Sector;
Kenyan microfinance has shown resiliency despite local droughts and high inflation rates that afflicted the nation over the past years. With the Kenyan government and the Central Bank of Kenya emphasizing financial access as a key to modernizing the economy, the sector has been strengthened by progressive policies and innovative approaches to delivering financial services. Large deposit bases, along with the existence of well-developed MFIs, have allowed financial and operational expenses to remain relatively low and have led to some of the highest profitability measures in Sub-Saharan Africa. A detailed explanation of growth trends as well as relevant policy measures taken by the government can be found throughout the Kenya Country Briefing (Mix Market, 2014)

2.8.1 Overview
Innovative forms of microfinance and progressive government policies have helped to make Kenya’s microfinance sector one of the most developed in Sub-Saharan Africa. The leading contributors to this dynamic are Safaricom MPESA success in mobile banking, the passing of the Finance Act of 2010 allowing for agent banking, and the development of effective credit bureaus throughout the country.

2.8.2 Supply & Demand
A strong culture of savings has meant that MFI outreach to depositors has far outweighed outreach to borrowers, although overall loan portfolio and total deposits have both increased steadily since 2008. High product-line diversification has allowed MFIs to evolve to meet customer needs, although growth has primarily targeted an urban clientele.

2.8.3 Funding
Deposits account for nearly 70% of the funding base for the sector, with the savings of micro depositors contributing the majority of these funds. Kenyan microfinance also benefits from the confidence of many international lenders, although the largest national source of microfinance credit is Kenya itself.
2.8.4 Performance

The ability to maintain low financial and operational expense ratios has made Kenyan microfinance fairly profitable with an ROA of over 5% in 2010. High Portfolio at Risk (PAR) levels do however raise concerns about the riskiness of the overall portfolio, and whether profitability can be sustained over time.

2.9 The Government’s role in supporting microfinance

Government’s most important role is not provision of retail credit services; it can contribute most effectively by:

1) Setting sound macroeconomic policy that provides stability and low inflation
2) Avoiding interest rate ceilings - when governments set interest rate limits, political factors usually result in limits that are too low to permit sustainable delivery of credit that involves high administrative costs—such as tiny loans for poor people. Such ceilings often have the announced intention of protecting the poor, but are more likely to choke off the supply of credit
3) Adjusting bank regulation to facilitate deposit taking by solid MFIs, once the country has experience with sustainable microfinance delivery,

Creating government wholesale funds to support retail MFIs if funds can be insulated from politics, and they can hire and protect strong technical management and avoid disbursement pressure that force fund to support unpromising MFIs. (Microfinancegateway, 2014).

2.10 Entrepreneurship and Financial Access in Kibera

Despite the negative reputation of Kibera, it is a place where there is a population of young people who are Small Micro Entrepreneurs and are eager to change their lives and those of their families (Cumming, 2014) there are local initiatives and activities done by members to uplift their life status, also there are vibrant communities yearning for change towards a better life.

Micro Finance Institutions (MFIs) are often considered as the major source of financial funding or solution to the MSEs. This is seen from the fact that Commercial Banks shy away from the informal sector in favor of the corporate sector where lending risks are considered low. Access to affordable financial services has been
identified as a major problem facing Small Micro Enterprises (SMEs) doing business in Kibera. Previous research findings indicate that traders face a number of obstacles while trying to obtain credit from MFIs (Cumming, 2014). Chief among them are the lending conditions and lack of proper information on MFI services; The current MFI services available to the residents poorly suits their needs, demands for collateral that don’t exist or put pressure on families, interest rates that are too high, wait times that are too long, criteria that is too strict, groups that are difficult to maintain and the high level of risk have dissuaded youths from accessing credit from these institutions.

Therefore most SMEs operating in Kibera have formed “merry-go-rounds” groups where each member contributes towards the group fund in form of savings and later each member is allowed to borrow small loans to start or boost their businesses, these aren’t savings groups as such, but rather methods of acquiring and spending in larger amounts than would have otherwise been possible from MFIs. These kinds of microfinance initiatives (merry-go-rounds) usually fail because the investment is too small to sustain their ideas and needs. Also in Kibera, there are over seventy organizations working with adolescents and other vulnerable groups for economic and social support needs (Kalibala, 2009). Their funds originate from donor funds and local initiatives and activities such as sports, carwash business, garbage collection, culture activities such as performing songs at functions at a fee, supporting with HIV awareness campaigns and volunteering work.

Recommendations from the previous studies (Cumming, 2014) is that; MFIs should advertise their services, recruit and train competent credit officers, consider individual lending, use a bottom up approach of doing business and adopt a community based approach to Microfinance to reduce cases of default on loan repayment.

Locating MFIs within Kibera will help in providing a solution to the financial needs of the SMEs in the area in terms of growth and development, the MFIs will assist in providing the mush needed affordable loans especially to the entrepreneurs, also the youth-focused agencies in the area will benefit as they will be assisted by the MFIs to understand how to identify and grow business which remains key challenges for them. Combining local knowledge with program design, tailoring financial products to
include the most vulnerable and enabling young people to make informed financial and economic decisions that will help their transition out of poverty is crucial.

2.11 Geographic Information Systems (GIS)

Geographic Information Systems is a term applied to computerized information storage, processing and retrieval systems (Church, 2002), which have hardware and software specifically designed to cope with geographically referenced spatial data and the corresponding attribute data. The sources of such spatial data could be maps, field surveys, censuses, aerial photographs and satellite imagery. It is therefore evident that these data sets vary in format, level of detail, accuracy and reference.

GIS systems have been developing for many years on the basis of geographic data applications. In the early 1960’s, GIS started its innovation of the academy, and took its first step in the 1970’s and became a completely commercial technology during the 1980’s (Wikipedia, 2014). Currently GIS is becoming more and more significant in many related fields; it can improve the efficiency of transaction systems, enhance precision of many types of decision-making and influence building organizational strategy among others.

The use of GIS has come of age as a result of several interrelated factors (Church, 2002) first; there are many GIS software products that are available from commercial vendors and universities. Second, computer workstations are now capable of handling many of the computational, retrieval, and storage problems within a reasonable amount of time and at reasonable cost. Third, graphical displays and plotters are now sophisticated and fast, producing high-quality and high-resolution output. Fourth, geographic data vendors as well as governmental agencies especially in developed countries such as America (Bureau of the Census of the US Government) have made large amounts of geographic data available online at reasonable cost. Fifth, the use of remote sensing has expanded, especially in environmental monitoring and this has led to the need for systems that are capable of handling large amounts of data as well as serve as major source of land coverage information. Sixth, the emergence of the satellite based Global Positioning System (GPS) has made it easy to collect attribute data along with its location at relatively low cost and with relatively high accuracy. Each of these factors has contributed to the growth of the GIS industry.
In Kenya, GIS has continued to grow rapidly since its inception. There has been a major move to develop spatial data/ metadata to help in GIS related study and research by the concerned institutions. Universities and Non Governmental organizations have for example produced massive research work through GIS techniques and analysis that has been implemented in various projects to bring change needed for growth and service improvements in various organizations.

2.12 Market and Geographic Segmentation

Market segmentation is a marketing strategy that involves dividing a broad target market into subsets of consumers who have common needs and priorities, and then designing and implementing strategies to target them (Wikipedia, 2014). Market segmentation strategies may be used to identify the target customers and provide supporting data for positioning to achieve a marketing plan objective. Businesses may develop product differentiation strategies, or an undifferentiated approach, involving specific products or product lines depending on the specific demand and attributes of the target segment.

Geographic Segmentation involves segmenting according to geographic criteria— nations, states, regions, countries, languages, cities, neighborhoods, or postal codes (Wikipedia, 2014). The MFIs can use this method to identify and create products and services that best suits the needs of the poor Kibera slum residents, GIS assist in producing the data of the geographic criteria (e.g. Kibera locations) which is important for MFI marketers.

For Example: An agent may choose to target only customers from the local neighborhood, while a larger MFI can target its marketing towards several neighborhoods in a larger area covering several sub locations within Kibera Division. Geographic Segmentation is important and may be considered the first step to international marketing, followed by demographic and psychographic segmentation, the use of national borders is the institutional use of geographic segmentation (Wikipedia, 2014).
2.13 Use of GIS in MFI

In Uganda a project has been done to map the various MFIs and assess determinants of the MFIs location using GIS technology (Haverford, 2012). The basic data used were the locations of microfinance institutions (MFI’s) and their branches. Where possible, these data were amended with more detailed location information, such as town location and in some instances, specific street addresses. The results indicated that: Geographically dispersed clients raise the cost of Microfinance provision, so population densities play a large role; also it was noted that there is a concentration of MFI locations where there is high proportion of poverty i.e. high poverty density areas. Generally from this research it was evident that population densities, poverty ratios, historical conflict and access to basic conveniences such as clean water all play a role in MFI locations.

2.14 Uses of GIS for Population Estimation in Kibera

Population estimation of Kibera, often said to be the “biggest slum in Africa” was done in 2009 by the French Institute for Research in Africa (IFRA) Nairobi and Keyobs, a Belgian company using Geographical Information Systems (GIS) methodology and a ground survey. Aerial satellite image of Kibera was taken by Keyobs and designed the shape files of the buildings, the roads and rivers. IFRA conducted the fieldwork and completed the information by identifying landmarks such as clinics, schools, churches, NGOs and government offices. The field survey was conducted throughout Kibera by 12 surveyors from the community, coordinated by a supervisor to acquire better knowledge on Kibera residents Amelie and Sophie (2009). This project utilized a GIS based estimation of the population and a fieldwork household survey to collect demographic data. The results of the survey suggested that previous figures are a substantial overestimation of Kibera’s population. The results estimated that there are about 200,000 residents, instead of the 700,000 to 1 million figures which are often quoted. The 2009 census and statistics on Kibera’s population also confirmed that the IFRA findings were accurate.
Fig 2.1 Survey map used for population estimation in Kibera by IFRA, Nairobi.

Source French Institute for Research in Africa (IFRA) 2009.
2.15 Other uses of GIS

The usage of GIS in business areas have increased over the years. Many of the western countries use GIS in many kinds of applications (Elliot, 2011) including selection of new branch sites, identifying risks for closing a branch, performing targeted marketing campaigns, navigating customers toward their spatial locations, gaining better understanding into markets served among other services.

It is now common to see GIS software in use in both developed and developing countries, it is used in municipalities, states, utilities and governmental departments like fire and forest service, transportation companies and consulting. Such systems range from simple, limited systems to large and complex software systems. Many utilize commercial off-the-shelf systems, but some agencies and companies have developed their own proprietary systems especially in developed countries. There are now many trade magazines and journals that are devoted to aspects of GIS and many universities maintain special GIS laboratories and offer specialized classes in GIS.

Hanbali Nedal Al (2003), made a research in site location for Bank of Jordan in Amman. His paper discusses the criteria used in the spatial analysis and reports the success of the resultant GIS analysis to suggest proper locations for ATMs. In this project, the first phase is data collection. He collects data from all available resources such as digitized hardcopy cadastral maps, digital satellite images, GPS, and statistical data. For his analysis, these underlying layers were needed: Jordan boundaries, governorates boundaries, Amman districts and sub-districts, Previous experiences of GIS applications in banking industry main and sub-main streets in Amman, blocks and city-blocks, government organizations, commercial areas and trading centers with cinemas and theatres, commercial companies, insurance companies, restaurants, hotels and hospitals, gas stations, Jordan Bank branches layer, and the branches of all other banks with their ATMs in the entire city of Amman.

After preparing required geospatial data layers, he uses spatial analysis like spatial queries to show the trade area or the distributions of all banks in one district. Also making a buffer zone can show area that there is no bank branches coverage within a zone of certain distance. In his conclusion, using GIS technology is a powerful tool to
help banks in planning since digital maps can be used in defining the best positions for banks, ATMs, new restaurant, new stores and so on.

Geographical Information Systems (GIS) support location studies and plays a significant role in location model development and application, it has evolved into a mature research and application area involving a number of academic fields including Geography, Civil Engineering, Computer Science, Land Use Planning, Environmental Science etc.
CHAPTER 3: THEORETICAL FRAMEWORK

The main objective of the study was to suggest a model that supports decision-making to determine the optimal sites for microfinance facilities.

3.1 Tools Used

3.1.1 Hardware
System type: 64 bit operating system
RAM: 2GB minimum
Processor: Pentium Dual-Core 2.10GHz
GPS system: data collection.

3.1.2 Software
The software used for the analysis was Microsoft Excel for tables, ArcGIS 10 and the ArcGIS Spatial Analyst extension from Environmental Systems Research Institute (ESRI). ArcGIS includes a suite of integrated applications that allow one to perform GIS tasks, from simple to advanced, including mapping, geographic analysis, data editing and compilation, data management, visualization, and geo processing. It comprises of ArcMap, ArcCatalog and Arc Toolbox.

3.2 Criterion for locating MFI facilities in Kibera
The goal in a site selection exercise is to find the best location from a large number of candidate sites/alternatives, with desired conditions that satisfy predetermined selection criteria. In this project criterion for locating MFI facilities was determined by the MFIs stakeholders such as CEO, Managers and Officers who run the MFIs in Kenya and have the skills and experience in the microfinance business. Their opinions and preference were sought through personal interviews to identify the criteria commonly used in opening new branch or agent. They identified the following criteria specifically for the area of study: Kibera, which were used for this project.
1) Security which is in terms of the distance from police post
2) High Population Density (HPD)
3) Distance from Existing Financial Facilities (DEFF)
4) Proximity to Main Roads (PMR).
A site selection decision is structured according to the following steps:

1) Determining the criteria that are used in evaluating the alternatives;
2) Describing relevant criteria in decision making process
3) Developing the multi-criteria site selection alternatives
4) Evaluating the alternatives and making the final site selection decision

(Ertugrul, 2008), and are steps that guided this project to completion.

3.3 Data Layers/criterion maps

3.3.1 Security data
Point data containing location of the police camps, security lights, security groups and crime hotspots collected using GPS and used for creating security layer/map.

3.3.2 Population data
This is statistical data containing population by sex and density of 2009 Kenya Population and Housing Census done by Kenya National Bureau of Statistics which was used to create population distribution map.

3.3.3 Existing financial institutions data
Locations of Commercial Banks, Agents, Mpesa and Cooperative Savings and Credit Associations collected using GPS, and was used for creating current location of financial institutions and facilities layer.

3.3.4 Buildings and Infrastructure
This data contains information on roads, railway line, boundaries and buildings in Kibera and was acquired as a shape file from Ramani Company in Nairobi, Kenya.

3.4 Methodology
Generally the project was done using the steps below (see Fig.3.1):

a) Definition of the problem/objective (site selection for micro financial facilities) and type of facility and region of interest.

b) Definition of the potential criteria for finding the optimal sites.

c) Data collection, preparation and transferring to GIS environment.

d) Data standardization (assigning preference values to the relevant criteria).
e) Creating a model
f) Running the model.
g) Obtaining the result: suitability map for potential micro finance facilities.
h) Analyzing the results

Figure 3.1 Flow chart of the methodology.

Figure 3.2 Representation of three level structure of objective, criteria and alternative
3.5 Criterion maps for Analysis

3.5.1 Population Layer
Kibera is highly populated, being a slum many people migrating from rural to urban areas in search of employment and better life find themselves in Kibera as they look for ways to start their new life. This layer is an input to basic buffer and proximity analysis, used in the analysis of the population pattern and trends. Also the relationship between population and financial institutions can be mapped. 2009 Kenya Population and Housing Census data acquired from Kenya National Bureau of Statistics (KNBS) in a table form was used to create the population distribution map below.

3.5.2 Security Layer
Coordinates of available police posts or camps in the area were collected using GPS receiver and overlaid in the base map for buffer analysis, security lights and crime spots areas were included as part of the security data.

3.5.3 Existing financial institutions layer
Coordinates of bank branches, MFIs, mobile money agents, ATMs, and/or POS were overlaid for buffer analysis. These coordinates were collected using GPS receiver. Additionally; an increasing number of smart-phones are equipped with built-in GPS receivers. These can also assists in mapping the entire retail financial access points in the area of study.

The maps/layers are displayed below;
Fig 3.3 Population distribution map for Kibera
Fig 3.4 Security map for Kibera
Fig 3.5 Map of existing financial institutions in Kibera
3.5.4 Roads and Infrastructure data

This data was acquired from KERRA as a shape file and used in proximity analysis.

Fig 3.6 Map of Kibera showing Buildings and Infrastructure
3.6 Spatial Analysis

The analysis for this project was done by first, performing Buffer analysis for each layer separately, this involved making buffer analysis for security criterion that ranges from 0 to 200 meters which is the closest to security personnel as suggested (by MFI experts) distance from police post. Distance from existing financial institutions criterion that ranges from 0 to 500 meters and proximity to the roads which was 0 to 300 meters. This was followed by performing Euclidean distance for each of the buffered layers using the same parameters.

Reclassification for all the layers was done, This project established 6 class values from low to high, the ranking of the class values from 1 to 6 was assigned as equal interval breaks. There are some data classification methods including equal interval, quartile, natural breaks and standard deviation in GIS environment. The equal interval classification divides the total range of features into equal sub ranges. This creates an easy to understand legend and works best with continuously distributed data. This method is good for easier interpretation of data especially for familiar values, such as percentages. Finally weighted overlay analysis was done using the criteria. Below is a screenshot of the weighted overlay analysis that was done.
Fig 3.7 Weighted overlay analysis using criteria
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Priorities/Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Security</td>
<td>40%</td>
</tr>
<tr>
<td>2. High Population Density</td>
<td>20%</td>
</tr>
<tr>
<td>3. Distance from existing financial institutions</td>
<td>20%</td>
</tr>
<tr>
<td>4. Proximity to the main roads</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 3.1 Criteria Priorities/Weight
The process of combining data layers, each weighted by some factor, can now be easily accomplished in most GIS software. Some softwares provide interfaces to help determine appropriate weights. For example, the IDRISI (IDRISI, 1997) system (IDRISI is named after a medieval geographer from North Africa and is the product of Clark University) contains a module for such location analysis which involves the use of the Analytic Hierarchy Process.

This project used Arc GIS software and the criteria were assigned the weights in the weighted overlay table, the criteria were assigned weights of 20% except security that was assigned 40%; according to the MFI experts, security is an important criterion and needed to be given more priority especially considering the area being a slum which is prone to security risks.
3.7 Results

Fig 3.8 Result of the analysis
3.8 Analysis of the Result

The results of above weighted overlay analysis show most suitable areas in dark color, these areas have high population, are closer to police posts and to main roads, and are best suited for location of the MFI facilities. These areas include Ayany, Serangombe, Karanja, Laini Saba, Kisumu ndogo, Mashimoni, Kambi muru and lower parts of Soweto east.

Least suitable areas are shown in light color which represents those regions that do not fully fit the criteria; even though the regions are highly populated, they are 200 meters away from police post and exceed 300 meters from major roads. Suitability map has six class values in terms of color; The value of 1 represents those areas that are least suited for location and represented with the light color, the value of 6 indicates that new facilities can be built/located and are the suitable areas, these areas are represented in dark color.

GIS and MCE combines decision support methodology with powerful visualization and analyzing capabilities which considerably facilitate finding optimal locations of MFI facilities and this process improves the decision-making in location management.
CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 Conclusions

The project identified security, population distribution, roads and distance to existing microfinance institutions as the main criteria for locating microfinance in Kibera slum. Weighted overlay analysis demonstrated how GIS can be used to provide a spatial depiction of suitable location(s) where MFIs could establish banking facilities in Kibera. This study is useful to the MFIs and business entrepreneurs in Kenya.

MFIs would have to visit the sites for physical location analysis and infrastructure evaluation to ensure the identified suitable sites meets physical criteria such as parking space, suitable building etc.

Generally, this project demonstrates that GIS technology and analysis can assist MFIs in making informed decisions before venturing into banking opportunity thus similar techniques can be used elsewhere with good results.

4.2 Recommendations

It is recommended that:-

1) Further research is done using GIS methods to identify further criteria for locating banking institutions or to enhance the results in a project similar to this.

2) Further research is done on GIS application to improve MFI performance and customer service through location and demographic analysis.
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APPENDICES

Appendix A

A1) Buffer Analysis

Procedure

- Open the model (model builder)
- Open Arc Toolbox – Analysis Tools - proximity – buffer – select a layer as input feature – specify distance and unit of measure – click on apply – click OK

A2) Euclidean Distance

This calculates for each cell the euclidean distance to the closest source of police posts and roads

Procedure

- Open the model (Model Builder)
- Open Arc Toolbox – Spatial Analyst Tools - Distance – Euclidean Distance – select a buffered layer as input raster – specify maximum distance – click on apply – click OK

A3) Reclassification

This identifies or gives order of the most and least suitable areas in terms of values

Procedure

- Open Arc Toolbox – spatial Analyst Tools – Reclass – Reclassify – select a layer as input raster (after buffer and Euclidean Distance operations) – click on apply – click OK

A4) Weighted Overlay Model

Procedure

1) Open the model (model builder)
2) Open Arc toolbox
3) Click on Spatial Analyst Tools
4) Click Overlay
5) Click Weighted Overlay
6) Create a model of the weighted overlay and all the layers (with buffer and Euclidean distance operations).

7) Select the weighted overlay model box in the model window; this opens the weighted overlay window containing weighted overlay table.

8) Under the weighted overlay table, enter the percentage influence values of the raster. The total percentage influence should add up to 100%.