A GIS-BASED APPROACH IN THE DETERMINATION AND SELECTION OF THE MOST SUITABLE MOBILE BANKING OUTLET: A CASE STUDY OF SAFARICOM'S M-PESA DEALERSHIP

Kirui Hillary Kipngetich
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CERTIFICATION

This is my original work and has not been presented for a degree in any other university

Signature.....Date.....12/08/09.....

Kirui Hillary Kipngetich

This project has been submitted for examination with my approval as a university supervisor

Signature.....Date.....12/08/2009.....

Dr. Faith Karanja

DEDICATION

To my parents, Mr and Mrs Ngeno

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ABSTRACT

As mobile banking industry is a relative newcomer in using GIS in the developing nations, applications on the area is yet to be fully realized. This is partly due to the unavailability of spatial datasets. GIS technology provides the ability to measure proximity and location. However, use of spatial datasets from different sources, even if the datasets exhibit mismatch in scales may still go a long way in helping understand suitability analysis for the purpose of guiding broad policies in mobile banking industries in developing countries.

The overall objective of this study was to demonstrate how GIS can be used in the selection and determination of new M-Pesa outlets. More importantly it investigates how the spatial element of GIS can allow location to be modeled based on different weighted variables. The results are of crucial value in strategic policy making in the mobile banking industry. Roads data was digitized from Nairobi Toposheet. Data was also collected from the ground using handheld GPS. Reclassification, buffering and overlaying was done in order to combine all the identified variables within ArcGIS environment.

The study showed that the most suitable areas (hotspots) for new locations were those which had a relatively high number of people, infrastructural facilities as well as good level of security. These results were a clear correlation of the weighting done and importance of each element in the area. In conclusion, several proposed guidelines have been suggested for incorporation in future M-Pesa recruitment processes.

Keywords: Mobile Banking, M-Pesa, GIS, Hotspots

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ACRONYMS

ATM	Automatic Teller Machine
CBK	Central Bank of Kenya
CCK	Communication commission of Kenya
CDMA	Code Division Multiple Access
FSD	Financial Sector Deepening
GIS	Geographic Information System
GPRS	General Packet Radio service
GPS	Geographic Positioning System
HTML	Hypertext markup language
IT	Information Technology
KIMC	Kenya Institute of Mass Communication
LG	Life is good
PC	Personal Computer
RTI	Railway Training Institute
SIM	Subscriber Identity Module
SOAP	Simple Object Access Protocol
Sok	Survey of Kenya
TELCO	Telecommunication company
UMTS	Universal Mobile Telecommunication System
WAP	Wireless application Protocol
XML	Extended Mark UP Language

CHAPTER 1: INTRODUCTION

1.1 Background to the study

In the last decade computer systems which can handle large amounts of "Geographic Information" have become sufficiently powerful and inexpensive to be used on a wide scale. Currently even personal computers are well suited to be used in GIS environments. The field of Geographical or Spatial data is very wide and GIS systems can be used for many different purposes (Longley, 2006)

Some of the more important fields of application are:

- Land & Property Systems;
- Environmental Management;
- Socioeconomic Analysis;
- Telecommunications and Information and Communications Technology;
- Health.

More and more data are becoming available in digital format. Investments in the field of data communication are huge and enable the transfer of large amounts of data all over the world.

Internet and Intranets are increasing the availability of information for large parts of society. These developments change the way organizations think and act. Well designed GIS systems enable quick and easy access to these large volumes of data and enable organization to use them to gather information either for their own benefit or for the public benefit in order to:

- Provide services;
- Increase competitiveness
- Provide information.

Many organizations nowadays recognize that geographic information can serve as an important resource. A successfully implemented GIS can also enable the "non" GIS population to be more effective without increasing the complexity of their work. For instance, GIS can help dealer recruitment manager monitor performance and prioritize sites that need new branches.

It is worth noting that, the traditional tabular data has often posed great challenges to analyze and draw conclusions when it is large with common

computer programs such as Microsoft Excel. With GIS, one can easily map different datasets meeting certain criteria on a piece of paper. It becomes easy to understand how different retail outlets, for instance, stand against each other and also suggest if any geographic pattern exist (Anyolo, 2007).

With Excel, the recruiting manager would otherwise need to spend significant time and energy to understand the outlet coverage of different areas as well as understand the geographic distribution. However, with GIS, the manager has both the information – what is the performance and where they are located – at the same time in the same piece of paper. The recruiting managers often need prioritization to make decisions of allocating scarce resources. Given the volume of problem areas and given the limited resources available, a best decision need to be made. GIS permits interactive queries of information contained within the map, table, or graph. GIS coupled with GPS can be used to mapping mobile banking outlets and their assessment.

GIS with its usual capability of combining various spatial datasets with ease has enabled data which used to be represented by single parameters in lumped models to be represented by continuous spatial surface in a GIS environment. Data which were considered time and space invariant for computational convenience can now be considered a variable. This means that, it is possible to investigate how an element like insecurity can affect the performance of a given M-Pesa outlet (Nyadawa,M.O, 2008).

South B area has been chosen as a representative of the other parts of the country. It should be noted that the area has got very unique features which might not be necessarily applicable in other parts of the country. Caution however needs to be taken while applying the data to other areas especially the rural parts of the country. The methodology adopted can be employed in carrying out similar research studies.

1.2 Problem statement

The success of any business undertaking is normally attributed to the proximity of service to its customers among other factors. Nearness to a given facility or outlet is an element that needs to be well thought out when planning on the overall distribution network. Lack of proper planning will lead to certain crucial areas being left out, duplication of services and in some cases concentration of outlets in areas that do not need the service. (Longley, 2006)

Planning and decision making are complex tasks that involve looking at various parameters as a whole. Based on the degree of importance, one is able to determine the area to focus on more while leaving out an area that does not need much concentration. Spatial information makes the work rather challenging given its nature.

The recruitment of **M-Pesa** dealers has over the years been faced with serious challenges. This has been especially where geographic related information is not available. This is especially where strategic planning is to be conducted for the entire country. The absence of spatial data not only makes it tough for the policy makers in decision making but also likely to contribute to the omission of certain deserving agents and therefore marginalization in service provision.

Concentration of M-Pesa services in only certain places goes against the company's policy of being an equal opportunity service provider. This tends to harm the corporate image from the citizens who sees the company being far from them.

The recruitment procedures have also been a big challenge to the M-Pesa administration due to the existence of many clients and therefore production of many records. This fact has resulted in the consumption of a lot of office's space by the storage cabinets and other filling equipment. Even though the records are often digitized, several other documents with legal perspective are often kept in filing systems.

The other main challenge of the current system has been the lack of tangible value added map products either in electronic or hard copy. As such, the recruitment manager has all along been forced to rely on the information captured by the dealer manager and use them as the basis for recruitment. In a number of instances, data redundancies and inconsistencies has resulted as well as errors due to data entry. What if scenarios containing spatial angles have been lacking making the decision process lacking to some extent.

The registration and signing up of new M-Pesa agents has had the following limitations:

- Lack of proper geographical location and know-how of the dealer locations from recruitment managers
- Absence of maps and geographic related data showing spatial data on the locations of the dealers.

- Ad hoc reports justifying the need for recruitment of particular agents
- Lack of proper value adding reports from the available documents

1.3 Research Objectives

1.3.1 General Objective

The main goal of the research is to demonstrate how Geographic Information system can be used in the selection and determination of the most suitable mobile banking outlet using Safaricom's M-Pesa dealership as a case study.

1.3.2 Specific Objectives

This research undertaking aims at achieving several objectives. These include the following:

- To review indicators / variables that play a role in the M-Pesa localization.
- To review the role of spatial dimension in the current system of M-Pesa dealer recruitment
- To investigate how GIS can be used in the selection and determination of a M-Pesa dealer.
- To develop an M-Pesa GIS database(spatial and attribute data)
- Application of an M-Pesa GIS database in the suitability analysis.

1.4 Project scope

M-Pesa and its administration is a huge management activity in Safaricom. As such, this project will only limit itself to the role in which GIS plays in providing suitable information on selecting the best sites to locate dealer agencies. It will restrict itself to the identification, analysis and determination of the most suitable places to establish the areas to locate the dealer outlets. In summary, the study will limit itself to the following:

- GIS and selection of the best site or place to locate or setup a Safaricom M-Pesa dealer outlet.
- Way M-Pesa works
- M-Pesa as part of a product in mobile banking
- The study will only focus on the identified ***six variables*** namely: Population, security, colleges, roads and shopping centres. The reason for this is based on data availability and the fact that the variables could be mapped.

The assumptions made in the study include:-

- That mobile banking and money transfer services are the same i.e. they mean one and the same thing.
- The phrases "M-Pesa dealer, Safaricom M-Pesa agent" mean one and the same thing in this study.

1.5 Overview of the Methodology

In the study, a number of GIS hardware and software were used. ArcGIS software formed the pillar for the study as it provided the environment to carry out analysis. Data collection and editing as well as data analysis were the critical activities carried out in the research study.

The coordinate system to use was first **defined as UTM WGS84 Zone 37S.** Field data was collected using a GPS receiver. Afterwards, digitization of roads data was done on the topo sheet obtained. To correct errors generated, data editing was carried out. The Dealer manager plus the M-Pesa agents were interviewed to obtain the attribute data.

Data analysis entailed the setting of variables fitting the scope of the study. The parameters set for the study included *population, roads, existing M-Pesa points, educational institutions (colleges), Security agencies* and the *Shopping centres.* Buffers were then created to determine the appropriate distances. Classification and reclassification followed thereafter where values were assigned to areas based on suitability. Suitable areas were assigned higher values and vice versa. Suitable layers were achieved after reclassification.

Weighting of the datasets based on their impact in the site selection was carried out after the suitable layers had been achieved. The parameters with more impact were assigned higher values than the rest with minimal significance. Finally, overlaying was done to combine all the layers under consideration. Potential M-Pesa points were generated in the process.

1.6 Organization of the Report

The organizational structure of this report is illustrated in the figure below.

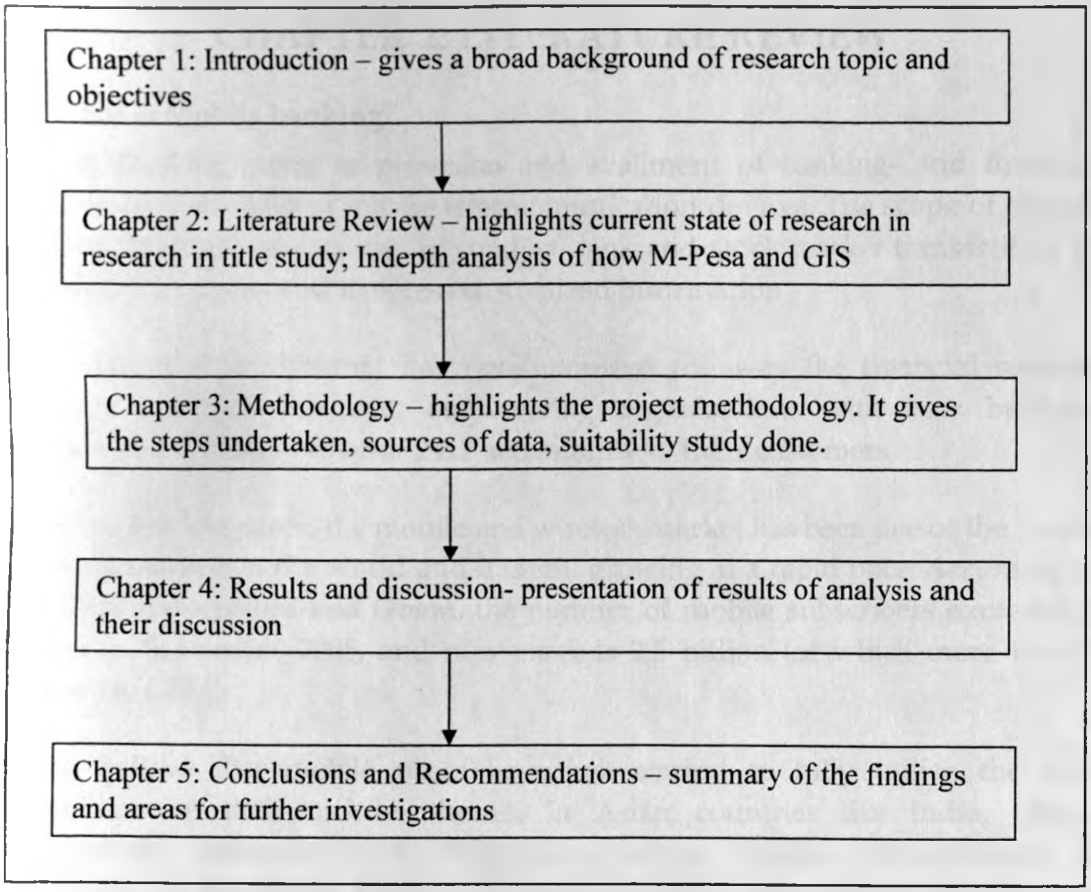

Fig 1.1 Organizational Structure of the report

CHAPTER 2: LITERATURE REVIEW

2.1 What is Mobile banking?

Mobile Banking refers to provision and availment of banking- and financial services with the help of mobile telecommunication devices. The scope of offered services may include facilities to conduct bank and stock market transactions, to administer accounts and to access customized information

The advent of the Internet has revolutionized the way the financial services industry conducts business, empowering organizations with new business models and new ways to offer 24x7 accessibility to their customers.

Over the last few years, the mobile and wireless market has been one of the fastest growing markets in the world and it is still growing at a rapid pace. ***According to the GSM Association and Ovum,*** the number of mobile subscribers exceeded 2 billion in September 2005, and now exceeds 2.5 billion (of which more than 2 billion are GSM).

Many believe that mobile users have just started to fully utilize the data capabilities in their mobile phones. In Asian countries like India, China, Bangladesh, Indonesia and Philippines, where mobile infrastructure is comparatively better than the fixed-line infrastructure, and in European countries, where mobile phone penetration is very high (at least 80% of consumers use a mobile phone), mobile banking is likely to appeal even more.

The proliferation of the 3G (third generation of wireless) and widespread implementation that was expected for 2003–2007 will generate the development of more sophisticated services such as multimedia and links to m-commerce services.

A wide spectrum of Mobile/branchless banking models is evolving. However, no matter what business model, if mobile banking is being used to attract low-income populations in often rural locations, the business model will depend on banking agents, i.e., ***retail or postal outlets*** that process financial transactions on behalf the parent company.

The banking agent is an important part of the mobile banking business model since customer care, service quality, and cash management will depend on them (***Infogile Technologies, 2007***).

2.2 Why Mobile Banking?

Internet Banking helped give the customer's anytime access to their banks. Customer's could check out their account details, get their bank statements, perform transactions like transferring money to other accounts and pay their bills sitting in the comfort of their homes and offices. However the biggest limitation of Internet banking is the requirement of a PC with an Internet connection (*GSM association, 2007).*

Mobile banking addresses the fundamental limitation of Internet Banking, as it reduces the customer requirement to just a mobile phone. Mobile usage has seen an explosive growth in most of the Asian economies like India, China and Korea. The main reason that Mobile Banking scores over Internet Banking is that it enables 'Anywhere Anytime Banking'. Customers don't need access to a computer terminal to access their bank accounts, now they can do so on-the-go while waiting for the bus to work, traveling or when they are waiting for their orders to come through in a restaurant. The scale at which Mobile banking has the potential to grow can be gauged by looking at the pace users are getting in the economy.

According to the Cellular Operators' Association of India (COAI) the mobile subscriber base in India hit 40.6 million in the August 2004. In September 2004 it added about 1.85 million more. The explosion as most analysts say, is yet to come as India has about one of the biggest untapped markets. China, which already witnessed the mobile boom, is expected to have about 300 million mobile users by the end of 2004. All of these countries have seen gradual roll-out of mobile banking services, the most aggressive being Korea which is now witnessing the roll-out of some of the most advanced services like using mobile phones to pay bills in shops and restaurants.

As mobile networks are upgraded with WAP, GPRS and UMTS to deliver next-generation multimedia services, the banks are getting ready to unleash services on mobile phones. Customers will be able to view their account statement, transfer funds between accounts, be notified of large payments or get notified of transactions above a pre-defined threshold, and will have immediate and full control over their finances. Next-generation mobile banking services will deliver significant improvements with user-friendly icon driven instructions, instant access, security and immediate transaction processing all at a lower session cost. Banks will attain higher levels of customer satisfaction and increased loyalty by providing anywhere, anytime banking. They will benefit further from lower

administrative costs, lesser number of branches, reduced headcount, streamlined call centres and lower handling charges - savings which, hopefully, will be passed onto customers.

2.3 Mobile Banking Business Models

A wide spectrum of Mobile/branchless banking models is evolving. These models differ primarily on the question that who will establish the relationship (account opening, deposit taking, lending etc.) with the end customer, the Bank or the Non- Bank/Telecommunication Company (Telco).

Models of branchless banking can be classified into three broad categories - Bank Focused, Bank-Led and Non Bank-Led.

2.3.1 Bank-focused model

The bank-focused model emerges when a traditional bank uses non-traditional low-cost delivery channels to provide banking services to its existing customers. Examples range from use of automatic teller machines (ATMs) to internet banking or mobile phone banking to provide certain limited banking services to banks' customers. This model is additive in nature and may be seen as a modest extension of conventional branch-based banking

2.3.2 Bank-led model

The bank-led model offers a distinct alternative to conventional branch-based banking in that customer conducts financial transactions at a whole range of retail agents (or through mobile phone) instead of at bank branches or through bank employees. This model promises the potential to substantially increase the financial services outreach by using a different delivery channel (retailers/ mobile phones), a different trade partner (Telco / Chain Store) having experience and target market distinct from traditional banks, and may be significantly cheaper than the bank based alternatives. The bank-led model may be implemented by either using correspondent arrangements or by creating a Joint Venture between Bank and Telco/non-bank. In this model customer account relationship rests with the bank.

2.3.2 Non Bank-led model

The non-bank-led model is where a bank does not come into the picture (except possibly as a safe-keeper of surplus funds) and the non-bank (e.g. Telco) performs all the functions. Infogile's Mogile suite of mobile applications enables financial companies in providing 'anywhere', 'anytime' transaction processing and convenience.

As per *Online Banking Report estimates, +/- 33%, Aug. 30, 2007,* originally posted at Netbanker, Motorola/CSam recently announced mobile payments announcement. His was followed by similar payments platform launches from PayPal, Black Lab Mobile Inc., Commerciant LP, Sify Ltd., Q-Pass, and SVC Financial Services Inc., It became obvious that mobile payments weren't the mere pipedream they seemed to be last year. What's less obvious was the change about to befall the payments industry, especially banking, that mobile payments embodies. Mobile Banking Forecast for US 2007 2008 SMS Banking 50,000 300,000 Mobile Website 600,000 1.5 million One Touch Banking 100,000 350,000 **Total** 700,000 2 million

In countries like Korea, two SIM Cards are used in mobile phones. One for the telephonic purpose and another for banking. Bank account data is encrypted on a smart-card chip. About 3.3 million transactions were reported by Bank of Korea in 2004. In Kenya however, most mobile phones with dual SIM cards are used to get services from different network providers.

2.4 Mobile Banking Services

Banks, money transfer firms or mobile companies offering mobile access are mostly supporting some or all of the following services:

2.4.1 Account Information

- Mini-statements and checking of account history
- Alerts on account activity or passing of set thresholds
- Monitoring of term deposits
- Access to loan statements
- Access to card statements
- Mutual funds / equity statements
- Insurance policy management
- Pension plan management

2.4.2 Payments and Transfers

- Domestic and international fund transfers
- Micro-payment handling
- Mobile recharging
- Commercial payment processing
- Bill payment processing

Fig 2.1 Mobile devices showing mobile products used by Bank of America

2.4.3 Investments

- Portfolio management services
- Real-time stock quotes
- Personalized alerts and notifications on security prices

2.4.4 Support

- Status of requests for credit, including mortgage approval, and insurance coverage
- Check (cheque) book and card requests
- Exchange of data messages and email, including complaint submission and tracking

2.4.5 Content Services

- General information such as weather updates, news
- Loyalty-related offers
- Location-based services

One way to classify these services depending on the originator of a service session is the *'Push/Pull'* nature. 'Push' is when the bank sends out information based upon an agreed set of rules, for example your banks sends out an alert when your account balance goes below a threshold level. 'Pull' is when the customer explicitly requests a service or information from the bank, so a request for your last five transactions statement is a Pull based offering. The other way to categorize the mobile banking services, gives us two kind of services – Transaction based and Enquiry Based. So a request for your bank statement is an enquiry based service and a request for your fund's transfer to some other account is a transaction-based service.

2.5 Advantages of Mobile Banking

- The biggest advantage that mobile banking offers to banks is that it drastically cuts down the costs of providing service to the customers. For example an average teller or phone transaction costs about $2.36 each, whereas an electronic transaction costs only about $0.10 each.
- Additionally, this new channel gives the bank ability to cross-sell up-sell their other complex banking products and services such as vehicle loans, credit cards etc. For service providers, Mobile banking offers the next surest way to achieve growth.
- Countries like Korea where mobile penetration is nearing saturation, mobile banking is helping service providers increase revenues from the now static subscriber base.
- Service providers are increasingly using the complexity of their supported mobile banking services to attract new customers and retain old ones.
- A very effective way of improving customer service could be to inform customers better. Credit card fraud is one such area. A bank could, through the use of mobile technology, inform owners each time purchases above a certain value have been made on their card. This way the owner is always informed when their card is used, and how much money was taken for each transaction.
- Similarly, the bank could remind customers of outstanding loan repayment dates, dates for the payment of monthly installments or simply tell them that a bill has been presented and is up for payment. The customers can then check their balance on the phone and authorize the required amounts for payment.
- Mobile phones are set to become a crucial part of the total banking services experience for the customers.
- Also, phones have the potential to bring down costs for the banking itself.

- Through mobile messaging and other such interfaces, banks and money transfer firms will provide value added services to the customer at marginal costs. Such messages also bear the virtue of being targeted and personal making the services offered more effective.
- Banks will also carry better results on account of better customer profiling.
- Another benefit is the anywhere/anytime characteristics of mobile services. A mobile is almost always with the customer. As such it can be used over a vast geographical area.

2.6. Challenges for a Mobile Banking Solution

Key challenges in developing a sophisticated mobile banking application are:

i). Interoperability

There is a lack of common technology standards for mobile banking. Many protocols are being used for mobile banking – HTML, WAP, SOAP, XML to name a few. It would be a wise idea for the vendor to develop a mobile banking application that can connect multiple banks. It would require either the application to support multiple protocols or use of a common and widely acceptable set of protocols for data exchange.

ii). Security

Security of financial transactions, being executed from some remote location and transmission of financial information over the air, are the most complicated challenges that need to be addressed jointly by mobile application developers, wireless network service providers and the banks' IT departments.

iii). Scalability and Reliability

Another challenge for the managers of the banks is to scale-up the mobile banking infrastructure to handle exponential growth of the customer base. With mobile banking, the customer may be sitting in any part of the world (true anytime, anywhere banking) and hence banks need to ensure that the systems are up and running in a true 24 x 7 fashion. As customers will find mobile banking more and more useful, their expectations from the solution will increase.

Kenya's M-Pesa has had issues of unavailability at times during peak hours. This has necessitated the need for the company to establish more robust systems capable of minimal if any downtimes.

iv). Application distribution

Due to the nature of the connectivity between bank and its customers, it would be impractical to expect customers to regularly visit banks or connect to a web site for regular upgrade of their mobile banking application. It will be expected that the mobile application itself check the upgrades and updates and download necessary patches (so called "Over The Air" updates). However, there could be many issues to implement this approach such as upgrade / synchronization of other dependent components.

2.7. About Safaricom

Safaricom Limited is Kenya's current leading Mobile Telephone operator. It was formed in 1997 as a fully owned subsidiary of Telkom Kenya. In May 2000, Vodafone group Plc, the worlds largest Telecommunication company acquired a 40% stake and management responsibility for the company. Safaricom aim is to remain the leading Mobile Network Operator in Kenya. Currently, Safaricom has been listed as a public company in Nairobi Stock exchange.

In order to achieve this, a strong focus has been placed on quality of service to its customers. Safaricom continues to implement best practices based on Vodafone's vast international experience and unique knowledge of the market conditions. The result has ensured a superior quality of service that is customer focused and of beneficial to every subscriber.

Due to the fast growing subscriber base, Safaricom has employed 2000 members of staff so as to keep up with the fast growing industry. Safaricom has also opened several retail shops countrywide. The retail shops are located in Nairobi, Mombasa & Kisumu and the major towns in the country. It also has a countrywide dealer network to handle distribution and selling of Safaricom services and products.

In the modern world of globalization, Safaricom has been able to keep pace with the global mobile telecommunication scenario by having strategic business associations; associations which add value to the global mobile telecommunication initiative and which help in meeting the dynamic challenges of the modern mobile telecommunication world. One of the major and most innovative and successful product is M-Pesa. It has worn the hearts of many Kenyans. *(www.safaricom.co.ke)*

2.7.1 Mobile banking in Kenya

With the advancement in the Information and Communication Technology, several mobile banking products in Kenya have come up. This has been largely attributed to the widespread market liberalization as well as increased competition which has seen many major companies innovating new products. In the Kenyan market the following are the major banking products in place:

- M-Pesa (Safaricom's)
- Zap (formerly sokotele for Zain Kenya Limited)

Mobile banking products will continue to increase exponentially as the years progresses. As such, more and more telecommunication firms as well as private enterprises will invest lots of resources in innovative products in order to remain competitive as well as maintain their relevance in the market.

2.8 M-Pesa

M-Pesa is a registered trademark for Safaricom's mobile banking service. It is a financial service that allows a user with an appropriate SIM card to transfer money to other people with or without an M-PESA account. It is a product which came up a result of joint partnership between Safaricom and Vodafone plc.

M-Pesa arose not only as an innovative product in Safaricom but also due to the company's intention to reach out to the unbanked population left out by the mainstream banking sector. Majority of the unbanked population resides in the rural parts of the country and therefore do not often have the benefit of getting near the urban infrastructural facilities.

The other reason for not Banking as per The FSD (2006) survey is the ***Cost***: 23% stated they could not afford a bank account CBK (2007) survey shows for banks with national coverage the average cost of operating a checking account was about $17/ month. The average cost of operating a savings account was about $8/ month while the average minimum balance on savings account was about $15 / month.

The other reason as per The FSD (2006) survey is ***Convenience***: There are 44 banks with 443 bank branches, and about 600 ATMs in Kenya. Approx 45% of these are located in Nairobi alone while 68% reported that the nearest bank was very far

away. 20% reported the nearest trading center was very far while 27% reported that nearest high school was very far.

The reasons stated has led to the innovation of such products like M-Pesa which are tailor made to suit the needs of the people. M-Pesa is a new product in the Kenyan market which has been adopted and used by a large percentage of Kenya's population. It is a money transfer service where depositor's money is kept in some Trust Fund where an independent custodian oversees its safekeeping.

As compared to similar products in the market, M-Pesa works independently. In other words, it does not have a strategic banking institution like Zain's Zap which works together with Standard chartered bank. M-Pesa uses its own authorized dealer agents in carrying out any financial transactions. In this case, several outlets plus certain Automatic Teller machines (Pesapoint) as well as certain chain of supermarkets provide M-Pesa services are part of the distribution network.

Adoption of M-Pesa Adoption rate has exceeded expectations. According to Pauline Vaughn (2007), the first 3 months: a total of 111,000 registrations were made, new 450 service points established (compared to 443 banks, 600 ATM's and 350 western union outlets). Approximately $6 million transferred person to person. (Average transfer about $45). According to Safaricom (2007), by the end of November: there were 1.1 Million registered subscribers, Almost 1,400 service points (dealer agents). The cumulative total $87 Million had been transferred. A whopping $24 Million was transferred in November alone

2.8.1 Advantages of M-Pesa

M-Pesa as brought about a lot of benefits to the nation which by far outweighs its negative effects. Some of the benefits/advantages accrued from M-Pesa are as follows:

- Provides taxes to the government
- Offers direct and indirect employment opportunities for several thousands of Kenya.
- Revenue to Safaricom limited
- Service to the citizens: convenient and cost effective way to send and receive money
- Additional means to buy and send Safaricom airtime
- A means to pay bills e.g. utility bills etc.

2.8.2 How M-Pesa works

There certain basic requirements which one is supposed to have in order to utilize the service. They include:

- One has to be a registered Safaricom subscriber
- Has an active Safaricom line
- Register for the service by providing relevant statutory documentation
- New generation sim card provided by Safaricom

The M-Pesa service has a pivotal role in Safaricom. It is a revenue generator as well as a means in helping the company retain its subscriber base.

2.8.3 M-PESA Agents

According to M-Pesa Recruitment Manager, M-PESA Agents provide services to M-PESA customers. There are over 11,000 M-PESA agents countrywide with new outlets being added daily.

M-PESA Agent's key tasks are:

- Register M-PESA Customers.
- Deposit cash into registered customers M-PESA accounts
- Process cash withdrawals for registered M-PESA customers
- Process cash withdrawals for non-registered M-PESA customers
- Customer Education
- Compliance with Safaricom Anti Money Laundering & Know Your Customer Policy
- Compliance with Safaricom business Practices
- Branding of their outlets as per provided guidelines

M-PESA Agents include:

- Safaricom authorized dealers, operating one or more outlets around Kenya
- Other retailers with a substantial distribution network like petrol stations, distributors, supermarkets and registered SMEs
- Selected Banks and Micro-Finance Institutions

Figure 2.2 M-Pesa logo

2.8.4 M-Pesa dealership

As part of its quest to offer top of the range customer service, Safaricom has established several retail centres. The retail centres play a central role in ensuring that services not provided by Safaricom authorized dealers are taken care of. So far over fifteen retail centres exists and are located in Nairobi, Mombasa, Kisumu and several major towns in Kenya.

Several other new retail centres have been planned for roll out in the near future. The retail centres also offer M-Pesa services in addition to general customer service. These centres are however not enough to cover all parts of the country adequately. As such dealership programme has been developed strategically to fill the gap.

The M-Pesa dealership forms a very powerful marketing and distribution force in Safaricom. The dealers exist all over the country. These dealers are expected to promote and sell Safaricom products and services thus ensuring that the company's national outreach and presence is not compromised. Due to the company's policy of competitive payment structure, all authorized agents are by default M-Pesa agents!

So far, over five thousand authorized dealers currently exist in the entire country. The number is however rising since a huge percentage of subscribers are still not covered by the services adequately. This phenomenon is common in the rural parts of the country and some very remote town centres.

Recruitment of M-Pesa agents is a continuous process in Safaricom. The company is constantly in the process of setting up more and more retail centres in order to gather for the ever increasing need for M-Pesa services. M-Pesa administration is

structured in such a manner that several people identify, analyze and finally approve for the recruitment of additional dealers in a given place. Of interest to the study is the Dealer Manager who is on the ground. The dealer manager recommends the need for a particular area to have an agent. In normal cases, this is done in an addhoc manner without much scientific analysis. Once recommendation has been done, the M-Pesa Dealer Recruitment Manager collates the information and interviews the dealer to see if he/she has the capacity to run the business in that area in addition to meeting the minimum basic requirements. Once certified, the dealer is given the go ahead to run business.

2.8.5 M-Pesa Outlet Categories

M-Pesa service provision is a wide and diverse activity in Safaricom. This is so because of the intention by the company to provide an efficient distribution network as well as ensuring existence of the M-Pesa product nationally. There has been a need of partnering with certain firms to ensure value addition as well as providing value addition to its potential and real customers.

There are five identified categories ***according to the M-Pesa Recruitment Manager*** namely:

- ATM based outlets
- Bank Based Outlets
- Mall based Outlets
- Authorized Dealer outlets
- Safaricom Retail Centre outlets

1. ATM based Outlets

This is the kind of M-Pesa outlet where customers are served via Automated Teller Machines. This service is solely offered by Pesapoint. In this case, customers are able to interact with the ATM wirelessly and manage to with draw money. A picture of the appearance of the facility is a shown below:

Figure 2.3 Pesapoint outlet offering M-Pesa services

2. Bank Based M-Pesa outlet

This is the kind of outlet where Safaricom provides M-Pesa service in partnership with a bank. There are several banks which have joined hands with Safaricom in order to provide the service. Examples include; Equity Bank, Housing Finance, Family Bank, Gulf Bank among others. Customers are able to withdraw money in their phones directly from the banking hall. A dedicated counter is normally set aside for the M-Pesa customers. The other dealers also purchase float from the banks.

3. Mall Based Outlet

This type of outlet is one where the M-Pesa site/outlet is located at the mall. A good example of this is one such as the Capital centre, Village market, Westgate, Sarit centre among others. The target in this case is normally the shoppers visiting the area. The example below is one for Capital Centre mall.

Figure 2.4 Entrance to Uchumi capital centre (mall) offering M-Pesa service

4. Authorized dealer agents

These are M-Pesa who have been given the mandate by Safaricom to carry out M-Pesa activities on its behalf. These outlets from the bulk of M-Pesa agents in the country. An example is one indicated below:

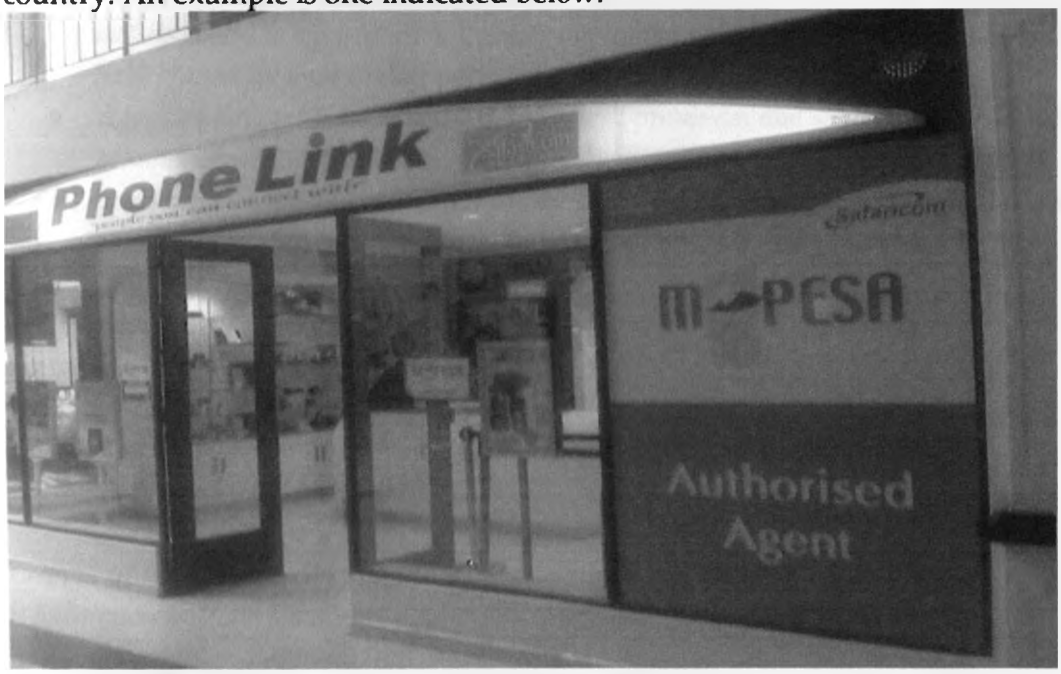

Figure 2.5 Phonelink: authorized M-Pesa dealer

5. **Safaricom Retail Centres**

By default, Safaricom care centres are M-Pesa outlets. These are Safaricom main braches which offer services not provided by any other mentioned outlets. These outlets are located in major towns of the country. Safaricom is currently expanding the retail outlets countrywide.

2.8.6 Criteria for registration of new dealers

Over the years , the registration of new Safaricom M-Pesa dealers has been done based on reports obtained from statistics often collected by the dealer managers on the ground. The dealer managers often compile reports and forward them to the dealer recruitment manager who determines if a M-Pesa dealer agent can be recruited or not. This can only be done once some minimum basic requirements have been fulfilled. The requirements have been divided based on the different categories identified. These categories are aimed at meeting certain unique areas. They include the following: *(www.safaricom.co.ke)*

A) STANDARD REQUIREMENTS

I) Minimum Agent outlets

- *Prospective agent must be a* ***LIMITED*** *Company or equivalent with at least 3 outlets ready to offer M-PESA under the company names. The company* ***MUST*** *have traded for a minimum period of 6 months*
- *Agent outlets must be in at least 2 different provinces and shall be audited prior to commencement of business.*
- *Only applications for outlets in opportunity areas will be considered.* ***The outlets must be located outside Nairobi with the exception of the Head Office***

a) SPECIAL CATEGORY

Circumstances of appointment of special agents:

a) Remote locations (a radius of 50-80km from an existing M-PESA agent)

b) Temporary agents for special purposes – to be approved from time to time.

c) Unique operations (Hospitals)

Copies of the generic documents apply to this category

i) Minimum outlets: 1 outlet

ii) Minimum float: Kshs 200,000 per outlet

- *Copies of IDS of Office Administrators and Primary Assistants as indicated in the application forms*
- *Completed agent application forms*

b) GENERAL REQUIREMENTS – FOR ALL PROSPECTIVE M-PESA AGENTS

i) Premises and their Maintenance

An M-PESA agent must conform to our branding and merchandising policy. The minimum branding requirements will be
Supplied to you on commencement of business.

ii) Staff

The agent should preferably employ competent staff with minimum of KCSE to handle the service.

iii) Technical Requirements

The agent head office must have the following equipment to ensure that operations are conducted in a professional manner:

(a) 1 Computer and ancillary equipment approved by Safaricom. At least 512 MB with Windows 2000.
(b) At least 2 people to handle head office operations on a day to day basis ***(not on a full time basis).***
(c) Internet connectivity with good connection speeds
(d) 1 printer for printing downloaded reports.
(e) Any other items/equipment necessary to conduct the business like desks hairs, stationery, pens and a pay point.
(f) A telephone line either landline or mobile for contact.
(g) Official E-mail contact.
(h) ETR Machine

2.8.7 Role of GIS in mobile Banking

Due to its ability to permit interactive queries of information contained within a map, GIS can be utilized in supporting effective and efficient decision making. In the emerging market of mobile banking, GIS can be utilized in the following ways:

- Deciding on the most suitable areas to locate customer retail outlets
- Together with ICT, applications can be developed and loaded onto mobile phones in order for customers to utilize the service
- GIS can be utilized in producing maps showing areas offering particular specialized mobile banking needs. A good example is a map showing the

malls and the kind of services offered in each mall e.g. Withdrawal services only (Pesapoint)

- GIS can be harnessed in a company to aid top management in making strategic decisions. A good example is where a company wishes to merge with another company which has a wide network/distribution coverage. GIS will be able to evaluate the distribution network and produce information which would guide the leadership on the position to take.

GIS has a massive potential to revolutionize mobile banking industry. This is more so given the introduction of Fiber Optic cable in Kenya which will see more mobile banking products emerging. The immediate effect will be a reduction in the prices of usage. With the liberalization of the mobile banking industry, use of GIS will be an effective tool to be adopted by companies which aims at curving a niche for themselves as well as fighting competition.

2.9 Success Stories

Mobile banking is a rather new concept in the developing nations especially in Africa. In the developed worlds, the concept has however been adopted and the industry is in its stages of full adoption. The reason for the slow introduction in Kenya and in Africa as a whole is mostly due to the rather slow pace of technological advancement. There is however rapid take up of the service in the Kenyan market.

In mobile banking, application of GIS is yet to fully develop as is the case with mainstream banking. Its exploitation has rather been vague as opposed to professional utilization. Adoption has been mostly in areas of map creation where maps are produced to show a general view of the service coverage, location of existing outlets among others. Use of GIS to decide new a location is an area that has generally not been explored.

Some of the mobile banking success stories are explained below:

LG Telecom, South Korea

In terms of the evolution of services being offered on mobile applications, South Korea is showing the way. The big push came when LG Telecom Ltd., the smallest of Korea's three mobile service providers teamed up with the Kookmin bank to launch the 'Bank on' service. Under this scheme mobile users were able to use smart chips embedded in cell phones for accessing all of the transaction and enquiry based services. The chip-based service automated the authentication of users when they accessed their bank's financial services to make the whole process much faster and convenient. The icing on the cake came with the ability of these chip enabled cell phones to be used simultaneously as cash cards. By October 2004 there were already about 100,000 infrared readers adapted to take payment directly from mobile phone handsets in Korea. Users can now use their cell phones to pay for everything, from restaurant bills, travel tickets, merchandise and even haircuts.

Reliance Communications, an Anil Dhirubhai Ambani Group company, has announced introduction of money transfer through mobile phones across India with the help of ICICI Bank ***as a joint venture partner***. This new facility for the subscribers of Reliance Communications is an easy to use alternative for account-to account transfer of money which is normally associated with banks and other agencies. The money transfer market, according to R Comm, is more than $24 billion annually including global transfers to India. This will help customers having accounts with ICICI Bank to send and receive money anytime anywhere using Reliance mobile phones. The service is made available to the masses on Reliance mobile world enabled phones.

Reliance Infocomm, India

When Reliance Infocomm, India rolled out its CDMA network, (at the time the mobile market in India was still in its infancy, and data services were almost never heard off) it made sure that all handsets supported Java. The Reliance application platform, also known as R-World brought Java compatibility even to the lower end phones..

Instead of storing applications statically on their cell phones, users access a single menu based application called R-World, which connects them to the Reliance servers. Using the menu based user interface, mobile users select the application, which they want to run and download them over-the-air to their cell phones. These applications are then executed locally on the mobiles. From mid-2004 Reliance tied up with two of the popular private sector banks, HDFC and ICICI,

to provide a host of their enquiry and transaction based mobile banking services through its R-World environment.

2.9.1 Conclusion

Mobile banking is poised to become the big killer mobile application arena. However, banks going mobile the first time need to tread the path cautiously. The biggest decision that banks need to make is the channel that they will support their services on. Mobile banking through an SMS based service would require the lowest amount of effort, in terms of cost and time, but will not be able to support the full breath of transaction-based services.

Mobile application standalone clients bring along the burden of supporting multiple mobile device profiles. ***According to the Gartner Group,*** mobile banking services will have to support a minimum of 50 different device profiles in the near future. However, currently the best user experience, depending on the capabilities of a mobile phone, is possible only by using a standalone client.

Mobile banking has the potential to do what E-mail did to the Internet. Mobile Application based banking is poised to be a big m-commerce feature, and if South Korea's foray into mass mobile banking is any indication, mobile banking could well be the driving factor to increase sales of high-end mobile phones. Nevertheless, Bank's need to take a hard and deep look into the mobile usage patterns among their target customers and enable their mobile services on a technology with reaches out to the majority of their customers.

Banks and telecom companies can collaborate to offer the latest in banking services to the unranked in rural areas. Mobile banking is the evolutionary step after Internet banking. It is an additional service bolted on top of an existing solution, making access to services more immediate and reducing customer reliance on branch infrastructure or access to the Internet. As customer confidence increases over the security, it is expected that mobile phones will be the most preferred and convenient device for conducting banking transactions and emerge as one of the major payment channels in India.

The existence of well located outlets will not only make the mobile banking service provision efficient but also ensure that effectiveness is achieved in the delivery of customer service as well as ensuring that the available space and facilities are well utilized. GIS will go along way in providing informed decisions to policy makers. Adoption of GIS in recruiting of mobile banking agents is something whose time is long overdue.

2.9.2 Terminologies

General terms/acronyms:
MMS >>> Multimedia messaging service: An evolution from SMS, allowing messages to contain multimedia objects such as images, audio, video, and rich text.
CSC >>> Common short codes: Special short telephone numbers of just four to six digits used typically by businesses to make it easier to send text messages their way. E.g. 2124; 8040

WAP >>> Wireless Application Protocol: An open, international standard for applications that use wireless communication; primarily used to enable Web access from mobile devices

Mobile IM >> Mobile instant messaging: Similar to desktop instant messaging, but slimmed down to fit on a much smaller mobile device screen

SMS or text alerts >> Simple one-way messages from the financial institution or payments provider to the mobile user with account-specific information

Mobile payments >> Payments initiated through a mobile device, could be via SMS, WAP, or a device-specific application.

Mobile banking >> Online banking functions performed via a handheld mobile device (PDA, cell phone, etc.); the general term that encompasses WAP Banking, SMS Banking, or True Mobile Banking.

WAP banking >> Accessing secure online banking functions through a mobile device's browser.

SMS or text banking >> Two-way messaging; for example, using text messaging to query the server for account-specific information and have it returned to the mobile device, or responding to a bank-initiated text message to initiate a transaction

True mobile banking >> Term used for banking functions delivered through a downloaded application run locally on the mobile device
The customers can also request for additional information. They can automatically view deposits and withdrawals as they occur and also pre- schedule payments to be made or cheques to be issued. Similarly, one could also request for services like stop cheque or issue of a cheque book over one's mobile phone.

Economic activities

The main shopping centre comprises of several businesses most of which are small scale micro enterprises. The major activities carried out in the centre include: butchery, bar and restaurants. The Capital Centre is a business hub in the area. The place is situated along the busy Mombasa road and sits next to the South B police station. The place is a shopping centre with a wide variety of business units. The major ones include Uchumi supermarket, several ATMs, Diamond trust Bank, Dormans coffee and several other food and restaurants

Population

South B is made up of two sub-locations Nairobi South and Hazina both in Mukuru Nyayo Location. The cumulative population for the locations is: 36,232 i.e. Nairobi south (23460); Hazina (12772)

Educational Institutions

Railway Training Institute, is a college in the study area with a student population of between 5,000 and 8,000. Under normal circumstances, the students in the Institute study in college for nine months in a year. As such, the place is characterized by a high number of people in the area all year round. Over 50 percent of the student population own a mobile phone. ***Kenya institute of Mass communication*** is also situated in the area and is to the north western part of the study area. It is adjacent to Mombasa road and the south B shopping centre.

Infrastructural Facilities

South B has got a relatively good transport network. It is characterized by a Mombassa Road to the south, and several feeder roads to the north and central part of the area. Most of the roads are all weather and tend to serve the residential areas. The major road in the area is Kapiti road that joins the shopping centre to Mombasa Road. Aoko road also Joins the shopping centre to Hazina estate and provides access to Mukuru Slums.

Security

South B has generally a good level of security as compared to other parts of Nairobi City. Police station and two chief camps have been identified in the area as the existing security agencies.

3.2 Suitability Analysis

This section describes the processes carried out in the research project. It gives an in-depth into the tools and equipment used; software as well as the various procedures done in order to achieve the required output.

Resources Used:

GPS Receiver

The handheld GPS receiver was used to pick the geographic locations of the M-Pesa outlets and physical addresses on the roads and streets.

GIS Hardware

This included the following:

- Laptop (Pentium IV, 80 GB hard disk),
- Inkjet printer,
- Flash disk (512MB ram),
- Scanner
- Camera(2.0 Mega pixels Minimum)
- Optical disks.

GIS SOFTWARE

In the study, the major software used was ArcGIS version 9.2 and its various extensions including ArcGIS Spatial Analyst. The three main applications of interest in ArcGIS are: ArcToolbox, ArcMap and ArcCatalog. Adobe Photoshop software was used in cleaning the scanned image.

ArcMap was used to display spatial data. It was also used to create, edit, query and analyze maps. It offers many ways to interact with maps such as exploring, analyzing, customizing and presenting results.

The ArcGIS Extension used was the Spatial Analyst. Spatial Analyst tools can easily perform analysis on the data such as answering simple and complex spatial questions such as the best location for a new facility, or the least costly path from point A to B (*ESRI, Spatial Analyst Tutorial 2006*).

In the study, ArcGIS Spatial Analyst was used to determine the most suitable location for an M-Pesa outlet using overlays.

3.3 Mapping of existing M-Pesa outlets

The study involved both office and fieldwork. Fieldwork concerned the researcher visiting the M-Pesa stations and picking their geographic coordinates using hand held GPS. Attribute data was obtained from the M-Pesa stations' attendants. Office work involved collection of all relevant information from existing maps, reports, digital data and historical documents.

The toposheet was acquired from the Survey of Kenya. The topo sheet number is 148-4 which covers the whole of Nairobi including south B.

The primary data collected for the database required editing. ArcGIS suite application ArcMap was used for editing the data. For example, attribute table of the digital M-Pesa points did not have all the names and labels.

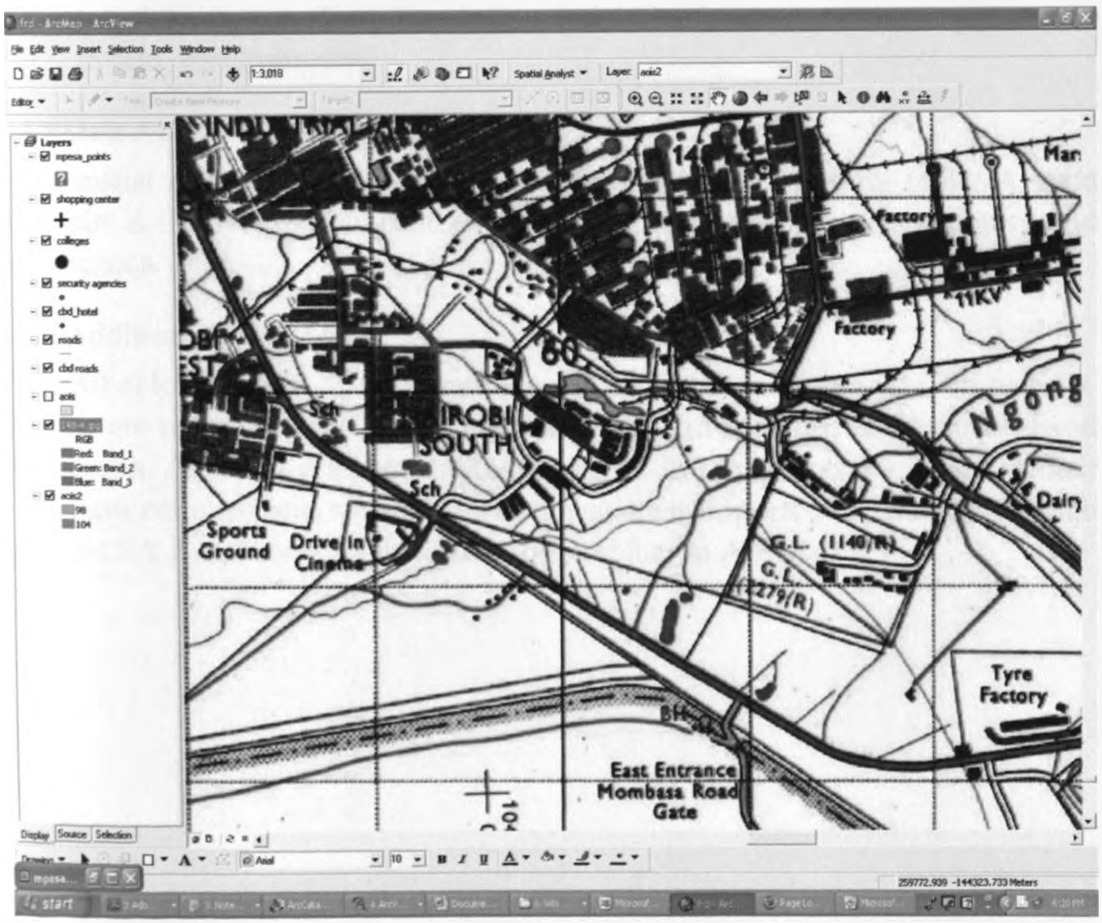

Fig 3.1 Toposheet showing the area of study

3.3.1 Data preparation

The topo sheet was georeferenced to a common projection UTM WGS84.

3.4 DATA

Data collected are of two different types

(a) Spatial data

The positions of the M-Pesa outlets were captured using GPS receiver and a digital map created on the Topomap environment. Nairobi topomap data was acquired from Survey of Kenya (SOK). The spatial data includes roads, shopping centres, M-Pesa points, security agencies, colleges and sub location boundary.

(b) Attribute data

Attribute data was collected from M-Pesa agents and linked to the map to make it intelligent. The attribute data included M-Pesa agent name, transactions per day, category and Location. Updating the spatial data regularly is a quality process that should be followed so that it reflects the recent developments.

3.4.1 Data Attribute Identification

Non spatial data of the shape file were added in the attribute table. A good example is the M-Pesa shape file which includes attributes like category and transactions.

3.4.2 Addition of GPS Data

The spatial locations of M-Pesa centres were picked by a hand held GPS receiver. These were recorded in the interview schedules and recorded in Microsoft Excel workbooks. All other relevant data with regard to the centres was filled in their respective columns and saved. This data was then imported to ArcMap through the Add X Y data functionality in the Tools toolbar in Arc Map.

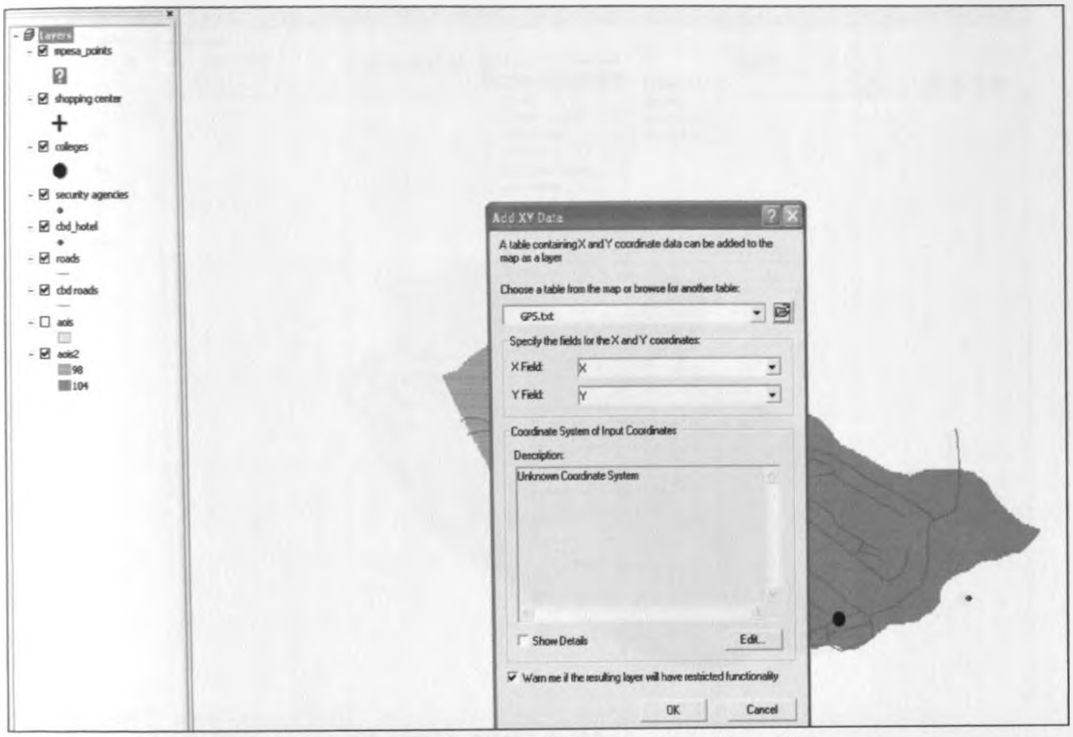

Fig 3.3 Adding GPS points using ArcMap XY data functionality

3.4.3 Manipulation

The working environment was ArcGIS. Data frames were prepared for all the major layers in the project i.e. M-Pesa points, road network, population, educational institutions, security agencies, shopping centres.

3.4.4 Data cleaning

This aims at removing errors generated while digitizing. These errors included undershoot, overshoot and overlay. Topology of the dataset was build as shown below to remove errors.

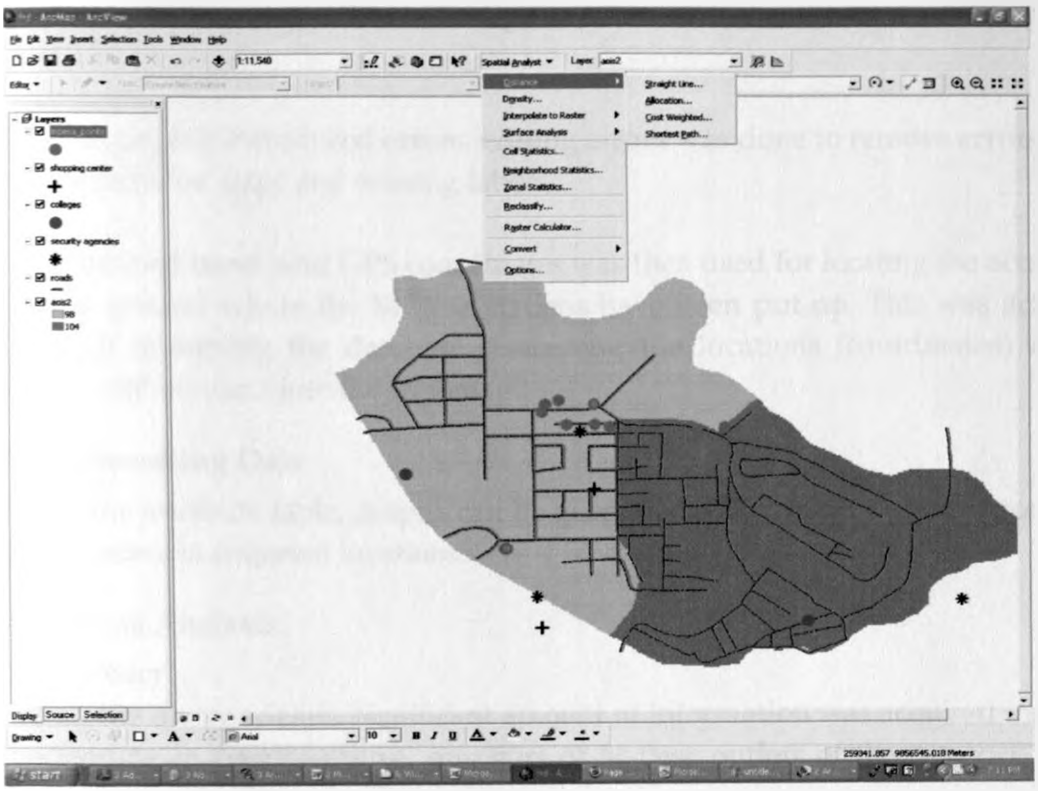

Fig 3.4 Data cleaning illustrated

3.5 Sources Of Data

3.5.1 Nairobi City Topomap

This would be used to form the base map and will be acquired from SoK.

3.5.2 GPS Positional data

The M-Pesa outlet locations were collected using the GPS by visiting the points on the ground.

3.5.3 Attribute data about the M-Pesa points

This information was collected from the M-Pesa attendants

3.5.4 Information on the mobile banking

This information was obtained from documentations from the Safaricom website and CCK, Ministry of information and also from Central Bank of Kenya (FSD).

3.6 Data Capture

The Nairobi Topomap was scanned and brought into a GIS environment. It was

then geo referenced and the roads digitized. Georeferencing was done using ArcGIS.

Since digitizing introduced errors, editing errors was done to remove errors. Such errors included gaps and missing labels.

The obtained hand held GPS coordinates was then used for locating the actual site on the ground where the M-Pesa stations have been put up. This was achieved through importing the database containing the locations (coordinates) among other attribute data into the topomap.

3.6.1 Processing Data

From the attribute table, graphs can be generated to show the performance of M-Pesa outlets in different locations.

3.6.2 Data Analysis

Data query

Using the query wizard, significant amount of information was acquired instantly by feeding in commands i.e. numbers of M-Pesa outlets of the category "ATM based outlets"

3. 7 Application of M-Pesa Database for suitability Analysis

After preparing all layers in ArcMap, it was an optimum time to utilize GIS to determine suitable area to locate new M-Pesa centres within the area of study in relation to the parameters to be used i.e. road network, population, colleges, existing M-Pesa outlets, security agencies and shopping centres.

The tool used for the study was Spatial Analyst Tool of ArcGIS.

The following steps were involved

1. Problem was stated i.e. locating suitable site for new M-Pesa outlet
2. A combination of data sets was done to come up with suitable sites. The following dataset was put into consideration:
    - Population
    - Security agencies
    - road network
    - colleges
    - shopping centres
    - existing M-Pesa points

The data set were then overlaid using ArcMap spatial analyst tool.

3.7.1 Population Data

The *Fig 3.5* below shows the population distribution of Kenya for Mukuru-Nyayo location as per the population census of 1999. The Kenya administration boundary was used to define the boundaries.

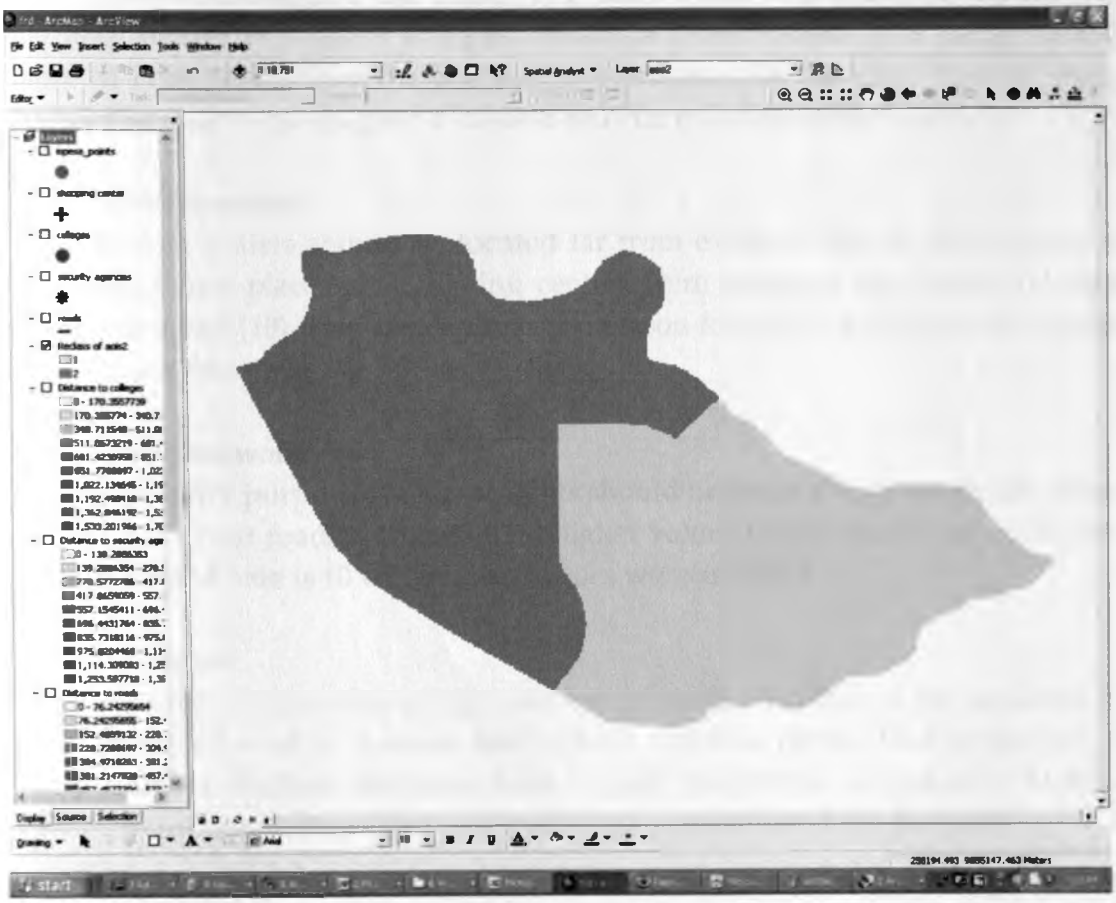

Fig 3.5 Population data distribution

NB: A lot has really changed since the 1999 census in terms of the population. As such, it might not be a very true picture on the ground.

3.7.2 Buffering

Buffers were created using the following data sets; population, security agencies, roads network, colleges, shopping centres and existing M-Pesa points. For this study, *M-Pesa points* datasets (as shown in *figure 4.6)* will be used for illustration.

3.7.3 Reclassification

Reclassification refers to the process whereby the suitable areas are assigned higher values while the unsuitable ones are assigned low figures.

- **Population**

Places having high population were assigned high value (2) and places with less population were assigned low value (1) as shown below. In this case, the areas in the map whose population is higher stands a better chance of it being located more M-Pesa outlets than the one with a lower one. In this case, Nairobi South Sublocation has been assigned a value 2 and Hazina sublocation a value 1.

- **M-Pesa points**

New M-Pesa outlets should be located far from existing once so as to improve coverage, hence places near existing centres were assigned low values (1) than places far away (10) from the centres. The reason for this is simply to discourage competition and make the outlets efficient.

- **Road network**

For accessibility purposes, M-Pesa points should be located near the roads. Areas accessible or near roads were assigned higher values than those far away. Higher value assigned here is 10 while lower values were assigned 1.

- **Colleges**

Colleges form blocks with a high number of students. Most of the students in colleges are allowed by Kenyan law to have a mobile phone. Due to this fact, a good number of these students form a good proportion of potential M-Pesa users.. Areas near colleges were assigned high values than those far away.

- **Security**

M-Pesa service involves money. As such, security is paramount for its success. The presence of security agencies in the area makes the place a good one for the establishment of the M-Pesa outlet. South B police post, Hazina sub location Chief's camp as well as Nairobi South sub location chief's camp have been considered in the study.

- **Shopping centre**

There are two major shopping centres in south B. they are south B min shopping centre and capital centre which is along the main Nairobi Mombasa highway.

Most residents in and around south B visit the two places when running their errands.

3.8 Overlays (Combination of all the Reclassified datasets)

Using the raster calculator, the shape files were overlaid and weighting was done based on the impact/significance of the parameter on the selection of a suitable location for M-Pesa site.

Weighting was done as shown in the table 3.1:

Data set	Weights
Population	0.25
Colleges	0.20
Roads	0.20
M-Pesa	0.20
Security	0.10
Shopping centres	0.05

Table 3.1 Dataset layers with their corresponding weights

3.8.1 Justification for the weights

- **Population**

For any successful M-Pesa undertaking, population forms a crucial part. An M-Pesa point cannot succeed in an area where the number of people is quite low. In south B for example, Nairobi South sub location has a slightly higher population as per 1999 census as compared to Hazina sub location within Mukuru Nyayo location. This is also attributed to the widespread ***slum*** in the area. From the ***observation*** in the field, the areas with high population perform well as compared to those not. The ***recruitment manager in*** the interview did confirm the importance of population too. A higher population translates to a higher number of people with mobile phones thus more people with a potential of using M-Pesa. The value assigned is 0.25 which translates to 25%.

- **Colleges/roads/M-Pesa points**

All the above data sets carry equal weights. Colleges and existing M-Pesa points imply population and competition respectively. New M-Pesa points to be created need not be near existing ones to avoid competition. The value assigned here is 0.20 which makes 20% of the total weight.

- **Security**

A value of 0.10 has been assigned here. This value translates to 10%. Security is not as important as population or competition.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 INDICATORS

Based on the ability to map them, there are six indicators/variables that have been identified in the study. Data availability on the areas is the main reason for their choice. These variables are:

- Population
- Security agencies
- Road network
- Colleges
- Shopping centres
- Existing M-Pesa points

There exist other several parameters which could determine the success of a particular M-Pesa outlet. Some of them include; hours of operation, nature of staff in terms of training and technical know-how, float availability, visibility to the public among other factors. This study will only consider the six variables only.

4.2 Mapped M-Pesa facilities

The *Fig 4.1* below shows the existing M-Pesa points. The coordinates for the points were collected from the ground using a GPS handheld device. They are marked MP1, to Mp15. Appendix III shows the raw data of the M-Pesa points together with the X Y coordinates.

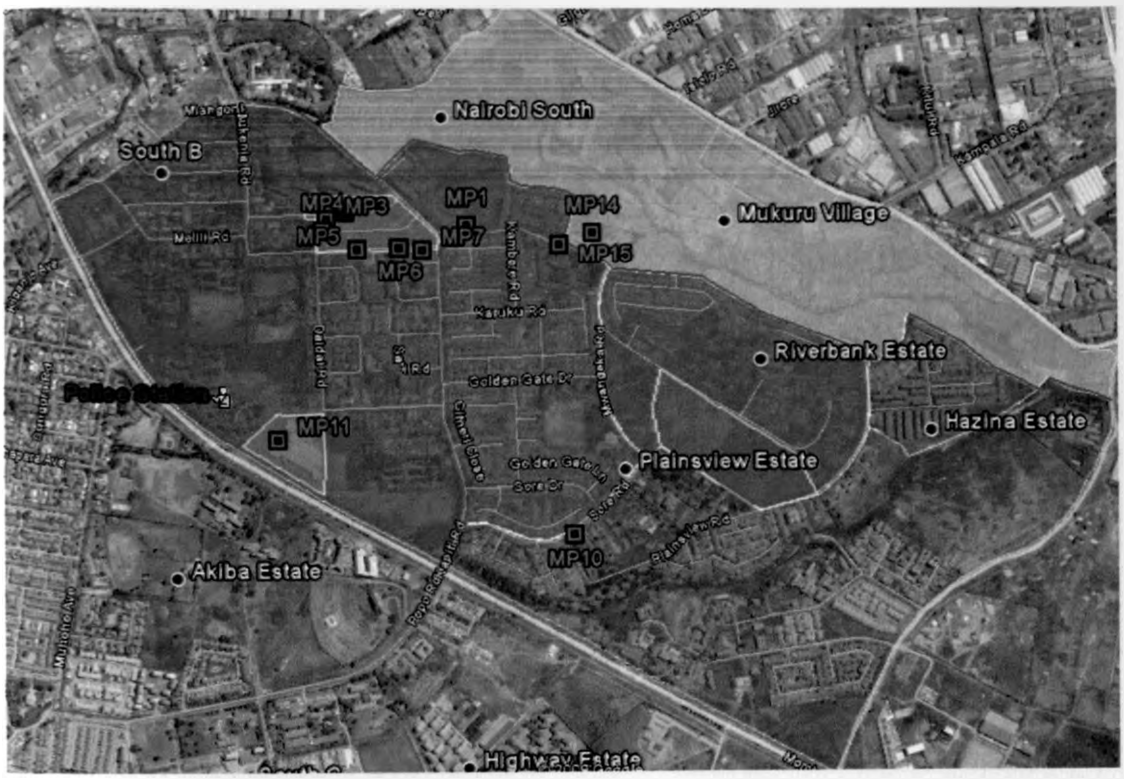

Fig 4.1 Existing M-Pesa outlets: MP1 to MP15

The topo sheet in *Fig 4.2* below forms the basis on which the roads data was collected. Digitization was done in order to get the roads data.

Georeferencing was done on the toposheet

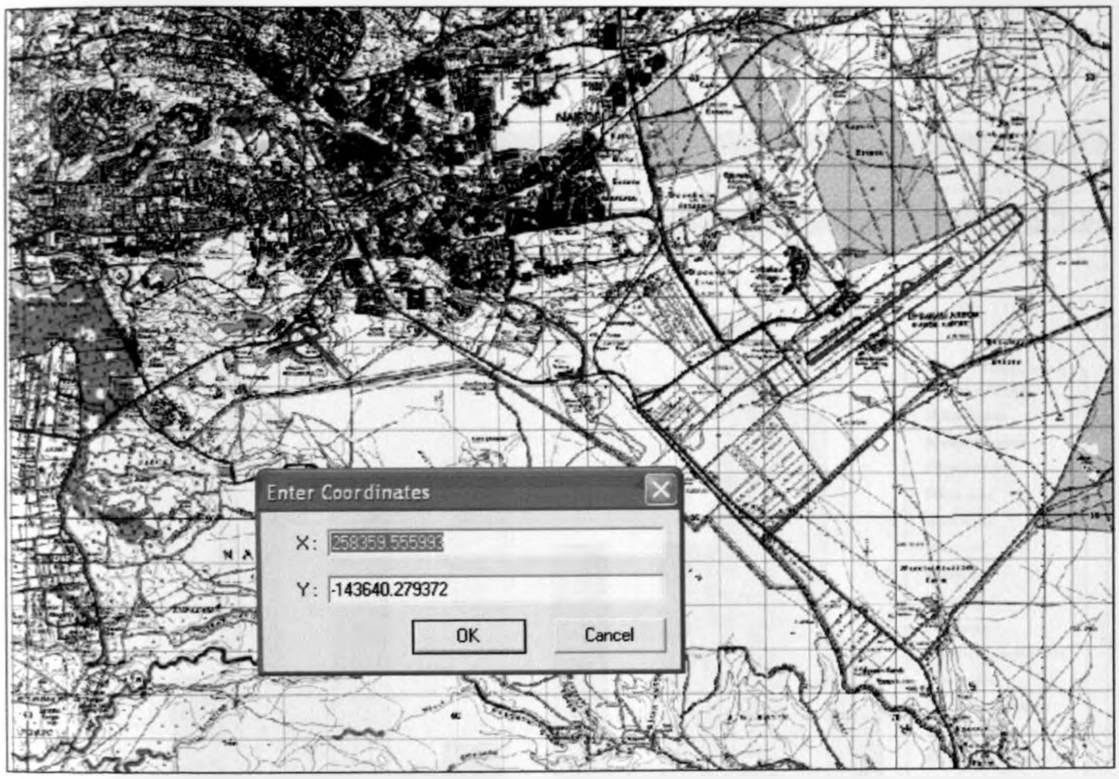

Fig 4.2: Georeferencing toposheet for Nairobi

Existing M-Pesa database: Data attribute identification

Attributes of mpesa_points

FID	Shape *	X	Y	name	transactions	category
0	Point	259264	9855310	caltex_pesa point	15	ATM based
1	Point	259126	9855328	oddsey plaza	75	authorized dealers
2	Point	259073	9855312	southlands clinic	150	authorized dealers
3	Point	259061	9855282	IPA chemists	350	authorized dealers
4	Point	259155	9855228	tech cyber	150	authorized dealers
5	Point	259265	9855228	tele center	300	authorized dealers
6	Point	259326	9855220	south b1	75	authorized dealers
7	Point	259326	9855220	south b2	100	authorized dealers
8	Point	259326	9855220	south b3	20	authorized dealers
9	Point	259695	9854450	sanasana	250	authorized dealers
10	Point	258921	9854730	capital center pesa point	80	ATM based
11	Point	258921	9854730	phone link	250	authorized dealers

Record: 3 Show: All Selected Records (0 out of 15 Selected) Options

Table 4.1 Attribute data for the M-Pesa points

The attribute table category has been added to the existing datasets as shown in table 4.1

Results on data processing

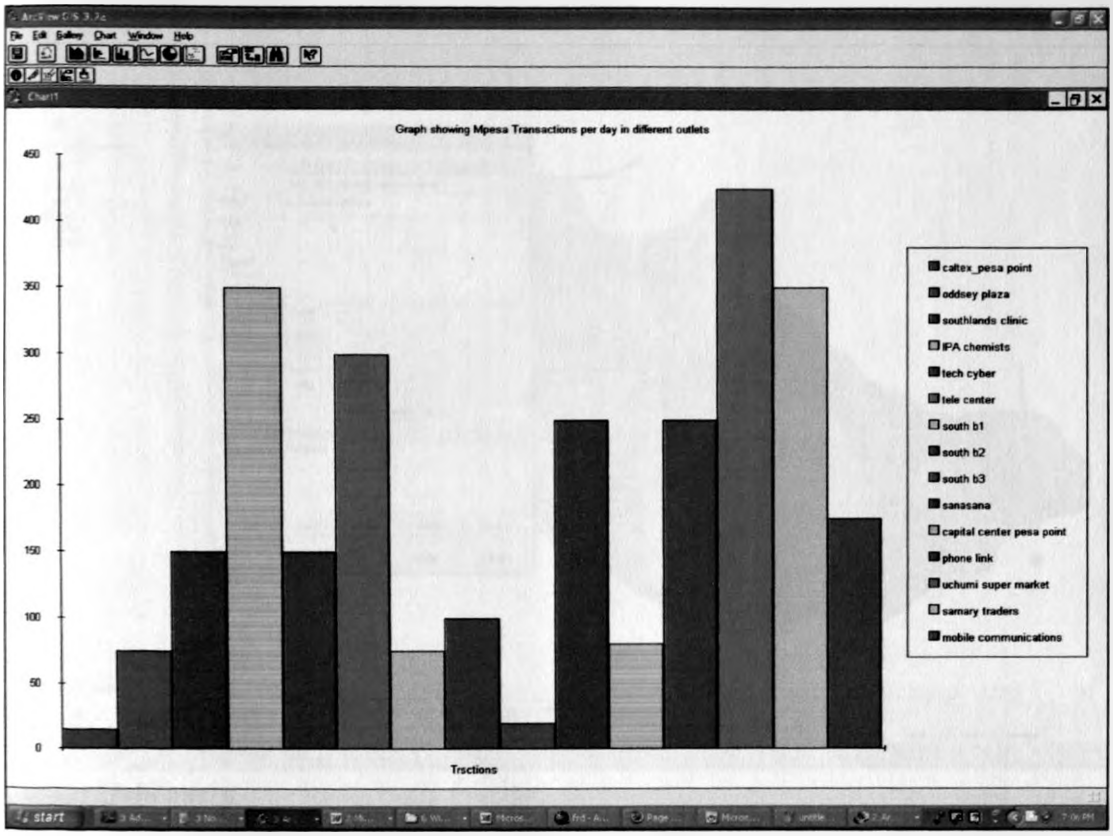

Fig 4.3 Graph showing performance per M-Pesa outlet

Layers

The map in *Fig 4.4* below shows the layers used in the study. The different attributes are all illustrated in figure 4.4 showing the data layers used in the study.

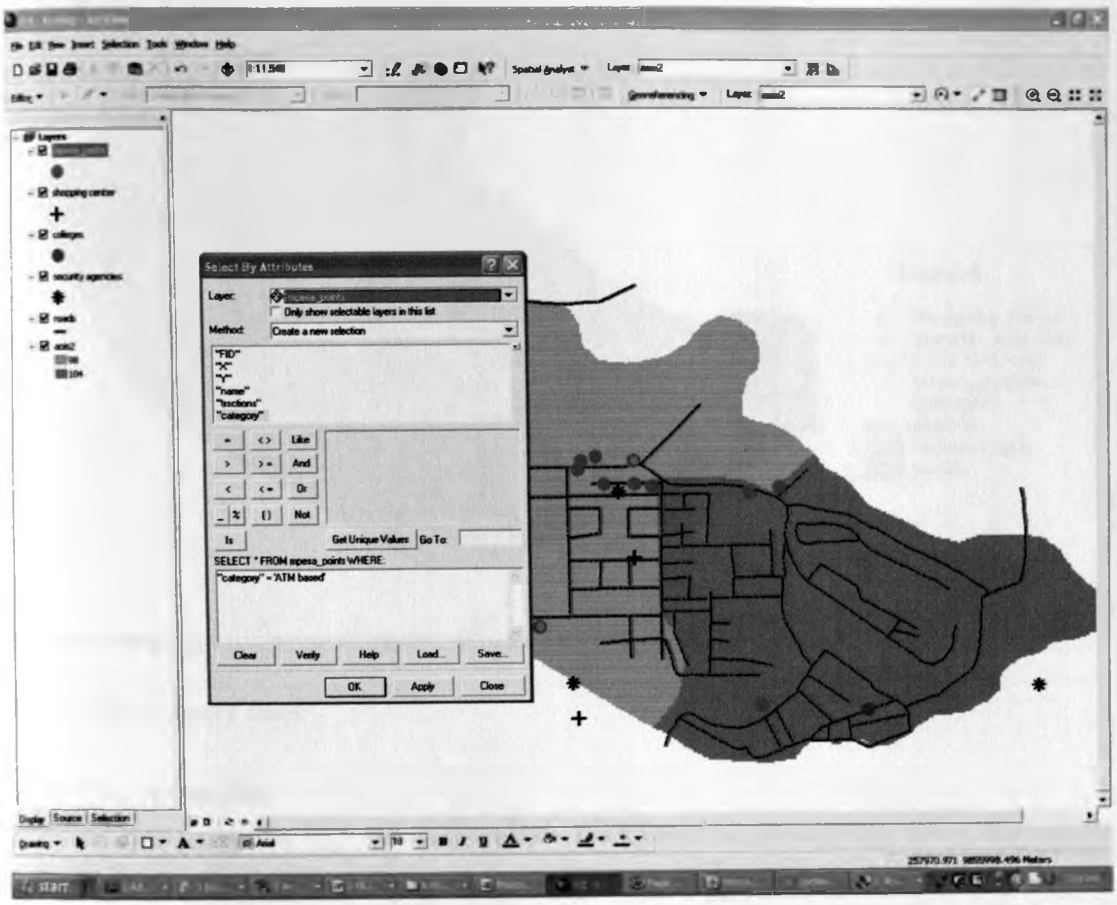

Fig 4.5 Data query

4.3 Buffers on M-Pesa points

The diagram in *Fig 4.6 below* shows the buffers generated on the existing M-Pesa outlets. The concept of buffering utilized in the study is similar for the other existing variables. As such, this one will suffice as an illustration.

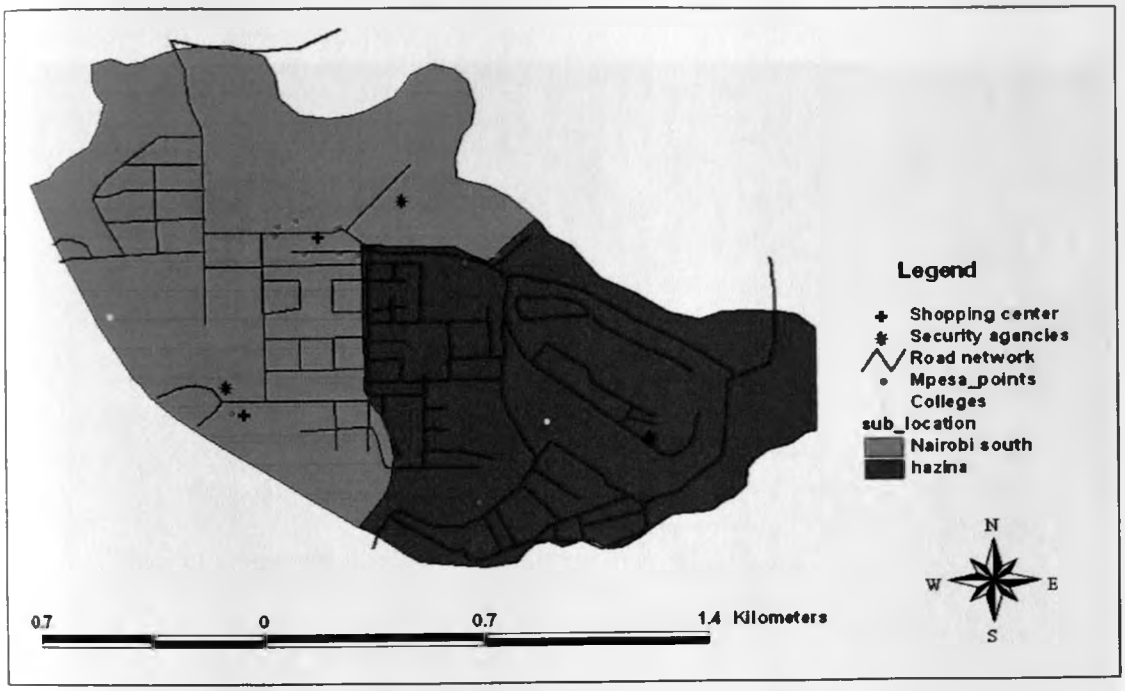

Fig 4.4 Data layers used

Data Query output

ArcGIS can produce lots of data when subjected to querying using the query wizard. Below data shows how an example used in the study:

Example; wizard showing the specific M-Pesa outlets of the category "ATM-Based outlet" as shown in *Fig 4.5* below.

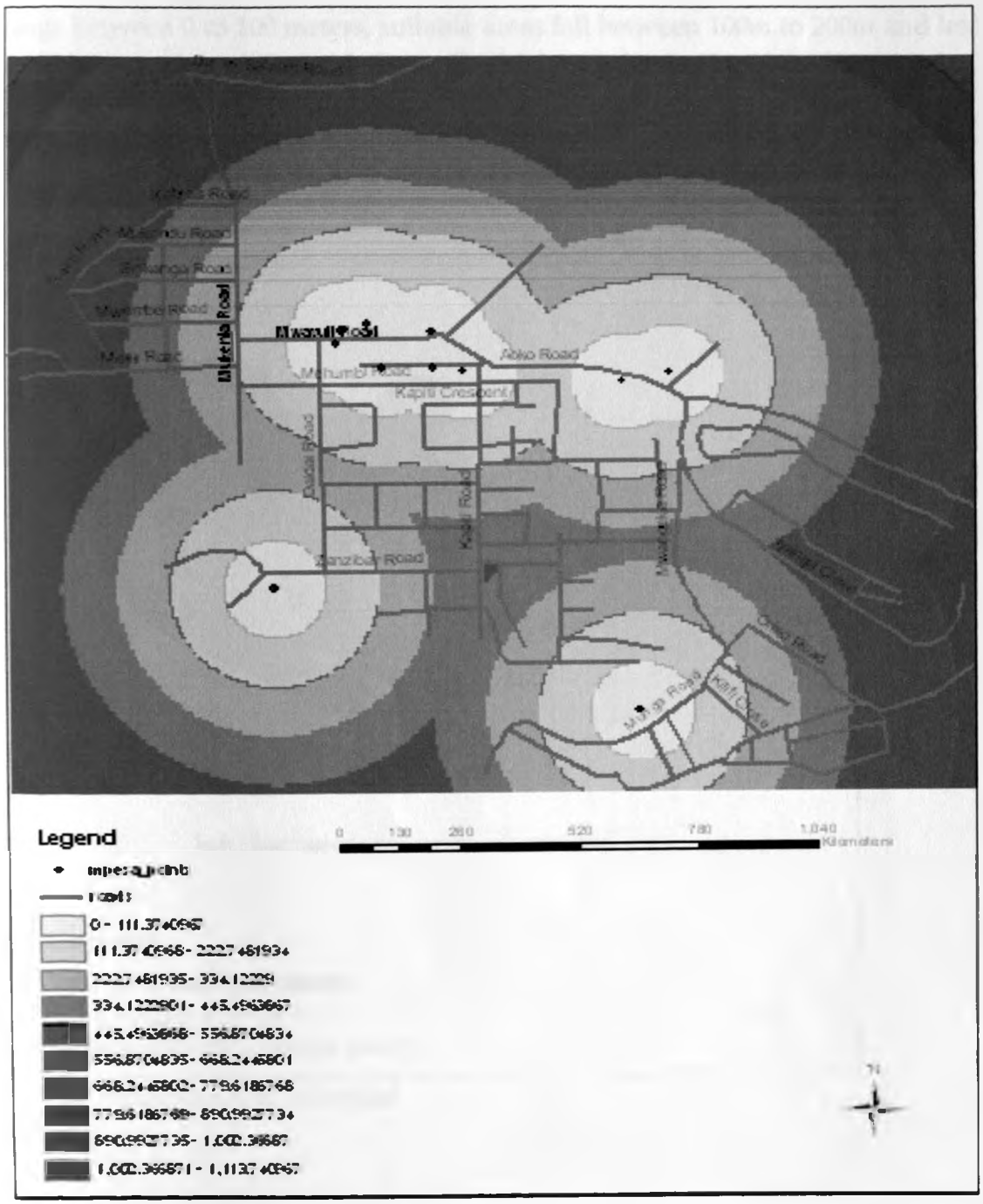

Fig 4.6 Buffers on Existing M-Pesa points

4.4 Reclassification output

As explained earlier, reclassification is the processing of assigning values to areas based on their suitability. The most suitable areas are given higher values and the less suitable ones are assigned lower ones. In this study, the most suitable areas

range between 0 to 100 meters, suitable areas fall between 100m to 200m and less suitable range from 200m and above. The highest value is 10 and the lowest is 1.

Population considered here is based on the values obtained in the 1999 census. The two sub location in the area are considered; Hazina and Nairobi south.

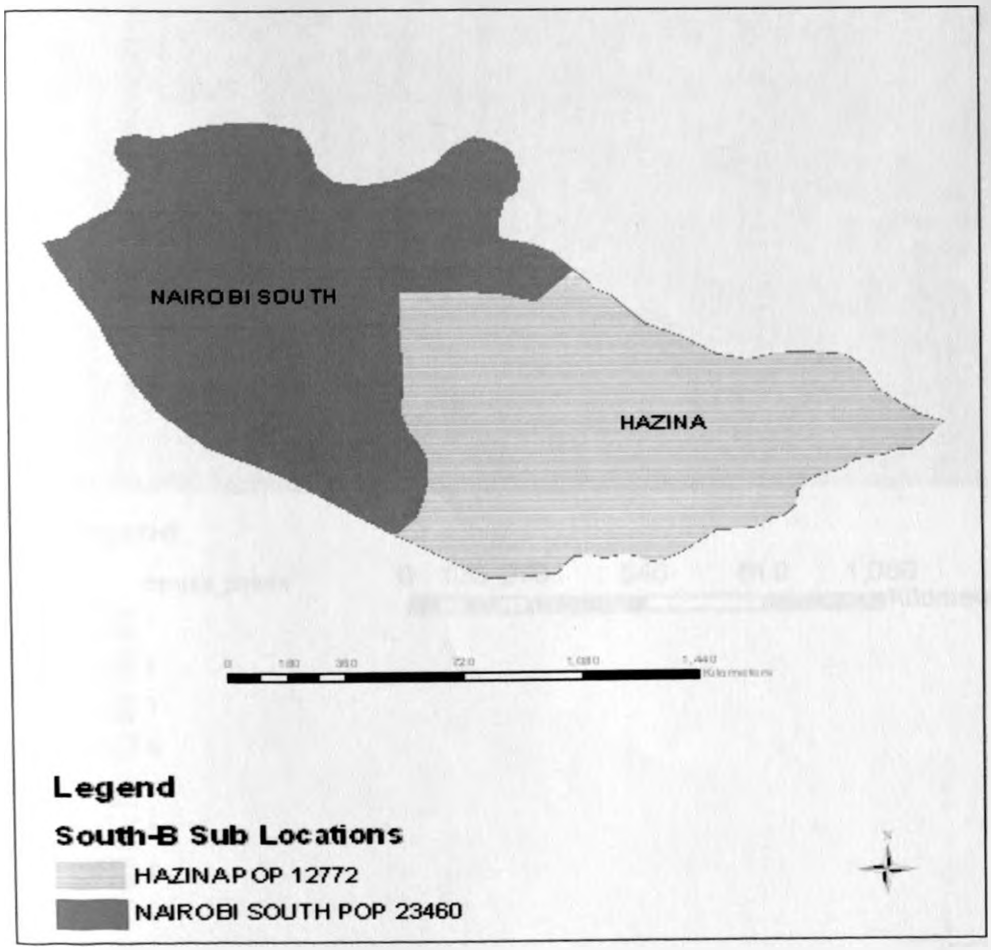

Fig 4.7 Population data reclassified

4.5 M-Pesa Points reclassification

Here points near the existing outlets are assigned low values and those far away assigned higher values.

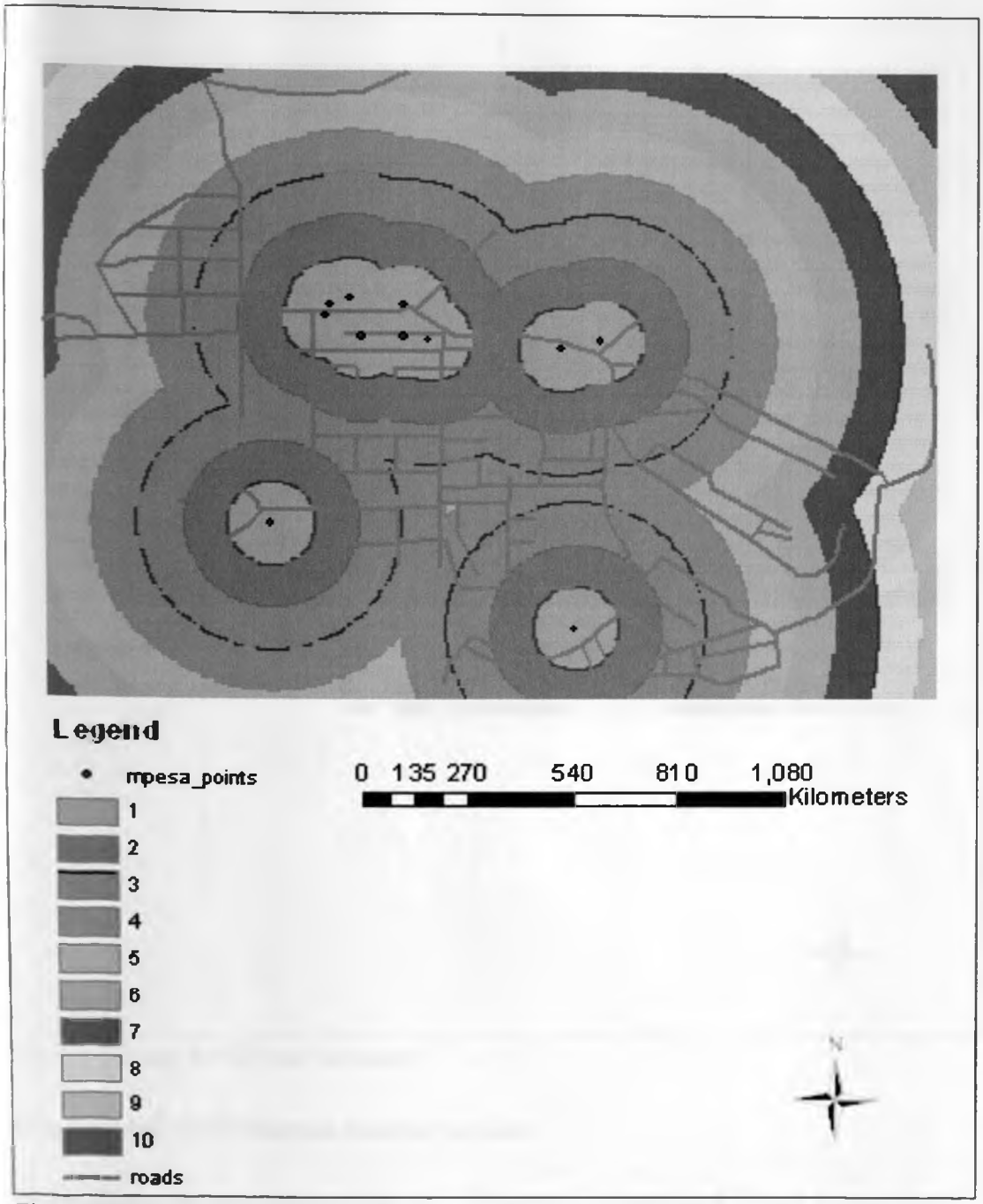

Fig 4.8 M-Pesa points reclassified

Road network Reclass

Areas near the road (between 0 and 100 Meters) get higher values than those away (101 meters and above). The result is as shown in *fig 4.9*:

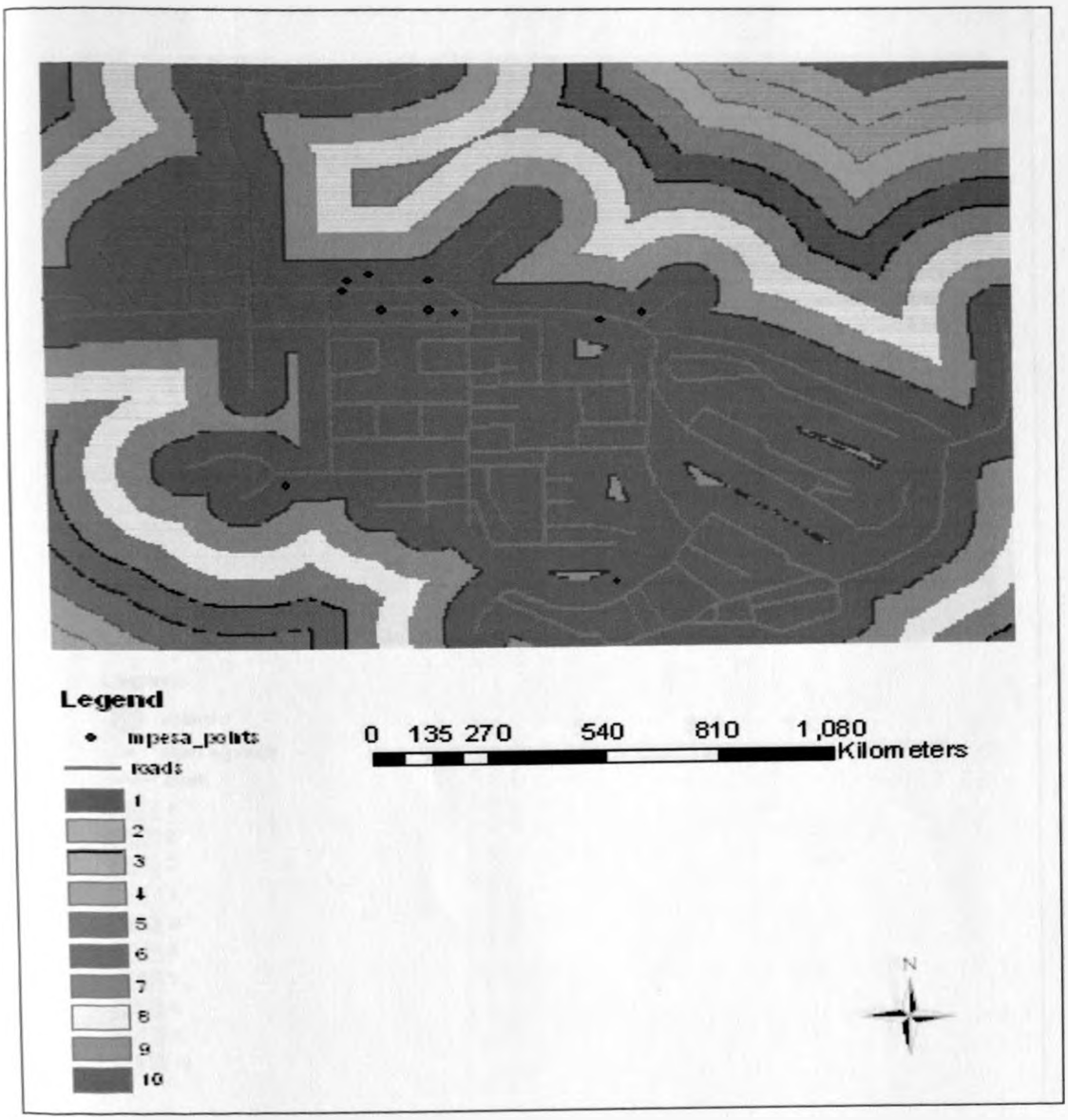

Fig 4.9 Reclass for the road network

Educational Institutions (colleges) reclass

Areas near colleges as shown in *fig 4.10* below are assigned higher values than those away from them.

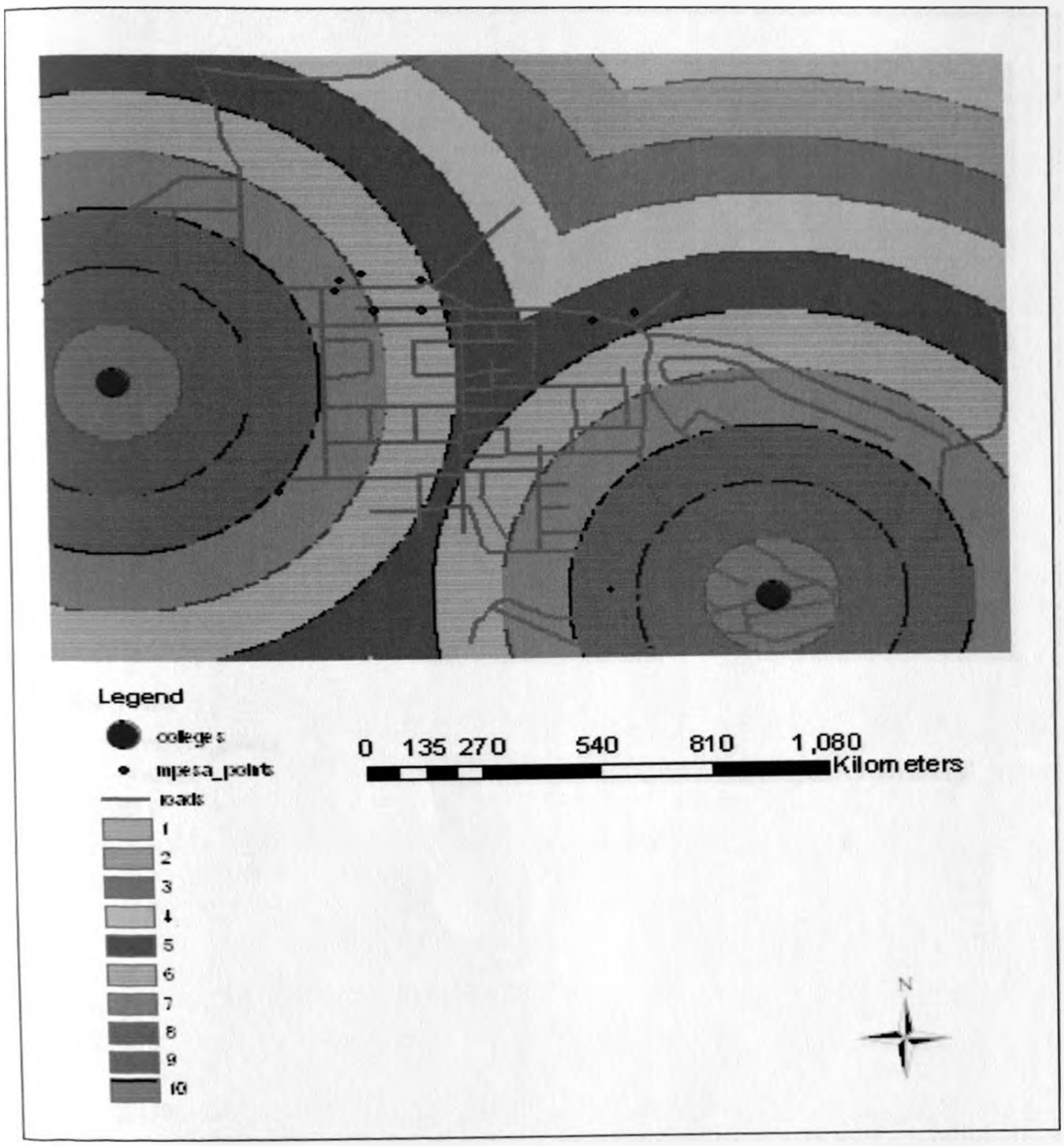

Fig 4.10 Educational Institutions reclassified

Security Agencies Reclassified

Areas near the specified agencies are considered to be more secure. These areas provide an excellent potential for setting up M-Pesa outlets. The reclassified output is shown in *fig 4.11*:

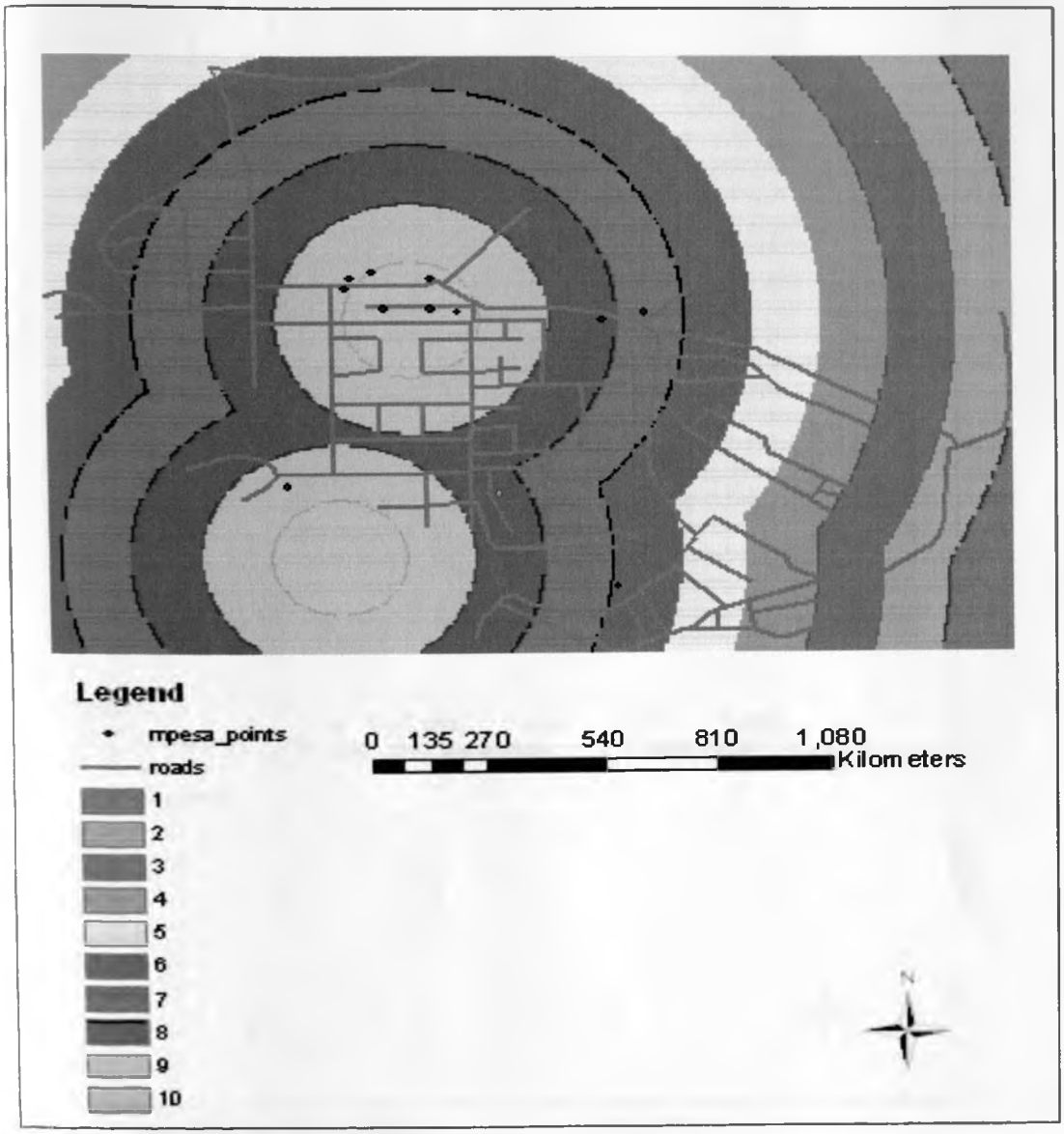

Fig 4.11: Security agencies reclassified

Shopping Centre

The two major shopping centres identified in the area form an impact on the success of any M-Pesa outlet. A lot of economic activities take place in the area thus being a force to reckon with. *Fig 4.12* below shows the Reclass output.

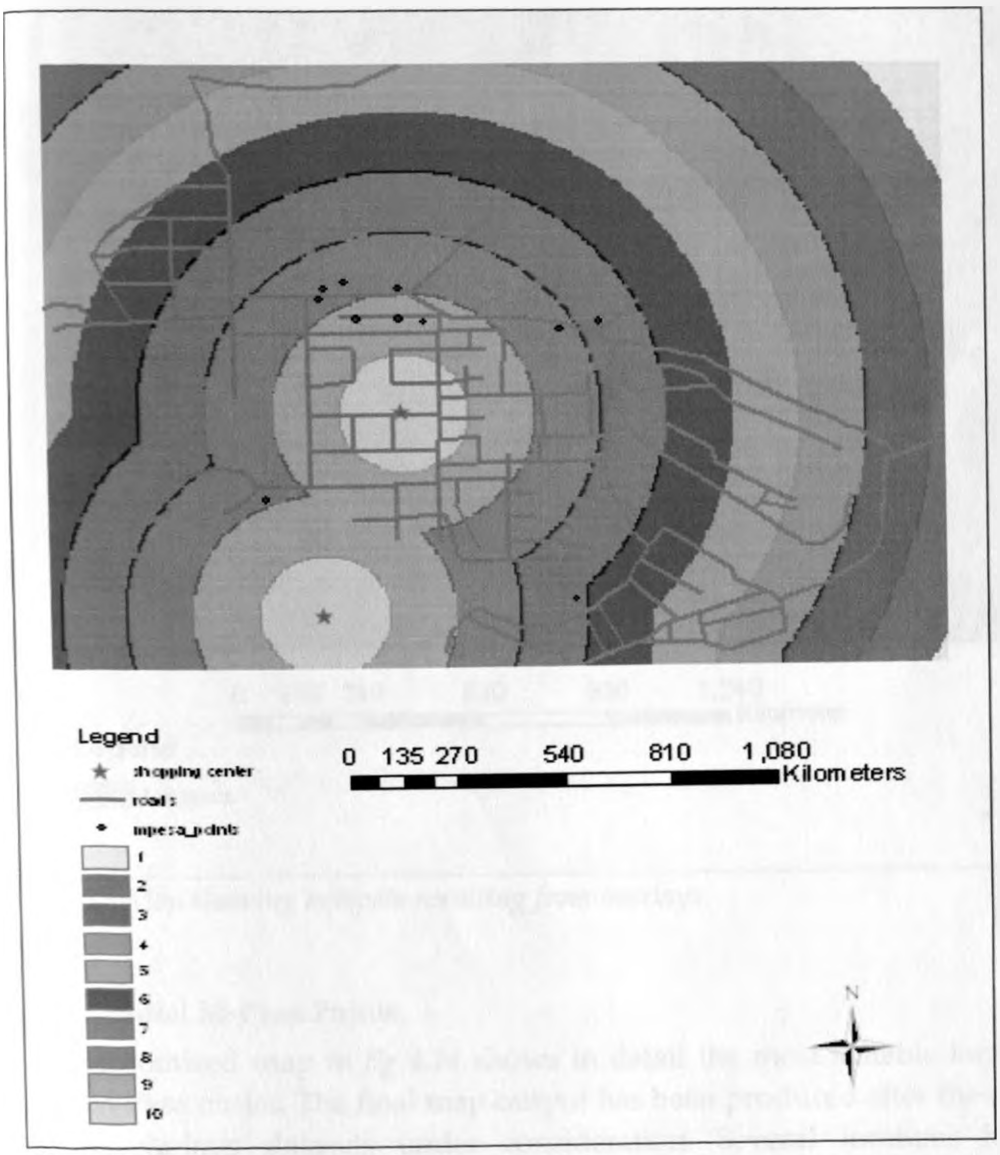

Fig 4.12 Shopping centres reclass

4.6 Overlaying of various variables

After carrying out the reclassification, the following colour map *(shown in fig 4.13)* was produced based on the dataset weights under consideration. The areas with red colors were considered the most suitable. The areas are shown clearly using the colored polygons

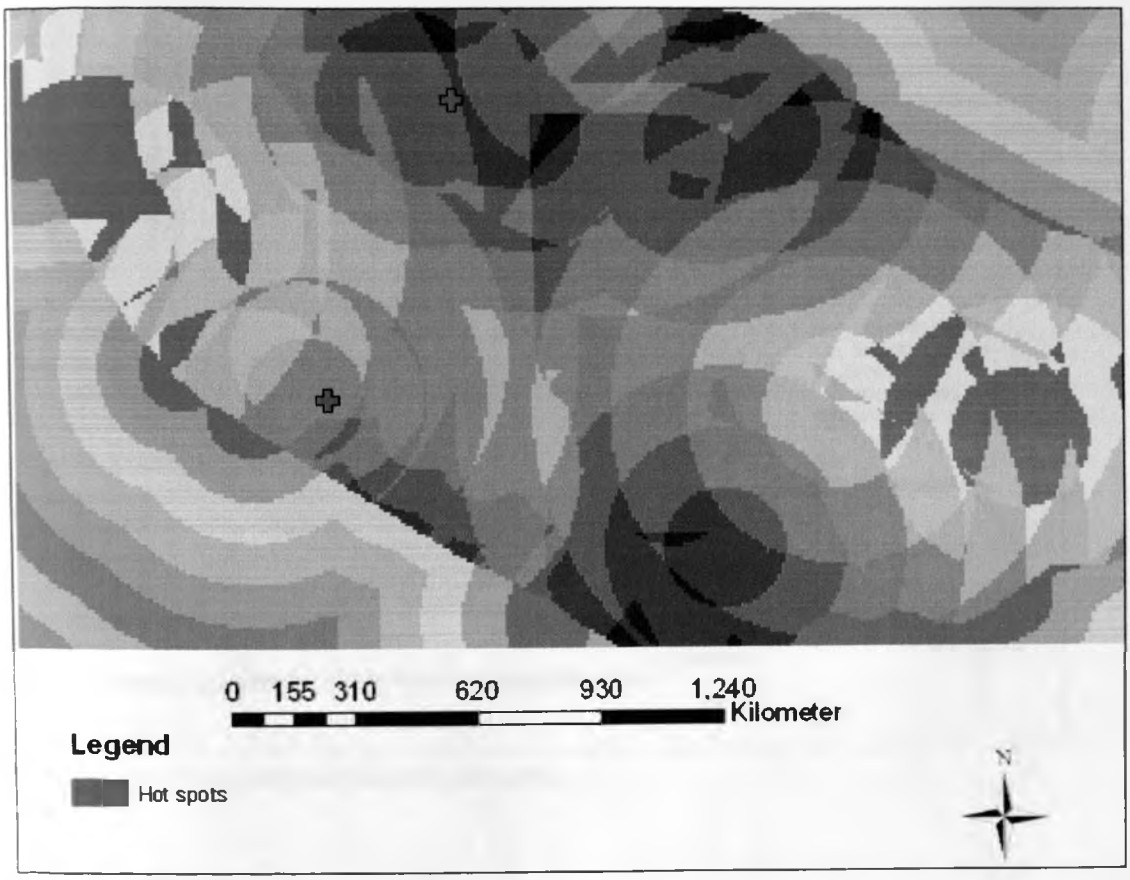

Fig 4.13 Map showing hotspots resulting from overlays

4.7 Potential M-Pesa Points

The customized map in *fig 4.14* shows in detail the most suitable location for a new M-Pesa outlet. The final map output has been produced after the overlaying of the various datasets under consideration. Several locations have been generated for the establishment of new M-Pesa points.

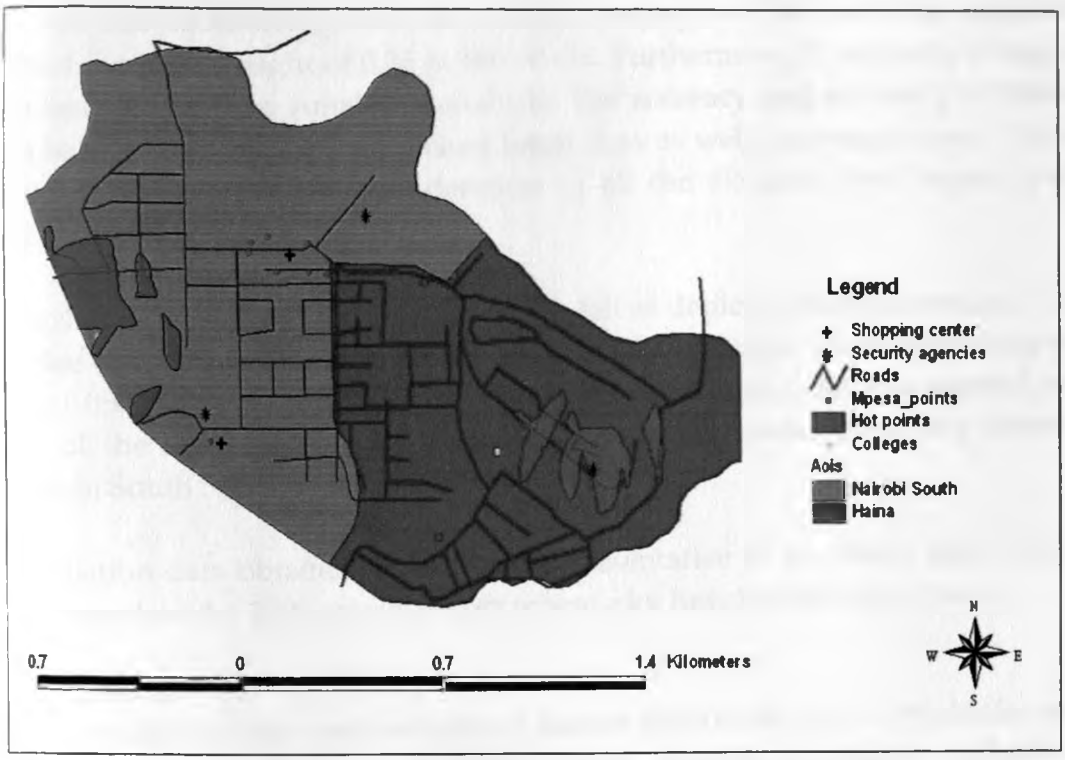

Fig 4.14; M-Pesa potential location hot spots

4.8 Discussions

In the selection of the most suitable M-Pesa outlet, there exist several factors that come into play. These factors include: visibility of the M-Pesa outlet, marketing as well as the availability of float (e-money) among others. In this study, the parameters picked for analysis were educational institutions (colleges), shopping centres, Existing M-Pesa points, population, security agencies and roads. These parameters were reclassified based on the effect it will have on the location of the M-Pesa outlet. The most suitable areas ranged from 0 to 100 meters while the least suitable ones fell at distances of 200 meters and above. The value assigned to the most suitable area was 10 while one assigned to the least suitable one was 1.

After reclassification, the datasets were all overlaid together. The outputs generated by overlaying the datasets were hotspots of the areas meeting the set parameters and thus forming the most ideal places to establish M-Pesa outlets. On Google Earth, these areas fall near Hazina Estate in Hazina sub location as well in the area adjacent to Nairobi-Mombasa road near KIMC.

The results obtained aptly brought out the power of GIS even though limitations of data existed. The hotspots produced in the map were shown to be from both

the two sub locations as well as clearly spelling out the fact that population carried the most weight of 0.25 in the study. Furthermore, it evidently brings out the concept of GIS in suitability analysis. The accuracy and efficiency of this tool can be improved by the existence of latest data as well as enough time. This will make it possible for the consideration of all the elements that impact on the subject area.

The shopping centre element is not much felt as depicted from the results. This is so due to the little weight it carries on the outlet location. The weight assigned is only 0.05. The final output clearly demonstrates this since, the area selected as the one of the most suitable falls around the Capital centre (shopping centre) in Nairobi South Sub location.

Population data obtained is not fully representative of the entire area. The data was based on the 1999 census report where a lot has changed since then.

Data Queries

It is possible to carry out a number of queries that could yield in vital information useful for decision making. The spatial analysis procedure includes the following:

- Database Query and
- Proximity analysis.

The facilities (M-Pesa stations) under interest will be highlighted. Query Builder Tool, a module of the spatial Analyst helps the agent (user) makes a Query. Graphs can be used to show the performance of each outlet based on the basis for the query.

The interactive map provides visual analysis. A Safaricom recruiting agent can identify the **hotspot** meeting the laid down criteria. Also the map should be able to produce at a glance area which have a high concentration of M-Pesa outlets and those areas which are not well covered.

Overall output/deliverables achieved

The project has achieved its objectives. The following are part

- Buffers (in form of a map) of areas that M-Pesa agent should be located or serve.
- Guidelines on the maximum number of M-Pesa agents to operate within an area.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of the study to determine the suitable area for an M-Pesa outlets and create a geodatabase model was successfully accomplished. Several specific objectives of the study were achieved. The study managed to identify the parameters that play a key role in M-Pesa Localization. A basic M-Pesa database showing the existing M-Pesa points was designed. Suitability analysis was done to determine the most suitable sites (hotspots). The functionality of the geodatabase to address other management issues like site location was clearly brought in the study through generation of hotspots.

The level of service in the M-Pesa outlets is above average even though some areas do experience low customer turnover. ATM based M-Pesa outlets *(as can be seen from the graph in figure 4.3)* face low usage. This could be attributed to the complexity of usage of the services by M-Pesa customers. Mall based outlets are doing extremely well and there is need for increasing the same in the area. Certain outlets performing pretty well are often curtailed by lack of security in the area. A good example is Samary Traders which is located in Mukuru slum.

Competition in some areas is bringing down the efficiency of certain M-Pesa outlets. There is need to remove the outlets which are not performing well and relocating them to areas identified. Safaricom can assist in doing this so as to increase the long term revenue.

Effective Information Systems (IS) and systematic use of information and pragmatic perspectives on implementation will significantly increase quality, equity and accessibility of M-Pesa centres.

5.2 Recommendations

Based on the research study carried out, it is paramount that GIS is a force to reckon with in as far as M-Pesa activities is concerned. The following are recommended for incorporation into the existing system

- There is a need to map all existing M-Pesa outlets all over the country. The same should be subjected to query and analysis in order to determine if they are well situated.
- The company should be able to invest in GIS in terms of the infrastructure as well as the manpower to steer forward the establishment of the M-Pesa recruitment process
- GIS should be extended to other sections in the company. Such areas include; facility management and in the establishment of new retail centres.
- Recruitment of a lead consultant to promote the use of GIS in the company. Of critical and urgent need is in the M-Pesa department.
- There is need for the more customer education utilizing ATM based M-Pesa outlets.
- Safaricom needs to liaise with the government in order to beef security in certain areas.
- There is a need for an improvement in the quality of M-Pesa services by monitoring the M-Pesa centres and increasing the number of M-Pesa agents.

5.2. 1 Proposed recruiting guidelines

As demonstrated by the power GIS can give to decision makers, it is hereby proposed that the following be incorporated in recruiting M-Pesa agents. These guidelines will go a long way in enabling sustained and effective recruitment process. They include the following:

- Ensuring that spatial information forms the basis for M-Pesa agent recruitment. This can be done by ensuring that the coordinates of a potential outlet be taken and added to the agents' database in the company. The capturing of the data on the ground can be done by:
  i. Company staff i.e. dealer recruitment managers or
  ii. Outsourcing such services to professional firms who have experience in handling such activities.
- Incorporating GIS with M-Pesa agent recruitment process. This will go along way in adding value to existing minimum requirements.

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Appendix: I

Interview Schedule for the M-Pesa Dealer / Recruitment Manager

1. What is your role in Safaricom?
2. How do you recruit a Safaricom M-Pesa dealer? What are the basic requirements needed for one to be recruited?
3. Do you think the basic requirements set in place are adequate to address all the strategic and business needs of M-Pesa?
4. What are the challenges you face while conducting recruitment process?
5. Do you think spatial information should be incorporated in the dealer recruitment process?
6. Of what importance is geographic/spatial information to M-Pesa administration?
7. In your opinion, should spatial data be made as a requirement in the M-Pesa recruitment process?

Appendix II

Interview Schedule for the M-Pesa Dealer agent

1. What is your role in M-Pesa?
2. How many branches do you have and where are they located?
3. Do you think the basic requirements set are adequate and fair enough for you to operate the business?
4. Do you think spatial information can add value to your business?
5. What do you think should be done to improve your business?
6. How many customers on average do you serve in a day?
7. What challenges do you face in your day to day running of M-Pesa services?
8. In your opinion, what would you wish to be incorporated or changed in the current recruitment process?
9. In your opinion, is M-Pesa a viable and profitable business?

Appendix III: M-Pesa points collected using GPS

ID	X	Y	Location	Average Customers per day
MP1	259264	9855310	Caltex Pesapoint	No data: 10-20
MP2	259126	9855328	Odyssey Plaza	closed; 50-100
MP3	259073	9855312	Southlands clinic	100-200
MP4	259061	9855282	IPA chemists	300-400
MP5	259155	9855228	Tech Cyber comms	100-200
MP6	259265	9855228	Telecentre (3pcs)	200-400
MP7	259326	9855220	South B shoppy	closed; 50-100
MP8	"	"		No data: 100
MP9	"	"		No data closed
MP10	259695	9854450	Sanasana	200-300
MP11	258921	9854730	Capital centre Pesapoint	80-90
MP12	"	"	Phonelink	100-200
MP13	"	"	Uchumi supermarket	400-450
MP14			Samary Traders Seasons	300-400
MP15			Mobile communications	150-200
MP 16			chemist in shopping centre	60-70