# DEVELOPMENT OF THE ZAMBIA AGRICULTURE MANAGEMENT INFORMATION SYSTEM (ZAMIS)

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## ABSTRACT

Despite the important contribution the agriculture sector makes to household food and nutrition security and the national economy, it faces a number of challenges to increased productivity. Other than the natural calamities and socio-economic factors such as access to agriculture inputs, credit facilities and markets, poor access to agricultural information remains a decisive challenge to increased agricultural productivity at household level. The prevailing low crop and livestock productivity among small scale farmers could greatly be attributed to low farmer access to and utilization of agricultural technologies that are meant to enhance productivity. Utilization of such technologies has been poor among the small scale farmers because such information is not readily available. This situation is further worsened by the poor, inadequate and weak communication links between researchers, extension and farmers. All these factors consequently lead to low adoption of improved agricultural technologies among small scale farmers. Therefore, in order to improve agricultural production and productivity there is need to develop an agriculture information system.

This project report highlights the importance of having an information system which facilitates the transfer and accessibility of agriculture technology. The vast store of information on agriculture has been built up in the Zambia over many years but the information is stored in various media that is not readily accessible by the intended end user. The information is needed by the farmers, extension officers, researcher`s, policy makers, trainers and agriculture consultants. The development of the web-based agriculture Zambia Agriculture information system was the primary objective of the study. The information system will contain all the provinces of Zambia and their respective districts containing information on vegetation, climate, soil type, past research works, landforms and land use of a specific District. For this project only 7 Provinces were inserted. The data reviewed in this study is from the environmental impact assessment reports and from the soil map of Zambia with a scale 1: 1 000 000. The data base of the information system is WAMP server 2.0. The information system was developed using a waterfall model of lifecycle system of software development. The system is designed to be dynamic and embrace new changes.

## DEDICATION

This project report is dedicated to my family and Mukwiza Halwindi. The patience they showed and the support they provided during my studies was wonderful.

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## ACRONYMS

| | |
|---|---|
| CIS | Computerized Information System |
| CSS | Cascading Style Sheets |
| XML | Extensible Markup Language |
| GDP | Gross Development Product |
| GRZ | Government of the Republic of Zambia |
| HQ | Headquarters |
| ICT | Information Communication Technology |
| IICD | International Institute for Communication and Development |
| IS | Information System |
| IT | Information Technology |
| MACO | Ministry of Agriculture and Cooperatives |
| MySQL | Structured Query Language |
| NAIS | National Agriculture Information Service |
| NGO | Non-Government Organization |
| PHP | Perl Hypertext Preprocessing |
| RDBMS | Relational Database Management System |
| SLA | Service Level Agreement |
| WAMP | Windows Apache, MySQL, PHP |
| WUI | Web User Interface |

| | |
|---|---|
| ZAMIS | Zambia Agriculture Management Information System |
| ZARI | Zambia Agriculture Research Institute |

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## CHAPTER 1

## 1.0 INTRODUCTION

In many developing countries including Zambia, national data are unavailable or are to a substantial degree unreliable. Once the project area or clientele has been determined, once a conceptual boundary has been drawn, local information on which to base the analysis can be efficiently gathered, field trials can be undertaken, and a judgment can be made about social and cultural institutions that might influence the choice of project design and its pace of implementation.

The vast store of information on agriculture has been built up in the world and Zambia in particular over many years with the ultimate aim of increasing agricultural production therefore improved flows to-, from-, and within the agricultural sector is a prerequisite for effective agricultural development. Investing in information technology can facilitate effective flow of information in all sectors of the economy.

Agriculture is regarded as the engine of development in most developing countries. Agricultural development is usually measured in terms of increase in production and productivity, and is often brought about by the adoption of new technologies. Specifically, agriculture is a significant factor in the improvement of the living conditions of the rural people and farmers in particular (Manda, 2002). This is why developing countries are putting more emphasis on shaping the future of agriculture. Thus, growing market opportunities in certain developing countries have been coupled with a shift in production and exports of farm commodities. Like other developing counties whose livelihood depends mostly on agriculture, Zambia is not an exception.

Zambia has tremendous agricultural potential, but more than 80 percent of the country's farmers are poor small holders. However, farming provides one of the most common livelihoods for the populace, especially since the decline of the mining and manufacturing industries. One reason this sector has performed below expectations is because of weak links between farmers, extension workers and researchers. Currently, there is one extension worker to approximately 1000 farmers, and most information is collected in person from sources and

then stored as hard copy; sometimes it is delivered in a format or language inaccessible to local farmers (National Agricultural Information Services 2005).

The proposed Zambia Agriculture Management Information System (ZAMIS) will cover all provinces of Zambia including their districts. The ZAMIS will contain relevant information about agriculture that may facilitate decision making in land use planning in a specific area and avoid duplication of work or research. Among some of the information that will be included are length of the growing period, rainfall at 70% probability, vegetation, climate, soil types, agriculture profiles and environmental profile of the area just to mention a few. This information system or program or software was designed in such a way that it will be upgradeable as new information becomes available.

The Government of the Republic of Zambia has been talking of diversification of the economy to agriculture but the information to base the decision on land use, is not readily available to the policy makers. The ZAMIS will try to focus more on the specific requirement of agriculture production in an area as opposed blanket recommendations.

An information system (IS) is and by definition it is the study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data ( Archibald, 1975). The study bridges business and computer science using the theoretical foundations of information and computation to study various business models and related algorithmic processes within a computer science discipline. Computer information system(s) (CIS) is a field studying computers and algorithmic processes, including their principles, their software and hardware designs, their applications, and their impact on while IS emphasizes functionality over design.

As such, information systems inter-relate with data systems on the one hand and activity systems on the other. An information system is a form of communication system in which data represent and are processed as a form of social memory. An information system can also be considered a semi-formal language which supports human decision making and action (Jessup et al. 2008).

## 1.2 STATEMENT OF THE PROBLEM

There is so much agriculture information being generated by research work in Zambia but it is not readily accessible because it's disseminated in various media including reports, journals, books and other publications. Following the recent advances in information technology time has come to develop an agricultural management information system to harness agricultural information for ease access and use

## 1.3 OBJECTIVE

The primary objective of this study was to develop the web-based Zambia Agriculture Management Information System (ZAMIS)

## 1.4 SPECIFIC OBJECTIVE

The specific objectives of the study were:

- Review the agricultural information available in the literature in Zambia
- Access the information needs of various users such as farmers, researchers, extension workers and policy makers
- Develop an agricultural management information system which meets the requirements of various users

## 1.5 OVERVIEW OF THE STUDY

This study is structured into six (06) chapters. The first chapter has given a brief overview of the problem this study is pursuing, and what it expects to achieve by the end of its discourse. The chapter that follows expands on the background of the study. It shows the importance of agriculture in Zambia. It further discusses the relevance of the Zambia agriculture information system (ZAMIS).

Chapter three (03) discusses on the methodology of the program. This includes system requirement and system design. As much as is possible the discussion in this chapter specifically looks at practices focused on by this study. The chapter highlights the method of data collection which is then embedded in the system.

The fourth chapter presents the results as they appear when the program is fully functioning. The presentation is in the form of diagrams. Chapter five makes some inferences based on the results and discussion of this study and it suggests future research efforts and makes policy recommendations aimed at enhancing at improving the Zambia agriculture information system (ZAMIS). The last chapter (06) describes the material that has also tried to make information systems as a way of transferring agricultural information and its importance.

## CHAPTER 2

## 2.0 LITERATURE REVIEW

Management information system is an integrated user-machine system for providing information to support operations, management and decision making functions in an organization. The system utilizes computerized and manual procedures; models for analysis, planning, control and decision making; and a database (Davis, G.B. 1985).

There has been no systemic storage and retrieval of the information gathered over these years. There has been no centralized information access point for farmers and other stakeholders such as extension offices in form of information resource centers. These short comings have led to farmers not receiving the information they require at the right time and in the right format (NAIS 2005). Most of the information is recorded and stored in hard copies and retrieval and accessibility of such information is difficult. Most of the research works are being duplicated due to lack pre-information of a particular area. Most or the ICTs used for the dissemination of agriculture information is through radio station, television, journals and magazines. Therefore this paper tries to develop a computer based information system that will be easily accessible through the internet and update information as it becomes available. The ZAMIS will be able to gather, process, package, store and disseminate information between research, extension, farmers and other stake-holders, strengthening linkages. Information products will be collected and delivered online from sources to the end users, in or on time and in appropriate formats.

In line with this project, NAIS has been carrying out a project that will ensure that information products are processed and stored using appropriate ICTs (for example, CD-ROM, Database, etc). Using ICTs, NAIS members of staff are now able to research for agricultural information technologies that are or may not be locally available. The project title was "Development of an effective information flow network for the Zambian Agriculture institute. The results achieved from this project are;

1. Improved information sharing through an operational and easily usable local area network at HQ;

2. Improved NAIS efficiency in gathering of information products from Zambia Agricultural Research Institute (ZARI), Ministry of Agriculture and Cooperative (MACO) subject matter specialists and other stakeholders;

3. Strengthened linkages between NAIS, ZARI and extension;

4. NAIS staff trained in ITCs use;

5. Project incorporated in GRZ budget.

The National Agricultural Information Services (NAIS) is responsible for transferring knowledge from researchers to extension officers who work with farmers to ensure the development of a healthy agriculture sector in Zambia.

NAIS further stated that Information flows have become slow and ineffective, and the use of ICTs can significantly improve this, especially in terms of the level of efficiency in gathering, processing and disseminating knowledge (NAIS 2005).

The pilot stage of the project involved managing the information flow between Lusaka and Kasama, which demands not only that information travel a substantial distance but also that it be translated into the local language, Bemba. Overall, this project aims to

- Improve information flow within NAIS
- Strengthen linkages between agricultural research, extension, farmers and other stakeholders
- Increase the capacity of NAIS to collect, process, package, store and disseminate agricultural information
- Increase capacity of NAIS to publish in more accurate and appropriate formats

A smoothly-functioning information loop between farmers and researchers will ensure that extension officers and farmers are better informed about current and relevant agricultural issues. This project will eventually help improve small-scale farmers' livelihoods by expediting the flow of critical knowledge, which should result in greater food and export crop production, improved food security and higher incomes for farmers. While the project is not expected to generate revenues itself, access to information by stakeholders could significantly alter the way

farming and marketing is done, leading to a more efficient and competitive agro-business environment.

Any specific information system aims to support operations, management and decision making. In a broad sense, the term is used to refer not only to the information and communication technology (ICT) that an organization uses, but also to the way in which people interact with this technology in support of business processes (Davis, G.B. 1985).

According to Rajkai (2010) Information has a central role in our modern way of living and agriculture is no exception: to be successful in farming requires gaining, processing, using and evaluating a huge amount of information (policy, markets, new methods etc.). Farmers are working in an information-intensive environment and numerous studies have showed that information and communication technologies (ICT) can play a vital role in realizing benefits with more effective information management in the farm level. The supply chain in agriculture not only means the flow of products and income but also that of information (Niderhauser et al., 2008). The toolkit of the information society, information communication technologies (ICT) offers new opportunities for efficient operation, decision-making and adaptation to the environment (Herdon, 2009). This, however, can only work successfully if certain conditions are met. The potential opportunities can only be exploited to an optimum under the right circumstances, and it is also important that they are harmonized with the previously used farm management practice, or else the much-awaited success will suffer.

In Kenya, a Kenya agriculture information network (KAINet) was initiated in April 2006 in response to demand from national and international communities to build systems that promote information exchange and access among stakeholders in the agriculture sector, including researchers, extension workers, students, policy makers, major public libraries and archival institutions and others. The focus is to support decision making, promote innovation in agriculture, and subsequently improve livelihood, with the aim to modernize and increase productivity of the sector through the application of information and communication technologies (ICTs)for agriculture information management.

KAINet is focused on the vision to make public domain agriculture information and knowledge in Kenya truly accessible to all, based on its mission to build a common and freely accessible information system through partnership in the generation, collection, processing, archiving and disseminating of agricultural information. The organizational core values to attain this are centered on social responsibility, respect, accountability, professionalism, teamwork and strong partnership, collective responsibility, innovativeness and meritocracy. The strategy used by KAINet to disseminate information to the stakeholders is through radio, television, exhibitions, national agricultural show, through the institutions websites and publications (journal articles, brochures, newsletters, technical and annual reports.

Farmers need to have access to agricultural information if their agricultural efforts are to be realized. In a study in Delta state in Nigeria, Adomi et al. (2003) found out that farmers need to have access to agriculture information in order to improve their agriculture production. Furthermore, Irivwieri (2007) stressed that access to and utilization of appropriate information services by all members of society is a duty of every government. Irivwieri (2007) opined that rural people, who are mainly illiterate, require access to appropriate information to be able to make decisions and participate fully in the national development process, including agriculture.

The characteristics of quality information involve relevancy, accuracy, sufficient, timeliness, and currency. Majid et al. (2001) maintained that lack of current, accurate, sufficient, relevant and timeliness of information could hinder agricultural research and development. Aina (2007) suggested that the road to success for information centers in Africa is the provision of relevant and timely information to rural communities. Other authors also agree and contend that in order for agriculture to improve, there is a need to strengthen the existing information so as to provide information that is timely, relevant, accurate and reliable and in an appropriate language and format. In a study by Yongling (2004) conducted in China, it was found that there is a problem of low quality, out-dated, inaccurate or incomplete information because farmers lack the ability distinguish between bad and good information due to low education levels.

Irfan et al. (2006) indicated that the available technologies, if adopted by farmers, can enhance agricultural production considerably. A study by William et al. (2010) conducted in Lesotho,

sought to find out which medium technology or channels were appropriate to disseminate agricultural information to farmers. Such medium could include: radio, television, computer, cell phone, public campaign and the library service. It was found that radio is one of the most widespread and popular tools of communication in Africa. Chapman et al. (2003) argue that the strength of radio as an extension tool is widely praised for its ability to reach small scale farmers and provide them with information related to all aspects of agricultural production in a language they understand. Television is another means of disseminating agricultural information to farmers. Irfan et al. (2006) stressed that television is used to reach large number of people quickly and serves an important and valuable function in stimulating farmers' interest in new ideas. However, Tshabalala (2003) maintained that although television is a powerful medium, many people could not afford it in most developing countries. Furthermore, Kari (2007) also stressed that to some of the farmers, television is not seen as a source for obtaining information, but rather as entertainment media. This study indicated that only 24.6% of respondents chose television as the most appropriate medium of communication. The use of computers and the number of Internet Service Providers (ISPs) as well as Internet users is increasing day by day in the world. Agricultural information technology systems are being developed now based on web technology. Better connection between the IT and research bodies is now needed for generation, compilation, dissemination and exchange of agricultural information (Zaman, 2002). Similarly, Ha et al. (2008) contend that Internet use has become a new skill that farmers have realized can be useful for them to find agricultural information they need. Furthermore, Kiplang'at and Ocholla (2005) in a study conducted in Kenya maintained that the rapid development and application of the Internet and other forms of ICTs in the agricultural sector have presented a whole new dimension in the transfer and access of agricultural information and showed that these technologies had improved the provision of agricultural information among agricultural researchers, extension workers and other actors. However, findings from this research study shows that only 2.51% chose computer as the most appropriate medium to disseminate information to them.

These are the software applications most used by the actual businesses. They must keep accounting, personnel and crop production records (e.g., pesticides used). They also use

software to reduce the time, effort and cost of processing the transaction records. This is why payroll packages, and shipping and billing systems are commonly employed on these operations. This usage will continue to grow in importance (Harsh et al. 1981).

The information system of the future will need to concentrate more on the upper levels of Haechel's hierarchy -- knowledge and wisdom. Knowledge has two forms, tacit (subjective) and explicit (objective). Tacit knowledge is gained from experiences and practice, whereas explicit knowledge is based more on theory and rationality. As decision makers address problems, they convert knowledge between the two forms. An information system that focuses only on one form will have shortcomings. The information system of the future must have both forms of knowledge, and encourage the conversion of knowledge between the forms as a continuous process. Only by this process will the manager's knowledge base grow in size and function.

Information systems of the past have tended to concentrate on explicit knowledge (e.g., linear programming to balance a ration) and, to lesser extent tacit knowledge. Many of the problems of the future will involve tacit knowledge. The challenge will be designing information systems that will allow for an easier and more effective means of sharing tacit knowledge. The Internet will no doubt play a key role in meeting this challenge. Perhaps a system for documenting experiences (e.g., structured case studies) can be used to enhance the sharing of tacit knowledge (Facts and Trends 1986).

According to Hoganson, (December 2001) some authors make a clear distinction between information systems, computer systems, and business processes, Information systems typically include an ICT component but are not purely concerned with ICT, focusing instead on the end use of information technology. Information systems are also different from business processes. Information systems help to control the performance of business processes.

A work system is a system in which humans and/or machines perform work (processes and activities) using resources to produce specific products and/or services for customers. An information system is a work system whose activities are devoted to processing (capturing, transmitting, storing, retrieving, manipulating and displaying) information (Lucas, H., Jr. 1978).

## 2.1 SIGNIFICANCE OF AGRICULTURE IN ZAMBIA

The Government views agriculture as the best alternative to mining due to its contribution to the gross domestic product (GDP) – 18.5% in 1995 and 17.2% in 2000 (BOZ 2003). The sector has been able to contribute a considerable amount of foreign exchange earnings through the horticultural subsector. Agriculture is important in Zambia because of the following reasons:

*(1) It employs most of the rural households and it is the primary source of food for the population; and (2) It is a potential source of foreign exchange for the country.*

The smallholder farmers in Zambia heavily depend on land and rainfall for their agricultural activities. This land is held in trust for the nation by the President, and people get it on lease for a period of ninety-nine years through the Ministry of Lands. Only very few smallholder farmers have land with title deeds while the majority of the people have customary use rights. They access land through the customary tenure system after getting approval from traditional rulers. Arable land covers 47% of the country's total land mass but only 15% or 7% of total land, is under cultivation (BOZ 2003). Most land lying in opened up areas is occupied but unexploited agricultural land, which generally is far from where minimal infrastructure is developed, still remains unoccupied. This has resulted in great pressure on cleared arable land by the fast growing population, which currently is increasing at 3.2% annually. Farmers in northern Zambia are now constrained in their traditional practice of shifting cultivation (the fertility management methods are fully explained below) from the previous average period of 15-20 years to 3-4 years now. This period is not long enough for farmers to sustain their agricultural production.

The agricultural sector is composed of three categories of farmers. These are large-scale, medium-scale and small-scale farmers. According to the classification of Ministry of Agriculture and Co-operatives, large-scale farmers comprising about 2% of the farmer population cultivate more than 20 hectares. They are generally characterized by high mechanization and have a well-organized farmer network, which facilitates the acquisition of inputs. Medium-scale farmers, comprising about 13% of the farmer population, by definition cultivate a land area between 5 and 20 hectares. In the case of small-scale farmers (85% of farmer population), they cultivate land area that is less than 5 hectares. There are five major farming systems that have

*been identified in Zambia. These are shifting cultivation, semi-permanent hoe system,* semi-permanent hoe and ox plough system, semi commercial cultivation and commercial systems (Saasa 2003). The smallholder households are mainly associated with the first four farming systems whilst the large-scale farmers are largely associated with the latter farming system.

## CHAPTER 3

## 3.0 JUSTICATION OF THE ZAMBIA AGRICULTURE MANAGEMENT INFORMATION SYSTEM (ZAMIS)

Due to the high significance of agriculture in Zambia there is need to develop an information system that will allow for easy accessibility of information when required without the difficulty of trying to gather the information from various research station. It is for this purpose that the ZAMIS will be able to capture agriculture information for the different districts of Zambia. This will allow the extension department and extension workers in various districts to have readily accessible information as soon as it available unlike waiting for days or maybe weeks for the new development, technology and research finding to reach the District that are far from where the research is being done. This will also facilitate decision making as information will be readily available. Therefore the ZAMIS will show relevance when dealing with the following issues;

### 3.3.1 Research

Research managers need management information to monitor and evaluate research activities and make sound decisions on research programs.

- Improving technical support, to research - extension linkages.

Linking service providers to sources of innovation and technical support, including national research programs, is essential if they are to have technically sound advice to offer clients. Technical support generally requires some in-house technical specialists (if the service provider is large enough) in addition to effective linkages to other programs. Extension programs should be structured so that farmers, agribusinesses, and various extension providers can develop demand driven linkages with researchers, private firms, and universities to access relevant technical support as needed.

### 3.3.2 Transfer

- Improving development communications support

Not enough attention has been given to packaging information and training materials through brochures, radio and TV programs, posters, demonstration materials, videos, and technical reports that help convey information and knowledge to farmers and extension workers, including input suppliers, financial services agency staff, and NGO staff.

### 3.3.3 Accessibility

- Expanding use of mass media and communication technologies

The mass media has been underutilized by extension, and new communications technologies now offer opportunities to deliver a richer array of valuable information of value to farmers and rural households. Development communications and mass media like radio and print media have long been a part of extension systems but have generally not received adequate attention or financing. New information and communications technologies (ICTs) can make production of mass media and development communications products more efficient and can provide higher-quality products that are more effective in delivering information messages and transmitting knowledge. Many benefits from new ICTs, such as Internet, computer systems, and telecommunications, will come from linking these to traditional communications media. This would enable radio broadcasters, for example, to access global sources of information in preparing programs. The advances in telecommunications and information technologies also provide extension systems with opportunities to deliver information services in new ways (FAO 2000). Rural tele-centers, cellular phones, and computer software provide new sources of information for extension agents and farmers in ways that allow for interactive two-way communications. Private services delivery, cost recovery, and "wholesaling" of information—providing it to intermediaries (NGOs, private sector, press, and others) which will use it to provide services to farmers—are important strategies for expanding use of ICTs in rural extension systems.

### 3.3.4 Extension

Extension officers need information to keep abreast of new agricultural technological developments and to produce extension materials for the end users. Through extension service it also helps to cover the following the topics;

- Improving the quality of services

While all of the above reforms aim to improve the relevance and quality of extension services, additional investment is essential to improve the capacity of service providers to deliver advice and information to farmers. Quality of extension services depends on a range of technical and support services which must often be provided through public funding agencies even to private extension providers.

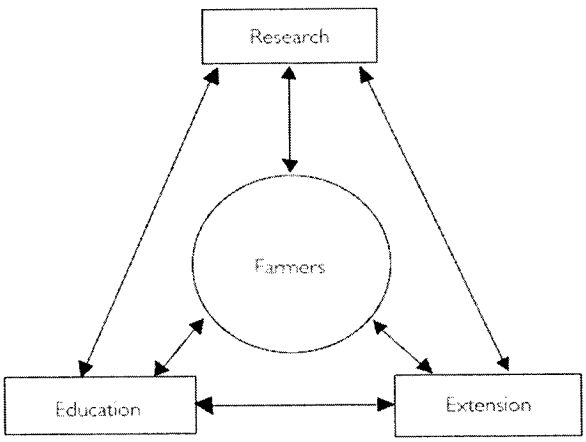
- Strengthening training of extension agents.

Training is a critical need and often inadequately provided in extension programs. Improvements are needed in both pre-service (university) and in-service training for extension agents. Training programs need to emphasize new extension concepts and methodologies, as well as expand attention to marketing, management, environmental issues, and the development of farmer and other client organizations. For sustainable and long-term development, investment in practical and well-rounded curricula for university programs can provide a base for training the future of extension agents. Most of the crops in Zambia especially wheat are grown by large scale farmers and in a specified location. The failure to expand the production of this crop is due to lack of extension services.

Past returns to extension investment have been valuable but often high. Future increases in agricultural production and rural income must come from intensification, rather than "extensification" of agriculture. Knowledge and related information, skills, technologies, and attitudes will play a key role in the sustainable intensification of agriculture and the success of other rural investments. New technologies and markets offer rural households new opportunities, but they require better access to information. Globalization and the need to trade in a global environment requires farmers and other rural people to become more competitive by acquiring more knowledge to base decisions on and new skills to implement those decisions.

Although agriculture remains critically important for their economic well-being, rural people need other options and expect more information than in the past, including information on health care and nutrition, consumer products, and government and other programs. Many

farmers want to stop farming (or because of lack of competitiveness will be forced to) and will seek information, education, and alternative skills to prepare them for new employment. Extension services make significant contributions to environmental protection and sustainable management of natural resources by promoting conservation of land, water, and forests; conservation of biodiversity; pesticide safety and residue minimization; livestock waste management; and water quality preservation and watershed protection. The client base for environmentally oriented extension goes beyond the small scale farmer because the varied activities of rural residents, such as hunting, disposal of waste materials, harvest of fuel wood, and other products, affect the environment (Neuchatel Group. 1999). The flow of Agriculture information is summarized with the help of the Agriculture knowledge triangle (FAO 2000).




Source: FAO/World Bank 2000.

Figure 1 Agriculture knowledge triangle

## CHAPTER 4

## 4.0 METHODOLOGY

A literature review was done in order to have an in-depth understanding of the problem statement. The study of similar systems was done, and a number of relevant literatures were studied. These include Software Engineering book by Ian Sommerville and Project Management and Advanced Object Oriented Programming by Kathy Schwalbe. Also, journals and conference papers were deemed helpful.

The first thing done was defining the system requirement of the program or software and the second part comprised of the development of the actual system which is the data base of the information. This program or software was developed in such a way that it will be upgradeable as information becomes available. The information was collected from Zambia Agriculture Research Institute (ZARI). The information was then transferred or embedded in the program were it would be easily accessed by everyone just by the click of the button.

In order to study Zambia Agricultural Information System (ZAMIS), reference to a number of publications and websites were also made. These include:

1. National Agriculture Information Service (NAIS) The pilot stage of this project involves managing the information flow between Lusaka and Kasama.

2. Information flow in agriculture – through new channels for improved effectiveness

### 4.1 SYSTEM REQUIREMENTS

System requirements are services that a system should provide. These are measurements that quantify how efficient the system becomes. Thus, the Zambia Agricultural Management Information System (ZAMIS) was designed to satisfy the following requirements:

#### 4.1.1 USER LOGIN

The system was developed in a way that access to system resources is restricted, and therefore only authorized users would be able to insert, update and delete data residing in the system.

Authorized users will be required to provide valid credentials, which are Username and Password in order to access the system.

### 4.1.2 SYSTEM ADMINISTRATOR

A System Administrator is a super user responsible for regulating the usage of the system. Depending on how the system is utilized, System Administrator will be able to add new users, update, and delete data from the system. Also, the Administrator shall be responsible to assign roles to particulars users.

### 4.1.3 NEW USERS

For users that are not in the system, they will be required to submit their details by filling-in the appropriate form. Text fields for entering first-time user details were provided. New users will only be able to access the system only after their details are matched and approved by the System Administrator. The same shall effect to users whose accounts had been deleted or deactivated and later wished to be readmitted to the system.

### 4.1.4 USER INTERFACE

The Zambia Agricultural Information System is a web based system, and therefore its interaction is sorely dependent on the Web User Interface (WUI). Using an appropriate web browser be it Google Chrome, Firefox, Safari or Internet Explorer, or preferably Netscape the system shall respond accordingly. This particular requirement was easily met, as most of these browsers are preconfigured and resident on the Operating System.

### 4.1.5 VALIDATION

Identifying who attempts to enter the system and what type of information is fed into the same is a very crucial algorithm to any Information Management System. Therefore, the system was developed to check whether a particular user was entering the correct data in to the system. If, in any way the user has no clue as to what type of data-types should be entered in a particular field, the system provides hints for the same. Also, the system checks whether users attempting to enter the system are eligible to do so. If they do, then they are valid users. If they do not,

then they are required to register. Therefore, all these mentioned techniques are referred to as validation.

Since the Zambia Agricultural Information System (ZAMIS) is a Three-Tier-Client-Server architecture, another form of validation called Server-Side Validation was considered. This type of validation is one that is executed on the server. Also, Client-Side validation takes effect on the client in the context of a web browser. In a nutshell, before a web form is submitted to the server, a client-side script checks the data that was entered and determines whether valid or invalid. If valid, user proceeds to the next level of interaction. If not, a prompt to enter valid data pops up.

### 4.1.6 FLEXIBILITY

Flexibility is a spine of any Client-Server architecture. The Zambia Agricultural Information System (ZAMIS) was implemented to embrace the change. Therefore, the system was dynamically developed so that changes can be made according to specified needs.

### 4.1.7 PERFORMANCE

Performance of a system is dependent on the quality of resources invested in implementing that system. Resources include hardware and software. Ensuring that legitimate tools and techniques are used in the development of the Zambia Agricultural Management Information System (ZAMIS) was one of the major tasks. For the database, WAMP Server 2.0 was used. This version encompasses Apache Web Server, PHP and other necessary tools. Therefore, the system requires that the same is running before executing the system.

Also, the system requires Operating System such as Windows XP, Windows Vista, Windows 7 or latest version. Minimum memory requirements of 256 Megabytes or more is necessary, and a minimum hard disk space. Processer specification of Pentium III (700GHz) and Network Interface Card are major requirements as well.

### 4.1.8 USER REQUIREMENTS

Service Level Agreement (SLA) is the most important aspect of every successful Information Technology project. This ensures that all ideas and theories are refined into accurate needs and expectations of the system. Hence, both the developer and user were influenced by the same.

## 4.2 SYSTEM DESIGN

### 4.2.1 DEVELOPMENT PROCESS

Figure 2 shows the skeletal layout information system for the simplicity of the program illustration. The figures below show how the information system looks like after completion. Figure shows the home page of the information system which indicates the features that the ZAMIS will contain which include home, vegetation, soils, climate, research works, land forms, land use and environment. It also has a login feature. The figure below shows the layout of the system.

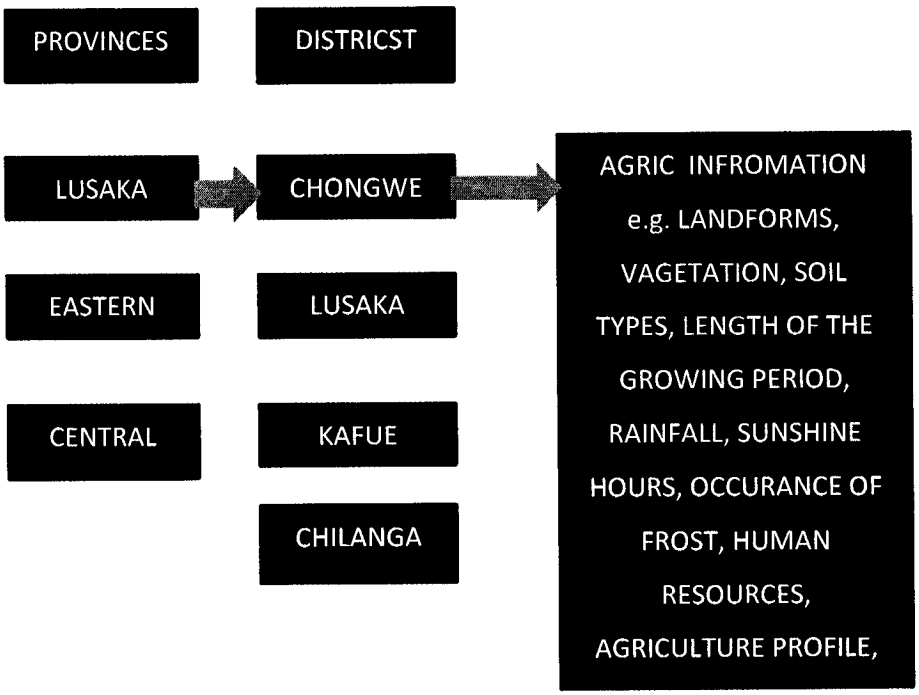



Figure 2: Skeleton layout of the ZAMIS

The system was developed using Waterfall model lifecycle system of software development (Ian 1998). The main reason as to why the same was used is because it provides easy and flexible production of milestones and deliverables at each phase. Waterfall model made it easier to iterate through various stages and thus include all necessary information that may have been forgotten in the previous developmental phases. The figure below illustrates the Waterfall model that was used in implementing the Zambia Agricultural Management Information System (ZAMIS).

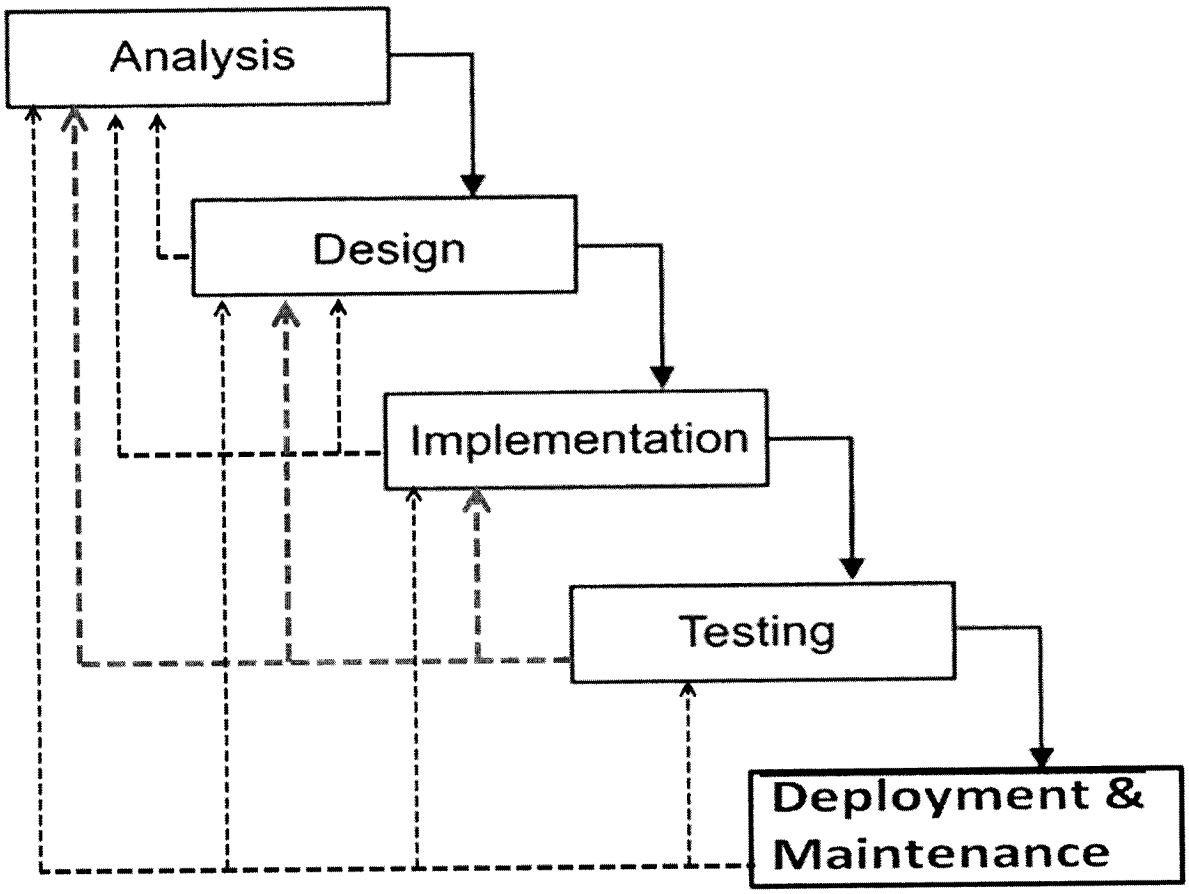



Figure 3 Waterfall Lifecycle Model

The diagram below describes the detailed step of each phase described in Figure 1. The steps involve problem definition by the user of the system all the way to system testing and evaluation. This ensures that the system designed is as proposed by the user. These are the

steps through which the waterfall lifecycle model of software development under go before the system can be fully functional.

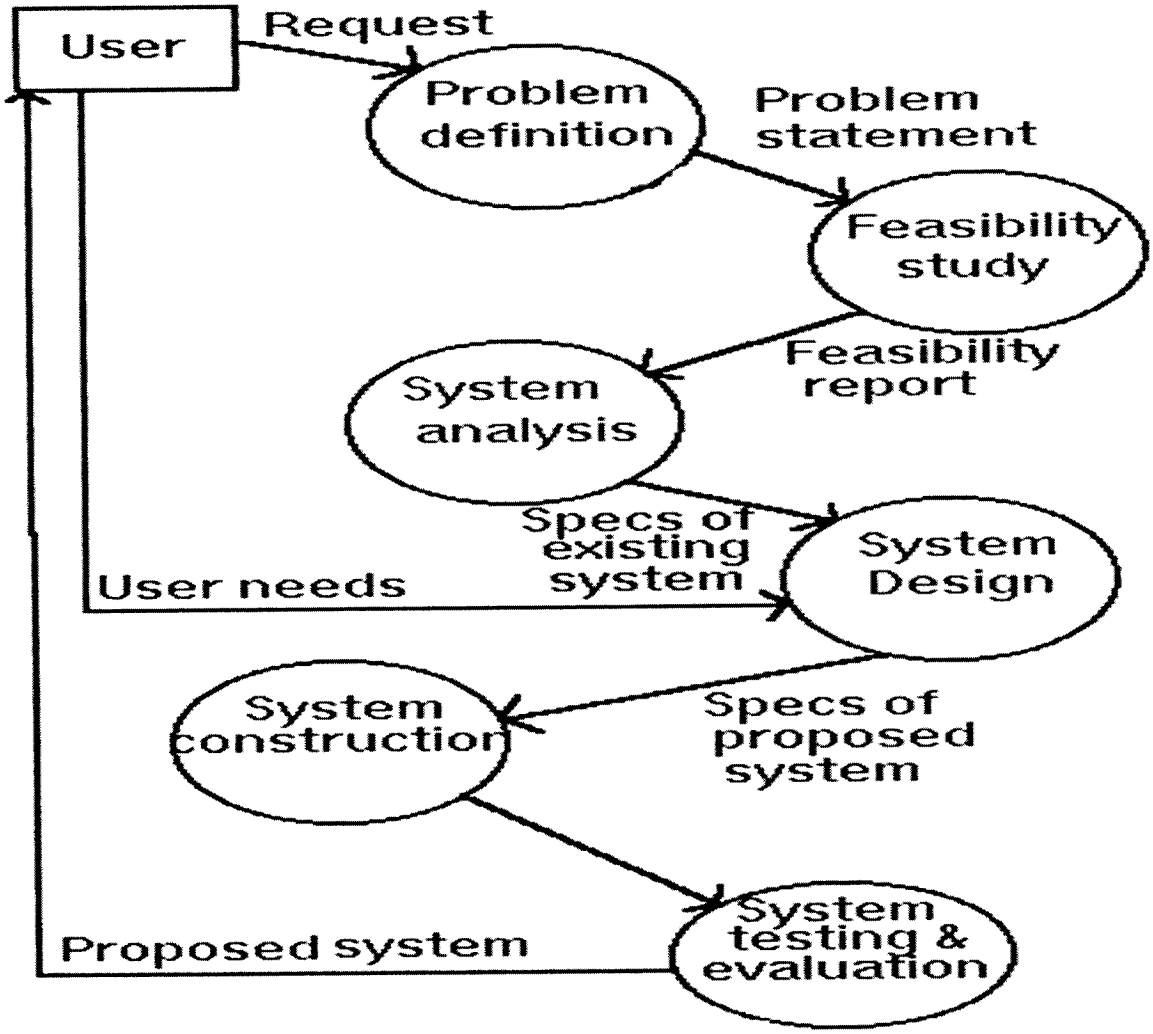



Figure 4 Descriptions of the steps in Figure 3

### 4.2.2 USE CASE DIAGRAMS

A Use case diagram (Schwalbe 2000) shows how the system functions in terms of Actor and Use case. In the same context, Actor is a system user. Users include System Administrator and other users that are granted privilege to interact with the components of the system. On the other hand, Use cases are nothing but activities or actions that are carried out by the user. This

section illustrates a pictorial analysis on what actions are carried out by the user. The same depicts the boundaries of system functionalities.

Below are Use Case diagrams that were constructed using Argo UML, a Unified Modeling Language Tool. This software development tool allows Systems developers to plan, design and decide parameters to be represented in software development process. The same allows developers to logically determine the objects and their interactions within the system.

The diagram below shows the actions that a System Administrator can perform with the system.

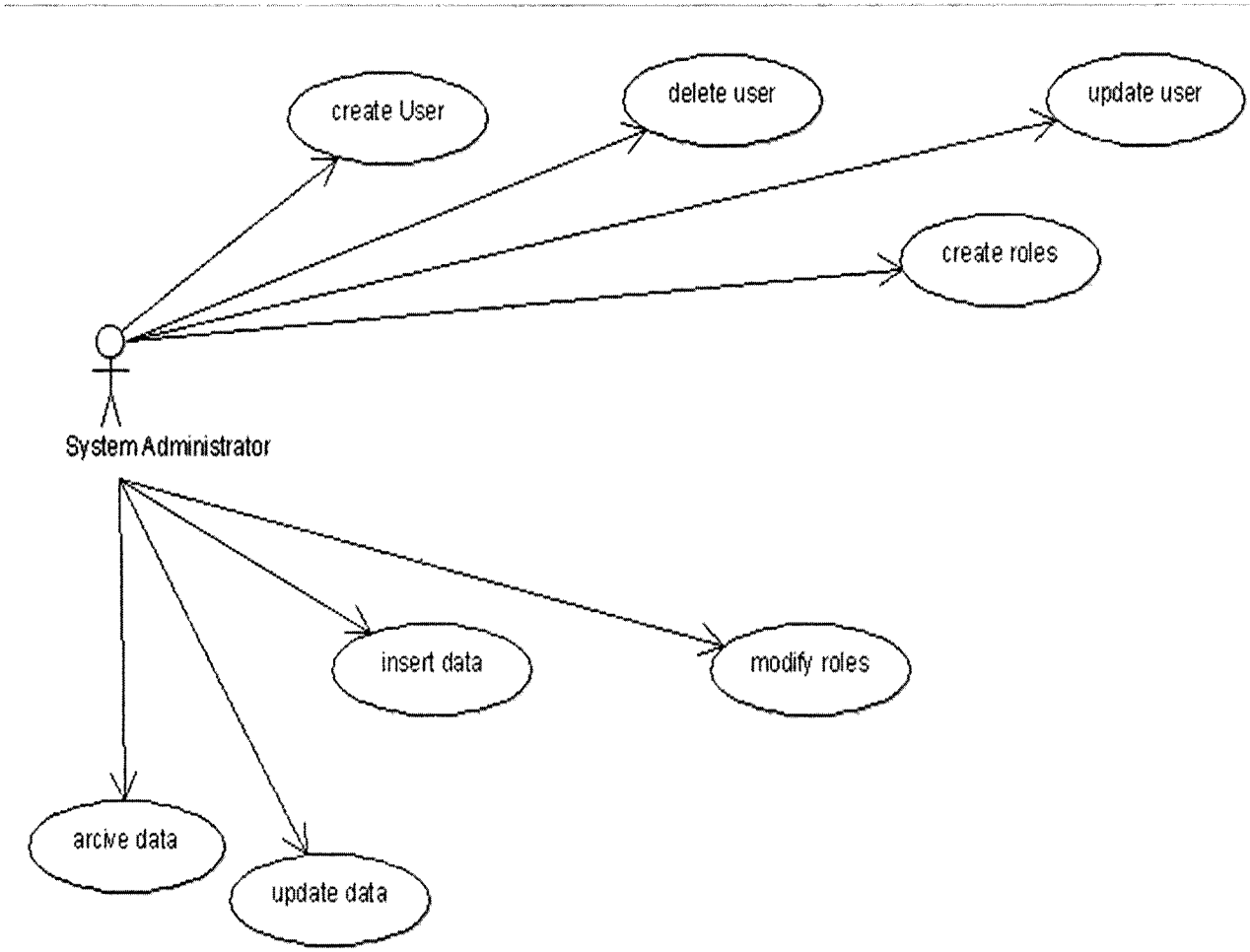



Figure 5: Administrator Use Case

The diagram that follows shows the activities carried by a user. In this context, an aggregate between System Administrator and normal user was defined. The same explains that normal users can only carry out a limited number of specified activities. However, special activities are left for the super user, System Administrator.

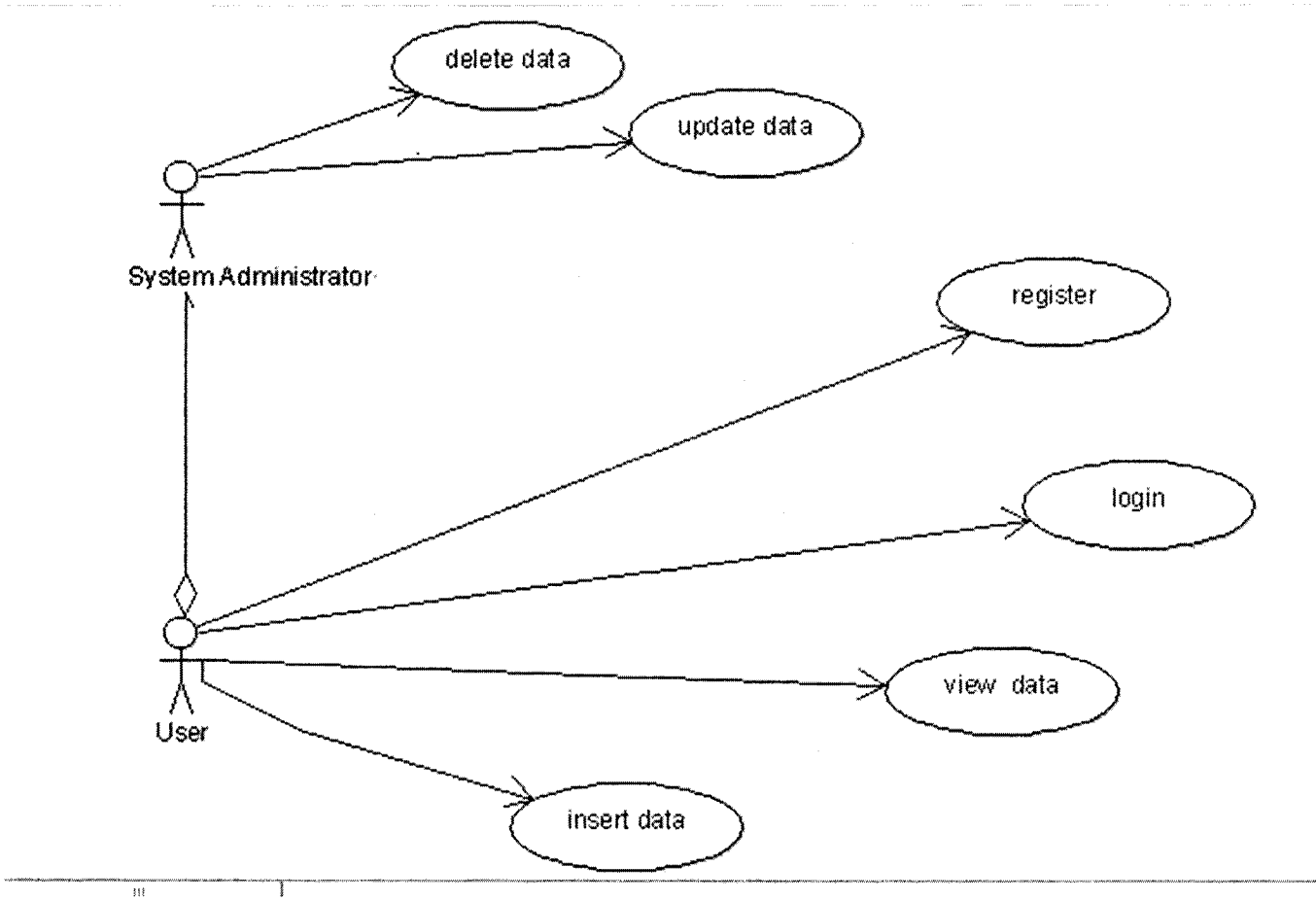



Figure 6: An aggregate between System Administrator and normal user

### 4.3 DATA COLLECTION

The information captured in the information system was collected from Zambia Agriculture Research Institute (ZARI) in Chilanga. Some of the information was from the environmental impact assessment report that provides a much better detailed survey of the agriculture information. Little survey has been done to detail the information of a particular District. The

only detailed survey that have been done have been done on specific farms and areas of interest. Therefore the information of the soils captured in the information system is at a scale of 1:1,000,000. The information collected at the Research Station is the soil types of the districts. For the purpose of demonstration data entered was from Chongwe and Mazabuka District.

## CHAPTER 5

## 5.0 RESULTS AND DISUSSION

### 5.1 RESULTS

The ZAMIS design included the development of the system, data collection and entering data into the program. The results of the system in this report are shown by indicating the layout of the system when it is fully functional and the actual result or outputs are shown by illustrating on the functionality of the system. The Figure 7 shows the system at home page. The home page only shows the type of data that you can find in the system, a brief introduction of the project and the login feature. The login feature helps with the systems security and limits the number of people who can have access to the system to minimize on data distortion.

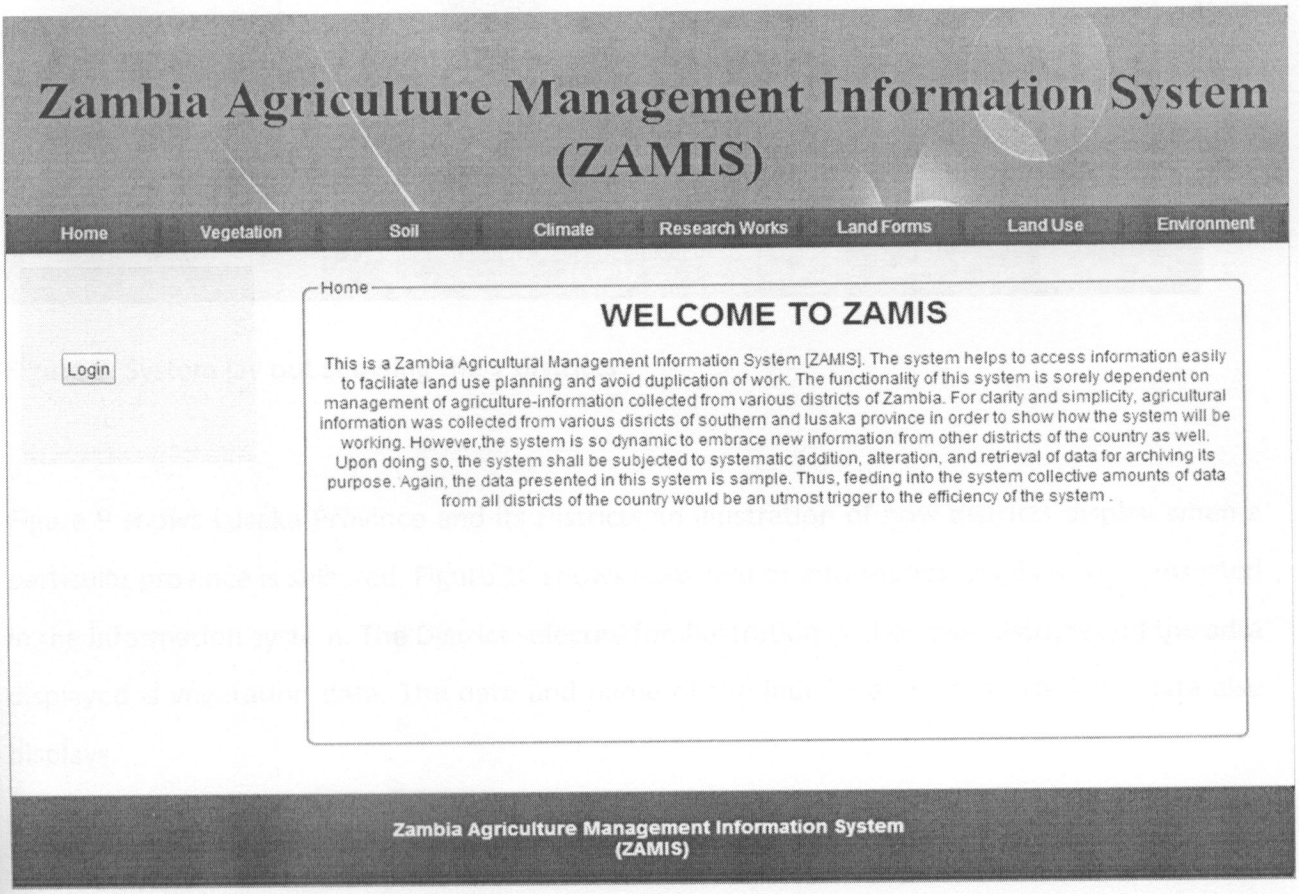



Figure 7: System lay out at home page

Figure 8 shows an option of province which further gives an option of the seven (07) Districts. The seven districts are just for the purpose of illustration.

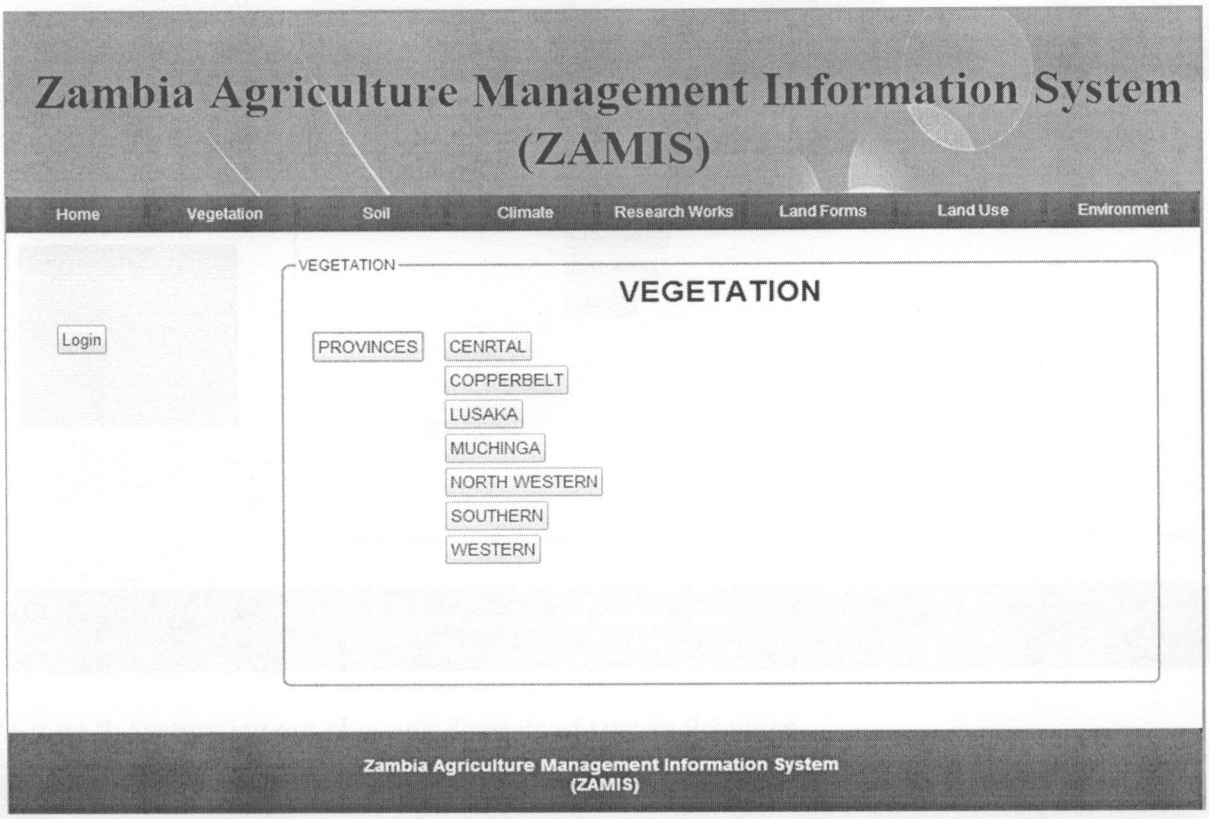



Figure 8: System lay out showing the 7 districts

Figure 9 shows Lusaka Province and its Districts an illustration of how districts display when a particular province is selected. Figure 10 shows how data or information displays when inserted in the information system. The District selected for illustration is Chongwe districts and the adta displayed is vegetation data. The date and name of the individual who inserted the data also displays.

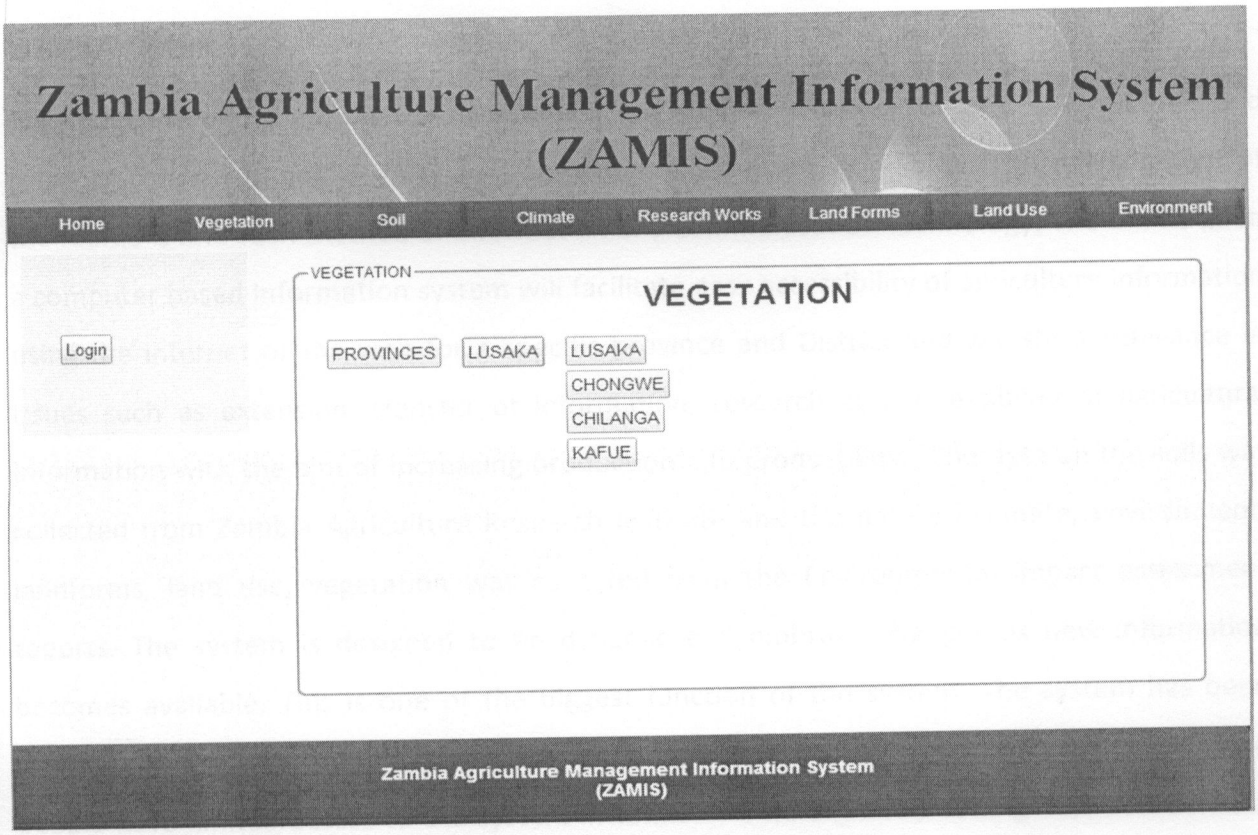



Figure 9: System lay out showing districts of Lusaka Province.

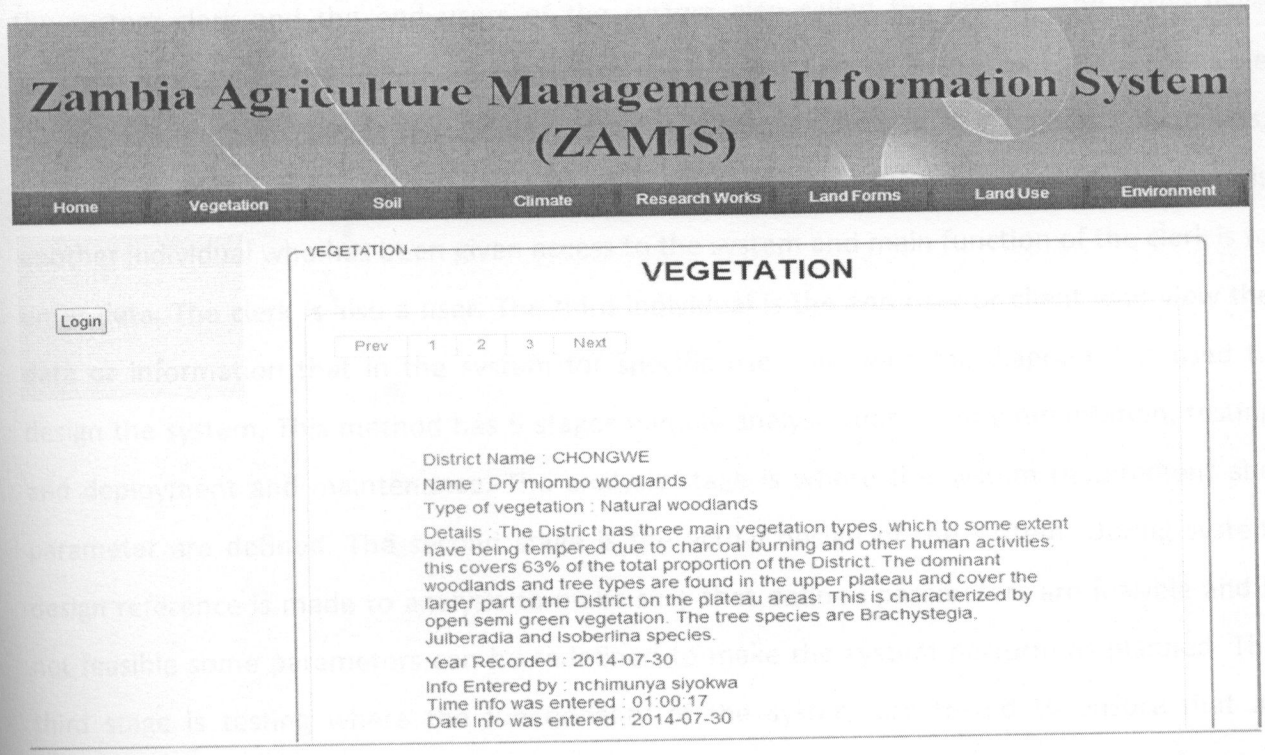



Figure 10: showing how information displays in the Information system.

## 5.2 DISCUSSION

The past decade has been characterized by major changes in the information and communication technology (ICT) environment in agriculture worldwide. The development of the ZAMIS is one such method of information and communication technology. The ZAMIS been a computer based information system will facilitate easy accessibility of agriculture information using the internet or the web for a specific province and District and will show relevance in issues such as extension, transfer of information, research and accessibility of agricultural information with the aim of increasing production and productivity. The data on the soils was collected from Zambia Agriculture Research Institute and the data on climate, environment, landforms, land use, vegetation was collected from the Environmental impact assessment reports. The system is designed to be dynamic and embrace changes as new information becomes available. This is one of the biggest function of the system. The system has been designed with a security function which is the login option. This option ensures that limited people have limited access to the system in terms of entering data, editing data and deleting data. The system has been designed with two types of users namely the system administrator, the system clerk and the end users of the system also called the clients. The three have different function as the system administrator is the super user of the system and responsible for creating system clerks. The system administrator can perform the following functions: create and delete clerks, delete data, edit data. The administrator is also a user. The clerk is another individual who has been given access to the system and main function of the clerk is to enter data. The clerk is also a user. The third individual is the end user or client who view the data or information that in the system for specific use. The waterfall diagram was used to design the system. This method has 5 stages namely analysis, design, implementation, testing and deployment and maintenance. The analysis stage is where the system requirement and parameter are defined. The second stage is the actual design of the system. During system design reference is made to analysis to make sure that defined parameters are feasible and if not feasible some parameters can be redefined to make the system perform as planned. The third stage is testing where the functionality of the system are tested to ensure that all parameters are working as designed. The fourth stage is the implementation stage when the

system is function according to the planned design. The fifth and final stage is the deployment and maintenance.

The data base used for this information system was WAMP (windows apache, MySQL, PHP) server 2.0. Windows Apache is a web server application notable for playing a key role in the initial growth of the World Wide Web. Apache supports a variety of features, many implemented as compiled modules which extend the core functionality. Structured Query Language (MySQL) is a special-purpose programming language designed for managing data held in a relational database management system (RDBMS).Originally based upon relational algebra and tuple relational calculus, SQL consists of a data definition language and a data manipulation language. The scope of SQL includes data insert, query, update and delete, schema creation and modification, and data access control. Although SQL is often described as, and to a great extent is, a declarative language, it also includes procedural elements. Perl Hypertext Preprocessing (PHP) is a server-side scripting language for creating dynamic Web pages. You create pages with PHP. When a visitor opens the page, the server processes the PHP commands and then sends the results to the visitor's browser.

Other computer languages used are Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The design goals of XML emphasize simplicity, generality, and usability over the Internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services.

Cascading Style Sheets (CSS) were developed as a means for creating a consistent approach to providing style information for web documents. Cascading Style Sheets (CSS) is a style sheet language used for describing the look and formatting of a document written in a markup language. The language can be applied to any kind of XML document. CSS is a cornerstone specification of the web and almost all web pages use CSS style sheets to describe their presentation.

CSS is designed primarily to enable the separation of document content from document presentation, including elements such as the layout, colors, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics, enable multiple pages to share formatting, and reduce complexity and repetition in the structural content. CSS can also allow the same markup page to be presented in different styles for different rendering methods, such as on-screen, in print, by voice (when read out by a speech-based browser or screen reader) and on Braille-based, tactile devices. It can also be used to allow the web page to display differently depending on the screen size or device on which it is being viewed. While the author of a document typically links that document to a CSS file, readers can use a different style sheet, perhaps one on their own computer, to override the one the author has specified. However if the author or the reader did not link the document to a specific style sheet the default style of the browser will be applied. CSS specifies a priority scheme to determine which style rules apply if more than one rule matches against a particular element. In this so-called cascade, priorities or weights are calculated and assigned to rules, so that the results are predictable. The ZAMIS will ensure that information is packaged, processed and accessible easily.

## CHAPTER 6

### 6.1 CONCLUSION

There are great opportunities in applying information technology in agriculture so as to increase agricultural productivity and bring about development of the sector. The opportunities include improvement of food security through access to timely information, provision of equitable access to new techniques for improving agricultural production, improved information flow for better research and extension service linkages, better coordination and information flow. Thus the ZAMIS will facilitate the flow of information to the intended end users and the stakeholders when fully functional.

### 5.2 RECOMMENDATION

The data in the system is incomplete thus more data from the districts needs to be collected and inserted in the system. The system itself should be viewed as work in progress because it needs to be improved upon. The next researcher should complete the information system and compare the efficiency and effectiveness of information dissemination of the ZAMIS with other forms of information dissemination such as radio television and magazines.

From the way data is packaged in the current system through hard copies and most of the surveys have been done at a scale of 1:1,000,000 and some at a large scale but in more specified areas. The surveys at large scale have been done in farm blocks were parties doing the survey and the client have an interest in the outcome of the results. Most of the areas surveyed have not been clearly identified and this is becoming more costly as the surveys and the research is been carried out twice or duplicated. Therefore my recommendation are that the areas that are been surveyed to be located or identified through global positioning system (GPS) coordinates and later digitize them in geographical information system (GIS) so that it is easy to locate the area that has been already worked on in terms of research and soil survey.

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