BUILDING WEB-BASED FARM INFORMATION SYSTEM USING 3D VISUALIZATION TECHNOLOGY: A CASE STUDY OF JIGAWA STATE

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AHMADU BELLO UNIVERSITY, ZARIA

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DECLARATION

I declare that the work in this thesis titled "Building Web-Based Farm Information System using 3D Visualization Technology: a case study of Jigawa State" has been carried by me in the Department of Mathematics under the supervision of Dr. A.A. Obiniyi and Dr. S.E. Abdullahi.The information contained in the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any university.

Abubakar Ibrahim

…… ……

Name of Student Signature/Date

CERTIFICATION

This thesis titled "BUILDING WEB-BASED FARM INFORMATION SYSTEM USING 3D VISUALIZATION TECHNOLOGY" by ABUBAKAR IBRAHIM (M.Sc./Sci./2356/2011-2012) meets the regulations governing the award of the degree of M.Sc. Computer Science of Ahmadu Bello University (ABU), Zaria, and it is approved for its contribution to knowledge and literary presentation.

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……. …… ……

Chairman, Supervisory Committee Signature Date

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Dean, School of Post Graduate Studies Signature Date

DEDICATION

This thesis is dedicated to my mother, who gave me all her support and prayer in completing this work.

ACKNOWLEDGEMENT

Firstly, I thank Allah (SWT), with His mercy everything is possible. I would like to thank my Supervisor, Dr. A.A. Obiniyi. It would have been impossible for me to complete this dissertation without his knowledge, guidance, and encouragement. Through this process, you were not just a supervisor, but also a mentor. I am also grateful for my minor supervisor Dr. S.E. Abdullahiwho provided the necessary support for me to complete this project. Thank you.

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ABSTRACT

Better developments in farming have been achieved when the information required by farmers on agricultural technologies are made available as accessing latest information of agricultural activities will produce a sustainable farming improvement.The research is aimed at the dissemination of information to farmers through 3D visualization technology forthe development of agriculture to improve the life of citizen. The thesis examines the basic 3D form of visualization technology of major plants found in the farms of Jigawa State farming environment. The methods used in the research provided a reviewed of the related work in order to make a clear understanding of two dimensional works. Next, itmade designed of the farm information model using Sketchup with Ruby for three dimensional farms. Itstarted with observing some works previously done on disseminating information to farmers including organization and surveyed project based on how toimprove the flow of agricultural information through modern channels for sustainable farming development where the works are not 3D enabled form of disseminating information The research continues with design of Web-based farm informationtechnology which is a 3D form of information dissemination. To address none 3D limitation identified, we designed, implemented and evaluated a 3D farm information system. Results obtained showed that our 3D information system provided enhanced information dissemination to farmers in Jigawa State. Our 3D farm information system can be adapted and used in other environments to achieve better information dissemination.

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ABREVIATIONS

ACDI/VOCA Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance

AICC Agriculture Information and Communication Center

AIS Agricultural information system

ARENET Agricultural Research and Extension Network.

COLLADA: COLLAborative Design Activity

CTA Technical Centre for Agricultural and Rural Cooperation

DTMA Drought Tolerant Maize for Africa

ESRI: Environmental Systems Research Institute

GIS: Geographic information System

GPS Geographic Positioning System

GUI Graphical User Interface

HTML: Hyper Text Markup Language

ICT Information and Communication Technologies

KML: Keyhole Markup Language

MCTs Multipurpose Community Telecentres

NAADS National Agricultural Advisory Services.

NAERLS National Agricultural Extension and Research Liaison Services

NARO National Agriculture Research Organization

NASA National Aeronautics and Space Administration

NLT Nokia Life Tools

SMS Short Message Service

URAIS Uganda Rural Agricultural Information System

XML: eXtensible Markup Language

2D Two Dimension

3D: Three Dimension

CHAPTER ONE

INTRODUCTION

1.0. Background of the study

Computer technology has improved many aspects of the oldest occupations, which is Agriculture. In Agriculture, these improvements include automated milk collection that comprises the robotic milking machine andthe use of Geographic Information System (GIS) and Remote Sensing in Agriculture, automated Weather station, Geographic Positioning System (GPS)in agriculture and computerized farmland assessment.With this, it is believed that computers have transformed farming activities.

Advanced disseminating agricultural information technology has brought about strong changes in farming practices such as Information and Communication Technology application in agriculture, Mobile phone application of Agriculture and internet application of Agriculture. With this application, it results in wonderful increase in production capacity of Agriculture. Most common use of computers in today's agriculture has been in replacing human work and involvement in oldest farming machinery and other farming tools. The automatic forms of farming such as use of machines and application of fertilizers are in use. With all these we can say computers have changed farming system while Internet has also doubled that change toward agricultural information dissemination.

Agricultural information dissemination is an important stage of agricultural technology development. It is essential because if it is not done properly and through the appropriate channels it will not serve the purpose it is intended for. The importance of information in agricultural development can never be over emphasized. Information generally is considered as being an essential production factor in Agricultural and rural development (Zijp, 2002).

Agricultural information is needed for overall development of Agriculture in order to improvethe living standard of farmers. Adefuye andAdedoyin (1993) suggest that for a steady flow of accurate understandable andfactual Agricultural progress, farmers must know, and act in accordance with Agricultural information. Therefore, how far people progress in agriculture depends largely upon the availability and access to accurate and reliable information.

Positive Agricultural managementrests on farmer's ability to make good decisions. While good decision making depends on correct information dissemination.Community's farms are becoming larger and Jigawa State farms are improving as well as people becoming new farmers, and affected by changes in many Agricultural factors especially with introduced good farming information. Decision making has become more and more complex requiring more types of information. With that, it is viewed thata farmer should set goals for his farming and accepts responsibility for decision made in reaching these goals.

The world is leaving the industrial age and entering the information age. According to Dillman (1988), with society's entrance into the information age, farmers must be able to adopt management practices to take advantage of the information technology becoming available to them.

Geographic Information Systems (GIS) are being used for developing ranking systems that evaluate land and provide a site assessment to aid, what is now known as precision agriculture. These hi-tech, interactive systems provide information based on a variety of factors such as soil conditions, drainage and slope conditions, soil pH and nutrient status. Prior to the use of these systems, farmers were often in the dark about soil output, and unpredictable weather conditions affecting crop quality and profitability (precision agriculture). Agriculture provides farmers with control by predicting vital information including fertilizer application and problems with

drainage, insects, and weeds (precision agriculture). This kind of technology equips farmers with enough information to increase crop yield in a manner that is consistent with the best environmental practices for sustainable Agriculture (Preeti, 2011).

The research attempts to contribute to the better understanding of how Geographic Information System (GIS) and 3D visualization tools can be used to disseminatefarms agricultural informationto farmers in Jigawa state. It will determine how farm information can be represented through the use of visualization tools to allow farmers make good farm use decisions. The visualization tools used include the Google Earth digital globe product. Google Earth is one of a family of 3-D geobrowsers (that includes Microsoft's Virtual Earth and ArcGIS Explorer) that offer easy to use service for visualizing a 3D digital model of the earth via the Internet. It is readily extended to act as an output medium for a wide range of products that contain spatial data and facilitates data access on information dissemination.

One of the main functionality of the geographical information systems is to visualize georelated objects based on their geometry stored and determined by coordinates in a reference system. The study of geo-related features and the relationships between them can be applied to many areas of the Agriculture industry. Regardless of scale –whether at the farm field level analyzing crop yield information or across an entire country– GIS is becoming fully integrated and widely accepted for assisting government agencies to manage programs that support farmers and protect the environment. These are the Agriculture GIS application in the field (Kumar, 2011).

The thesis includes Google Earth for the research in visualizing the farm information. Where Google Earth is geobrowser software for viewing satellite imagery, spatial data layers and allows addingplacemarks, lines, polygons and 3D models.The software also creates virtual environments of user selected areas, such as a farm. Using Google Earth people may choose to

simply view a location as a virtual 3D environment or to view the effects of an environmental process on that area.

Also the thesis usesgeographic information system (GIS) for mapping the areas of the research. According to United States Geological Survey (USGS) GIS is a computer hardware and software system designed to collect, manage, analyze and display geographically (spatially) referenced data.It is concluded that, GIS is a computer system that is capable of storing, managing, and presenting geographically referenced information. GIS systems are used in many fields, such as environmental control, tourism, scientific researches, resource management, and the definition is suitable for Agricultural applications of GIS.

Agricultural production are supported by use of GIS systems, because if you look at origin of Agricultural data for example,it is frequentlygeoreferenced and may consist ofelements of Agricultural activities such as climatic features like air pressureand soil quality. Farmers can make experiment on soil samples or product taken from different places at the farms. Later, thesamples are taken to a laboratory for processing. This is part of the GIS system work on Agriculture.

1.1. Statement of the Research Problem

A lot of researches have been done based on 2D to improve Agricultural productivity through information dissemination. Kakade(2013); views that Radio is one of the most powerful mass media for the dissemination of Agricultural information, and its effectiveness has been well established by many researchers. According to Shahid*et al*, (2003) the most used form of print media for Agricultural information was pamphlets followed by posters, newspapers, book/booklets, magazines and journals. But our researchfocuses on Agricultural information dissemination in 3D visualization technology with help of GIS and digital globes.Disseminating

of Agricultural information is one of the most important factors that affect production. This means that getting better agricultural production depends on the enough and latest technological Agricultural information. Considering this, therefore 3D technology with support of GIS and Google Earth can bring better Agricultural information for good production. According to ESRI (2010), Producers use GIS to better manage their farms by creating information-dense reports and maps that give them a unique perspective of their operations. The powerful analytical capabilities of GIS offer an array of options for visualizing farming conditions, as well as measuring and monitoring the effects of farm management practices, ESRI (2010). With that, it is concluded that for a qualitative, attractive and better visualize access to Agricultural information to provide greater yield of farm product in farming system, the use of three dimension is the solution to problem of other forms of accessing Agricultural information.

1.2. Motivation

Jigawa State is naturally blessed with large expanse of land, rivers and flood plain resources for production of wide range of crops. The diversity of climate, soils and vegetation across the state providesa conducive environment for sustainable Agriculture. This, indeed explains why nearly 90% of the adult population depends solely on agriculture as a means of livelihood.This therefore motivates the researcher to place the state in the line of computer simulation.

Internet has become a media which can allow displaying Geographical Information in better position and compromise interfaces familiar to user. The attractive feature of Geographic Information System (GIS) in the present history called three dimensions (3D), especially with help of Google sketchup and Keyhole Markup Language (KML). This also motivates me to enhance the technologies in 3D.

Another motivation is possibility that farmers could try different scenarios on models to disseminate information on Agricultural activities of their farms. For this reason, the study is interested in providing interactive and well developed information dissemination to farmers for better agricultural productivity to people living in rural areas.

The emergence of the World-Wide Web (www) has produced a new computing technology in farming system. This has motivated me in this discipline to develop the web based farming system toward a better crop production.

1.3. Aim and Objectives of the Thesis

The aim is to:

Accessesfarm information to farmers over a network through the application of 3D visualization technology, with the help of geographic information system (GIS) and digital globes (Google earth) technology.

The objectives are to:

a. Develop web based farm information system using 3D visualization technology.
b. Import created 3D models on Google earth.
c. Associate Google earth with Geographic Information System (GIS).
d. Assess information dissemination results of the 3D system side-by-side those of the 2D system

1.4. Methodology

Comparing real world in which peopleare living and the imaginary worlds designed by computer designers or game designers is usually consideredas three-dimensional. As such, the need for 3D in disseminating information is rapidly increasing.

a) The area of study (Jigawa State) will be drawn using GIS. The State map consist of four zones drawn with GIS were local governments of the each zone will be viewed on the Google map through satellite imagery. The portion of the information displayed shows the major plant of that area in 3D format, and the information associated with the plant. With that the farmers will be inform and to decide on the suitability of farm management.

b) Spatial referencing to extract points for the area captured in the satellite imagery that is Jigawa State will also be used as mentionedin (a) to display the farm information of the area in 3D form to allow farmers making plant use decisions.

ArcGIS software was used for this thesis indigitization andmodification of Jigawa State map. Google Earth is Earth browser software, which can be used to view satellite imagery of the area. Keyhole Markup Language (KML) file format that can be used to store and display geographic data. Number of plants models and farm can be created in Sketchupwith help of Ruby. Hyper Text Markup Language (HTML) and File Geodatabase can be used in developing a web site as well as database of the map system.

1.5. Organization of the Thesis

This thesis has five chapters that concentrate on a web based 3D farm information system for enhanced information dissemination. The general outline is as follows:

Chapter One, Introduction, begins with a general discussion of the background of the thesis, statement of the problem, motivation of the study, objectives of the thesis, and methodology of the thesis.

Chapter Two outlines literature review, where in the introduction the concept of 3D was discussed together with GIS and Google earth. In this chapter the study area was described and a

review of farm management was discussed. The review of related literature touched the work of some organizations and other project related to this work is carried out.

Chapter Three outlines the design of web-based farm information system, system requirement, system architecture, dataflow diagram of the system, design of GIS map, design of 3D farm and 3D farm on Google Earth.

Chapter Four is about implementation and discussion which consist of implementation tools and platform, code implementation, testing, results and discussion.

Chapter Five providessummary, conclusion and recommendation for future work.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Most of the business today in globe has profited from the arrival and world spread of the Internet, agriculture is one of them. Farmers can exchange ideas, connect with one another and other experts on agriculture using several forums and social networking sites. They can also acquire knowledge base on disseminating of information on large agricultural activities, while this makes rural digital divide to be reduce to an extent. For example farmer can easily seek out and connect with an agriculturalist and expert on agriculture where information such as farming system, price for grain and livestock, pest information and weather information in any part of the world is exactly available on one's hand.

The information on farming system can have opportunity to communicate through the application of 3D visualization technology. The thesis focused on how plant information can be displayed through 3D visualization to enable farmers to make better decisions on crop to grow. 3D representation is nothing but the ability to make virtual worlds, using 3D computer models to give people a feeling of reality in the imaginary world. The use of GIS makes the work more inform for farming system. Zhu *et al* (2012) views that, the Web has become a new medium which can display geographical information in rich forms and offer user-friendly interfaces. One of the promising trends in current Geographic Information System (GIS) is the use of Web 3D technology.

2.2 3D form of Visualization

WikiEcho (2012)compare 3D and 2D as follows: 3D refers to the actual dimensions in a computer's workspace. 2D is 'flat', using the X and Y (horizontal and vertical) axis', the image

has only two dimensions and if turned to the side becomes a line. 3D adds the 'Z' dimension. This third dimension allows for rotation and depth. It's essentially the difference between a painting and a sculpture.

In his dissertation, Tory (2004) compared 2D and 3D views as, A 2D view is a representation of an object or data set that provides information about only two spatial dimensions. A slice or orthographic front/back, right/left or top/bottom projection. While 3D view is any representation of an object or data set that directly provides information about 3D spatial structure (depth information). A 3D view is typically a perspective or orthographic projection of an object from a viewing angle other than front/back, right/left, or top/bottom. 3D views include, but are not limited to, stereo projections of objects.

3D techniques are initially applied in game design. It has many advantages

a. 3D makes well-organized use of space compare to 2D Tory (2004). One of the major problems addressed in graph visualization is the size of the graph. The size of the graph can make a normally good layout algorithm completely unusable. There are systems that can deal effectively with thousands of nodes. When the scale of software increases, the visibility, usability, and discernibility of the graph visualization accordingly experience dramatic drops. Also, the density of the layout makes the interaction, navigation, and query about particular nodes very difficult and even impossible. 3D has one more extra dimension that can be used to encode some knowledge compared to 2D (Tory, 2004). It works better for high dimensional data than 2D views. 3D has much greater working volume and has more flexibility to represent and organize the information. The efficient use of a 3D space for visualization is proposed as a solution to overcome the limitation of available exploration space and the problem of link crossing.

b. The average distance between entities in 3D space would be less than an equivalent 2D space. This is due to the fact that 2D diagrams are forced to be spread out, whereas 3D has the potential to be more compact. As an example, consider a map of the world. The distance between countries on opposite sides of the map would be significant if the map were to be displayed in detail on a computer screen. A user would be forced to scroll for some time to move from one country to the other. Now imagine if this map were rolled up to make a cylinder. That is, the two most distant edges were brought together. By doing this the average distance between countries is reduced. A globe of the world is a practical example of this, being a sphere rather than a cylinder(Lachlan, 2000).

c. Disorientation is one of the shortcomings of 3D. A user may become lost within a diagram, by facing in an inappropriate direction, or by moving too close to some object or too far from the model in general. Disorientation problems are preventable, however, with sensible model design. A user can be prevented from getting too far away from a model by encasing it in walls,(Lachlan, 2000)

2.3. Why 3D?

The research deals with accumulationof an additional dimension (z-axis) to the traditional 2D visualization. This provides opportunity to visualize additional layers of information that will enhance the information dissemination. To test it, we developed a 3D visualization technology with help of GIS and Google Earth for agricultural information technology. Certainly the strongest argument for 3D visualizations is living in a 3D world and our brains are designed to recognize and interact with 3D (Ware, 2004).

In Agriculture, it isunderstood that, the benefits of using visualization tools for information dissemination through 3D technologyarrives at reality, themore 3D models you provide to views, therefore the better information. The research used 3D visualization technology because:

a. Most often 3D visualization is dynamic and allows for change of the display based on the input of the human operator. However, especially navigation is an important part of 3D visualization as it allows the user to overcome occlusion (making hidden objects visible through a change of the viewpoint) or to look at the information from a different angle.
b. A great deal of research indicates that performance of tasks requiring, information integration, or mental model development, improve with 3D Visualization.
c. The potential advantages of 3D displays over 2D displays are significant. The added dimension and pictorial enhancements will often increase the amount of information (e.g., non-distance quantities) that can be presented on standard display screens and facilitate more accurate mental models of the farming system.
d. The thesis used 3D visualization in order to represents data in a format that can be perceived and understood much more quickly and easily than the raw numbers or words alone.

Noah said “A picture can speak 1000 words. 3D Visualization – even more”.

So, the inclusion of 3D technology in agriculture is about to radically change the whole process of farming. According to BluEnt, an US based large international IT-company specializing in technology-enabled services and architectural solutions; it is obvious that 3D visualization is here to stay. Visualization allows us all to see and understand our data more efficiently. 3D representation of property gives an extensive knowledge to people who see it. Knowledge breeds

confidence. Confidence breeds good decisions. So, make 3D visualization work for you (Noah, 2013).

Indeed, the evidence suggests that 3D visualization may be an effective visualization technology in the domain of information dissemination to farmers.

2.4 Geographic Information System (GIS)

Since the late 1960s computers have been used to store and process geographically referenced data. Early examples of GIS related work from the late 1960s to 1970s include the following:

a. Computer mapping at the University of Edinburgh, the Harvard laboratory for computer graphics, and the Experimental cartography unit (Coppock, 1988),
b. Canada land inventory and the subsequent development of the Canada Geographic Information System(Tomlinson, 1984).

For many years, though, GIS was considered to be too difficult, expensive, and proprietary. The advent of the graphical user interface (GUI), powerful and affordable hardware and software, and public digital data broadened the range of GIS applications and brought GIS to mainstream use in the 1990s.

Melnick, (2002) points out that GIS is an automated system for capturing, storing, analyzing, displaying, and querying spatial data. GIS is a rapidly growing technology that is used to generate intelligent and dynamic maps. Its applications are integrating more and more with many fields such as urban planning (Webster, 1993).

A GIS allows access to large amounts of information quickly and efficiently. “Geographic Information Systems let you visualize information in new ways that reveal relationships, patterns, and trends not visible with other popular systems” (Environmental Systems Research Institute, 1999).

2.5 Google Earth

Google Earth is a virtual globe, map and geographical information program that was originally called EarthViewer 3D, and was created by Keyhole, Inc., a Central Intelligence Agency (CIA) funded company acquired by Google in 2004. It maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS3D globe. According to pedagogy in action, it defined Google Earth as the geobrowser that accesses satellite and aerial imagery, ocean bathymetry, and other geographic data over the internet to represent the Earth as a three-dimensional globe. Geobrowsers are alternatively known as virtual globes or Earth browsers(Yu and Gong, 2012)

Google Earth provides search capabilities and the ability to pan, zoom, rotate, and tilt the view of the Earth. It also offers tools for creating new data and a growing set of layers of data, such as volcanoes and terrain that reside on Google's servers, and can be displayed in the view. It also uses elevation data primarily from NASA's Shuttle Radar Topography Mission (SRTM)to offer a terrain layer, which can visualize the landscape in 3D. For some locations, such as most of the western portion of the United States, the terrain data is provided at significantly higher resolutions. (Science Education Resource Center at Carleton College, 2010)

2.6 Description of the study Area.

The study area was Jigawa State (figure 2.3.) which wasexcised from Kano State, it covers a total land area of about 22,410sq Km. It is bordered on the West by Kano State, on the East by Bauchi and Yobe States and on the North by Katsina States and the Republic of Niger. Jigawa state which has a population of over 4.6 million people is located between latitudes 10°.57′ and 13°.03' North and longitude 8°.08' and 10°.37' East is naturally blessed with large expanse of

land, rivers and flood plain resources suitable for commercial production of wide range of crops, livestock and fisheries.

Out of the two million, two hundred thousand and four hundred Hectares total land area of the State, about 1.6million Hectares is cultivable during the rainy season which is about 72.7% of the total land mass. The State is also endowed with thousands hectares of forest reserves and populations in form of estates and shelter belts. Flood plains often referred to as FADAMA constitutes about 355.87ha (i.e. 16% of the total land mass) and are cultivable during dry season using irrigation. From this background information 80% of the State's land mass is considered arable which makes it one of the most agriculturally endowed state in the country today.

The diversity of climate, soils and vegetation across the state provides a conducive atmosphere for sustainable commercial agriculture. Thus indeed explains why over 90% of the adult population depends solely on agriculture as a means of livelihood. The mean annual rainfall for the state ranges from 538mm to as low as 1.132mm while the average annual temperature is 27^0C. The average relative humidity during the rainy months (June – Sept.) ranges from 49 – 79%. This relative humidity may drop to as low as 20% during the dry months of the year. Solar radiation can be as high as 25.1mz/day in the month of February – March. The lowest value of solar radiation occurs in the month of August (about 15mz/day) when cloud cover is most frequent which incidentally coincide with the peak period of rainfall.

In terms of water resources however, the state is drained by many rivers of which River Hadejia is the major one. This river conveys the major releases from Tiga and Challawa Gorge Dams bisecting the State and eventually draining into Lake Chad. It however bifurcates at Agufa through Miga to form the Kafin Hausa Rivers which also drain into Lake Chad. Other river systems that support irrigated agriculture in the state include:- Garin-Marke, Tomas, Jekarade,

Bunga and Chaichai. These river systems provide an estimated water volume of 667.8million cubic meters annually. In addition to this, the annual average rainfall of the state that ranges from 538mm to as low as 1.132mm facilitates an annual recharge of underground water to the tune of 2,018million cubic meters per annum. The contribution of the river system to the aquifer recharge is to the tune of 1,658million cubic meters annually (Brochure on Agricultural transformation in Jigawa state, 2011).

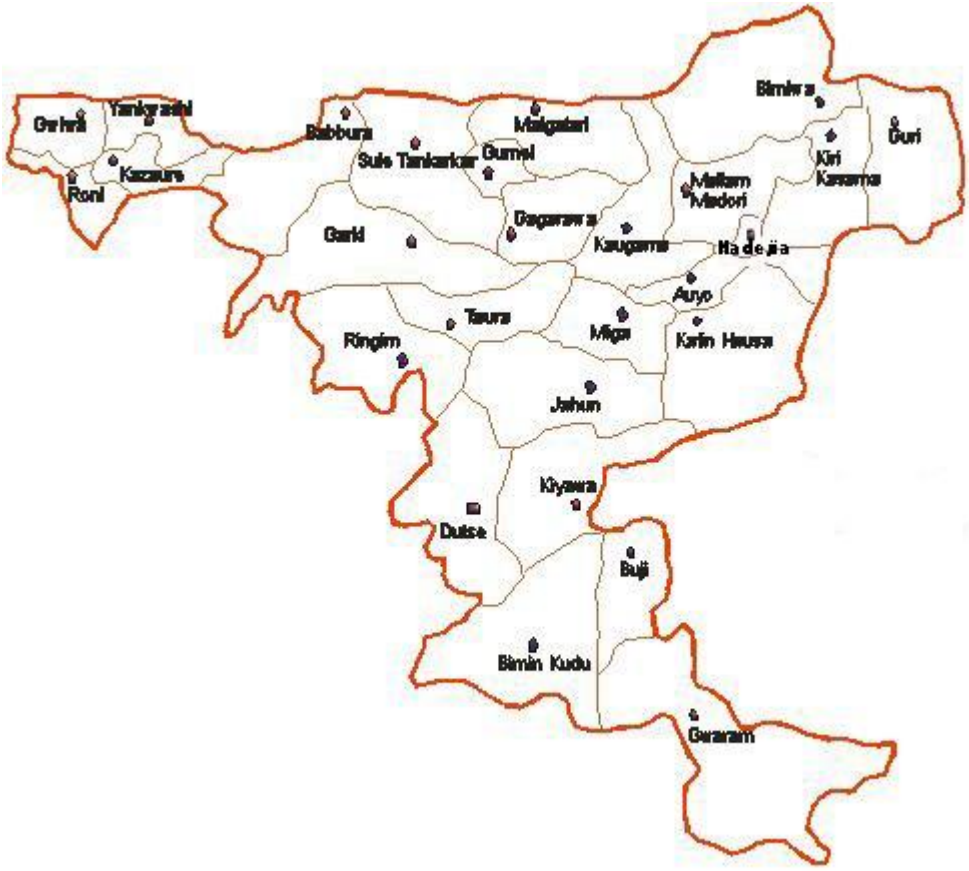


Figure 2.3 Jigawa State Map. (Agricultural transformation, 2011)

2.7. Review of farm management software.

More than 350 websites were identified as portals to farm management software applications and found that it fell into two categories: general Geographic Information Systems (GIS) / Remote Sensing packages and customized farm/agricultural systems. Some of the customized systems

were independent of GIS platforms and others were bundled with other products and exchanged data with them. The software is being used for analysis, farm operation support and for providing access to expert information.

Two of these customized farm/agricultural systems are introduced below.

a. Trimble agriculture, a GPS, guidance, and precision agriculture solutions for all seasons, crops, terrains, and vehicles. The products integrate advanced positioning solutions with software, wireless communications, and other technologies to allow you to easily collect, manage, and analyze complex information on your farm so you can make the best decisions for your operations season after season, year after year (Trimble, 2013)

b. AFFIRM - The Alberta Farm Fertilizer Information and Recommendation Manager (AFFIRM) is an interactive user friendly system that allows the user to select a crop to be grown, identify the field's agro-climatic region, input soil and crop management practices and enter soil test results from a laboratory report into the model. In addition, the model requires values for fertilizer costs and an expected crop value. The model is designed to access a series of databases to retrieve various coefficients based on the information entered by the user (Alberta, 2013)

None of these packages are currently 3D enabled

2.8. Review of related literature

Disseminating agricultural Information technologies are playing a very important role in creating awareness on agricultural technologies in farming system.

In their paper Pettit, *et al* (2007) stated that, there are a range of farm management systems and spatial technologies to assist farmers in making better land use decisions. In the paper they

described the development and application of the online farm management and catchment planning prototype tool known as eFarmer.

Their paper broadly address the following research questions: What are the state-of-the-art spatial tools that can assist farmers and land managers in making better land use decisions? How can land information be displayed through 3D visualisation to enable farmers and land managers to make better, collaborative decisions? It is limited to test the effectiveness of providing farmers and land managers with spatial information in a 3D form.

Khumphicha (2011): In his dissertation; Information Dissemination for Farming Communities in Thailand, developed a framework for the improvement of the dissemination of agricultural information among farmer groups in Thailand via mobile phone. The structure consists of three groups thus; the system developer, the system administrator, farmers receiving information from the system. The system developer worked on collecting agricultural information according to the target group's requirements. Then, the information from any formats was transformed into a database in order to be readily distributed to the target group through an SMS service on mobile phones. The system administrator's main responsibility was to update the relevant recent agricultural information in the database. The farmers receiving information from the system were determined as the system users who obtained specifically required information via an SMS service on registered mobile phones. Figure 2.4. shows the architecture of his framework.

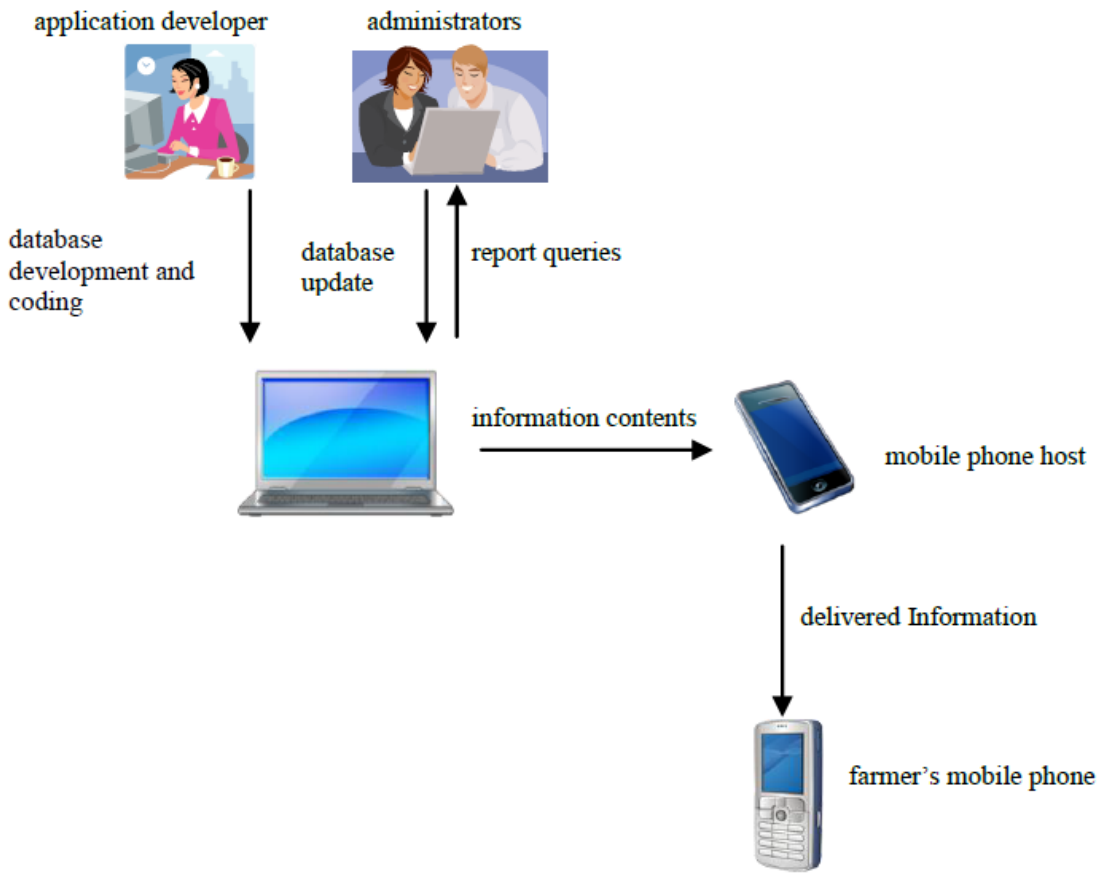


Figure 2.4. Khumphicha'sDissertation Framework. (Khumphicha, 2011)

According to a study conducted in the central Punjab, majority of the farmers consulted pamphlets, magazines, and newspapers for getting the information regarding sugarcane production technologies. These were regarded as the most suitable forms of print media for adoption of sugarcane production technologies (Shahid*et. al*., 2003). Farm publications have proved to be effective means for dissemination of information, especially to introduce new technologies. Farm publications are also useful for disseminating information among literate farmers (Singh, 2001).

In her dissertation, Sarah, (2011) developed "Uganda Rural Agricultural Information System (URAIS) Model" The model highlight structural elements through which information process activities should be performed to realize the goal of accessing and utilizing agricultural

information by the rural women in Uganda. The purposes of URAIS are,Develop infrastructure including buildings, power, telephony and other communication facilities for example satellites and information providers. These are the foundation of ICTs application to the access and utilization of agricultural information services by the Rural Women.Establish the facilities infrastructure - libraries/resource centres/Telecentres, cyber cafes, wired villages and rural community centres. These are places where the people would gather and consume information services and produce and distribute information resources such as posters, pamphlets, basicprimers, video, films, instruction and discussion programmes, according tothe established Agriculture information needs.

The model comprises four major elements/components, information sources, Information and Communication Technologies (ICTs), Information and Communication Technologies (ICTs) support and non-Information and Communication Technologies support resources. The non ICT support include, human, physical, and financial resources all dedicated to the production, processing, storage, retrieval, accessing and utilization of agricultural related information.URAIS is conceived as a central hub/utility or framework to guide the agricultural information processes, generating, collecting, processing, storing, retrieving, accessing and utilizing agricultural information to ensure that the rural women in Uganda access and utilize agricultural information.

Structurally, the proposed model should be a Ugandawide Rural Agricultural Information System/Network based at the Multipurpose Community Telecentres (MCTs) mostly situated in rural areas. It is at the MCTs where ICT facilities are found. Examples of these ICT facilities include community telephones, community radios, video recordings, the Internet and the library. All the above facilities generate process, store, retrieve and disseminate general information, for agricultural information to the rural women.

She further stated that, the Model illustrates that there should be "information sources" which should be feeding the MCTs with relevant information, accurate and timely information to be accessed and used by the rural women. Examples of information sources include National Agriculture Research Organization (NARO), National Agricultural Advisory Services (NAADS) and Non-Governmental Organizations (NGOs) among others. The staff managing the MCTs must be alert and should have information management skills that track, process and make information accessible quickly to the rural women.

The proposed model use the ICT support resources such as Video Cassette Recorders (VCR) and Television sets which should assist the rural women in visual encounter with the recorded information. Additionally, a few rural women were found using their own mobile telephones to receive agricultural information. The mobile phones proved to be very convenient because they do not need one to be present at the telecentre to acquire the needed agricultural information.

Another component included in the structure is the non ICT support resource. Findings from the study also revealed that the rural women benefited from the non ICT support resources such as the rural women social networks and the agricultural extension workers because they offered a forum of discussing agricultural related issues such as control of pests, weather forecast, market situations, as well as sharing experiences thereby acquiring important agricultural development information. Figure 2.5 is the URAIS model

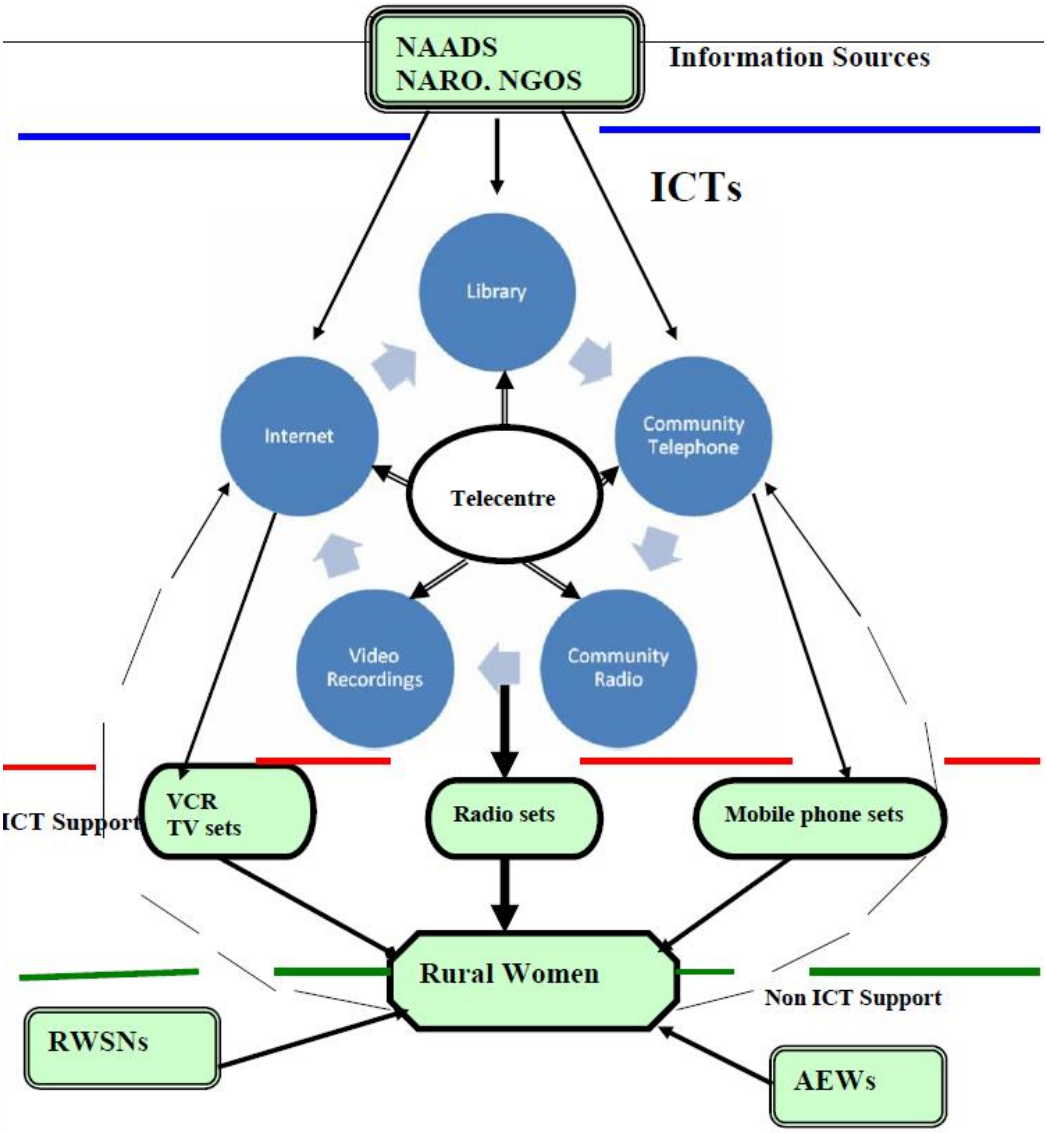


Figure 2.5. Proposed URAIS. (Sarah, 2011)

In their study Haruna*etal* (2013), extent of information and communication technologies (ICTs) usage among rice farmers in Kura local government area of Kano State, they examined the impact of ICT usage by Rice farmers to describe the socio economic characteristics of rice farmers in the study area and identify the extent of ICT facilities used in disseminating information on improved rice production technologies to the farmers. The result of their research is show in figure 2.6.

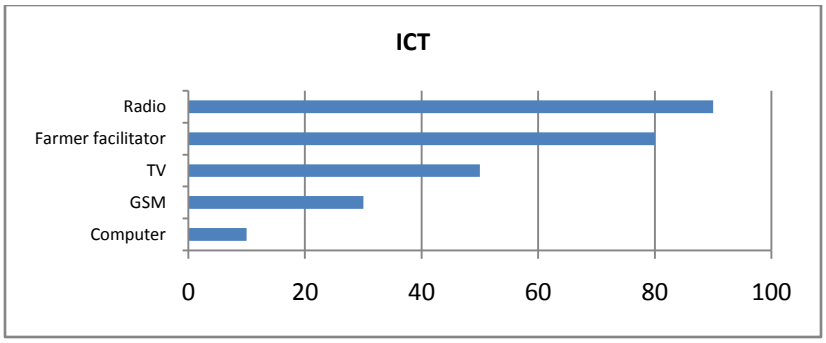


Figure 2.6. Extent of ICTs facilities in disseminating information (Haruna*et al*, 2013)

The result in Figure 2.6 shows that majority (87%) of rice farmers frequently used radio as their primary source of information, followed by farmer-friend with about 79 responses. The patronage of GSM by 36 rice farmers indicates their advancement on ICT usage. However, information dissemination and usage through TV has a decreasing effect only 13 out of 97 farmers reported as patronage. With that, all the reviewed work related in the research take part in this work from NAERLS in Agricultural information dissemination and can take extent of ICTs facilities in disseminating information as yardstick of the other reviewed studies. The illustration in figure 2.6 is in two-dimensional visualization. It display the two dimensional view of the use of radio, farmer facilitator, TV, GSM and computer.

There are some organizations that works related to the thesis, which include;

The National Agricultural Extension and Research Liaison Services, of the Ahmadu Bello University (NAERLS/ABU), which was formerly funded by the Federal Ministry of Science and Technology (FMST), is one of the Research Institutes being funded by the Federal Ministry of Agriculture and Natural Resources. The Institute is charged with the primary responsibility of research, development, collation, evaluation and dissemination of agricultural technologies to rural farm families and other interested end-users, through print material, skill acquisition center,

farm broadcast studio, web and multi-media, and adopted villages and outreach centers (NAERLS, 2007)

Another organization that works related to the work is Programme for Agricultural Information Service (PRAIS). The University of the Free State in South Africa was selected as the leading institution, with the South African Agricultural Research Council (ARC) and the South African Bibliographical and Information Network (SABINET) as backup. Similar services exist for Central, Eastern, and Western Africa, as well as in the Caribbean area, and forty-seven countries benefit from these services. Since August 1998, the Library and Information Services of the University of the Free State coordinates a Question and Answer Service for Southern Africa. The service is known as the Programme for Agricultural Information Services (PRAIS) and aims to promote the use of information in order to enhance sustainable agriculture and rural development and improve food security in Southern Africa (Erném, 2010).

The Technical Centre for Agricultural and Rural Cooperation (CTA) is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and European Union (EU). The Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA) was established in 1983 under theLome Convention between the ACP countries and EU member states.CTA work focuses on following key areas.

a. Providing information products and services (e.g., publications, question-and-answer services and database services) to farmers.
b. Promoting the integrated use of communication channels, old and new, to improve the flow of information (e.g., e-communities, web portals, seminars, study visits and social media)(CTA, 2013).

E-Agriculture is a global Community of practice, where people from all over the world exchange information, ideas, and resources related to the use of information and communication technologies (ICT) for sustainable agriculture and rural development. With over 10,000 members from 160 countries and territories, the e-Agriculture Community is made up of individual stakeholders such as information and communication specialists, researchers, farmers, students, policy makers, business people, development practitioners, and others. They have a common interest that brings people together: improving policies and processes around the use of ICT in support of agriculture and rural development, in order to have a positive impact on rural livelihoods (e-Agriculture, 2013).

The name ACDI/VOCA dates back to the 1997 merger of Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance. Both were nonprofit international economic development organizations founded by the U.S. cooperative community. It has worked to provide farmers with technical information and help them meet the demands of various sales outlets. Their work has focused on integrating smallholder horticulture farmers into commercial supply chains and facilitating mutually beneficial partnerships between smallholder farmers and major retail, wholesale, processor and export buyers. To help bridge the information gap between farmers and markets, it worked with Indian IT giant Infosys Limited to create an information dissemination system called fresh Connect (ACDI/VOCA, 2013)

GFRAS is the Global Forum for Rural Advisory Services. Their idea is to see rural advisory services effectively contributing to the sustainable reduction of hunger and poverty worldwide. Their work is to provide advocacy and leadership on rural advisory services within the global development agenda. Traditionally, Rural Advisory Services (RAS) disseminate information

about technologies, markets, inputs and financial services, and assist farmers to develop their farming and management skills through social media (GFRAS, 2013)

Agriculture Information and Communication Center (AICC): AICC is one of the main departments under the Ministry of Agriculture and Cooperatives Nepal. This governmental department is responsible for dissemination of agricultural innovation to the lower branches as well as to the farmers through television, radio, print media, internet and mobile phone. At the moment, AICC is collaborating with Nepal Television channel, Radio Nepal, Nepal Telecommunication Authority to disseminate agricultural information to the farmers (Chintan, 2012).

Other surveyed projects related to the thesis are;

a. **Pakistan: Pakissan** Pakissan.com is the first and largest agricultural web portal in Pakistan, providing a platform where the entire agri-community can connect with each other, sharing ideas, experiences and information. Viewable in both English and Urdu, the portal offers features like the latest news and issues from around the world as well as inside Pakistan. There are also advisory, report and business center sections, including a regular special report on important aspects of agriculture. To promote the site, Pakissan.com inaugurated its digital mobile van in 2002. The internet-ready van travels around the country to familiarize rural farmers with the use of information technology in the Agricultural sector, and how it can enhance their profitability(Fritz, 2010)
b. **Kenya: Kenya Farmers' Helpline – m-Kilimo:** This service was initiated by the call center operator KenCall. KFHL started in September 2009 and provides agricultural and horticultural information, advice and support. The service primarily targets individual farmers and will also be accessible to Agriculture extension facilities. In-house

agricultural experts answer registered farmers 'queries in English or Swahili. In the event that an agricultural expert is unable to respond at once, the helpline agent contacts the second-line consultants and reverts to the farmer within 24hours (Fritz, 2010).

c. **Agricultural Research and Extension Network (ARENET):**ARENET is a web based information system and network created to improve communication, exchange, sharing and access to practical, technical and relevant agricultural information that is strengthening Information and Communication Linkages between Agricultural Research and Extension in Uganda. It was developed through a Technical Cooperation Project – TCP between the Uganda government and Food Agricultural Organization (FAO).

   The project offers a simple Internet tool for documenting, storing, sharing and disseminating simple but technical agricultural information applicable to the farmers and extension agents. The objectives of the project are; to avail agricultural technical information about best practices and to share experiences and technical knowledge among National Agricultural Advisory development Services (NAADS) and farmers (Sarah,2011).

d. **Nokia Life Tools**: Launched in India in 2008, Indonesia and China in 2009. Information related to commodity prices, commodity news, agri-inputs (seed, fertilizer and pesticides) prices, weather forecasts and agricultural tips and techniques. In Indonesia, instead of market price, which is the main focus in India, Nokia Life tools concentrates on information related to animal husbandry, fisheries, etc. The information is pushed daily via text messages. There are two categories of services. Basic offers weather and agriculture news and tips for Rs. 30/-per month. Premium, which in addition provides selected market prices, costs Rs. 60/- per month. The service is currently available in

India (since early 2009), Indonesia (since Nov 2009), China (since May 2010) and Nigeria (since Nov 2010). As of April 2011, over 15 million people have experienced NLT services in these four countries (Fritz, 2010)

e. **Digital green**: Digital Green seeks to disseminate targeted agricultural information to small and marginal farmers in India through digital video. The system includes a database of digital videos produced by farmers and experts. Sequencing of the various content types enables farmers to progressively become better farmers. The Digital Green system provides structure to traditional, informal peer-to-peer training. The system improves the efficiency of extension programs by delivering targeted content to a wider audience and enabling farmers to better manage their farming operations with reduced field support (Digital Green , 2013)

f. **Philippines: Farmers' Text Center (FTC)**: FTC was started by the Open Academy for Philippine Agriculture (OPAPA) of the Philippine Rice Research Institute. This is a SMS service for providing technical knowledge to rice farmers as well as agricultural extension workers. Farmers receive message for one peso each. Through the FTC facility, farmers and extension workers can ask questions and get answers directly from rice experts. Started in 2004, the service answered around 2'000 SMS queries per month in 2010(Fritz, 2010)

g. **e-Sagu:** This project was established with the purpose of reducing the digital divide between farmers and agricultural experts. This was achieved by obtaining field information via coordinators to experts in order to provide personalized and timely advices to the farmers (Krishna *et al* 2007). The e-Sagu ("Sagu" means cultivation in Telugu language) system consisted of five components: farmers, coordinators,

agricultural experts, agricultural information systems and communication systems. Firstly, the farmers registered into the system by providing requested farm information to the coordinator. Then, at weekly intervals, the coordinators would visit each corresponding farm to gather crop situations and feedback about the previous advice, in order to send to the Agricultural information system (AIS) through the communication system using text and digital photographs. Usually, one coordinator was responsible for several farmers or some educated farmers might act as coordinators as well. After receiving farm data and crop situational data, agricultural experts prepared specific advice for each farm. Then, all the advices were stored in the AIS, ready to be retrieved by the coordinators for their corresponding farmers (Krishna *et al*,2007)

h. e-Choupal India: This project was launched by a private company in order to establish a direct connection to farmers by bypassing local government middle-markets. A set of kiosk facility containing a personal computer, Internet connection, uninterruptible power supply (UPS) including solar-powered battery backup and a printer was provided by the company but then operated and maintained by local villagers. In each kiosk, farmers were able to log on and retrieve provided information they were interested. With the corporations between the company and meteorological department, agricultural universities and input suppliers, the company was also able to offer input supplies in reasonable prices, provided free agricultural expert advice including relevant information such as weather forecasts, market price and farming practices through the company (Narula andArora, 2010),

The e-Choupal system has had a measurable impact on what farmers choose to do: in areas covered by e-Choupals, the percentage of farmers planting soy has increased

dramatically, from 50 to 90% in some regions, while the volume of soy marketed through mandis has dropped by as much as half. At the same time, ITC benefits from net procurement costs that are about 2.5% lower (it saves the commission fee and part of the transport costs it would otherwise pay to traders who serve as its buying agents at the mandi), and it has more direct control over the quality of what it buys. The system also gives ITC direct access to the farmer and to information about conditions on the ground, improving planning and building relationships that increase its security of supply. The company reports that it recovers its equipment costs from an e-Choupal in the first year of operation and that the venture as a whole is profitable.

2.9. Limitation of the existing work

If agricultural information is disseminated properly through the suitablemedia it would serve the purpose it was proposed to serve. Limitations regarding to current work encountered was that, the literature of the related work, found that the existed work such as;

a. The organizational works and the surveyed projects disseminated information using; skill acquisition center, farm broadcast studio, web and multi-media, and adopted villages and outreach centers, publications, question-and-answer services and database services to farmers, exchange information, ideas, and resources related to the use of ICT, The information is pushed daily via text messages, digital video e.t.c.
b. Considering the work of Pettit, *et al*, the work examines the 3D visualisation to enable farmers and land managers to make better, collaborative decisions. But the research is limited to test the effectiveness of providing farmers and land managers with spatial information in a 3D form.

c. Examines the research of Khumphicha and that of Sarah, they developed a prototype for model to access agricultural information via mobile phone, posters, pamphlets, basicprimers, video, films, instruction and discussion programmes.

Since 2D models is the computer-based generation of digital images such as geometric models (also called vector graphics), digital images (also called raster graphics), text to be typeset (defined by content, font style and size, color, position, and orientation), mathematical functions and equations, and more (Wikipedia, 2014).

Therefore, it is concluded that. 3D data representation often provides a more enhanced and intuitive user approach than a two dimensional approach. From definition of 2D, the works above considered as 2D information dissemination technologies.

CHAPTER THREE

DESIGN OF WEB BASED FARM INFORMATION SYSTEM.

3.1. Introduction

Information technology has succeeded in used of computers for effectivedissemination of information. Designing of farmer's three dimensional visualization technologies will make significant information for decision-making in Agriculture, which results in developing a model of Web based farming system.

For better improved and higher productivity of Agriculture, the use of 3D technology lies in bringing about an overall qualitative improvement in Agricultural activities. Access to information makes successful development of Agriculture and technologies which are making their best efforts to raise the benefits of farming to rural farmers.

Empowering farmers with relevant timely information about different plant varieties, including details about their ability to withstand biotic stresses (e.g. drought, salinity, nutrient deficient and growing conditions) can significantly reduce farming risk (Seyedand Seyed, 2012). New Information technologies, including Geographic Information System (GIS) can make such information available more widely in rural farming. This chapter outlines the research plan and the processes on the architecture of the farmers' 3D visualization technology as well as the design of 3D model.

3.2. System Requirement

The requirement of the system for the designing of farmer's 3D visualization technology is that, there is need for Google Earth Pro installed on computer, desktop GIS currently popularly known ArcGIS of ESRI also installed for the designing of the maps and installedsketchup or Google sketchup and Ruby programming language 2.0. The information of Jigawa State web

based farm information system on how the farmers will decide on farming process can develop. There are two types of end users in this system: the staff and the farmers. The staff are working in system, and using the original information system to manage the information. They have the training on how to use the system, and the efficiency is their main concern. While the farmers do not receive any training for the system and their technical skills vary greatly also to them, the web map showing the information should be easy to use and the interface should be user-friendly. The web based should meet the following requirements:

a. Provide the information of plants in 3D form to users.

b. Provide the information of plants, like the name and the soil type or soil PH of the area;

3.3. System Architecture

The system architecture is made up three layers, thus; GIS map layer, Data layer and interface layer (Figure 3.1).

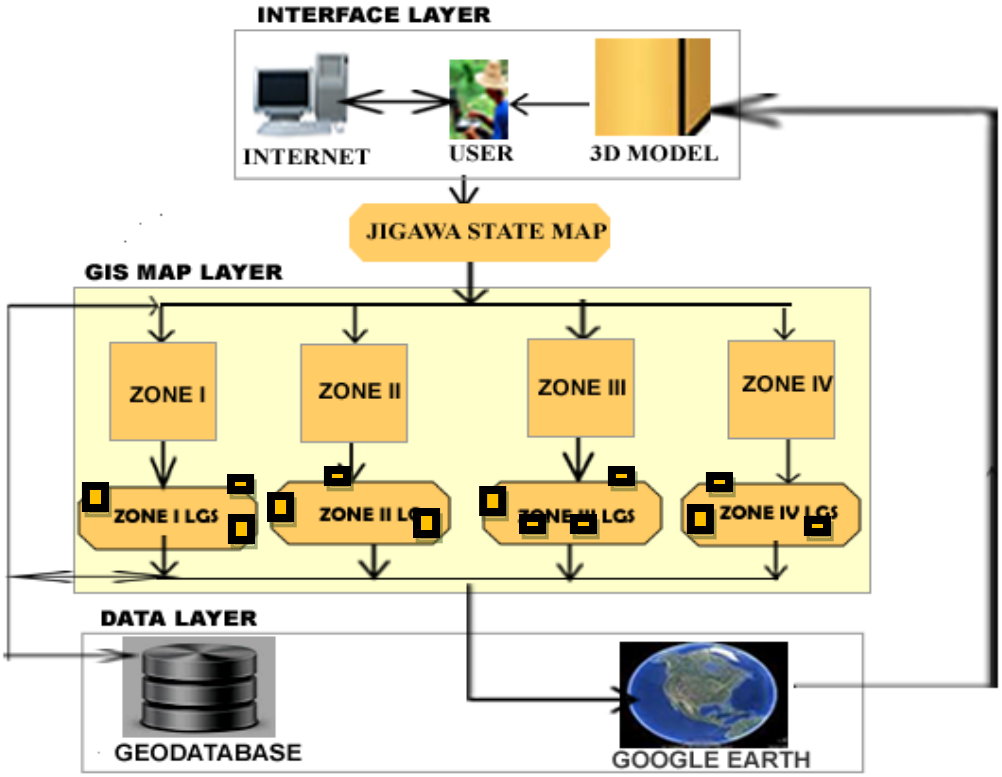


Figure 3.1 Architecture of Web-Based Farm Information System.

The layers of the Architecture are:

3.3.1. GIS map layer

The layer of GIS map consists of Jigawa state map as the zones created by the state Agriculture department and the local governments under each zone.

A GIS is a computer system capable of capturing, storing, analyzing, and displaying geographically referenced information;Kang-Tsung (2010)said that, data identified according to location. He continues, “Practitioners also define a GIS as including the procedures, operating personnel, and spatial data that go into the system.” Two key components to a GIS system are; the database that contains the geographically referenced information. The other is the set of maps on which the geographical referenced data are presented. An important part of the designing of a GIS system in this work is constructing the map of Jigawa state where the four zones of agricultural process are separated. The map can be constructed using desktop mapping program.

Other kinds of geographic referenced information can be displayed on the maps. For example, a map can be used to give a view of certain area. Then graphic markers such as points can be placed on the map to give indications on Agriculture as farm parcel.

The map was created with data from the ArcGIS, as a set of software produced by ESRI for the design of a complete GIS map.The Coordinate Systemis the most common way to locate a point on the earth by using latitude and longitude. The latitude value represents the angular distance measured in degrees between a point on the surface of the earth and the equator. Longitude represents the angular distance measured in degrees from a point on the surface of the earth to the prime meridian (the longitude line that runs through Greenwich, England, internationally accepted as the 0 degree longitude line), the map use coordinates in constructing the areas The map contained data from the Jigawa State. It contained feature classes that were created from coordinates which stored GIS maps. The application in the thesis has a user interface from where the GIS map can be view. Geodatabase was used in the system to store the data used in developing the maps of the state. The map of local government consist of the tip that can allow the user to decide on the area to choose either the link to Google earth in which model can be view or link to PDF file forfarm management information.

3.3.2. Data layer

The data layer contains two modules: the Geodatabase and the Google Earth. The modules control the georeference data and non georeference data use in the application.

a. GeoDatabase

Geodatabase also called Geographical Database is a GIS database which serves as the computer-based representation of the real world. A database or file structure is used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system,

attributes, and behavioral rules for data. Various types of geographic data sets can be collected within a geodatabase, including feature classes, attribute tables, raster data sets, network data sets, topologies, and many others (United Nations, 2000)

Filegeodatabase is used in this research, it contains file geodatabase which collects various types of GIS datasets held in a file system folder. This is the recommended recent data format for ArcGIS stored and managed in a file system folder. Each dataset is a separate file on disk, and the file geodatabase is a file folder on disk that holds its dataset files. The geodatabase consists of a file geodatabase feature dataset which holds related map data. Feature datasets hold related geographic information, such as all of the features that comprise a single geologic map. The homogeneous collections of common features, each having the same spatial representation, such as polygon, parcels, soil types and lines are example of file geodatabase feature class used The feature classes of the geodatabase of this thesis consist of the state map, zones, local governments and farm parcels, where all are grouped together in a file geodatabase feature dataset. The file geodatabase has file attachments to the records of a geodatabase feature class. The attachments are stored internally in the geodatabase in a separate attachment table that maintains linkage to the target dataset. The Attachments contain input records of pdf and 3D model in .kml file. An example of geodatabase architecture is shown in figure 3.2. The kml file used in the thesis is used to

i. Display 3D model data as elements within Google Earth.
ii. The files have a .kml file extension

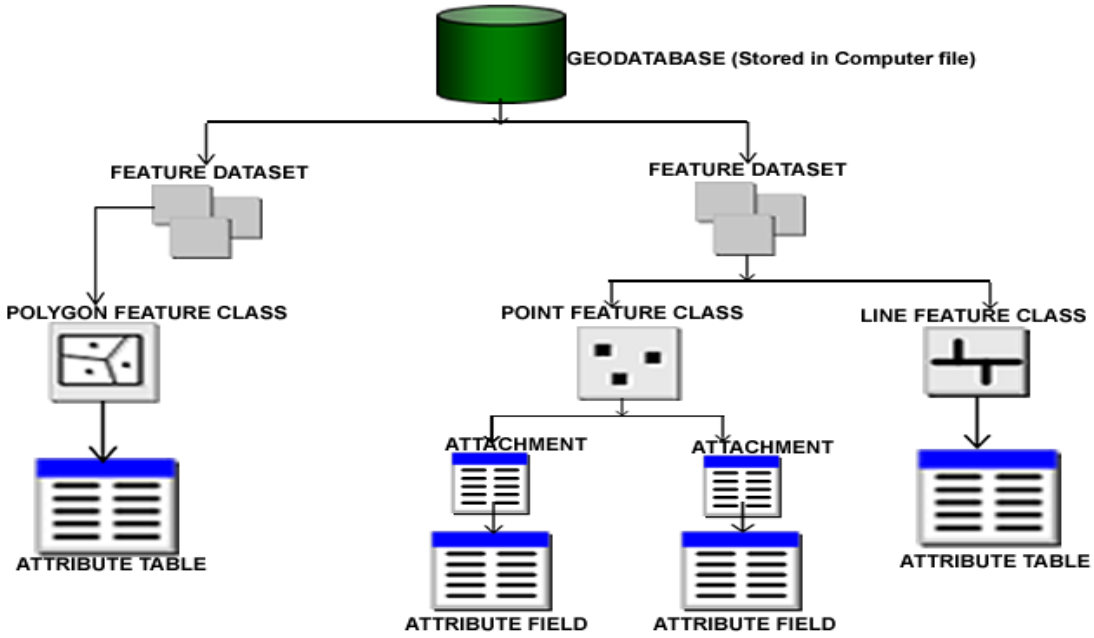


Figure 3.2 Architecture of File Geodatabase.

b. Google Earth

Associated with Google's powerful search engine, Google earth offers the service of finding a specific area on the map - users can quickly find a location by entering an address or the name of general area. Also, like other online map services, Google Maps provides the users with a driving direction service. They can get a step by step list of how to get to the destination and an estimated travel timeZhennan, (2007). In the thesis when the tip from GIS map shows GE is open and click on it, it will take the application to the Internet where google earth can be used to view Jigawa state imagery satellite area that contains local governments where the major plants can be import to view in 3D model using kml code.

3.3.3. Interface layer

The interface layer is the layer that allows for inputting the data to the system through the Internet and producing the output as 3D model by the user. The components in the layer are:

a. User

This is system interface where farmers can use to have access to the map of the application. The system has been developed using HTML which establishes a web database connection that enables users to integrate to GIS map. Therefore, from the interface the user can link to the map and then to Jigawa state where zones can be identified.

b. Internet

Internet has given the globe a reduction effect where each kind of information is only a few clicks away. The time has come to exploit this medium to the best-suited interests in the other fields of life such as Agriculture. In this architecture the internet is used to permit user to have accesses to overall GIS map to look for his request. It also allows user get his output in text and 3D model.

c. Three Dimensional model

SketchUp is a 3D modeler or a 3D modeling program integrated with Google Earth. The program is created by "@Last Software Company" in august 2000 as a general 3D content creation tool Dominique, (2009).Ruby is the programming language that can be used to extend SketchUp capabilities,in this thesis it's in version 8. Google Sketchup was used as the primary environment to create and present the 3D model of plant in this thesis. It allows the Google earth view from the Internet then Three Dimensional model of the plant can be import on the earth map of google earth under Jigawa state areas.In the thesis users are able to easily discover 3D models with Google Sketchup's zoom, pan, orbit, walk, and look around on the Google Earth.

3.4 Dataflow

The Dataflow of the farmers 3D visualization technology as in figure 3.3 is applied in the stat terminal as user interfaces with internet to look for the farm mangement portal of the Jigawa

state farming system within his computer web service. The user in the user interface searches for jigawa map image and looks for the zone of his choice between four zones viz; zone I, II, III, and IV. From there, the overall map in GIS displays where he chose for the zones in GIS maps which will take him to map of local government of any zone of his choice also in GIS. From the local government the user clicks on the area where he decides on either model of 3D or the information of land and farms in pdf form as text. If his decision is 3D model that is 'yes' as shown in the flowchart, the Google earth will display while the 3D visualization of plant will show in the farm as example of major crop grown in the area. But, in some areas, the example of farm information in 3D model will also display, and the program terminate. When the user select other round, that is no as shown in the chart, it will take him to textual output, where the information comprising the farm and land displays in pdf. Then the chart terminates.

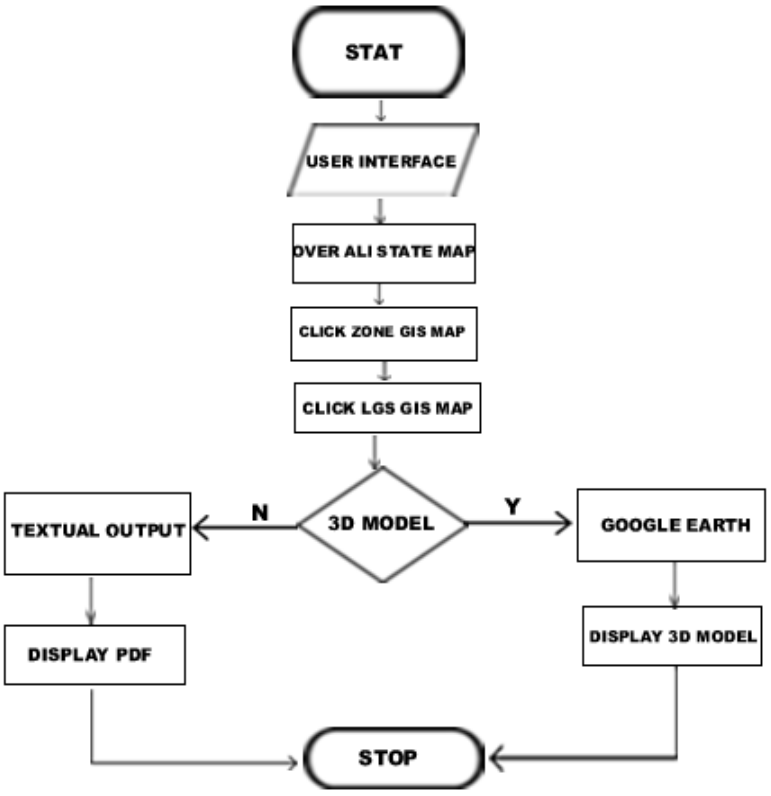


Figure 3.3. Data Flow Diagram of Web-Based Farm Information System

3.5. Design of GIS map

The GIS Map of the zones was designed using ArcGIS 10 from ESRI. The ArcMap part of the ArcGIS helps in the designing of the maps. ArcMap is the comprehensive map authoring and data analysis component of ArcGIS. It's the application the thesis used for analyzing and mapping of the data. The Tables below show the geodatabase used in the mapping of Zone II of the area and other information associated with a spatial location used.

OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	LGA	No_of_farm_parcel
2	Polygon	198121.6551	1335913499	GARKI	2
3	Polygon	67796.61867	232767100.5	GUMEL	2
4	Polygon	112407.9705	666482850.2	MAIGATARI	2
5	Polygon	141983.8226	866387734.4	GAGARAWA	2
6	Polygon	167923.5495	920590938.3	RINGIM	2
7	Polygon	138365.7067	650871192.5	TAURA	2

Table 3.1. Geodatabse Table of local Governments of zone 2.

3.6. Designing 3D Farm model

The 3D farm model was designed using ruby programming language which is used to extend SketchUp abilities. 3D model also has an embedded programming feature that is the Ruby API (Application Programming Interface). Ruby is an interpreted scripting language for quick and easy object-oriented programming. Most importantly for the thesis, it's a language that SketchUp can understand via its SketchUp Ruby API.Ruby is also associated with Sketchup in the form of plugins, which are loaded on start up from the Sketchup/Plugins folder to improve the way Sketchup works. Ruby scripts can be written in Ruby code editor program, and saved as .rb files. These files are then loaded to the editor which is attached toSketchup.

3.6.1 Tools

a. Ruby code editor

Ruby code editor plugin offers an easy-to-use and visually appealing way to create and modify Ruby scripts directly within SketchUp. These scripts can then be used to create geometry, add functionality or add data within the SketchUp 3D modeling environment. The research used ruby code editor in order to allow entries of multiple lines of ruby scripts, which are not allowed in ruby console of sketchup. This editor helps in the designing of 3D model farm.

b. SketchUp Extension

A SketchUp Extension is an extension used in the thesis to add code editor within the sketchup, which means that it can easily turn on or off by clicking a checkbox under the SketchUp Preferences then Extensions menu. Extensions are a little more work to code, but they make it easier for work to manage all rubies.

3.7 3D farm on Google Earth

After the farm model was designed in order to load it on the Google earth there is need to save in SketchUp native format as .skp (SketchUp) files for further editing and modification. They also saved as an interoperable format COLLAborative Design Activity (COLLADA) file to use in Google Earth.A COLLADA is a text-based format file arranged in XML style with the extension .dae.The .dae files can be saved as collada filename. It lastly saved in Keyhole Markup Language (KML). KML is a markup language in XML format used byGoogle Earth. It has an extension of .kml. The markup code is a set of text defining how elements such as text or graphics appear. The .kml file will be exported as files directly in Google Earth. This is shown in figure 3.4.

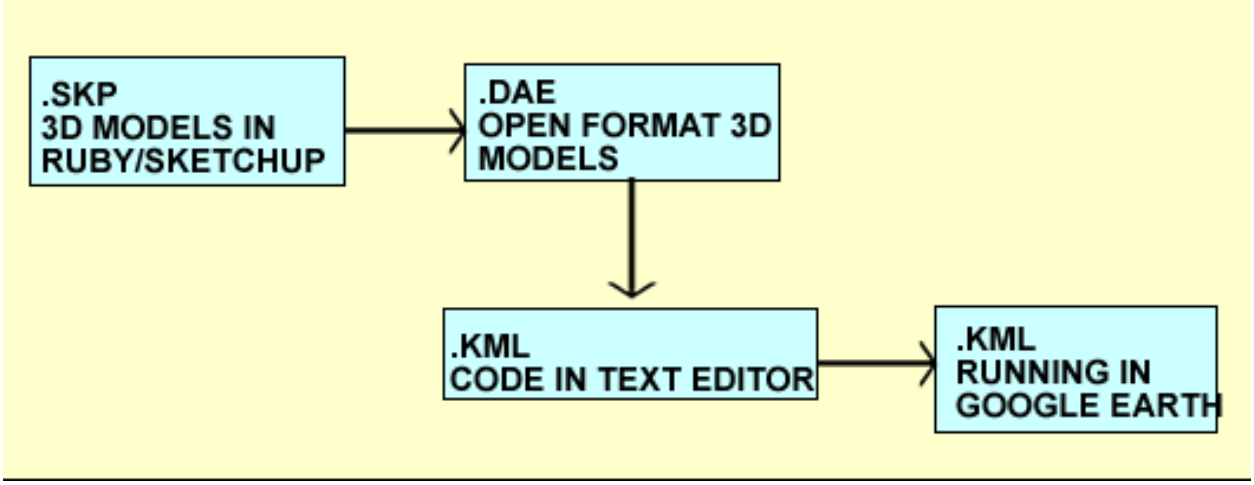


Figure 3.4: Export 3D Farm Model on Google Earth.

CHAPTER FOUR

IMPLEMENTATION AND DISCUSSIONS

4.1. Introduction

This chapter explains the implementation and discussion of the result. Firstly, the main features and the implementation of this tools and platform wilbe discussed. The second part will elaborate on the implementation of 3D visualization technology of the system that has been developed. The third part of this chapter will talk about the testing of the model while the fourth and the last part discuss the result of the work.

4.2. Tools and Platform.

4.2.1. Google Earth

An example of digital globe tools like Google Earth is used for accessing geospatial data in many places. The tools make a simple means of visualizing, different datasets based on a global view. Google Earth is a virtual globe, map and geographic information program that maps the Earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS 3D globe.

In this thesis, Google Earth has become a powerful tool for visualization of 3D model on 3D globe. It has been used to import the farm in 3D form. An interesting feature of Google earth in this research is its use in viewing geographic structure such as farming field.

4.2.2. Keyhole Markup Language (KML)

The research used KML file format to display geographic data in an Earth browser (Google Earth). Collada data can be exported into Keyhole Markup Language (KML) file format and viewed on Google Earth. Kml is a computer language similar to Hyper Text Markup Language (HTML) applied to Google Earth.KML is computer languageschema used to express

ageographic visualization on web-based andEarth browsers. KML wasestablished for use with Google Earth andit specifies a set of figures foreach represented pointsuch as placemarks and polygons..

4.2.3. ArcGIS

The thesis use Desktop ArcGIS 10 for mapping the area of the study. GIS is a computer-based system that stores geographically referenced data. The main components used in the thesis under ArcGIS are the ArcMap and ArcScene.

a. ArcMap

ArcMap is one of the components of Esri's ArcGIS suite of geospatial processing programs, and to create view and edit geospatial data. It allows the creating of maps such as zones use in the research.

b. ArcScene

ArcScene is a 3D visualization application that allows you to view GIS data in three dimensions. ArcScene allows you to overlay many layers of data in a 3D environment. In this researchArcSceneis used for developing and visualizing three-dimensional datasets

4.2.4. Ruby Programming Language

Ruby is associated with Sketchup in the form of code which is loaded to extend the functionality of Sketchup in this study. It is used to perform actions such as adding tools, simplify multi-step operations, and otherwise to improve the way sketchup is working.

Ruby scripts can be written in any basic text editing program, and saved in the folder as .rb files. In this research Ruby code editor is used to write multiple line of code in order to ease the work were Ruby console, which is in the sketchup take only one line of code.

4.2.5. Google Sketchup

Google Sketchup is an open source software tool developed by Google. It is a tool that allows 3D construction of objects using a standard set of tools provided. These tools are categorized into principle, drawing, modification, camera, construction etc. sketchup 8 is used in this study to design 3D models of the plant and farm in general with ability of Ruby support.

4.2.6. COLLADA

COLLADA is an attempt for establishing an interchange file format for interactive virtual environments. COLLADA is defined as an XML Scheme and was developed to replace 3D designs that are developed. The research used COLLADA as the native file format for storing 3D geometry, where Google Earth allows loading 3D model under COLLADA through KML.

4.2.7. HTML

HTML or Hypertext Markup Language is the standard markup language used to create web pages.The work use HTML in user interface developing.

4.2.8. Geodabase

ArcGIS in the research usedGeodatabase as part of Geographic Information System (GIS).This helps to store and manipulate geographical data of the maps in the thesis. Geodatabase is a combination of two words Geo and Database. It allows representing the real world with creation of a data model.

4.3 Code Implementation

In this section of the work, the chapter will explain and display the screenshots of the codes usedin developingall parts and layers used in the research.

4.3.1 User Search Interface code.

User interface allows users to work with the application through internet, in order to access the web site of farmer's 3D farm. The farmer or user will lastly receive the information in the Jigawa state based on 3D model. Figure 4.1 show the screenshot of the code use in HTML for developing the interface.

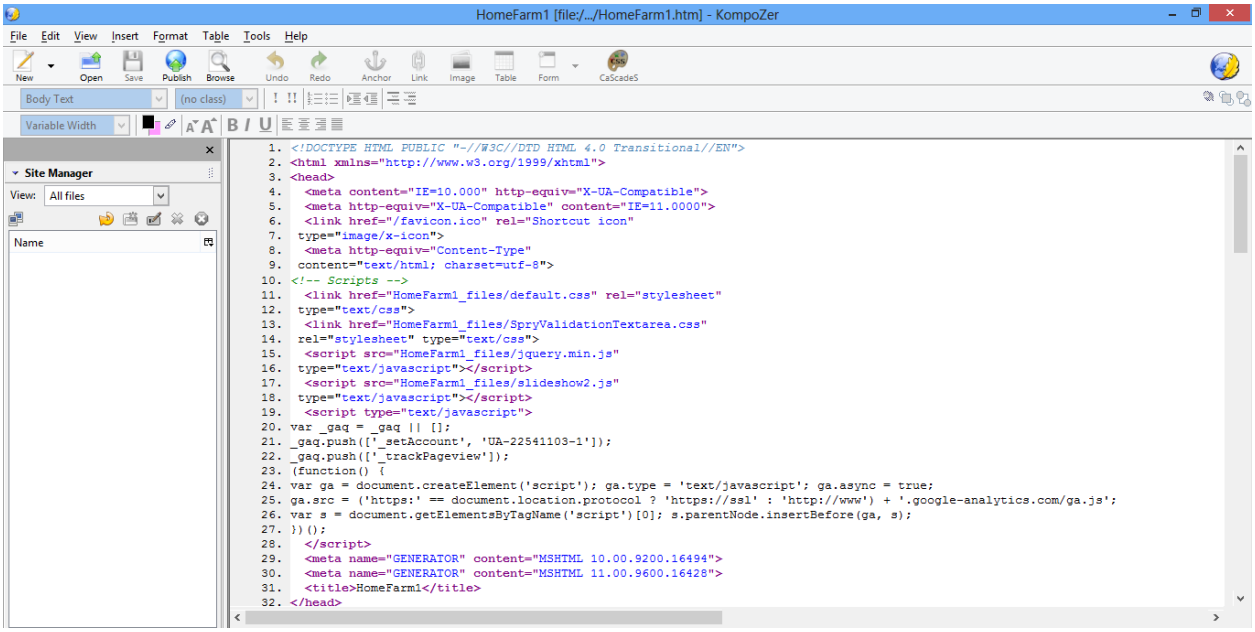


Figure 4.1Screenshot of User Interface code

4.3.2 Zone Searching

After the user interface, user will view the Jigawa state map and search for the zone he likes to access. The zones consisting of zone I, II, III, and IV. Figure 4.2 is a screenshot of table of geodatabase used in Zone1 farm parcel for developing the map zone using ArcGIS.

Table

Farm_parcel_1

Parcel_no	Location_X	Location_Y	L_G_A	Village_town	Soil_type
JSFM/14/01	599489	1218536	Gwaram	Gwaram	sandy
JSFM/14/02	606050	1232718	Gwaram	Gwaram	sandy
JSFM/14/03	575570	1244148	Gwaram	Gwarm	sandy
JSFM/14/04	583614	1253038	Gwaram	Gwaram	sandy
JSFM/14/05	577052	1269125	Buji	Buji	sandy
JSFM/14/06	580227	1282671	Buji	Buji	sandy
JSFM/14/07	562870	1271241	Birnin-ku	Birnin-kudu	sandy
JSFM/14/08	559695	1263621	Birnin-ku	Birnin-kudu	sandy
JSFM/14/09	555039	1289021	Kiyawa	Kiyawa	sandy
JSFM/14/10	538952	1288598	Dutse	Dutse	sandy
JSFM/14/11	535777	1302991	Dutse	Dutse	sandy
JSFM/14/12	565622	1313151	Kiyawa	Kiyawa	sandy
JSFM/14/13	545514	1321406	Jahun	Jahun	sandy
JSFM/14/14	555674	1329873	Jahun	Jahun	sandy
JSFM/14/15	574089	1345960	Miga	Miga	sandy
JSFM/14/16	574300	1353580	Miga	Miga	sandy

Figure 4.2 Attribute Table of Zone1 Farm Parcel

4.3.3 Accessing the Google Earth

KML was used in this thesis to access Google earth, where the code is used to upload the 3D model on the areas used in the study. Figure 4.4 shows the screenshot of code used in loading the 3D model, while Figure 4.3 shows COLLADA generated code for the 3D farm model in the research.

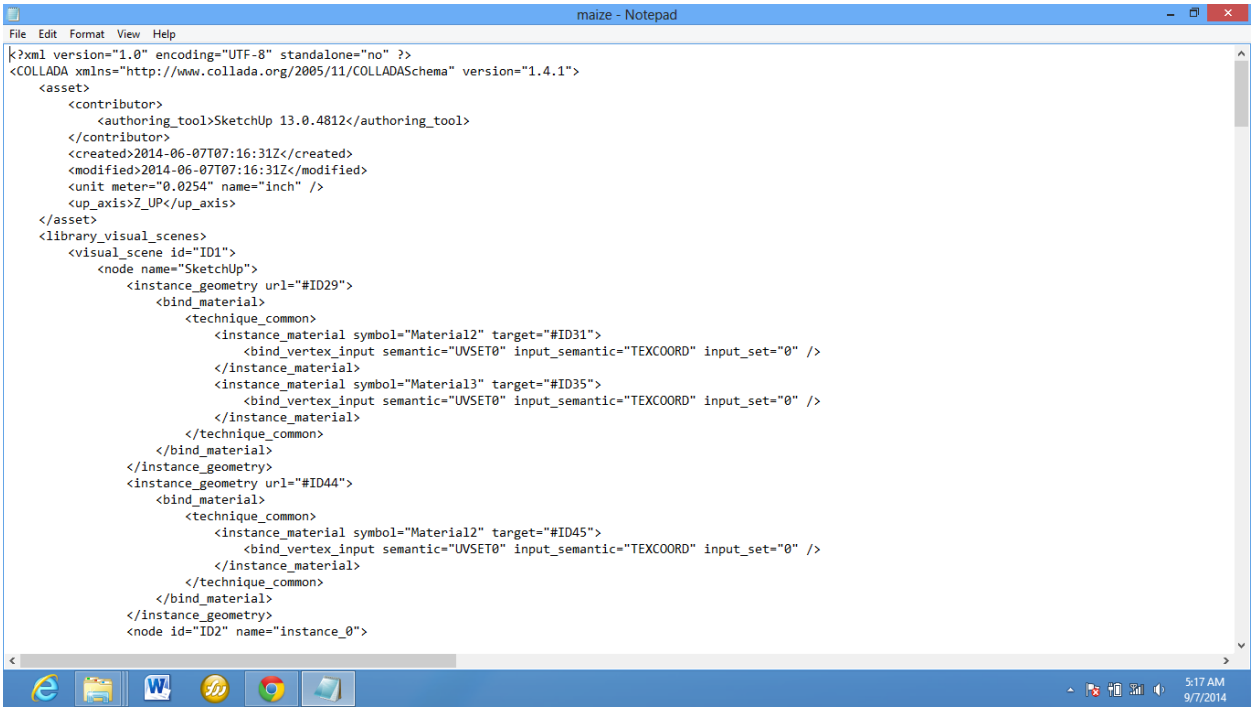


Figure 4.3. Sample of Generated Collada File

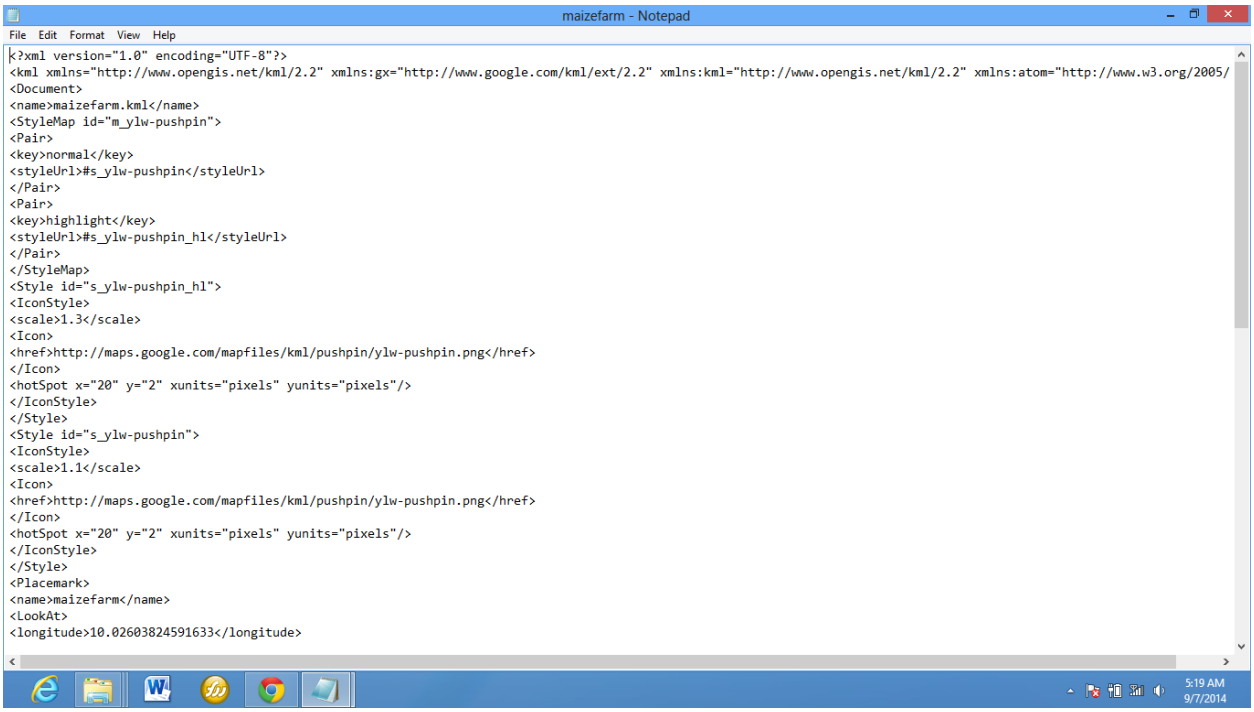


Figure 4.4. Sample KML code for loading 3D model on Google Earth

4.3.4 3D model

After designing the plant in 3D form, the farm will develop using Ruby programing language with helps to improve the ability of sketchup. Ruby code editor becomes the environment for writing multiple line of code in the work. The sample of code for creating 3D farm model was shown in figure 4.5.

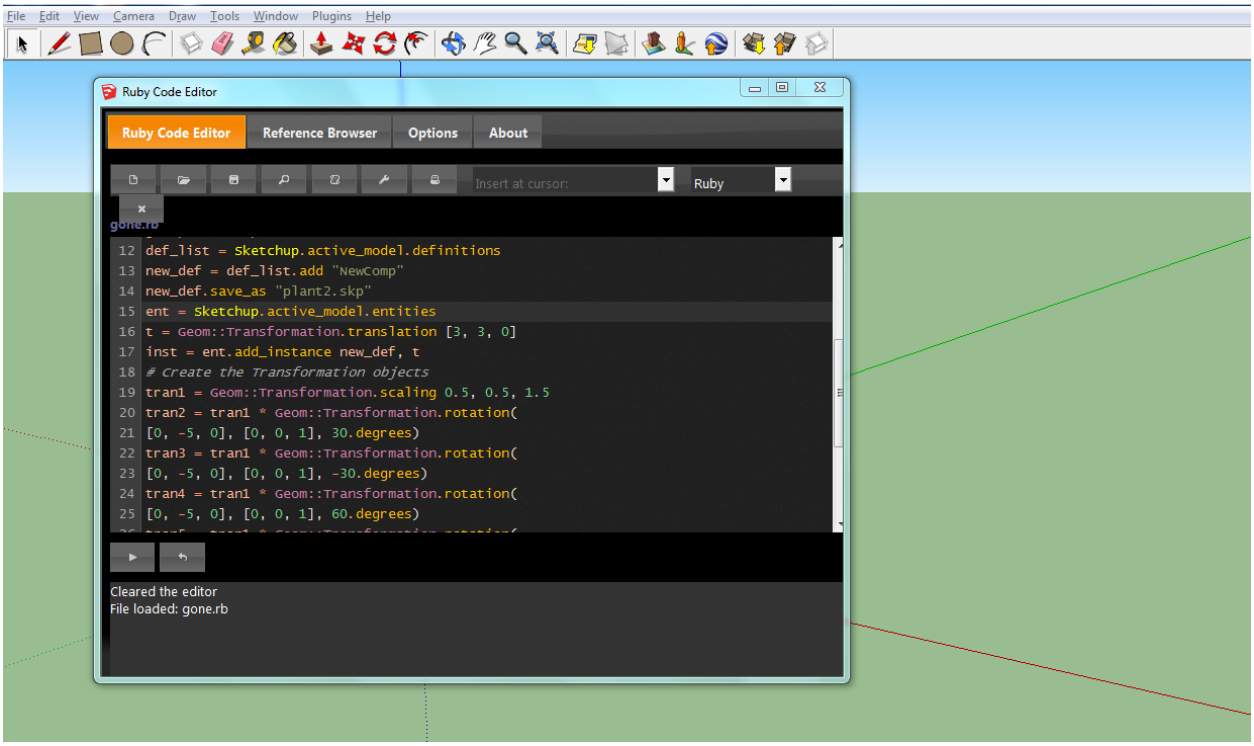


Figure 4.5. Sample Ruby Code for Creating 3D Farm.

4.4. Testing

The section considers the screenshot of all view part of the system

4.4.1. User Interface Level

This level shows a screenshot of the user interface and the mapping interface of the thesis in which figure 4.6 and 4.7 are shown respectively.

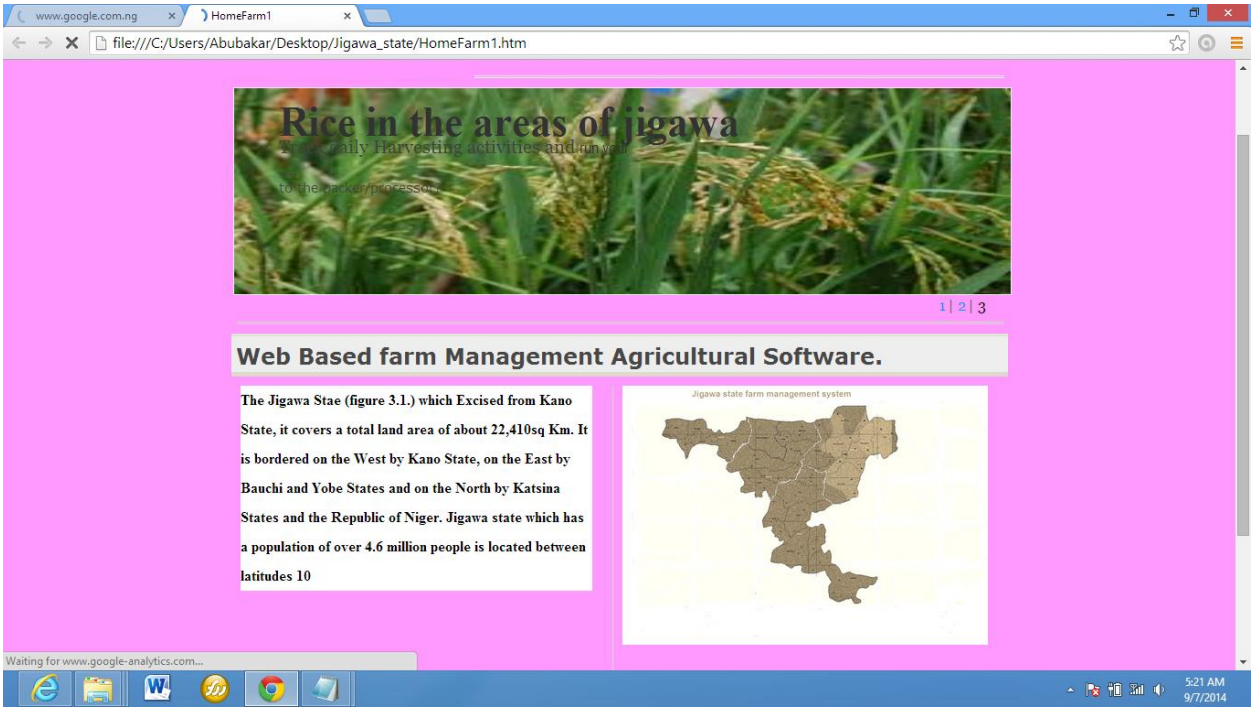


Figure 4.6 User Interface

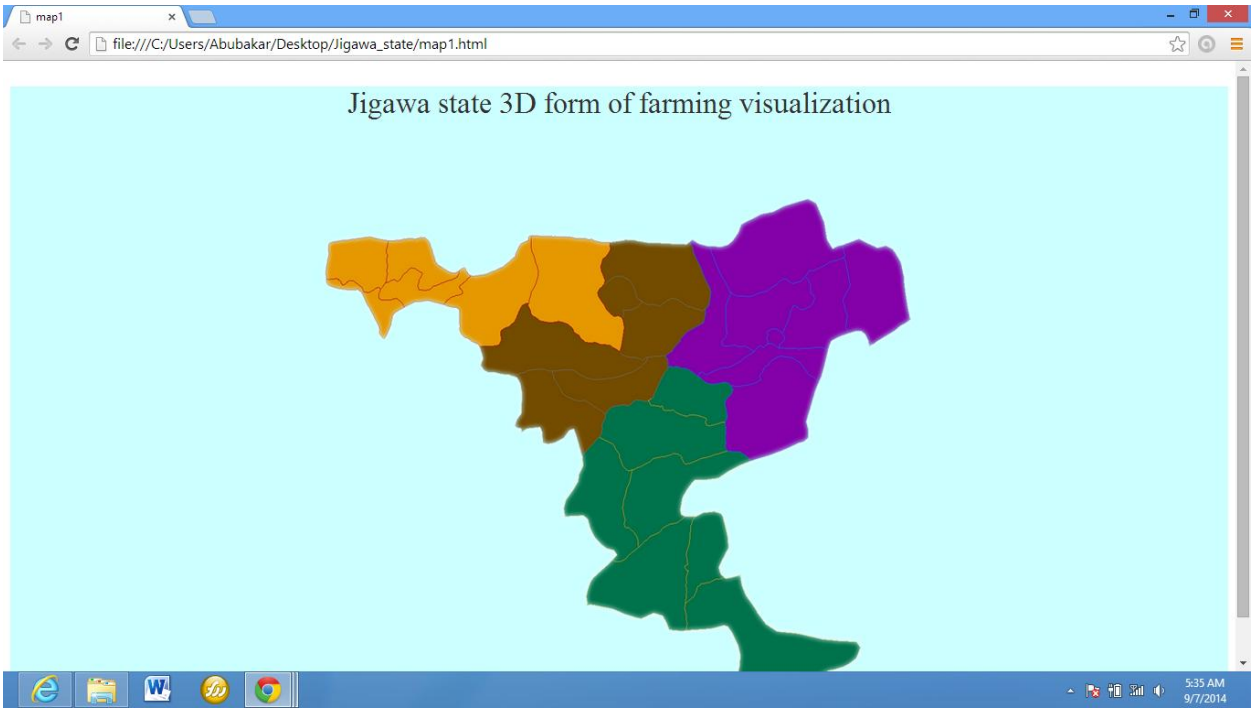


Figure 4.7 General Map

4.4 2. GIS Maps Level

According to Jigawa State Agricultural and rural development authority, this consists of seven local governments. The zone was produced using ArcGIS to show the farm parcel in each local government as example. Figure 4.8 shows a screenshot 2D view of Zone one part of Jigawa state Agricultural location, The screenshot of 3D form of Zone1 is shown on figure 4.9.

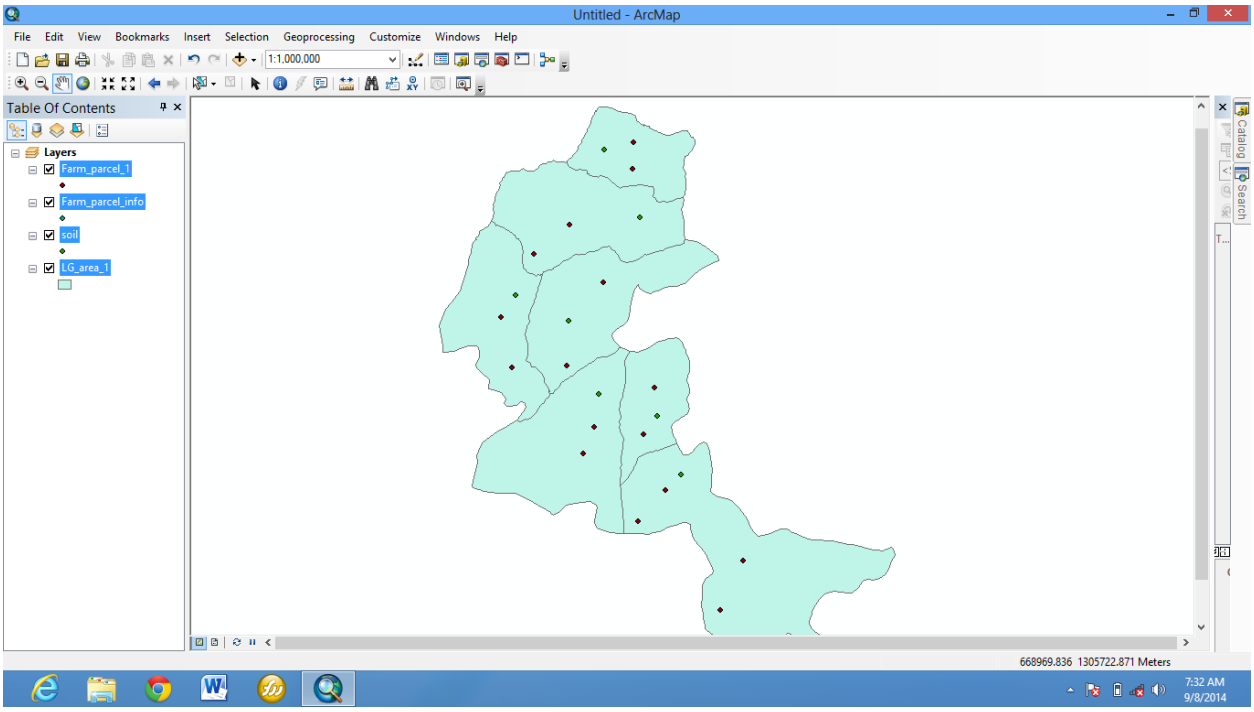


Figure 4.8 Zone1 in 2D

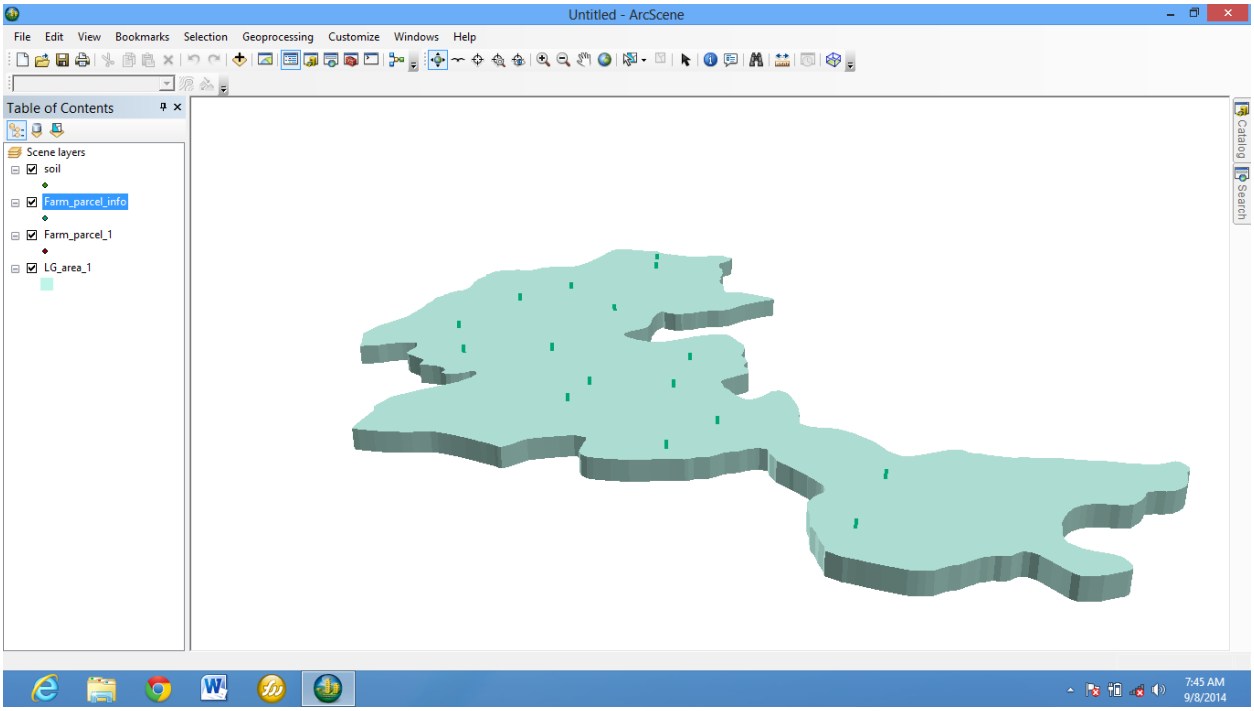


Figure 4.9 Zone1 in 3D Model

4.4.3. Data level

This unit deals with the data from Geobrowser, in the sense that the 3D farm model imported from it. Figure 4.10 shows the screenshot of a geobrowser with plant imported.

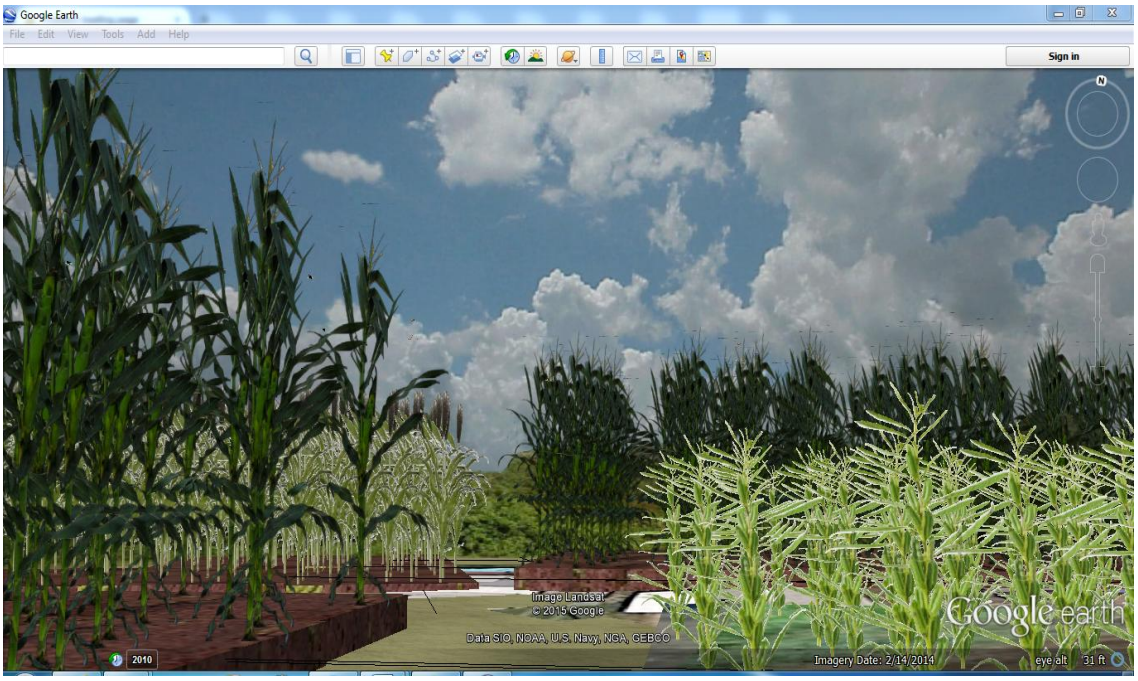


Figure 4.10. Screenshot ofGeobrowser with Plant Imported

4.4.4. Modeling the 3D effect

This is part of the user interface. Forming 3D model is the biggest work in the research. When the users click on the option that leads to Google maps, it takes user to the 3D farm model. Figure 4.11 is the screenshot of one of the major plants grown in Jigawa state known as

sesame.It is one of the oil producing crops in the world. in figure 4.12 shows the sesame farm,

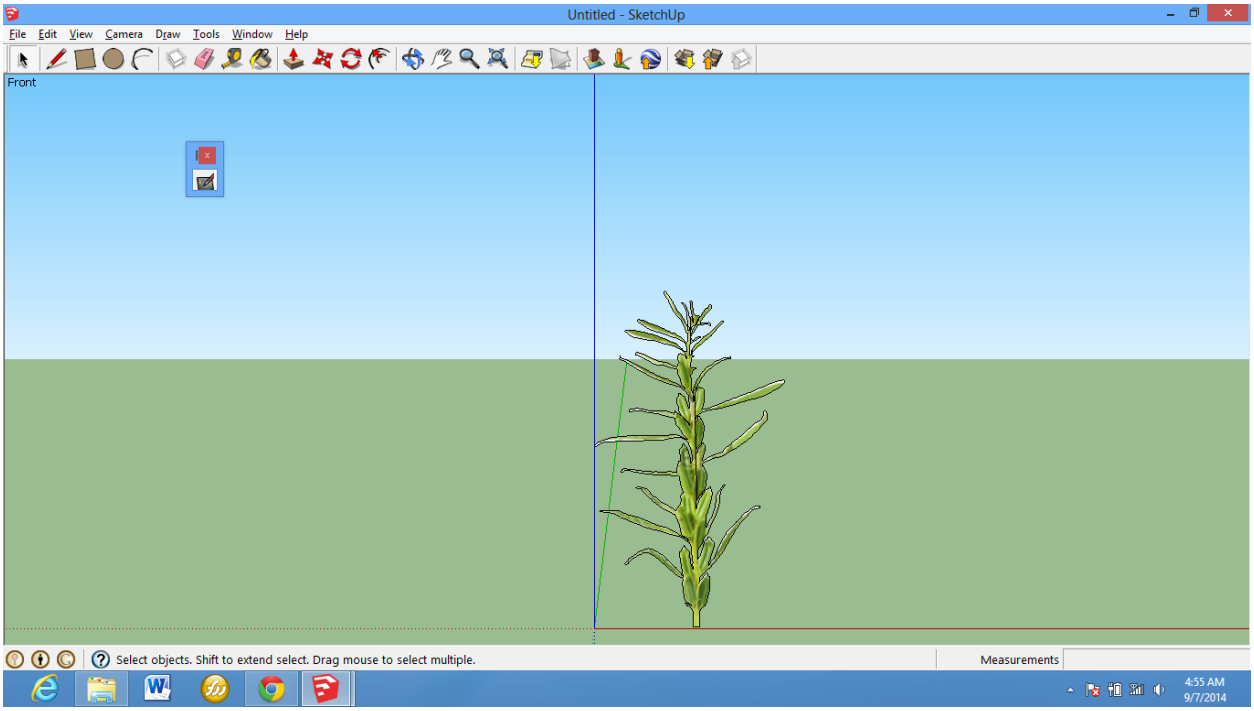


Figure 4.11. 3D Model of Sesame Plant

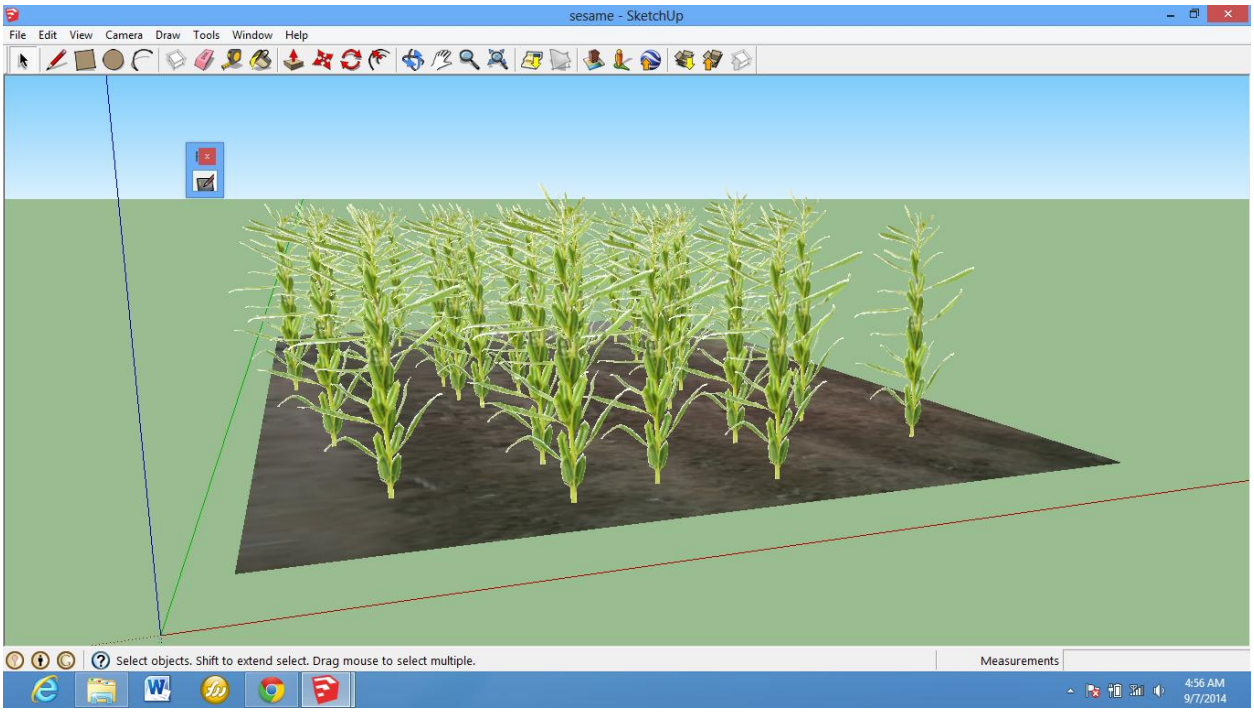


Figure 4.12. 3D model Sesame Plant Farm

The screenshot of Drought Tolerant Maize for Africa (DTMA), the plant and Farm are shown below in Figure 4.13 and 4.14 respectively.

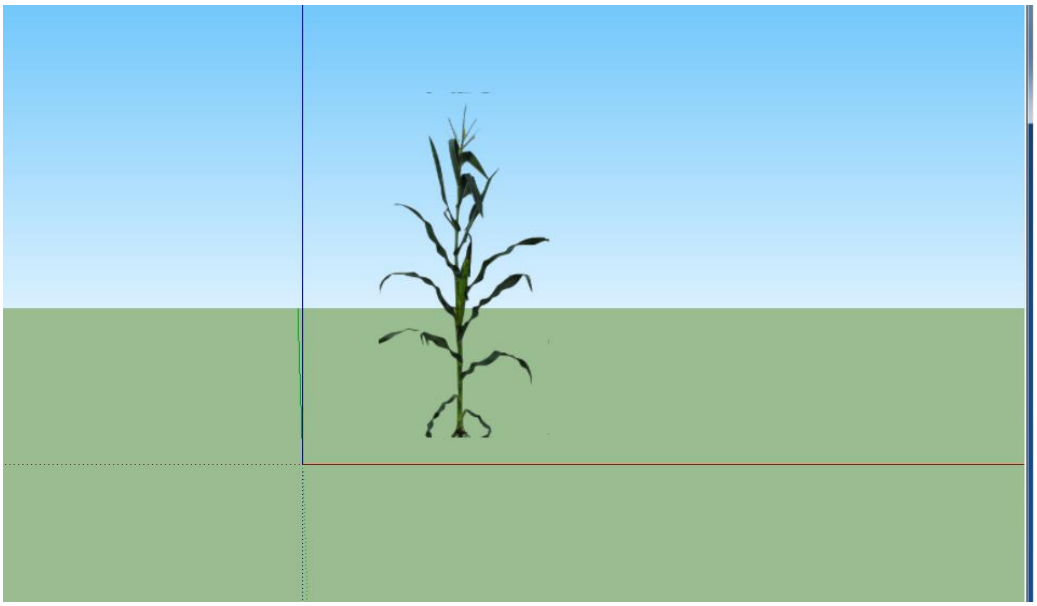


Figure 4.13. 3D model of Maize Plant

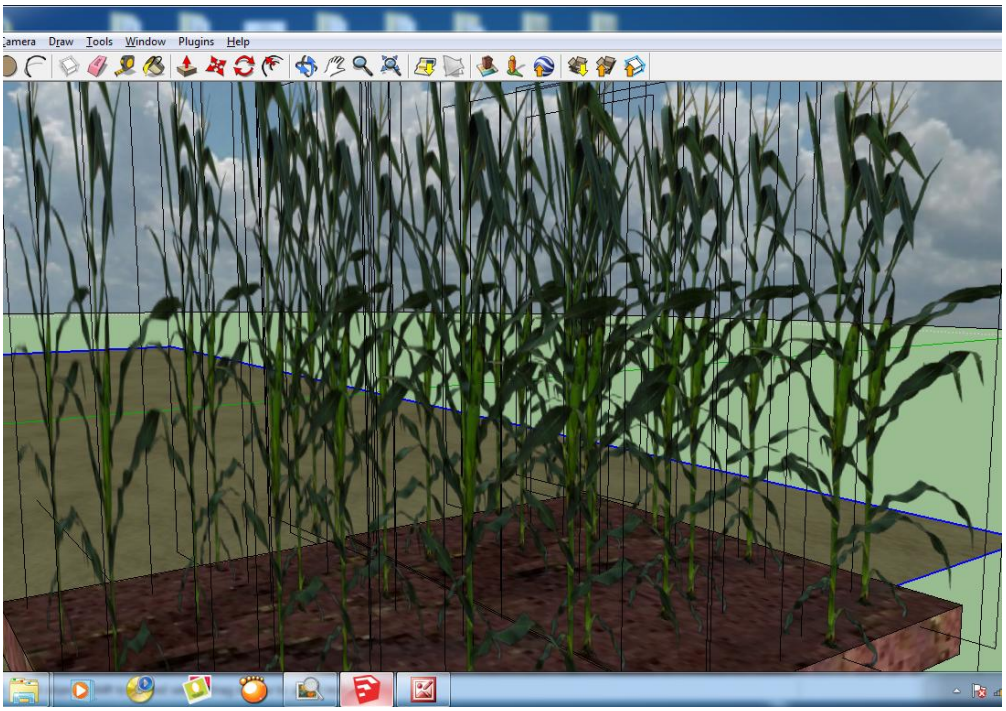


Figure 4.14. 3D model of Maize Farm

4.5 Results and Discussion

The research can be defined to disseminate technological information consisting of 3D technologies (ArcGIS, Google Earth and Sketchup) and network connection. The information is received by farmers and other people that need it in order to improve the daily activities of the farm.The research wishes at disseminating the plant Agricultural information to farmers, that is how the farm view in 3D with type of plant grown in the areas of Jigawa state

The results started with Interface which allows users to accesses internet, in order to view the web site of farmer's 3D farm and user will lastly receive the information disseminated based on 3D model. It continues with Jigawa state maps view in 3D form as designed with Arc GIS. The Arc scene was used to allow map views in this mode (3D) under each zone. The zones developed based on geodatabaseof ArcGIS.

The study designed the plant in 3D form using Ruby programing language with helps to improve the ability of sketchup. Ruby code editor becomes the environment for writing multiple line of code in the work in order to design the plants on sketchup. It is with Ruby that the farm field created and made the plants displayed on farm field. The sample 3D farm model was shown in figure 4.15. (a) When considering the reviewed work ofKhumphicha, for dissemination of agricultural information among farmer groups via mobile phone figure 4.15 (b), in his study the information distributed on group through an SMS service on mobile phones. Based on the definition of 2D model, this work was done in two dimensions while distributed information to farmers, this is no difference compare to other organization's work and project reviewed. Relating with our work in three dimensions, it is believed that a 3D form of information dissemination will be better, because in his work he used text messages to explain the plant

situation and other farm activities, but our work explain the farm situation in form of 3D view models and will allows people to feel that the information disseminated attains at reality.



(a)Information in 3D Model



(b) Information in 2D Model

Figure 4.15: Shows information dissemination on 3D and 2D model.

On the other hand, farm model was designed in order to load it on the Google earth, firstly to save the developed models in SketchUp native format as .skp. it then saved as COLLADA file to use in Google Earth and lastly write KML code The KML codes wrote to makes the farm directly view in Google Earth as shown in figure 4.16 (a). In view of the work reviewed such as that of; Sarah, other projects and organizational work, they disseminated information on Agriculture using radio and other ICTs, which is in two dimensional forms figure 4.16 (b), while our study focuses on disseminating information through GIS based to view the location in Google earth as 3D form. It is through this people will understand the area that produced the type of plant shown in the research and visualizationprovides a more enhanced view, good natural user style and understood much more quickly and easily, but the work reviewed are not GIS enabled and their visualization provides a less and natural user method.



(a) 3D farm information imported on Google Earth.



(b) 2D information disseminate through Radio.

Figure 4.16. Shows the information disseminated using Google earth(3D) and Radio (2D)

However, another work developed in the research on 3D is the use of sketchup to design an animated three dimensional plants. In this form the 3D model developed was divided on scene in a sketchup so that it was rendered to produce the animation on how the plant grown within 75 days especially the DTMA improved variety maize, figure 4.17. Looking at the reviewed work, they are all none 3D and animation enabled. With that we can say Viewers tend to enjoy 3D animated object greater than static information because it tells a story and creates a more rich experience compare to still 2D models.



Figure 4.17. A screenshot of an example of animated farm in 3D

The result shows that, 2D models only supports a very limited comprehension of the plant information dissemination compare to 3D models which provides a flexible visualization of the information. It is concluded that 3D displays with appropriate coordinate can be most effective

for approximate navigation and relative positioning. A lot of information can be extracted by just looking at a 3D model. It can also give the observer an insight of the surroundings of an area of interest.

The result of the thesis can be discussed as follows:

a. To develop web based farm information system using 3D visualization technology, the system is having user interfaces for the visualization of Internet and the visualization of 3D model. The interface and the mapping interface are viewed in a web browser and information transmitted in HTML format. The mapping interface is the overall Jigawa state map, where the map will allow locating the zones in 3D visualization under ArcGIS from ESRI. This means that a basic map operation such as zooming will allow for viewing the area correctly.

b. To Import 3D models on Google earth, firstly launched GIS map of zones, there is option to lead user to the text on PDF that will explain the plant and management of Agricultural activities of the area, or to the 3D technology of Google Earth for visualizing the 3D farm model which has been developed. This research is capable for spatial operations that are useful in GIS with results loaded in Google Earth. The research used a number of essential GIS components: the ArcMap and ArcScene together with ArcCatalog of their geodatabase containing a point, a line and polygon under features classes.

c. To associate Google earth with Geographic Information System (GIS). The dissemination of information is a vital characteristic of GIS and Google Earth which supports the research to a certain extent. The features generated by web-based farm information system and visualised in Google Earth can be done using KML. Viewing the contents of this feature can be easily done using sketchup and ruby on ruby code editor.

Another style involves in generating the 3D model is the used of COLLADA file format, this accomplished the modification of 3D model into XML like form for given user access to Google Earth. The research used text editor to write KMLand loads the COLLADA file that will make the 3D model view on Google Earth. However, this would allow users to visualize the farm information on 3D model in the user interface as shows on system architecture.

An advantage of web–based farm information system that develops on 3D models, is introducing the local plant on this new technology especially the major plant in North-eastern part of Nigeria. However, local farm designed in this model will allow people or farmers to view the virtual farm and feel as real farm where he choose the improved plant variety among the major plants grown in the area. The thesis helps to allow the visualization on solid looking like objects and this will make disseminating of the required information to farmers for better improved Agriculture. In their research Koua*et al*. (2006) found maps were more effective for certain visual tasks such as locating and distinguishing with this study. The research works on GIS map will help to view, locate and identifying the areas and major plant grown.

Another feature of disseminating information to farmers in the research is the used of improved variety maize called the Drought Tolerant Maize for Africa (DTMA). The project aims to mitigate drought and other constraints to maize production in sub-Saharan Africa. This work allows farmers to be informed on the extra-early Maize, which maturesin about 75days.It has been recommended for drought prone areas of Sudan Savanna. According to Bamire*et al*, (2010).The objective of the Drought Tolerant Maize for Africa (DTMA) project is to decrease hunger and increase food and income security of resource-poor farm families in sub-Saharan

Africa (SSA) through the development and dissemination of drought tolerant, well-adapted maize varieties.

4.5.1 Comparison of reviewed and proposed research

Since 2D models is the computer-based generation of digital images such as geometric models (also called vector graphics), digital images (also called raster graphics), text to be typeset (defined by content, font style and size, color, position, and orientation), mathematical functions and equations, and more (Wikipedia, 2014). From this definition, it is concluded that all the work reviewed in the research are considered two dimensions.

For better use of proposed work, the following comparisons were examined in agricultural information dissemination in figure 4.18: The comparison identified that, the first part shows 2D design of plant which removes many information from the real structure and 3D visualizations have taken care of it. The second part shows the overall ICT usage from the related literature reviewed and identified the differences with 3D visualization that demonstrated the use of web 2.0, radio, TV, farmer facilitator, GSM and computer with an improved use of GSM and web 2.0 in information dissemination to agriculture but this is better than 2D form of visualization. While the third item of the comparison examined the motionless image of the farm as stated in the existing work and that of the animated farm designed in the proposed work of Agricultural information dissemination. Here the plants are animated in its life period of about 75 days in 3D visualization technology.

However, it is observed that using 3D visualization form, farms added realism successivelyas compare to living in a three dimensional world likewise 3D objects can be manipulated for different viewing perspectives. This manipulation is like holding an object in your own hand. In

farming, this adds to the effect of realism can increase agricultural decision as well as analyzed information faster.

Furthermore, as the users may considered to be illiterate, the used of 3D is better for information dissemination to them because,2D visualization provides a less and natural user approach, but 3D visualizationprovides a more enhanced view, good natural user approach and understood much more quickly and easily.

Perhaps no other communication medium can match the power of 3D animations when it comes to delivering high impactful and concise representationof information, this brings a great visual effect. The people viewing will get a feeling that it is real in action. 3D animation is one of the most valuable illustrative tools to improve the look as well as the feel of future information dissemination.Animated information is highly interactive and more dynamic. Viewers tend to enjoy it greater than static information because it tells a story (or at least it should) and creates a more vivid experience.Nevertheless, animated information generally attracts a wider audience and creates a bigger ripple than static information. Definitely, the indication suggests that 3D visualization and Animation may be a real visualization technology in the field of information dissemination to Agriculture.

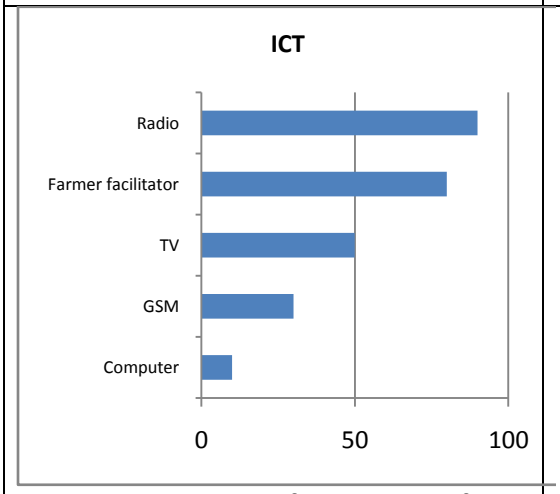
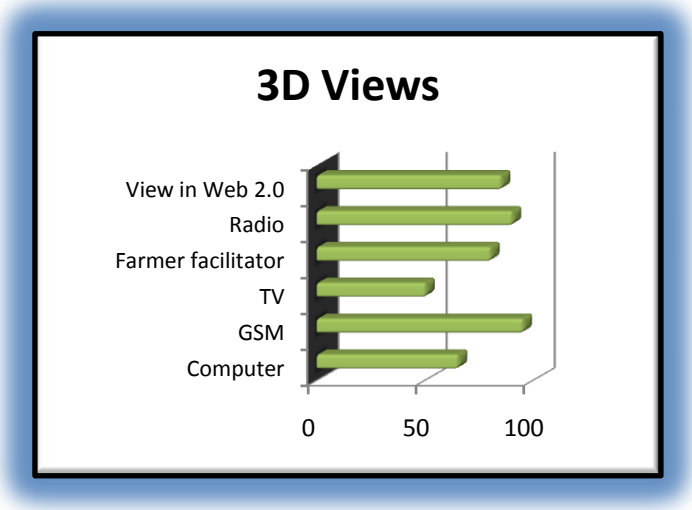
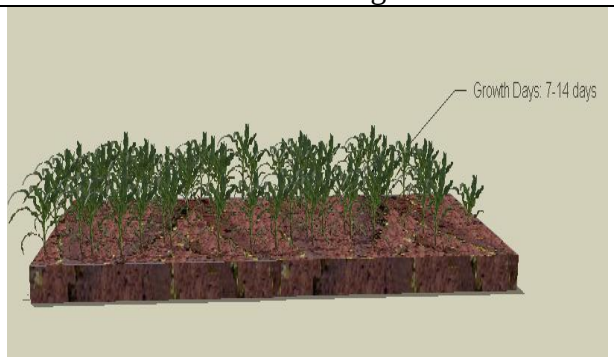
Reviewed Research	Proposed Research (3D)
 1. show example of complete structure of the image of plant in MCTs	 All available structural information present
 2. The use of ICTs usage for ovarall reviewed in 2D	 The use of 3D visualization in Agriculture
 3. The work in still image Farm	 The work in Animated farm Model (DTMA)

Figure 4.18. Compare Reviewed work and the proposed work

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The thesis is entitled“a web-based 3D farm information system for Enhanced information dissemination”. It examined how to disseminate information to farmers through 3D visualization technology. The thesis was based on the motivation that, the computer is changing every day and the people living in local areas received some changing over a year or some years after. Considering the current changes in game application which is still running on the world of computer as three dimension work, so the thesis focuses on three-dimension to display the plant of local areas in 3D model. The thesis aims at developing a plant and farm model of the Jigawa state major crops produced in the state communities through GIS and Google Earth 3D technologies in order to allow farmers and other rural families view the virtual world of the farm for better decision in choosing the appropriate crop toward valuable farming activities.

Traditionally, two dimensional design is less viewable, since it is much of x and y dimension, and it is a picture like view object. But, 3D designs is always shown and reach in x, y and z dimension which can rotate and move in such a way people will feel like a real life world. The plants are in 3D design, so it can be viewed as real life plants. 3D plant model was preferred because of its interactive ability to disseminate information to farmers and other people. Its interactive ability will help in developing and enriching agricultural product as well as well-being of the farmers. It will also help in reducing the global hunger in rural community.

In its richest form in computer, GIS as collective component of computer and other described earth’s surface data, helps in better performance of disseminating information to farmers. This is because the thesis considers it as the most developing desktop software for mapping 3D model of

the research area, while physical farmers through it can import to Google earth. With Google earth, the users can view any part of the world including Jigawa state. Google earth as a three dimensional representation of the earth over the internet to access the satellite and aerial imagery can quickly allow locating the local government areas in the research for viewing the 3D model farms when combined with KML.

This thesis presents the conceptual architecture of the farmers using three dimensional visualization application which consists of three layers via: interface, GIS map and data layer. The layers combined together to form a clear and interactive vision of 3D model for reliable accessing of information by farmers to generate high Agricultural productivity.

5.2. Conclusion

The contribution of digital globe towards dissemination of information on Agriculture is very essential compare to other way of sending information. This work discovered that the role of Google earth as digital globe in farming makes enhanced and qualitative information dissemination on internet. Then there is need to develop more information dissemination on Agricultural activities to internet at appropriate time in a place its needed where farmer can get well farm product.

The research purposes was to deliver enhanced communication of farm information to farmers through the application of 3D visualization technology, with the help of geographic information system (GIS) and digital globes technology. It is also aimed to provide web based Agricultural information dissemination to farmers and to effectively use Google earth in accessing Agricultural information.

There are several phases in Agricultural practices where the advanced technologies are inevitable for providing highly productive Agriculture. Digital globe technology is a key factor

in this age of computer technology for disseminating Agricultural information in order to provide best farming product. The work looks at the previous work done related to the thesis, but none is digital globe enabled toward effective information dissemination.

The constraints issue to use of Web-based 3D for disseminating Agricultural information, based on the research views that, poor Communication of information are the technical constraints influencing dissemination of Agricultural information. The work also indicated that if hardware and software are user-friendly, it might be work for successful decision in plants needs to grow for good farming yield.

5.3. Recommendation

Information dissemination through GIS and Google earth technology to farmers for better productive Agriculture in the area of the study recommends the following:

a. Government and private providers of information need to work together with farmers to find precise needs of information that would assist them to develop a better farming product and to find more operative communication channels in which to access better information.
b. There is the need to look at phases like education, farming experience and women farmers when disseminating information. This will consider illiterate farmers, local farmers and women farmers when spreading information.
c. The farmers should participate in other information and communication technology, so that they will improve in day to day activities of internet toward retrieval of modern way of information concerning farming.

d. Digital information technology is key factor in this time of computer technology, where many Agricultural activities are expected to yield valuable agricultural product. This form of digitizing should be well understood by farmers.

e. Indication of uses of internet in the world Agriculture is huge. However, Jigawa state should be able to expose Information dissemination technology in its Agricultural activities which is already on process. With this, the technology should be implemented.

f. Internet is difficult to get to most of the farmers. Then establishment of internet centers in most rural areas is the easiest way to eliminate the digital divide between rural farmers and urban farmers along with this, there is need for government to establish centers for alighting farmers and training them on new farming technology and the accessing of information through internet.

g. There is no good environmental condition in most of the rural areas of the state, in which material needed for internet accessibility such as internet services of mobile phones, electricity poles, cables. Considering this condition, the collaboration with authorities like GSM service providers and electricity suppliers is needed in order to make concrete arrangement so that information dissemination could made easy to access.

5.4. Future Work.

The thesis uses 3D visualization to directly disseminate Agricultural information to farmers. However, the section will outline the number of further improvement for delivery of better Agricultural information.

a. In the thesis, scripting language known as Ruby was used to extend the capability of the sketchup, therefore optional software that allows users to automate tasks and add capabilities to Sketch Up, can either be written using language like C++ or Java.

b. In future, the design of 3D can also be done using Extensible three dimensional (X3D) graphics standard.

c. The research covers Jigawa state area and then in future it can cover the North-East geo political zone.

d. Virtual Animal farming and environmental information can be considered in the future work for Agricultural information dissemination.

e. Building a more sophisticated Internet GIS application using Google Earth, in future it will considerWeb GIS in disseminating information to farmers.

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Appendix

Below is the HTML code for user interface designing:

```
<body
 style="background-color: rgb(255, 153, 255); color: rgb(0, 0, 0);"
alink="#ee0000" link="#0000ee" vlink="#551a8b">
<div id="main-container">
<div id="New%20folder/img2.jpg"></div>
<div id="main-nav">
<ul>
<ul>
<li>
<p style="text-align: left;"><big><big><big><span
 style="font-weight: bold;">  Help</span></big></big></big> </p>
</li>
</ul>
</ul>
</div>
<div id="features">
<div class="banner one feature"><span class="image"><img
 style="width: 850px; height: 225px;"
 alt="Web-based Agriculture Software"
src="HomeFarm1_files/RIVER1.jpg"></span>
<div class="banner-text"><span class="thin">Farms</span>
<br>
<span class="fat">3D FARMS</span><br>
<span class="p">SMALL SOFTWARE FOR SOLVING YOUR PROBLEM!</span><span
 class="p verdana"></span><span class="p verdana"></span>
<ul>
```

```
<li> web-based farm management software in Jigawa </li>
</ul>
</div>
</div>
<div class="banner two hide"><span class="image-2"><img
 alt="Web-based Agriculture Software" src="" height="225"
 width="850"></span>
<div class="banner-text"><br>
<span class="fat">in 3D.</span><span class="p">Want
to <span>see</span> JIGAWA farms</span><br>
<span class="p">see you farm in 3D</span><br>
<span class="p"><span>anywhere</span>, <span>Time
you Like</span>?</span></div>
</div>
<br>
<div class="banner four hide"><span class="image-4"><img
 alt="Web-based Agriculture Software"
src="HomeFarm1_files/RICE1.jpg" height="225" width="850">
</span>
<div class="banner-text"><span class="fat">Rice
in the areas of jigawa<br>
</span><span class="p">Track daily Harvesting
activities and </span><span>run</span> your<br>
<span class="p">....</span><br>
<span class="p verdana">to the packer/processor?</span>
<br>
<br>
</div>
</div>
</div>
```

This is a ruby code for Modelling the farm in 3D form (sesame farm)

```
# Create the face
ents = Sketchup.active_model.entities
face = ents.add_face [4, 4, 0], [4, 15, 0], [12, 15, 0], [12, 4, 0]
mats = Sketchup.active_model.materials
fm_mat = mats.add "white"
face.material = fm_mat
face.pushpull 0.3
purple_mat = Sketchup.active_model.materials.add "blue"
purple_mat.color = [0, 0, 225]
# Create a sesame farm
mod = Sketchup.active_model # Open model
```

```
ent = mod.entities # All entities in model
sel = mod.selection # Current selection
n = 5
s = 100
# Load the component definition
model = Sketchup.active_model
ents = model.entities
def_list = model.definitions
def_path = Sketchup.find_support_file "sesame1.skp", "Components"
comp_def = def_list.loaddef_path
# Load the fram
(0..n).each { |i|
  (0..n).each { |j|

     transformation = Geom::Transformation.new([i*s,j*s,1])
componentinstance = ent.add_instance(comp_def, transformation)
   }
  }
```

The KML code for importing farm on Google earth:

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
<Document>
<name>Flat Region</name>
<Region>
<LatLonAltBox>
<north>37.430419921875</north>
<south>37.41943359375</south>
<east>-122.080078125</east>
<west>-122.091064453125</west>
</LatLonAltBox>
<Lod>
<minLodPixels>128</minLodPixels>
</Lod>
</Region>
<GroundOverlay>
<name>Mountain View DOQQ</name>
<Icon>
<href>files/image.JPEG</href>
</Icon>
<LatLonBox>
<north>37.430419921875</north>
<south>37.41943359375</south>
```

<east>-122.080078125</east>
<west>-122.091064453125</west>
</LatLonBox>
</GroundOverlay>

<Placemark>
<name>SketchUp Model of Sesame1 plant</name>
<description>model created by A. I..</description>
<LookAt>
<longitude>10.013938</longitude>
<latitude>12.330905</latitude>
<altitude>0</altitude>
<range>127.2393107680517</range>
<tilt>65.74454495876547</tilt>
<heading>-27.70337734057933</heading>
</LookAt>
<Model id="model_1">
<altitudeMode>relativeToGround</altitudeMode>
<Location>
<longitude>10.013938</longitude>
<latitude>12.330905</latitude>
<altitude>0</altitude>
</Location>
<Orientation>
<heading>0</heading>
<tilt>0</tilt>
<roll>0</roll>
</Orientation>
<Scale>
<x>1</x>
<y>1</y>
<z>1</z>
</Scale>
<Link>
<href>sesame31.dae</href>
</Link>
<ResourceMap id="model_1">
<Alias>
<sourceHref>sesame3/sesame.jpg</sourceHref>
<targetHref>sesame3/sesame.jpg</targetHref>
</Alias>
</ResourceMap>

</Model>
</Placemark>
</Document>
</kml>

Below is a generated COLLADA code for Sesame farm in 3D.

<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<COLLADA xmlns="http://www.collada.org/2005/11/COLLADASchema" version="1.4.1">
<asset>
<contributor>
<authoring_tool>SketchUp 13.0.4812</authoring_tool>
</contributor>
<created>2014-10-30T08:04:31Z</created>
<modified>2014-10-30T08:04:31Z</modified>
<unit meter="0.0254" name="inch" />
<up_axis>Z_UP</up_axis>
</asset>
<library_visual_scenes>
<visual_scene id="ID1">
<node name="SketchUp">
<instance_geometryurl="#ID97">
<bind_material>
<technique_common>
<instance_material symbol="Material2" target="#ID98">
<bind_vertex_input semantic="UVSET0" input_semantic="TEXCOORD" input_set="0" />
</instance_material>
</technique_common>
</bind_material>
</instance_geometry>
<instance_geometryurl="#ID105">
<bind_material>
<technique_common>
<instance_material symbol="Material2" target="#ID106">
<bind_vertex_input semantic="UVSET0" input_semantic="TEXCOORD" input_set="0" />
</instance_material>
</technique_common>
</bind_material>
</instance_geometry>
<node id="ID2" name="instance_0">
<matrix>1 0 0 0 0 1 0 10000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>

<node id="ID27" name="instance_1">
<matrix>1 0 0 0 0 1 0 20000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID28" name="instance_2">
<matrix>1 0 0 0 0 1 0 30000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID29" name="instance_3">
<matrix>1 0 0 0 0 1 0 40000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID30" name="instance_4">
<matrix>1 0 0 0 0 1 0 50000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID31" name="instance_5">
<matrix>1 0 0 10000 0 1 0 0 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID32" name="instance_6">
<matrix>1 0 0 10000 0 1 0 10000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID33" name="instance_7">
<matrix>1 0 0 10000 0 1 0 20000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID34" name="instance_8">
<matrix>1 0 0 10000 0 1 0 30000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>
<node id="ID35" name="instance_9">
<matrix>1 0 0 10000 0 1 0 40000 0 0 1 1 0 0 0 1</matrix>
<instance_nodeurl="#ID3" />
</node>