Cropguard and pest control system

Shamiso Mandeya (R152331J)

Cropguard and pest control system

By

Shamiso Mandeya (R152331J)

Submitted in partial fulfilment of the requirements for the degree of

BSc Honours Information Systems

Department of Computer Science and Information Systems

in the

Faculty of Science and Technology

at the

Midlands State University

Gweru

November 2018

Supervisor: **Mr. Furusa**

ABSTRACT

This project was focused at designing and implementing an android cropguard and pest control application system which will assist farmers to acquire farming knowledge and know how they can deal with pests and diseases so as to improve the output. Experts in farming will be able to offer expert advice to farmers and as well acquire additional knowledge and try new crops. Farmers would be able to report their needs to the ministry of agriculture and make the ministry of agriculture recognize farmers in different regions. Ministry of Agriculture Information Technology will be able to assign roles to the experts and extension officers and create a knowledge base which will be useful in the future. Experts remains in their line of expertise thereby could not try different crops. They remain with limited information but through the use of the proposed system they will be able to increase their knowledge. Administrators spends a lot of time in offices but due to the use of the system they will be able to try farming during weekends and public holidays which intern benefit them and their families. Farmers has no knowledge of where exactly they ca access farming products and their prices. Farm shops has no knowledge of which products should always be available in storage

DECLARATION

I, **Shamiso Mandeya**, hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institution or individuals for the purpose of scholarly research

Signature………………………………………… Date……………………………...

APPROVAL

This dissertation entitled **"Cropguard and pest control system for Ministry of Agriculture"** by **"Shamiso Mandeya"** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University**, and is approved for its contribution to knowledge and literacy presentation.

Supervisor's Signature…………………………………………………….

Date…………………………………………………………………….

ACKNOWLEDGEMENTS

DEDICATION

I dedicate this work to my loving daughter Adrienne Tariro Gutu being my strength and hope.

Would like to say grow well baby and become someone great.

LIST OF ACRONYMS

.

CD	Compact Disk
DVDs	Digital Versatile Disk
DFD	Data Flow Diagram
ID	Identity number
IT	Information Technology
HTTP	Hyper Text Transfer Protocol
RAM	Random Access Memory
R.O. C.I	Return on Capital invested
SQL	Structured Query Language
UPS	Uninterrupted Power Supply
CCTV	Closed Circuit Television

LIST OF TABLES

x

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter outlines the research problem and all aspects related to it. Issues covered include the background of the study on this project and then look at the problem definition which briefly explains what farmers are experiencing. The objectives of the study are stated giving full detail on what is intended to be done. It further gives the significance of the study to the farmers in Zimbabwe and gives the delimitation which outlines the beginning and the ending of the research and limitations of the study which are constraints which could prevent the study from being completed.

1.2 Background of study

According to Jorgensen (2016) farming started long back ago when people would cultivate what only was enough for them and if they had excess they would exchange with what they wanted known as trade exchange. Crops cultivated included maize, beans, vegetables, fruits only to mention but a few. Animal rearing was also practiced as part of farming and the animals included goats, cattle, sheep's, chickens, donkeys and animal skins was used as clothes and seating mates among other uses. But still crops failed due to poor soils and pests affecting crops and animals.

Places in Manicaland and Matabeleland, many farm produces are failing because of poor soils and pest and diseases infections and the system is a solution to all the crop failure due to a number of reasons some which includes poor soil management and poor crop management only to mention but a few. Farmers are harvesting below the best grade farm produce when they can maximize the output using whatever the space they have. The system is for both small scale farmers as well as large scale farmers and commercial farmers of cause.

1.2.1 Background of the organization

The Department of Agriculture was established in 1896 and was one of the principal divisions made by the British Colonial Government. In 1913 the principal Director of the Department to be named was the universally popular agriculturist Panagiotis Gennadios from Greece, as part of an

overall governmental reorganisation the Department of Agriculture was upgraded. The essential goal of the Department of Agriculture was and stays to this day to be country improvement and the prosperity of the rural application. In 1966 the Agricultural Extension Service was rearranged and right up 'til today keeps on playing an imperative and vital job in the training of farmers. The department has begun to implement the Rural Development Programme (RDP) for the period 2007-2013. In the meantime, since the Department of Agriculture has advanced and regulated a large number of Legislations emerging from the acquis, for example, enactment for the control of feed, agrochemicals and numerous others. Its work force partake effectively in all the European Union (EU) establishments in which choices are taken, continually meaning to defend the interests of our rural population.

1.2.2

1.2.3   Organisational structure

According to Custworth and Franks (2013), organisational structure shows how authority is passed down the organisation. Highlights how roles, power and responsibilities are passed on and controlled and how people communicate between management levels.
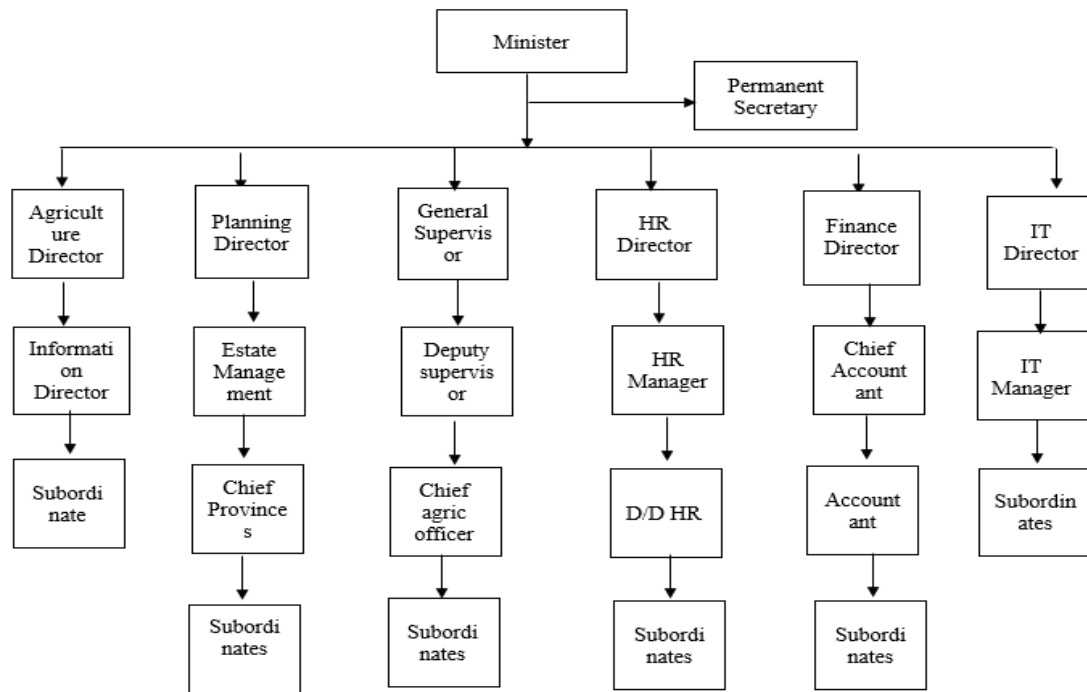
Figure 1.1   Organogram

Key

Agric – Agriculture   IT-Information Technology

HR – Human Resources   D\D - Deputy Director

1.2.4   Vision

To impact market forces through energetic and supportable farming movement that decreases poverty, diminishes the danger of food insecurity and expands the commitment to GDP.

1.2.5   Mission statement

To excel in the provision of customer focused and market driven services in the agriculture sector. In particular, the elements will be:

• Efficient administration of technical, administrative, financial and personal services

• Sound human resource administration and development

• Investment improvement through innovative work with all interest groups.

3

• Development of collective and consultative unions at all levels

• Maintenance and improvement of the responsibility to food and income security

• Enact and implement legislation both inside the Ministry and all through associated offices

1.2.6 Values

- Commitment
- Honesty
- Accountability
- Impartiality
- Professionalism
- Equity
- Responsibility
- Innovation

1.3 Problem definition

- Few farmers are not known and their needs are not heard and catered for which result in them not having enough inputs and enough knowledge about farming different crops which is lessening the crop production and thereby reducing the nation's GDP
- Farmers have little knowledge on how they can cultivate their crops which is leading to a lot of declining in soil nutrients and raising soil PH will lower down the final produce and due to poor produce potential farmers are not eager to try farming as they see think there will be no return.
- Pests and disease infections normally spreads throughout the farm and destroying a lot of crops as a result that they are not taken care of during the early stage thereby having a greater impact.
- Farmers have limited knowledge on where they can find pesticides and insecticides and how much do they cost which is causing poor budgeting in a way that they will not be

4

able to buy them in the middle of the farming season thus affecting the final produce as the crops will be greatly affected by not having the pesticides.

- Farm animals are dying because farmers do not know the possible disease affecting the animals and how they can prevent them or if affected they have little knowledge of the chemicals used for the disease and where they can access it with the price and dosages.
- Experts have nowhere to display their knowledge

1.4 Aim

To develop ministry of agriculture farmers cropguard and pest control system.

1.5 Objectives

- To keep record of all the farmers per region and their needs.
- Create farmer's knowledge base which will be very useful in providing the best and effective solutions to farmers.
- Provide a platform where experts and extension officers offer expert advice to farmers.
- To enable farmers to review farming products for after utilising them so as to assist other farmers in purchasing products
- Offer farm shops a platform to upload available products for farmers to make price comparisons.

1.6 Instruments and methods

1.6.1 Instruments

The project was implemented using the following:-

Comment [OM1]: Instruments heading

- **Programming Language**- Android IDE which is used to develop system that run on android operating systems such as phones.

- **Database**- MySQL- is a fast and robust multi-threaded SQL database server with a client/server implementation which helps to store data for future use and future reference and to see areas that upgrades to the system should be done.

5

- **Word Processing**- Microsoft Office 2016 and Adobe Acrobat which helps to read and type the information and to produce reports.

1.6.2 Methods

The information was gathered using following:-

- **Questionnaires-** Is a data collection method which allows analysts to study attitudes, beliefs, characteristics and behavior of those affected by the current and the proposed system? Questionnaires allows respondents to answer in their own time

- **Interviews-** This is a technique of gathering information face to face from interviewees and the types includes structured, semi-structured and unstructured and the analyst will have to choose which method to use

- **Observations-** This technique is basically developed to observe people in doing their day to day activities were the analyst will have to participate or watch farmers doing their day to activities in order to see how the current system operates.

- **Document review-** Document review is used to get an insight of the current system and the researcher had to look at the farmer's documents through the management. It was easier to understand how the current system works.

1.7 Justification of the proposed system

Farming is the backbone of the country as most of our products comes from farming and we export to supplement that which we need the most, the system will provide solutions on poor soils and pest and insects which are damaging crops and animals thus lowering the output. The system consists of expert farmers giving advice and providing solutions to questions asked. The system can be accessed on android mobile phone that make it accessible by many users.

1.8 Conclusion

To round up, this project proposal has introduced the system and what it is going to perform at large. Background of the study has been layered out as well as organisational background providing the organisational structure. Problems being faced by the farmers have been identified and the system will provide solutions. Aim and objectives of the system has been pointed out. Instruments and methods will enable the system to be produced and finally the system is justified.

CHAPTER TWO: PLANNING PHASE

1.9 2.1 Introduction

Webb (2017) defines planning as ''an activity that reduces future risks, that is lessening the unknown and maximising the known''. Planning is a future oriented activity. This chapter will focus into the business value of the system, Feasibility study which help determine whether to come up with the system or not. Risk and stakeholder analysis are also looked at and the time in which the project is expected to be finish will be layered out.

1.10 2.2 Business Value

The system has greater impacts to different stakeholders and the stakeholders include:

1.11   2.2.1 Farmer

Each and every farmer has an aim to produce an excellent output at the end of the season and be able to take care of other important things and the system is there to fulfill the aim. Impacts of crops being destroyed by pests will be minimized. Farmers will be able to know how they can take care of their soils so as to provide good nutrients for the crops. Information about where to access pesticides is provided as well as price quotations which will help farmers budget for what they might need throughout the farming season. Farmers will benefit in a number of ways from the system as they will acquire expert knowledge about farming and be able to notify the ministry of their needs.

1.12   2.2.2 Expert

Expert farmers will increase their farming knowledge thus improving their expertise in farming. They will be able to try new different crops as they will have acquired knowledge on how to grow different crops and they can as well request for advice. Experts will have a platform to showcase and express how much they know about farming. They will also know where to access farming products

1.13   2.2.3 Extension officers

Extension officers will be able to know more and know the experts in farming. Knowledge of where to access farming products and their prices will be available.

1.14   2.2.4 Management

The ministry of agriculture will be able to recognize each and every farmer in different regions and know their needs. It helps the ministry help farmers so as to miximise farming production.

1.15   2.2.5 Farm shops

Farm shops will be able to showcase their available products and prices. They will be able to have the knowledge of which product to keep in store and their price comparing to competitors

1.16   2.2.6 Administrators

They can make use of the system for personal benefits and try farming which is good for the families. As an author having access to all the information being provided I would like to give farming a try.

1.17   2.3 Feasibility study

Kendal (2016) states that feasibility study guides the organization in determining on whether or not to proceed with a project and identification of the important risks associated with the project that must be addressed given that the project was approved. It can be a measure of how practical or beneficial the proposed system would benefit farmers. It helped in the analyzation of possible alternative solutions to farm related problems and a recommendation on the best measures to take. It justified the development of the proposed system and outlines why the project should be discontinued. The chapter assisted the author to determine whether it was possible to develop the system in-house under the prevailing economic, financial, organisational and technological constraints and whether the costs of the system compared with the benefits and if benefits outweigh costs the system will be feasible.

.

1.18   2.3.1 Technical Feasibility

Technical feasibility is resources needed to develop the system. This is the identification of system requirements which includes inputs, software facility and procedures. User friendliness and greater processing speed are offered by the system. Maintenance costs are very low as farmers only requires an android cellphone to run the application and the farmer is notified if there are any upgrades. Considering the technical facilities needed to develop the system it will be successfully executed as the facilities are available.

2.3.1.1 Technical Expertise

Kendal (2016) says it is an assessment measure to see if the system can be built or not and the availability of technical expertise. This was established to assess whether expert programmers capable of developing   the system before it was developed and in this case the ministry has enough developers within the organization who were well vested in different programming languages. The developer could consult other software developing companies or individuals if they needed any more clarifications about the system.

9

2.3.1.2 Hardware

As this system is being developed for the first time there is need to check availability of hardware equipment to be used which include the following:

Table 2.1 Hardware requirements

Item Required	Recommended Specification	Quantity required	Available
Desktop Machines	2Gig RAM, 2.16GHz, 160HDD SATA-RAID, DVD/RW,	3	Yes
10/100/1000 Base T CAT5 Ethernet Cable	100 meter Reel	1	Yes
Application Server	4Gig RAM, 200HDD SATA-RAID 3GHz+ Dual Core Processor	1	Yes
Database Server	4Gig RAM, 2 x 200HDD, 3GHz+ Dual Core Processor,	1	Yes
Backup Server	4Gig RAM, 2 x 200HDD, 3.0GHz Dual Core Processor,	1	Yes
Network Switch	6port CISCO Switch	1	Yes
Printer	HP LaserJet	2	Yes

2.3.1.3 Software

Software are those packages that are used to develop the system and they are as follows:

Table 2.2: software requirements

Name	Description
Android IDE	To run on smart phones
MySQL database server	A multi-threaded SQL database server
Java Script	An application to develop a web based system

2.3.1.4 Overview of Technical feasibility

The task is in fact attainable as the service of horticulture has the vast majority of the dependable equipment and programming that can meet the prerequisites of the of the proposed system. Scarcely any assets should be acquired and refreshed frequently particularly programming.

The project is technically feasible as the ministry of agriculture has most of the required hardware and software that can meet the requirements of the of the cropguard and pest control system. Few resources need to be purchased and updated regularly especially software.

1.19   2.3.2 Economic Feasibility

Economic analysis is used when assessing the effectiveness of the system. Most commonly referred to as cost/benefit analysis to determine the advantages and savings expected from a system and comparing them with costs and make decisions on designing and implementing the system. It gives enough economic justification for the new system. The developer doesn't need additional hardware resources and it should be saving a lot of time.

A system is feasible when benefits outweighs costs of developing the system.

2.3.2.1 Costs

The costs will be divided into development and operating cost

2.3.2.2 Development and maintenance costs

These are costs incurred in the development stage of the cropguard and pest control system for instance software and user training Hullet (2016), The farmers and the developer are going to incur these costs and maintenance costs in the life cycle of the system. They cover the costs incurred during the development of the system and these include:

• Communication costs

• Costs related to salaries and wages, traveling as well as research costs for the development team

• Stationery costs

The costs included upgrades and any other modifications to be done. The costs cover the supporting costs which will be incurred when using telephones and or visiting the sites.

Table 2.3 Development costs

	Estimated costs for 3 years		
Description	2018 ($)	2019 ($)	2020 ($)
Server	500	200	200
Network Switch	100	100	100
Communication	50	50	50
Stationery	60	45	45
Salaries	800	800	800
Travelling and research	700	200	150
HP color Printer	500	200	200
Total cost	**2710**	**1595**	**1545**

2.3.2.3 Operational costs

These costs incur during the running of the system. The costs included are labor and user training as highlighted below:

Table 2.4 Running/operational costs

	Estimated costs for 3 years		
Description	**2018 ($)**	**2019 ($)**	**2020 ($)**
Maintenance costs	200	180	160
Labor	400	200	200
Stationery	300	150	150
User Training	300	100	100
Other expenses	300	200	200
Total cost	**1500**	**830**	**810**

2.3.2.4 Benefits

These are advantages that arises when the proposed system has been implemented

2.3.2.5 Tangible benefits

They can be converted into monetary value.

Table 2.5 Tangible benefits

	Estimated tangible benefits for 3 years		
Description	2018 ($)	2019 ($)	2020 ($)
Reduction in labour	1500	2500	2500
Reduction of stationery	2000	1500	1500
Estimated saved expenses	3000	1200	1400
Total benefits	**6500**	**5200**	**5400**

2.3.2.6 Intangible benefits

The intangible benefits expected from the system include:

- Increased data quality.
- Goodwill improved
- Improved efficiency.
- Increased farmer satisfaction

2.3.2.7 Cost benefit analysis

This is the difference between expected development and operation costs and system benefits Johnson and Kristram (2015). A good project should have greater benefits than jeopardizing the investment. The benefits are weighed against costs as illustrated below:

Table 2.6 Cost-Benefits Analysis

	Cost benefit analysis for 3 years		
Description	**2018 ($)**	**2019 ($)**	**2020 ($)**
Benefits			
Tangible	6500	5200	5400
Intangible	(1000)	(2000)	(2700)
Total benefits	**7500**	**7200**	**8100**
Costs			
Development	2710	1595	1545
Running	1500	830	810
Total costs	**4210**	**2425**	**2355**
Net benefit	**790**	**4775**	**5745**

2.3.2.6 Comments to the Cost–Benefit Analysis results

From the obtained results the benefits are greater than the costs and the project can safely continue. Timing and costs are taken into account and benefits relating to the investment size so as to choose between projects. Return of Investment (ROI) method is used to compare projects basing on their cash flows

2.3.2.7 Return on capital employed, (ROCE)

Measures the return per each dollar of capital invested in the business and is expressed in percentage in this case will calculate it for 3 years.

15

$$ROI = \frac{TotalBenefits - TotalCosts}{total\ Costs} \, x\, 100$$

Year 2018

Total Benefits expected: $7500

Total Costs: $4210

Therefore $ROI = \dfrac{7500 - 4210}{4210} \, x\, 100$

1.20   **=78%**

The return of Investment is a simple, easy to calculate measure. In this case a percentage of initially the project has a higher return which means the ministry will benefit from the proposed system and probably the returns will continue rising as the project progresses hence the project can be carried on as the ROI figure is very high.

2.3.2.8 Net Present Value

It is the most appropriate and recommended investment appraisal technique which assists in determining if the project is worth taking or not. The project is accepted if the NPV is positive as it has greater benefits vice versa. It is recommended over other investment appraisal techniques as it considers time value of money, uses cash flows instead of accounting profits which can be manipulated and it factors in risk through discounting cash flows into present values.

Discount Factor = $1/(1+r)^n$ where r = Discount rate and n= number of years

Present Value = Annual cash flow * Discount Factor

Net Present Value =$\sum$ PV

Based on a discount factor of 20%:

Table 2.7 Net present value

Year	Details	Cashflows	Discount Factor @ 20%	Present Value (USD)
0	Initial outlay	(10000-00)	1	(10000-00)
1	**1.21 Cashflows**	**1.22 $3350-00**	1.23 0.8333	**1.24 2792**
2	Cashflows	**1.25 $3350-00**	1.26 0.6944	**1.27 2326**
3	Cashflows	**1.28 $3350-00**	1.29 0.5787	**1.30 1931**
4	Cashflows	**1.31 $3350-00**	1.32 0.4852	**1.33 1625**
	1.34	**1.35**	1.36 NPV	**1.37**

The NPV shows that the project can continue. The system has greater benefits as it has a positive NPV value.

1.38

1.39   2.3.3 Social Feasibility

Kampira (2018) says this is how the users will interact with the system. Socially cropgaurd and pest control system has been accepted as it was designed to make farmers to have a better control on their farm produces. It shows the impact of the proposed system to the farmers. The system will encourage more produce thus improving Gross Domestic Product (GDP) which will benefit every citizen.

1.40   2.3.4 Operational Feasibility

Operational feasibility focuses on identifying problems within an existing system. Will make use of P.I.E.C.E.S framework:

Performance problems- The current system is very much unreliable as the farmers ask around for advice and be told what one think works which may not be the best. When using the internet, a lot of conflict information is provided thereby one getting confused about the best idea to take.

17

Information problems- Conflicting and biased information can be accessed from the internet and get biased information from fellow farmers.

Economic problems- Due to the economic hardships the country is currently experiencing it is very rare for one to buy bundles to go on the internet but rather ask around and getting biased information which at the end affects production

Control problems- Control for the current system is a hard nut to crack as the internet cannot be controlled by anyone and farmers cannot control what they are being told but can do so by assessing the provided information.

Efficiency problems- The current system is not even efficient as the internet maybe affected by poor network. Asking from fellow farmers proved hard as they may be unavailable or end up talking staff unrelated to farming.

Taking into consideration of the above explained problems the developer used the problems to come up with the system that can do away with all the stated problems of the curren.t

1.41   2.4 Risk Analysis

During system development a number of risks will be incurred. Risk analysis points out the key risks associated with the project Dennis et al (2015).

1.42   2.4.1 Stakeholders' Risks

1.43   Management

Management will have overall control of the system through budgeting of resources allocated to the project which include money and time. Management support will encourage other stakeholders to view the project in a positive way.

Users

Some farmers are illiterate in such a way that they will fail to use the system. Other farmers might welcome this project as they will be able to acquire expert advice and know better about farming. The farmers highly support the project thereby the risk being low.

1.44   2.4.2 Technical Risks

The system will meet the set obligations when it comes to receiving advice considering that the farmers did not have such a system to use. System maintenance and upgrade will be a problem that farmers might be faced with. A full backup of the system will be required such that a knowledge base will be generated. Design problems where encountered as there was no enough time to perfectly look at the project. The technical risks are not important as there is another plan if system failure arises.

1.45   2.4.3 Social Risks

The proposed system has been socially approved as it will help farmers to acquire expert advice from experts and extension officers. The system is quite easy and interesting to use.

1.46   2.4.4 Economic Risks

Due to what the country is currently going through the project is at risk of termination because of high prices and some products being unavailable on the shelves. The ministry has to well budget for the project so as to avoid shortfalls. All the resources where available and on time. The ministry has to budget a lot more in the event that the prices continue to rise and resources continue to be unavailable.

1.47

1.48   2.5 Stakeholder analysis

The proposed system is going to affect various stakeholders in agriculture as it is the backbone of this country. The stakeholders include:

1.49   2.5.1 Management

The ministry will be able to know each and every farmer per region and be able to address their needs and know experts and how much they are contributing to the agriculture economy. Will be able to give roles to the users.

1.50   2.5.2 Extension officers

They will be able to enhance their farming knowledge and be able to know experts in farming and provide expert advice to farmers.

1.51   2.5.3 Farmers

Farmers will request for solutions and acquire expert advice about farming and know which product is best to use together with its price quotations. They will be able to address their needs to the ministry.

1.52 2.5.4 Farm shop

Will be able to know which best product to keep in stock as it will be mostly used by farmers and know the reasonable price for the products.

1.53 2.5.6 Expert farmers

With the proposed system experts in the field of farming will be able to acquire additional information and be able to try some new farming techniques and try new crops besides their line of expertise.

1.54

1.55 2.6 Develop work plan

Is the recording and keeping track of all activities that will occur during the life of the project, there will be identification of tasks and durations of the project as illustrated in the following diagram:

Table 2.8 Project Schedule

Phase	Start	End	Duration(weeks)
Proposal	27/08/2018	31/08/2018	1
Planning	01/09/20188	07/09/2018	1
Analysis	11/09/2018	26/09/2018	2
Design	29/09/2018	09/10/2018	2
Implementation	12/10/2018	23/10/2018	2
Maintenance	26/10/2018	30/10/2018	Ongoing

The following Gantt chart shows project time allocation for each stage:

Table 2.9: Gantt chart

ACTIVITY	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9
Project proposal	■								
Planning		■							
Analysis			■	■					
Design					■	■			
Implementation							■	■	
Maintenance									■
Documentation	■	■	■	■	■	■	■	■	■

1.56

1.57   2.7 Conclusion

Conclusively through visibility study, business value analysis, cost benefit analysis, risk and stakeholder analysis the project proved to be viable and bring greater benefits to farmers The next phase is the analysis phase.

CHAPTER THREE: ANALYSIS PHASE

1.0 3.1 Introduction

The chapter focuses on gathering information so as to get a clear understanding of the existing system and current systems dataflow diagrams and context diagrams so as to get a better understanding of the importance, complexity and scope of the existing challenges.

1.1

1.2 3.2 Information Gathering Methodologies

This stage helps in acquiring detailed knowledge about the system from all associated users. Methods used include:

- Questionnaires
- Interviews
- Observations
- Document review

Using the above methods gathering data but they have their strength and weaknesses. By overlooking them it helped eliminate the problems associated with others. It helps give light to the project carried out. Provide the analysed problems associated with the current system so as to come up with the best solutions.

1.3 3.2.1 Interviews

According to Kendall (2016) interview is a technique of gathering information face to face from interviewees and the types includes structured, semi-structured and unstructured. The analyst will select which one between the three is the best to use.

3.2.1.1 Structured Interviews

Each and every question outlined must be read thoroughly by the researcher without saying or meaning otherwise. Should be able to take note of body language, facial expressions, and emotional affect. This is the most used interview type. It is most useful when looking for very specific information. Keeps the data short and precise.

3.2.1.2 Semi-structured Interviews

Much more flexible. Small room for clarifications and additional information. There is freedom of being friendly. Used when the information is much personal. Participants' trust can be gained and better response understanding. Larger data sets are obtained.

3.2.1.3 Unstructured Interviews

They are much more flexible. The interview was more like a conversation and the researcher only had a checklist of topics. So much information can be uncovered in response to the researcher's topic. There was no limitation to the protocol as the researcher and the respondents were free to air out their responses. Management, farmers, extension officers and experts were selected for the interview. As an analyst, unstructured interview proved to be more beneficial as compared to the other types.

Unstructured interview was the most preferred technique as it:

- Allow for direct communication with the people responsible of the current system thus, the analyst got a first-hand understanding of how farmers access their farming knowledge as well as the problems they are facing and what exactly do they expect from the system.
- The interview offers immediate responses.
- It was very private and confidential.

3.2.1.4 Advantages
- Immediate and direct responses were obtained
- Participants where free and requested for questions, interpretations or elaborations which encouraged truthful answers.
- What is currently happening was clearly layered out.
- There was room for additional information and clarification.

3.2.1.5 Disadvantages
- The method took a lot of time to conduct.
- Respondents were busy working in their fields and answered to get over with the interview as the interview took place during working hours.
- Some interviewees gave biased answers as they could not understand the demands of the questions.

3.2.1.5 Findings from the interviews

The author discovered farmers have little knowledge about farming activities and they have little information source to rely on which is a challenge for them to maximise output and try new crops. Experts are there but they are not recognised and have few farmers to share their expert advice with. Farmers needs are not heard and taken care of especially by the ministry of agriculture.

1.4

1.5 3.2.2 Questionnaires

According to Kendall Kendall et al (2016), is a data collection method which allows analysts to study attitudes, beliefs, characteristics and behavior of those affected by the current and the proposed system. Questionnaires were issued to most of the farmers farming different crops. They were designed and distributed to the farmers asking about the challenges associated with the current system They are less costly and responses maybe be compared from one farmer to the other. They ensure anonymity thus respondents are free to air their views. They are more objective however respondents may forget important issues as the method occur after event. The author used open ended and structured questionnaires

3.2.2.1 Open ended questionnaire

Open ended questionnaire allows respondents to answer whatever they feel. Large amounts of data are generated which takes time to process and analyse. Respondents may provide unclear answers especially if the questionnaire take long time to complete

3.2.2.2 Structured questionnaire

Responses are straight to the answer as respondents can only answer with a YES or NO and there is no full expressing of oneself and will save on time.

3.2.2.3 Advantages

- More information can be gathered

- They feel free to air out their views

3.2.2.4. Disadvantages

- Provides unclear answers

- Some questions are left unattended as respondents could not understand them

- Takes a lot of time to gather and compile the information

3.2.2.5 Findings from the questionnaires

It was discovered that some respondents could not understand the demands of the questions due to the inability to read and write properly. It took a long time to gather all the information and some answers where hard to interpret and draw meanings from. Some questionnaires where never returned which made it more difficult to draw a good conclusion.

3.2.2.6 Response rate

As it is well known that people doing farming do not worry much about being able to read or write which greatly affected the responses gathered. About 50% of responses where returned and some, where spoiled or the answers where unclear

3.2.2.7 Target population

- The researcher was mainly targeting young commercial and small scale farmers with the idea that they were able to provide best answers. Farmers who had many years doing farming where targeted as they knew better and knew ways that could be done so as to increase farming in Zimbabwe

1.6 3.2.3 Observations

According to Otto (2013) this type of technique is basically developed to observe people in doing their day to day activities. The observer can participate or watch people doing what they do and have the know-how of the current system. With this technique the observer was able to see what they may require to make farming easier and to observe if they are farming properly and how they treat pests and diseases.

3.2.3.1 Advantages

- It was less costly as no material was required

- Data relevant to the context was obtained.

- First-hand information was obtained.

- No bias

- Identified unanticipated outcomes

3.2.3.2 Disadvantages
- Most farmers changed their behaviors as they felt that they were being watched which led the observer not to get the exact information that was needed leading to biased conclusions.

- Few operations were observed.

- Proved to be expensive and time consuming
- Could not observe and analyse the respondent body language.

3.2.3.3 Findings from observation

Most farmers had little knowledge about farming though they had many years doing farming. They did not know where to access farming products and the best product to use. They had a lot of needs which ministry of agriculture should take care.

1.7 3.2.4 Documentation review

Otto (2013) states that document review is looking at the previous used documents so as to get an insight of the current system. To get an insight of the current system the researcher had to look at the farmer's documents through the management. It was easier to understand how the current system works.

3.2.4.1 Advantages

First-hand information was obtained

3.2.4.2 Disadvantages

Incomplete information as reports could not explain data source.

3.2.4.3 Findings from documentation review

Not much was found from document review as farmers did not document most of their activities

1.8

1.9 3.3 Analysis of the existing system

The stage focuses on the operation of the current system and mainly focusing on weaknesses and how the problems can be solved by the implementation of the new system.

The analysis was carried out in view of the following aspects:

- Input

- Processes

- Output

1.10

1.11   3.3 Process analysis

Is done to show activities taking place in the system. It helps to get a clear understanding of the order in which activities takes pace and show those responsible for each and every activity. It makes use of activity diagram.

Advantages

- Easy to understand and assimilate

- Helps the analyst to get a full understanding of processes and sequence of operations

- Need little technical knowledge so as to use the flow chart as communication between users and analysts.

Previous Experience | **Farmer** | **Internet**

Want Advice

Decides on information source

Ask others

Type request on browser

Get feedback

Provides websites to access information

Assesses the solutions

Provide detailed information on the selected website

Implement the best solution

Assesses the provided information

Closes the web pages

Implement the best solution

Fig 3.1 Activity diagram of the current   28

Key
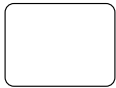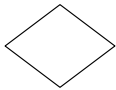
◯	Start
⭕	End
▭	Process
◇	Decision
⟶	Data flow

3.3.1 Description of the current system

Currently there are a number of systems that farmers use differently but there is no a similar system to this. Currently farmers use knowledge from other fellow farmers when they ask around for information. They make use of what they know and experienced from the previous years and what they did to solve the problems and if they experienced otherwise they would choose another alternative. Farmers can search on internet about pests and diseases which sometimes does not provide solution to the problem. They go to farm shop to ask for products and their prices and sometimes they just go with no knowledge if the product would be available or not which end up costing them.

3.3.1.1 Input

- Type of pests and diseases
- Soil nutrient problems
- Product and price requests

3.3.1.2 Process

- Surfing the internet
- Asking around for information

- Using previous experience

3.3.1.3 Output

- Information from the internet

- Fellow farmers experience

- Alternatives from previous ones

1.12   3.4 Data analysis

Shows processes and activities performed in the current system as well as how data flows. Provided a pictorial image of what was really happening in the organisation. It uses the following diagrams:

- Context diagram
- Data flow diagram

1.13

1.14   3.4.1 Context diagram

It was an outline of the system boundaries currently in use and shows how the system is related to the external environment with the fact that it was not a closed system but rather an open system. The following   is   the   context   of   the   current   system:

30

FARMER

CROP ENQUIRY

SOLUTION

CURRENT SYSTEM

PRODUCT

UPLOAD

ADVICE

ENQUIRY

FARM SHOP

EXTENSION OFFICER
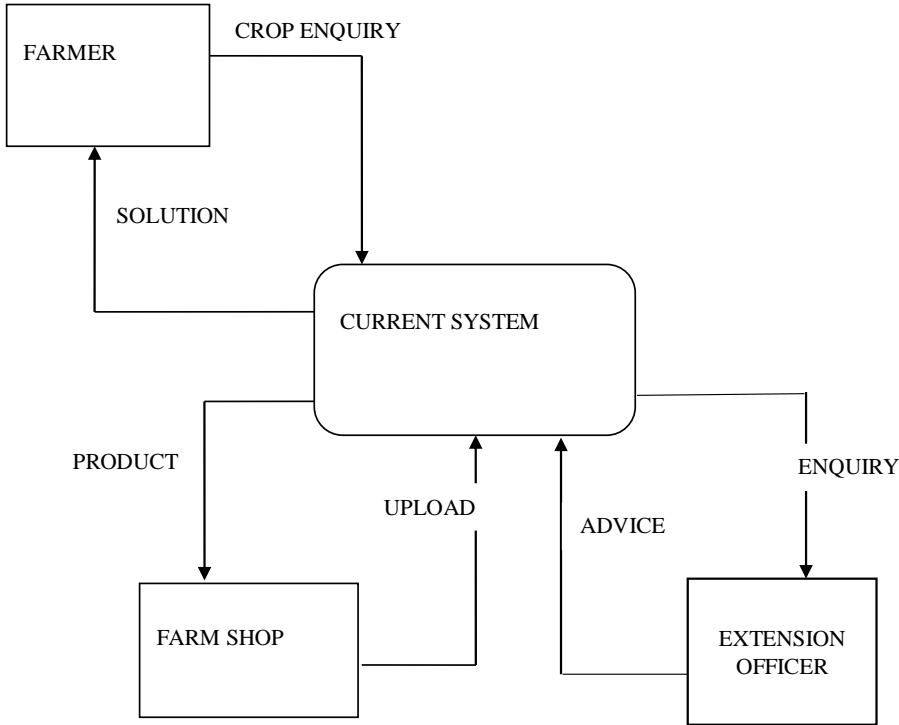
Fig 3.2 Context diagram of the current system

3.4.1.2 Context diagram Key

Data flow

Entity

Main system

1.15

1.16

1.17

31
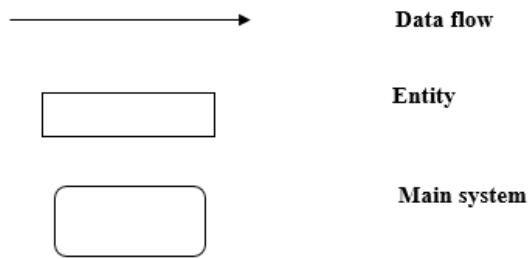
1.18   3.4.2 Data flow diagram (DFD)

This shows how data flows in the current system between entities and processes Hathway…etal (2016). The developers had to capture inputs and processes and present it in the form of data flow diagrams
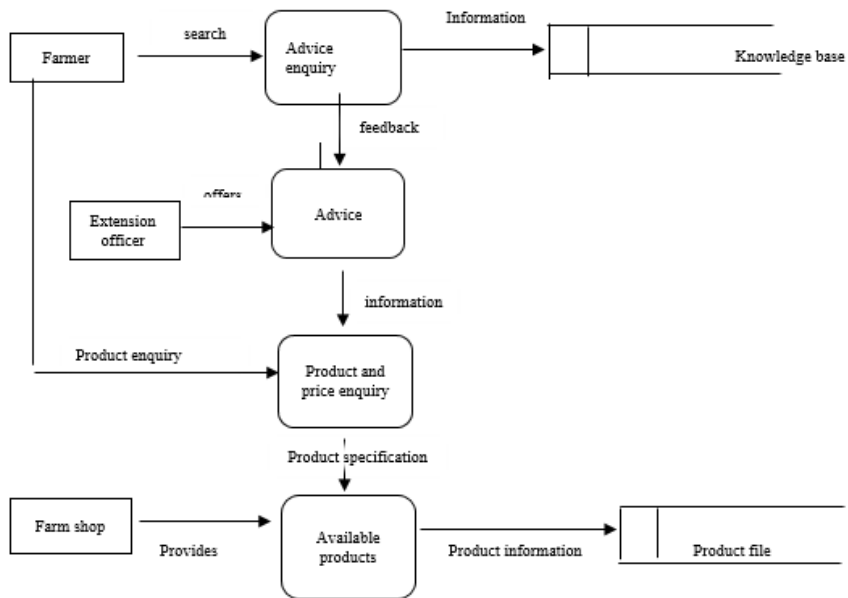
Fig 3.3 dataflow diagram of the current system

3.4.2.1 Data Flow Diagrams Keys

Entity

Data Store

Main System

Data Flow

1.19   3.5 Weaknesses of the current system

- It is very costly

- Unreliable information sources

- Poor problem solving

1.20   3.6 Evaluation of alternatives

This stage focuses on the system development approach which are:

- Outsource

- Off-shelf

- In-house development

1.21   3.6.1 Outsourcing

This is the development of the system outside the ministry with companies or individuals Hillary (2014).

3.6.1.1 Advantages of outsourcing are as follows:

- Product of high quality will be developed as contracting companies provide professionals and specialist

- Less staff is required since the system will be developed outside the ministry.

33

3.6.1.2 Disadvantages of outsourcing:

- It is expensive.

- Higher training due to constant reference to developers.

- Confidential information being lost to competitors.

- Poor service offered as it has many companies

1.22   3.6.2 Off shelf software

An alternative to buy a software package that was developed outside the ministry of agriculture.

3.6.2.1 Advantages

- Lower development costs

- Less implementation time

- Less technical staff is required for development

3.6.2.2 Disadvantages

- Costly due to training as a result of reference to developers

- Requirements specifications not met since the systems are custom made

- Relatively expensive due to much more attention needed.

- The method is not favorable due to its drawbacks.

1.23   3.6.3 In-house development

This is when the system is developed by the available personnel within the organization. This help the developers to develop a system which solves the problems not addressed by the current and meeting the requirements.

3.6.3.1 Advantages

- Easy reference to corrections since developers are always available

- Inexpensive to implement.

- User requirements are incorporated during system development in such a way that hey assume ownership.

34

- Reduced manpower since there was small tasks integration.

3.6.3.2 Disadvantages
- If there is no expertise the system will not function well as it will have many bugs and errors.

1.24   3.6.4 Summary of alternatives
Table 3.1 summary of alternatives

ALTERNATIVE	COST ($)
OUTSOURCING	**10000**
OFF-THE SHELF SOFTWARE	**7000**
IN-HOUSE DEVELOPMENT	**3310**

1.25

1.26   3.6.5 Conclusion of alternatives
In conclusion the system was developed in-house since the Ministry has all the required resources and the developers. The ministry can make use of the existing hardware currently being used.

1.27   3.7 Requirements analysis
1.28   3.7.1 Functional requirements
- Database enables capturing and manipulation of real time data to facilitate access of advice at any time and any day.

- Farmers will be able to rate a product depending on how best it solves a problem

- Generate a knowledge base which will be useful in future

- Experts and extension officers will give expert advice to farmers

- Farm shops will be able to upload available products and know what best product to keep in store

1.29

1.30

1.31   3.7.2 Use Case diagram

These are sequence actions performed by the system to produce what the actor does. They specify the behavior and not how it happened. They are created based on identified functional requirements as illustrated below:
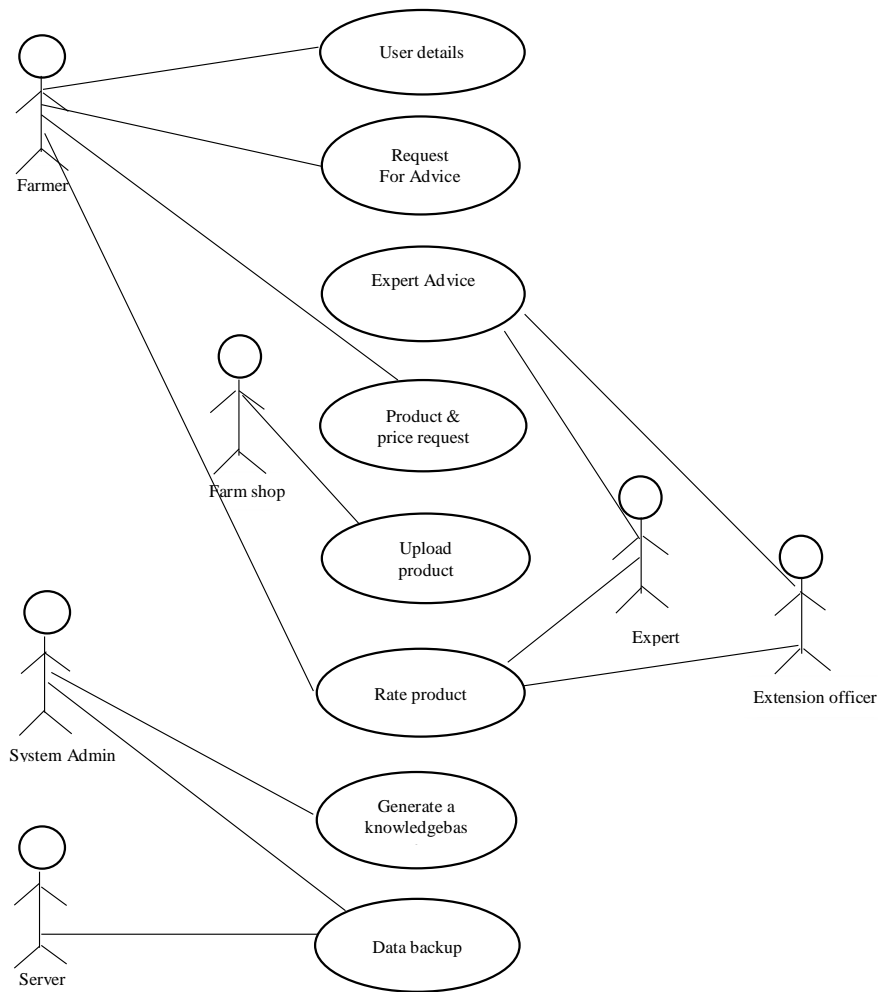
Fig 3.4 Use Case diagram

3.7.2.1 Key of case diagram

Actor

Use case

Communicator
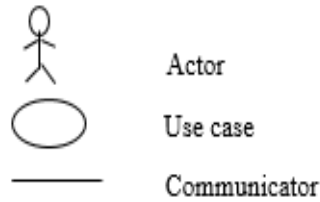
1.32   3.7.2 Non-functional requirements

These are constraints experienced during the system development.

3.7.2.1 User Interface and Human Factors

- Simplicity.
- User interface easy to use.
- Errors should be easily recovered.
- The system must be user friendly

3.7.2.2 Error Handling

The system should have error handling for

- Data entry\capture
- Data analysis

3.7.2.3 Security Issues

- There should be different access levels for the sake of protecting information
- Passwords must be long enough and contain special characters

3.7.2.4 Security of information

There should be the use of strong passwords and access levels to the farmers. Details of the users currently log on must be captured.

3.7.2.5 System efficiency and throughput

The proposed system is supposed to:

- Data should be always available whenever needed.
- Every problem faced should have a solution.
- Response time, efficiency and reliability must be a priority

37

3.7.2.6 User requirements

The user must be able to enter correct information so as to use the system and retrieve information from the database.

1.33   3.8 Conclusion

To conclude Information about the current system was gathered and analysed though there was a shortage of time. The proposed system brings about greater benefits will help in increasing the organisation's efficiency and increase GDP thus the system being worth to be designed. Alternatives to develop the system where discussed and in-house development being a way to go as it proved less costly than the other two. Will be focusing on the next stage.

1.34

1.35

1.36

1.37

1.38

1.39

1.40

CHAPTER FOUR: DESIGN PHASE

1.41

1.42   4.1 Introduction

The chapter focuses on how the cropguard and pest control system was accomplished. It looks at the system design and the context and DFD of the proposed system is also provided. Architectural   physical and database is also looked at. It consists of design activities that produce the cropguard and pest control system. There is need to improve the quality before the system is implemented. At this stage the author will have to make decisions such that the system will be a success.

1.43

1.44   4.2 System Design

This process defines the architectures, interfaces and system data as a way of satisfying requirements Villafiorita (2016), In this phase a reliable maintainable and effective system was produced. The following features should be available:

- Effectiveness.
- Reliability.
- Maintainability.
- Adaptability

Cropgaurd and pest control system should have the above mentioned features

1.45   4.2.1 Effectiveness

It is the measure of how set objectives have been met and to what extent has the problems dealt with. Effectiveness in short entails doing the right thing. The proposed system must be easy to work with and reduce costs. The users of the system will be involved in its development such that a system meeting their needs will be made. The users must be able to use the system comfortably Villafiorita (2016),

1.46   4.2.2 Reliability

The system must be able to consistently perform what it is intended to do without degrading or failing. No defects should recognised on the system and should not fail during execution. For it to be reliable it should be able counter for the problems of the existing internet system. Villafiorita (2016)

4.2.3 Maintainability

By this the system must be able to be restored in case it has failed. The system must be serviceable which is the scheduled inspections and reparable which is restoration after failure. The system must be easy to maintain for example upgrades and adding more features. The system should be flexible to adopt to changes in response to technological advancements. Villafiorita (2016),

1.47

1.48   4.2.4 Adaptability

1.49   The proposed system can be upgraded to later versions depending on the technological advancement. By adaptability the system will be made for various smart phones which include iPhone. It will be added more functions and design with time.

1.50

1.51   4.2.5 Description of the proposed system

The cropguard and pest control system is a very easy application to use and all those going to use the system are actively involved so they lay out where to correct and what they expect. It will help farmers to know more about farming and have a better access to farming products which will help in improving farming production which is good for everyone. The system provides farmers with what they need be it advice or products. It is a serviceable and reparable system. It can adopt to technological advancement. Farm shops will be able to keep product that are mostly wanted by farmers basing on the results of product rating. Experts and extension officers will be able to offer what they know about farming and as well try new different crops as they will be knowing knew ideas of different crops in such a way that there will be diversity of crops being produced. It will motivate even the administrators and management by seeing the information to try farming which intern increase farm production in Zimbabwe

1.52

1.53

1.54

1.55   4.2.1 Context Diagram

The context diagram for the proposed system outlines the system boundaries. It shows the system as a whole with its inputs and outputs it reflects how the system relates external environment. The following diagram illustrates the context diagram of the proposed system:
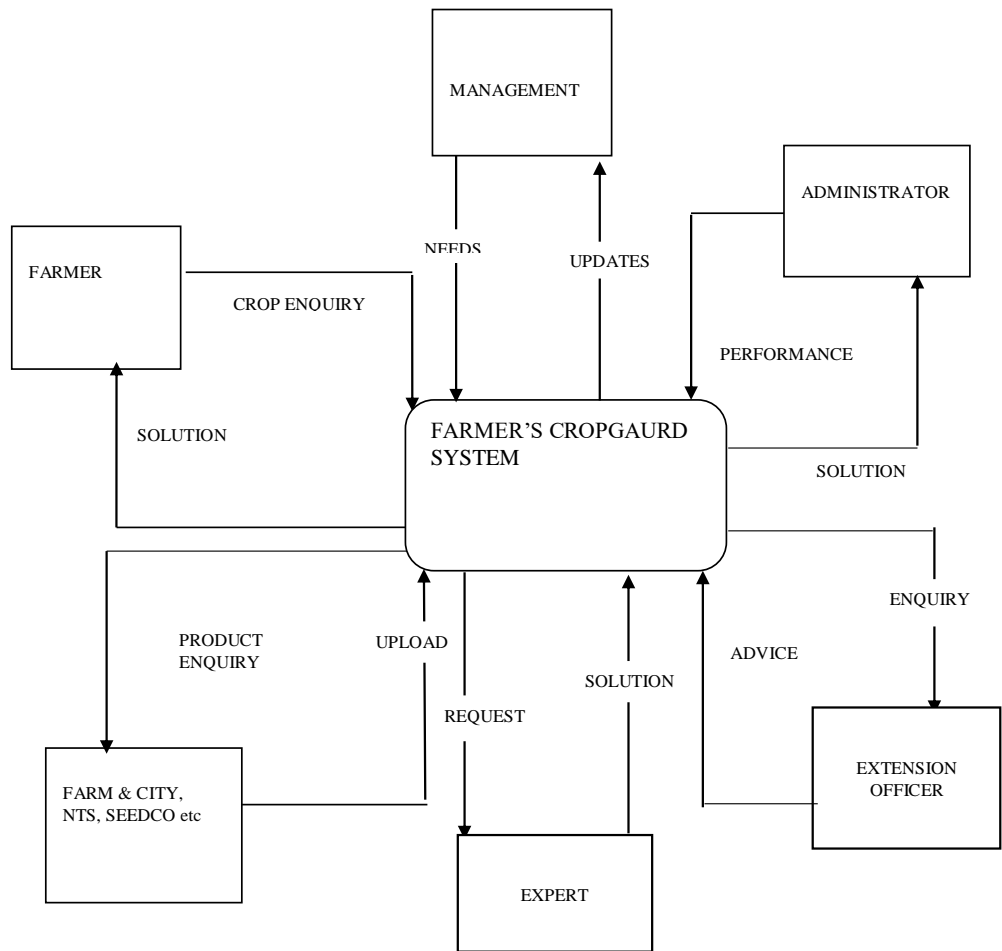
Fig 4.1 Context diagram of proposed system

Key:
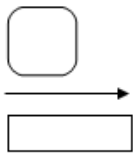
Process
Data Flow
Entity

Data flow diagram for the proposed system

Farmer	Sign up →	Farmer details	authorisation →	Farmer details

Farmer → Sign up → Farmer details → authorisation → Farmer details

System update ↓

Advice enquiry

enquiry ↓

Expert → provides → Expert advice → information → Knowledge base

Extension officer → provides →

Solution ↓

Product and price enquiry

request ↓

Farm shop → upload → Available product

Best product ↓

rating → Product rating → Report
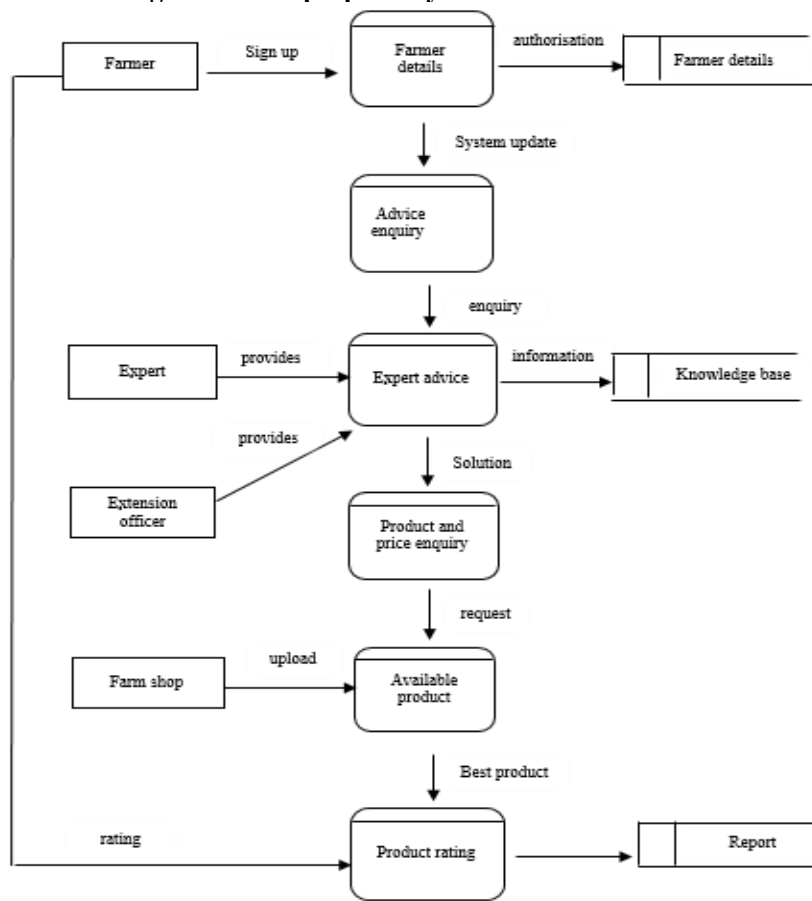
Fig 4.2 Data Flow Diagram of the proposed system

42

Key:

Process

Entitv

Data store

Data flow
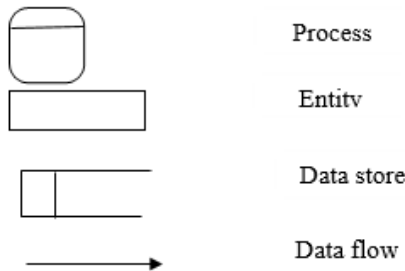
1.56

1.57   4.3 Architectural Design

This is the identification of sub-systems and establish a framework control and communication Schmidt (2016). This include determining whether the system is a networked or standalone based system. In a server based architecture operations of the system are into a server and the other computers will be typically in a network infrastructure. On the stand-alone deployment services are done in one computer that operates alone and does not communicate with each other even if they are many. The following table illustrates the differences between the two architectures:

Table 4.1 Comparison of client server and stand-alone architecture.

	Client-Server Based	Stand –Alone
Cost	Very high	Low
Control and Security	Very high	High
Ease of Development	High	Low
Room for Future Growth	Very high	High

Architecture design
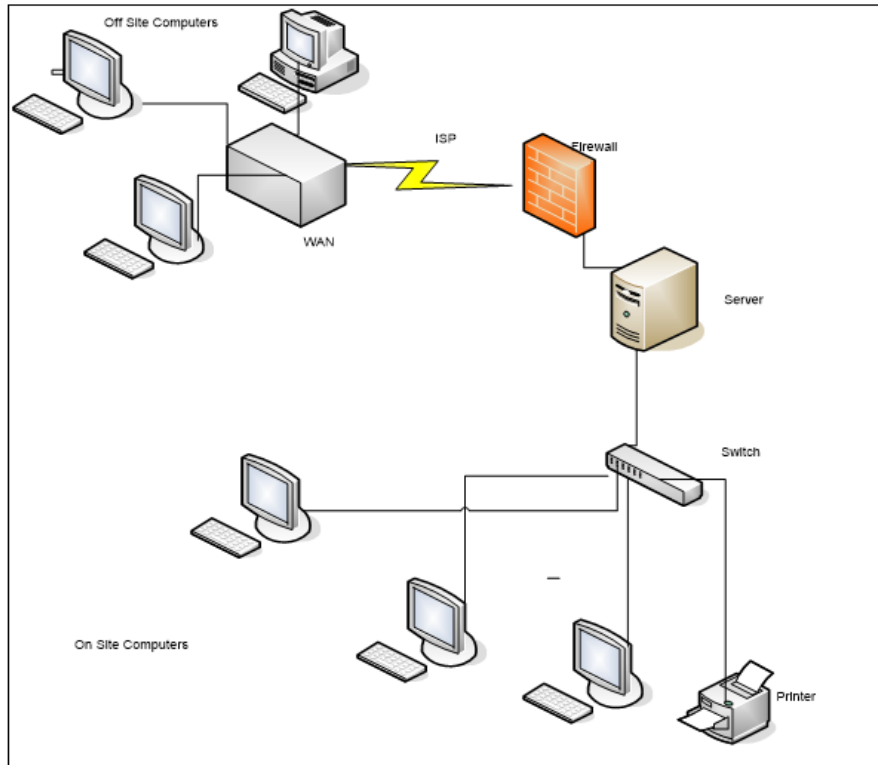
Fig 4.3 Architectural design of proposed system (Z M............. et al (2017)/

A wide area network is used as the system comprise of users in different geographical locations through it will be centrally controlled on one station which will be in Harare. A firewall will be put in place so as to prevent attacks from the internet service provider on the ministry server. Routers and switches will be used to as a connection to other onsite computers and printers. All the information will be stored in the database which is good for future use.

1.58

1.59   4.4 Physical design

Looks at how the proposed system will be physically layered out. The administrator is the only one who can access the database and make changes. The server is only used when the administrator will be performing administrator duties. There will be need for constant backing up

of the database such that all the information will be stored. The following diagram illustrate the setup of the machines:

Farmers

Administrator

Management

Server

Printer
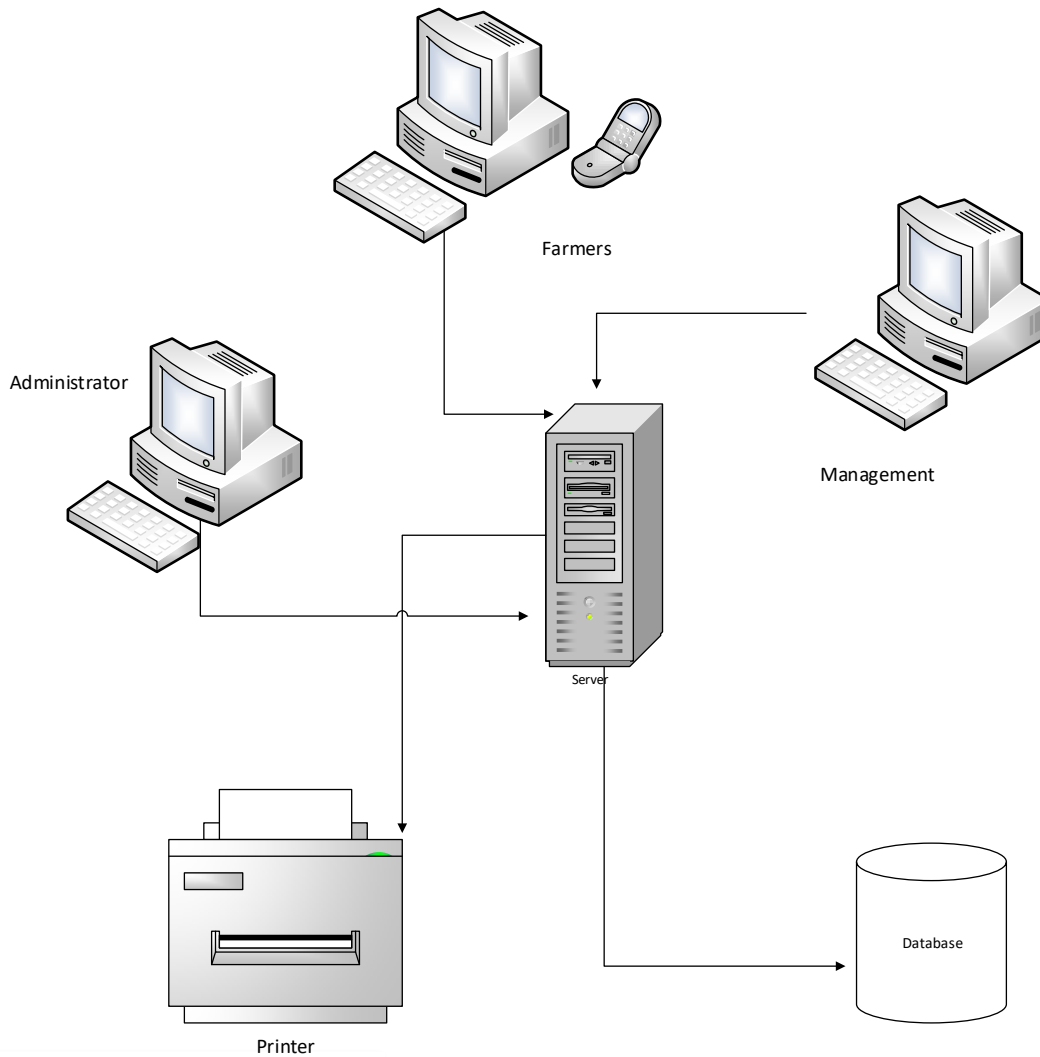
Database

Fig 4.4 Physical design

1.61

1.62

1.63 4.5 Database Design

A detailed data model of a database and containing all of the needed logical and physical design and storage parameter is produced. These are the tables and views in a relational model. A

45

database is a collection of related information organised in an efficient manner. The analyst will make use of the database as a central repository of the cropguard and pest control system, a program written in java.
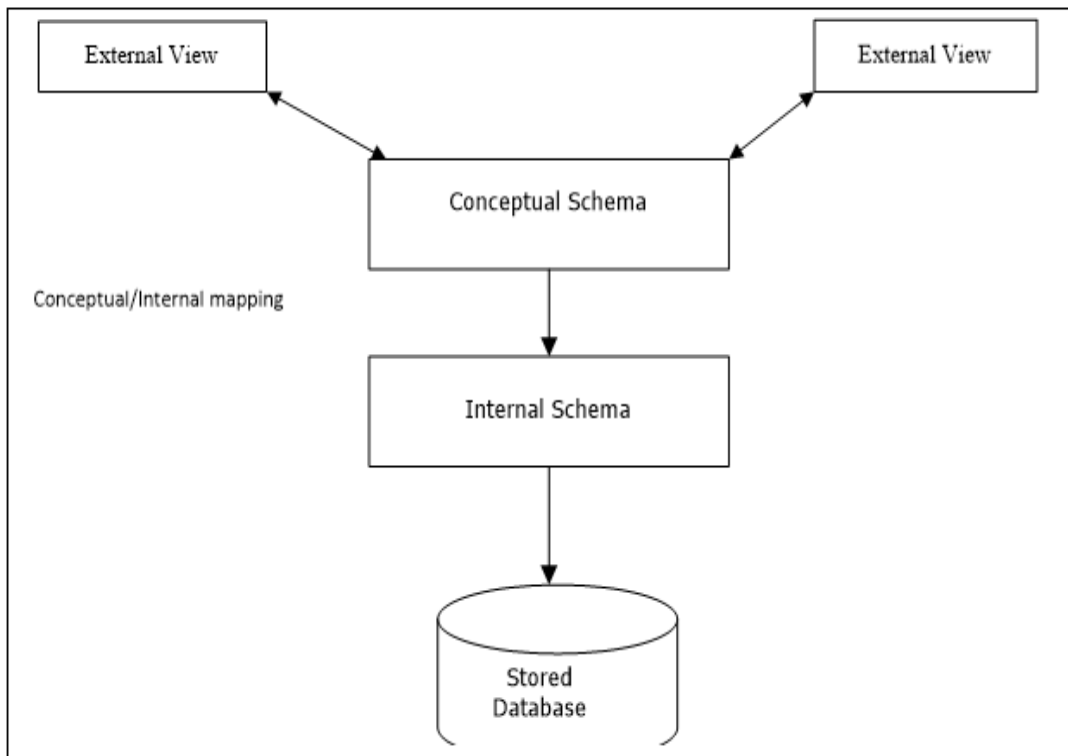
Fig 4.5 Database design

1.64

1.65   4.5.1 Physical level

It is the lowest and shows how the data is actually stored.

1.66

1.67   4.5.2 Conceptual Level

 Looks at the stored data and the relationships that exists among that data.

1.68   4.5.3 External view Level

Provides a simplified interface for better manipulation of data. The records can be viewed using forms and reports. MyStructured Query Language (MySQL) is used to design the database. Relationships between tables include:

- One to many- In this case an expert can help may farmers
- Many to many- This is where many experts can help many farmers
- Many to one – many farmers sharing one expert.

Reasons of using relational databases

- Support diverse data and good handling of data.
- Operations like updates, retrieval, deletion and other functions that are required on stored data are effectively supported.
- Good in implementing measures that reduces external manipulation.

1.69   4.5.5 Database Tables

These are elements where actual data is stored. The proposed system must successfully meet user requirements. The characteristics of data repository possess the following:

- Consistency
- Reduced data redundancy.
- Data integrity

Table 4.2 Administration

Attributes	Data type	Description
Username	Varchar(30)	Name of the user
Password	Varchar(30)	Password of the user
Position	Varchar(30)	Level of access

Table 4.3 Farmers, experts and extension officers

Attributes	Data type	Description
Username	Varchar(30)	The username of the user
Password	Varchar(30)	password of the user
Name	Varchar(30)	Name of the user
Surname	Varchar(30)	Surname of the user
Region	Varchar(30)	Region of the user
Number of hectares	Int (10)	Status of the user
Residential address	Varchar(30)	Address of the user

1.70

1.71   4.5.4 Enhanced Entity Relationship Diagram

The Enhanced Entity Relationship Diagram is the perfect and preferred model as it provides a better picture of relationships that exist between entities Thalhem (2016). The EER views the real world as entities and relationships. The EER diagram for the cropguard and pest control system is shown below.
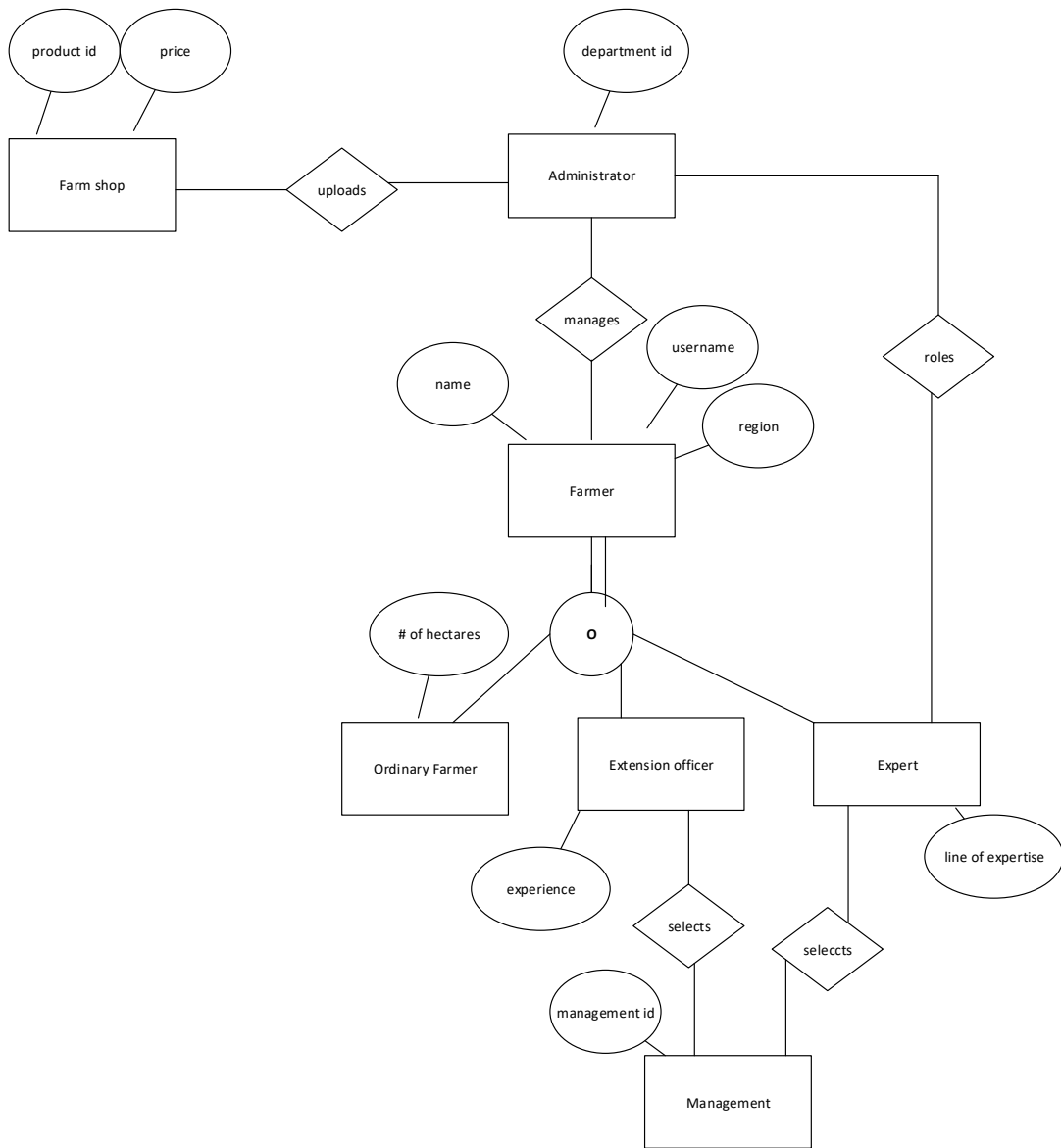
Fig 4.6 EER diagram of the proposed system

1.72

1.73

1.74

1.75

1.76

1.77

1.78   4.6 Program design

Are steps taken by the programmer before coding using a specific language in this case using java jdk and android studio. If the steps a properly followed it makes it easier to maintain the system. Will make use of class and sequence diagram in program logic planning.

1.79

1.80   4.6.1 Class diagram

They describe how the system is developed by showing the systems classes, their attributes and methods and the relationships that exist between classes. The following diagram illustrate the class diagram of cropguard and pest control system:
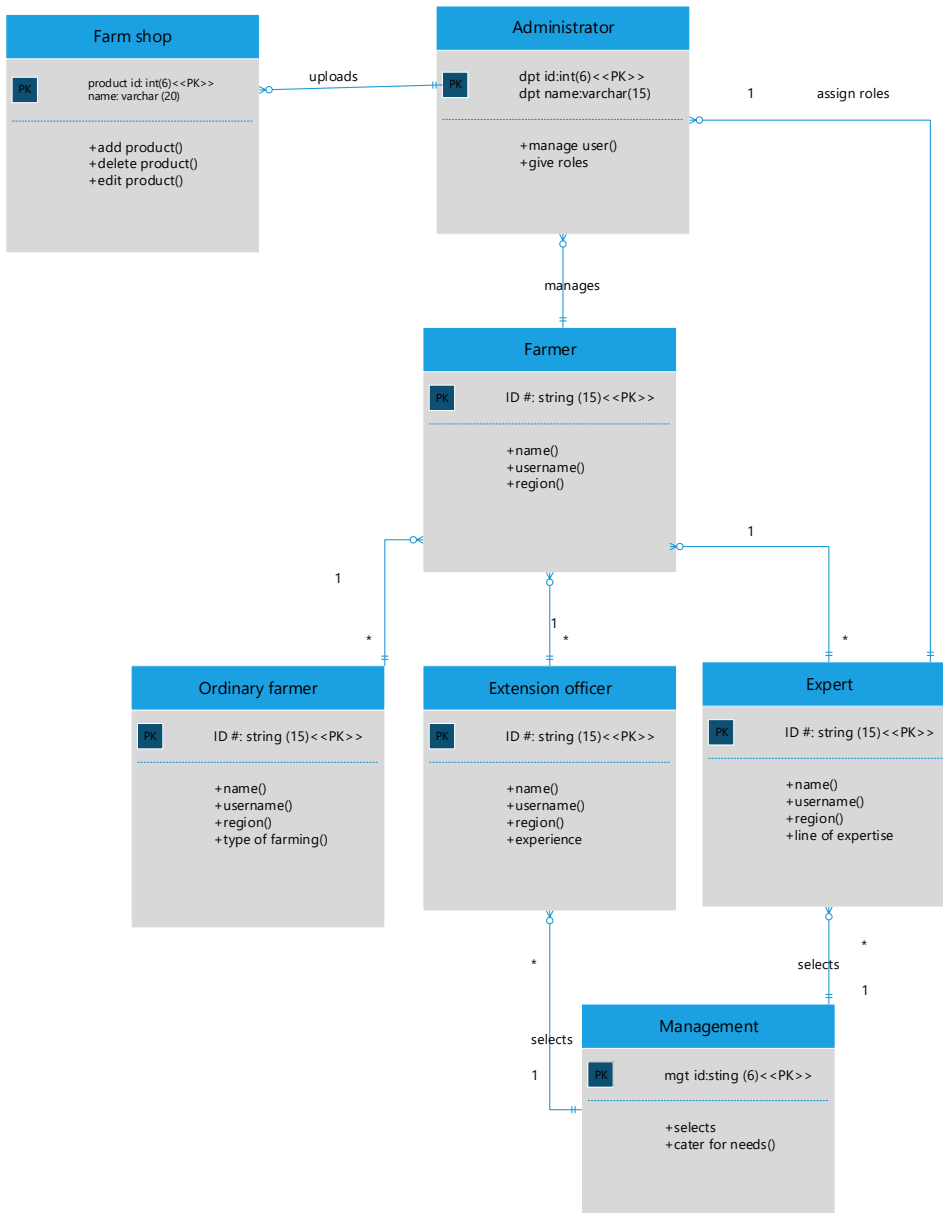
Fig 4.7 cropguard and pest control System Class Diagram

1.81

1.82

1.83   4.6.2   Package Diagram

The package diagram shows the requests send. That is, the tests, results and customer management processes are shown. The main considerations touch the main as well as the user interface and the available products. This shows how components interact with each other.

Fig 4.8: Package diagram of the proposed System

1.84

1.85   4.6.3 Sequence Diagram

Is a kind of interaction showing interaction processes with each other and their order? Enables the documentation, validation, analysis and design purposes.
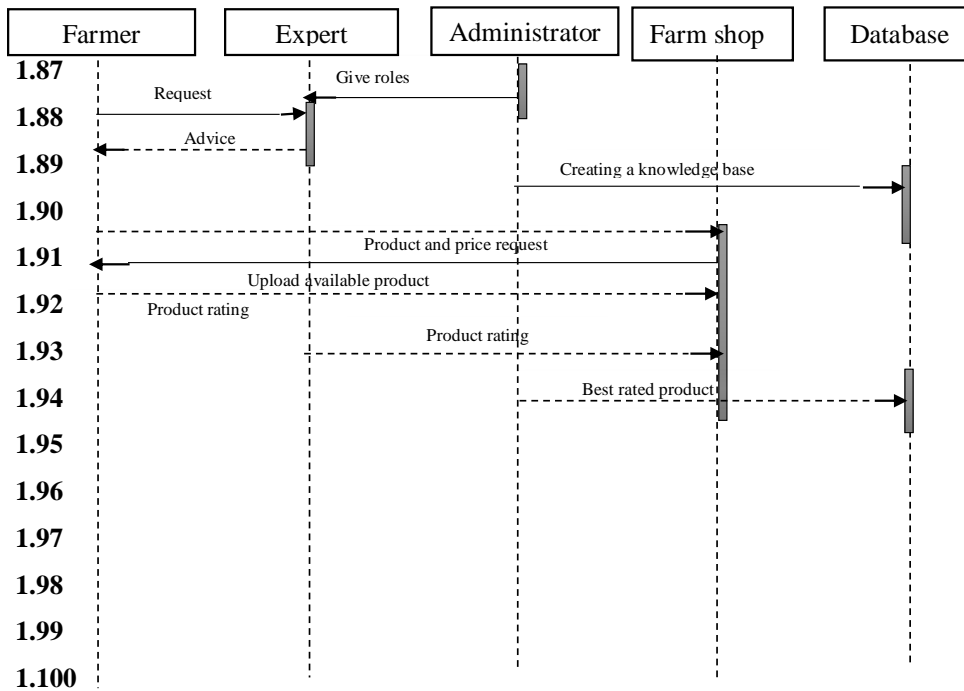
Fig 4.9 Sequence diagram of proposed system
1.101

1.102 4.7 Interface Design

The interface shows how the farmers will be able to use the. It thus provides a mode of communication between the user and the system.

1.103 4.7.1 User interface

Shows the users interaction with the system. Hides the complexity of the system by providing an application interface. It outlines the design for the menus, forms, reports, and the help screens.

1.104

1.105 4.7.2 Input Design

This is the highest level of abstraction and hides the complexity of the system. This is an input form where users input data into the system. It provides user with interface and ensure input processes that provides data quality, timeliness and accuracy. The users should only provide the required information as illustrated in the following forms:

53

Name
◯ Farmer   ◯ Specialist
Username
Email address
Contact address
Username
Region
Password
Confirm

Register

Fig 4.10 Main menu

1.106 4.7.3 Output Design

The output design entails what the users will be able to see after they input data such that the designer what is required before starting to work on the system. This helps to determine the system inputs.

54

Question   What causes yellow leaf

Solution   Poor soil nutrient

Question   What can I do

Solution   Put manure

….   ………………

1.107

1.108

1.109

Fig 4.11 Question and answers

1.110

1.111   4.7.5 Report Layout

The reports from the system will show what has been asked by farmers and the corresponding responses as well as the best product that farmers think is the best. Report title, field headings and report elements will be provided and saved in the database The following diagrams shows the report design:

<div align="center">

Cropguard and pest control records

Report Title

Reporting Elements

</div>

Heading1	Heading 2	Heading 3	Heading n
Deatail1	Detail2	Detail3	Detail n

 Fig 4.12 report layout

1.112

1.113

1.114   4.8 Pseudo code

1.115   4.8.1 login

Enter username and password

If correct then

Go to Account

Else

Try again until you insert the right details

    End if

1.116

1.117   4.8.2 Connecting to the database

Check if connection has been made

If not yet set, then

Set the connection

    Else do nothing

1.118

1.119   4.2.3 Updating data in the database

Get the key fields

Check if record does exist

If not, then

Report error

Else

Validate all the information

If some of the input is invalid

Report error

Else

Using the established connection, save record

1.120

1.121   4.9 Security design

The security design focuses on how the system prevents from any threat Shostack (2014). Threats come from various ways which can be from the hackers or from natural disasters such as

flooding and the system was designed in such a way that risks will be minimised and good infrastructure for the system be built. The following are the security concerns:

4.9.1 Software concern

Limits user access with the use of login control and can only access what they have been assigned by the administrator and those only with the right can access the system. Unauthorised users must not access the system as it will pose many threats such as information loss as that user format all the data.

Access levels

Access levels include system access, module access and menu access. The system should only be accessed by the administrators who has administrator log in credentials so as to keep the information private and confidential. The farmers should only access their application using the menu available and be able to perform what only they should and the rest is done by the administrators.

Physical concerns

The following levels of physical security concerns were taken note of the users can access the system using their credentials. CCTv's should be installed in the server room so as to monitor people who gets in and out of the server room in case something happens. The machines used should be quite high above the ground such that there will be no contact with fire. The rooms should have fire extinguishers in case there will be a fire. Information should be backed up regularly so as to prevent information loss.

The chapter helped the designer to come up with a simplified interface of the new system. Designed inputs, processes and output of the new system. Database design was also looked at illustrating how entities relate to each other and the processes involved in the system. Security design was done so as to make sure the system was perfectly secure.

1.122
1.123

1.124

CHAPTER 5: IMPLEMENTATION PHASE

1.125 5.1 Introduction

This is a process when the working system is delivered to the user Reifer (2012). The chapter will focus on the coding which is the programming of the system. The system will then be tested to see if it meets user requirements. After being tested installation takes place and finally maintenance will be done to the system.

1.126

1.127 5.2 Coding

This involves writing instructions that are executable by a computer program. The user interfaces were constructed using android studio and java jdk. The database was the first to be constructed and tables were created as well. System functionality where developed as modules and later integrated into a working system. The example following illustrate how the system was coded:

```
/*
 * To change this license header, choose License Headers in
Project Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package com.murimi.db;

import java.io.Serializable;
import java.util.Date;
import javax.persistence.Basic;
import javax.persistence.Column;
import javax.persistence.Entity;
import javax.persistence.Id;
import javax.persistence.NamedQueries;
import javax.persistence.NamedQuery;
import javax.persistence.Table;
import javax.persistence.Temporal;
import javax.persistence.TemporalType;
import javax.validation.constraints.NotNull;
import javax.validation.constraints.Size;
import javax.xml.bind.annotation.XmlRootElement;

/**
 *
 * @author happiness
 */
@Entity
@Table(name = "ANSWER")
@XmlRootElement
@NamedQueries({
    @NamedQuery(name = "Answer.findAll", query = "SELECT a FROM
Answer a")
```

Fig 5.1 Coding

1.128

1.129 5.3 Testing

To see that all the database components were functioning as required intensive testing was done. Numerous testing methods were done such that the system at the end meets user requirements. Black (2014) defines the procedures of testing in:

TESTING PROCESS.
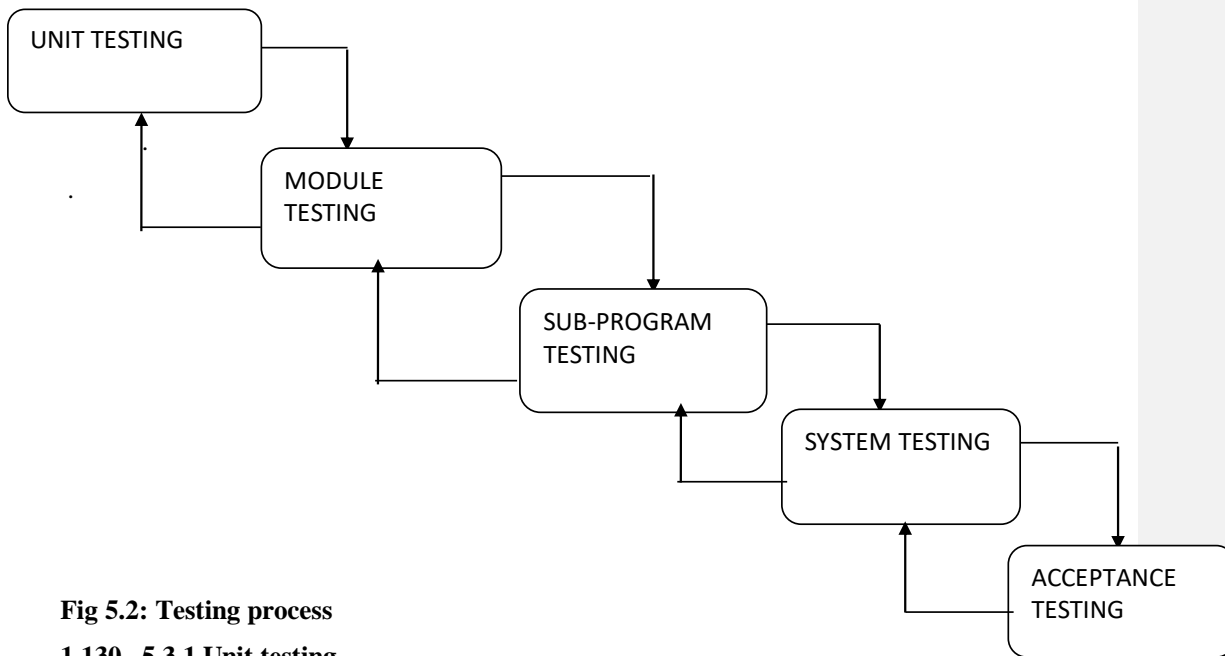
Fig 5.2: Testing process

1.130   5.3.1 Unit testing

Main focus is only on one unit, objective and function of the program to see if each unit performs its specified task.

White box tests

It is testing designed documents and the code to see if the system performs as intended in this case it does as farmers can post their requests and get feedback in form of advice from the experts in farming. It is used to validate whether code implementation follows intended design for the good of farmers. Focuses the internal structure of the system. It includes analysing data and information flow, coding practices and exception, error handling within the system, to test for the unintended and intended software behaviors system has passed.
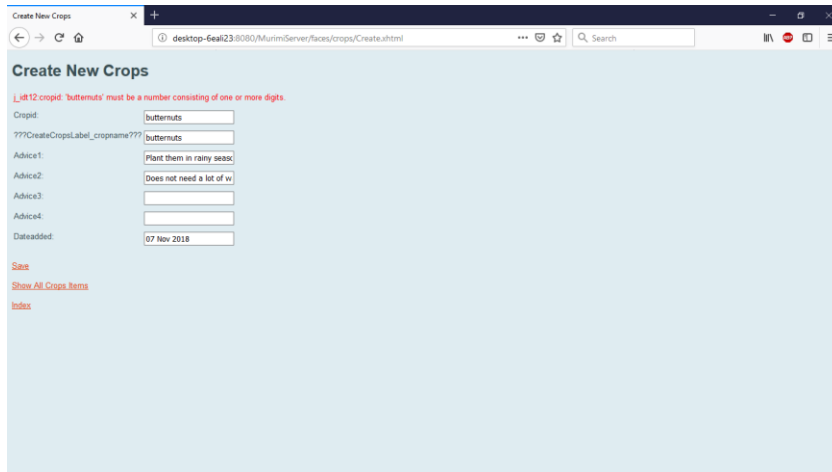
1.131

Fig 5.3 Incorrect information entered
1.132

1.133 5.3.2 Module testing

1.134   This is testing to see if every component of the system performs as intended by the user. For instance, to see if the user can enter a question and be able to post it as follows:

1.1 Fig 5.4 Question asked

1.135 5.3.3 Subsystem testing

Related system modules formed subsystems which were tested for data, stress, and error integrity. Database as a subsystem was tested independently. Related subsystems where tested for data stress and error integrity. Database was tested independently. The purpose of subsystem testing is to test the interfaces between programs in the same functional area. Each program is linked to all the other programs with which it interacts. What is being tested is not only that the data is correct and in the correct format, but that it happens in the specified sequence and within the specified response time. Let's say a farmer post a question and gets feedback

Fig 5.5 Question asked by the farmer
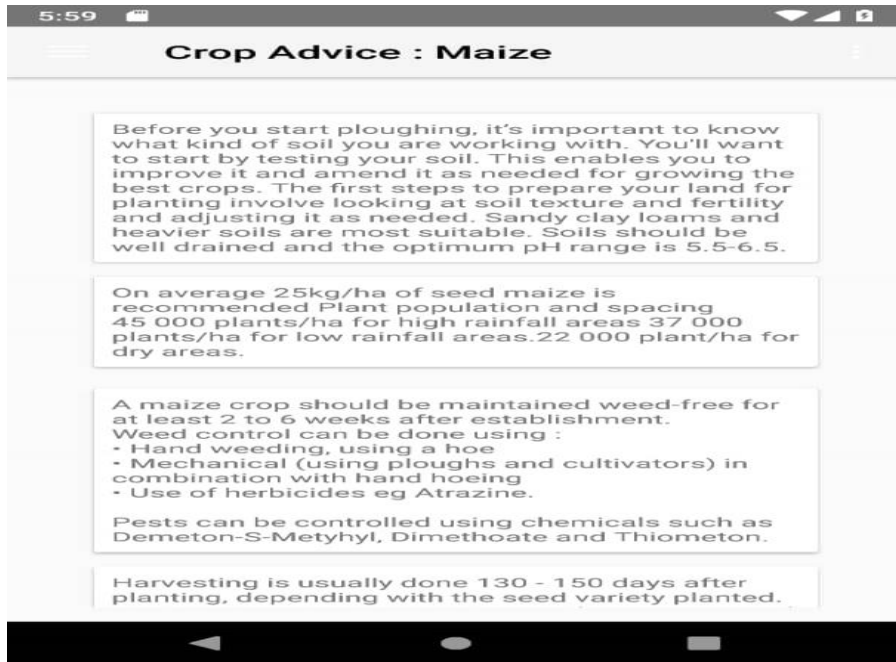
1.136 Fig 5.6 Response by the expert

1.137

1.138 5.3.4 System testing

Debbabi et al (2014) state that system testing involves testing of the entire information system and it includes all processing situations. This involves testing of all subsystems as one system so as to find if there were any errors which affect system performance. Made use of live data and verification to see if the whole system worked as intended. The developers validated the completely integrated system by testing end-to-end capabilities as in test plan. Produced a user manual produced a system documentation. It will be complete when all the specified tests in the system plan has been run successfully. The following diagram illustrates system testing as the administrator can view all the processes taking place in the system:
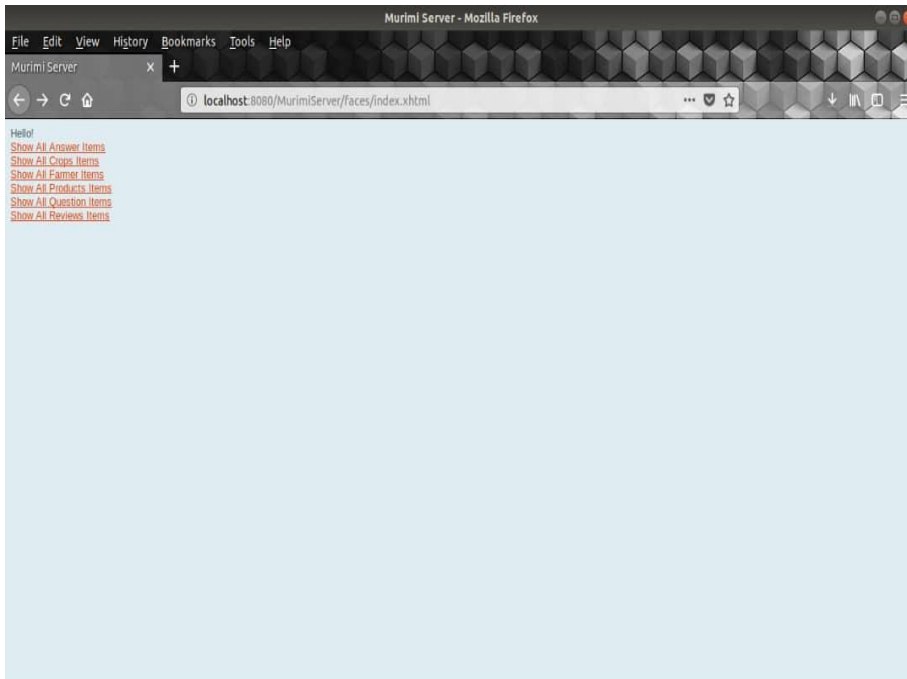
Fig 5.7 System testing

1.139   5.3.5 Acceptance testing

This is the stage before system acceptance by ministry of agriculture (Sommervile, 2004). The system was tested with data supplied by the farmers and experts in farming as well as farm shops. Users were called in such that they point out where there were errors and omissions such that they would be perfected and gave comments on whether they accept the system or not and whether the system performed as intended by the farmers until the system performed as intended by the farmers.

1.140

1.141   5.3.6 Verification and validation

Alpha Testing (Verification) Concerned with whether the developers are building the system right and ensuring that the software package implements a particular function correctly Debbabi et al (2014). Will be searching for errors and omissions not taken of during development. User specifications are compared with the actual system to see if all the problems stated are solved

63

and does a lot more than what it is requested of it. The system should allow for developers to see the final product
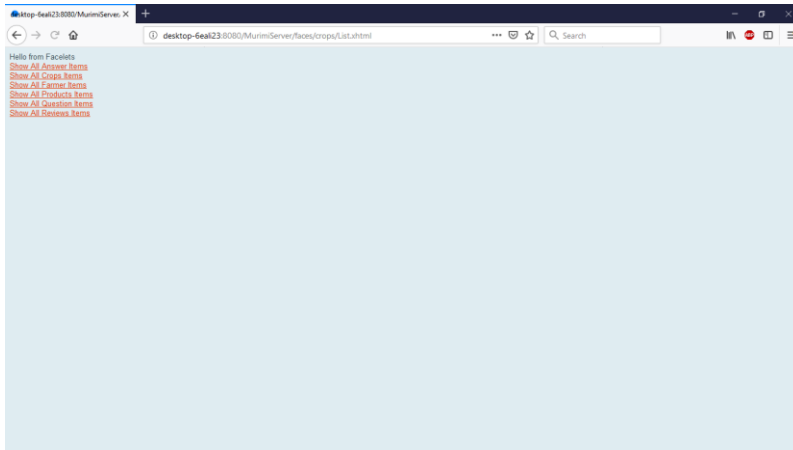
Fig 5. 8 Verification

Beta Testing (Validation) Shows if there is any invalid information being entered into the system and informs the user through message boxes Debbabi et al (2014). If data integrity is met data will be saved into the database. The system is tested using real data supplied by the farmers and the administrators and the management who will be using the system will input their data. The system will be ready for delivery only when all the only when all the errors and omissions are discovered and dealt with

Validation of null Fields

This aims to inform the user where the data has been omitted for example forgetting to username when registering into the system.
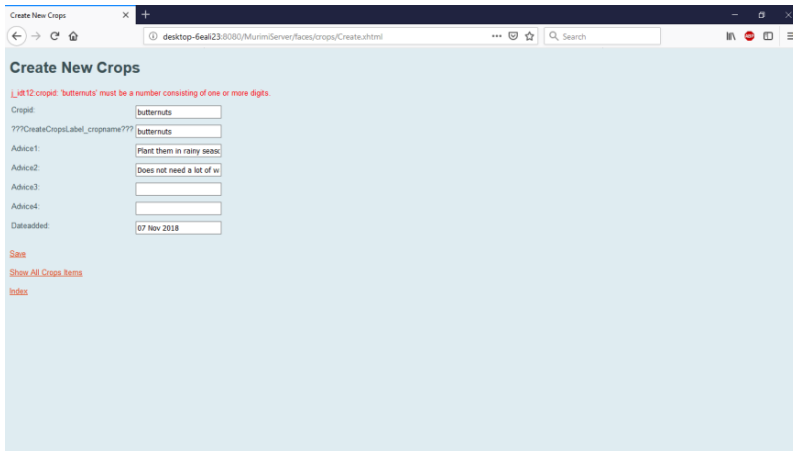
Fig 5.9 Wrong information entered

1.142

1.143 5.3.7 Testing against system objectives

- To enable fast retrieval and processing of data
- To eliminate data manipulation by unauthorized personnel.
- **T**o produce reports of all processed data.
- To provide a centralised database.

1.144 5.4 Installation

For the installation of the system pilot conversion is what is best as this system is a pilot system within the organization and the farmers used to acquire information from the internet mainly. This has an advantage that it is an ongoing process as it will give room for upgrading with time and allows for alteration if need be. A number of activities such as training, file conversion, system changeover methodologies such as pilot operation are carried out during this stage. The installation steps include the following:

- Downloading the application or request for the application to be send to you
- Run the application and make sure unknown sources in phone security settings is not marked if marked unmark it as it may block the installation of the application.
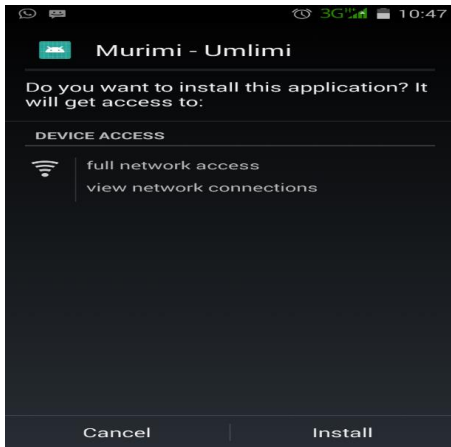
Fig.10 Running the setup

Click install to continue with the installation then if unknown devices are not selected go to settings
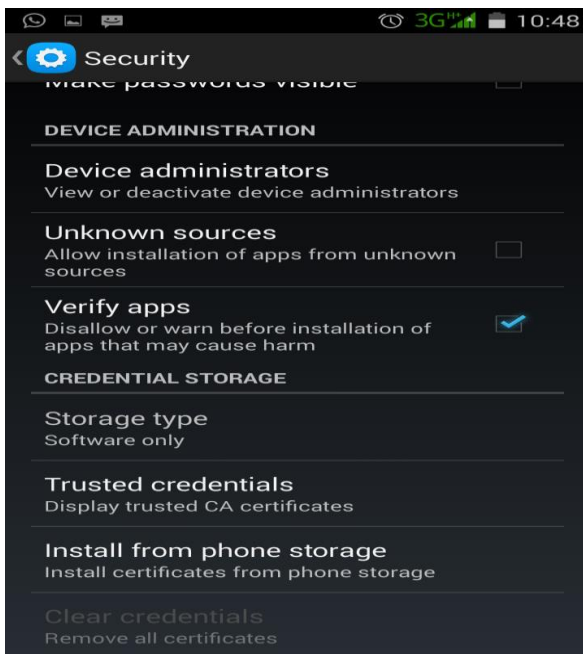
Fig 5.11 Security settings

Select on unknown sources and continue with the installation
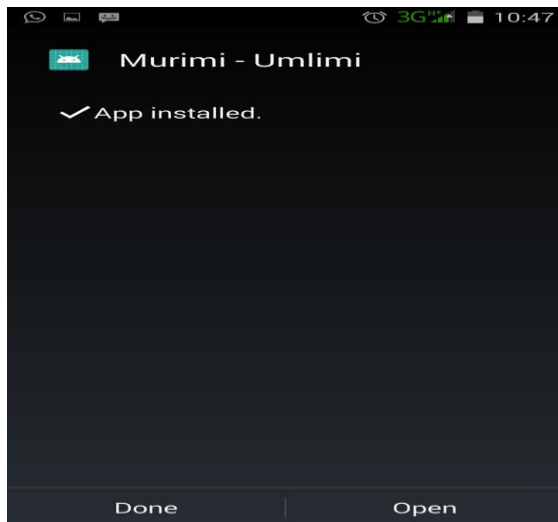
Fig 5.12 Installed application

Finally click on open and register into the system

- After finishing installation test if the application can run and enables you to register into the system.

1.145

1.146   5.4.1 User training

A training plan which included all the entities involved in the in the system was done Michael (2015). Management was also available such that all the users familiarize with the system so as to evaluate reports provided for evaluation purposes. Training was done so as to enable users to use the system. Training was not only for farmers but management, administrators, experts and extension officer needs to be trained so as to familiarize with the system. Trainees felt free to ask questions and have clarifications on what they wanted.

Training plan

The training was such that few experts and extension officers and few young and intelligent farmers to be selected and paid for the expenses by the ministry to go for the workshop which was help in the Capital on the 15th of October 2018 at Harare Agricultural Show. The developers had the projectors and showed the users on how they can access the system up to how they can make use of the system. Those who were available had the setup send to them and they would

send the same application to the farmers in their regions. The costs are summarized in the following table:

Table 5.1 Training costs

Description	Cost ($)
Travelling	1500
Food	300
Toiletries	50
Total	**1850**

1.147 5.4.2 Operational environment

The testing is done before file conversion Davis (2013). There was user access limitation and the author made use of live data and verified all changes and finally obtained user approval to the system. The following components affecting the system where examined:

- Hardware
- Software configuration
- Operating system programs
- Utilities
- Network resources

 The hardware available met the system specifications and it was ready to be put to use. Software configurations where in place which included antiviruses to protect from virus threats. Operating system programs included windows 8 and 10. Network resources where available which included wireless and cables to use.

1.148

1.149 5.4.3 File conversion

 Is the migrating from the old to the new system? Currently there was no data an organization has about the farming as they could only access the internet for information and ask fellow farmers for ideas. Data will be entered onto the system by the users as they will be using the system and this helps users to get used to the new system.

1.150 5.4.4 System conversion

Davis (2013) Is a technical process when the old is replaced by the new system. The farmers will have to make use of the application system after their training and the process is known as changeover. The changeover can be trivial to traumatic depending on the differences between the two systems. Pilot conversion is the changeover method used. The method is one in which the system is new to the organization altogether. Approaches used include:

5.4.4.1 Direct changeover
The new system immediately replaces the old system and the old no longer functions. It requires a lot of testing and training as it is too risky. It is a quick transition as there is not much to be done. It should be done when the organization is not under a lot of pressure as it may affect its
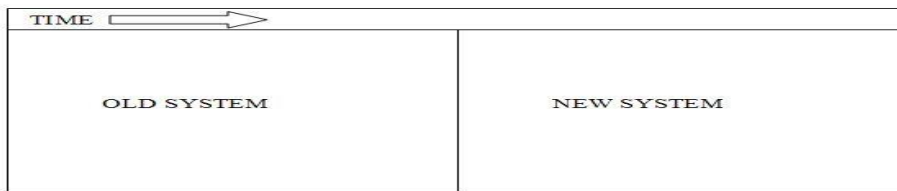
operations.

Fig 5.13 Direct changeover diagram

5.4.4.1 Advantages
Davis (2013) provides the following benefits and drawbacks of using direct changeover conversion:

- Efficient method as there is less duplication of work.
- Less costly as only one system would be in operation.

5.4.4.2 Disadvantages
- New system may meet the required objectives.
- During use some errors are identified which need corrections and this affects the system operation.
- Requires a lot of planning and testing.

1.151

1.152 5.4.5 Parallel running
The new and old systems run in parallel for a short period then the old ceases operation after sometime Marchekwa (2014) Gain certain benefits of keeping the old system installed and running if possible. It is possible only when the new and the old systems are

69

independent of each other and impossible when running both of them dependently as this will lead to the same data being captured. Using the conversion is less risky but more expensive as operation work will be doubled.
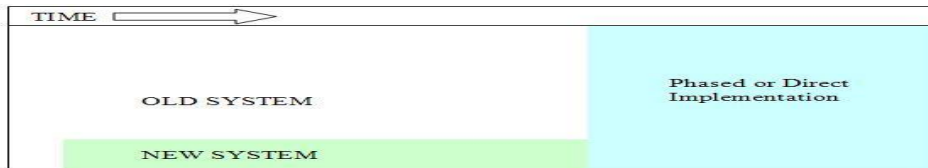
Fig.5.14 Parallel running diagram

Marchekwa (2014) give the following benefits and drawbacks

5.4.5.1 Benefits

- Low risk as a result can be verified and a backup option exists.
- Efficient and effectiveness of the old and the new system can be directly compared
- No harm is done since the old system will be up and running.

5.4.5.2 Drawbacks

- Very costly since both systems will be operating at the same time.
- Cannot be used for different systems.

1.153

1.154   5.4.6 Pilot conversion

Davis (2013) is a process where the old and new systems operate at the same time in a pilot site and the rest of the organization continues to make use of the old system. It is less costly and risky than parallel run approach. Errors are easily traced without affecting the business operations and b this builds confidence of using it. The organization may implement the new system in IT department and see how it performs and correct all errors before it is implemented to the whole organization and to the farmers
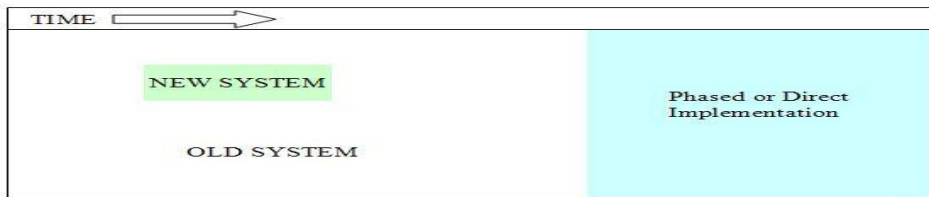
Fig 5.15 Pilot conversion diagram

5.4.6.1 Benefits

Davis (2013) the following benefits are provided:

- Moderate costs as the system will be running in one site
- Risk is minimised as the system is installed in one site.
- Check if the system meets the set aims and objectives before actual use.

1.155   5.4.7 Phased changeover

The system is implemented in stages or modules across the organization. Cost will be relatively moderate as the system is not implemented all at once. Several components will be introduced one after the other. This take more time but the users will be able to familiarise with the system. Problems with any step are dealt with before moving to the next step. It is impossible if the system is a one piece where it is all or nothing like the database systems
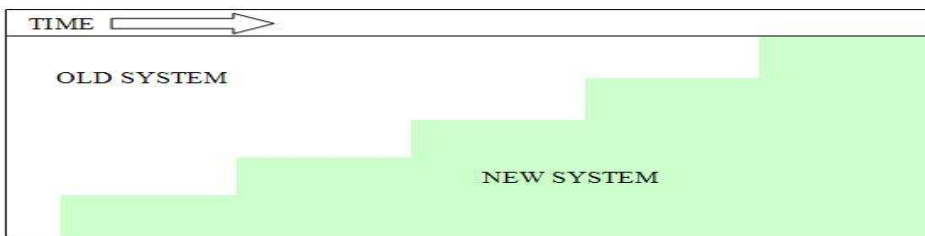
Fig 5.16 Phased changeover diagram

1.156   5.4.8 Post implementation

The proposed system proved to be very accurate and took a shorter time in producing outputs. There was higher farmer satisfaction. The system was easy to maintain and proved to be reliable. It had better security and control. After training the farmers could perfectly use the system and saw that it was much easy to use.

71

1.157 5.4.9 Conclusion on system conversion

Direct changeover was the best method of installing as the system is new to the organization and it lowers duplication of work and is less costly as one system will be operating.

1.158 5.5 Maintenance

Ahmed (2016) is a process done on a regular basis to ensure that the newly implemented system meets its addressed objectives. Periodic review, audit or monitoring is done so as to make sure the system is operating correctly and meeting organizational objectives. It is necessary for eliminating errors and change the system in response to the changes in technological environments.

1.159

1.160 5.5.1 System maintenance

Software maintenance include the following principles corrective, adaptive, and perfective Webb (2017). System review needs to be done. The types include:

- Corrective maintenance
- Perfective maintenance
- Adaptive maintenance

1.161 5.5.2 Corrective maintenance

This is for repairing software faults. Ahmed (2016) involves dealing with errors found and fixing them. The cropguard and pest control system will need coding errors as they arise after the users have become used to the system and coding errors is usually easy to correct, more design will be required to best suit user requirements which is costly. Cropguard and pest control system will require redesigning which is much more expensive because of requirements errors whereby the system should be able to operate on different operating system platforms like iPhone. Some anomalies may still exist even after all the intensive testing validation and verification done. All the corrections done are documented. It is an ongoing process as the users may notice the differences existing in the system. Management may find inadequate functions and lastly developers may notice differences not solved during development.

1.162

1.163 5.5.3 Adaptive maintenance

72

The software must be able to adopt changing operating environments Ahmed (2016). Done in response to the changes in the operating environment of the system. The system should be able to operate on iPhones and other devices and not only android devices. This is done when environment changes. Changes in technological environment may create limitations to the system thus adaptive maintenance has to be done.

1.164

1.165   5.5.4 Perfective maintenance

During development best implementation maybe done but situations like ignorance or schedule constraints may make the system perform otherwise. It involves changes, modifications and enhancements among other things which includes popups which are entertaining such that farmers use the system often and the display that is eye catching. The main goal is to upgrade from what is currently available. Webb (2017)

This is improving the application such that it functions at an optimum level. This is done to add more functionalities to the system.

1.166   5.5.5 System Evaluation

System evaluation is assessment of the system to see if it meets its requirements.

1.167

5.5.5.1 System Vs Objectives

The newly developed system met user requirements. The following objectives were met as stated in chapter one.

- To keep record of all the farmers per region and their needs.
- Create farmer's knowledge base which is very useful in providing the best and effective solutions to farmers.
- Provide a platform where experts and extension officers offer expert advice to farmers.
- To enable farmers to review farming products for after utilising them so as to assist other farmers in purchasing products
- Offer farm shops a platform to upload available products for farmers to make price comparisons.

1.168

1.169   4.6 Recommendations for future developments

1.170   The system was developed to cater for the unknown that may happen. There should be constant upgrades to the system such that it moves with the changing operational environment. It should be able to run on different platforms in the future and should be developed that it may be accessed internationally over the internet in common languages, Java is good as the system was coded using java

1.171

5.7 Conclusion

The cropguard and pest control system is an initiative that aims to improve farmer's knowledge about farming and increasing the GDP. The system is an ongoing process that will need constant upgrades in respect to technological advancement and will be able to operate on iPhone in the coming years. It can be used by any farmer and it is a very easy system to use.

1.172

APPENDIX A: USER MANUAL

Farmer

The farmer must first download the murimi application and do as follows
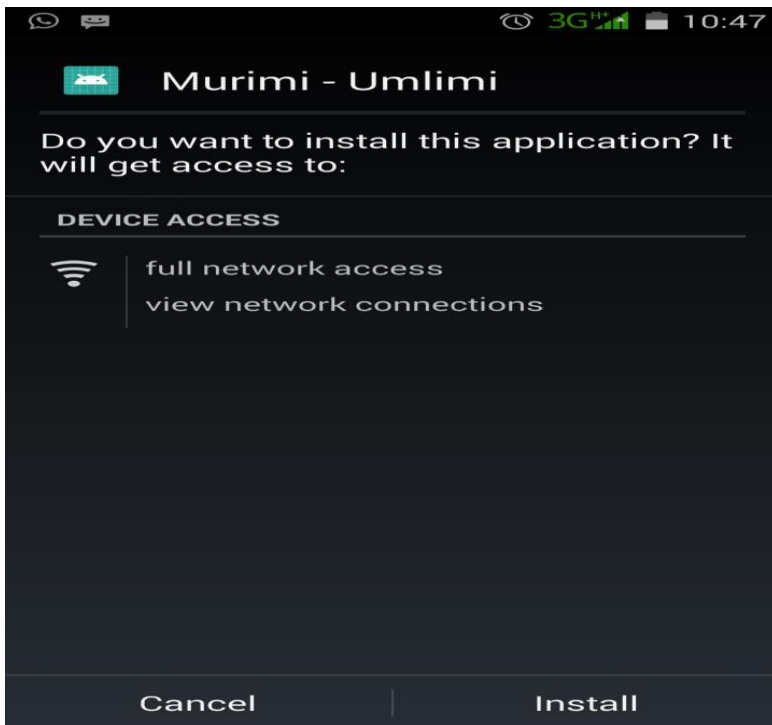
Click install and if installation is blocked it will lead you to settings or manually go to settings:
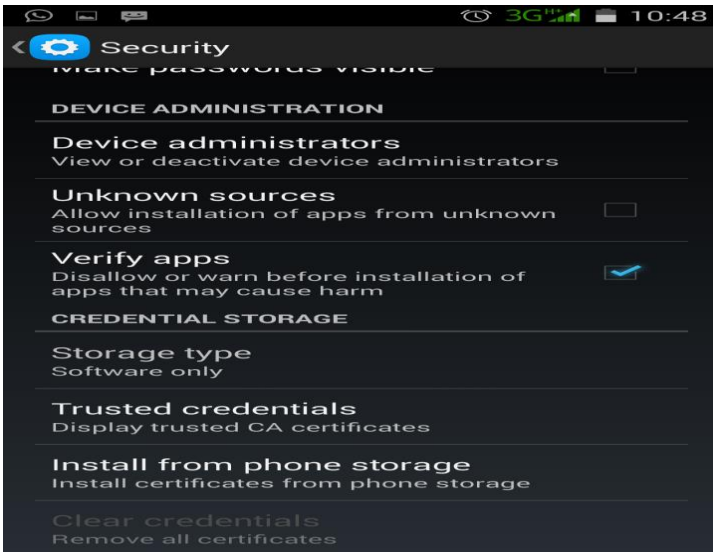
Select on unknown sources under device administration
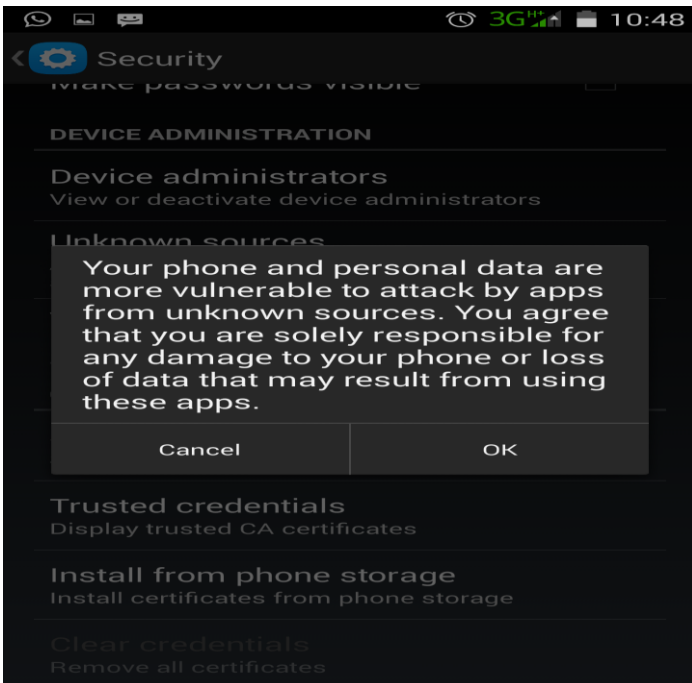
Click on OK then the installation process will continue
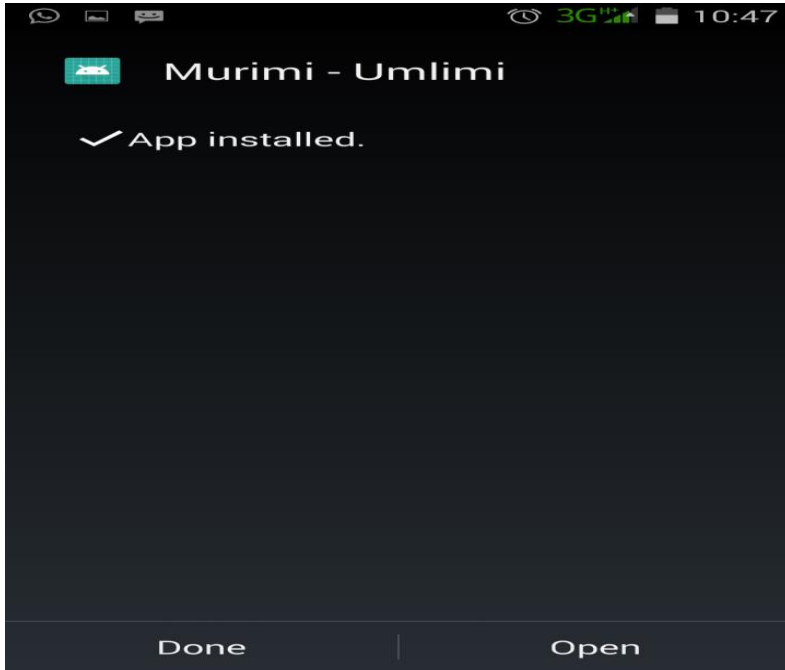
Finally, the application will be installed and click on Open then start the registration process
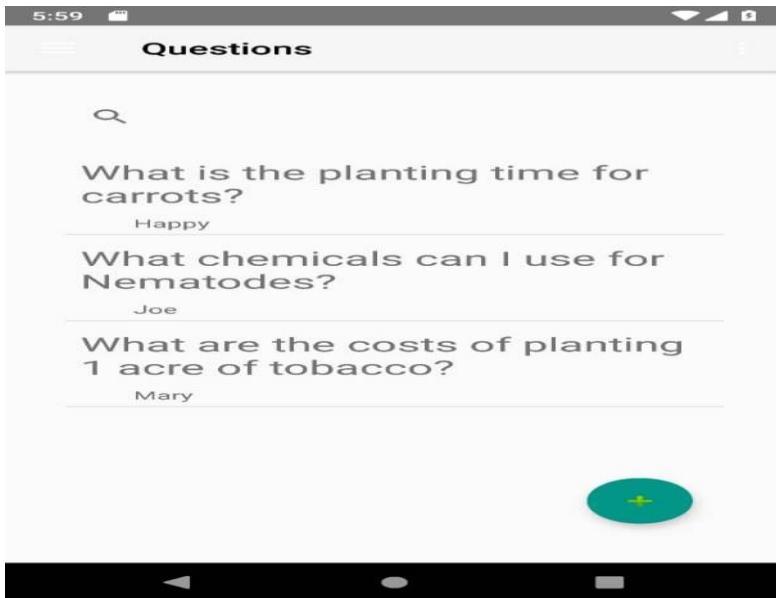
Question asked
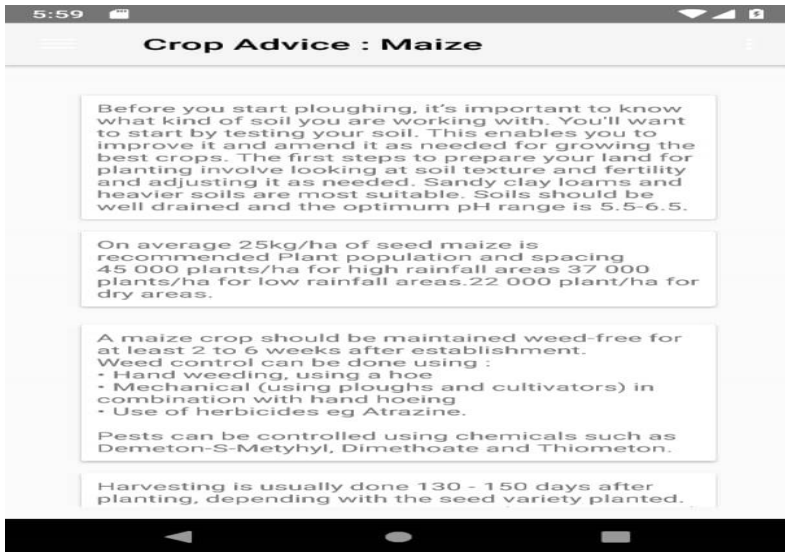
Solution to the question asked

Farm shop
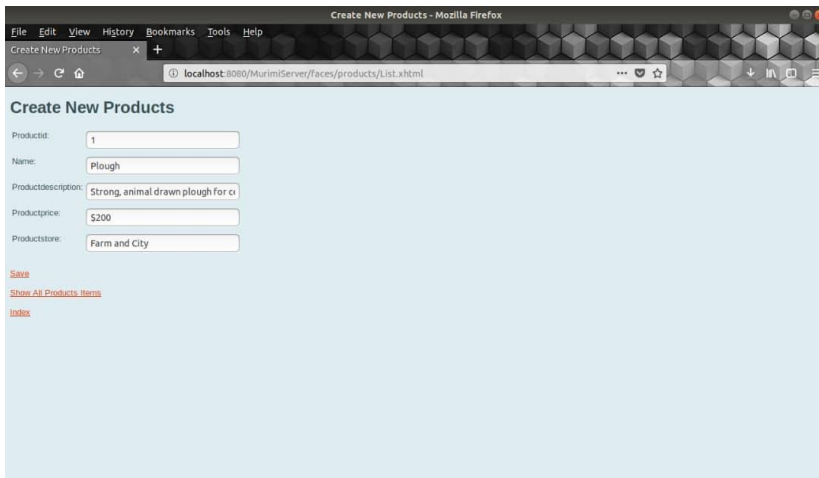
Uploads the available products and their price as well as the name of the farm shop
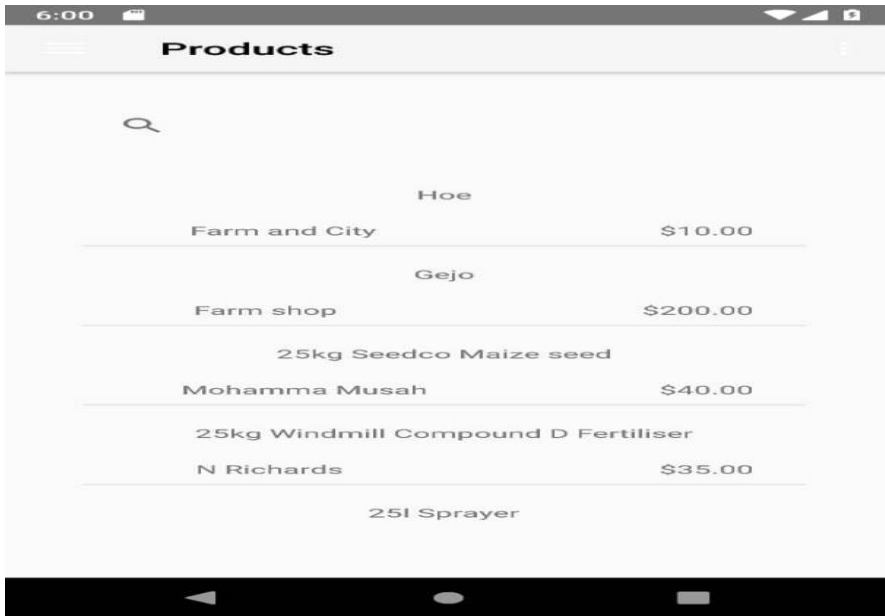
Available product by the farmer

Administrator, Management
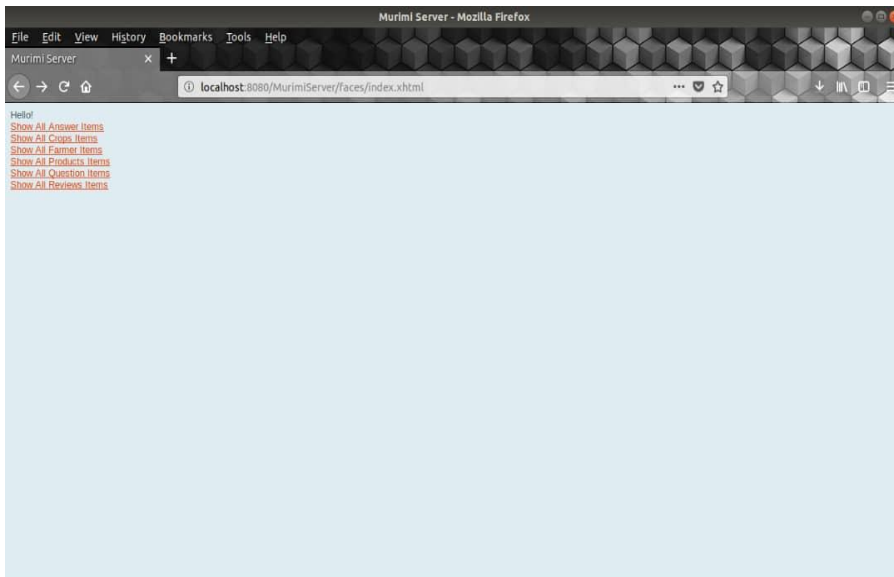
Administrator accessing all the information

APPENDIX B: QUESTIONNAIRES

Management

Instructions.

Tick in the appropriate box.

1) Q. How do you rate the current system?

A. Excellent ☐   B. Good ☐   C. Fair ☐   D. Poor ☐

2) Q. Do you vote for creation of a cropguard and pest control system?

A. Yes ☐   B. No ☐   C. Undecided. ☐

3) Q. Do you think the current system is reliable, efficient   and efficient in communicating with fellow farmers?

A. Excellent system ☐   B. Fair ☐   C. Ineffective ☐

4) Q. How much do you feel helpless about using the current system?

A. Very often ☐   B. Infrequently ☐   C. All the time ☐

5) Q. Have some of the fellow farmers complained about the current system's performance?

A. Yes ☐   B. No ☐

Q. Do you think a cropguard and pest control system will assist in communication and how?

………

………

Farmers, expert and extension officers

Q. Are you happy with the current system?

A. Yes   B. Some aspects are good   C. Not at all

☐   ☐   ☐

Q. Do you wish for the ministry to introduce a communication platform?

A. This has been long overdue   B. Yes   C. No

☐   ☐   ☐

Q. How much do you think your communication will be improved if the cropguard and pest control system is implemented?

…………………………………………………………………………………………..

…………………………………………………………………………………………..

Q. Do you find any difficulty in communicating with fellow farmers?

A. Yes   B. No   C. sometimes

☐   ☐   ☐

APPENDIX C: INTERVIEW QUESTIONS

Management

1. How does your system work?

…………………………………………………………………………………………………

………………………………………………………………………………………

2. Who is responsible with the current system?

…………………………………………………………………………………………………

………………………………………………………………………………………

3. How are you coping with the current system? Are there any problems that you are encountering using the system?

…………………………………………………………………………………………………

………………………………………………………………………………………

4. How do you rate the system performance?

…………………………………………………………………………………………………

…………………………………………………..

5. Are there any precautions in place to safeguard against unauthorized access to the database?

…………………………………………………………………………………………………

……………………………………………………………………………………….

7. How does your system deal with the experts and ordinary farmers?

…………………………………………………………………………………………………

……………………………………...

8. Are there any complaints or drawbacks of the existing system currently available?

…………………………………………………………………………………………………

……………………………………...

9. What view/ opinion about migrating from the current system to a mobile application system do you have in mind?

……

…………………………………...

Farm shops.

1. Do you enjoy working with the current communication system and if so what are the strengths?

………………………………………………………………………………………………………

………………………………………..

2.How do you market your product to the farmers?

………………………………………………………………………………………………………

……………………………………………………...

3. What view do you have about developing a platform for uploading your products?

………………………………………………………………………………………………………

…………………………………………………………………………………………………

4. What expectations of the proposed system do you suggest?

………………………………………………………………………………………………………

………………………………………..

APPENDIX D: OBSERVATION SCORE SHEET

Observation guide schedule

Name of Observer: _____ Section: _____

Date: _____ Time: _____

Observation:_____

_____

_____

_____

_____

_____

_____

_____

Conclusion:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

DOCUMENT REVIEW REPORT

Reviewer	
Department under review	

Criteria	Documents reviewed	Remarks
....	.... …………………………… …….. …………………………… …….. …………………………… ……….	………………………………… …………… ………………………………… …………….. ………………………………… ………………… ………………………………… ………………… ………………………………… …………………… ………………………………… ……………….. ………………………………… ………………….
…………………………… …………..	…………………………… ……………… …………………………… …………….. …………………………… ……………… …………………………… ………………	………………………………… …………….. ………………………………… …………….. ………………………………… ……………… ………………………………… ………………….

| | | ………………………………
……………………
………………………………
………………………
………………………………
……………………… |
|---|---|---|
| ………………………………
……………… | ………………………………
………………………
………………………………
…………………
………………………………
………………
………………………………
……………………… | ………………………………
………………………
………………………………
………………
………………………………
………………
………………………………
…………………
………………………………
…………………………
………………………………
…………………………
………………………………
…………………………… |
| ………………………………
……………… | ………………………………
………………
………………………………
………………...
………………………………
……………
………………………………
…………… | ………………………………
………………
………………………………
………………
………………………………
…………………
………………………………
…………………
………………………………
…………………………
……………………………… |

		……………………
		…………………………………
		……………..

OVERALL DOCUMENT REVIEW REMARKS:

....
....
....
....
....
....
....
....
....
....
....
....
....

Reviewer …………………………………

Date ……………………………

APPENDIX E: REFERENCE LIST

1.A Webb (2017), *The Project Managers Guide to Handling Risk,* Sower, England.

2.A Kampira (2018), *Feasibility Study: New Product Development and Launch*, South African Afregrande Strategy.

3.A Ahmed (2016), *Software Project Management: A process Driven Approach*, CRC Press, New York.

4.A Johnson and M Kristram (2015), *Cost Benefit Analysis for Appraisal,* Cambridge Press, UK.

5.A. Shostack (2014), *Threat Modelling and Designing for Security*, Wiley, USA.

6.Aditya D.M (2013), *Foundations of Software Testing*, Pearson, USA.

7.B Thalhem (2016), *Entity Relationship Modelling: Foundation of Database Technology,* Wiley, USA.

8.D Hullet (2016), *Integrated Cost Schedule Risk Analysis*………………… New York.

9.D Reifer (2012), *Software Maintenance Success,* CRC Press, New York.

10.Dennis et al (2015), *Systems Analysis and Design*….. USA.

11.Davis B (2013), *Mastering Software Projects Requirements*,….. USA.

12.E.C Foster (2104), *Software Engineering a Methodical Approach*, Apress, USA.

13. G.B Shelly and Rosenblatt H.J (2016), *Systems Analysis and Design*, Cengage USA.

14.H Rosenblatt (2013), *Systems Analysis and Design*, Cengage, USA.

15.Hathway and Hathway (2016), *Data Flow Diagram Process Modelling Techniques*, Wiley, USA.

16.Hillary M (2014), *Outsourcing to India: The Offshore Advantage*, Springer, London USA.

17.H Saleh (2013), *JavaScript Unit Testing*, Packet Publishing, USA.

18.J.W Custworth and T.R Franks (2013), *Managing Projects in developing countries,* Routledge, USA.

19.J.F Dodey (2017), *Software Development Design and Coding*, Cengage, Canada.

20.J.T Marchekwa (2014*), Information technology Project Management*, Wiley, USA.

21.J………. (2012), *Data Mining Concepts and Techniques*, MK USA.

22.J.W S…….. et al (20 *), Systems Analysis and Design in a Changing World*, Cengage Learning, USA.

23.K.E Kendall and J.E Kendall (2016), *Systems Analysis and Design*, Pearson, USA.

24.K Wiegers (2013), *Creating Software Engineering,* Dorset House Publishing, New York.

25.K Michael (2015), *Design IT: From Programmer to Software Architect*, Wiley, USA.

26.M.E Whitman and H.J Mattord (2017), *Principles of Information Security*, Wiley, USA.

27.M.H Cohen et al (2016), *Voice User Interface Design*, Pearson, USA.

29.Markandeya S (2014), *Data Migration*, Pearson, India.

30.M Chemuturi (2012), *Requirements Engineering and Management for Software Development*, Springer, London.

31.M Debbabi et al (2014), *Verification and Validation in Systems Engineering*, Wiley, USA.

32.Otto M. (2013), *Feasibility study and Future Projections*, Diplomide, Germany.

33.Paradkar (2017), *Mastering Non-Functional Requirements*, Padet, Mumbai India.

34.Pigaski T.M (2013), *Practical Software Maintenance*, Pressman, USA.

35.R Reilly and R Schweihs (2016), *Valuing Intangible Assets*, McGraw hill, New York.

36.Romney and Steinbart (2012), *Accounting Information Systems*, Pearson, Australia.

37.R Black (2014),……… *Software Testing*, Wiley, Canada.

38.R Schmidt (2016), *Adaptable Architecture Theory and Practice*, …………, New York.

39.S Robertson and J Robertson (2012), *Mastering the requirements Process*, Wesley, London.

40.Stain and Reynolds (2012), *Fundamentals of Information Systems*, Cengage Learning, USA.

41.S.A Kelkar (2012), *Software Project Management a Concise Study*, Wiley, USA.

42.S Gnesi and A ……(2014), *Fundamental approaches to Software Engineering*, G…….., France.

43.Swatnz A. (2014), *The art of business value*, Portland, Oregon.

44.T Kendrick (2015), *Identifying and Managing Project Risk*, Wiley, USA.

45.Villafiorita A. (2016), *Introduction to Software Project Management*, CRC Press, New York.

46.Wilkson and Johnstone (2016), *Encyclopedia of Human Resource Management*, Edward Elgar Publishing, USA.

47.W Stuart (2017), *Mastering Macros Programming*, Padet, Mumbai India.

48.Z M…………. et al (2017*), Cloud Computing Concepts Technology and Architecture*, Cengage, USA.

APPENDIX F: SNIPPET OF CODE

```java
package com.example.happiness.murimi.model;


import androidx.lifecycle.LiveData;
import androidx.room.Dao;
import androidx.room.Delete;
import androidx.room.Insert;
import androidx.room.Query;

import java.util.ArrayList;
import java.util.List;

@Dao
public interface AnswerDao {

    @Insert
    void insertAnswer(Answer answer);

    @Delete
    void deleteAnswer(Answer answer);

    @Query("SELECT * FROM Answer WHERE questionMainId = :id")
    LiveData<List<Answer>> getQuestionAnswers(long id);

    @Query("SELECT * FROM Answer")
    LiveData<List<Answer>> getAllAnswers();

    @Insert
    void insertAllAnswers(List<Answer> param);
}
```

```xml
    <?xml version="1.0" encoding="UTF-8"?>
<manifest package="com.example.happiness.murimi"
xmlns:android="http://schemas.android.com/apk/res/android"><uses-permission
android:name="android.permission.INTERNET"/><uses-permission
android:name="android.permission.ACCESS_NETWORK_STATE"/><uses-permission
android:name="android.permission.ACCESS_WIFI_STATE"/><uses-permission
android:name="android.permission.READ_EXTERNAL_STORAGE"/><uses-permission
android:name="android.permission.WRITE_EXTERNAL_STORAGE"/><application
android:theme="@style/Theme.AppCompat.Light.NoActionBar" android:supportsRtl="true"
android:roundIcon="@mipmap/ic_launcher_round" android:label="@string/app_name"
android:icon="@mipmap/ic_launcher" android:allowBackup="true"> \ <activity
android:name=".ui.WebTestActivity"/><activity android:name=".ui.MainActivity"
```

package com.example.happiness.murimi.model;

import java.io.Serializable;

import androidx.room.ColumnInfo;
import androidx.room.Entity;
import androidx.room.PrimaryKey;
import androidx.annotation.NonNull;

@Entity
public class Answer implements Serializable {

    @PrimaryKey(autoGenerate = true)
    @NonNull
    @ColumnInfo(name = "id")
    private int id;
    private long dateAnswered;
    private long mainId;
    private long answerUserId;
    private long questionMainId;
    private String answerSubject;
    private String answerTag;
    private String answer;
    private String answerUser;

    public Answer() {}

    public int getId() {
        return id;
    }

    public void setId(int id) {
        this.id = id;
    }

    public long getDateAnswered() {
        return dateAnswered;
    }

    public void setDateAnswered(long dateAnswered) {
        this.dateAnswered = dateAnswered;
```

```
}

public long getMainId() {
    return mainId;
}

public void setMainId(long mainId) {
    this.mainId = mainId;
}

public long getAnswerUserId() {
    return answerUserId;
}

public void setAnswerUserId(long answerUserId) {
    this.answerUserId = answerUserId;
}

public String getAnswerSubject() {
    return answerSubject;
}

public void setAnswerSubject(String answerSubject) {
    this.answerSubject = answerSubject;
}

public String getAnswerTag() {
    return answerTag;
}

public void setAnswerTag(String answerTag) {
    this.answerTag = answerTag;
}

public String getAnswer() {
    return answer;
}

public void setAnswer(String answer) {
    this.answer = answer;
}

public String getAnswerUser() {
    return answerUser;
}
```

```java
   public void setAnswerUser(String answerUser) {
      this.answerUser = answerUser;
   }

   public long getQuestionMainId() {
      return questionMainId;
   }

   public void setQuestionMainId(long questionMainId) {
      this.questionMainId = questionMainId;
   }


}

package com.murimi.db;

import com.murimi.db.util.JsfUtil;
import com.murimi.db.util.PaginationHelper;

import java.io.Serializable;
import java.util.ResourceBundle;
import javax.ejb.EJB;
import javax.inject.Named;
import javax.enterprise.context.SessionScoped;
import javax.faces.component.UIComponent;
import javax.faces.context.FacesContext;
import javax.faces.convert.Converter;
import javax.faces.convert.FacesConverter;
import javax.faces.model.DataModel;
import javax.faces.model.ListDataModel;
import javax.faces.model.SelectItem;

@Named("answerController")
@SessionScoped
public class AnswerController implements Serializable {

   private Answer current;
   private DataModel items = null;
   @EJB
   private com.murimi.db.AnswerFacade ejbFacade;
   private PaginationHelper pagination;
   private int selectedItemIndex;

   public AnswerController() {
   }
```

94

```java
    public Answer getSelected() {
        if (current == null) {
            current = new Answer();
            selectedItemIndex = -1;
        }
        return current;
    }

    private AnswerFacade getFacade() {
        return ejbFacade;
    }

    public PaginationHelper getPagination() {
        if (pagination == null) {
            pagination = new PaginationHelper(10) {

                @Override
                public int getItemsCount() {
                    return getFacade().count();
                }

                @Override
                public DataModel createPageDataModel() {
                    return new ListDataModel(getFacade().findRange(new int[]{getPageFirstItem(),
getPageFirstItem() + getPageSize()}));
                }
            };
        }
        return pagination;
    }

    public String prepareList() {
        recreateModel();
        return "List";
    }

    public String prepareView() {
        current = (Answer) getItems().getRowData();
        selectedItemIndex = pagination.getPageFirstItem() + getItems().getRowIndex();
        return "View";
    }

    public String prepareCreate() {
        current = new Answer();
        selectedItemIndex = -1;
```

95

```
      return "Create";
   }

   public String create() {
      try {
         getFacade().create(current);

JsfUtil.addSuccessMessage(ResourceBundle.getBundle("/Bundle").getString("AnswerCreated"))
;
         return prepareCreate();
      } catch (Exception e) {
         JsfUtil.addErrorMessage(e,
ResourceBundle.getBundle("/Bundle").getString("PersistenceErrorOccured"));
         return null;
      }
   }

   public String prepareEdit() {
      current = (Answer) getItems().getRowData();
      selectedItemIndex = pagination.getPageFirstItem() + getItems().getRowIndex();
      return "Edit";
   }

   public String update() {
      try {
         getFacade().edit(current);

JsfUtil.addSuccessMessage(ResourceBundle.getBundle("/Bundle").getString("AnswerUpdated")
);
         return "View";
      } catch (Exception e) {
         JsfUtil.addErrorMessage(e,
ResourceBundle.getBundle("/Bundle").getString("PersistenceErrorOccured"));
         return null;
      }
   }

   public String destroy() {
      current = (Answer) getItems().getRowData();
      selectedItemIndex = pagination.getPageFirstItem() + getItems().getRowIndex();
      performDestroy();
      recreatePagination();
      recreateModel();
      return "List";
   }
```

```
    public String destroyAndView() {
       performDestroy();
       recreateModel();
       updateCurrentItem();
       if (selectedItemIndex >= 0) {
          return "View";
       } else {
          // all items were removed - go back to list
          recreateModel();
          return "List";
       }
    }

    private void performDestroy() {
       try {
          getFacade().remove(current);

JsfUtil.addSuccessMessage(ResourceBundle.getBundle("/Bundle").getString("AnswerDeleted"))
;
       } catch (Exception e) {
          JsfUtil.addErrorMessage(e,
ResourceBundle.getBundle("/Bundle").getString("PersistenceErrorOccured"));
       }
    }

    private void updateCurrentItem() {
       int count = getFacade().count();
       if (selectedItemIndex >= count) {
          // selected index cannot be bigger than number of items:
          selectedItemIndex = count - 1;
          // go to previous page if last page disappeared:
          if (pagination.getPageFirstItem() >= count) {
             pagination.previousPage();
          }
       }
       if (selectedItemIndex >= 0) {
          current = getFacade().findRange(new int[]{selectedItemIndex, selectedItemIndex +
1}).get(0);
       }
    }

    public DataModel getItems() {
       if (items == null) {
          items = getPagination().createPageDataModel();
       }
       return items;
```

```java
    }

    private void recreateModel() {
        items = null;
    }

    private void recreatePagination() {
        pagination = null;
    }

    public String next() {
        getPagination().nextPage();
        recreateModel();
        return "List";
    }

    public String previous() {
        getPagination().previousPage();
        recreateModel();
        return "List";
    }

    public SelectItem[] getItemsAvailableSelectMany() {
        return JsfUtil.getSelectItems(ejbFacade.findAll(), false);
    }

    public SelectItem[] getItemsAvailableSelectOne() {
        return JsfUtil.getSelectItems(ejbFacade.findAll(), true);
    }

    public Answer getAnswer(java.lang.Integer id) {
        return ejbFacade.find(id);
    }

    @FacesConverter(forClass = Answer.class)
    public static class AnswerControllerConverter implements Converter {

        @Override
        public Object getAsObject(FacesContext facesContext, UIComponent component, String
value) {
            if (value == null || value.length() == 0) {
                return null;
            }
            AnswerController controller = (AnswerController)
facesContext.getApplication().getELResolver().
                    getValue(facesContext.getELContext(), null, "answerController");
```

```java
            return controller.getAnswer(getKey(value));
        }

        java.lang.Integer getKey(String value) {
            java.lang.Integer key;
            key = Integer.valueOf(value);
            return key;
        }

        String getStringKey(java.lang.Integer value) {
            StringBuilder sb = new StringBuilder();
            sb.append(value);
            return sb.toString();
        }

        @Override
        public String getAsString(FacesContext facesContext, UIComponent component, Object
object) {
            if (object == null) {
                return null;
            }
            if (object instanceof Answer) {
                Answer o = (Answer) object;
                return getStringKey(o.getAnswerid());
            } else {
                throw new IllegalArgumentException("object " + object + " is of type " +
object.getClass().getName() + "; expected type: " + Answer.class.getName());
            }
        }

    }

}

/*
 * To change this license header, choose License Headers in Project Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package com.murimi.db.util;

import com.google.gson.Gson;
import java.io.IOException;
import java.io.PrintWriter;
import javax.ejb.EJB;
import javax.servlet.ServletException;
```

```java
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
import service.ProductsFacadeREST;

import com.google.gson.JsonObject;
import com.google.gson.GsonBuilder;
import com.google.gson.JsonArray;

import com.murimi.db.Products;
import java.util.ArrayList;
import java.util.List;
/**
 *
 * @author happiness
 */
public class ClientInterfaceServlet extends HttpServlet {

    @EJB
    private ProductsFacadeREST productsFacadeREST;

    /**
     * Processes requests for both HTTP <code>GET</code> and <code>POST</code>
     * methods.
     *
     * @param request servlet request
     * @param response servlet response
     * @throws ServletException if a servlet-specific error occurs
     * @throws IOException if an I/O error occurs
     */
    protected void processRequest(HttpServletRequest request, HttpServletResponse response)
            throws ServletException, IOException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
            /* TODO output your page here. You may use following sample code. */
            out.println("<!DOCTYPE html>");
            out.println("<html>");
            out.println("<head>");
            out.println("<title>Servlet ClientInterfaceServlet</title>");
            out.println("</head>");
            out.println("<body>");
            out.println("<h1>Servlet ClientInterfaceServlet at " + request.getContextPath() +
"</h1>");
            out.println("</body>");
```

```java
      out.println("</html>");
    }
  }

  // <editor-fold defaultstate="collapsed" desc="HttpServlet methods. Click on the + sign on the
left to edit the code.">
  /**
   * Handles the HTTP <code>GET</code> method.
   *
   * @param request servlet request
   * @param response servlet response
   * @throws ServletException if a servlet-specific error occurs
   * @throws IOException if an I/O error occurs
   */
  @Override
  protected void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {

    response.setContentType("text/html;charset=UTF-8");
    try (PrintWriter out = response.getWriter()) {
      /* TODO output your page here. You may use following sample code. */
      //out.println("Size is " + productsFacadeREST.count());
      //out.

      List<Products> list = productsFacadeREST.findAll();
      Gson builder = new GsonBuilder().create();
      String json = builder.toJson(list);
      out.println(json);
    }
  }

  /**
   * Handles the HTTP <code>POST</code> method.
   *
   * @param request servlet request
   * @param response servlet response
   * @throws ServletException if a servlet-specific error occurs
   * @throws IOException if an I/O error occurs
   */
  @Override
  protected void doPost(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
    processRequest(request, response);
  }

  /**
```

```
   * Returns a short description of the servlet.
   *
   * @return a String containing servlet description
   */
  @Override
  public String getServletInfo() {
     return "Short description";
  }// </editor-fold>

}

package com.murimi.db;

import com.murimi.db.util.JsfUtil;
import com.murimi.db.util.PaginationHelper;

import java.io.Serializable;
import java.util.ResourceBundle;
import javax.ejb.EJB;
import javax.inject.Named;
import javax.enterprise.context.SessionScoped;
import javax.faces.component.UIComponent;
import javax.faces.context.FacesContext;
import javax.faces.convert.Converter;
import javax.faces.convert.FacesConverter;
import javax.faces.model.DataModel;
import javax.faces.model.ListDataModel;
import javax.faces.model.SelectItem;

@Named("farmerController")
@SessionScoped
public class FarmerController implements Serializable {

  private Farmer current;
  private DataModel items = null;
  @EJB
  private com.murimi.db.FarmerFacade ejbFacade;
  private PaginationHelper pagination;
  private int selectedItemIndex;

  public FarmerController() {
  }

  public Farmer getSelected() {
     if (current == null) {
        current = new Farmer();
```

102

```java
        selectedItemIndex = -1;
    }
    return current;
}

private FarmerFacade getFacade() {
    return ejbFacade;
}

public PaginationHelper getPagination() {
    if (pagination == null) {
        pagination = new PaginationHelper(10) {

            @Override
            public int getItemsCount() {
                return getFacade().count();
            }

            @Override
            public DataModel createPageDataModel() {
                return new ListDataModel(getFacade().findRange(new int[]{getPageFirstItem(),
getPageFirstItem() + getPageSize()}));
            }
        };
    }
    return pagination;
}

public String prepareList() {
    recreateModel();
    return "List";
}

public String prepareView() {
    current = (Farmer) getItems().getRowData();
    selectedItemIndex = pagination.getPageFirstItem() + getItems().getRowIndex();
    return "View";
}

public String prepareCreate() {
    current = new Farmer();
    selectedItemIndex = -1;
    return "Create";
}

public String create() {
```

```
        try {
            getFacade().create(current);

JsfUtil.addSuccessMessage(ResourceBundle.getBundle("/Bundle").getString("FarmerCreated"));
            return prepareCreate();
        } catch (Exception e) {
            JsfUtil.addErrorMessage(e,
ResourceBundle.getBundle("/Bundle").getString("PersistenceErrorOccured"));
            return null;
        }
    }

    public String prepareEdit() {
        current = (Farmer) getItems().getRowData();
        selectedItemIndex = pagination.getPageFirstItem() + getItems().getRowIndex();
        return "Edit";
    }

    public String update() {
        try {
            getFacade().edit(current);

JsfUtil.addSuccessMessage(ResourceBundle.getBundle("/Bundle").getString("FarmerUpdated"))
;
            return "View";
        } catch (Exception e) {
            JsfUtil.addErrorMessage(e,
ResourceBundle.getBundle("/Bundle").getString("PersistenceErrorOccured"));
            return null;
        }
    }
```