DIGITAL AGRICULTURE PLATFORM

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MIDLANDS STATE UNIVERSITY

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By

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Supervisor: **Mr. R. Gumbo**

ABSTRACT

The goal of this project was to develop a digital agriculture platform that would help Chiredzi Rural District modernize its farming methods. By offering a central hub for information and services, the platform aims to improve current agricultural systems rather than replace them. In order to make sure the system is easy to use and adapt for local farmers, the project was organized into five stages. JavaScript and PHP were used to build the platform, and XAMPP was used for testing to ensure a smooth interface with a dependable backend. To evaluate the expected benefits and implementation costs, economic feasibility studies were carried out. To learn more about the community's present agricultural difficulties, data collection methods such as surveys, interviews, and observations were used. The proposed platform will enable farmers to access real-time market prices, apply for loans and government grants, receive agricultural guidance, and obtain timely weather updates. Furthermore, it will facilitate connections between farmers and buyers, such as the Grain Marketing Board and Ingwebu Breweries. Throughout the development process, validation and verification testing were conducted to ensure the platform's functionality and reliability. Ultimately, the Digital Agriculture Platform aims to empower local farmers, improve agricultural productivity, and enhance food security in the region.

DECLARATION

I, Wright Makondo, affirm that this dissertation is entirely my work. I give Midlands State University permission to lend this dissertation to other organizations or people for scholarly purposes.

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

APPROVAL

This dissertation entitled "Digital Agriculture Platform" by Wright Makondo meets the regulations governing the award of the degree of Bcomm Honours in Information Systems of the Midlands State University, and is approved for its contribution to knowledge and literacy presentation.

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

Date: ……………………………………………………………..

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This acknowledgement will be incomplete if I leave out the contribution made by my beloved parents, Mr. P. Makondo and Mrs. L. Makondo for their love and financial support and my sisters, Margret Makondo and Ashley Makondo deserve a thank you for their love and encouragement.

DEDICATION

This dissertation is devoted to my parents, whose financial support has enabled me to reach this point, whose dedication has allowed my project to come to an end, and my supervisor Mr. R. Gumbo, who has been providing crucial direction that has proved to be beneficial to my project.

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MSU…………………………………………………....... MIDLANDS STATE UNIVERSITY

CRDC…………………………………………….. CHIREDZI RURAL DISTRICT COUNCIL

RDC………………………………………………………… RURAL DISTRICT COUNCIL

CTC………………………………………………………. CHIREDZI TOWN COUNCIL

CEO……………………………………………………... CHIEF EXECUTIVE OFFICER

EO……………………………………………………………….. EXECUTIVE OFFICER

EAT……………………………......... ENVIRONMENT AGRICULTURE AND TOURISM

CS………………………………………………………………. COMMUNITY SERVICES

HR…………………………………………………………...... HUMAN RESOURCES

NGO…………………………………………. NON-GOVERNMENTAL ORGANAISATION

EMA……………………………………… ENVIRONMENTAL MANAGEMENT AGENCY

PA……………………………………………………………....... PERSONAL ASSISTANT

CHAPTER 1: INTRODUCTION

1.1 Introduction

This project's objective is to develop a digital agriculture platform that will change Chiredzi District's rural farming methods, since many people believe that sustainable agriculture in rural regions is often perceived as a potential opportunity made possible by digital technologies. The system will be developed for all farmers within the Chiredzi Rural District Council's jurisdiction. By utilizing artificial intelligence, the system will offer useful data, market trends, weather forecasts, and recommendations to farmers, extension workers, and other agricultural stakeholders. The technology will enable rural farmers to make better decisions, implement better agricultural methods, and increase output, productivity, and income by bridging the information gap. The system will be implemented with MySQL, JavaScript, PHP, and Python. In addition, some of the instruments that will be utilized to acquire information during the needs gathering stages include questionnaires, observations, and interviews.

1.2 Background of the Study

Zimbabwe's economy depends heavily on agriculture, and as the country's population grows, so does the need for food production. This is more crucial now than it has ever been, particularly in light of sustainability and environmental effect. Seasonal changes are unpredictably occurring and are having a severe impact on farming. Massetti, Mendelsohn, and Van Passel (2017). Farmers are faced with the challenge of satisfying customer demands while abiding by all laws and regulations at the lowest feasible cost. (2015) Fountas et al. Information systems for farm management have developed into sophisticated tools to assist farmers in fulfilling these expectations. The systems have evolved to include sensors and positioning systems, among other features, to gather data and improve the farmer’s ability to make decisions.

Actors in the upstream phases of agro-food chains now have access to a wide range of digital technology. Among these, sophisticated decision support systems (DSSs) have attracted a lot of interest since they help farmers make well-informed decisions about financial and managerial operations in addition to agricultural techniques (precision agriculture technologies) Fountas et al., (2015). The researchers have focused particularly on the development of the Digital Agriculture Platform among these software solutions.

Due to their elderly age and lack of scientific knowledge, the great majority of farmers in our nation do not understand the value of sophisticated technology in agriculture. Every piece of knowledge used in farming originates with the farmer and is not appropriately recorded or kept on file. This indicates that a human skull can only hold so much information, and that a great deal of details is lost. According to Sangana Africa (2013), the majority of Zimbabwean farmers do not make use of cutting-edge technologies. The aforementioned author also observed that, even with the means, Zimbabwean farmers would be unable to invest in these technologies since they lack knowledge about them.

Mutimbanyoka (2019) advocates for accurate data documentation, as it can aid in forecasting the likelihood of farmers being affected by natural catastrophes. The author who was previously cited also emphasised that the government can use the data from these technologies to make choices. Data can be easily retrieved and examined if it is organised and kept correctly. However, the majority of Zimbabwean farmers lack the resources required to put the suggested method into place.

1.2.1 Organizational Background

According to the RDC Act, Revised Edition 1996 [Chapter 29:13], Section 8, sub-section 1 paragraph (a) through (c) requirement, Chiredzi RDC was formed. In accordance with the section, "whenever the President considers it desirable, he may, by proclamation in the gazette, do any one of the following: establish a Rural District Council for any district with effect from a date specified in the proclamation, which date shall be at least sixty days after the publication of the proclamation; assign a name to any Council, and divide a council into a number of wards" (The Government Printers, 1996).

Since the 18th century, Zimbabwe had some sort of local government, represented by its traditional system of Kings, Chiefs, Headmen, and Village Heads. Following colonization, local government institutions were created to meet the requirements of colonial governments; these were divided based on race known as African Councils before evolution. They were the higher authority and were composed of chosen representatives. An offshoot of African Councils, the Rural Council was established in the post-independence era to encompass commercial farming areas and only allow voting by landowners. They were interested in building highways inside agrarian communities and providing services to nearby minor cities.

The Hippo Valley business centre, which was a part of the same Rural Council and later known as Chiredzi Town, grew out of the pension neighbourhood along the Mutirikwi River. The eradication of racial bias from local government was symbolized by the founding of the Gaza Khomanani District Council in 1982. As a result, systems were merged and improved to create the Chiredzi Rural District Council (CRDC), which operated as a single local government. Its goal was to start development both in urban and rural areas. It was later divided in 1992 into Chiredzi Town Council (CTC) to manage the urban area and Chiredzi Rural District Council to manage the rural areas. Thus, was also further approved in in 2002, when the government circular was adopted, and thus led to the establishment of Chiredzi Rural District Council.

Chiredzi Rural District Council has been established in accordance with the RDC Act [Chapter 29:13] in order to become a body corporate with perpetual progression, be sued, and generally do, suffer, and perform whatever that is permitted by the said Act or any other legislation. It creates the arm of local government. According to Vosloo (1978), the phrase “Local Government” refers to a decentralized representative body that has been granted broad and particular competences by the central government. Functions, power, and authority were decentralized by the Central government to Local Authorities or Councils.

Chiredzi Rural District Council is located in the south eastern region of Masvingo Province in Zimbabwe. It shares borders with Bikita RDC and Zaka RDC to the north, Chipinge RDC to the east, Chivi RDC, Mwenezi RDC, and Beitbridge RDC to the west, Mozambique and South Africa to the south.

The district is 1748927 hectares, of which Chiredzi Town Council owns 632 hectares. It is located in region 5 at an elevation of less than 250 hectares above sea level and has a delicate ecosystem that is mostly irrigated by Save, Limpopo, Mwenezi, Runde, Mutirikwi, Chiredzi and Tokwe Mukosi Rivers. Its geology is pretty good, with alluvial soils from river deposits and black, reddish sodic soils.

1.2.2 Organizational Structure

The Rural District Councils Act [Chapter 29:13], the organization’s founding statute, serves as the basis for Chiredzi Rural District Council’s operations. The management group, which is led by the Chief Executive Officer (CEO), is in charge of running the organization’s everyday operations. In order to guarantee that the residents of the Chiredzi area have a better and enhanced quality of life, the interior council’s business is to supply and maintain services to the communities. CRDC’s Human Resources and Administration, Finance, Technical Services, Community Services, Environment, Agriculture and Tourism, and Audit departments, each of which specializes in a distinct task.

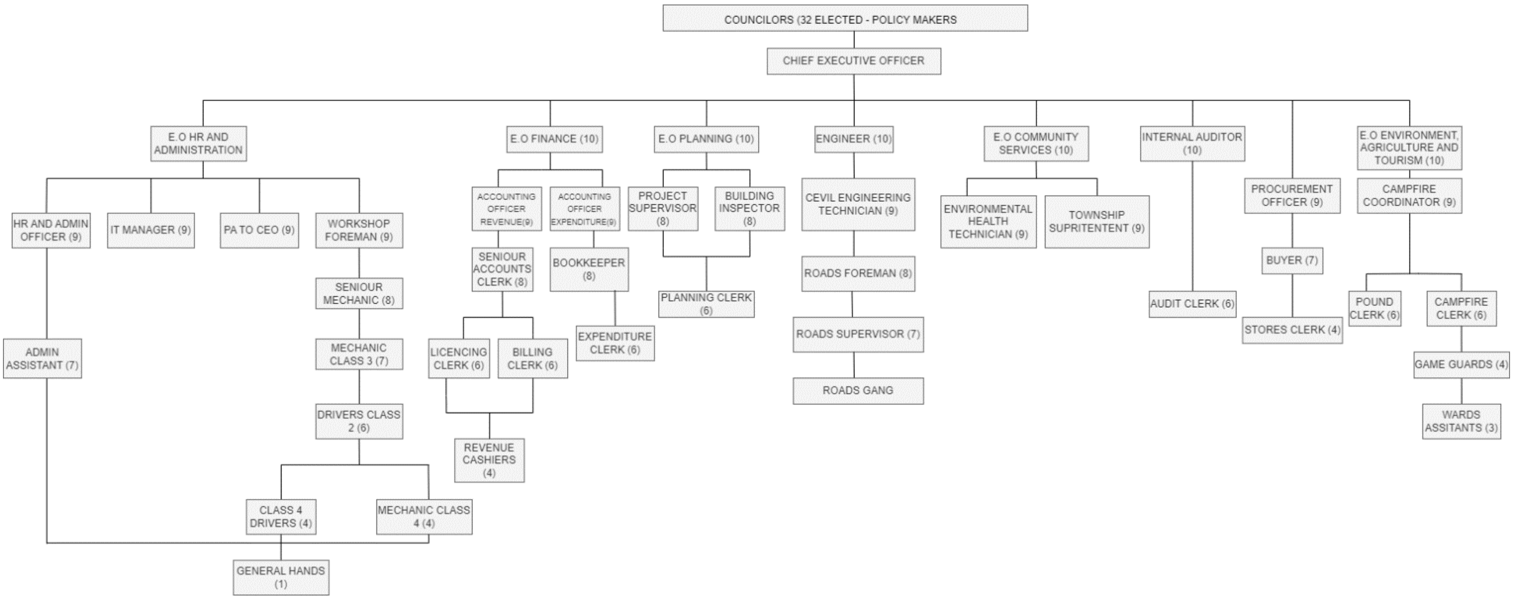


Figure 1.1: CRDC Organizational Structure

1.2.3 Vision

By 2030, our citizens will have better living conditions and excellent service delivery.

1.2.4 Mission Statement

To enhance living standards by establishing lasting relationships in all economic sectors and creating a variety of community livelihoods.

1.3 Problem Definition

Reliable and simple to use Digital Agriculture Platform is of great importance to both Chiredzi Rural District Council and the local farmers. Regretfully, the majority of local farmers still do not use technology to help them on their fields. They continue to struggle with the following issues since they haven't embraced contemporary technologies to help them:

- Access to current agricultural resources and knowledge is frequently limited in rural regions, which may jeopardise economic growth and productivity.
- Rural communities may take longer to accept technology. Chiredzi Rural District Council may encourage the use of digital apps on farms and perhaps open the door to the deployment of advanced agricultural technology by creating a Digital Agriculture Platform.
- The effects of climate change, such as ELNINO, which may have a major impact on agricultural output and food security, can be particularly dangerous for rural communities. In order to lessen the consequences of climate change and increase food security in the area, the Chiredzi Rural area Council may implement climate-smart agriculture practices with the use of a digital agriculture platform. Because this information is not widely available, new and inexperienced farmers may find it challenging to determine which plants may be grown in particular locations as well as which pests and diseases are most likely to affect their region.

- Last but not least, most farmers lack access to market trends. Thus, the Digital agriculture Platform will serve as a connection between farmers and buyers for example Grain Marketing Board and Ingwebu Breweries.

1.4 Aim

To develop a web-based, user-centred system that acts as a centralised hub for Chiredzi Rural District Council’s agricultural services and information.

1.5 Objectives

- To enable farmers to check current market prices online.
- To allow farmers to apply for loans and government grants within the system.
- To allow extension workers, Chiredzi RDC, and other stakeholders to give agricultural guidance to farmers.
- To provide decision support using collected data.
- To provide real time weather updates.
- To enable Chiredzi RDC to collect and analyse data on agricultural trends.

- To send early warning alerts to farmers.
- To guide farmers on crop selection, irrigation schedules and best practices.

1.6 Limitations of the Study

The implementation of digital agricultural platform in Chiredzi district may face challenges like:

- The installation and usage of digital agricultural platforms may be impacted by inadequate Internet connectivity in rural regions.
- Limited access to the technology and knowledge needed for the platform's successful implementation.
- Regarding the utilisation of technology and information systems, local stakeholders including farmers and extension agents may lack the necessary skills and expertise.
- The Digital Agriculture Platform must be tailored to the unique agricultural practises and community requirements in order to be implemented. Achieving this customisation can be difficult and resource-intensive.
- The platform's long-term viability is dependent on a number of aspects, including institutional support from stakeholders and local government, finance, and governance.
- To effectively use the platform's features and functions, users especially those with poor technical skills or digital literacy may need training and assistance which might be expensive.

1.7 Methodology

To learn about the flaws of the current systems and what the system designers might be able to include in the proposed system, a variety of data collection techniques will be used. The following methods of data collection will be utilised by the system analyst to acquire comprehensive, realistic, precise, traceable, and verifiable data.

1.7.1 Data Collection Methods

The following techniques for gathering data were used to collect information on how the current system works:

Interviews

Speaking with people who possess knowledge that can be utilised to develop the proposed system is part of this data collection technique.

Observation

Using this data collection method, the current system is observed in real time.

Questionnaire

This technique will be employed by the researcher to collect data from a large number of people regarding the current system issues.

1.8 Instruments

The following tools will be leveraged in the actual development process of the digital agriculture platform:

JavaScript – For coding

PHP – For coding

Visual Studio – For writing code

XAMMP – server for testing

1.9 Justification and Rationale for This Study

Adoption of the suggested system will be advantageous to Chiredzi Rural district Council, local farmers, extension workers and other agricultural stakeholders in the following ways:

- The Chiredzi RDC will benefit from the Digital Agriculture Platform's assistance in streamlining decision-making, planning, and agricultural programmes monitoring. This will assist in matching activities to the needs and conditions in the area. Additionally, it facilitates the exchange of knowledge between other parties and municipal authorities.

- Farmers will benefit from the system's improved access to financial services, weather predictions, market trends, and agricultural guidance. This encourages behaviours that are climate resilient and better-informed decision making. It also makes connections between buyers and suppliers of input easier.
- Additionally, the system will help extension agents by improving their capacity to introduce farmers to new technology and best practices. This will increase their impact. Farmers can also use the decision support tools it offers.
- On overall, the system modernises agriculture, increases productivity and revenue, and supports sustainable agricultural methods that are appropriate for the local environment. It also helps to connect farmers to markets, which strengthens the rural economy.

1.10 Conclusion

In this chapter, the proposed system, the history of the study that led to the development of the Digital Agriculture Platform, and the background of the Chiredzi Rural District Council the organisation for whom the proposed system is intended are briefly described. The chapter also provides a precise explanation of the problem and outlines the requirements that the suggested system must fulfil in order to address the issues raised by the problem definition. Additionally, it discloses the techniques that will be employed to gather information in order to ascertain the system requirements, along with the tools selected for the development process, which include MySQL, Python, and Xampp. Finally, it provides the rationale and justification for the research.

CHAPTER 2: PLANNING PHASE

2.1 Introduction

The planning phase is when the development of the proposed system is carefully planned. Time will be allotted to the various system development stages during the planning phase, which includes explicit procedures on how the system will be created. A feasibility study will be conducted at this stage in order to reassure managers and other stakeholders that the suggested solution is lucrative. At this stage, the risks that are most likely to have an impact on the proposed system's success will be identified along with potential remedies or mitigation strategies. Lastly, the researcher will create a Gantt chart and project work plan.

2.2 Reasons for developing the system

The development of a digital agriculture platform for Chiredzi RDC has the potential to revolutionise the local economy, the agricultural industry, and the society at large. A platform like this makes use of contemporary technology to improve farming methods, optimise processes, and promote sustainable development. The following are the main reasons for a rural Chiredzi RDC to develop a digital agriculture platform:

- Increasing the efficiency and productivity of agriculture.
- Granting access to vital resources and information.
- Assisting in decision-making based on data.
- Enhancing cooperation and communication.
- Promoting economic growth.
- Improving Supply Chain Management and Market Access.
- Assisting marginal farmers and smallholders.

2.3 Business Value

The adoption of the Digital Agriculture Platform and immediately address the special possibilities and problems faced by rural agricultural communities. The benefits expected from the proposed system are:

- Chiredzi RDC will benefit from the Digital Agriculture Platform’s assistance in streamlining decision-making, planning, and agricultural programmes monitoring. This will assist in matching activities to the needs and conditions in the area.

Additionally, it facilitates the exchange of knowledge between other parties and municipal authorities.

- Farmers will benefit from the system’s improved access to financial services, weather predictions, market trends, and agricultural guidance. This encourages behaviours that are climate resilient and better-informed decision making. It also makes connections between buyers and suppliers of input easier.
- Additionally, the system will help extension agents by improving their capacity to introduce farmers to new technology and best practices. This will increase their impact. Farmers can also use the decision assistance tools it offers.
- On overall, the system modernises agriculture, increases productivity and revenue, and supports sustainable agricultural methods that are appropriate for the local environment. It also helps to connect farmers to markets, which strengthens the rural economy.

2.4 Feasibility Study

A feasibility study, according to Perez (2024), is a comprehensive analysis that considers all significant aspects of a project proposal in order to determine its likelihood of success. The feasibility study can help the board of directors or other decision-makers decide whether to proceed with the project or not. It also determines if the system will be advantageous to the business and end users, and it signals the project's progress to the following phase. The purpose of the project's feasibility studies, which are shown in the figure below, was to demonstrate the benefits of implementing a digital agricultural platform and the project in general.

2.4.1 Technical Feasibility

Technical feasibility involves determining if the organization's present technical resources are sufficient and assessing the hardware and software needs. Thompson, 2005. The term "technical feasibility" describes how feasible the suggested solution is to implement using the available technology. It considers the skills, labour, and technology that are now accessible and needed. This analysis took into account the project's technical needs and compared them to Chiredzi Rural District Council's technical capabilities. The results of the investigation showed that the technical capabilities inside the company are sufficient.

To make sure they have the necessary abilities to complete the project effectively, the present IT staff which includes the IT manager and the IT clerk was assessed. Additionally, the organisation has internal expertise in C#, Visual Basic Programming, Microsoft SQL Server, Windows Server, networks, Web design, internet technologies, hardware maintenance and repairs, and systems analysis and design.

Additionally, members of the Chiredzi Rural District Council's IT department hold certifications in Microsoft Certified System Engineers (MCSE), Microsoft Certified Database Administrators (MCDA), Projects in Controlled Environments (PRINCE2), Cisco networking products, and the Information Technology Infrastructure Library (ITIL). Therefore, the internal technical talents that are accessible are sufficient to guarantee the project's viability.

2.4.1.1 Technical Expertise

There will be no development costs associated with employing more technical specialists because the Chiredzi Rural District Council's IT team is capable of creating the system.

2.4.1.2 Hardware and Software Requirements

For the proposed system to be built and implemented successfully, it will be required to run on specified hardware and be designed using specific software.

Hardware Requirements

The hardware specifications for the proposed system are as follows:

Table 2.1 Hardware Requirements

Items Required	Sufficient Quantity	Number of Available	Use
Hewlett Packard Server with minimum 4 Ghz processor, 4GB RAM, 1Terabyte Hard Disk space, monitor, keyboard, 100/1000 Network interface card, mouse, CD / DVD ROM Drive, 2Kva Uninterruptible power Client supply unit.	1	0	For hosting the System
Hewlett Packard desktop computers, with minimum 8GB RAM, keyboard, mouse, 10/100 Network Interface Card, monitor 500GB hard disk drive	4	0	For developing the system
CISCO Router 2901	1	1	allow devices to connect and share data over the Internet or an intranet
48 port CISCO network switch	1	1	Allows networked devices to communicate
48U network cabinet	1	1	Houses the network switch

Fibre connection	1	1	To provide internet service
Uninterruptible Power Supply (UPS)	2	0	For power backup

Software Requirements

The proposed system's software needs are as follows:

Table 2.2: Software Requirements

Program	**Status**	**Role**
Microsoft Windows Server 2012 Operating System	Available	Administrative control of data storage, applications and corporate networks.
Amazon Web Services	Accessible	For hosting
Windows 11 client operating system	Available	Manages all of the hardware, software, memory, and operations on the computer.
Microsoft Office Word	Available	Enable the councils to write agricultural reports that will be uploaded to the system.
Eset antivirus software	Available	It was used to stop, check for, identify, and remove viruses from computers.
Microsoft SQL 2012 Server software	Available	Manages the database.
Microsoft Visual Studio	Accessible	Used to write, edit, debug, and build code.

2.4.2 Operational Feasibility

Determining whether a project can be effectively executed and integrated into the current systems is the main goal of operational feasibility Martin (2024). The researcher will be assessing whether the problem worth solving or not. All of the shortcomings of the present system should be fixed by the functional requirements of the suggested solution. Among the characteristics of the suggested system are the following:

- Allow farmers to access current market prices online.
- Allow farmers to apply loans and government grants within the system.
- Allow farmers to communicate with extension workers, Chiredzi RDC and other interested parties through interactive forums and discussions.
- Examination past crop performance, soil conditions, and weather forecasts.
- Provides decision support based on the collected data.
- Provision of real time weather updates.
- Allowing Chiredzi RDC to collect and evaluate data on agricultural trends.
- Alerting farmers on Early Warnings.
- Providing farmers with agricultural guidance on crop selection, pest control, irrigation schedules and optimum agricultural practices.

2.4.2.1 Operating Costs

The expenses incurred in operating a new system are known as operational costs. The table below displays the expected operating expenses for the suggested system:

Table 2 3: Operating Costs

Item	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Total**
Hardware Maintenance	0	$450	$750	$350	$1550
Software Maintenance	0	$650	$550	$180	$1380

Internet	0	$1350	$1550	$1720	$4620
Training and Development	0	$6500	$5200	$1700	$13400
Total Cost	**0**	**$8950**	**$8050**	**$3950**	**$20950**

2.4.2.2 Initial Investment

Initial investment is the amount required to start the proposed project. The initial investment for the digital agriculture platform is shown below:

Table 2. 4: Initial Investment

Investment	**Cost**
New equipment acquisition, development expenses, and allowances	$145000
Disposal proceeds	$(2500)
Initial investment	**$142500**

Table 2.5: Operating Revenue

	Year 1	**Year 2**	**Year 3**
Increment Revenue	$145000	$180000	$245000

A decrease in administration cost	$5000	$4000	$5500
Fixed Costs (Incremental)	($6500)	($6500)	($6500)
Increase in electricity Cost	($50)	($50)	($50)
Reduction in System Analyst Cost	($300)	($300)	($300)
Increased Internet Cost	($100)	($100)	($100)
Incremental Revenue	$140100	$240300	$195600
Less tax 20%	($28020)	($48060)	($39120)
Revenue after tax	($112080)	($192240)	($156480)

2.4.2.3 Benefits

The new equipment will bring in an average of $153600 or equivalent ZiG annually for the three years that have been chosen.

2.4.2.3.1 Tangible benefits

Tangible benefits that are quantifiable and measurable, Smith (2020). In other words, they are advantages of improvement projects that can be quantified as having been attained through the project and have a precise monetary value, number of working hours, or other specified measure. The observable advantages of the suggested system are:

- Attracting economic development to Chiredzi District
- Improved access to real time weather forecast, market trends, and soil conditions.
- Improved yields through data driven decision making.
- Improved communication between location extension officers and local farmers.

2.4.2.3.1 Non-tangible Benefits

Benefits that are difficult to measure and evaluate are known as non-tangible benefits. The intangible advantages of the suggested system are listed below.

- Automates data collection and analysis which also improves policy formulation for Chiredzi RDC.
- Improves Chiredzi Rural District Council's communication with local farmers and agricultural stakeholders.
- Improves communication between location extension officers and local farmers.
- Facilitates knowledge sharing between farmers through interactive discussions.

Table 2.6: Identify Costs and Benefits

Development Costs	**Operational costs**
• HP ProLiant Server • HP Laptops • HP Printer • Router • 48 port Cisco network switch • 48U network cabinet	• Software and hardware maintenance • Licensing fees • Training and development allowances

• Fibre connection	
Tangible benefits • Attracts economic development to Chiredzi District at large. • Improved access to real time weather forecast, market trends, and soil conditions. • Improved yields through data driven decision making. • Improves communication between location extension officers and local farmers.	**Intangible benefits** • Improved data collection and analysis which also improves policy formulation for Chiredzi RDC. • Improves Chiredzi Rural District Council's communication with local farmers and agricultural stakeholders. • Facilitates knowledge sharing between farmers through interactive discussions.

2.4.3 Economic Feasibility

It determines the positive economic benefits to be realized in an organization after the project has been implemented, Murphy (2002). By evaluating the costs and benefits associated with the suggested system, giving values, projecting future cash flows, and assessing the project's financial stability, economic viability is established. The undertaking is a sensible and valuable endeavour if the benefits exceed the expenses. The expenses of development are its main issue (Dennis, Wixom & Roth, 2012).

2.4.3.1 Developmental Costs

Project team payment, component prices, consulting fees, training, office space, and equipment are some of the tangible expenses incurred during the building of a system. The suggested Digital Agriculture Platform's development expenses are shown in the table below:

Table 2.7: Development Costs

Requirements	**Cost ($)**
Microsoft Windows 11	$20
Microsoft Office 2019	$20
Microsoft Visual Studio	Free
Microsoft MySQL	Free
Xampp	Free

2.4.3.2 Cost Benefit Analysis

A cost-benefit analysis compares the costs and advantages of putting a system in place. To determine if the project is profitable, the expenses will be subtracted from the benefits. This gives managers the knowledge they need to make an informed choice:

Table 2.8: Cost Benefit Analysis

Cost	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Total**
	$145000				
Operational Cost	$0	($8950)	($8050)	($3950)	
Total Costs	**$145000**	**($8950)**	**($8050)**	**($3950)**	**($165950)**
Tangible benefits					

Intangible		$75000	$85000	$90000	
Net Benefits		**$66050**	**$76950**	**$86050**	**$229050**

Net Benefits = ∑ Total Benefits – ∑ Total Cost

= $229050 - $165950

= **$63100**

2.4.3.3 Return on Investment (ROI)

(Mansa, 2021) propose that's it is an assessment of the investment return in contrast to cost of investment and is stated using percentages.

Return on Investment (ROI) = $\frac{\text{Total Benefits} - \text{Total Costs}}{\text{Initial Investment}} \times 100$

$= \frac{\$229050 - \$165950}{\$165950} \times 100$

= **$38, 02%**

2.4.3.4 Payback period

The payback period is the amount of years required to recover the initial investment made in a project (Clayman et al, 2012). This is an effective approach because it demonstrates the length of time stakeholders are prepared to wait to see a return.

Table 2.9: Payback Period

Year	Annual Revenue	Cumulative Cash Flow ($)
0	$145000	
1	$75000	$70000

2	$87000	$17000
3	$95000	$112000

Payback Period = ($70000)/ ($87000)

= 0.805 years

= 0.805 years × 12 months/ year = 9.66 months

= **1 year + 9.66 = 1 year 10 months**

2.4.3.5 Net Present Value

NPV = Total PV of Benefits - Total PV of Costs

= $223631 - $145000

= **$78631**

We have a positive NPV, which is bigger than zero. This suggests the economic viability of our proposal.

2.4.4 Social Feasibility

According to (Finance Management, 2019), the goal of this study is to determine whether or not a suggested method is deemed acceptable by the general public. Following a comprehensive analysis, the researchers determined that implementing the suggested approach would have the following societal benefits:

- Food security as improved agricultural practices will result in higher yields from farmers.
- Farmers will be able to evaluate their crops' performance equitably.
- Easy access to information will inspire individuals to start farming, which might lead to a significant drop in unemployment.

2.4.4.2 Risk Analysis

All possible risks and obstacles to the growth of the Digital Agriculture Platform are the subject of risk analysis, along with ways to mitigate risks and find solutions when they do occur. It also takes into account every factor that might affect the effectiveness of the suggested system and how to prevent it.

2.4.4.3 Risk Planning

A risk management schedule helps to avoid risks and additional expenses before they occur and prepare for unforeseen hazards. Having a risk management strategy in place and taking into account any hazards before they materialise may assist save money and safeguard the company (Lavanya & Malarvizhi, 2008).

Table 2.10: Risk Planning

Risks:	**Effects:**	**Measures:**
Technology Changes in technology	Expensive	Use of current technology and continuous updates
Technical System familiarities	Training stakeholders on the usage of the digital agricultural platform takes a lot of time.	Trainings
Stakeholder The project may take too long to be completed than expected.	The stakeholders may propose project termination if more resources are used than were budgeted.	Work as scheduled

2.5 Work plan

The time required to build the proposed Digital Agriculture Platform is shown in the work plan. The work schedule is as follows:

Table 2.11: Work Plan

Task ID	Task Name	Start	End	Duration	Dependency
1.1	Proposal	05/08/2024	12/08/2024	8 days	
2.1	Planning	13/08/2024	28/08/2024	15 days	1.1
2.2	Analysis	29/08/2024	05/08/2024	8 days	2.1
3.1	Design	06/09/2024	20/09/2024	14 days	2.2
4.1	Development	21/09/2024	11/10/2024	20 days	3.1
5.1	Testing	12/10/2024	26/10/2024	14 days	4.1
6.1	Installation	27/10/2024	02/11/2024	7 days	5.1, 4.1
7.1	Maintenance	Continuous	Continuous	Continuous	

2.6 Gantt chart

A Gantt chart is a popular visual aid for project schedules. This type of bar chart shows the start and finish dates of the various project components, such as dependencies, resources, and planning. The Digital Agriculture Platform's Gantt chart is depicted in the diagram below.

Table 2.12: Gantt chart

Task Name (Weeks)	1	2	3	4	5	6	7	8	9	10	11	12	
Proposal													
Planning													
Analysis													
Design													
Development													
Testing													
Installation													
Maintenance													Ongoing Process

2.7 Conclusion

After evaluation, it has been determined that the suggested system will benefit both the farmers and the intended organisation. The researchers concluded that pursuing the proposed project would provide desired results after carrying out the different feasibility assessments, and they recommended that the suggested system be constructed in opposition to these findings. Every possible risk was evaluated, and mitigation strategies were recommended. After calculating a work plan and creating a Gantt chart, it is safe to go on to the analysis phase, where the present system will be carefully examined to identify areas for improvement.

CHAPTER 3: ANALYSIS PHASE

3.1 Introduction

An examination of the current system is required in order to develop a system that will address actual issues that are being experienced in the field. Because precise data is necessary for a thorough study, several data gathering techniques must be employed to guarantee that every facet of the existing system is examined equally. This stage can be thought of as an analysis of the existing setup. Prior to computing solutions, all of the current system's shortcomings must be found. The researchers will employ dataflow diagrams and context diagrams as visual assistance during the analysis phase. To determine which choice is best, the options developed within reach will also be investigated. Lastly, the functional and non-functional needs will be computed by the researchers.

3.2 Information gathering

Borges (2024) defines information collecting as a methodical process that includes obtaining, organizing, and assessing knowledge, facts, and data from a variety of sources while utilizing advanced information gathering instruments. A variety of data gathering techniques will work together to make sure that enough information is gathered to support the thorough analysis that needs to be done. The collected data is being utilized as high-quality data. Questionnaires and interviews were employed as data gathering techniques.

3.2.1 Questionnaires

Bhandari (2023) defines a questionnaire as a set of questions or items designed to extract information from respondents about their ideas, experiences, and/or beliefs. Farmers and other agricultural stakeholders in the district received the questionnaires.

Advantages of using Questionnaires

- Much less time was spent reaching more individuals.
- Respondents' answers were provided freely thanks to anonymity.
- Gathered a great deal of reliable data that will be analyzed.
- Flexibility
- Standardized responses

Disadvantages of using Questionnaires

- In several instances, the responses were unclear.
- Since the questionnaires were completed without their presence, the researchers were unable to detect nonverbal cues.
- Some questions were omitted by respondents because they were unable to request clarifications on complex inquiries.
- Some responses were meaningless since they failed to comprehend the purpose of the inquiries.
- The process of examining and gathering the data took a long time.

Findings from the questionnaires

- The Department of Agriculture's yearbooks are a major source of information for farmers.
- Farmers are unaware of the existence of digital agriculture platforms.

3.2.2 Interviews

According to George (2023), an interview is a qualitative research method where questions are used to obtain data. Interviews involve two or more participants, one of whom is the interviewer who asks the questions. All interviews were conducted over the phone in order to save on transportation expenses. In order to minimize disruptions to the Chiredzi RDC staff, interviews were held during lunch break.

Advantages of interviews

- When they were unsure about a question, they may ask for clarification.
- The response was prompt and straightforward.
- The investigator possessed the ability to interpret the nonverbal cues of the participants.
- Because the interviews were place around lunch and breaks, when the respondents had ample opportunity to answer, detailed information was given.

Disadvantages of interviews

- Since the analyst had to purchase airtime in order to contact the Respondents, the method was more expensive.
- Sometimes, while on call, respondents would eat and not give their whole attention to the interview.

Findings from Data Gathering

- Local farmers face challenges accessing current agricultural resources and knowledge due to limited availability in rural areas, hindering economic growth and productivity.
- Rural communities show reluctance to embrace technology, which impacts their ability to benefit from modern agricultural practices and tools.
- The effects of climate change, including phenomena like El Niño, pose significant risks to agricultural output and food security in rural areas, emphasizing the need for climate-smart agriculture practices facilitated by a digital platform.
- Inexperienced farmers struggle to identify suitable crops for specific locations and anticipate potential diseases and pests due to the lack of readily available information.
- Farmers lack access to market trends and opportunities, highlighting the need for a digital platform to bridge the gap between farmers and potential buyers like the Grain Marketing Board, Ingwebu Breweries and Delta

3.3 Weaknesses of the existing systems (Hardware and Software)

The features of the current system that prevent it from fully addressing the requirements of the farmers are known as its weaknesses. The following are the weaknesses of the current:

1. **Limited Access to Information:**
   Farmers in rural areas face significant barriers in accessing current agricultural resources and knowledge, which can hinder productivity and economic growth.
2. **Slow Technology Adoption:**
   There is a cultural resistance to adopting modern technology among rural communities, which delays the potential benefits of digital tools in agriculture.
3. **Climate Change Vulnerability:**
   Rural farmers are particularly susceptible to the impacts of climate change for example El Nino, and the absence of a digital platform limits their ability to adopt climate-smart agricultural practices.
4. **Lack of Guidance for Novice Farmers:**
   Inexperienced farmers struggle to identify suitable crops for their regions and are unaware of prevalent pests and diseases, leading to poor agricultural decisions.
5. **Insufficient Market Insights:**
   Farmers often lack access to real-time market trends, which prevents them from making informed decisions about selling their produce and connecting with buyers effectively.

6. **Poor Communication Channels:**

   Existing systems do not facilitate effective communication among farmers, extension workers, and Chiredzi RDC, leading to isolated decision-making and reduced cooperation.

7. **Inadequate Data Analysis:**

   The absence of a centralized data collection and analysis system means that valuable insights regarding agricultural trends and performance are not utilized for making informed decisions.

8. **No Real-Time Updates:**

   Farmers do not receive timely information about weather conditions and agricultural alerts, which can jeopardize their crops and yield.

9. **Limited Knowledge Sharing:**

   There is no structured platform for knowledge exchange among farmers, hindering collective learning and the sharing of best practices.

10. **Ineffective Decision Support:**

    Without a comprehensive decision support system, farmers are left to rely on outdated methods and intuition, rather than data-driven insights.

3.4 Data Analysis

Pauceanu (2016) defines data analysis as a process that involves analyzing data in order to extract important information. The information acquired would be useful to managers in their decision making. Data analysis demonstrates the flow of information inside a system. Details Analysis produces a visually appealing presentation for non-technical users.

3.4.1 Flow Chart

A flow chart is a diagram that displays the main elements of a system. It illustrates a system's external and physical components as well as its operational sequence (Dennis, Wixom, & Roth 2012). The following dramatic series of events is shown in the flow chart:

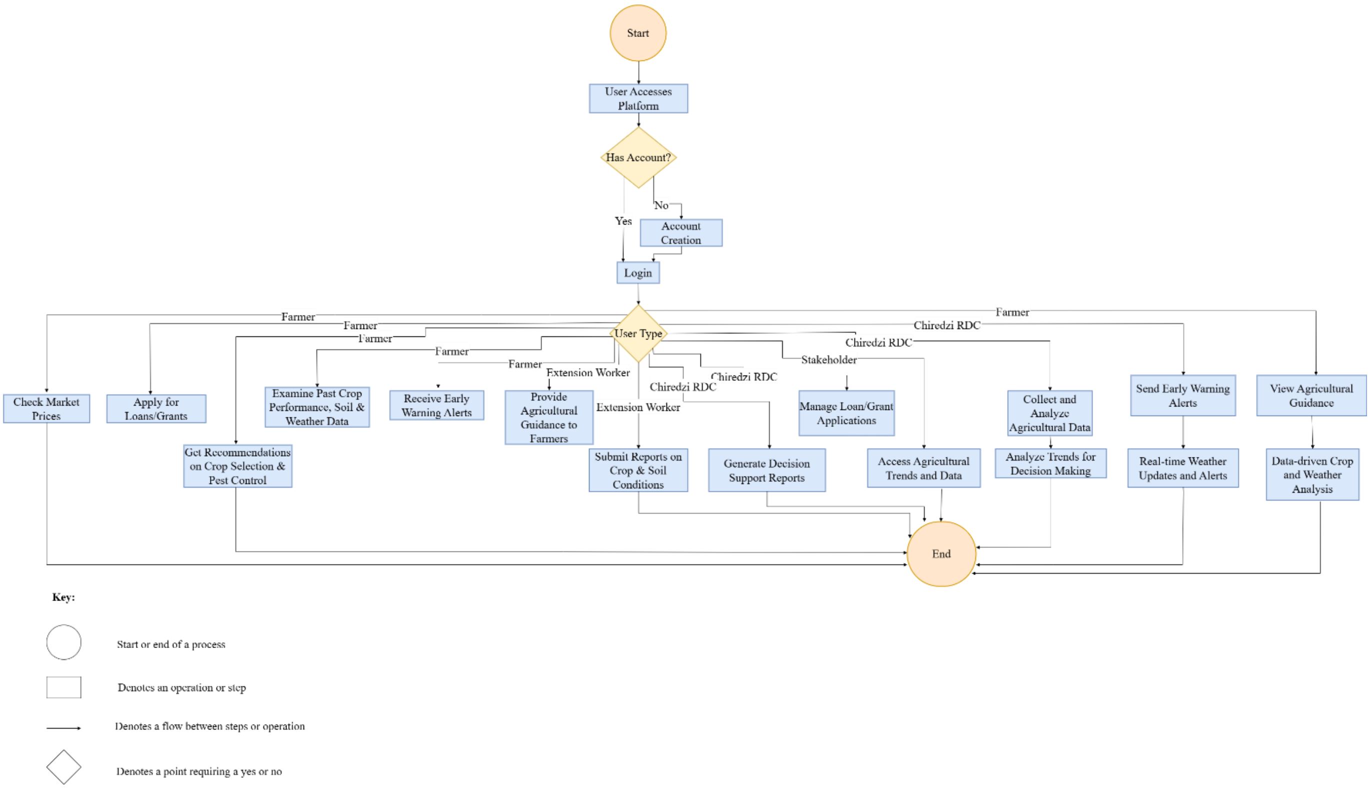


Figure 3.2: System Flow Chart

3.4.2 Context Diagrams

According to Tomboc (2024), a context diagram is a straightforward visual depiction of how a system interacts with its surroundings.

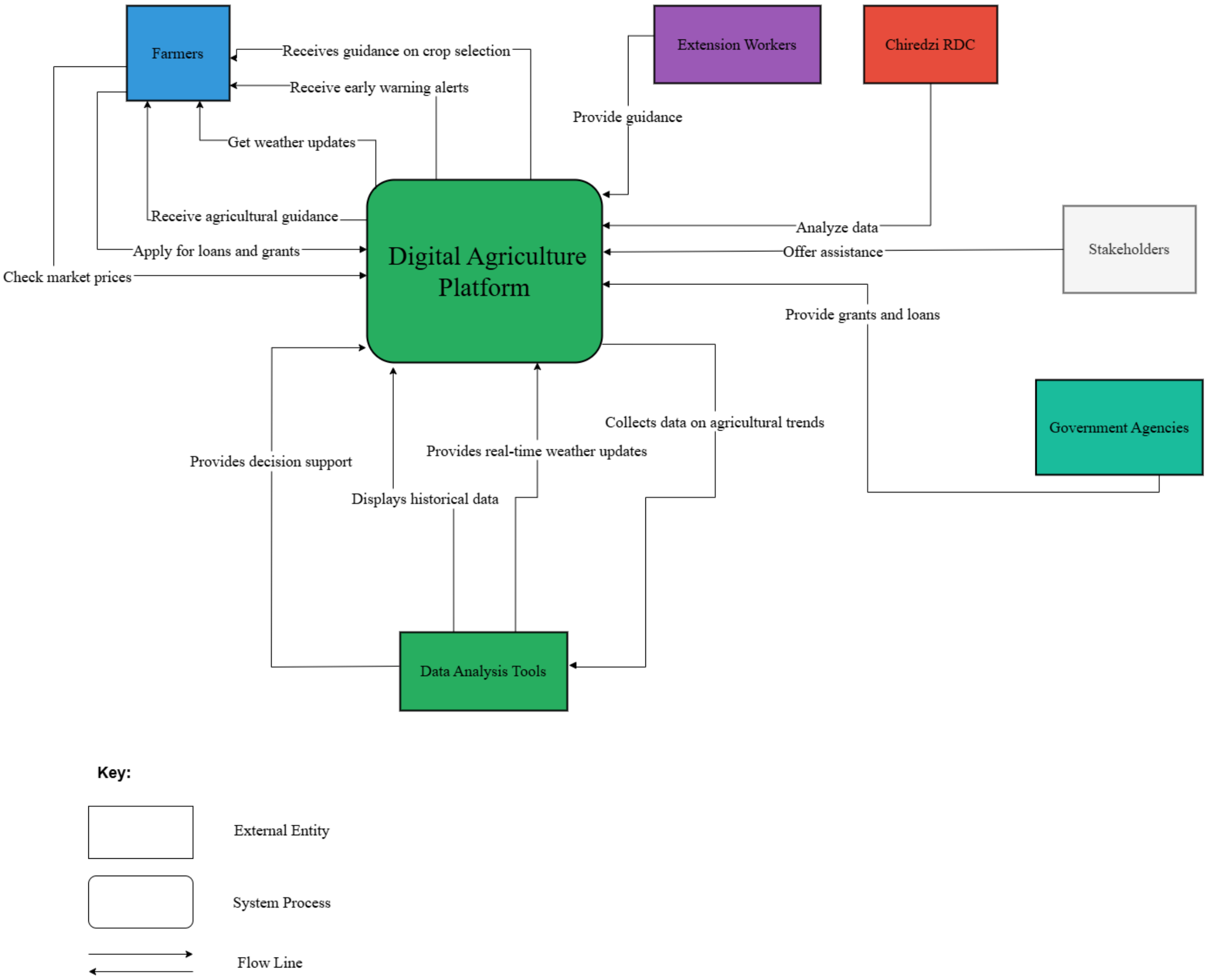


Figure 3.3: Context Diagram

3.4.3 Data Flow Diagrams

According to Stanislaw (2011), a DFD is a visual tool that helps analysts examine and visualise a system. The current DFD is displayed in Fig 3.3.

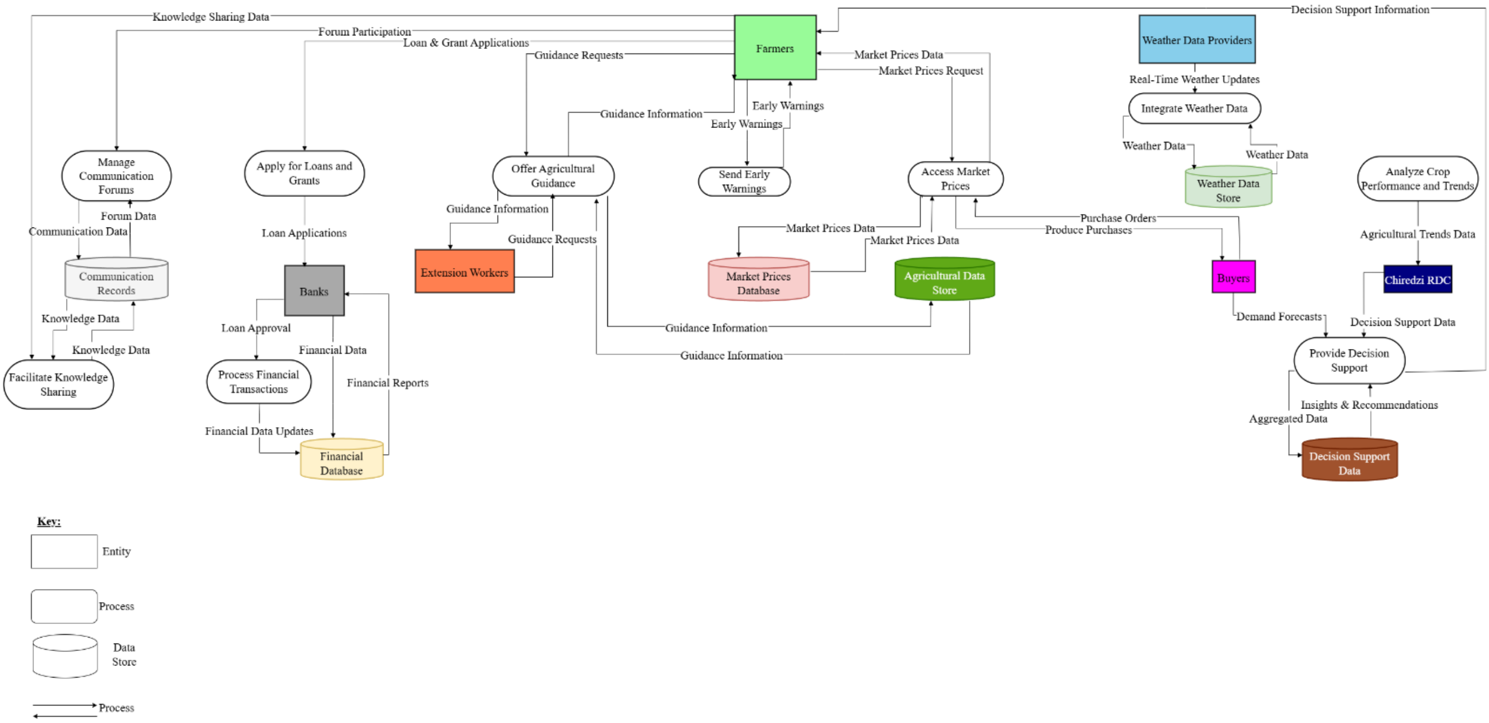


Figure 3.4: Data Flow Diagram

3.4.4 Weaknesses of the existing systems

The characteristics of the existing system that prevent it from fully addressing the requirements of the farmers are known as its weaknesses. The following are the weaknesses of the current:

- **Limited Access to Information:**
  Farmers in rural areas face significant barriers in accessing current agricultural resources and knowledge, which can hinder productivity and economic growth.
- **Slow Technology Adoption:**
  There is a cultural resistance to adopting modern technology among rural communities, which delays the potential benefits of digital tools in agriculture.
- **Climate Change Vulnerability:**
  Rural farmers are particularly susceptible to the impacts of climate change for example El Nino, and the absence of a digital platform limits their ability to adopt climate-smart agricultural practices.

- **Lack of Guidance for Novice Farmers:**
  Inexperienced farmers struggle to identify suitable crops for their regions and are unaware of prevalent pests and diseases, leading to poor agricultural decisions.
- **Insufficient Market Insights:**
  Farmers often lack access to real-time market trends, which prevents them from making informed decisions about selling their produce and connecting with buyers effectively.
- **Poor Communication Channels:**
  Existing systems do not facilitate effective communication among farmers, extension workers, and Chiredzi RDC, leading to isolated decision-making and reduced cooperation.
- **Inadequate Data Analysis:**
  The absence of a centralized data collection and analysis system means that valuable insights regarding agricultural trends and performance are not utilized for making informed decisions.
- **No Real-Time Updates:**
  Farmers do not receive timely information about weather conditions and agricultural alerts, which can jeopardize their crops and yield.
- **Limited Knowledge Sharing:**
  There is no structured platform for knowledge exchange among farmers, hindering collective learning and the sharing of best practices.
- **Ineffective Decision Support:**
  Without a comprehensive decision support system, farmers are left to rely on outdated methods and intuition, rather than data-driven insights.

3.5 Rationale of the proposed system

Adoption of the proposed system will be advantageous to Chiredzi Rural district Council, local farmers, extension workers and other agricultural stakeholders in the following ways:

- The Chiredzi RDC will benefit from the Digital Agriculture Platform's assistance in streamlining decision-making, planning, and agricultural programmes monitoring. This will assist in matching activities to the needs and conditions in the area. Additionally, it facilitates the exchange of knowledge between other parties and municipal authorities.
- Farmers will benefit from the system's improved access to financial services, weather predictions, market trends, and agricultural guidance. This encourages behaviours that

are climate resilient and better-informed decision making. It also makes connections between buyers and suppliers of input easier.

- Additionally, the system will help extension agents by improving their capacity to introduce farmers to new technology and best practices. This will increase their impact. Farmers can also use the decision assistance tools it offers.
- On overall, the system modernises agriculture, increases productivity and revenue, and supports sustainable agricultural methods that are appropriate for the local environment. It also helps to connect farmers to markets, which strengthens the rural economy.

3.6 Evaluation of Alternatives

According to Jawadekar (2013), evaluation of alternatives entails selecting the option that would work best to supply the needed product. The three options that the researcher assessed are as follows:

- Improvement
- Outsourcing
- In-house Development

3.6.1 Improvement of the current system

It involves modernising the existing system to enable it to function as required.

Advantages of Improvement

- There won't be much, if any, requirement for training because the work arrangement will only need minor adjustments.
- It will enhance the procedures used in corporate management. Development expenses will be drastically decreased.
- The system will continue to function while the required updates are being made.
- Negative aspects of improvement.
- To finish the jobs, highly competent labour is required.
- The majority of system flaws derive from their manual character, thus even with development, they won't completely disappear.

Reasons for not using improvement

Since the existing system is not integrated, it cannot be improved to function like the proposed system.

3.6.2 Outsourcing

In this case, the company allots funds to hiring outside developers to assist in building the proposed system. Mohamed (2012)

Advantage of outsourcing

- **Increased Scalability and Efficiency:** By outsourcing, Chiredzi Rural District Council may access cutting-edge knowledge, procedures, and technologies that could be expensive or difficult to create and maintain internally. This may result in service delivery that is more scalable and efficient.
- **Access to Specialised Expertise:** Through outsourcing, local governments may draw from a larger pool of specialised knowledge and skills that might not be present in their own personnel. This may be especially helpful when handling complicated IT systems and cyber security issues.
- **Enhanced Service Quality:** Dependable service providers frequently place a high priority on client happiness and service quality, which can enhance service delivery and produce better results for locals.
- **Reduced Risk:** Since the service provider assumes a larger portion of the duty, outsourcing can assist local governments in reducing some risks, including those related to regulatory requirements, employee turnover, and technology obsolescence.

Disadvantage of outsourcing

- **Dependency on an outside developer and loss of control:** Chiredzi RDC may experience an excessive degree of dependency on the external provider and lose direct control over the digital agricultural platform as a result of outsourcing. This might leave the authority exposed in the event that the supplier has problems or closes.
- **Unexpected or hidden expenses:** Chiredzi RDC may experience unexpected expenses outside the original contract, such as extra payments for support, maintenance, or customisations, can occasionally result from outsourcing. This may make it challenging to estimate and budget for the platform's actual cost.
- **Data security and privacy issues:** Giving sensitive agricultural data to a third party raises questions around cyber security and data protection. The local authority could be concerned about the provider's capacity to appropriately protect and secure the information.

- **Potential Loss of Flexibility and Responsiveness:** Because they may be dependent on the provider's procedures and deadlines, local authorities may find it more difficult to promptly adjust to changing demands or emergencies as a result of outsourcing. This may have an effect on how important services are provided.

Reasons for disregarding outsourcing

- Both in the short run and the long run, outsourcing is too expensive.
- Outsourcers may not have the time or flexibility to truly dedicate themselves to creating the best product since they work for several organizations.

3.6.3 In-house development

According to Valacich and George (2014), it occurs when a company devotes its resources to the process of creating a suggested system. These resources may include staff members' technological know-how as well as hardware and software.

Advantages of in-house development

- **Customisation:** The local government may create software that is precisely tailored to meet their unique business needs and procedures through in-house development. This guarantees that the local authority's pain points, opportunities, and difficulties are precisely addressed by the system.
- **Enhanced Security and Confidentiality:** Since internal team members are dependable members of the company, the local authorities may feel safe knowing that confidential information and intellectual property are protected.
- **Focus and Commitment:** An internal team will only work on the local authority's project, giving them complete dedication and the adaptability to address problems right away.
- **Long-Term Cost Savings:** Developing software internally avoids the need to pay ongoing licence costs for services or software provided by other parties. After the system is created, there are no recurring licence fees for the local government to utilise it.
- **Improved Management and Control:** The local government can manage priorities, make fast adjustments, and match the software with their strategic goals when it develops internally. This gives them complete control over the development process.
- **More Accountability:** Since the internal development teams' activities have a direct effect on the local authority they work for, they are held to a higher standard of

accountability. They are strongly linked to the mission, values, and objectives of the authority, which fosters a greater feeling of accountability and ownership.

Disadvantages of in-house development

- Substandard system might be developed.

The best choice was determined to be in-house development since it is more feasible than the other two options. The resources available to Chiredzi Rural District Council will allow it to develop the Digital Agriculture Platform. Moreover, the bulk of the problems associated with the existing system might be fixed by a system developed inside Chiredzi RDC.

Table 3.13: Comparison of All Alternatives

Alternatives	**Costs**	**Monetary Value (USD)**
In-house development	• Costs associated with labour and software. • Time outlays. • The price of purchasing equipment.	USD3000
Outsourcing	• Training costs. • Bills for maintenance and assistance. • Purchasing expense. Costs associated with licensing.	USD6000
Improvement	• N/A	• N/A

In conclusion, in-house development was thought to be the greatest option as it was affordable and practical.

3.7 Software development methodology

The software development methodology includes the following steps which are analysis, planning, development, testing, deployment, maintenance, and retirement (Dennis, Wixom & Roth, 2012). It facilitates the author's planning, scheduling, and supervision of the Digital Agriculture Platform's growth. Furthermore, researchers are better equipped to anticipate such dangers and plan ahead for any required adjustments. The team chose to employ the waterfall technique, a conventional software development process, for this project.

3.7.1 Waterfall methodology

The waterfall model is a project management technique where the developer initially determines the needs of the user and then creates a step-by-step project plan to meet those needs (Karim, 2011). The figure below shows the development steps of the waterfall model.

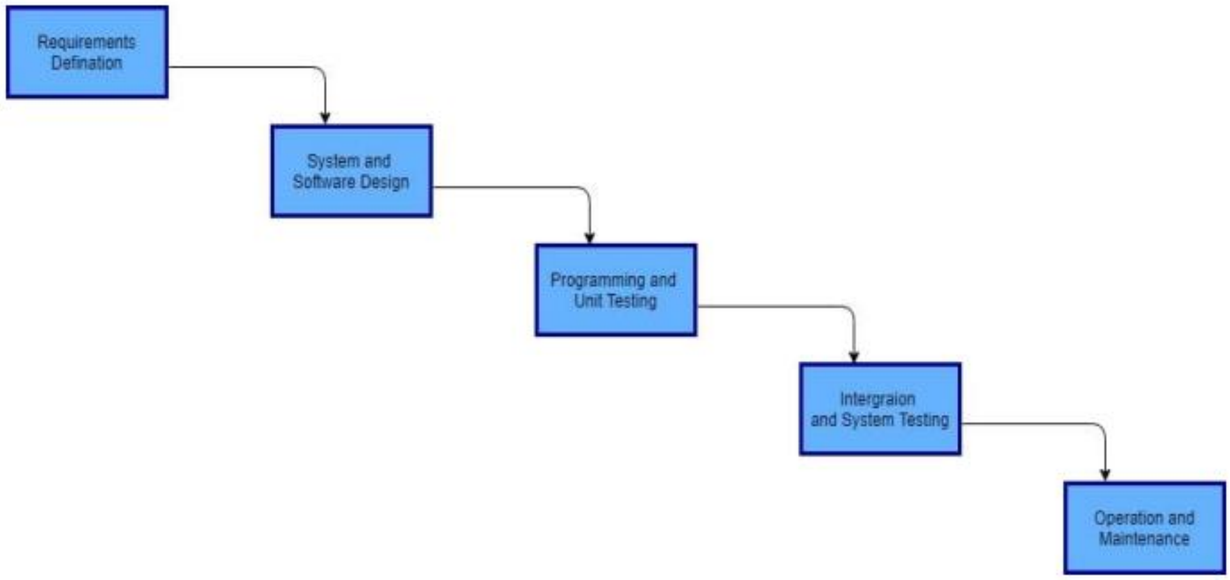


Table 3.14: Waterfall Model

3.7.1.1 Advantages of the waterfall model

- Existence of an obvious structure.
- Seamless information exchange.
- Easy to manage.
- Early setting of objectives.
- There are distinct phases in the process, including planning, analysis, design, and execution.
- By processing and finishing tasks one at a time, the project team was able to identify errors since sequential planning connects each step to the next.

I chose to build the Digital Agriculture Platform using the waterfall model because it offers advantages over other software development methodologies.

Table 2.15: Waterfall model and project chapter

Chapter	Waterfall Phase
Chapter One	Proposal
Chapter Two	Planning
Chapter Three	Requirements Analysis
Chapter Four	Design
Chapter Five	Implementation and Unit Testing. Integration and System Testing. Maintenance.

3.8 Requirements Analysis

The purpose of this approach is to set user expectations for the new product. The qualities a system has to have in order to address issues raised by stakeholders are known as software requirements. Establishing excellent communication with the end users is a simple method to ensure that the needs are precisely specified. There are two types of requirements which are functional and non-functional.

3.8.1 Functional Requirements

According to Dennis et al. (2015), these are the specifications that the end user actively requests the system should meet as minimum requirements. As mentioned in the contract, each of these elements must be implemented into the system. The Digital Agriculture Platform Requirements must meet the following functional specifications:

- The platform ought to make precision agricultural methods possible.
- The platform ought to facilitate the amalgamation and evaluation of heterogeneous data sources, including meteorological, market, and agricultural policies from the council.
- The system ought to enable cooperation and information exchange between farmers, agronomists, and the local government.
- Farmers should be able to manage their operations while on the move with the system's mobile device accessibility.
- Small and large-scale farmers should both be supported by the platform to offer services for agricultural extension.
- To offer more efficient reporting and data gathering.

- To help the farmers comply with the regulations set forth by the council.

Use Case Diagram

According to Dennis et al. (2015), it is a visual tool that shows how the requirements and functionality of the system work. A use case just shows the main functions of the system.

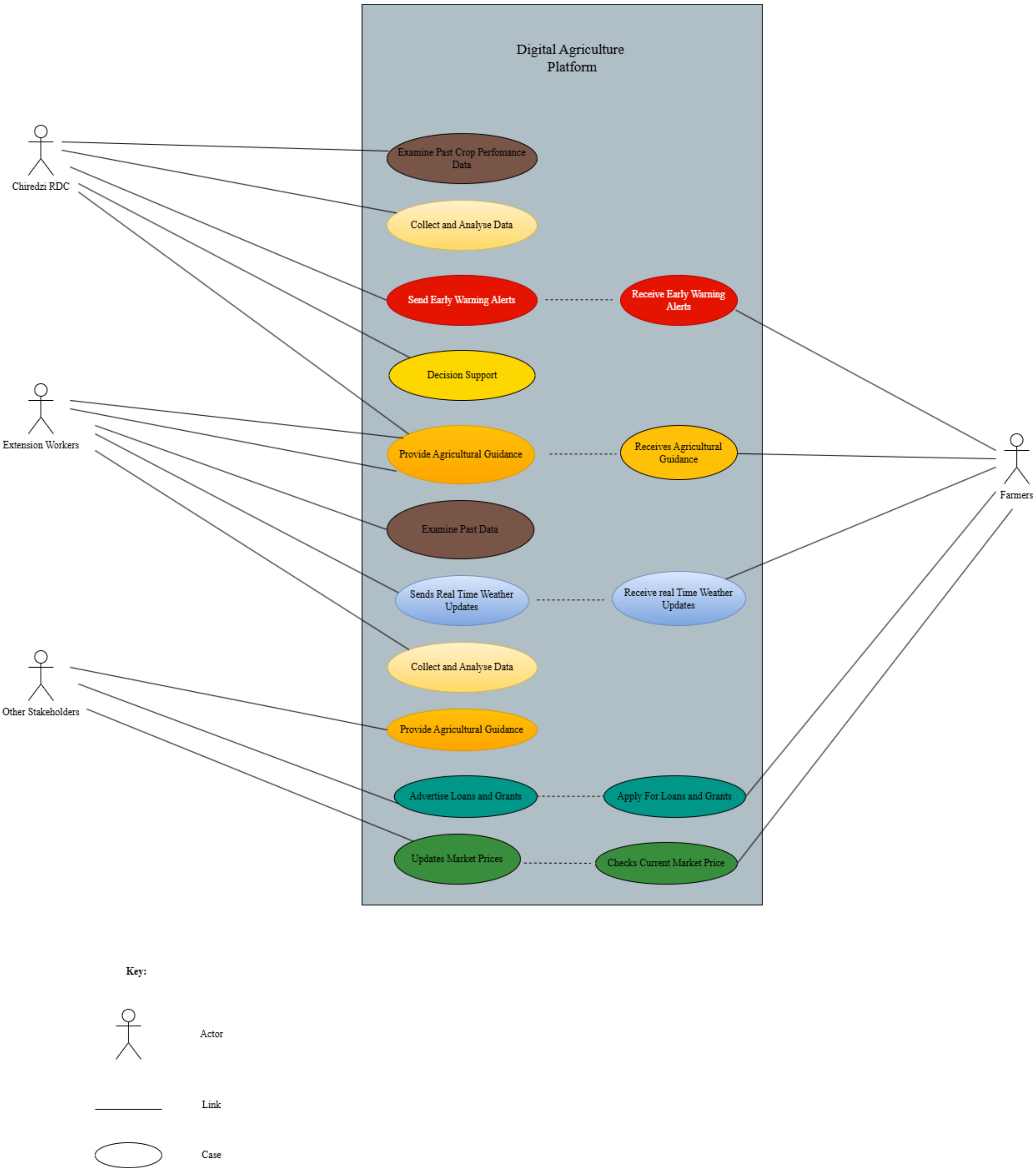


Figure 3.5: Use Case Diagram

3.8.2 Non-functional requirements

Meeting the non-functional needs that support the functional requirements is necessary for them to be satisfied, according to Dennis et al (2012). The prerequisites are:

System usability:

- It is necessary to provide a user guide for the system.
- The majority of mistakes must be recoverable by the system on its own.
- Developers should refrain from too complex systems that are challenging to operate.
- To guarantee that they are aesthetically pleasing and that users do not find it difficult to read the content, all interfaces must be clear and created with complimentary colours.

Performance

- This system should handle numerous users since several users will attempt to utilise it simultaneously.
- Timely replies must be provided to all user requests.

Reliability

- To guarantee the integrity of the data, validation is required.
- The database's contents must always be available upon request.
- Every user need must be satisfied, and every function must be performed.

Maintainability

- For the system to be able to bounce back from crashes and be quickly brought back to its previous state of complete functionality, regular backups must be enabled.

Security

- The password must be at least eight words long, contain alpha numeric characters, and not be composed of common terms.
- The characters on the screen won't be seen unless a password is provided. We'll be introducing access groups to limit the amount of access that each user has.

Constraints

- The technology will be made available as a web application, making it inexpensive and easily accessible to all farmers.

- Most rural places are still impacted by network issues. The lack of computer knowledge among farmers may make them hesitant to implement the system.

3.9 Conclusion

All of the information on the collection and analysis of data was provided in the third chapter. To examine the present system, tools such as context diagrams and dataflow diagrams were employed. After that, the researcher enumerated the problems and possible fixes for putting the recommended approach into practice. After considering other options, the internal development was chosen as the best choice. The researchers concluded by outlining the functional and non-functional requirements for the system. In the next step, the design of the proposed system will be discussed in detail.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

The proposed system will be designed using both functional and non-functional elements in this part. Logical, architectural, and physical design must be completed before the codding process starts in order for a system to be deployed properly. The blueprints will guide the Programmers are informed about the desired end result, ensuring that the necessary software will be created.

4.2 System Design

System design, according to (Alexander, 2024), is the process of defining a system's components, architecture, modules, and different interfaces. Modelling how system processes will communicate with data and one another to complete all tasks is part of system design.

4.2.1 Overview of the proposed system:

The proposed system will be able to do the following:

1. **Check Current Market Prices Online:**
   The platform will integrate real-time market price data for various agricultural products sourced from reliable sources. Farmers can access this information through a dedicated section on the platform, enabling them to make informed decisions about selling their produce.
2. **Apply for Loans and Government Grants:**
   A user-friendly interface will be provided for farmers to easily apply for loans and government grants directly through the platform. The application process will be streamlined, allowing farmers to submit necessary documentation and information digitally.
3. **Facilitate Communication through Forums:**
   Forums will be set up to foster communication among farmers, extension workers, Chiredzi RDC, and other stakeholders. Discussions, knowledge sharing, and problem-solving can take place in these forums, creating a collaborative environment within the agricultural community.
4. **Examine Past Crop Performance, Soil Conditions, and Weather Forecasts:**
   The platform will aggregate and present historical crop performance data, soil analyses, and weather forecasts in an easily understandable format. Farmers can utilize this

information to make informed decisions about crop selection, planting times, and farming practices.

5. **Provide Decision Support using Collected Data:**
Utilizing the collected data, the platform will offer decision support tools such as predictive analytics, crop management recommendations, and risk assessments. Farmers can benefit from data-driven insights to optimize their farming practices and increase productivity.
6. **Real-Time Weather Updates:**
The platform will integrate with weather APIs to provide real-time weather updates specific to the farmers' locations. This feature will help farmers plan their activities according to weather conditions, improving crop management and resource utilization.
7. **Data Collection and Analysis by Chiredzi RDC:**
The platform will enable Chiredzi RDC to collect, store, and analyse agricultural data to identify trends, challenges, and opportunities in the region. Data-driven insights will inform policy-making and resource allocation for agricultural development.
8. **Send Early Warning Alerts:**
Early warning alerts related to weather events, pest outbreaks, diseases, or market fluctuations will be sent to farmers through the platform. This proactive approach will help farmers mitigate risks and take timely actions to safeguard their crops and livelihoods.
9. **Guide Farmers on Best Practices:**
The platform will provide guidance on crop selection, pest control measures, irrigation schedules, and best farming practices through informative articles, tutorials, and interactive tools. Farmers can access this knowledge repository to enhance their farming skills and adopt sustainable agricultural techniques.
10. **Enable Knowledge Sharing:**
A dedicated section or feature will allow farmers to share their experiences, insights, and best practices within the platform. This knowledge-sharing aspect will foster a sense of community, encourage peer learning, and promote innovation in agriculture.

4.2.1 System Flow Chart

A flow chart is a graphic depiction of the main elements of a system. A system flow chart depicts the physical and external elements of the system and the sequence in which they interact. The figure below demonstrates how it diagrammatically depicts a series of events.

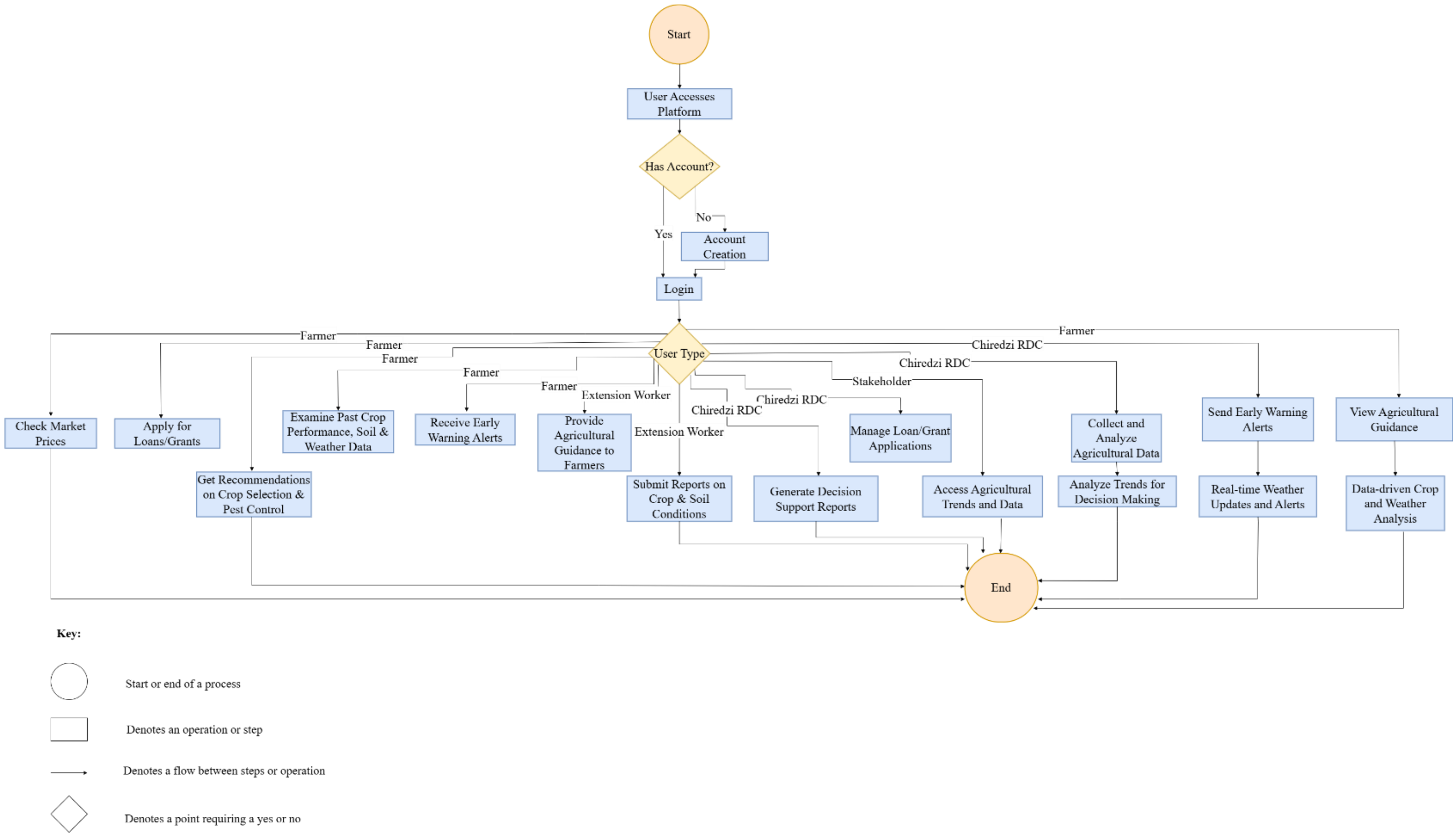


Figure 4.6: System Flow Chart

4.2.2 Context diagram for the system proposed:

According to Tomboc (2024), a context diagram is a straightforward visual depiction of how a system interacts with its surroundings.

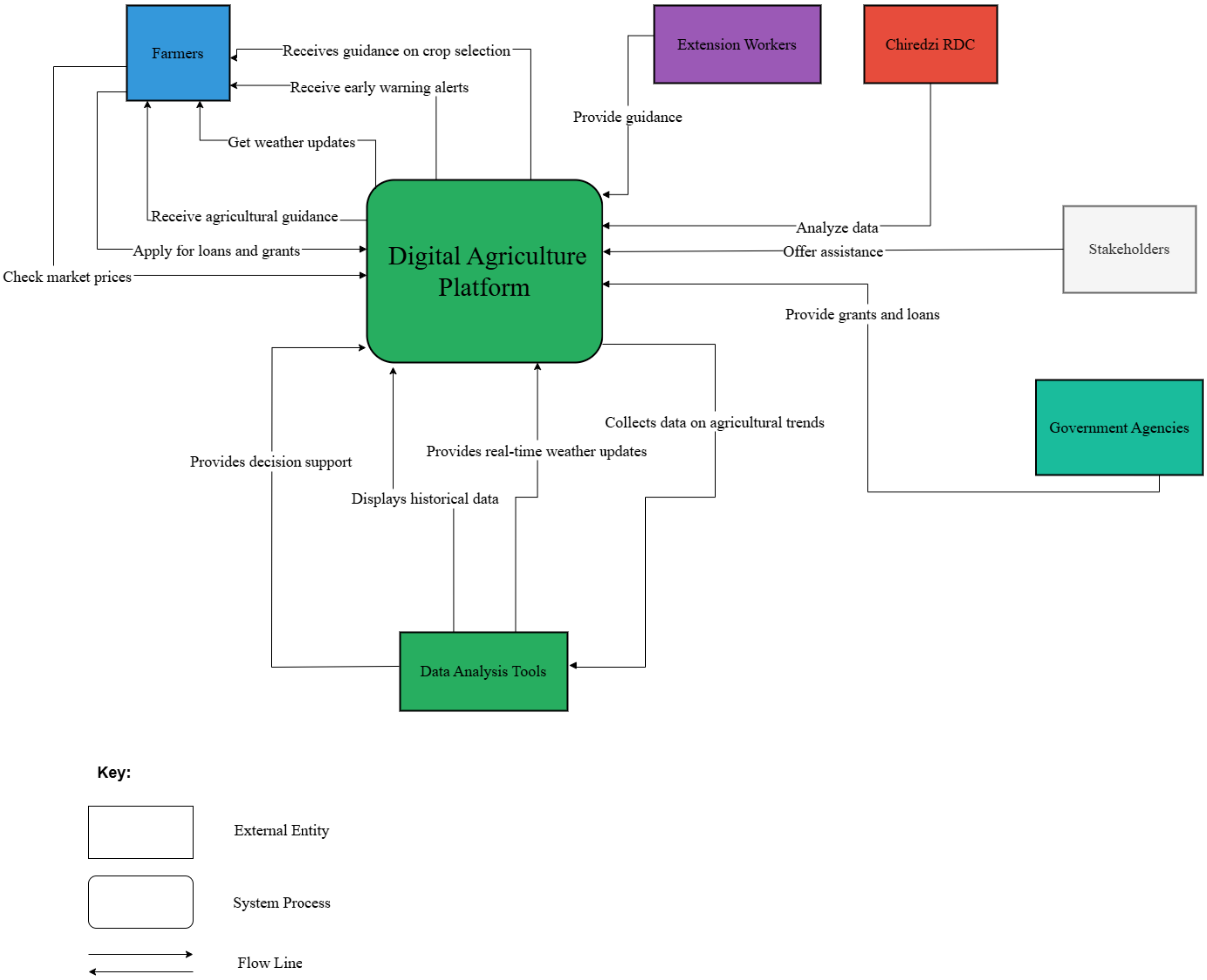


Figure 4.7: Context Diagram

4.2.3 Data Flow Diagram for the proposed system

Data flow diagrams are a kind of visual representation that highlight the inputs and outputs of a system's data processing. Below is the DFD for the current Digital Agriculture Platform:

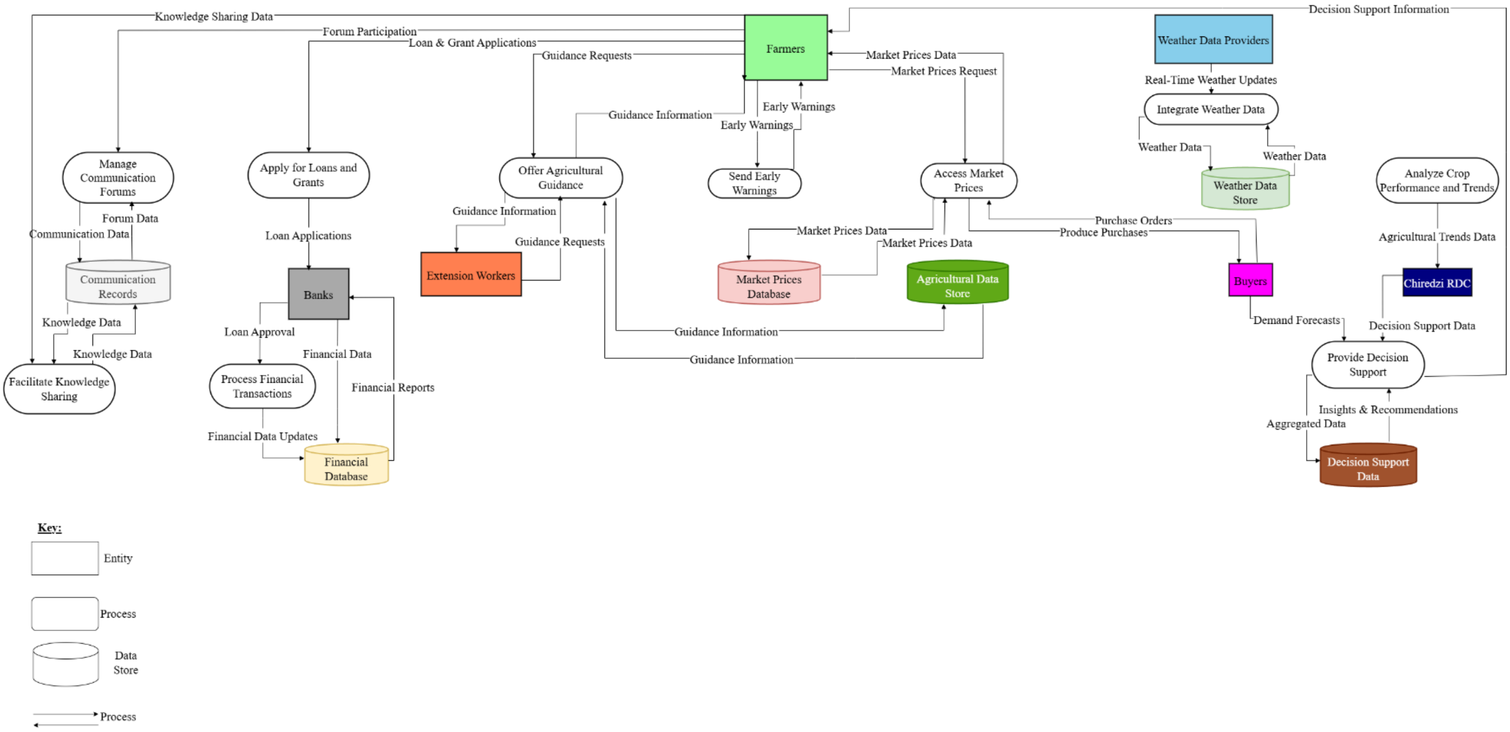


Figure 4.8: Data Flow Diagram

4.3 Architectural design

The most abstract version of the system is the architectural design. It views software as a system made up of several interrelated parts. At this stage, designers have a broad grasp of the proposed solution area (Sommerville, 2014). The outcome of the design process is a detailed outline of the software architecture. Architectural design involves creating a foundational structure that outlines the core components of the system and how they interact.

4.3.1 Architectural components

Servers: they are used to host web apps and systems.

CLIENT PC: this stands for every user of the system.

In order to enhance the system's performance, three interconnected layers will cooperate:

Presentation layer: consisting of the interface components

The application programs layer: is where all user requests will be handled.

The database server: will be responsible for hosting the system's database and enabling remote access to it.

Web browser: a program that enables users to access online web systems and applications.

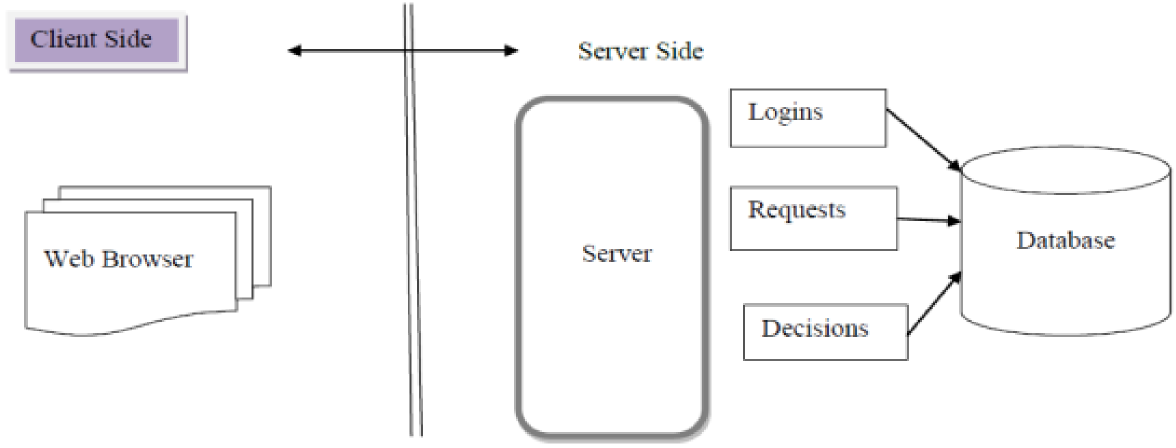


Figure 4.9: Architectural Design

4.4 Physical design

A system's inputs, processes, and outputs are shown in its physical design along with how they relate to and work with its other components (Dooley, 2017). This section describes how information is input into the system, processed, and presented inside the system. The following will be the elements of the Smart Health Prediction System:

4.4.1 Inputs

Inputs refer to the information that users provide through the system's user interface.

1. **User Data**
    - Farmers details (Name, ID Number and Phone Number)
    - Agricultural extension workers details (Name, ID Number, Phone Number and Ward)
2. **Market Data**
    - Current market prices for various agricultural products
    - Historical price trends
3. **Financial Data**
    - Information on available loans and government grants
    - Application forms and requirements for loans and grants
4. **Agricultural Data**
    - Historical crop performance data
    - Soil condition reports
    - Weather data (forecasts and historical records)

4.4.2 Processes

1. **Data Collection**
    - Gather data from local markets, weather stations, and agricultural databases.
    - Collect user inputs on crop performance and conditions.
2. **Market Price Update**
    - Regularly update current market prices and historical trends.
    - Analyse and display trends for farmers.
3. **Loan and Grant Application Processing**
    - Enable farmers to fill out applications online.
    - Streamline approval processes with automated notifications.
4. **Communication Facilitation**
    - Organize forums for discussions among farmers, extension workers, and stakeholders.
    - Provide a platform for knowledge sharing.
5. **Data Analysis**
    - Analyse collected agricultural data to identify trends and insights.
    - Provide decision support using analytics and predictive modelling.
6. **Weather Monitoring**
    - Continuously monitor weather conditions and forecasts.
    - Send real-time updates to farmers.
7. **Guidance and Recommendations**
    - Offer tailored advice on crop selection, pest control, and irrigation schedules based on collected data.
    - Provide access to best practices in agriculture.

4.4.3 Outputs

1. **Market Insights**
    - Dashboard displaying current prices, trends, and forecasts.
2. **Loan and Grant Status**
    - Notifications on the status of applications submitted by farmers.
3. **Communication Logs**
    - Records of discussions and knowledge shared in forums.

4. **Data Reports**
    - Regular reports on agricultural trends, weather impacts, and farmer performance.
5. **Weather Alerts**
    - SMS or app notifications for real-time weather updates and early warnings.
6. **Decision Support Recommendations**
    - Personalized guidance for farmers based on data analysis.
7. **Knowledge Base**
    - A repository of shared knowledge, best practices, and resources accessible to all users.
8. **User Feedback**
    - Insights and feedback from users for continuous improvement of the platform.

4.5 Database Design

The database of the system will be designed using the ANSI-SPARC three level architectural design. At least the third normal form must be used for every table. It is feasible to make changes to some database components without affecting other components because to this architecture.

4.5.1 Physical database design

Physical database design transforms database schemas into actual database structures by translating entities into tables, instances into rows, and attributes into columns. The ANSISPARC model, which includes conceptual, physical, and external database layers, defines how data should be represented at the physical level.

4.5.1.1 External Level

The external level represents the user's view of the database, showing only the relevant data for that particular user. This level is composed of multiple external views, each displaying only the entities, attributes, and relationships the user needs. The same data can appear differently across these views; for example, one user might see a name formatted as (firstname, lastname), while another might view it as (lastname, firstname).

4.5.1.2 Conceptual Level

The conceptual level offers a shared view of the database, detailing the stored information, entities, their attributes, and their relationships. It highlights data integrity, security, and semantic details. Positioned as the middle or second layer in the three-level architecture, this level focuses on the database's logical structure without addressing storage details. It provides a comprehensive view of the database as required by the organization.

4.5.1.3 Internal View:

At the internal level, the database is represented physically on the computer, with a focus on data encryption methods and physical design to optimize runtime efficiency and storage utilization. This level interacts with the operating system to handle tasks such as data storage, allocation of storage space, and data retrieval.

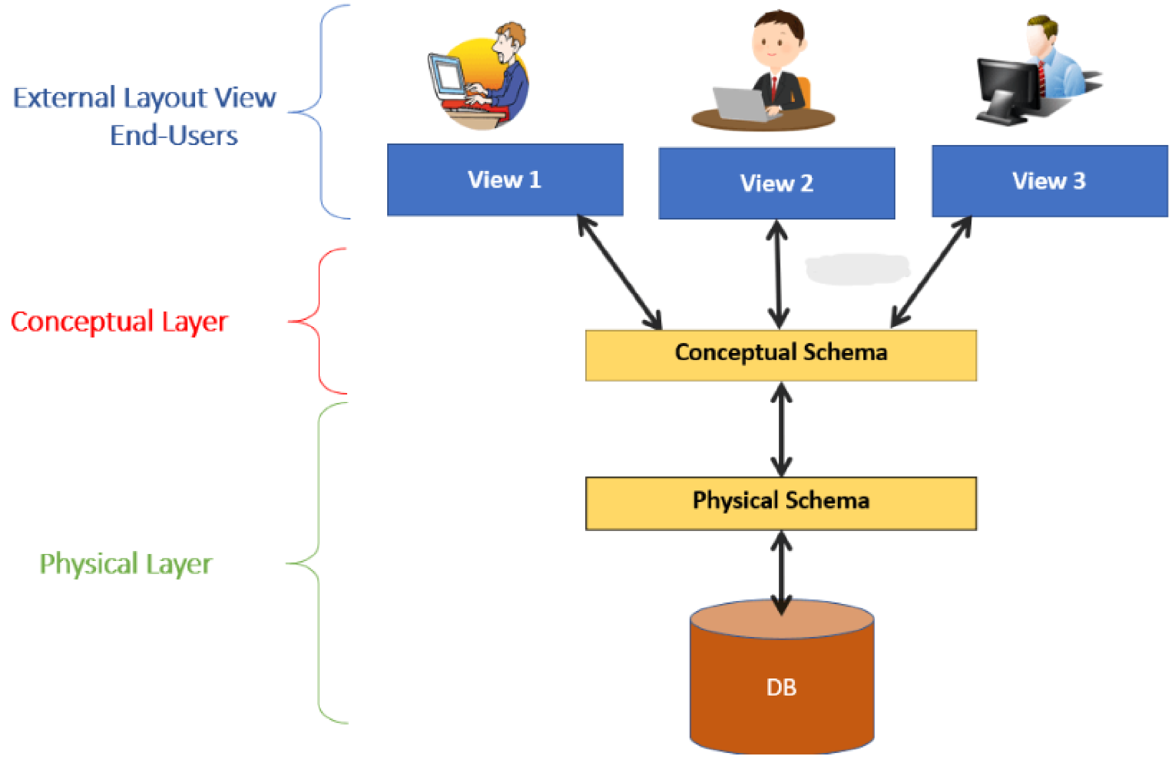


Figure 4.10: **Database Design**

4.5.2 Logical Database Design

The logical database design includes the identification of the entities and their connections in the proposed system. The following entities comprise the Digital Agriculture Platform.

- Farmer
- Extension Worker

- Chiredzi Rural District Council (RDC)
- Market Data
- Loan and Grant
- Weather Data
- Crop Performance
- Forum/Discussion Group
- Alerts/Notifications
- Decision Support System
- Knowledge Base
- User Feedback

4.5.2.1 Data Dictionary

A data dictionary is a table within a database that holds definitions, data items, and instance names.

- **Market Price Details**
  (Price-ID, ProductName, Market-Price, Currency, Date-Recorded, Source, Location)
- **Loan Details**
  (Loan-ID, Farmer-ID, Loan-Amount, Interest-Rate, Loan-Term, Application-Date, Status, Repayment-StartDate, Total-Repayment, Comments)
- **Grants Details**
  (Grant-ID, Farmer-ID, Grant-Amount, Application-Date, Status, Approval-Date, Disbursement-Date)
- **Communication Details**
  (Message-ID, Sender-ID, Receiver-ID, Message-Content, Date-Sent, Status, Reply-To-Message-ID)
- **Crop Performance Details**
  (Performance-ID, Farmer-ID, Crop-Type, Year, Season, Yield, Soil-Condition, Pest-Issues, Weather-Conditions, Comments)
- **Weather Details**
  (Weather-ID, Location, Date-Recorded, Temperature, Humidity, Precipitation, Wind-Speed, Weather-Condition, Comments)

- **Decision Support Details**
  (Decision-ID, Farmer-ID, Crop-Type, Analysis-Date, Yield-Forecast, Optimal-Irrigation, Pest-Recommendations, Soil-Nutrient-Levels, Weather-Impact, Decision-Recommendations**,** Comments)
- **Alerts Details**
  (Alert-ID, Farmer-ID, Alert-Type, Message, Date-Issued, Severity, Status, Expiration-Date, Comments)
- **Guidance Details**
  (Guidance-ID, Crop-Type, Guidance-Type, Description, Recommendation, Season, Date-Created, Last-Updated, Comments)
- **Knowledge sharing details**
  (Knowledge-ID, Contributor-ID, Title, Content, Date-Posted, Category, Visibility, Comments-Count, Likes-Count, Last-Updated)

4.5.2.2 Normalisation

In order to display the required relationships, normalisation entails creating and constructing tables. This procedure entails organising the database according to a set of criteria while protecting data. The database is normalised by following a set of guidelines. The following data tables have been normalised and satisfy the normalisation requirements.

Table 4.16: Market Price

Fields Name	Data Type	Constraints
Price_id	Integer	Not Null
Product_name	Varchar(100)	Not null
Market_price	Decimal(10, 2)	Not Null
Currency	Varchar(10)	Not Null
Date_recorded	Date	Not Null
Source	Varchar(255)	Not Null
Location	Varchar(100)	Not Null

Table 4.17: Loans

Field Name	**Data Type**	**Constraints**
Loan_id	Integer	Not Null
Farmer_id	Integer	Not Null
Loan_amount	Decimal(10, 2)	Not Null
Intrest_rate	Decimal(5, 2)	Not Null
Loan_term	Integer	Not Null
Application_date	Date	Not Null
Status	Varchar(50)	Not Null
Repayment_start_date	Date	Nullable
Total_repayment	Decimal(10, 2)	Nullable
Comments	Text	Nullable

Table 4.18: Grants

Field Name	**Data Type**	**Constraints**
Grant_id	Integer	Not Null
Farmer_id	Integer	Not Null
Grant_amount	Decimal(10, 2)	Not Null
Application_date	Date	Not Null
Status	Varchar(50)	Not Null
Approval_date	Date	Nullable
Disbursment_date	Date	Nullable
Purpose	Varchar(255)	Not Null
Comments	Text	Nullable

Table 4.19: Communication

Field Name	Data Type	Constraints
Message_id	Integer	Not Null
Sender_id	Integer	Not Null
Receiver_id	Integer	Not Null
Message_content	Text	Not Null

Date_sent	DateTime	Not Null
Status	Varchar(50)	Not Null
Reply_to_message_id	Integer	Nullable

Table 4.20: Crop Performance

Field Name	**Data Type**	**Constraints**
Performance_id	Integer	Not Null
Farmer_id	Integer	Not Null
Crop_type	Varchar(100)	Not Null
Year	Integer	Not Null
Season	Varchar(50)	Not Null
Yield	Decimal(10, 2)	Not Null
Soil_condition	Varchar(100)	Not Null
Pest_issues	Varchar(255)	Nullable
Weather_conditions	Varchar(255)	Nullable
Comments	Text	Nullable

Table 4.21: Weather Data

Field Name	**Data Type**	**Constraints**
Weather_id	Integer	Not Null
Location	Varchar(100)	Not Null
Date_recorded	Date	Not Null
Tempreture	Decimal(5,2)	Not Null
Humidity	Decimal(5,2)	Not Null
Precipitation	Decimal(5,2)	Not Null
Wind_speed	Decimal(5,2)	Nullable
Weather_condition	Varchar(5)	Not Null
Comments	Text	Nullable

Table 4.22: Decision Support

Field Name	Data Type	Constraints
Decision_id	Integer	Not Null
Farmer_id	Integer	Not Null
Crop_type	Varchar(100)	Not Null
Analysis_date	Date	Not Null
Yield_forecast	Decimal(10.2)	Not Null
Optimal_irrigation	Decimal(5.2)	Not Null
Pest_recommendations	Text	Nullable
Soil_nutrient_levels	Varchar(255)	Nullable
Weather_impact	Varchar(255)	Nullable
Decision_recomendations	Text	Not Null
Comments	Text	Nullable

Table 4.23: Alerts

Field Name	Data Type	Constraints
Alert_id	Integer	Not Null
Farmer_id	Integer	Not Null
Alert_type	Varchar(50)	Not Null
Message	Text	Not Null
Date_issued	DateTime	Not Null
Severity	Varchar(20)	Not Null
Status	Varchar(20)	Not Null
Expiration_date	DateTime	Nullable
Comments	Text	Nullable

Table 4.24: Guidance

Field Name	Data Type	Constraints
Guidance_id	Integer	Not Null
Crop_type	Varchar(50)	Not Null
Guidance_type	Varchar(50)	Not Null

Description	Text	Not Null
Recommendation	Text	Not Null
Season	Varchar(50)	Not Null
Date_created	DateTime	Not Null
Last_updated	DateTime	Not Null
Comments	Text	Nullable

Table 4.25: Knowledge Sharing

Field Name	**Data Type**	**Constraints**
Knowledge_id	Integer	Not Null
Contributor_id	Integer	Not Null
Title	Varchar(150)	Not Null
Content	Text	Not Null
Date_posted	Date Time	Not Null
Category	Varchar(50)	Not Null
Visiblity	Varchar(20)	Not Null
Comments_count	Integer	Not Null
Likes_count	Integer	Not Null
Last_updated	Date Time	Not Null

4.5.2.3 Entity Relationship Diagram

The following figure presents the entity relationship diagram, illustrating the connections between entities within the Digital Agriculture Platform and their interrelationships.

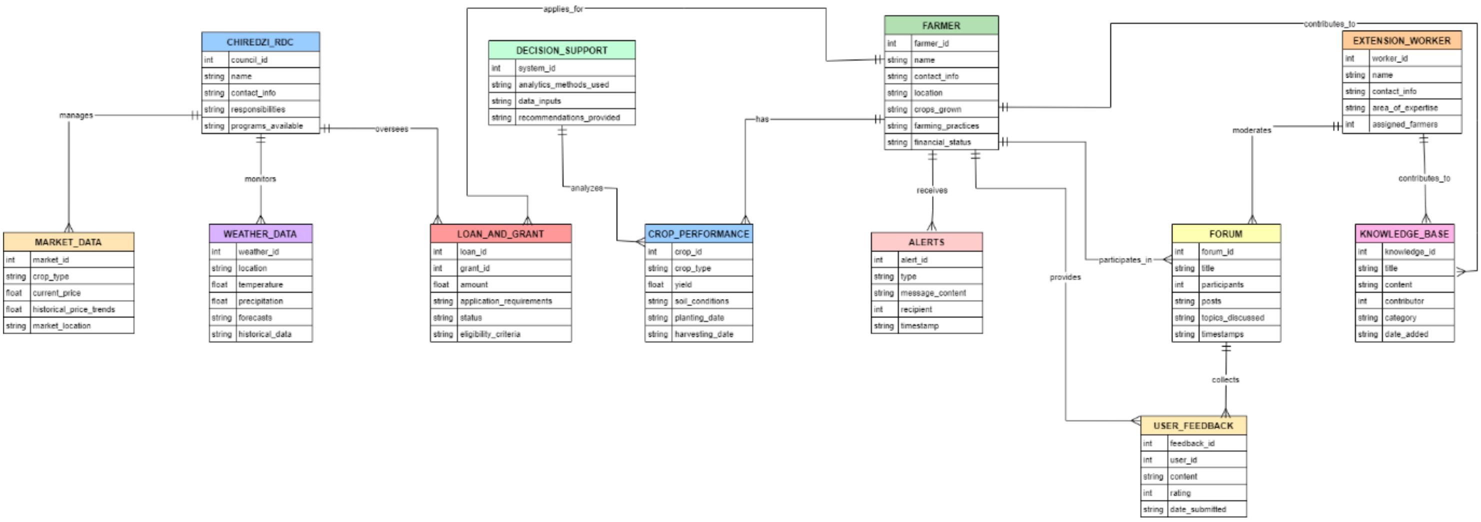


Figure 4.11: Entity Relationship Diagram

4.6 Design Interface

Dennis, Wixom, and Roth (2012) describe interface design as the front-end view through which users interact with and operate the system. The user interface enables users to manage and control the software, serving as a medium for interaction with the computer. The proposed system's interface will use a Graphical User Interface (GUI) because of its user-friendly and intuitive design. The system is easy for users with little to no expertise to learn how to use. The process of switching is swift. A quick full-screen interaction is provided, enabling users to swiftly switch between tasks and instantly engage with various programs and information.

Block Diagram

A block diagram illustrates the core components of a system and the connections between its modules. It allows for quick full-screen interaction, providing instant access to multiple programs and information.

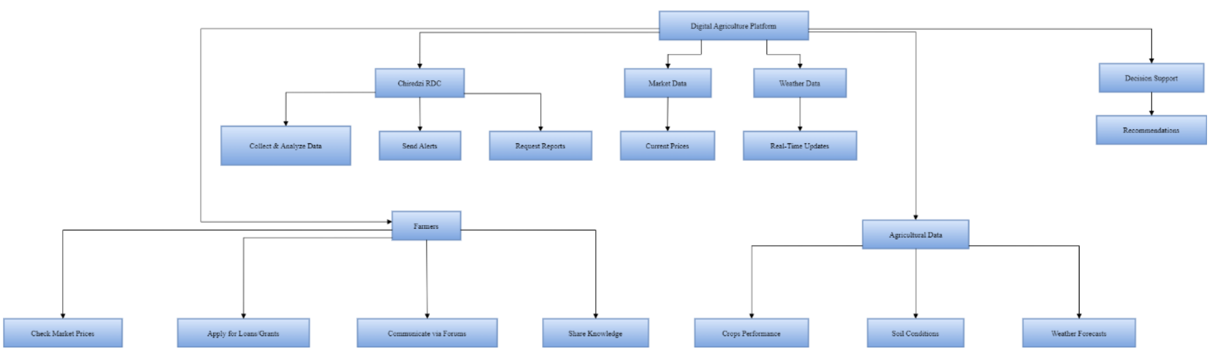


Figure 4.12: Block Diagram

4.6.1 Input Design

The input design refers to the layout of the pages used by administrators and users of the smart health prediction system to submit data. It is essential that every piece of information entered into the system is thoroughly verified and validated.

Login

To ensure security, all users are required to create usernames and passwords in the database and log in before accessing the system. The digital agriculture platform's login form design is seen below:

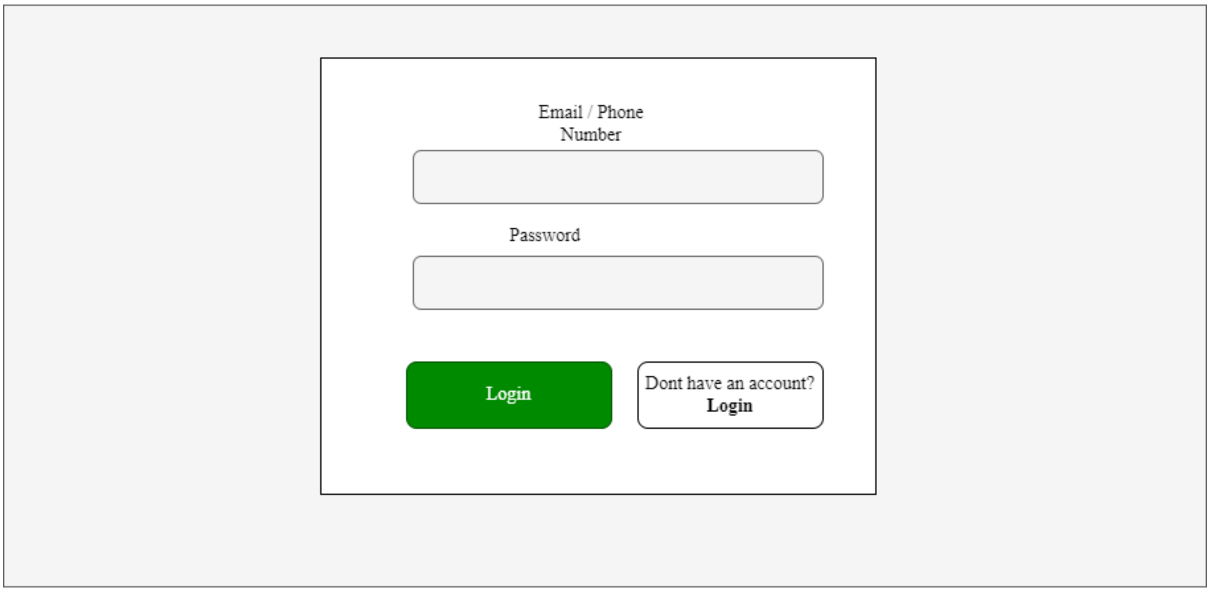


Figure 4.13: Login Page Design

Farmer Registration

To register as users of the Digital Agriculture Platform, new farmers fill out the registration form. Following completion of the registration form, the farmer will receive a user ID and password that they may use to access the system.

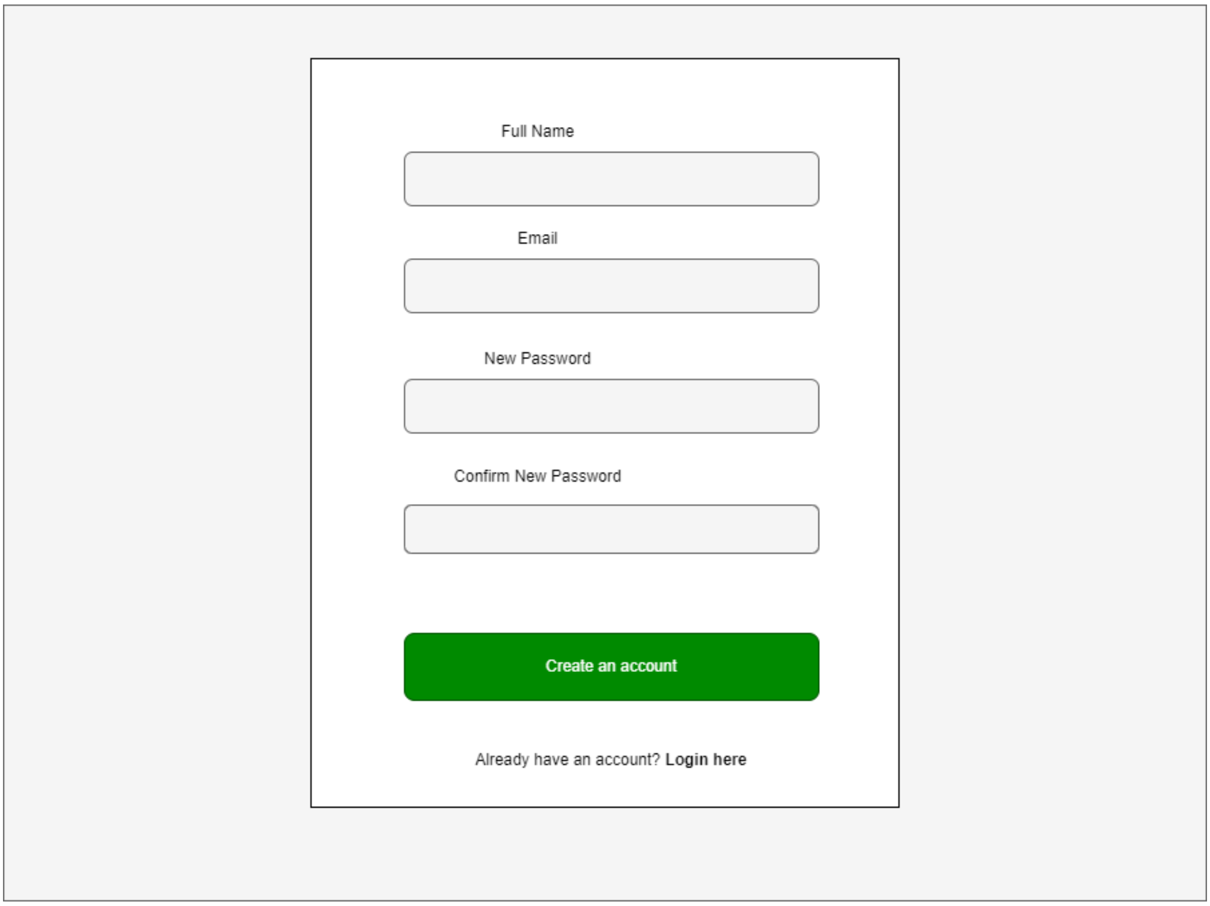


Figure 4.14: User Registration Design

Add Farm

New farmer will add their farm details so that they can receive real time weather updates and location-based recommendations from the platform

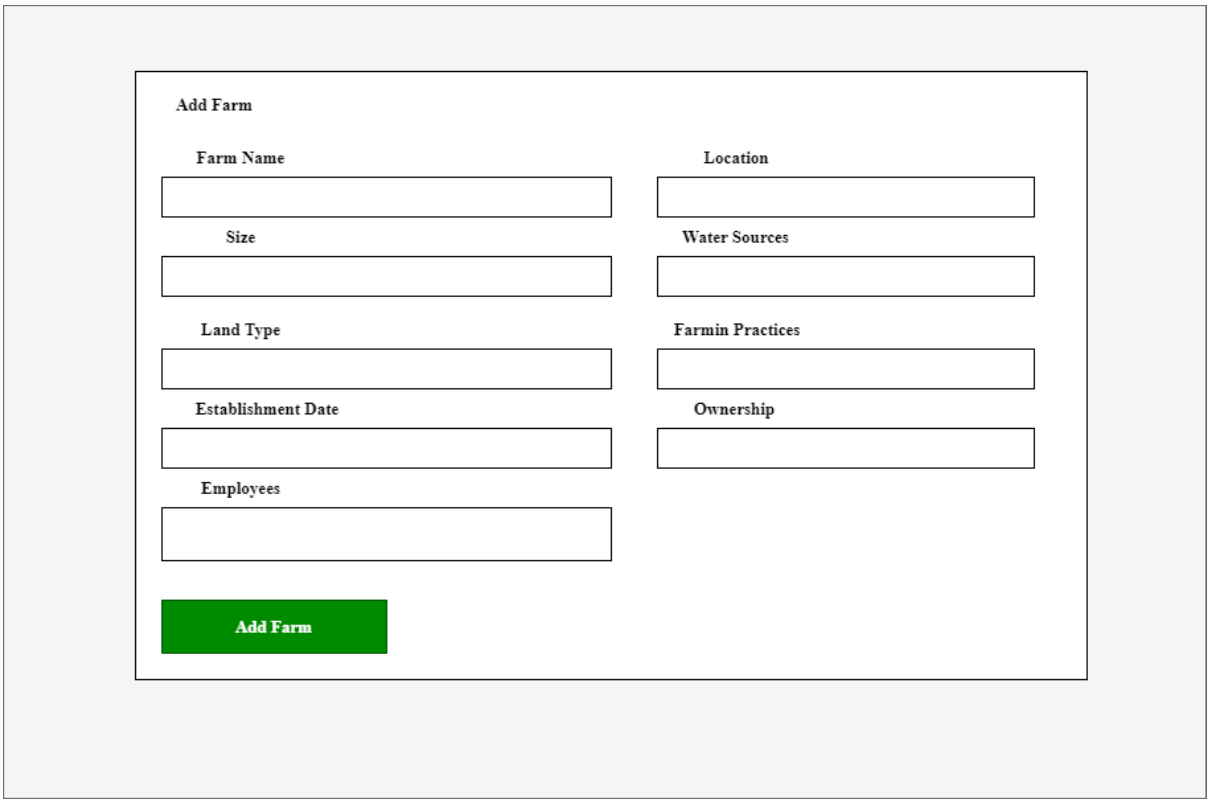


Figure 4.15: Add farm Design

Discussion

Registered farmers will share knowledge within the system using their usernames through this chat forum:

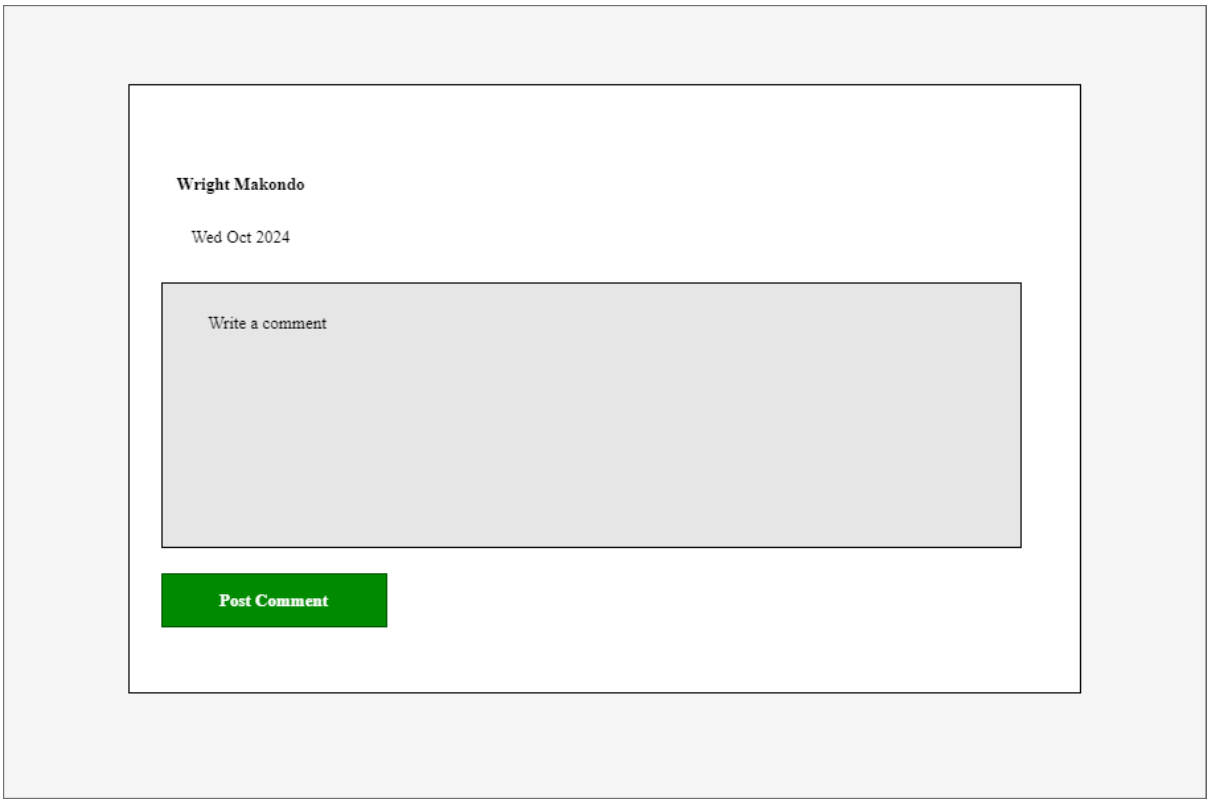


Figure 4.16: Discussion Design

4.6.2 Output Design

The output design refers to the presentation of data entered by the user, displayed as the output. It is structured to ensure that each user receives the correct output and that the final results are presented accurately. The output designs for the Digital Agriculture Platform are as follows:

Dashboard

This window will provide real time weather updates, farming updates and recommended crops as shown below:

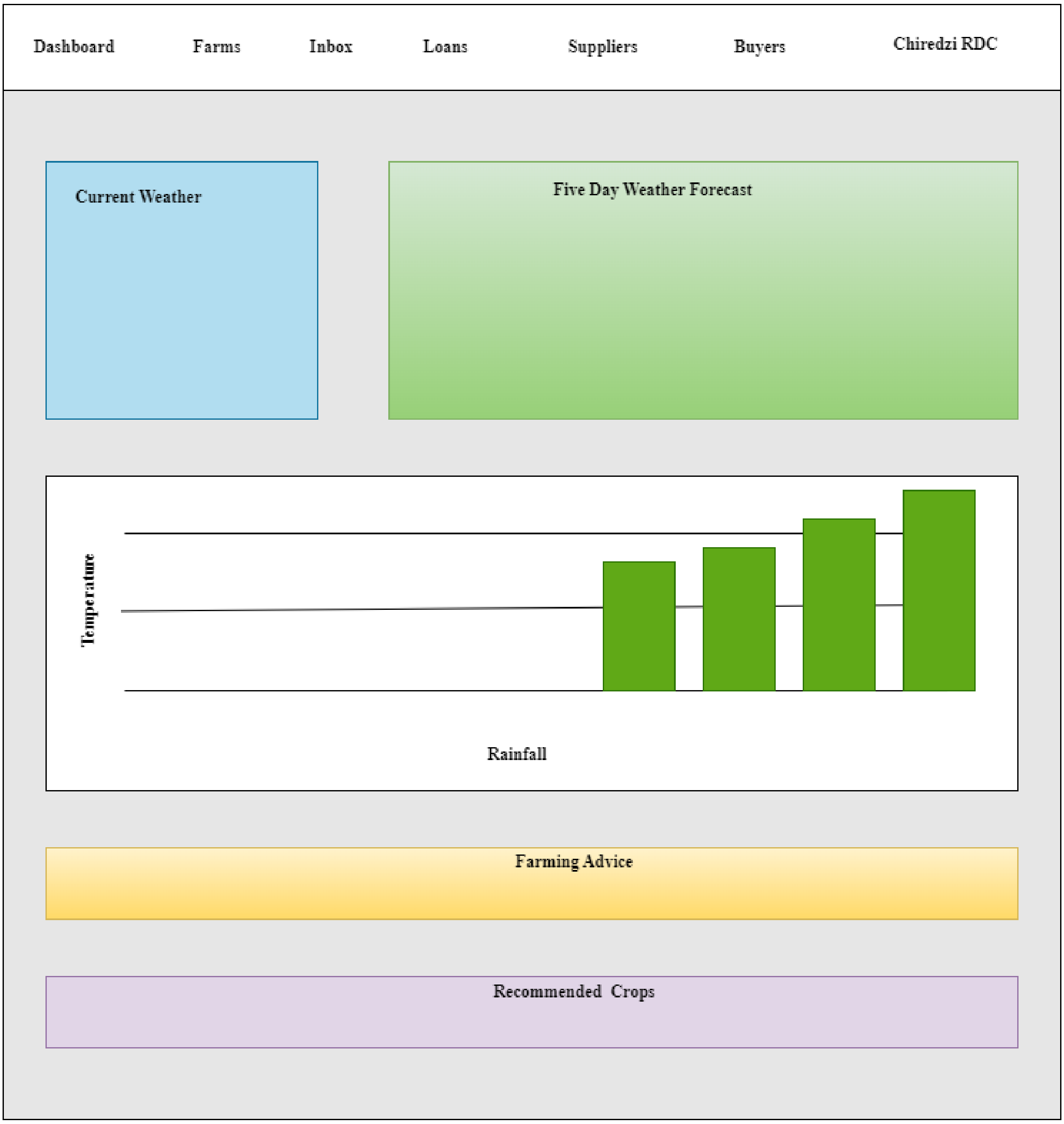


Figure 417: Dashboard Design

Loan Advert

This output window will allow farmers to see the loans that have been advertised by banks as shown below:

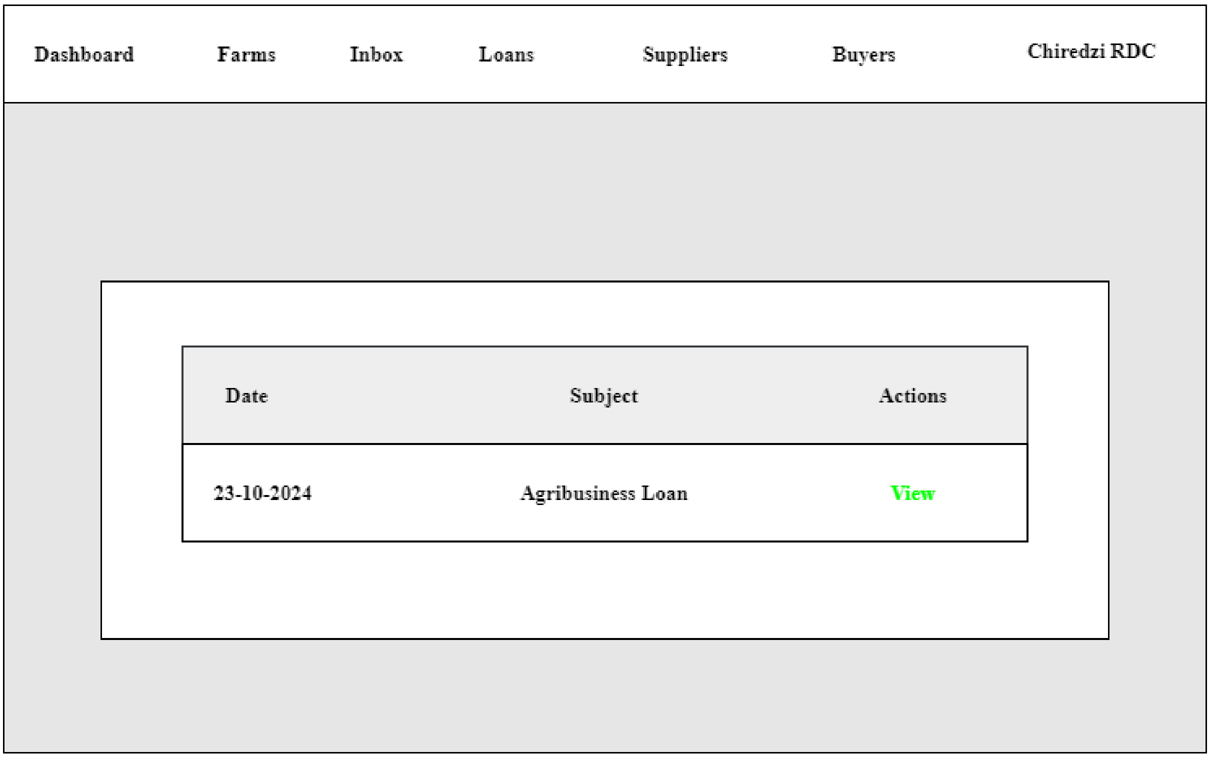


Figure 4.18: Loan Advert Design

4.7 Program Design

Program design is the process of translating user requirements into a format that allows the programmer to develop the software (Goyena & Fallis, 2019). It involves analysing the research data and generating user requirements that will guide the program development process.

4.7.1 Package Diagram

Scarlet (2013) asserts that the package diagram illustrates the interdependencies between different system modules.

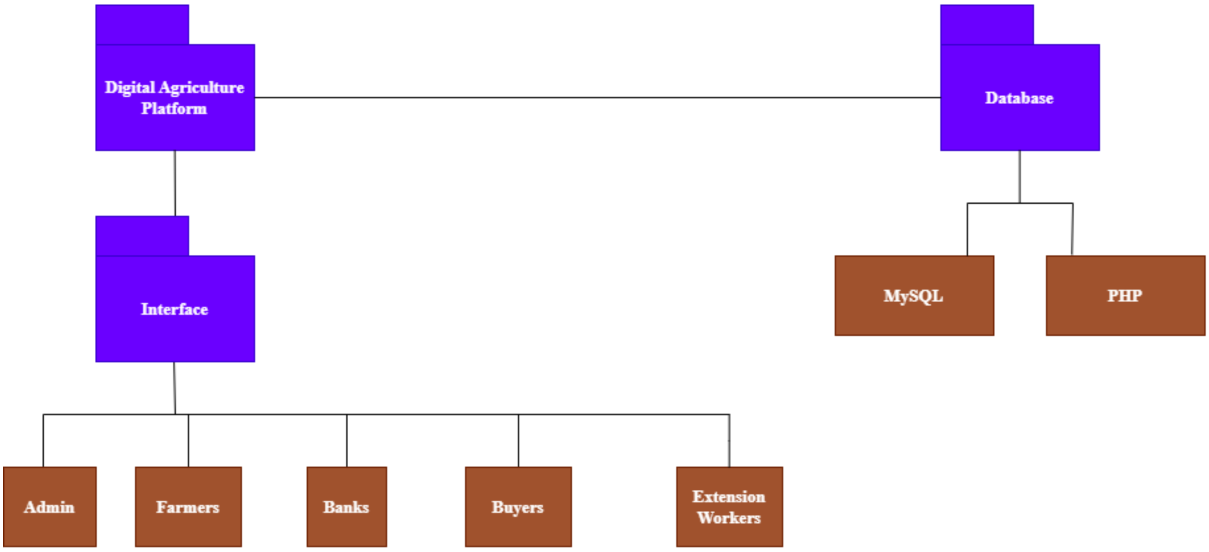
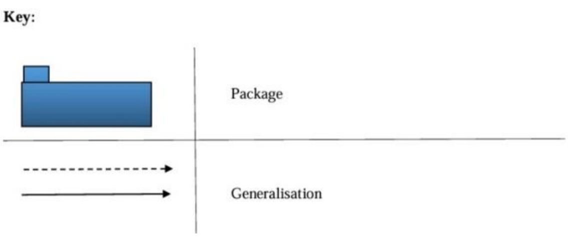


Figure 4.19: Package Diagram



4.7.2 Class Diagram

A class diagram is the most essential component of object-oriented modeling. It illustrates the various system objects, their attributes, methods, and relationships (Booch et al., 2003). It also shows the entities, their dependencies, and the actions performed by each entity. Specifically, the class diagram aligns with the functional requirements and data perspectives of the problem domain.

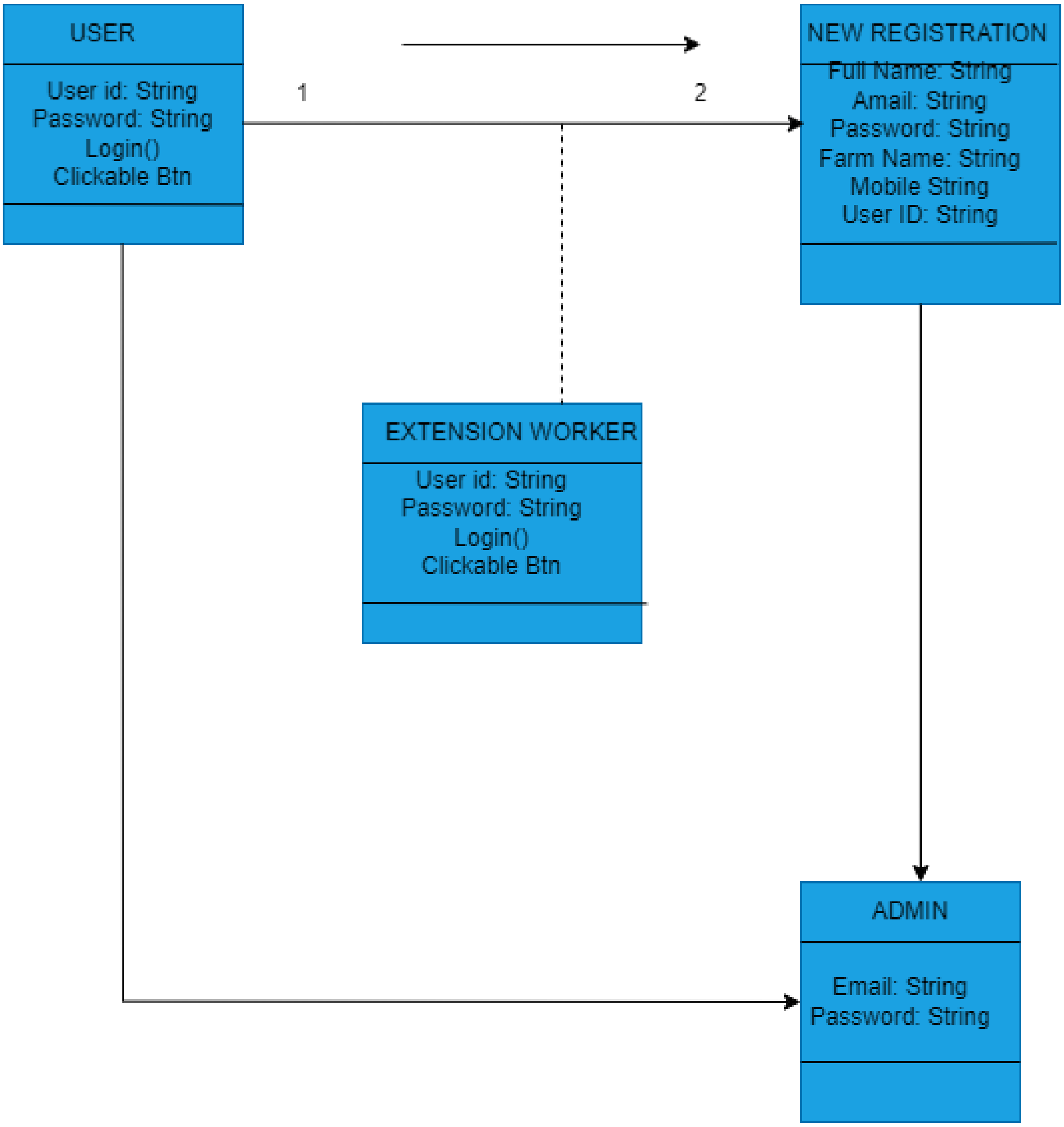


Figure 4.20: Class Diagram

4.7.3 Sequence Diagram

A sequence diagram illustrates the sequence of interactions between different subsystems to complete a task. These interactions occur when a specific use case is executed (Korth & Silberschatz, 1991).

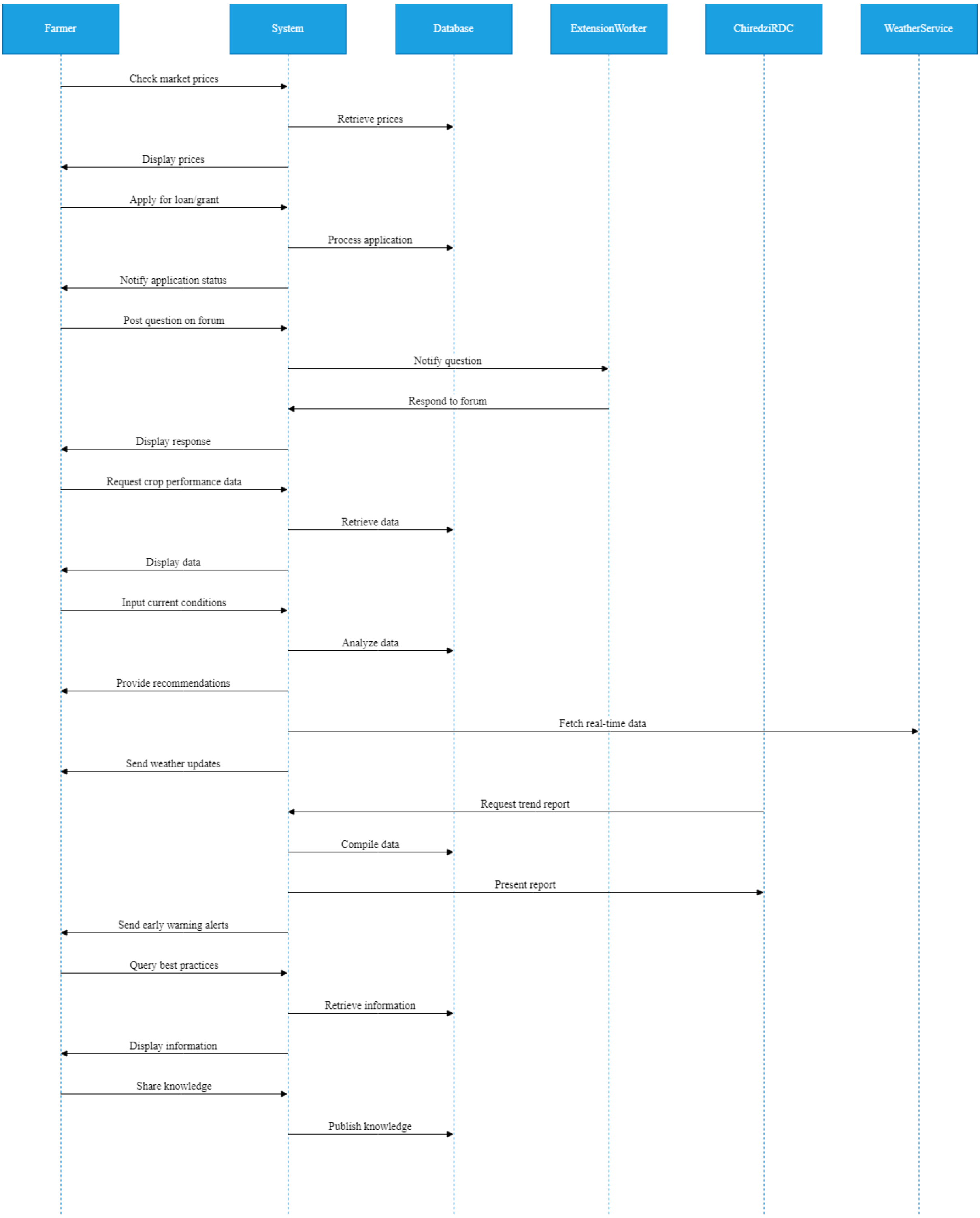


Figure 4.21: Sequence Diagram

4.8 Pseudocode

Pseudocode is a step-by-step description of an algorithm. It is designed for human understanding rather than machine processing, so it does not use any programming languages. Instead, it relies on simple, plain English. Pseudocode serves as the intermediate stage between a concept and its implementation in high-level programming code.

Start Digital Agriculture Platform

Initialize System

Display Main Menu

Options:

1. Check Current Market Prices
2. Apply for Loans and Grants
3. Join Forums
4. View past Crop Performance, Soil Conditions, and Weather Forecasts
5. Access Decision Support
6. View Real-Time Weather Updates
7. Data Collection and Analysis by Chiredzi RDC
8. Receive Early Warning Alerts
9. Get Guidance on Crop Selection, Pest Control, Irrigation, and Best Practices
10. Share Knowledge

User Input: Select Option

If Option = 1

Display Current Market Prices

If Option = 2

User Input: Apply for Loan or Government Grant

If Option = 3

Display Forums

User Input: Interact with Farmers, Extension Workers, Chiredzi RDC, and Other Stakeholders

If Option = 4

Display past Crop Performance, Soil Conditions, and Weather Forecasts

If Option = 5

Display Decision Support using Collected Data

If Option = 6

Display Real-Time Weather Updates

If Option = 7

Data Collection and Analysis by Chiredzi RDC

If Option = 8

Send Early Warning Alerts to Farmers based on Data Analysis

If Option = 9

Provide Guidance on Crop Selection, Pest Control, Irrigation Schedules, and Best Practices

If Option = 10

Allow Farmers to Share Knowledge within the System

If User Wants to Exit

Terminate System

End Digital Agriculture Platform

4.9 Security Design

Security design is a software development approach that integrates strict engineering, testing, and authentication protocols. The program will leverage customizable third-party features and built-in system security to ensure a flawless user experience.

4.9.1 Physical Security

The purpose of physical security is to safeguard the system's hardware components from unauthorized access. There is strict physical security in place in the rooms that are meant to house the on-site servers. Among the actions are:

- Cameras and closed-circuit television surveillance are installed in rooms with system accessories.

- To maintain acceptable indoor temperatures, install air conditioners.
- Use an independent disc technique backup drive with the safest redundancy array possible.

4.9.2 Network Security

Network security is the practice of protecting the underlying networking infrastructure from theft, misuse, and unauthorized access. It comprises setting up a safe framework for users, apps, devices, and programs to function on. Its goal is to safeguard data packets that system users input and output via the internet. The Digital Agriculture Platform requires the greatest level of protection against unauthorised access due to its web-based nature. The following are the network security migration strategies for the Digital Agriculture Platform:

- The end-device encryption network session key.
- A firewall to ward off malicious online attacks.
- Antivirus

4.9.3 Operational security (OPSEC)

The operational security approach helps system administrators monitor system security, promoting the protection of sensitive data through this procedural safety measure. Among the operational safety metrics are:

- Just provide the required Android permissions to the system to make sure that unused services cannot access the application.
- To manage authentication, use sessions and shared preferences.
- Utilising other licensed, more secure protocols, such as Secure Socket Layer (SSL).
- Making use of preventative firewall techniques to avert data breaches.

4.10 Conclusion

The results of the analysis step served as a guide for the design stage, allowing the researchers to develop the designs needed to put the suggested system into practice. A dataflow diagram was used to illustrate all of the new system's primary procedures and data needs. In order to facilitate good communication between the system and users, interfaces for entering and presenting data have been created. Finally, the system's security designs were developed to guarantee its security. The researchers will create, test, and apply the suggested system during the next and last stage of development.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

Since this is the final stage of the project, the programmers will physically design the system using MySQL and Python. Both the developer and the users will assess the finished system within a week after developing the code to see if it meets the required requirements. Once users and developers have obtained the required test results, the system will be deployed, and users will be trained on how to use it. The most suitable deployment method will be selected, and maintenance plans will be recommended. Ultimately, the researcher will propose further improvements.

5.2 Coding

Coding follows the system design phase. During this stage, developers begin constructing the entire system using the chosen programming language. The tasks are divided into smaller components or modules, which are then assigned to different developers for implementation. The Digital Agriculture Platform was developed by a modular modelling technique, in which individual modules were developed and then combined to build the system as a whole.

5.2.1 Database Connection Code

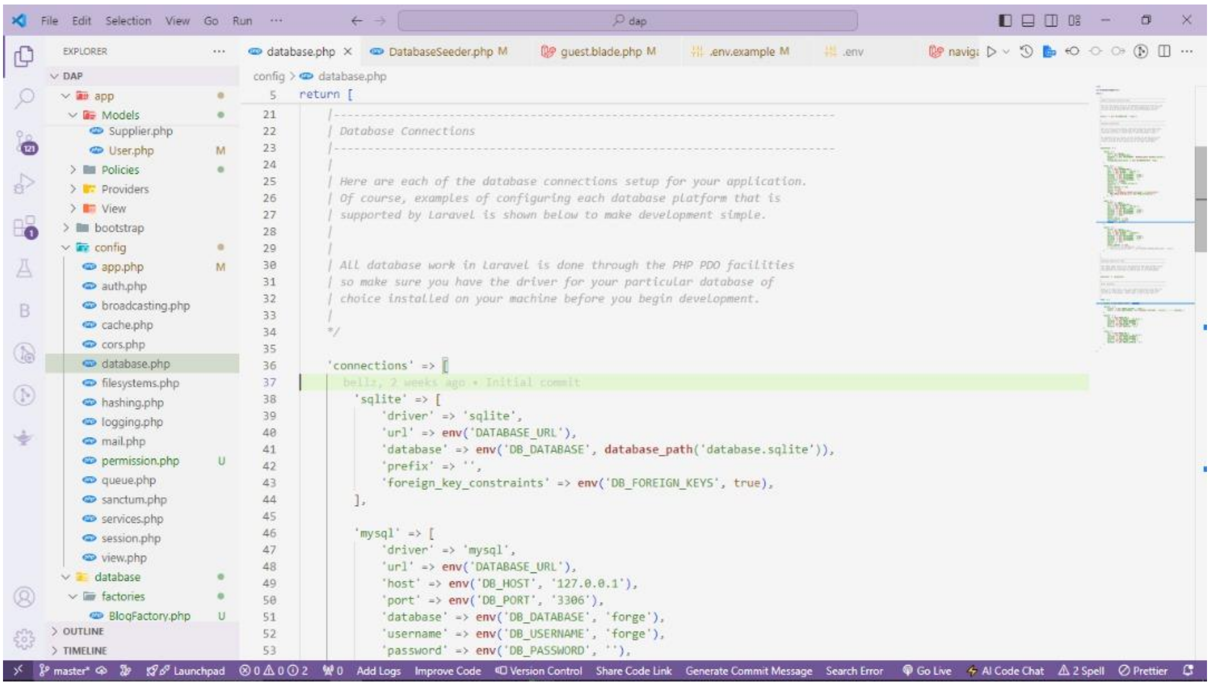


Figure 5.22: Database Connection Code

5.3 Testing

Once the program is completed and installed in the testing environment, the testing team assesses the entire system's functionality. This is done to ensure that the application performs as expected for the council's agricultural development. During this phase, the QA and testing team may identify bugs or issues, which are then reported to the developers. The development team resolves these issues and returns the system to QA for retesting. This cycle continues until the program is free of errors, reliable, and meets the system's business requirements. The testing process includes both functional and non-functional testing.

5.3.1 Unit Testing

Unit testing is the process of testing software components or individual units to ensure that each unit of program code functions as expected. The goal is to verify that every unit operates correctly. Developers perform unit testing while coding an application. During this process, a specific portion of the code is isolated and tested for accuracy. A unit can refer to a single function, method, step, module, or element of the code.

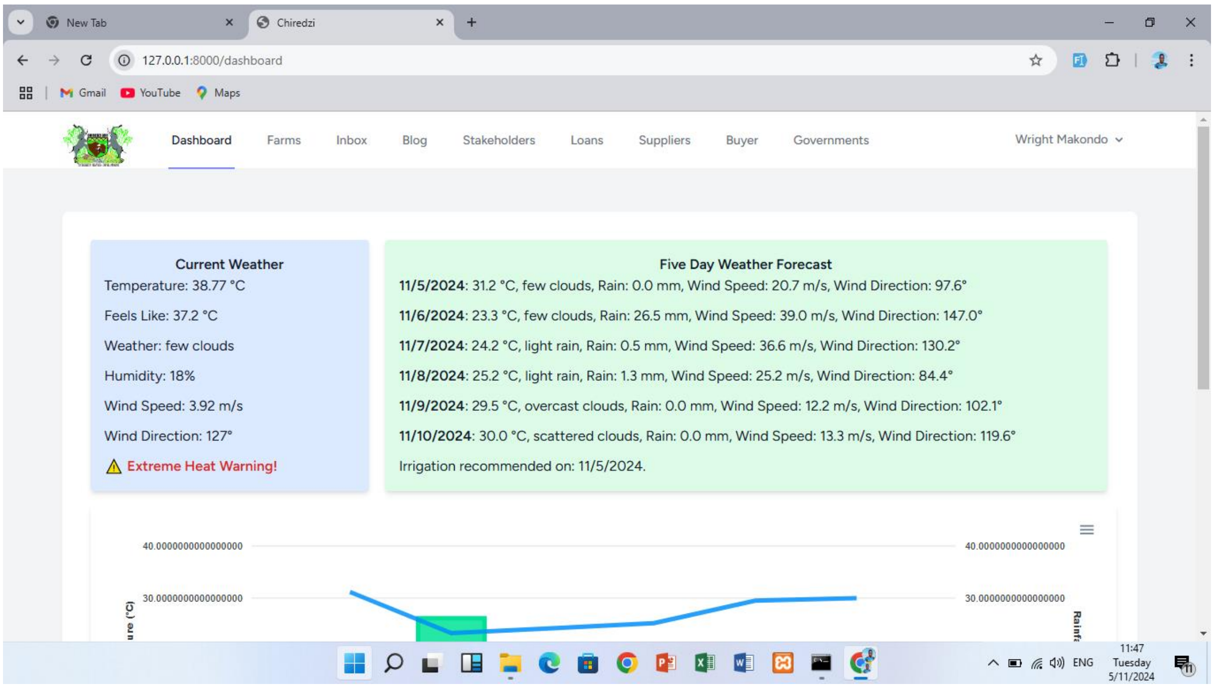


Figure 5.23: Dashboard

5.3.2. Module Testing

During the module testing process, the weather prediction, stakeholder engagement, grant, loan, extension worker, and buyer's modules provided accurate weather readings in accordance with readings from other sources at the time.

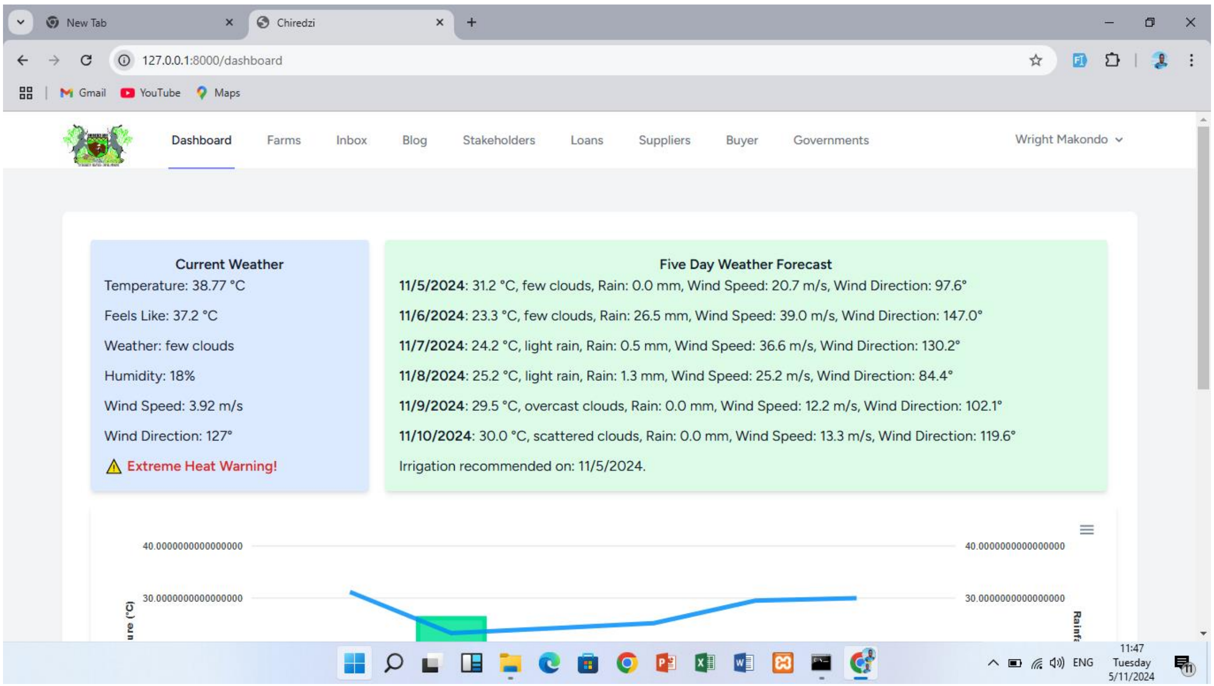


Figure 5.24: Weather forecast module

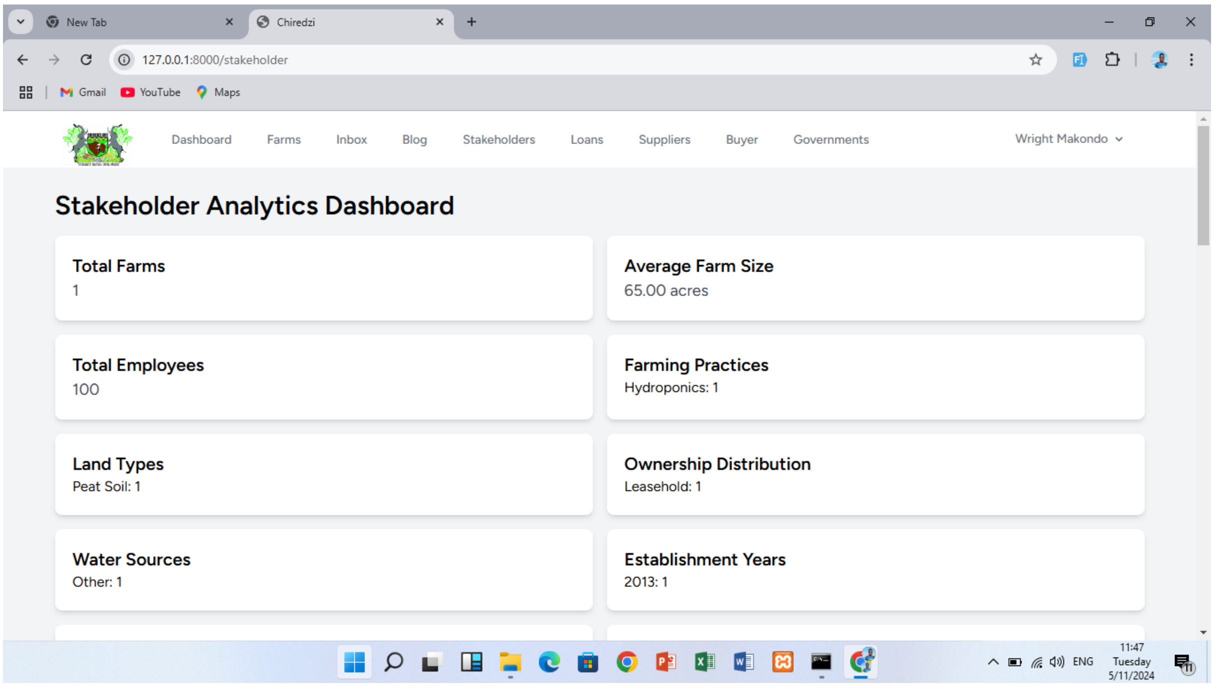


Figure 5.25: Stakeholder Engagement Module

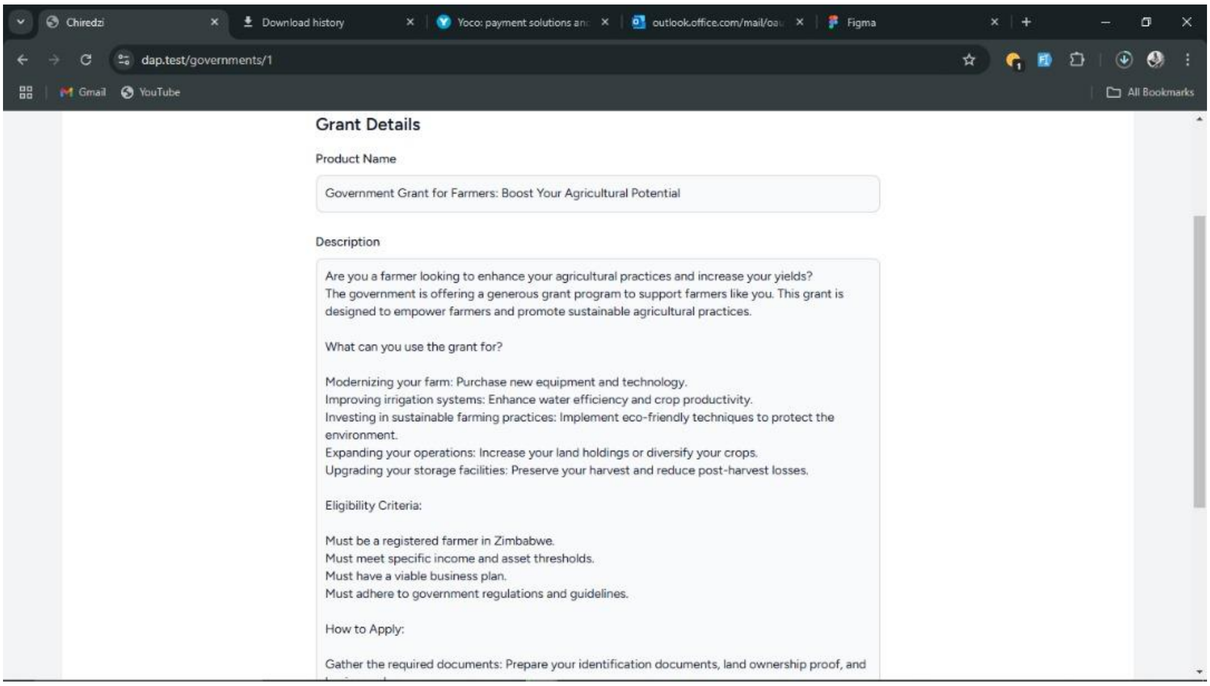


Figure 5.26: Grant Application Module

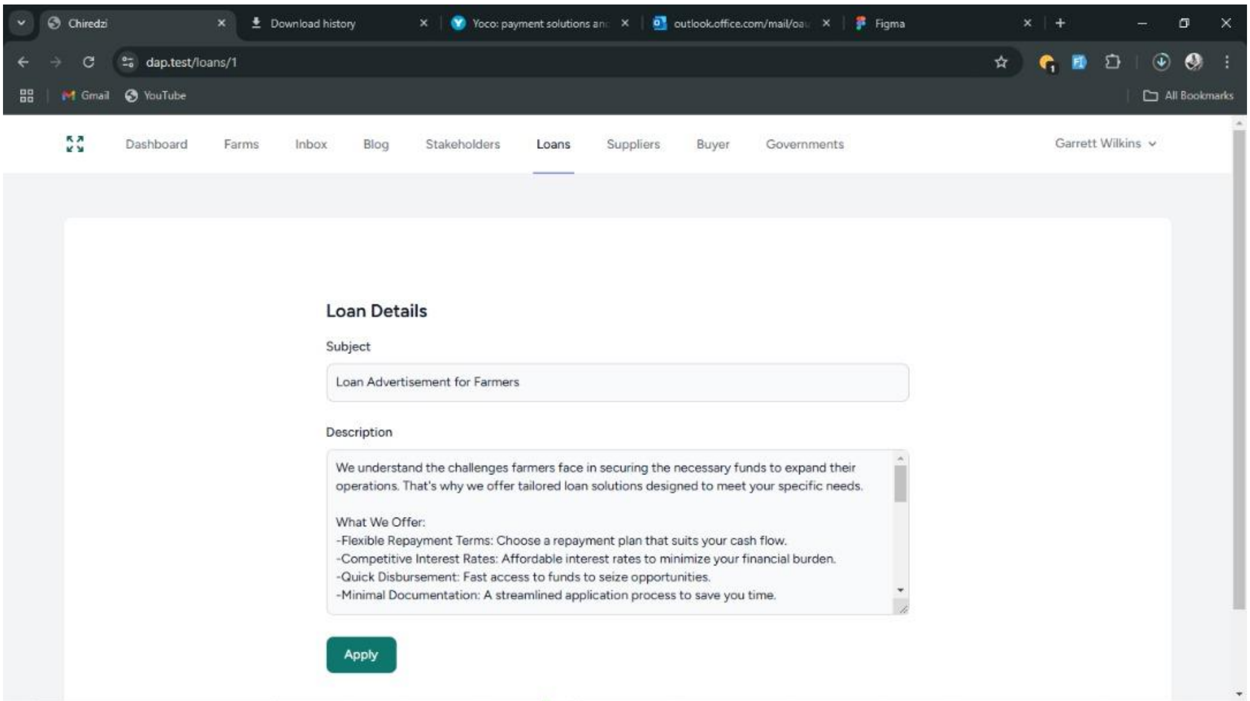


Figure 5.27: Loan Application Module

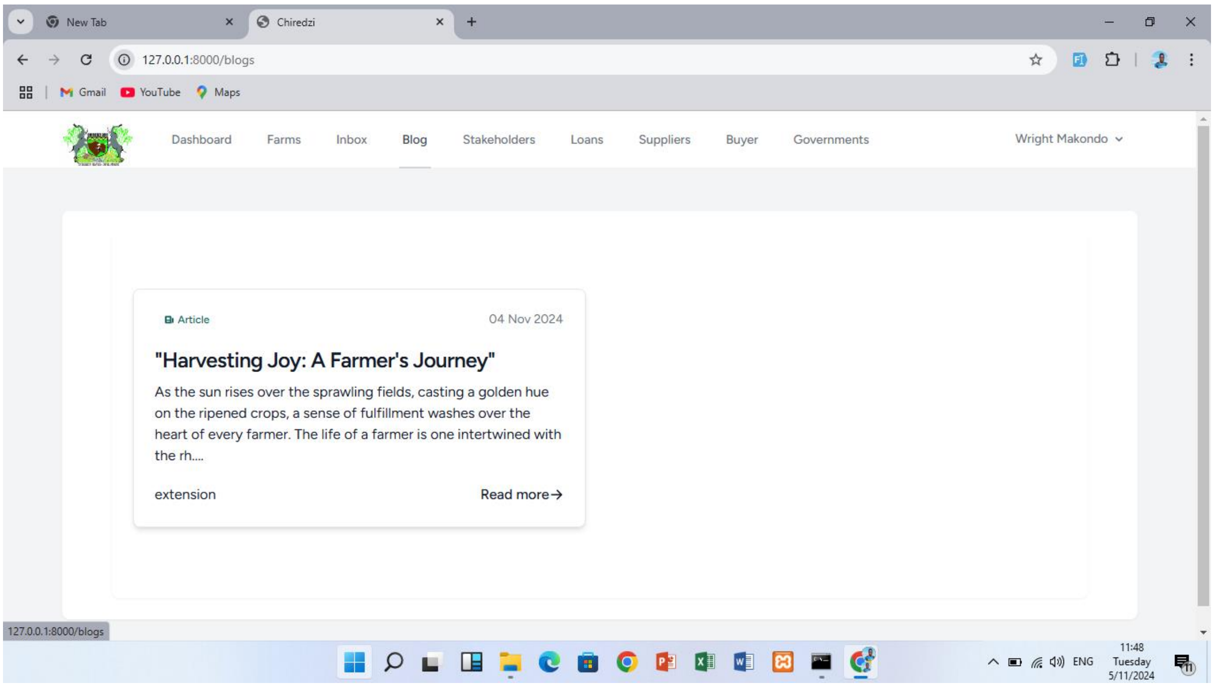


Figure 5.28: Extension Worker Module

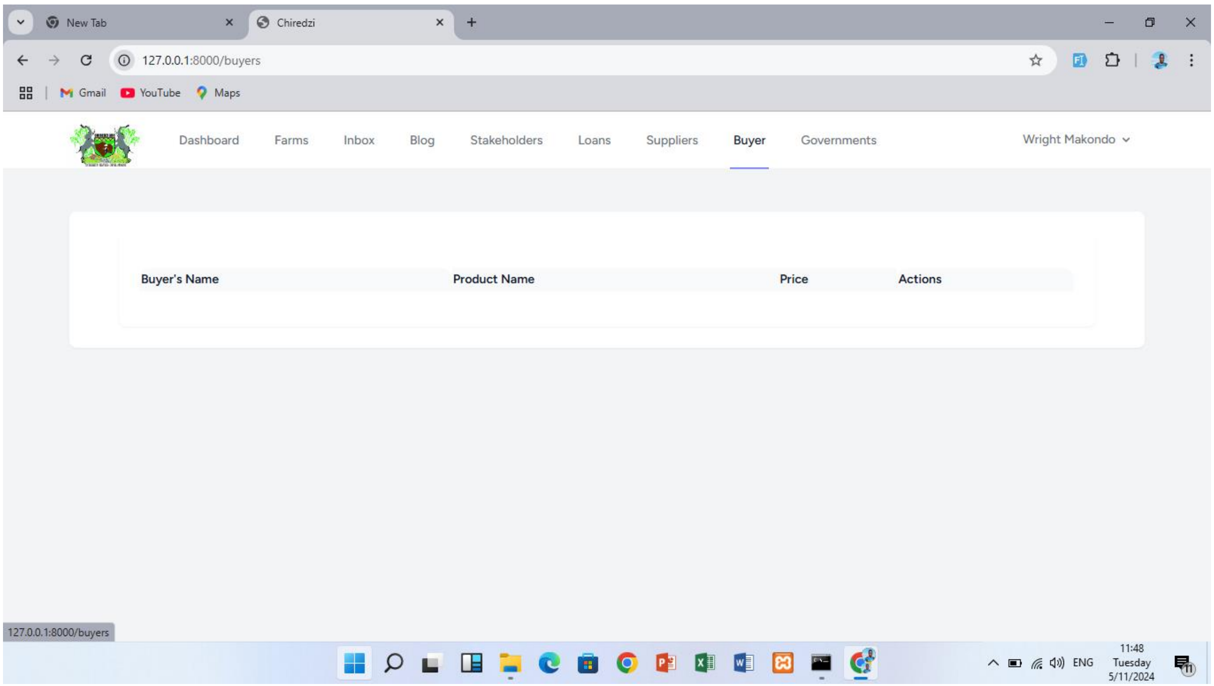


Figure 5.29: Buyer's Module

5.3.3 System Testing

Every internal module of the system was tested to make sure it was operating correctly.

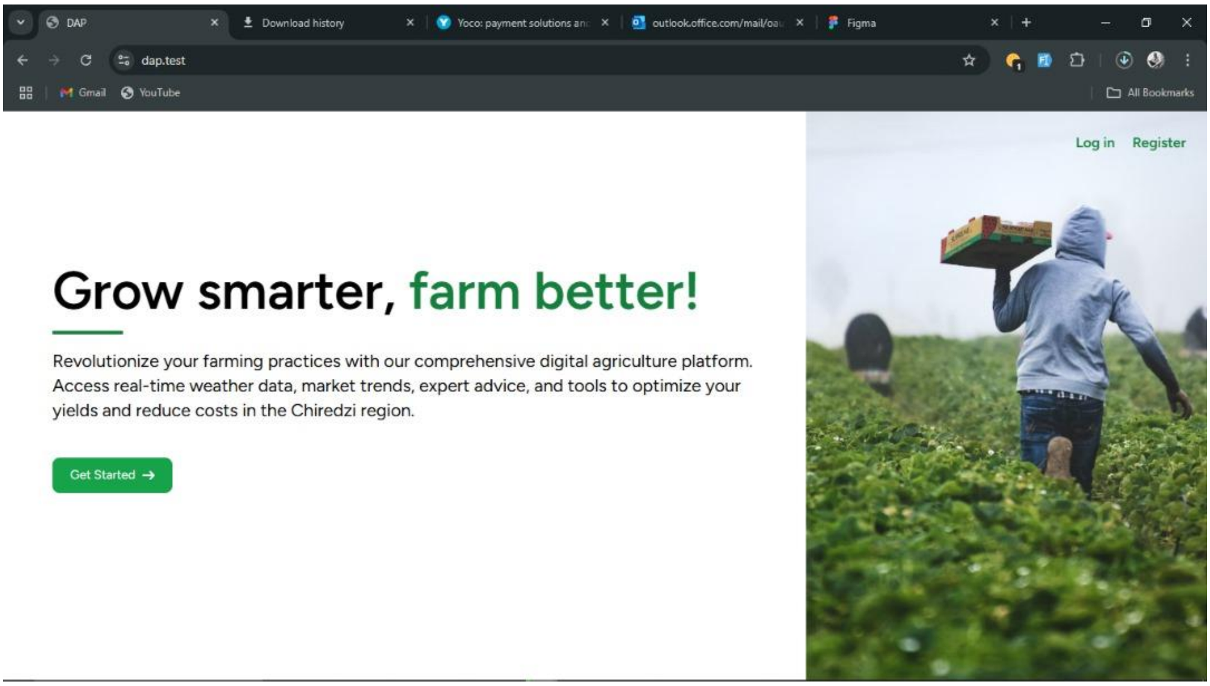


Figure 5.30: Testing Accessibility of the System

5.3.4 Acceptance Testing

Before the software program is deployed to the production environment, the end user or client performs User Acceptance Testing (UAT) to verify and approve the software system. UAT is the final testing phase, conducted after functional, integration, and system testing.

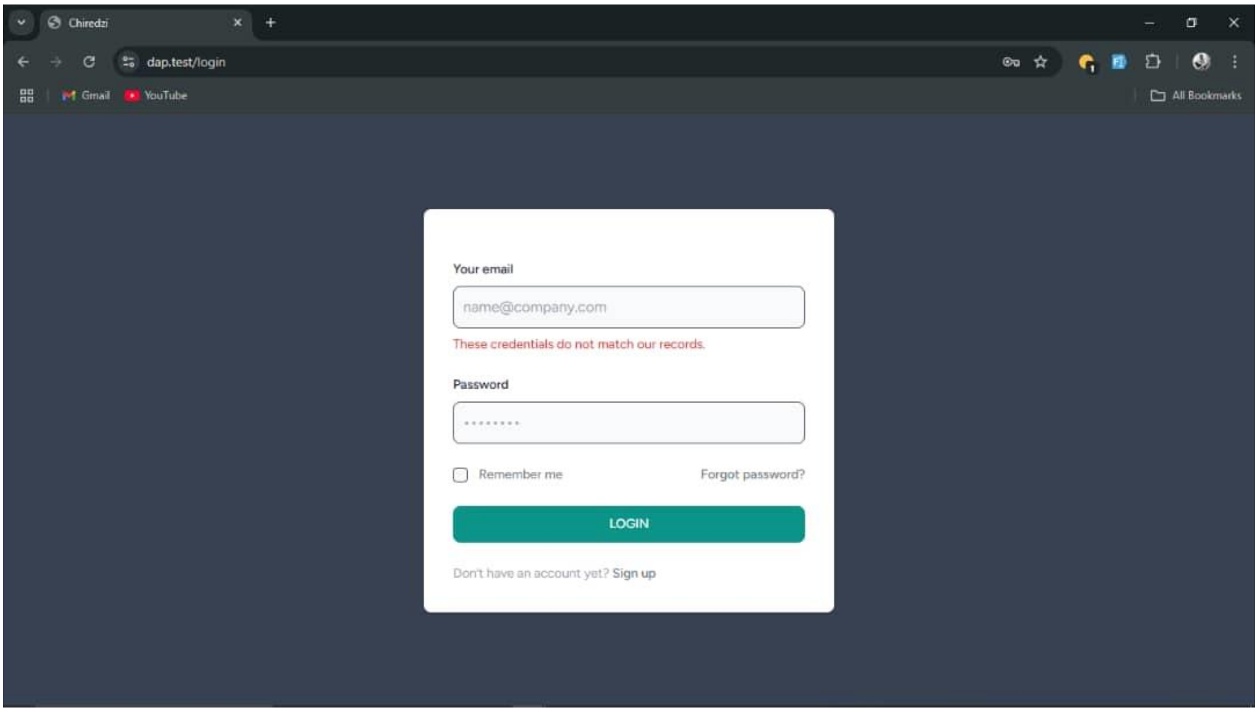


Figure 5.31: Acceptance Testing

5.3.5 Validation

Validation makes sure that the system does not accept erroneous data in the database table cells since the system needs relevant information to carry out its duties.

When a user deviates from the database fields' restrictions, error messages will appear as seen in the pictures below.

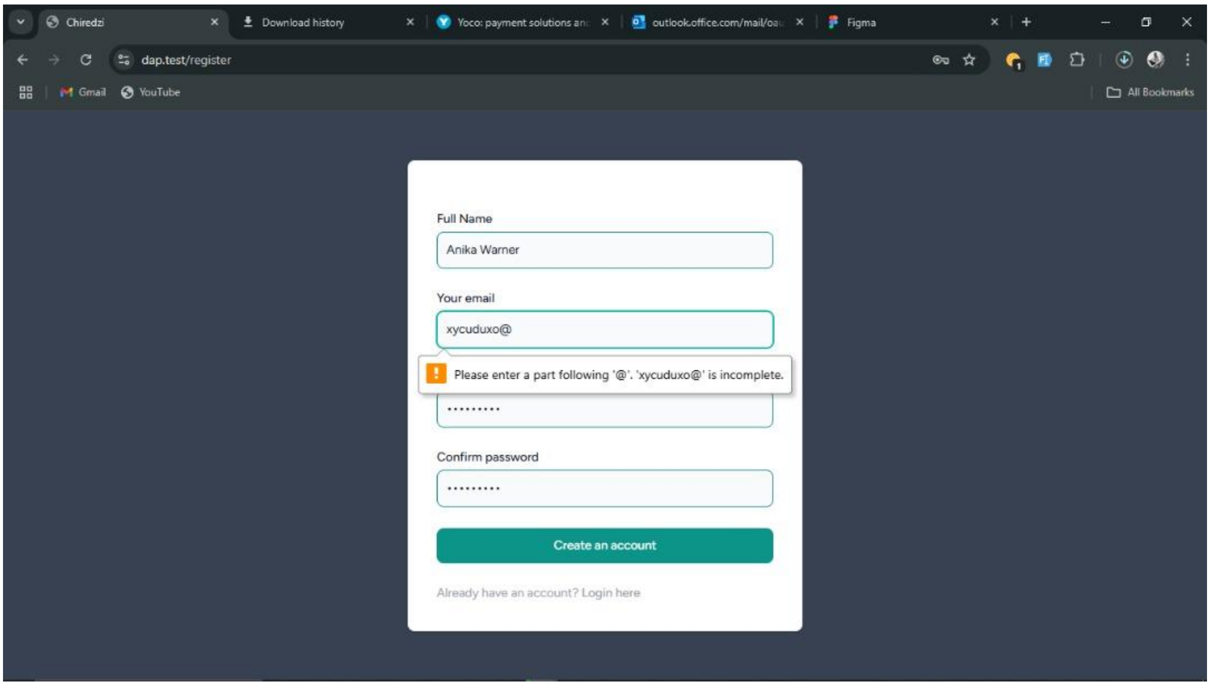


Figure 5.32: New user Registration form validation

5.3.6 Verification

As a result, prior to deployment, all systems need to be verified and satisfy user expectations.

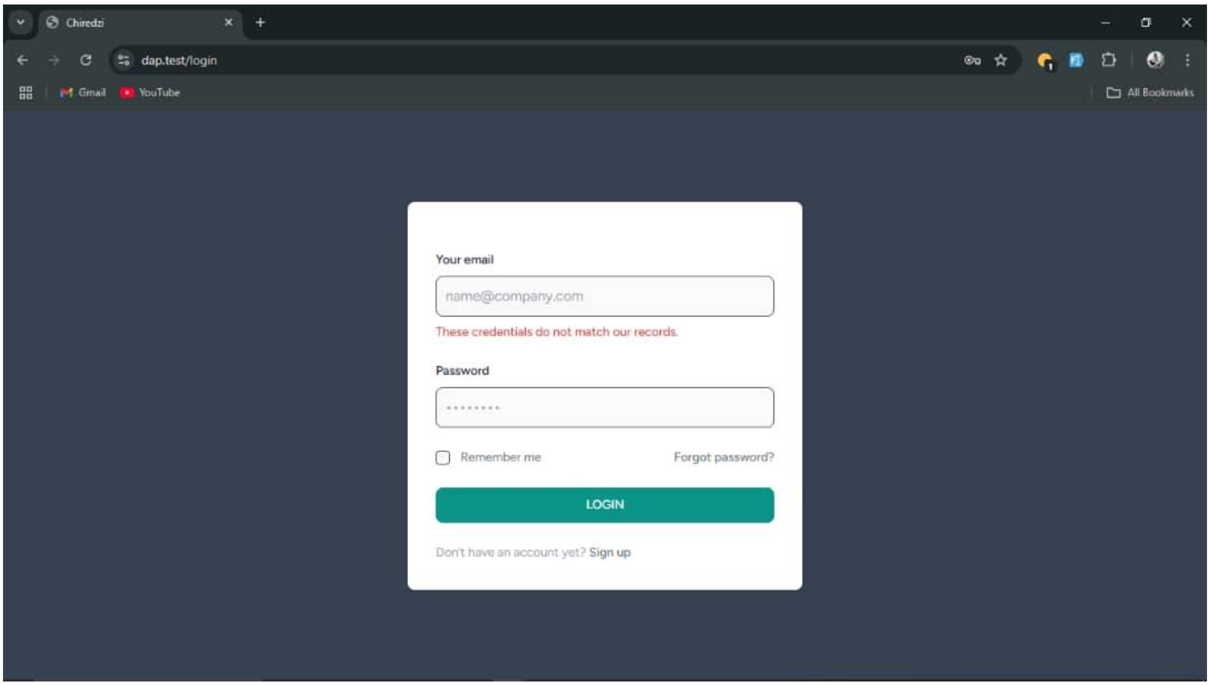


Figure 5.33: Verifying the security of the system

It was necessary to verify if the weather reports applied to the Chiredzi district.

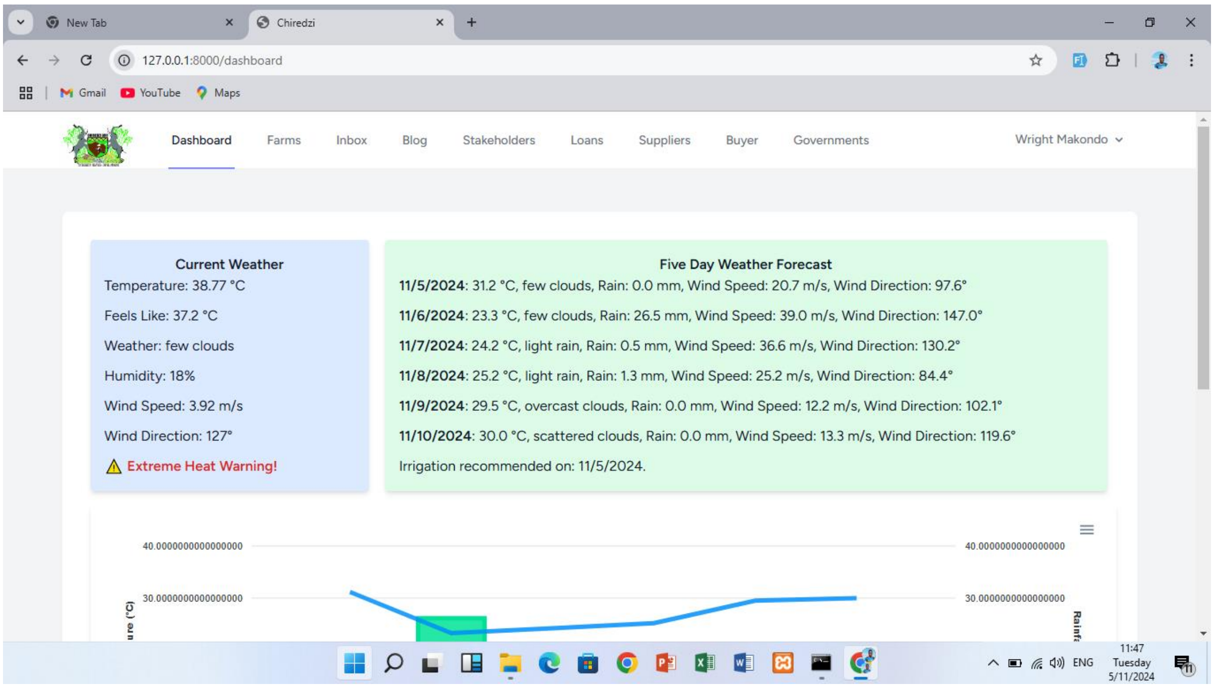


Figure 5.34: Weather Forecast Test

5.4 Installation

It is the procedure of installing the system, and it can be completed entirely once or in stages.

Installation of application software:

- The system will be hosted by an online server.
- The system is always available thanks to online servers.

5.4.1 User Training

On the Chiredzi Rural District Council Facebook page and YouTube channel, links to tutorial videos will be posted. These videos will show the farmers how to get the most out of the system and satisfy their demands.

5.4.2 System Changeover

The methods used to switch from the old to the new system might be direct, phased in parallel, or piloted. The researcher solely considered the pilot and phased switch for this investigation.

5.4.2.1 Direct Changeover

A direct changeover involves a full transition from an existing system to a newly implemented system, where the old system and its operations are entirely replaced by the new system and its processes. For instance, the organisation may decide to replace its antiquated manual project management methods with a cutting-edge online system.

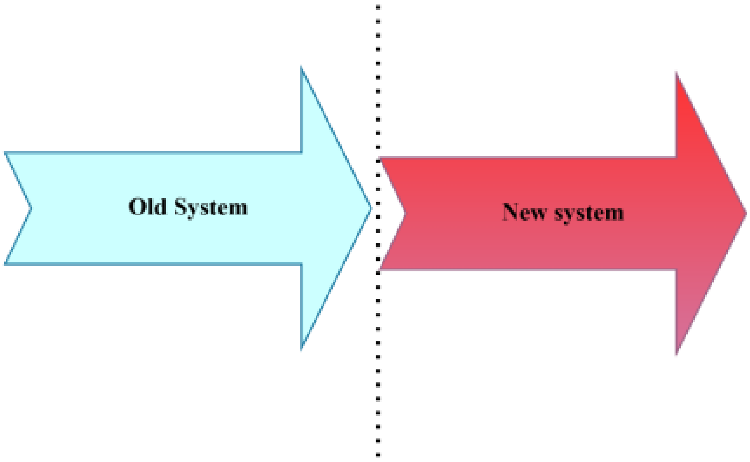


Figure 5.35: Direct Changeover

Benefits of direct changeover

- Rapid system transition.
- Savings on costs.
- Minimal number of migrations and backups.

Limitations of direct changeover

- extremely risky method of implementing a system
- shorter time it takes for consumers to get familiar with the system

5.4.2.2 Parallel Changeover

It means running the new and old systems simultaneously until the new system is deemed secure and efficient enough to be used. In the unlikely event that the new procedures in the Digital Agriculture Platform are misinterpreted, technology makes sure that the previous manual method is rolled back. The benefit for customers is that they may learn more about and get more confident in the suggested solution.

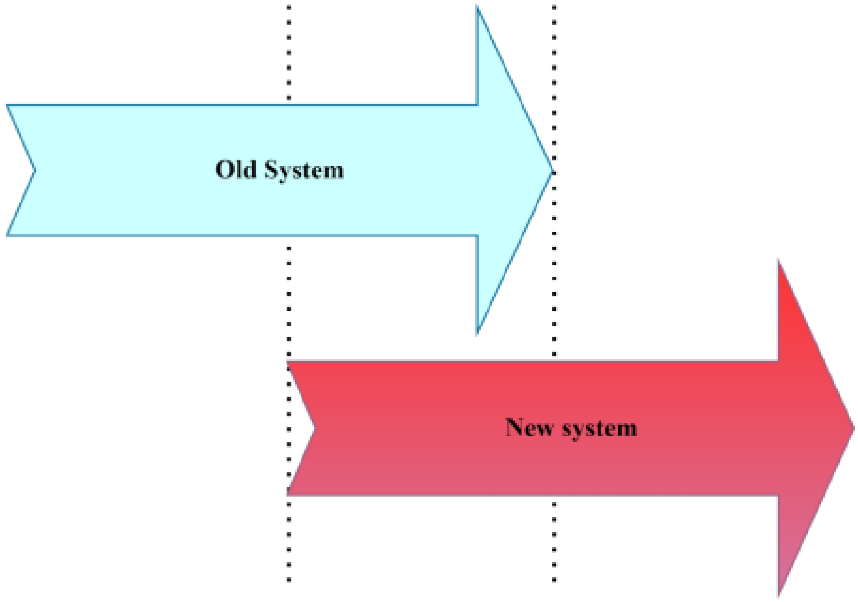


Figure 5.36: Parallel Changeover

5.4.2.3. Pilot run changeover

The pilot run changeover method is used to test the system's features within a controlled environment. Once the approach proves successful, the entire organization tests it before deciding to fully implement it. This method allows for system testing on a smaller scale before broader

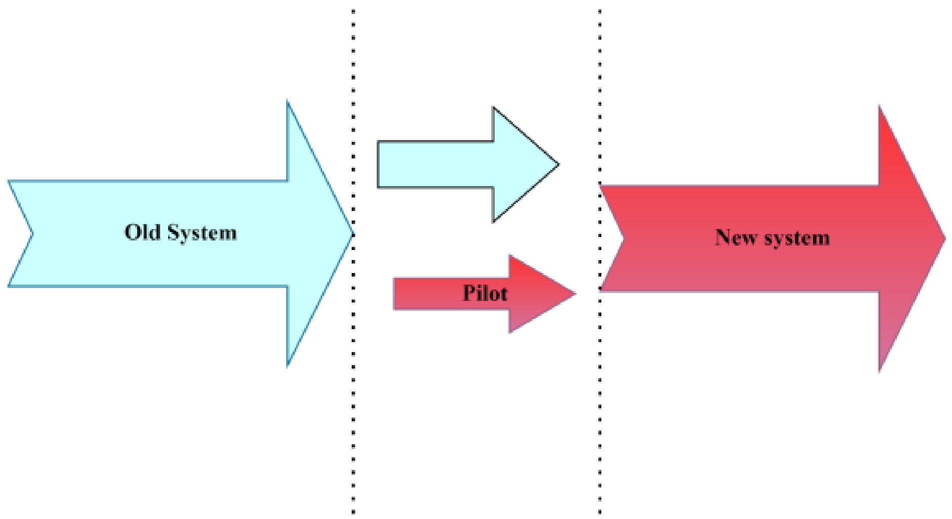


Figure 5.37: Pilot run Changeover

Advantages of switching to a pilot program

- Testing the system with a smaller subset of the workforce is less costly.
- If the system fails, just a tiny part of the organisation is affected.

- Employees can be trained on the system before it is fully implemented.

Pilot switchover's limitations

- The new system requires time to install completely.
- It is difficult to share data among organisations that use different platforms.

5.4.2.4 Phased Changeover

The use of phased changeover allows for a smooth transition to a new system. The stages of the old system that have been phased out can be found using this approach. When a system level is implemented successfully, it becomes simpler to phase out the next level of the preceding one.

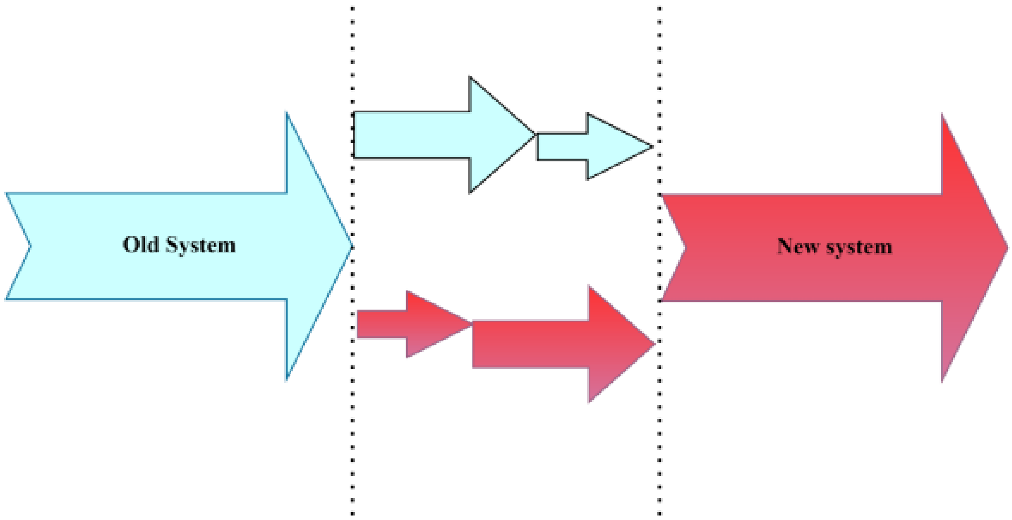


Figure 5.38: Phased changeover

Benefits of the Phased changeover

- The parallel run technique is more costly than a phased transition.
- Minimal loss of data in case of a system malfunction.
- Reverting to the prior system is a prudent decision.

Limitations of Phased changeover

- It takes a long time to finish implementation.

5.4.2.5 Recommendations for changeover approaches

The researcher has determined that a direct switchover should be used during the system implementation. Their primary contention was that the benefits exceeded those of other switchover methods. Should the new system satisfy the criteria, a direct transition strategy will be put into place? The organisation made the decision to switch over directly for the reasons listed below:

- The researcher chose to switch over directly since there is little to no chance of a system failure because the system was thoroughly tested before making this decision.
- Because they will only need to master the parts of the system that are presently being brought in, staff may receive training progressively.
- Adoption proceeds in stages in the early stages.
- The fact that pilot changeover may be halted makes the procedure simple to control.

5.5 Maintenance

Software maintenance is the process of adding, modifying, and tailoring it to the requirements of users. Software maintenance is performed for various reasons after a product has been released, such as enhancing performance, fixing bugs, and improving the overall quality of the program. It is an essential part of the software development life cycle. There are four types of software maintenance:

5.5.1 Corrective Maintenance

Since it is nearly difficult to test the system in every situation, certain problems will be found when it is put into use. Because of this, corrective maintenance is required to fix any faults that users or developers overlooked when testing.

5.5.2 Adaptive Maintenance

Adaptive maintenance is done because changes in the system environment need modifying it in order for it to function without interruption. It guarantees that the system adapts to changes in the surrounding environment.

5.5.3 Perfective Maintenance

Over time, developers are considered to be creative by nature, therefore they could come up with fresh concepts and methods to improve the system. Perfective maintenance makes it feasible to implement these additional adjustments.

5.6 Recommendations

To expand the body of knowledge, the researcher suggests integrating the system in the future with other Smart Agriculture systems from other nations that have had success with their farming endeavours.

5.7 Conclusion

The project's final phase included system coding, testing, installation, and user training. The programmers started testing the system as soon as they finished writing the last line of code, and some of the tests were carried out in real time. The technology was also made available for usage to a sample of users. All of the tests were conducted to make sure the system complied with all user, developer, and industry standard criteria. Once all of the corrections and testing had been completed, the developers installed the system and trained the users. Following the adoption of the changeover plan as the direct changeover approach, all maintenance recommendations were made. Lastly, the researcher offered suggestions for further advancements.

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APPENDICES

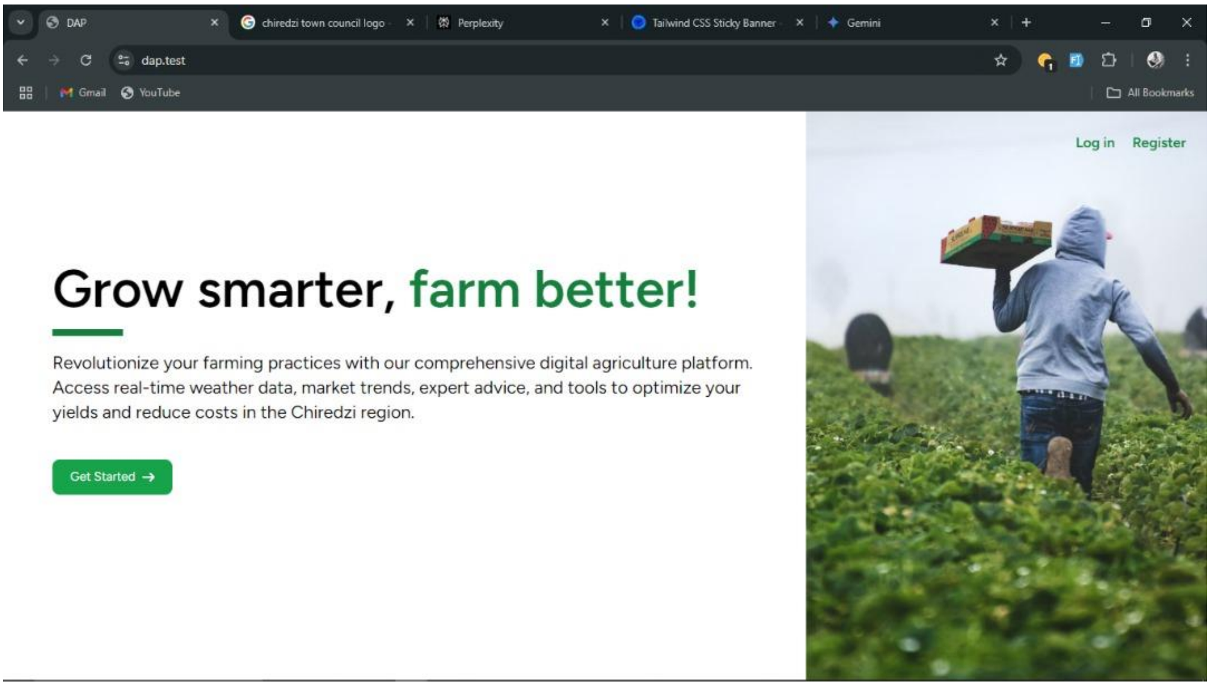
Appendix A: User Manual

Digital Agriculture Platform User Manual

The purpose of the user manual is to assist users in becoming acquainted with the system by providing a high-level overview of its capabilities. All of the module sets required to provide users access to the system are included in the user handbook. This user guide will outline every feature of the system.

Welcome Page

A welcome page appears when the user double-clicks the digital agriculture platform's icon, as seen below: The welcome page displays the login and the register button.



Registration

This functionality allows user to create accounts. Users are required to enter valid login credentials in order to create an account in the Digital Agriculture Platform.

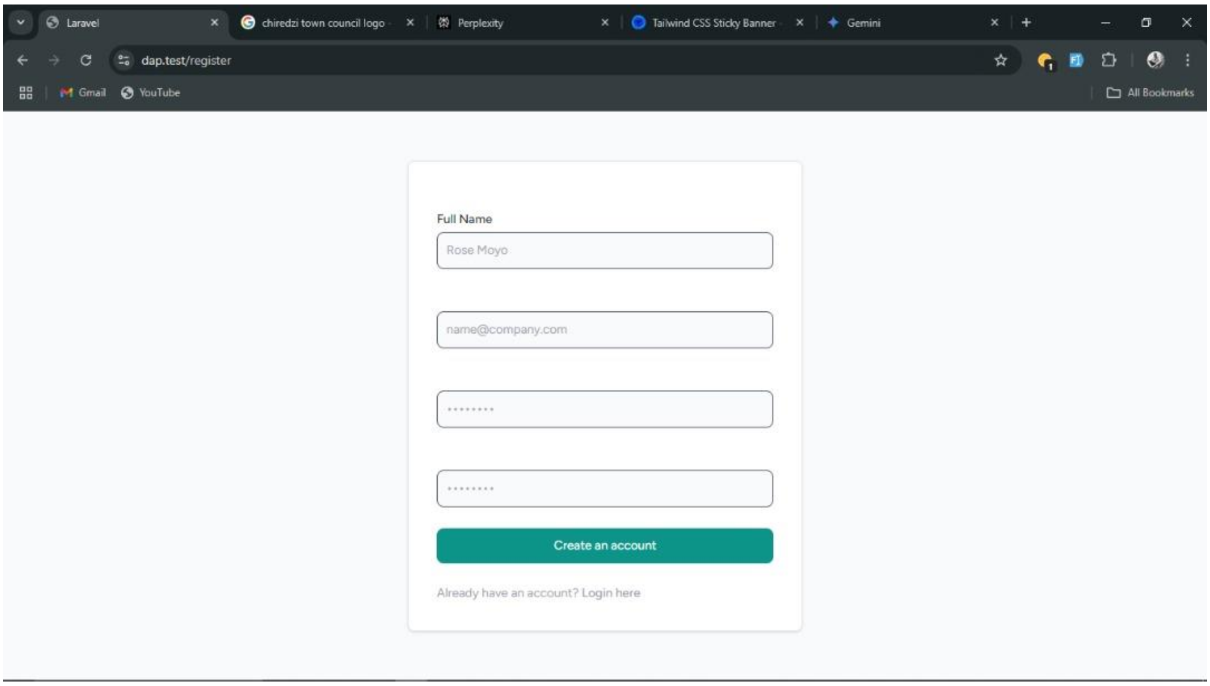
User Account creation

i. Clock on the register button on the welcome page.

ii. After opening the registration form.

iii. Fill in all the required information.

iv. Click the "Create an Account" Button to confirm the creation of the new user Account



Login Page

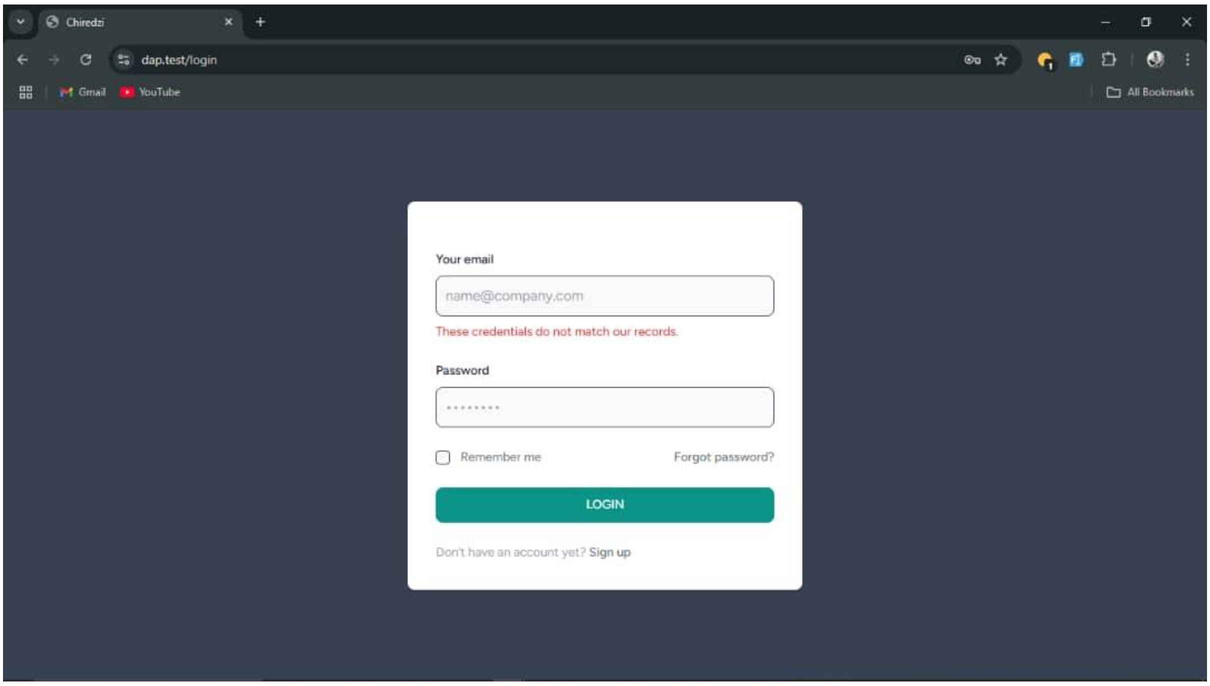
The second link from the welcome page is the login page and it allows registered users to enter valid passwords and user name to login to the Digital Agriculture Platform. This is only possible when the user account has been created.

To Login

i. Enter a valid password and username.

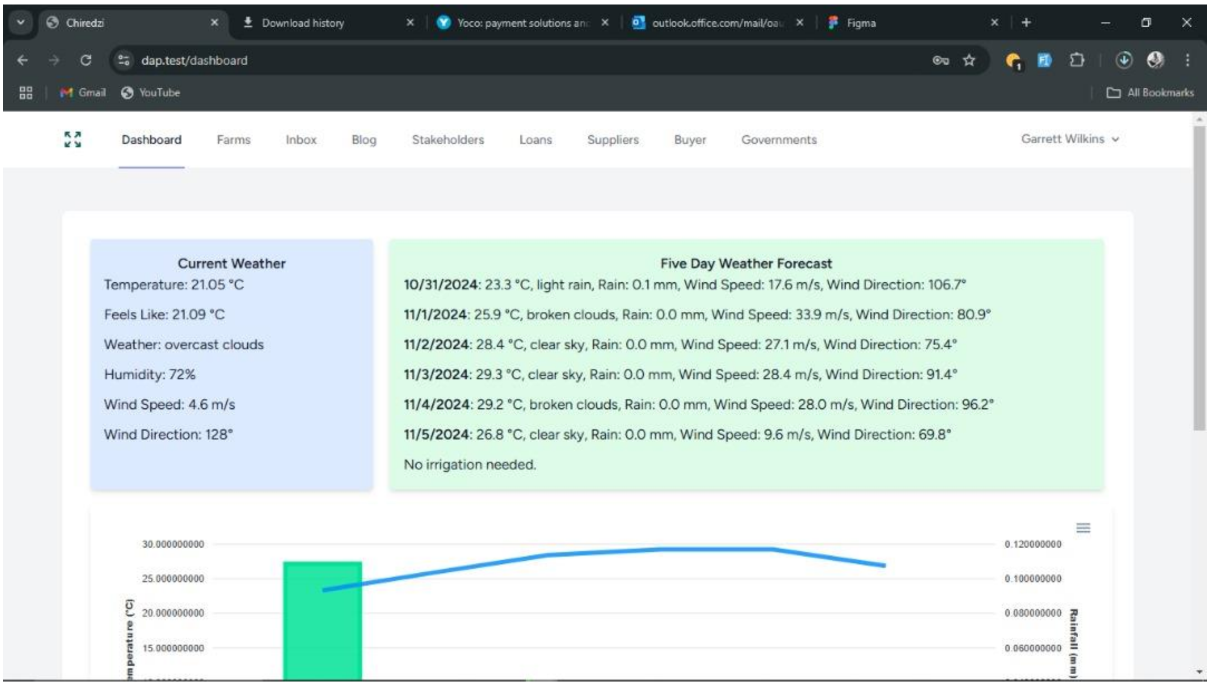
ii. Click on the Login button.

iii. If the username and the password are correct a user is guaranteed access to the system.



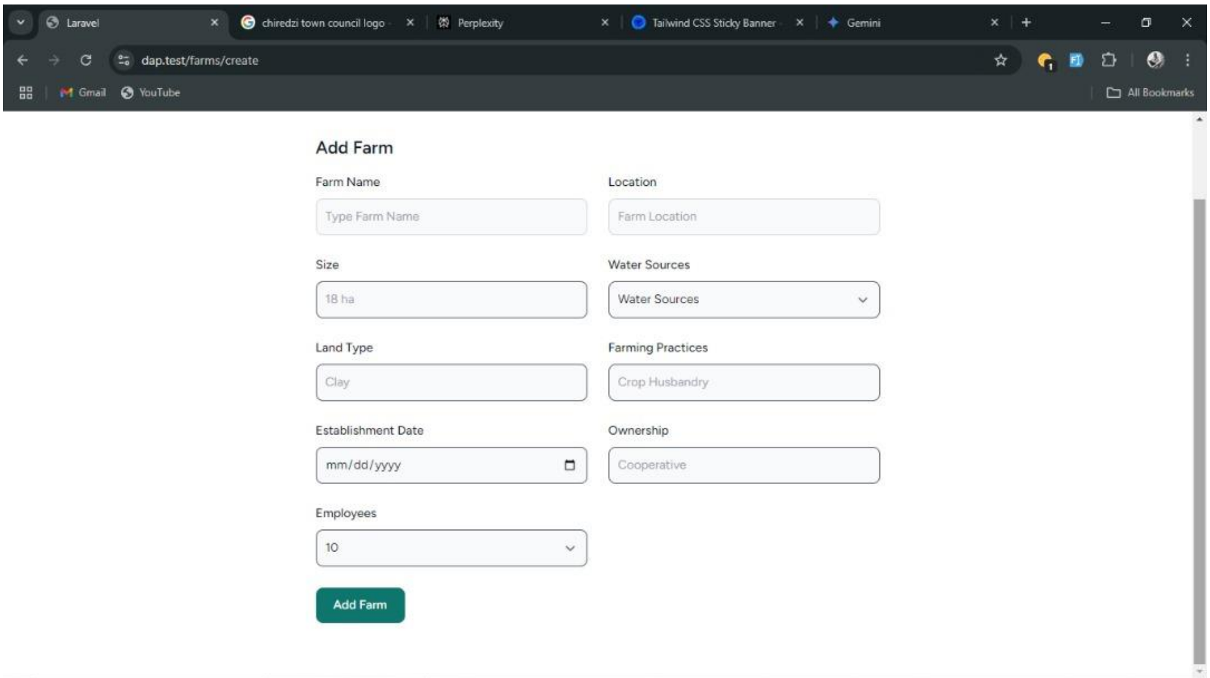
Dashboard

This is the first page that a valid user receives as they are granted access to the system. It is equipped with a navigation tab at the top, where user click to access other system functionalities and logout. The dashboard also shows the logged in user at the top right corner. The dashboard also displays the current weather, five-day weather forecast, farming advice and recommended crops



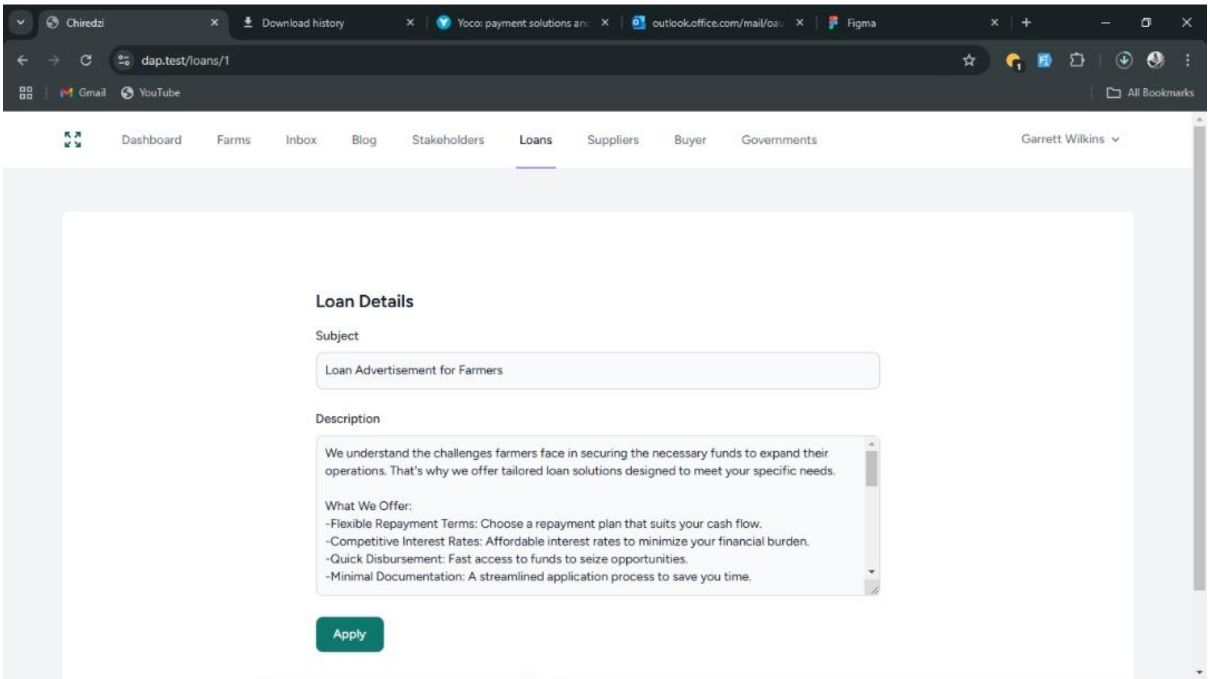
Farms:

This is the tab where new farmers add their farm details by filling the required details within the system in the system.



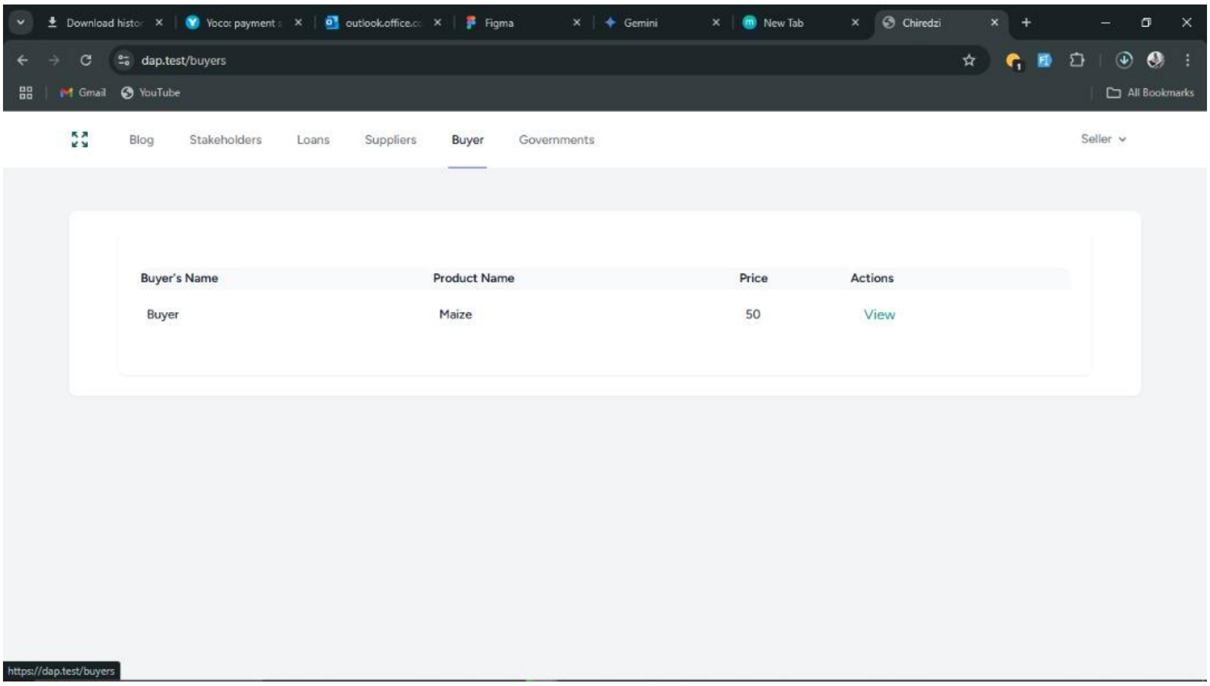
Loans

This is where banks advertise loans so that farmers can apply.



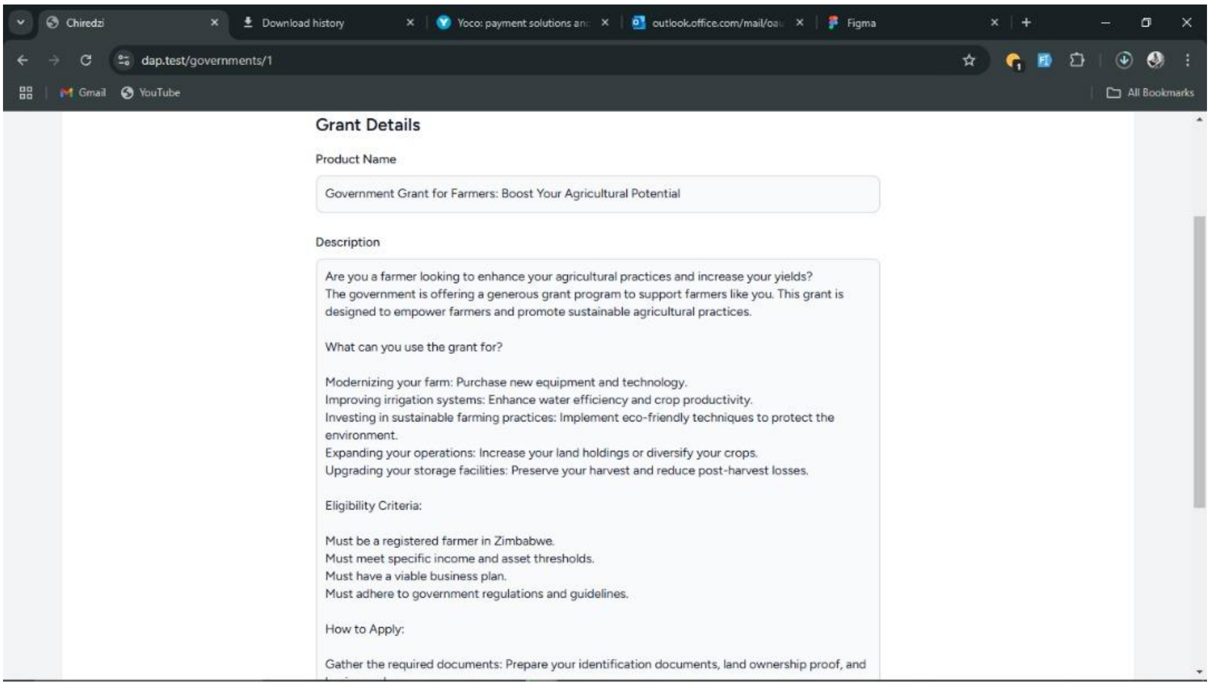
Buyer

On this tab the buyer update the current market prices, so that farmers can choose where to sell their products to:



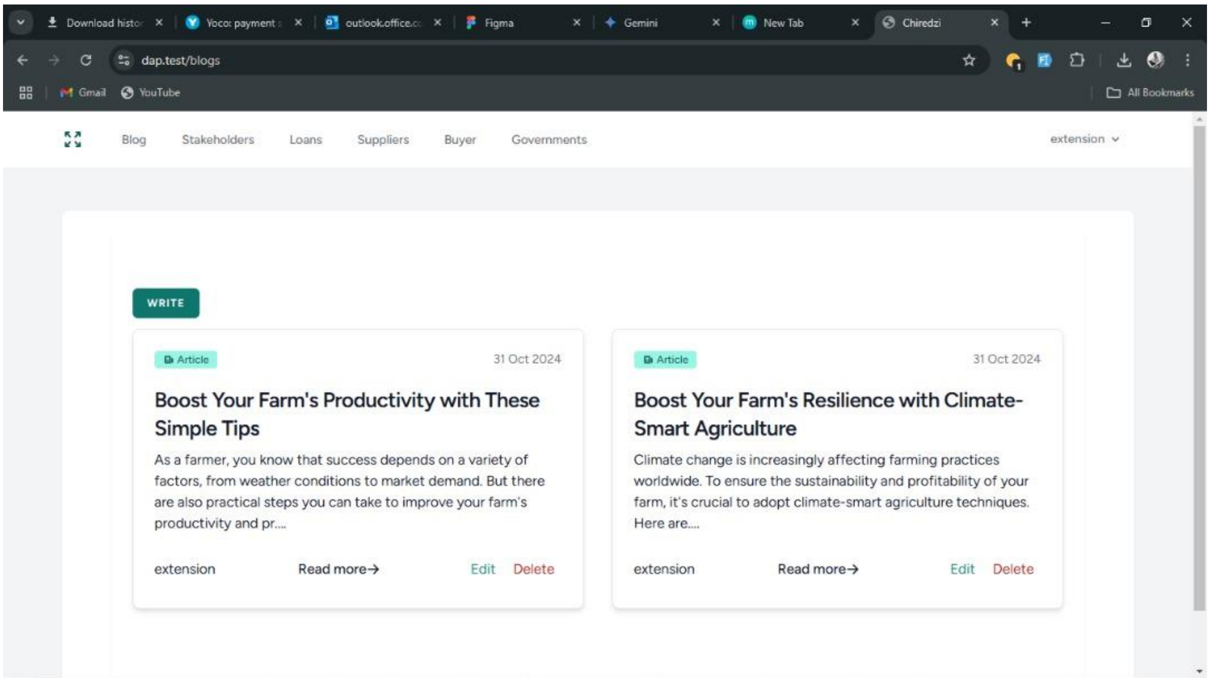
Grant Details

This is the tab where farmers apply for government grants, which could have been published by the government.



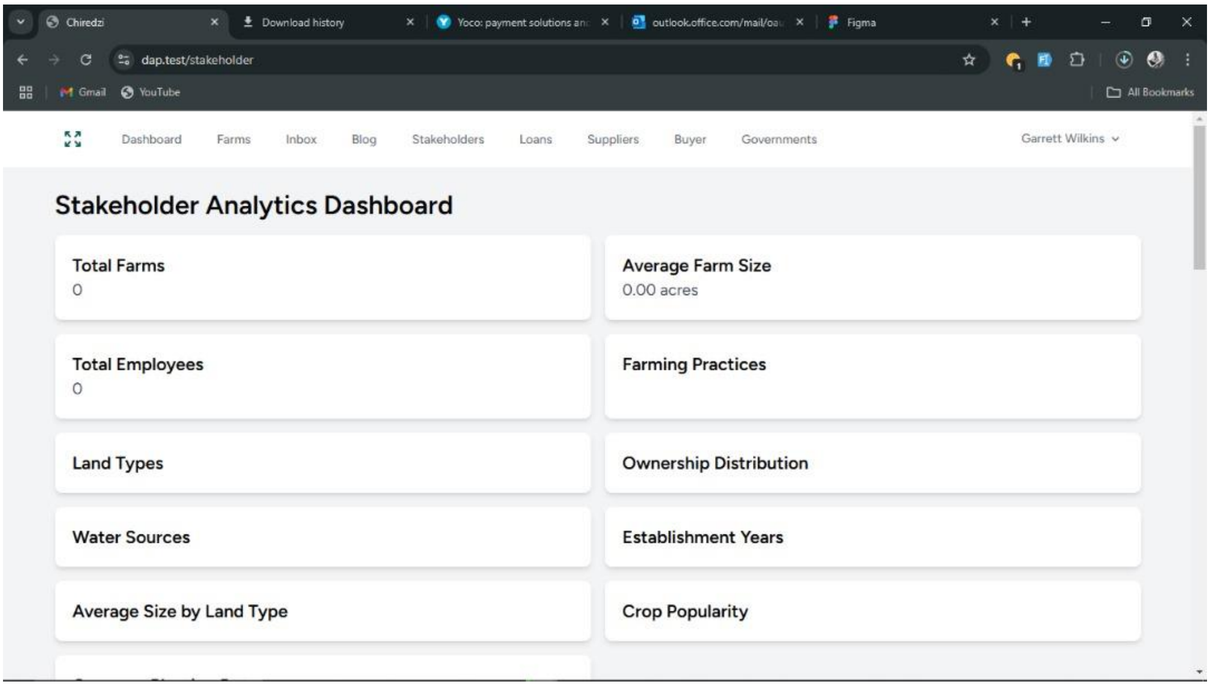
Blog

This is where agricultural extension workers can give agricultural guidance to farmers.



Stakeholder's Dashboard

This is dashboard is meant for stakeholders so that they can analyze collected agricultural data in order to make informed decision.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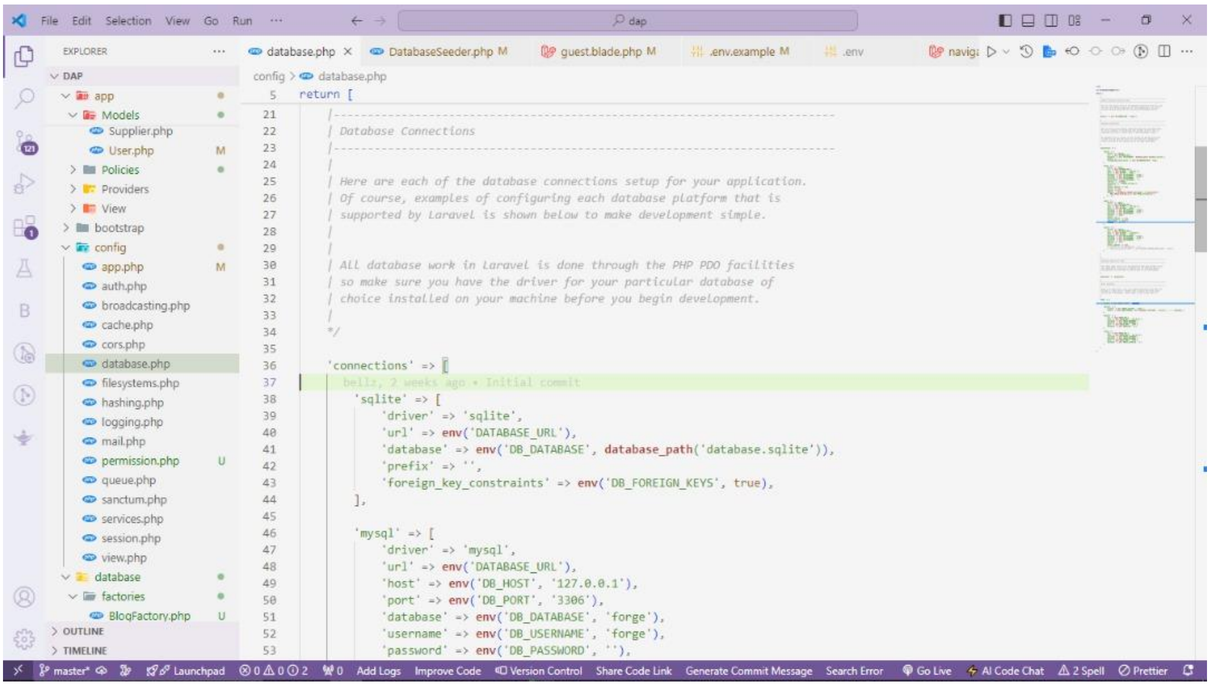
Download history
Yoco: payment solutions an
outlook.office.com/mail/oa
Figma
dap.test/stakeholder
Gmail
YouTube
All Bookmarks
Dashboard
Farms
Inbox
Blog
Stakeholders
Loans
Suppliers
Buyer
Governments
Garrett Wilkins
Stakeholder Analytics Dashboard
Total Farms
0
Average Farm Size
0.00 acres
Total Employees
0
Farming Practices
Land Types
Ownership Distribution
Water Sources
Establishment Years
Average Size by Land Type
Crop Popularity

Appendix B: Code Snippet



Appendix C: Interview Questions

Questionnaire for Research on Digital Agriculture Platform for Chiredzi Rural District Council

Section 1: Personal Information

1. **Name:** ______________________________________

2. **Age:**

   [ ] Below 18

   [ ] 18-25

   [ ] 26-35

   [ ] 36-45

   [ ] 46-60

   [ ] Above 60

3. **Gender:**

   [ ] Male

   [ ] Female

4. **Occupation:**

   [ ] Farmer

   [ ] Trader

   [ ] Agronomist

[ ] Cooperative Member

[ ] Government Official

[ ] Other (Please specify): ________________

5. **Level of Education:**

[ ] No formal education

[ ] Primary education

[ ] Secondary education

[ ] Tertiary education

6. **Location (Village/Ward):** ________________________________

Section 2: Farming Information

7. **What type of farming do you primarily engage in? (Check all that apply)**

[ ] Crop farming

[ ] Livestock farming

[ ] Horticulture

[ ] Agroforestry

[ ] Other (Please specify): __________________________

8. What crops or livestock do you typically produce?

[ ] Maize

[ ] Sorghum

[ ] Cotton

[ ] Cattle

[ ] Goats

[ ] Other (Please specify): ___________________________

9. What farming practices do you use?

[ ] Traditional farming methods

[ ] Modern farming methods (e.g., mechanized or climate-smart agriculture)

[ ] Mixed methods

10. What are your biggest farming challenges? (Check all that apply)

[ ] Lack of information on best farming practices

[ ] Weather unpredictability

[ ] Lack of market access

[ ] Water scarcity

[ ] Pest and disease management

[ ] Financial constraints

[ ] Other (Please specify): ___________________________

Section 3: Digital & Technological Access

11. Do you have access to a mobile phone?

[ ] Yes

[ ] No

12. What type of mobile phone do you use?

[ ] Basic phone (can only call and text)

[ ] Feature phone (limited internet access)

[ ] Smartphone (full internet access)

13. Do you have access to the internet?

[ ] Yes

[ ] No

[ ] Sometimes (e.g., through mobile data, internet cafes, etc.)

14. What digital tools do you currently use for farming or information? (Check all that apply)

[ ] SMS services for weather updates or prices

[ ] WhatsApp groups for farming advice

[ ] Mobile apps for agriculture

[ ] Internet searches for farming practices

[ ] None

[ ] Other (Please specify): ___________________________

15. How comfortable are you using digital tools and apps?

[ ] Very comfortable

[ ] Somewhat comfortable

[ ] Not comfortable

16. What would help you improve your use of digital tools in farming?

[ ] Training on how to use apps and online resources

[ ] Access to better technology (e.g., smartphones, internet)

[ ] Availability of tools in local languages

[ ] Other (Please specify): ___________________________

Section 4: Interest in a Digital Agriculture Platform

17. Would you be interested in using a digital platform to help with your farming?

[ ] Yes

[ ] No

[ ] Maybe

18. What type of information would you like from a digital agriculture platform? (Check all that apply)

[ ] Weather forecasts

[ ] Pest and disease alerts

[ ] Farming best practices

[ ] Market prices for crops and livestock

[ ] Financial support opportunities (e.g., loans, grants)

[ ] Other (Please specify): ___________________________

19. How would you prefer to receive this information? (Check all that apply)

[ ] SMS/text messages

[ ] WhatsApp

[ ] Mobile app

[ ] Radio

[ ] In-person training

[ ] Other (Please specify): ___________________________

Section 5: Challenges and Expectations

20. What do you think are the challenges that might prevent you from using a digital agriculture platform? (Check all that apply)

[ ] Lack of internet or network coverage

[ ] Cost of data or mobile bundles

[ ] Difficulty understanding how to use the platform

[ ] Language barriers

[ ] Lack of trust in digital solutions

[ ] Other (Please specify): ___________________________

21. What features would make a digital agriculture platform most useful to you? (Check all that apply)

[ ] Easy to use and understand

[ ] Available in local languages

[ ] Works without internet (e.g., through SMS)

[ ] Affordable or free to use

[ ] Regular updates and information

[ ] Other (Please specify): ___________________________

Section 6: General Feedback

22. Do you believe a digital agriculture platform can improve farming in Chiredzi Rural District?

[ ] Yes

[ ] No

[ ] Not sure

23. What other services or tools do you think should be included in the platform?

____

24. Please share any additional comments or suggestions:

____

____

Appendix E: Turnitin Similarity Index

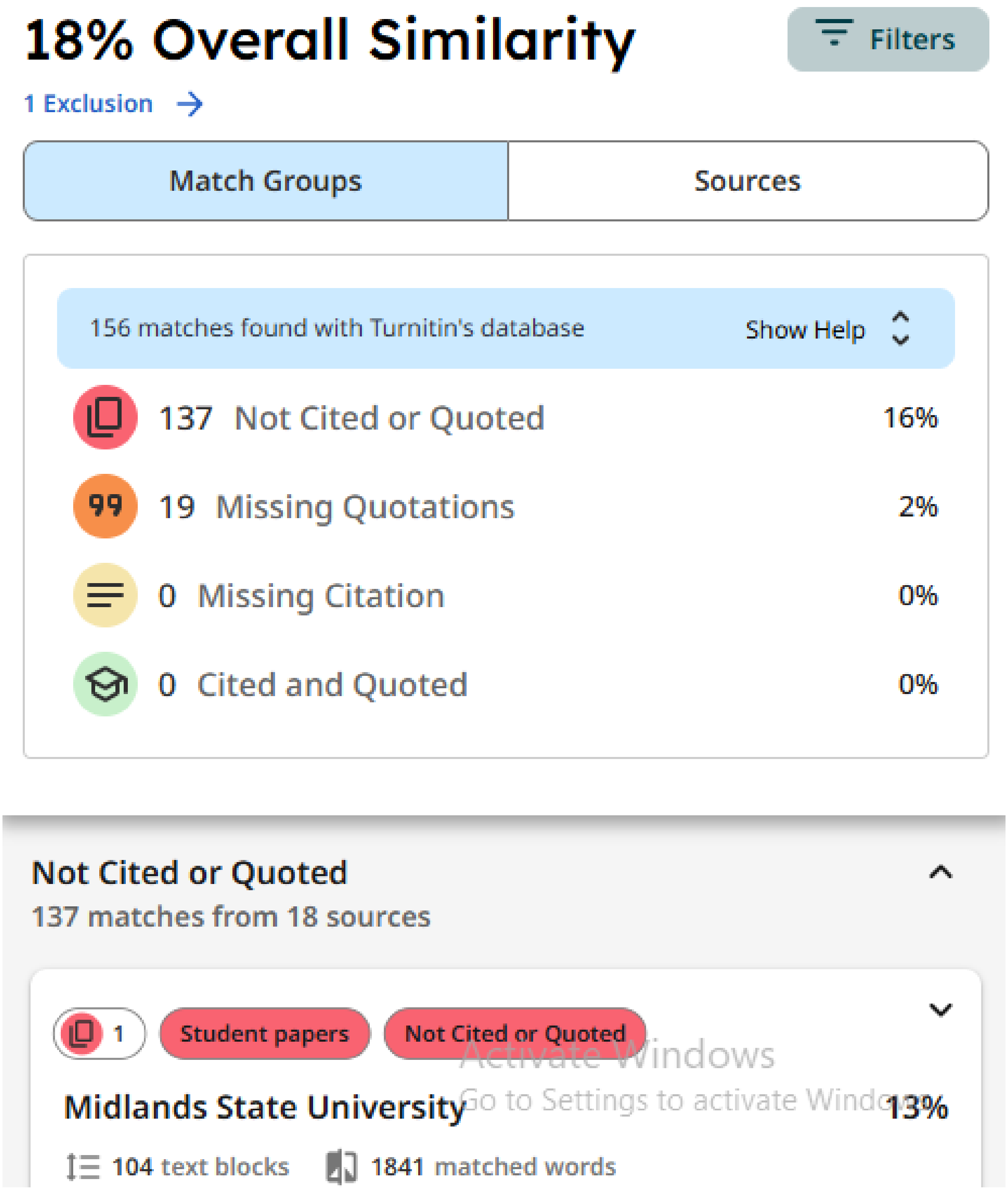


Figure 8: Similarity Index