
# THE CO-OPERATIVE UNIVERSITY OF KENYA(CUK)

## SCHOOL OF COMPUTING & MATHEMATICS

## PROJECT DOCUMENTATION

# AN APPLICATION FOR TRADING ASSORTED FARM PRODUCE IN KIAMBU TOWN

**BY**

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**REG NO: BITC01/0403/2020**

**PROJECT SUPERVISOR:**

**Mr. Don Chris Oyuech**

# DECLARATION AND APPROVAL

## DECLARATION

I, Karuku Judith Waithera, hereby declare that the work presented in this document is entirely my original work, unless otherwise attributed or cited. I further declare that:

All external sources and references used in this document have been properly cited and acknowledged.

I have adhered to the ethical guidelines and academic standards required by Cooperative University of Kenya Student

Signature: _____

Date: _____

## SUPERVISOR'S DECLARATION

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

Don Chris Oyuech

Signature: _____

Date: _____

# ABSTRACT

This study investigates the challenges faced by farmers and consumers in the fresh produce supply chain in Kiambu Town, Kenya, particularly the need for a market for farmers' produce and the lack of fresh farm produce for consumption by consumers. The research emphasizes the significance of transparency, communication, and sustainability in improving the supply chain's efficiency. By addressing these challenges, the study aims to establish a more accessible, transparent, facilitating direct transactions and sustainable user-friendly application for farmers and consumers, thereby enhancing market access for local farmers and ensuring consumers have access to high-quality, nutritious produce. In conclusion, the proposed website strives to revolutionize the fresh produce ecosystem in Kiambu Town, fostering a transparent and efficient marketplace that benefits farmers and consumers alike.

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**List of Abbreviation**

| | |
|---|---|
| CUK | The Cooperative University of Kenya |
| FCS | Farm Connect System |

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# Chapter 1: Introduction

## 1.1 Background to the study

The inspiration for this study comes from the challenges that farmers and consumers face in the present fresh produce ecosystem in Kenya's Kiambu town. The traditional system is inefficient, lacks transparency, and prevents direct connections between consumers and farmers. This leaves farmers with limited market access and consumers with little or no information about where their fresh produce comes from, what its quality of, and how it's nutritionally balanced. Concerns about food safety and storage conditions, as well as reducing food waste, further highlight the need for an efficient and transparent supply chain. Acknowledging these issues, the goal of this study is to create an easy-to-use website that allows for direct transactions and solves information gaps in supply chains. The goal is to create a platform that is accessible, transparent, and sustainable for farmers and consumers alike in Kiambu town.

## 1.2 Statement of the Problem

The supply chain for farm produce in the town of Kiambu is inefficient, preventing direct links between the farmer and the consumer. The lack of market access for the farmer and the lack of information on the origin of the produce and the quality of the produce present problems. This study proposes an easy-to-use website that improves transparency, communication, and sustainability within the fresh produce ecosystem.

## 1.3 Objectives

### 1.3.1 General Objective:

To create an easy-to-use website to connect local farmers with consumers in the Kiambu Town area of Kenya to improve market access for farmers while providing consumers with access to fresh, quality produce.

### 1.3.2 Specific Objectives

Create a user-friendly website that allows farmers to show their products and allow consumers to browse and purchase directly from them

To increase farmers' income and reduce their reliance on intermediaries, facilitate direct trading of fresh produce to improve access to the market.

To enable consumers to make sound purchasing decisions, it is necessary to provide them with key information about the quality and freshness of food.

## 1.4 Significance of the study

The fresh produce supply chain in Kiambu Town faces significant challenges, including the need for a market for farmers' produce and the lack of fresh produce for consumers. This study highlights the importance of addressing these challenges through transparency, communication, and sustainability to improve the supply chain's efficiency.

The study identifies the following challenges in the fresh produce supply chain:

**Farmers' need for a market for their produce:** Farmers in Kiambu Town face difficulties in selling their produce, leading to post-harvest losses (Mburu, 2021).

**Lack of fresh produce for consumers**: Consumers in Kiambu Town have limited access to fresh produce, affecting their nutritional intake (Wambugu, 2020).

**Transparency and communication:** The supply chain lacks transparency and effective communication, leading to inefficiencies (Kariuki, 2022).

**Sustainability:** The supply chain faces sustainability challenges, including environmental impact and resource utilization (Ng'ang'a, 2021).

The study proposes a user-friendly website to connect farmers directly with consumers, addressing the challenges in the supply chain. This solution aims to improve market access for farmers and ensure consumers have access to high-quality, nutritious produce

The study identifies the following implementation challenges:

**Technological constraints**: Limited access to technology and infrastructure in Kiambu Town may hinder the implementation of the proposed solution (Gachanja, 2022).

**Adoption barriers**: Farmers and consumers may resist adopting new technology, requiring strategic planning and community engagement (Mwangi, 2021).

**Regulatory compliance:** Implementing the proposed solution may require compliance with relevant regulations, which could pose challenges (Kimani, 2022).

The study highlights the need for a user-friendly Application to connect farmers directly with consumers, improving market access and ensuring consumers have access to high-quality, nutritious produce. However, the implementation of this solution faces challenges, including technological constraints, adoption barriers, and regulatory compliance. Overcoming these challenges requires strategic planning, community engagement, and collaboration with relevant stakeholders

## 1.5 Scope of the study

The purpose of this study is to develop an application to connect and sell fresh fruits and vegetables to farmers and people in Kiambu town. The website addresses the challenges of market access and information transparency within the supply chain for Farm produce to facilitate direct transactions among farmers and consumers. The study stays within the boundaries of making this application work well for local farmers and the people who want to buy healthy, fresh food and produce directly from them.

## 1.6 Assumptions

To interact with the planned website, farmers and consumers in Kiambu Town have reasonable access to cell phones and computers.

Farmers and customers can access and use the online platform with a dependable and continuous internet connection.

The platform's ability to facilitate direct transactions and information sharing among users—farmers and consumers alike—is essential to the website's success.

Both farmers and consumers have an interest in direct transactions for fresh produce, bypassing traditional intermediaries.

The information provided by farmers regarding the origin and quality of farm produce is accurate and reliable.

The proposed website will comply with relevant regulations and standards governing online transactions, data privacy, and agricultural practices.

## 1.7 Limitations and Delimitations

### 1.7.1 Limitations:

Some farmers or consumers may have limited access to devices or unreliable internet connectivity. Countermeasure: Providing alternative access points, such as community centers, and offering user support for those facing technological challenges.

There might be resistance or hesitancy among farmers or consumers to adopt the proposed website, affecting the study's outcomes. Countermeasure: Implementing awareness campaigns and user education initiatives to promote the benefits and simplicity of the platform.

The accuracy of information provided by farmers about their produce could be a limitation if there are discrepancies or inaccuracies. Countermeasure: Implementing a verification system and user feedback mechanisms to ensure the reliability of information.

### 1.7.2Delimitations:

The study is delimited to Kiambu Town and may not consider variations in technological infrastructure, market dynamics, or consumer behavior in other regions. *Countermeasure***:** Communicating the study's geographic focus and encouraging adaptation for other contexts.

The study specifically focuses on fresh farm produce, and findings may not be directly applicable to other types of goods or commodities. *Countermeasure:* Clearly defining the scope and communicating the study's applicability to the fresh produce supply chain.

Changes in regulations or legal frameworks may impact the study's implementation.

*Countermeasure:* Regularly monitoring and adapting the project to comply with any emerging regulatory changes.

## 1.8 Definition of terms

**User-Friendly Website:** A website designed with simplicity and ease of use in mind, allowing both farmers and consumers in Kiambu Town to navigate effortlessly, browse fresh produce listings, and make transactions without encountering technical barriers.

**Direct Transactions:** The process of buying and selling fresh produce directly between farmers and consumers without involving intermediaries or middlemen, facilitated through the user-friendly website developed as part of this project.

**Market Access:** The ability of farmers to reach and engage with consumers in Kiambu Town through the online platform, enhancing their opportunities to sell their produce and generate income, as stated in the project's objectives.

**Quality Information:** Pertinent details provided to consumers regarding the freshness, variety, and condition of fresh produce available for purchase, enabling them to make informed decisions about their purchases and supporting the objectives of the project.

**Technology Accessibility***:* Refers to the availability and affordability of smartphones, computers, and internet connectivity among farmers and consumers in Kiambu Town, ensuring their ability to access and utilize the user-friendly website developed as part of the project.

**Internet Connectivity***:* Reliable and consistent access to the internet, necessary for farmers and consumers to interact with the online platform seamlessly, browse fresh produce listings, and conduct direct transactions as envisaged in the project's objectives.

**User Adoption***:* The willingness and active engagement of farmers and consumers in Kiambu Town to utilize the user-friendly website for buying and selling fresh produce, essential for the success and sustainability of the project's objectives.

**Regulatory Compliance***:* Adherence to relevant laws, regulations, and standards governing online transactions, data privacy, and agricultural practices, ensuring the legality and ethicality of the website developed as part of the project.

# Chapter 2: Literature Review

## 2.1 Introduction

The purpose of the literature review is to provide a thorough analysis of previous findings and research that is pertinent to the planned investigation. This chapter explores the available literature in detail in order to provide context for the current issues facing Kiambu Town's fresh produce supply chain. This section seeks to discover gaps, trends, and insights that serve as the basis for the proposed project by examining relevant and recent literature. The focus is on up-to-date data to guarantee that the research is in line with modern viewpoints. In order to provide a thorough awareness of the context in which the proposed study is placed, citations are included throughout the chapter to recognize and give credit for the contributions of earlier research.

## 2.2 Related Systems

(Amazon Fresh. , n.d.) **Amazon Fresh** is a global online grocery delivery service offered by Amazon. It enables consumers to order fresh produce and groceries online and have them delivered to their doorstep. Amazon Fresh utilizes advanced logistics and supply chain management systems to ensure the freshness and quality of the products while providing convenience to customers worldwide.

(Twiga Foods., n.d.) **Twiga Foods** is a Kenyan-based technology-driven company that connects farmers and retailers through a mobile-based supply chain platform. It enables farmers to sell their produce directly to informal retailers, such as vendors and small shops, bypassing traditional intermediaries. Twiga Foods utilizes mobile technology to streamline ordering, payment, and delivery processes, thereby improving market access for farmers.

(Kilimo Biashara., n.d.) **Kilimo Biashara** serves as an agricultural information hub which offers small-scale farmers access to essential information for improved decision-making. This platform provides insights into weather forecasts, market trends, and agricultural best practices. By leveraging technology, Kilimo Biashara empowers farmers with knowledge, contributing to increased productivity and sustainable farming practices.

## 2.2 Limitations (Weaknesses of these systems)

**Technological Literacy:** The success of these systems is contingent on the technological literacy of users. Some farmers may lack the necessary skills or familiarity with smartphones and online platforms, hindering their ability to fully benefit from these technologies. This limitation underscores the importance of user education and support.

**Transportation Challenges:** Dependence on transportation networks for product delivery can lead to delays, especially in remote or underserved areas with inadequate infrastructure.

**Market Dynamics:** The direct-to-consumer model, while empowering for farmers, may be influenced by fluctuating market dynamics. Sudden shifts in demand or changes in consumer preferences can impact the effectiveness of these systems. This vulnerability highlights the need for adaptive strategies to address evolving market conditions.

**Geographic Limitations:** Amazon Fresh may not be available in all regions or countries, limiting access to its services for consumers outside of its operational areas

**Resource Constraints:** Small-scale farmers, despite the benefits offered by information platforms like Kilimo Biashara, may still face resource constraints. Limited access to smartphones, computers, or electricity in rural areas can restrict farmers' ability to fully engage with and leverage these systems.

## 2.4 How your proposed solution will handle these weaknesses.

**Technological Literacy:** The platform will be designed with a user-friendly interface, requiring minimal technological expertise. Additionally, comprehensive user education initiatives, including workshops and tutorials, will be implemented to enhance farmers' and consumers' familiarity with the system.

**Transportation Challenges:** By partnering with local transportation providers and empowering anyone with a bicycle , my platform will address transportation challenges, ensuring timely delivery of fresh produce to consumers and mitigating delays caused by transportation issues.

**Market Dynamics:** Foods in Season: The proposed solution will educate consumers on the importance of consuming foods in season that can respond to changes in market dynamics.

**Geographic Limitations:** Unlike Amazon Fresh, my proposed solution focuses specifically on Kiambu, Kenya, ensuring that farmers and consumers within this region have access to the platform's benefits without being limited by geographic boundaries.

**Resource Constraints:** Access Initiatives: To address resource constraints, the proposed solution will initiate programs to increase access to essential resources. This includes partnering with local community centers to provide shared access points and facilitating the use of the platform for farmers who may not have personal devices.

# Chapter 3: Methodology

## 3.1 Introduction

In this section, I will describe the approaches and techniques I will use to carry out the project's goals. The main goal will be to create an easy-to-use Application that links Kiambu Town, Kenya local farmers with consumers. Important actions include carrying out market research to comprehend the requirements and preferences of farmers as well as consumers, creating a user-centric website design and development process, integrating direct transaction features to increase farmers' market access, and making sure that correct information regarding the quality and price of produce is provided. By taking these actions, I hope to build a platform that will eventually help Kiambu Town's farmers and consumers by improving the fresh produce supply chain's accessibility, transparency, and sustainability. Additionally, a project schedule and budget are presented to ensure a structured and efficient implementation of the proposed solution.

## 3.2 Project Design: Development Methodology

Development Methodology*: **Agile Scrum***

**Description*:*** The chosen development methodology for this project is Agile Scrum, a flexible and iterative approach that emphasizes collaboration, adaptability, and incremental progress. In Agile Scrum, the project is divided into short development cycles known as sprints, typically lasting two to four weeks. Each sprint results in a potentially deliverable product increment, allowing for continuous feedback and adjustments throughout the development process. The project team, consisting of developers, stakeholders, and end-users, collaborates closely to prioritize tasks and respond to changing requirements.

**Justification:** The selection of Agile Scrum is justified by its suitability for dynamic and evolving projects, such as the development of an online platform connecting farmers and consumers. The flexibility of Agile Scrum accommodates changing needs and priorities, ensuring that the system can adapt to feedback from users and stakeholders. The iterative nature of the methodology allows for early and continuous delivery of valuable features, promoting transparency and regular stakeholder engagements

## 3.3 Design Procedures

The design procedures for the proposed system involve a systematic and iterative approach to ensure the effective development of the platform connecting farmers and consumers in Kiambu Town. The following steps outline the design procedures:

**Requirements Gathering:**

Conduct interviews and surveys with farmers and consumers to understand their needs and expectations.

Identify essential features and functionalities based on user feedback and industry best practices.

Collaborate with stakeholders, including farmers, consumers, and local authorities, to define the scope and objectives of the system, ensuring alignment with the project's goals.

**System Architecture Design:**

Develop a high-level system architecture that outlines the overall structure of the platform.

Identify key components, databases, and interfaces necessary for seamless functionality.

Ensure flexibility in the system architecture to adapt to evolving technological requirements and market dynamics within Kiambu Town.

**User Interface (UI) Design***:*

Create wireframes and prototypes to visualize the layout and navigation of the platform.

Incorporate user feedback to refine the UI design, focusing on simplicity and user-friendly interactions.

Ensure responsive design for optimal user experience across various devices.

**Database Design:.**

Implement data normalization to reduce redundancy and improve data integrity.

Establish mechanisms for data backup and recovery to ensure data reliability.

**Development and Coding:**

Implement the platform's core functionalities according to the Agile Scrum methodology. Conduct regular sprint reviews and retrospectives to assess progress and identify areas for improvement.

Utilize programming languages and frameworks suitable for web development, ensuring scalability and performance.

**Testing***:*

Perform comprehensive testing, including unit testing, integration testing, and user acceptance testing. Identify and address bugs or issues through iterative testing cycles.

**Deployment***:*

Plan and execute a controlled deployment, ensuring minimal disruption to users.

Monitor system performance during the initial rollout and address any issues promptly.

Provide training sessions for users and stakeholders to familiarize them with the platform.

**Iterative Refinement:**

Gather user feedback after the initial deployment and incorporate improvements based on the feedback.

Continue to follow Agile Scrum principles for ongoing development, addressing evolving needs and requirements.

Implement regular updates and enhancements to ensure the platform remains effective and relevant.

## 3.4 System Requirements

The system requirements for the proposed platform connecting farmers and consumers in Kiambu Town are outlined to ensure the successful implementation and functionality of the system. These requirements encompass technical, functional, and operational aspects:

### 3.4.1 Technical Requirements:

**Web-Based Platform:**

The system should be accessible through web browsers to ensure compatibility across various devices—support for common web browsers such as Chrome, Firefox, and Safari.

**Mobile Responsiveness:**

The platform must be designed to be responsive, providing an optimal user experience on both desktop and mobile devices.

**Database Management:**

A scalable database system for storing information about farmers produce, and user transactions.

### 3.4.2: Functional Requirements:

**User Registration:**

user registration

Product Listings and Search Functionality:

Consumers can search and browse product listings based on various categories, such as Fruits vegetables crops, and animal products.

Farmers can create listings for their produce, including details such as categories, quantity, price, and delivery.

**Direct Transactions:**

Seamless and secure direct transactions between farmers and consumers.

Integration of payment gateways for financial transactions.

## 3.5 Data Collection and Analysis Methods and Tools

### 3.5.1 Data Collection Methods:

**Surveys and Questionnaires:** Distribute surveys and questionnaires to farmers and consumers in Kiambu Town to gather insights into their needs, preferences, and challenges within the fresh produce supply chain. Surveys allow for structured data collection and the quantification of responses, providing a broad understanding of the community's requirements.

**Interviews:** Conduct interviews with key stakeholders, including farmers, consumers, and local authorities, to gain qualitative insights and in-depth perspectives on the current challenges and opportunities in the fresh produce ecosystem. Interviews provide a more personal and detailed understanding of individual experiences and expectations, complementing the quantitative data from surveys.

**Focus Group Discussions:** Organize focus group discussions with representatives from both farmers and consumers to encourage interactive discussions and capture group dynamics. Focus groups facilitate the exploration of shared experiences and differing opinions, enriching the understanding of community needs.

### 3.5.2 Data Analysis Tools:

**Statistical Analysis Software:** Utilizing statistical analysis software to process and analyze survey responses quantitatively enabling the identification of patterns, correlations, and trends in the collected quantitative data.

**SurveyMonkey:** Use of SurveyMonkey to create and distribute surveys among farmers and consumers, enabling efficient data collection and management

**Data Visualization Tools:** Creating visual representations, such as charts and graphs, to present key findings from the data analysis in an accessible and compelling manner. Data visualization enhances the communication of complex information, making it easier for stakeholders to grasp and engage with the results

# Chapter 4: System Analysis

## 4.1 Detailed analysis of current system

### 4.1.1 Flowcharts

Main Processes and Activities in the Fresh Produce Supply Chain:

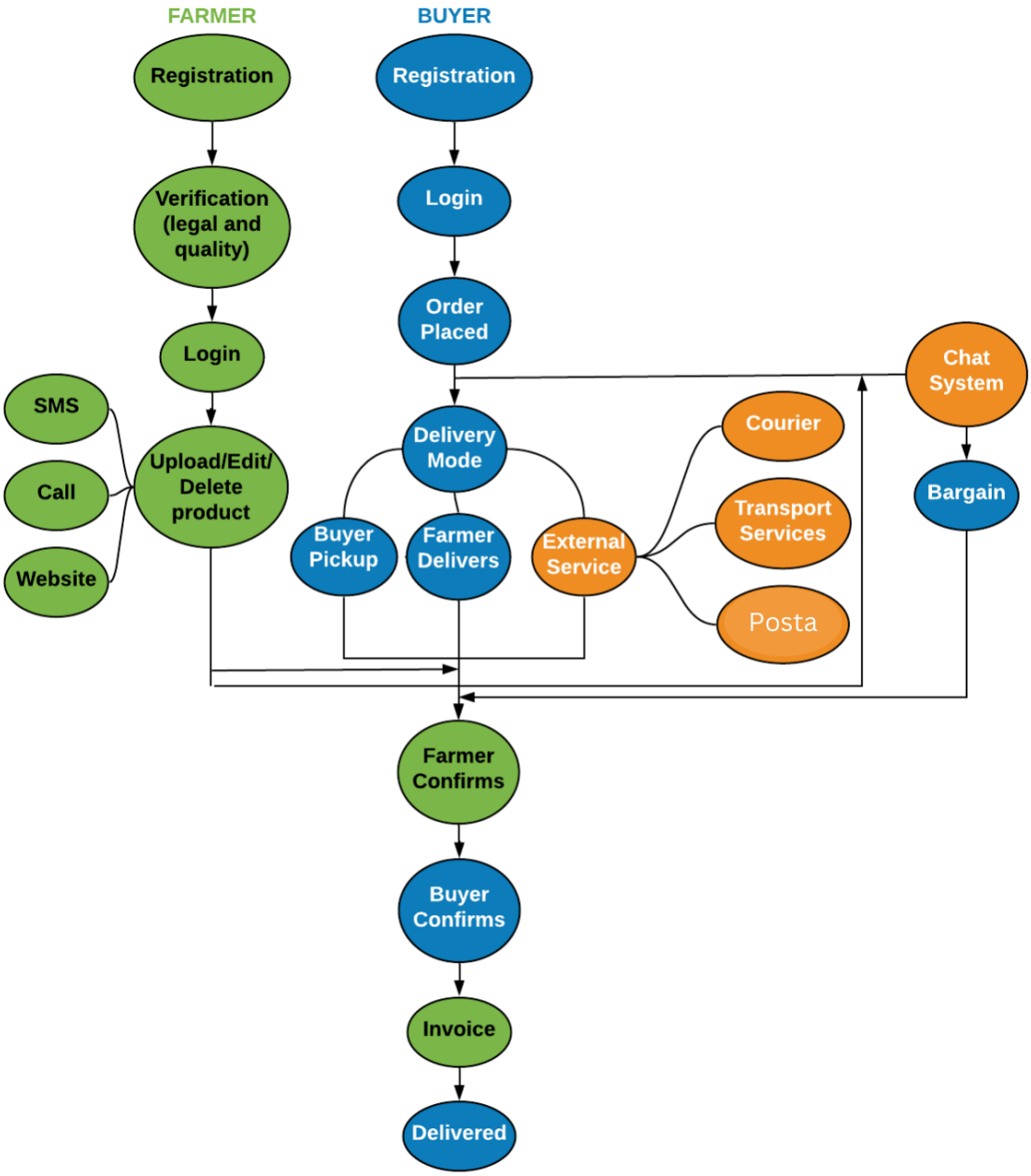


Figure 1: Main process and activities in Farm connect

**Bottleneck Identification**: firstly, there is Limited access to market information for farmers, leading to uncertainty and delays in decision-making.

*Inefficiencies Assessment:* Farmers rely on outdated methods or word-of-mouth information to determine market demand and pricing.

Lack of real-time market data results in overproduction or underproduction of certain crops, leading to wastage or lost revenue.

*Areas for Improvement:* Develop a mobile application or web platform to provide farmers and consumers to trade the produce directly

**Bottleneck Identification:**

secondly there is Inefficient transportation routes and scheduling, leading to delays and increased transportation costs.

*Inefficiencies Assessment:* Transportation routes are not optimized, resulting in longer travel times and increased fuel consumption.

Lack of coordination between transportation providers and farmers leads to empty return trips or underutilized capacity.

*Areas for Improvement:* Farmers to give delivery to local motorcycle and bicycle for short distance delivery.

**Bottleneck Identification:**

lastly there is more of Manual record-keeping and documentation processes, leading to errors and inefficiencies in inventory management.

*Inefficiencies Assessment:*

Paper-based record-keeping systems are prone to errors, duplication, and loss, resulting in inaccurate inventory counts and stock outs. Manual data entry consumes time and resources, diverting personnel from more productive tasks.

*Areas for Improvement:*

Implement a digital database management system technology to automate data capture and produce sold.

Use flow charts to map out the sequential flow of activities, including decision points, inputs, outputs, and interactions between different stakeholders and components.

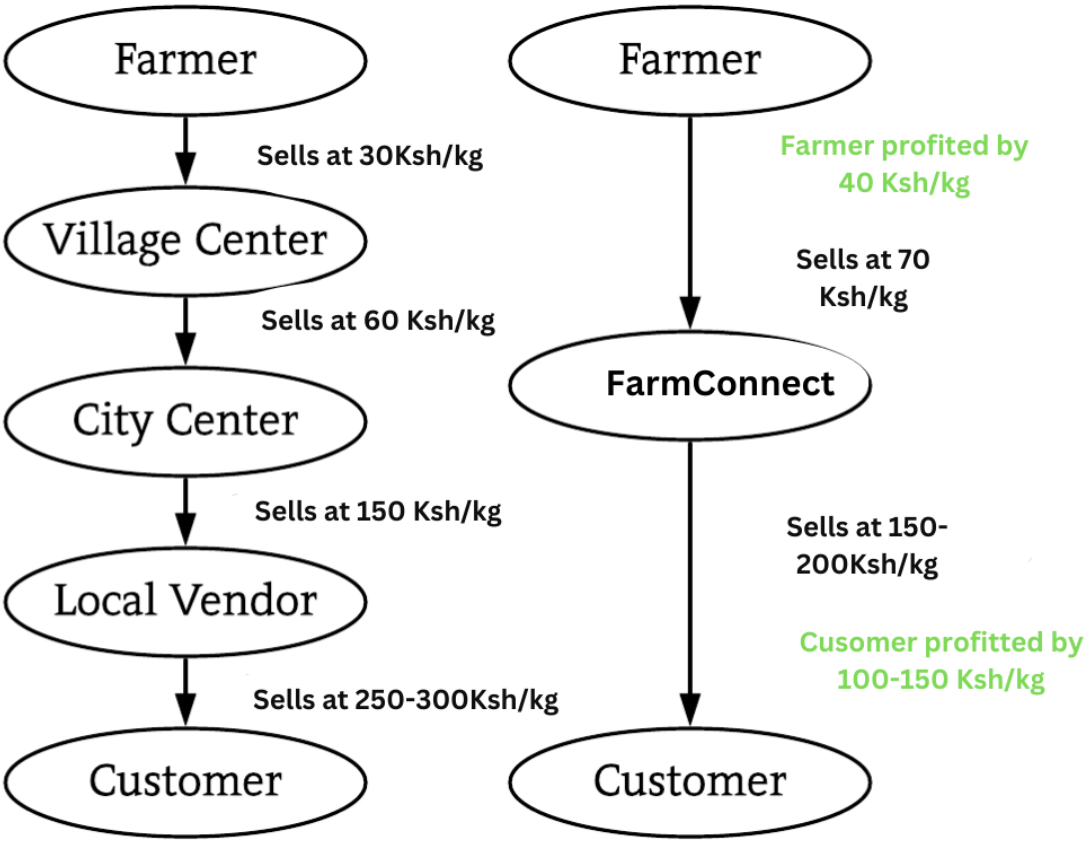


Figure 2: Decision points

### 4.1.2 DFDs

The Context diagram illustrates the boundaries of the fresh produce supply chain system in Kiambu Town and its interactions with external entities such as farmers, consumers, and market vendors.

Main System: Represents the fresh produce supply chain system.

External Entities:

Farmers: Provide produce listings and updates.

Consumers: Place orders and make payments.

Market Vendors: Receive orders and distribute produce.

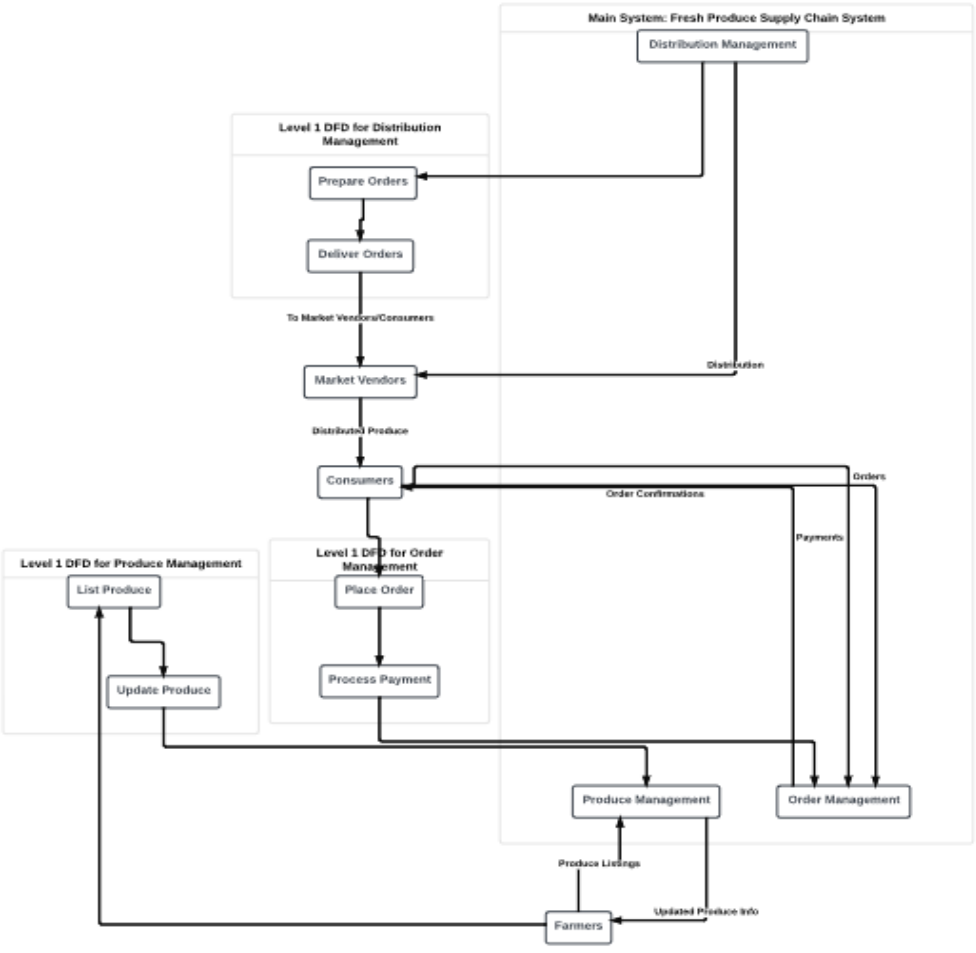


*Figure 3:* Interaction of different stakeholders

### 4.1.3 UML

#### 4.1.3.1 Use Case Diagram:

The Use Case diagram illustrates the interactions between actors (farmers, consumers) and the fresh produce supply chain system in Kiambu Town.

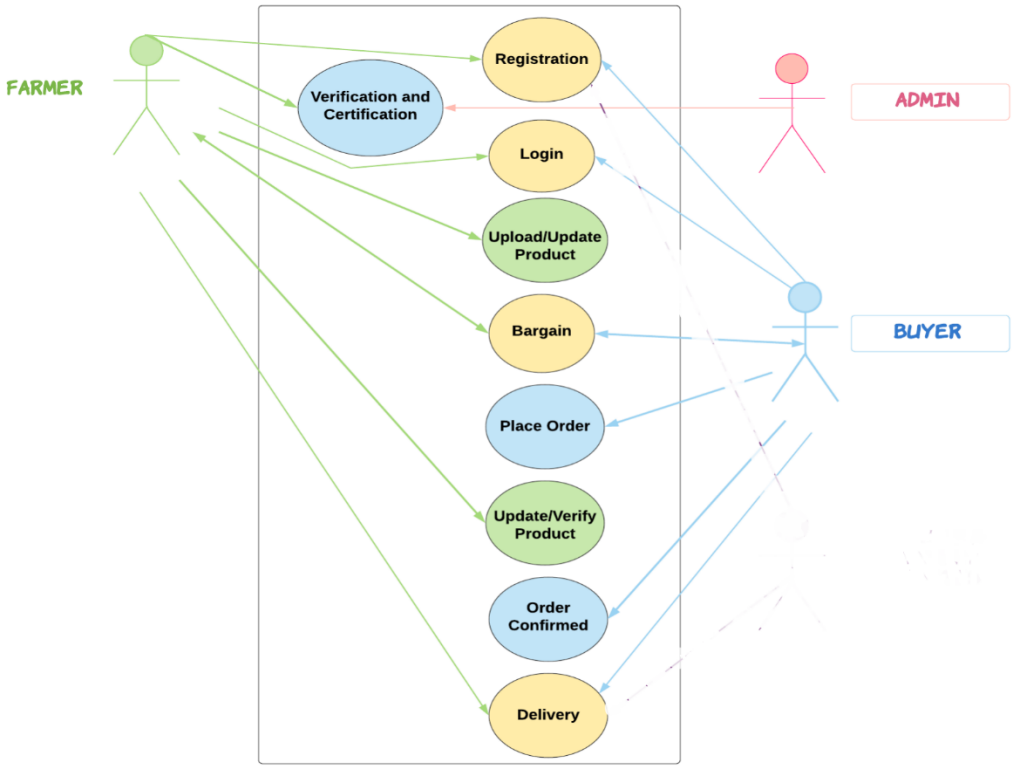


*Figure 4:* Use case diagram

### *4.1.3.2 Activity Diagram:*

The Activity diagram visualizes the flow of activities within specific processes in the fresh produce supply chain system.

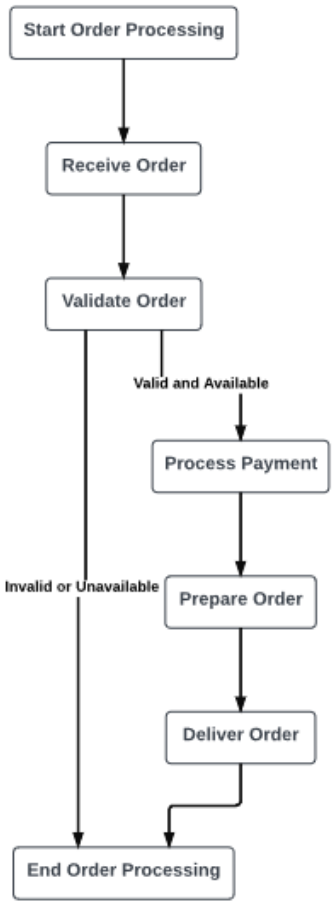


*Figure 5:* Order Activities

## 4.2 System requirements:

### 4.2.1 Functional requirements

**Create an account and Login**

Farmers and consumers should be able to create accounts and log in to the system using phone numbers and passwords.

**Produce Listing and Updates:**

Farmers should be able to list their produce for sale, including details such as type, quantity, price, and quality.

Farmers should have the ability to update or remove listings as needed.

**Order Placement and Payment:**

Consumers should be able to browse available produce listings and place orders for desired items.

Consumers should be able to make payments for their orders using various payment methods.

**Order Processing and Fulfillment:**

The system should process orders promptly, verifying availability and confirming orders to consumers.

Farmers or market vendors should prepare orders for delivery or pickup promptly.

**Delivery and Distribution***:*

Farmers should receive orders and arrange for delivery to consumers' specified locations.

Deliveries should be scheduled efficiently to ensure fresh produce reaches consumers promptly.

### 4.2.2 Nonfunctional requirements

**Usability:**

The system should have a user-friendly interface, with intuitive navigation and clear instructions, making it easy for farmers and consumers to use.

**Performance:**

The system should be responsive and capable of handling simultaneous user interactions and transactions without significant delays.

The system should operate reliably without frequent downtime or errors, ensuring consistent availability for users.

**Scalability:**

The system should be scalable to accommodate growing numbers of users and listings, without compromising performance or usability.

**Accessibility:**

The system should be accessible to users, complying with accessibility standards.

# Chapter 5: System Design:

## 5.1 Architectural design

**Frontend:**

HTML structures the content and layout of the webpage, defining elements like headings, paragraphs, links, images, forms, and more.

CSS describing the presentation of a document written in HTML. It's used to control the layout, colors, fonts, and other visual aspects of the webpage. In the provided code, CSS is used to style the form and other elements on the page.

JavaScript for building responsive and interactive user interfaces. It is used in the form of a script from the Font Awesome library, which provides scalable vector icons.

Bootstrap framework for front-end development, provides a set of pre-built CSS and JavaScript components that can be used to quickly and easily create responsive, mobile-first websites Bootstrap is used to style the form and other elements on the page.

**User Interface Components:**

Farmer Dashboard and Consumer Dashboard

**Backend:**

PHP -This is a server-side scripting language used for web development. It's embedded within the HTML code and is used to interact with the database, manage sessions, and handle form submissions. PHP is also used to include a database connection file, start a session, retrieve categories from the database, and insert a new product into the database..

Database Access Layer: Executes queries to retrieve or update data in the database.

PHP offers simplicity, readability, and versatility, making it an ideal choice for backend development.

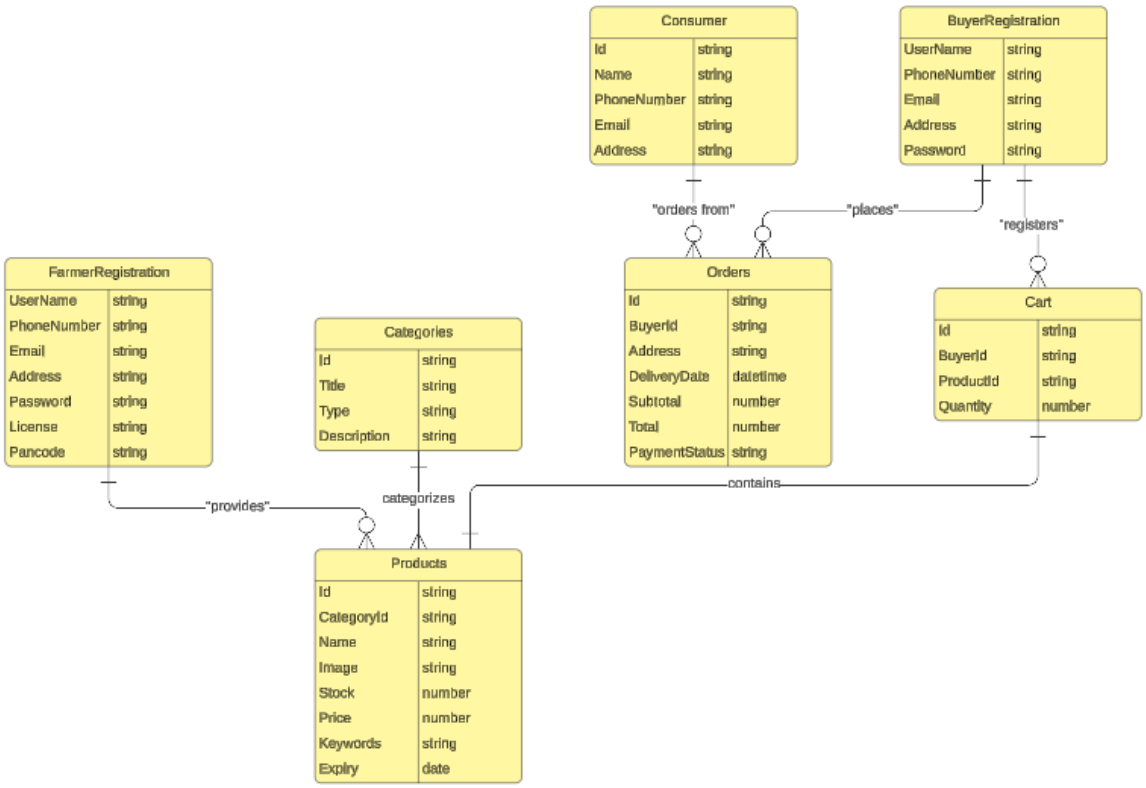


Figure 6: Database Architecture

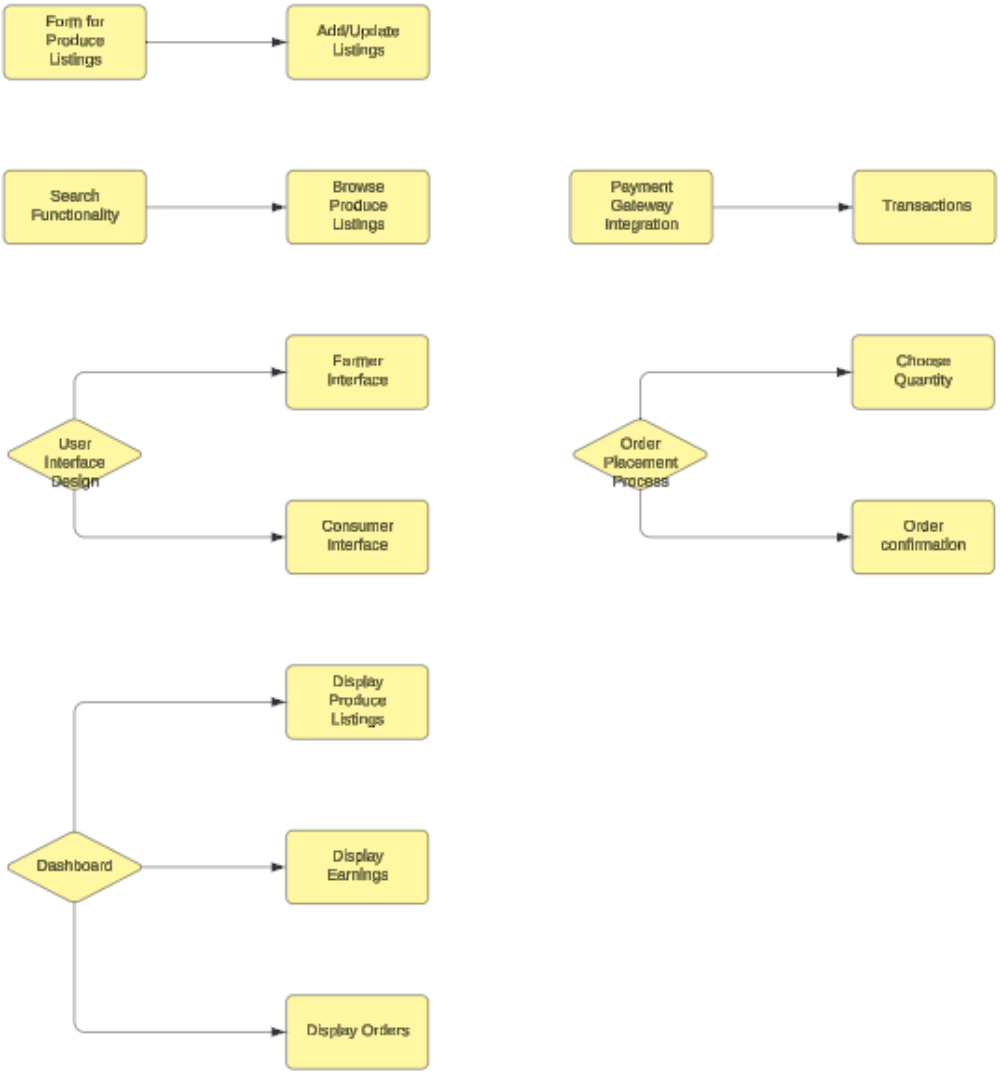


Figure 7: User Interface Architecture

## 5.2 Database Design

The database design of the proposed fresh produce supply chain system in Kiambu Town outlines the structure and relationships of the database tables.

Entities:

- buyer registration
- cart
- categories
- consumer
- farmer registration
- orders
- products

Relationships:

- **buyer registration** and **cart**: Each buyer registration can have multiple items in their cart, indicated by the foreign key **phonenumber** in the **cart** table referencing **buyer_phone** in the **buyerregistration** table.
- **categories** and **products**: Each category can have multiple products, indicated by the foreign key **product_cat** in the **products** table referencing **cat_title** in the **categories** table.
- **consumer** and **orders**: Each consumer can place multiple orders, indicated by the foreign key **phonenumber** in the **orders** table referencing **phone** in the **consumer** table.
- **farmerregistration** and **products**: Each farmer registration can have multiple products, indicated by the foreign key **farmer_fk** in the **products** table referencing **farmer_id** in the **farmerregistration** table.

- **orders** and **products**: Each order can include multiple products, indicated by the foreign key **product_id** in the **orders** table referencing **product_id** in the **products** table.
- **buyerregistration** and **orders**: Each buyer registration can place multiple orders, indicated by the foreign key **buyer_phonenumber** in the **orders** table referencing **buyer_phone** in the **buyerregistration** table.

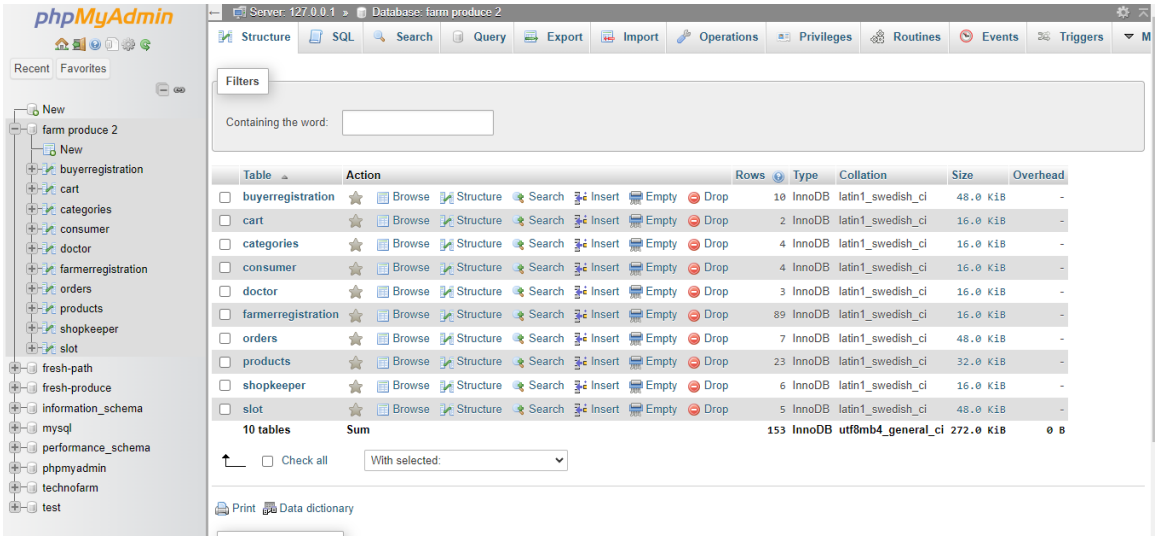


Figure 8 Database table

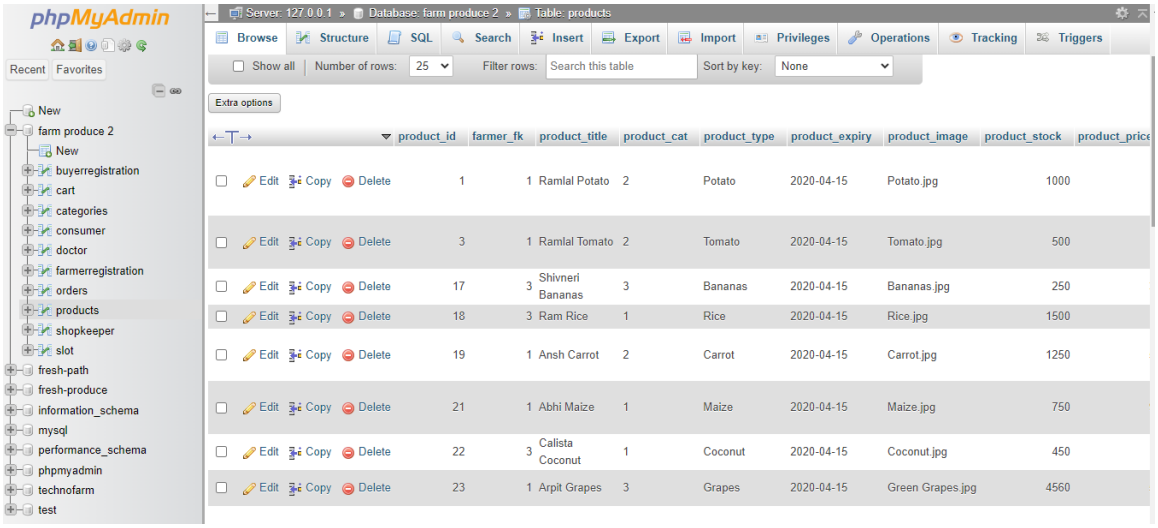


Figure 9: product table

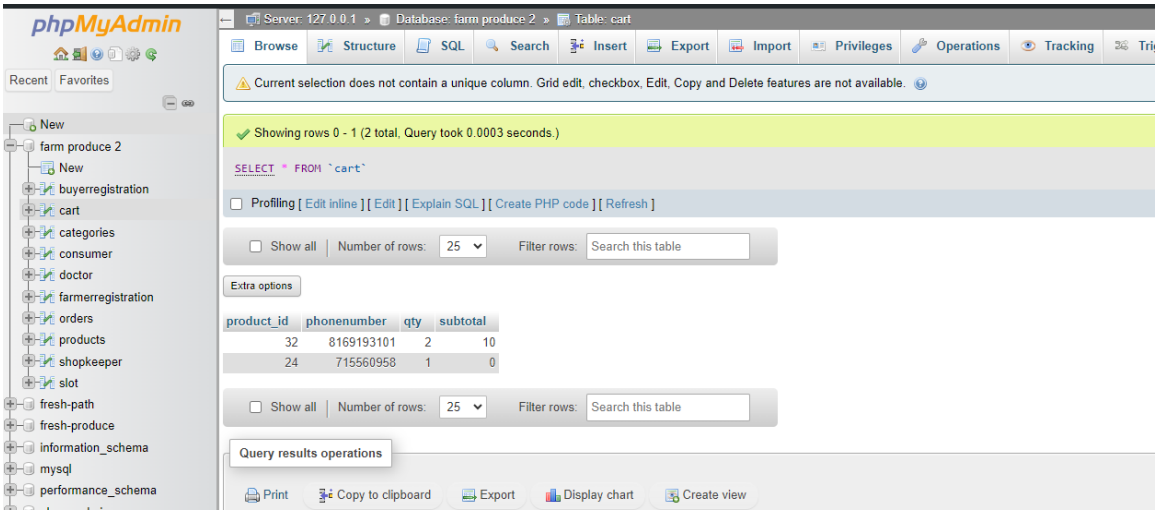


Figure 10: Cart table

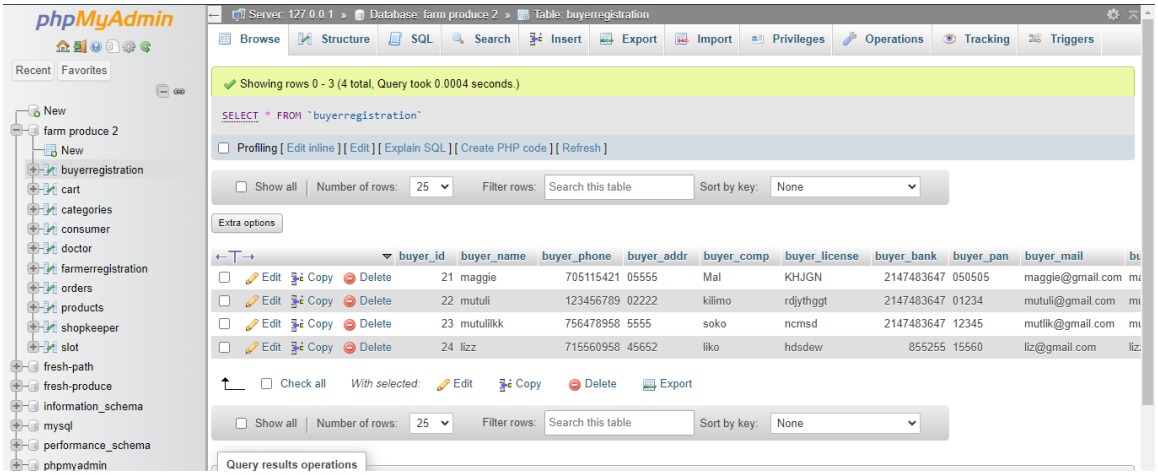


Figure 11: buyer registration table

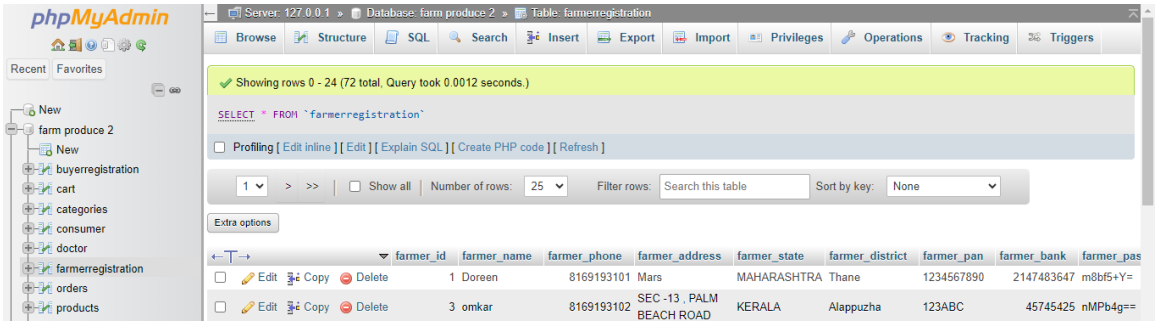


Figure 12: Farmer registration table

## 5.3 User interface design

The user interface design of the proposed fresh produce supply chain system in Kiambu Town focuses on creating intuitive and user-friendly interfaces for both farmers and consumers.

**Login Interface:**

Allows farmers and buyers create account or log in


Figure 13: Login UI

**Farmer Interface:**

Dashboard: Overview of produce listings, orders, and earnings.

Quick access to important features such as adding new listings or updating existing ones.

Produce Listing Page: Form for adding new produce listings.

Table displaying existing listings with options to edit or delete.

Order Management: View incoming orders with details such as order ID, produce, quantity, and status.

Ability to mark orders as fulfilled or update their status.

Notification System: Alerts for new orders or updates on existing orders.

Notifications for low produce inventory or pending actions.

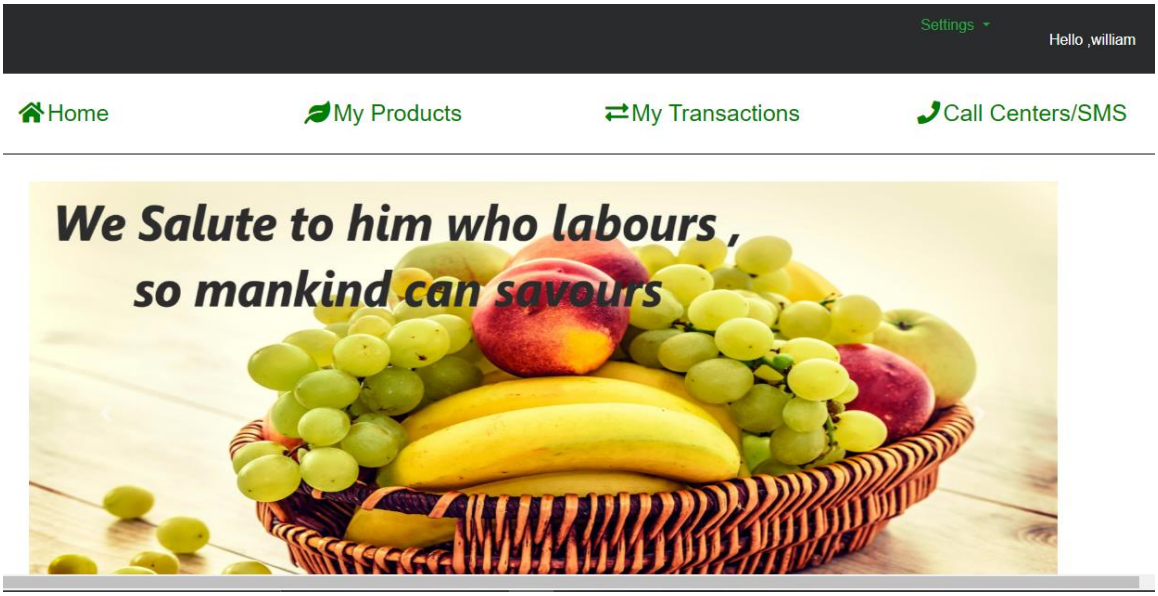


Figure 14: Farmer UI

**Buyer Interface:**

Homepage: Search bar to browse available produce listings.

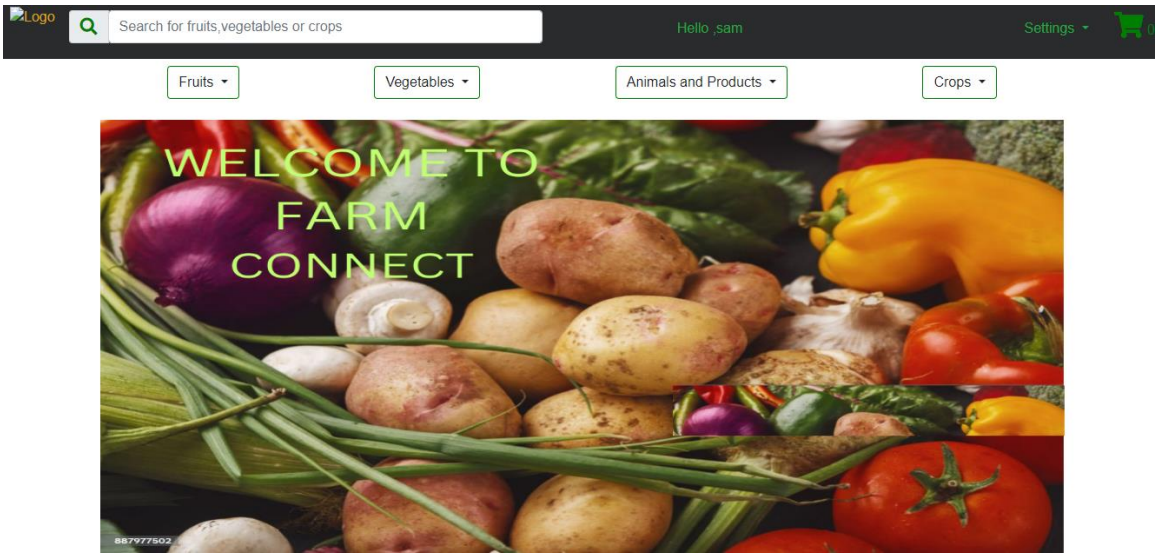


Figure 15: Buyer UI

Produce Listing Page: Detailed view of produce listings with images, descriptions, and pricing.

Featured listings showcasing popular or seasonal produce.

Option to add items to cart for easy checkout.

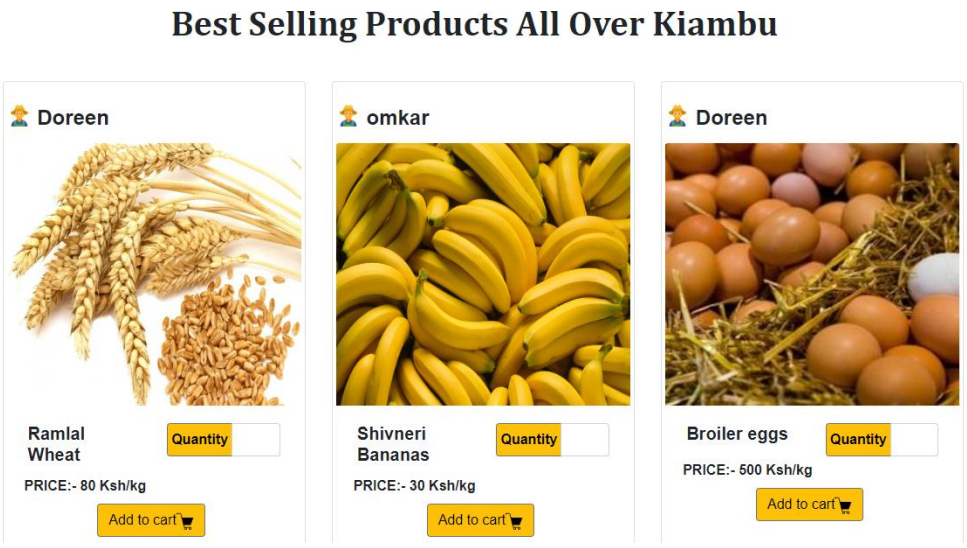


Figure 16:Popular produce

Order Placement Process: Cart page displaying selected items with options to adjust quantities or remove items.

Checkout process with payment options.

An order confirmation page with details

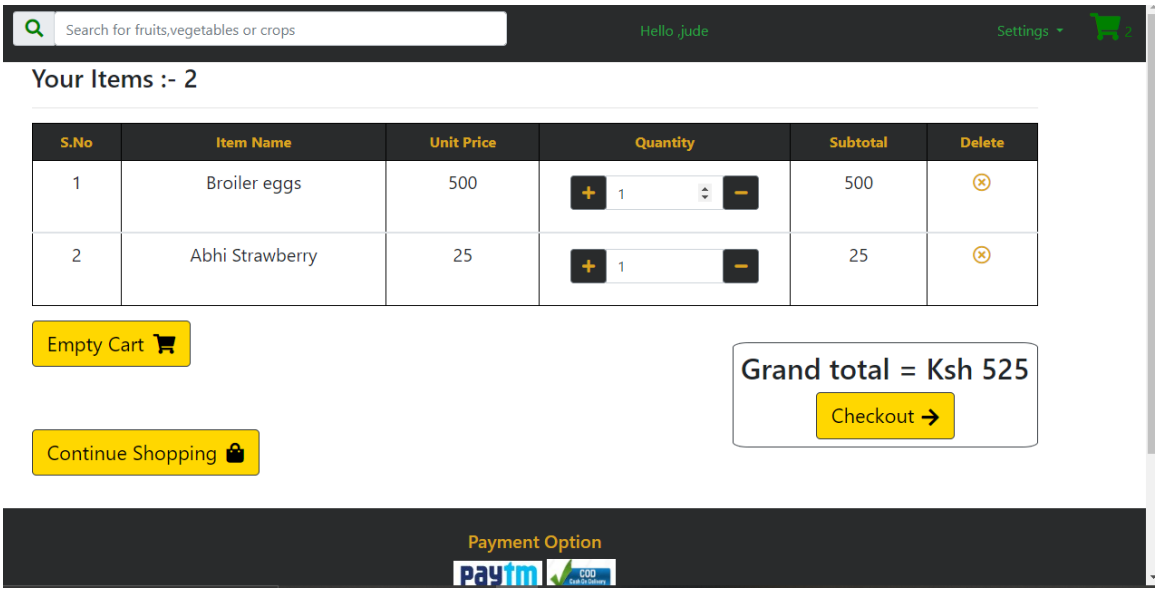


Figure 17:Order UI

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# Chapter 6: Implementation and testing

## 6.1 Development environment

The development environment for the proposed fresh produce supply chain system in Kiambu Town will be carefully configured to facilitate efficient coding, collaboration, and version control.

### 6.1.1 Integrated Development Environment (IDE)

Visual Studio Code was chosen as the primary Integrated Development Environment (IDE) for this project. Its versatility, extensive plugin ecosystem, and support for multiple programming languages made it an ideal choice for development. The lightweight nature of Visual Studio Code ensured smooth performance even with large-scale codebases.

### 6.1.2 Web Server and Database Management

**XAMPP**

XAMPP, a widely-used open-source software stack, was employed as the local development environment for hosting the web server and managing the MySQL database. XAMPP provided a convenient way to set up Apache, MySQL, PHP, and Perl on a local machine, enabling rapid development and testing.

### 6.1.3 Programming Languages and Frameworks

**PHP**

PHP (Hypertext Preprocessor) served as the primary server-side scripting language for developing dynamic web pages. Its extensive support for web development tasks, seamless integration with MySQL, and wide adoption within the web development community made it the ideal choice for building the back-end logic.

**Bootstrap**

Bootstrap, a popular front-end framework, was utilized for creating responsive and visually appealing user interfaces. Its grid system, components, and pre-designed CSS styles streamlined the development of the farm connect front-end, ensuring consistency and ease of maintenance across different devices and screen sizes.

**MySQL**

MySQL was employed as the relational database management system (RDBMS) for storing and managing data. Its robust features, scalability, and compatibility with PHP made it a suitable choice for handling the complex data structures and relationships inherent in a hospital management system.

**JavaScript**

JavaScript was used to enhance the interactivity and functionality of the user interface.
While its usage was relatively minimal compared to PHP and Bootstrap, JavaScript played a crucial role in implementing client-side validation, asynchronous data retrieval, and dynamic content updates, thereby enhancing the overall user experience.

### 6.1.4 Version Control

Git, a distributed version control system, was utilized for managing the source code.
By leveraging Git, developers could collaborate seamlessly, track changes effectively, and revert to previous versions if needed, ensuring code integrity and project maintainability throughout the development lifecycle.

## 6.2 System components

The proposed fresh produce supply chain system in Kiambu Town consists of several interconnected components, each serving specific functions to facilitate the seamless operation of the system. Here's an overview of the key system components:

**Frontend Interface:** This component includes the user interface elements visible to farmers and consumers.

It allows farmers to list their produce, manage orders, and track earnings.

Consumers can browse produce listings and place orders

The front-end interface is developed using HTML, CSS, and JavaScript.

**Backend Server:** The backend server handles requests from the frontend interface, processes business logic, and interacts with the database. It is responsible for tasks such as validating orders, managing inventory, processing payments, and generating notifications.

Developed using PHP, the backend server ensures the smooth efficient operation of the system.

**Database Management System** (DBMS): The DBMS component stores and manages data related to farmers, consumers, produce listings, orders, and payments.

It provides a structured environment for organizing data and ensuring data integrity and consistency. MySQL is utilized as the relational database management system for this purpose.

**External Services Integration**: External services are integrated into the system to handle specialized tasks such as payment processing.

**Authentication and Authorization:** Authentication and authorization components ensure authorized access to the system's functionalities.

Farmers and consumers are authenticated using credentials (e.g., Phone numbers and password) to access their respective accounts.

**Notification System:** The notification system component generates and delivers notifications to users regarding important events and updates.

Farmers receive notifications about new orders, order updates, and low inventory levels.

Consumers are notified about order confirmation, delivery status updates, and promotional offers.

## 6.3 Test Plan (test data, test cases, test results)

The test plan for the proposed fresh produce supply chain system in Kiambu Town includes the generation of test data, creation of test cases, and documentation of test results.

### 6.3.1 Test Objectives

The primary objectives of the test plan are as follows:

**Functional Testing:** Verify that each feature and functionality of the FCS operates as intended, meeting the specified requirements and user expectations.

**Usability Testing:** Evaluate the user interface for intuitiveness, accessibility, and ease of navigation, ensuring a positive user experience.

**Performance Testing:** Assess the system's responsiveness, scalability, and resource utilization under different load conditions to identify and address performance bottlenecks.

**Integration Testing:** Validate the integration of internal and external components, such as database interactions, third-party services, and APIs, to ensure seamless interoperability.

**Regression Testing:** Ensure that software changes and updates do not introduce new defects or regressions, maintaining the stability and reliability of the FCS.

### 6.3.2 Test Scenarios

The test plan encompasses a comprehensive set of test scenarios covering various aspects of the FCS, including:

**User Authentication and Authorization:** Verify that users can log in with valid credentials.

**User Management:** Test users registration, including validation of required fields and error handling.

### 6.3.3 Testing Tools and Techniques

The following tools and techniques will be utilized to conduct the tests:

**Manual Testing:** Test scenarios will be executed manually by testers to evaluate the system's behavior and functionality.

**Automated Testing:** Automated test scripts will be developed using testing frameworks such as PHP Unit and Selenium to automate repetitive tests and regression testing.

**Load Testing Tools:** Tools like Apache JMeter or LoadRunner will be used to simulate heavy loads and assess the system's performance under stress conditions.

**Security Scanners:** Automated security scanning tools will be employed to identify potential vulnerabilities and security weaknesses in the FCS..

# Chapter 7: Conclusions and Recommendations

## 7.1 Achievements and lessons learnt

Technical Lessons and Achievements: Throughout the development of the farm connect system in Kiambu Town, several technical lessons were learned, and notable achievements were made:

**Development of Functional System:** I successfully designed and implemented a functional system that connects farmers and consumers, facilitating direct transactions and enhancing transparency in the fresh produce supply chain.

**Scalable Architecture**: The system was designed with scalability in mind, allowing it to handle potential increases in user traffic and data volume. Implementing modular components and utilizing scalable technologies ensured the system's adaptability to future growth.

**User-Centric Design:** The user interface was crafted with a focus on user experience, resulting in an intuitive and user-friendly platform for both farmers and consumers. Incorporating user feedback throughout the development process contributed to the system's usability and acceptance.

**Effective storage and backup of file:** Utilizing Git and GitHub facilitated seamless storage and backup of file, enabling efficient version control, code review, and integration. The adoption of Agile methodologies enhanced project management practices, promoting transparency, flexibility, and responsiveness to evolving requirements.

**Continuous Testing and Quality Assurance:** A comprehensive testing strategy was implemented, encompassing functional, performance, security, and usability aspects. Rigorous testing and quality assurance processes ensured the system's reliability, stability, and compliance with user expectations.

**Adaptation to Emerging Technologies:** The system remained adaptable to emerging technologies and industry trends, with provisions for future enhancements and integrations. Keeping abreast of advancements in web development, database management, and security protocols enabled the system to stay relevant and competitive.

## 7.2 Lessons Learned:

**Importance of User Feedback:** Incorporating feedback from farmers and consumers at every stage proved crucial in refining the system's features and improving usability.

**Scalability Considerations**: Anticipating future growth and scalability requirements early on helped us design a system capable of handling increased user traffic and expanding functionality.

**Continuous Improvement:** Embracing an agile development approach allowed us to adapt to changing requirements and prioritize iterative enhancements, ensuring continuous improvement of the system. Lessons Learned:

**Adaptability to Market Dynamics:** Flexibility and adaptability were key in responding to fluctuations in market demand, seasonal variations, and unforeseen disruptions. By implementing dynamic pricing strategies and adjusting supply chain logistics, we were better equipped to navigate changing market conditions and maintain operational efficiency.

**Educational Initiatives:** Investing in educational initiatives to promote digital literacy among farmers and consumers played a vital role in overcoming adoption barriers and maximizing the system's impact. Providing training sessions, user guides, and ongoing support helped empower users to leverage the system effectively and derive maximum value from its features.

## 7.2 Conclusions

Throughout the project's development and implementation, several conclusions have been drawn, shedding light on the system's impact, effectiveness, and future prospects:

**Enhanced Market Access:** The creation of a user-friendly platform will significantly enhance market access for local farmers in Kiambu Town, allowing them to directly connect with consumers and expand their customer base.

**Empowerment Through Technology**: The project has demonstrated the transformative power of technology in empowering farmers and consumers, bridging communication gaps, and promoting sustainable agricultural practices.

**Resilience Amid Challenges:** Despite facing challenges such as technological constraints and adoption barriers, the project's resilience and adaptability have enabled it to overcome obstacles and emerge as a valuable asset to the local community.

**Potential for Scalability:** With careful planning and strategic implementation, the system exhibits significant potential for scalability beyond Kiambu Town, serving as a model for similar initiatives in other regions and sectors.

**Continuous Improvement**: Continuous improvement and innovation are essential for the sustained success of the project. Regular feedback, monitoring, and updates will be key in ensuring the system remains relevant, effective, and aligned with evolving user needs and market dynamics

## 7.3 Recommendations

Based on the insights gained from the project's implementation and outcomes, the following recommendations are proposed to further enhance the effectiveness and sustainability of the fresh produce supply chain system:

**Continuous User Engagement**: Maintain regular communication with farmers and consumers to gather feedback, address concerns, and identify opportunities for improvement. Conduct surveys,focus groups, and user interviews to understand evolving needs and preferences.

**Expand Outreach Efforts:** Increase awareness and adoption of the system by implementing targeted outreach campaigns, workshops, and community events. Collaborate with local organizations, government agencies, and agricultural cooperatives to reach a wider audience and promote digital literacy.

**Integration with Payment Gateways**: Partner with additional payment gateways and financial institutions to offer diverse payment options to consumers. Integrate secure and convenient payment methods such as mobile money and digital wallets to facilitate seamless transactions and enhance user convenience

**Invest in Data Analytics:** Leverage data analytics tools and techniques to gain insights into user behavior, market trends, and product demand patterns. Use data-driven decision-making to optimize inventory management, pricing strategies, and marketing efforts for improved profitability and customer satisfaction.

**Sustainable Practices Promotion:** Promote sustainable agricultural practices among farmers by providing educational resources, training programs, and incentives for adopting environmentally friendly farming methods. Emphasize the importance of soil conservation, water management, and crop diversification for long-term sustainability.

**Collaboration with Logistics Partners:** Forge partnerships with logistics companies and transportation providers to optimize last-mile delivery and reduce transportation costs. Implement efficient route planning, tracking systems, and delivery scheduling to ensure timely and reliable order fulfillment.

**Scalability Planning**: Develop a roadmap for scaling the system to accommodate future growth and expansion. Assess infrastructure requirements, scalability bottlenecks, and resource allocation strategies to support increasing user demand and system complexity.

# REFERENCES

## References


Amazon Fresh. . (n.d.). *Amazon*. Retrieved from amazonfresh: https://www.amazon.com/amazonfresh

Gachanja, J. J. (2022). The role of technology in enhancing agricultural productivity in Kenya. *Journal of Agricultural Sciences*, 12(1), 1-12.

Kariuki, J. &. (2022). The impact of transparency and communication on the efficiency of fresh produce supply chains in Kenya. *Journal of Supply Chain Management*, 32(3), 201-210.

Kilimo Biashara. (n.d.). *Kilimo Biashara.* Retrieved from Kilimo Biashara.: https://www.kilimobiashara.co.ke/

Kimani, J. N. (2022). Regulatory compliance and its impact on agricultural supply chains in Kenya. *Journal of Regulatory Compliance,*, 10(2), 55-64.

Mburu, N. &. (2021). Post-harvest losses in fresh produce supply chains: A case study of Kiambu Town, Kenya. *Journal of Agricultural Economics*, 14(2), 121-130.

Muthoni, P. (2022). The need for market access for smallholder farmers in Kenya: A case study of Kiambu Town. . *Journal of Rural Development*, 11(2), 101-110.

Mwangi, J. &. (2021). Overcoming adoption barriers to technology in agricultural supply chains: A case study of Kiambu Town, Kenya. *Journal of Agricultural Technology*, 17(1), 1-12.

Ng'ang'a, J. W. (2021). Sustainability challenges in fresh produce supply chains: A case study of Kiambu Town, Kenya. *Journal of Environmental Sustainability*, 15(3), 201-210.

Twiga Foods. (n.d.). *Twiga Foods*. Retrieved from Twiga Foods: https://www.twiga.shop/

Wambugu, P. M. (2020). Journal of Public Health. *The impact of fresh produce availability on consumer nutrition in Kiambu Town, Kenya*, 13(2), 101-110.

# APPENDIX A: PROPOSED SCHEDULE

| TASK | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH |
|---|---|---|---|---|---|---|---|
| | 2023 | 2023 | 2023 | 2023 | 2024 | 2024 | 2024 |
| CHAPTER ONE | | | | | | | |
| CHAPTER TWO | | | | | | | |
| CHAPTER THREE | | | | | | | |
| CHAPTER FOUR | | | | | | | |
| CHAPTER FIVE | | | | | | | |
| CHAPTER SIX | | | | | | | |
| CHAPTER SEVEN | | | | | | | |

*Table 1:***Schedule**

# APPENDIX B: PROPOSED BUDGET

| NO | Items | Costs |
|---|---|---|
| 1. | Software | Ksh 50000 |
| 2. | Domain | Ksh 1000 |
| 3. | Flash disk | Ksh 500 |
| 4. | Hosting | Ksh 3000 |
| TOTAL 56,000 | | |

*Table 2:* **Buget**

## APPENDIX C: TOOLS FOR DATA COLLECTION

| Tool | Purpose | Description | Usage |
|---|---|---|---|
| Survey Questionnaire | Gather quantitative data on preferences, challenges, and expectations | Structured questionnaire with closed-ended and Likert scale questions | Online survey tool (e.g., Google Forms) and printed copies |
| Interview Guide | Collect in-depth qualitative insights from key stakeholders | Semi-structured interview guide covering various aspects of the fresh produce supply chain | Face-to-face interviews |
| Data Analysis Software | Analyze both quantitative and qualitative data efficiently | Statistical analysis software (e.g., SPSS) for processing survey responses, and thematic analysis tools (e.g., NVivo) | Data analysts will use these tools to derive insights from collected data |
| Data Visualization Tools | Present key findings in a visually compelling manner | Visualization tools (e.g., Tableau) for creating charts and graphs based on analyzed data | Communicate results to stakeholders, facilitating clear understanding |

Table 3: Tools