AgTech: A Web Application for Enhancing Livestock Farming with Decision Support for Market Optimization

A Capstone Project by

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1 INTRODUCTION

1.1 Background of the Study

Agriculture, being the backbone of many economies worldwide, continuously evolves with the integration of technology to enhance productivity, efficiency, and sustainability (Sott et al., 2021). In this era of rapid technological advancement, the adoption of Agriculture Technology (AgriTech) has become vital for modernizing traditional farming practices and addressing the evolving needs of stakeholders across the agricultural value chain.

Market integration stands as a critical aspect of agricultural development, ensuring seamless connections between farmers, traders, and consumers. According to Crawford and Nations (1997), an interconnected network of participants emphasizes the significance of smooth connections across the agricultural value chain from farming to consumption. These efficient linkages are essential for boosting trade, promoting sustainability, and driving economic development. However, in many regions, including Albay Province, Philippines, fragmented markets and inadequate information channels pose significant challenges to market efficiency and transparency, particularly in the livestock sector.

Moreover, the absence of reliable decision support systems worsens these challenges, as farmers, traders, and consumers often lack access to timely and accurate market information needed to make informed decisions regarding production, marketing, and consumption. One study conducted by Lakovidis et al. (2024) demonstrates the potential of

Decision Support Tools (DSTs) in mitigating these issues. DSTs offer valuable assistance by improving the decision-making process for both farmers and advisors, enabling data-informed decisions that can enhance the sustainability performance of agricultural businesses in the region. A crucial component of designing a proficient DST is the prompt involvement of stakeholders using a participatory approach to define the needs and requirements of end users. This collaborative process ensures that DSTs are tailored to address the specific challenges faced by stakeholders in accessing market information and making informed decisions.

In response to these pressing issues, this study aims to develop and implement a user-friendly web application for livestock market integration and decision support tailored to the specific needs of Albay Province. By leveraging technology, the proposed solution seeks to address the identified gaps in market access, information dissemination, and decision-making processes among livestock farmers, traders, and consumers.

The primary objective of this study is to create and launch a user-friendly web application that facilitates seamless connections between livestock farmers, traders, and consumers in Albay Province. This application aims to serve as a platform for market analysis, providing users with valuable insights into livestock production data, market trends, and pricing dynamics. Additionally, the study intends to utilize the developed application to enhance market efficiency and transparency, thereby contributing to economic growth, livelihood enhancement, and food security within the region.

This study's significance lies in its potential to revolutionize the livestock market in Albay Province, benefiting farmers, consumers, traders, and the wider community. By providing market insights and facilitating direct communication, the web application empowers farmers to make informed decisions, enables consumers to access local products easily, and assists traders in optimizing operations. This fosters economic growth, promotes food security, and supports sustainable agricultural practices, ultimately benefiting the entire region.

In pursuit of our study objectives, we will implement a systematic approach, guided by the principles of Scrum agile methodology. This methodology will involve four key phases: product backlog, sprint planning meeting, sprint backlog, and finished work. Through this iterative process, we aim to enhance collaboration, streamline workflow, and promote adaptability throughout the project lifecycle. Furthermore, we will adhere strictly to the ISO/IEC 25010 software product qualities framework, focusing particularly on Functional Suitability, Interaction Capability, and Security. These quality attributes will serve as benchmarks to ensure that the developed application meets stringent standards, enhancing its overall effectiveness and user satisfaction.

1.2 Objectives of the Study

Our main objective is to develop and implement a user-friendly web application for livestock market integration and decision support in Albay Province, facilitating seamless

connections between farmers, consumers, and traders to enhance local agricultural trade and ensure food security.

1. Assess issues and challenges (problems) encountered in the livestock market from livestock farmers, traders to consumers.
2. Create and launch a user-friendly web application for livestock market integration and decision support benefiting farmers, consumers, and traders, while simplifying communication and facilitating local transactions for livestock products:

    a.) Price Percentage Change Dashboard: Access a dashboard where users can view price percentage changes for livestock products.

    b.) Market Graph Display: Present graphs resembling livestock market visuals, showcasing price trends and fluctuations of livestock products to provide users with a visual representation of market dynamics and facilitate informed decision-making.

    c.) Integrated Chat Functionality: Incorporate a chat feature allowing seamless communication between farmers, consumers, and traders to facilitate trade discussions and inquiries.

    d.) Trade Offer Management: Enable users to create and manage trade offers for livestock products, enhancing transaction opportunities and negotiation processes.

e.) Review-Based Recommendations: Provide recommendations based on user reviews and feedback to assist in decision-making.

3. Evaluate the developed system using ISO/IEC 25010 software product qualities in terms of: Functional Suitability, Interaction Capability and Security.

1.3 Significance of the Study

The development and implementation of a user-friendly web application for livestock market integration and decision support in Albay Province holds substantial significance.

- **Farmers.** Gain valuable market insights, direct communication with traders, consumers and better bargaining power, leading to higher profits and sustainability.
- **Traders.** Improve supply chain and market operations, find reliable sources, and simplify transaction processes for better business efficiency.
- **Consumers.** Access clear pricing information and communicate directly with farmers and traders, fostering trust and supporting local products and food security.

- **Community and Local Economy:** Enhance market efficiency and transparency, contributing to economic growth, stabilizing the agricultural sector, and promoting food security.
- **Agricultural Experts and Policymakers.** Obtain valuable data for understanding market trends, developing targeted solutions, and promoting sustainable farming practices and economic growth.

1.4 Scope and Delimitations

The scope of this study encompasses assessing issues and challenges in the livestock market, creating and launching a web application featuring a Price Percentage Change Dashboard, Market Graph Display, Integrated Chat Functionality, Trade Offer Management, and Review-Based Recommendations. System evaluation will adhere to ISO/IEC 25010 software product qualities, specifically Functional Suitability, Interaction Capability and Security. Delimitations include geographic focus solely on Albay Province. The development targets three key groups: livestock farmers producing chickens, eggs, and pigs; livestock dealers and traders; and consumers interested in locally sourced agricultural products

2 THEORETICAL FRAMEWORK

2.1 Review of Related Literature

This chapter examines the theoretical framework of AgTech: A Web Application for Enhancing Livestock Farming with Decision Support for Market Optimization. It investigates essential ideas and current theories pertinent to the research subject, giving a solid basis for the investigation.

2.1.1 Agricultural Technology Adoption

Recent studies have shown that Agricultural Technology (AgriTech), which includes technologies designed for agriculture, has made a big impact on how productive, efficient, and sustainable farming is in different parts of the world (Rose & Chilvers, 2018). Rose and Chilvers (2018) talked about how important it is for farming to be innovative and socially responsible, especially with more attention on policies and ideas about making farming more sustainable. Furthermore, Huang et al. (2023) highlighted the influence of ethical leadership on financial performance through environmentally proactive strategies, providing specific recommendations for performance improvements in sustainable agriculture (Huang et al., 2023). Some researchers, like Spanaki et al. (2021), said that artificial intelligence (AI) could really shake things up in farming, but right now, it's still early days for AgriTech research while Issa et al. (2022) talked about how much AI-driven technologies are affecting

companies that work with AgriTech, showing that AI is a big deal in this sector. In the UK, Stewart et al. (2014) talked about a strategy in the UK called the Agritech Strategy, that the sustainability and profitability, as well as the quality and resilience, of crops can be substantially improved through the green and scientific technologies used. It amplified the implication of AgriTech that can help combat greenhouse gasses emission, increase food safety and secure sustainable food production to meet the needs of our swelling population across the globe. Adesiyan (2024) brought up some exciting possibilities with AgriTech, like making farming eco-friendlier, food safer, and food production sustainable on a global scale. Bowen and Morris (2019) looked into how having better internet access, like through broadband, can help farms become more advanced in how they do things. And, Jellason et al. (2021) showed how parts of Sub-Saharan Africa are getting on board with the latest farming technology, giving farmers there a chance to improve in different areas of agriculture.

2.1.2 Market Integration and Efficiency

In continuation of the advancements in Agriculture Technology and its transformative potential, the focus shifts to the integration of agricultural markets, which integration of the markets is the basis of the being of agricultural economies, providing for trade, environmental sustainability, and economic development, as noted by Chitete et al. (2023), who emphasize how the agricultural value chain must

be well-aligned for effective market integration, as Abunyuwah (2020) also said, as an underrating of its impacts on trade flows and economic performance. Nevertheless, not only acquisitions but other factors, including information asymmetry and market fragmentation, pose the biggest challenges (Abunyuwah, 2020). Pretorius (2002) presents how different factors, such as industrial composition and market volatility, play their own significant role in determining the level of integration in stock markets among developed countries, while Paramati et al. (2015) focus on how bilateral trade linkages and financial market integration are deeply interconnected and explore the importance of trade intensity.

According to (Klychova, et al., 2021), agricultural marketing efficiency is considered one of the pertinent factors aimed at optimizing available resources and price control, thereby improving international trading conditions. Their research emphasizes the importance of understanding market agents' relationships to ensure marketing effectiveness and the well-being of both consumers and producers. They postulate an intermediate impact of deepening integration mechanisms into the oil market on gross domestic product (GDP) and government budget revenues, thus, underpinning societal and economic consequences of integration. Moreover, Jensen et al. (2019) state that the economic effects of the low carbon economy transition must also consider the agricultural sector. (Jensen et al., 2019) allow to show how the reduction of greenhouse gasses will go hand in hand with creating

new directions of growth for the agriculture sector; using this information to write and publish will prove that there isn't one factor that makes market integration a complicated matter; it is the market itself that makes it pivotal not only for the sustainability of smallholder farmers but also for the effectiveness of the whole agricultural sector. Furthermore, Zhou et al. (2018) employ web mining techniques on agricultural big data to gather information from diverse agricultural sources, enhancing efficiency in extracting text and evaluating theme relevance. Their study aims to offer insights for the development of agricultural data repositories, market surveillance, price prediction, production decision-making, and academic inquiry in agriculture.

2.1.3 Decision Support Tools (DSTs)

In alignment with the intricate dynamics of agricultural market integration, as emphasized by (Chitete et al., 2023; Abunyuwah, 2020), Decision Support Tools (DSTs) emerge as instrumental aids in navigating the complexities and optimizing efficiency within these integrated markets. Challenges such as information asymmetry and market fragmentation persist (Abunyuwah, 2020). These challenges underscore the need for innovative solutions to enhance market transparency and efficiency. Recent research has demonstrated the potential of Decision Support Tools (DSTs) in addressing challenges related to market information access in agriculture which Nygård et al. (2020) focused on the performance and end-user

preferences by essay pro of the DSTs in the Baltic Sea sector. They highlighted both the process of synthesizing complex information and the advisory role to decision makers in environmental management. Furthermore, the FAIRWAY Project, as presented by Nicholson et al. (2020), offered additional tips, including the use of decision support tools to curb nitrate and pesticide pollution in agriculture. This research emphasizes the potential of DSTs to successfully fix the problems and improve the decision-making processes in agriculture. Moreover, based on Tedeschi et al. (2021) there is improvement in sensor technology and ICT-based decision support to smart livestock farming which shows the potential of DST in improving decision-making process for livestock farmers. These studies altogether prove DSTs as vital in fixing problems relating market information access and raise market transparency and efficiency importantly in agriculture.

2.1.4 Web-based Application for Agricultural Markets

(Husaini, et al., 2020) emphasize that web-based applications form the bridge between traders in the livestock market and those who market them where it is the backbone of the livestock market. Their study highlighted how innovations in Internet-Based Applications Technologies have profoundly reshaped the markets by bringing on improvements in market efficiency and transparency. The web-based applications have overcome the difficulty of market analysis and direct linkages between participants in the short-term, providing these stakeholders with better

market interactions and decision-making processes (Husaini, et al., 2020). The implementation of web-based applications in livestock farming has allowed for remote monitoring of livestock, providing quantitative and early alerts to situations of poor welfare, thus requiring immediate attention (Benjamin & Yik, 2019). Furthermore, digital technology such as Internet of Things (IoT) and block chain technology which aid to develop smart solutions for livestock management, animal welfare, sustainable environment and health issues (Mate et al., 2022; Dlodlo & Kalezhi, 2015).

The web-based programs' effect on livestock farming is definitely considerable since they help farmers to enlarge their herds and to improve the production performance by solving economic concerns and allowing to keep the farming business viable (Norton et al., 2019). Additionally, these applications have played a pivotal role in optimizing land-based livestock systems, contributing significantly to sustainable agriculture and global agricultural output (Rendel et al., 2020). Moreover, the incorporation of the blockchain technology to the agricultural supply chain management system has taken the market transparency, and efficiency to the next level hence good for the entire agricultural system (Alkahtani et al., 2021).

Successful web-based applications in agricultural markets include reducing asymmetric information, providing transparency and thus carrying out better liquidity

in the market (Gajewski and Li, 2015; Jin et al., 2021). Consequently, alongside the reform of the legislative activities and the improvement of the financial and material support, digitalization has been admitted as a pressing requirement for the domestic agriculture sector on behalf of its managers with the objective of increments of the production intensity and the overall efficiency of agricultural production (Subach & Shmeleva, 2022; Husaini et al., 2019). These applications have also been instrumental in addressing security and privacy concerns in smart agriculture, ensuring the protection of sensitive agricultural data (Song et al., 2021).

2.1.5 Synthesis of the Study

The literature review in Chapter 2 focuses on several areas like agricultural technology adoption, market integration, decision support tools, and web-based applications for agricultural markets. Across these areas, the gaps and challenges become evident, which illustrate the aspect that requires further research and development of solutions.

Technology Adoption and Market Optimization. The literature is emphasizing the transformative power of application-based technology and digital technology in creating market efficiency and transparency. The studies of Husaini et al. (2020) and Mate et al. (2022) show that the use of web-based applications can help to overcome the market analysis challenges and make better decisions in

livestock farming. While the underlying reasons for the adoption of technology by farmers in the livestock section of livestock are not fully understood, it is also important to identify the specific barriers that make them to fully utilize the technology to optimize the production for market linkages. Additionally, although considerable importance is being given to the role of blockchain technology in market transparency, there is insufficient research on the adoption and effectiveness of the technology in the management of agricultural supply chains, clearly signaling a limitation in the understanding of the applicability and efficiency of blockchain solutions in agricultural markets.

Market Access and Information Dissemination. According to the literature review, the market access and information spreading out among the stakeholders in agricultural markets is the issue of greatest concern. The research by Chitete et al. (2023) and Abunyuwah (2020) shows that the problems like information asymmetry and market fragmentation make it hard to achieve effective market integration. On top of that, Nygård et al. (2020) and Nicholson et al. (2020) highlight how decision support tools (DSTs) are necessary to ensure market transparency and information access in agriculture. Nonetheless, the challenge here is how to precisely trace out the required mechanisms that would connect these gaps and lead to more equitable distribution of market information among livestock farmers, traders, and consumers.

Decision-making Processes. The literature highlights the need to strengthen the decision-making processes within the agricultural markets. Abunyuwah (2020) together with Tedeschi et al. (2021) underline the obstacles still existing in information symmetry and market fragmentation as these lead to ineffective decisions. Despite the fact that DSTs show their potential in combating these challenges, it seems inadequate to find out how they function best to support in the decision-making process among the stakeholders. Moreover, there is a lack of research on the integration of sensor technology and ICT-based decision support specifically designed for livestock farmers and the practical application of these technologies in decision-making processes in agriculture.

2.2 Concept of the Study

Presented below is the conceptual framework diagram of the study. The model outlines the process of the proposed system:

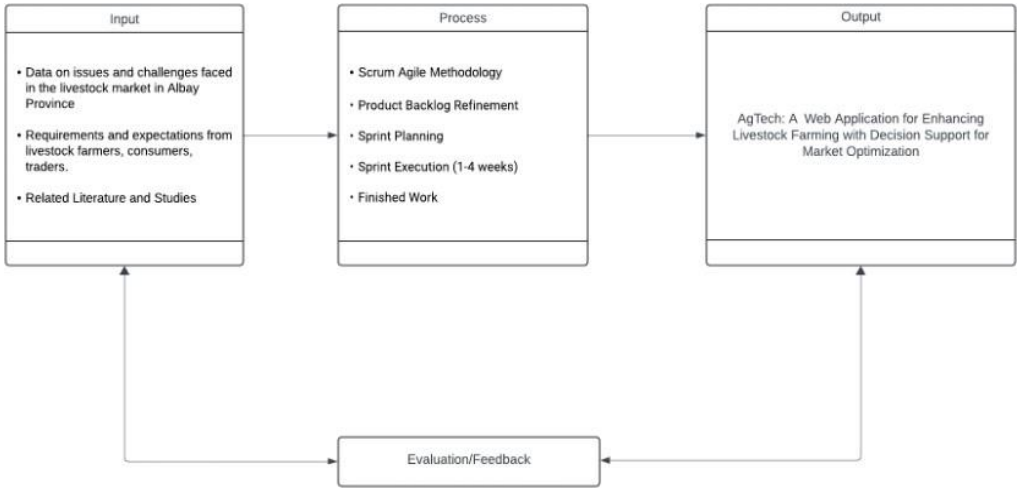


Figure 2-2. Conceptual Framework Diagram

Figure 1 represents the conceptual framework for developing an AgTech web application designed to support livestock farmers in Albay Province, Philippines. This framework outlines a development process aimed at improving farm management practices, enhancing market access opportunities, and streamlining operations for livestock farmers in Albay. The process incorporates data gathering, stakeholder needs assessment, and an Agile development methodology to deliver a web application that empowers farmers with decision-making support for market optimization.

Input:

- The first phase of the study will involve data gathering on the existing challenges being experienced faced in the livestock market. It involves production costs, limitations in market access and prevailing market trends.
- The study will take into account the interests and requirements of different stakeholders of the livestock farming environment, such as for livestock farmers, consumers and traders.
- To inform the developmental process relevant academic literature as well as research studies relating to agriculture and livestock management covering will also be reviewed.

Process:

- The Scrum Agile development methodology will be the framework for the web application's development.
- Backlog refinement: During this stage, the determination of features to be implemented and their prioritization will be done based on collected data and stakeholders` requirements.
- Sprint planning: An iteration (sprint) plan is created for each iteration, with all necessary tasks and time frames stated in this plan.
- Sprint execution: Each sprint (which is usually 1-4 weeks long) is the time when the actual development of the web application takes place.
- Finished work: The sprint cycle closes with releasing the executed part of the web application, which is evaluated and improved according to the feedback received from users.

Output:

- The result of this research is an AgTech web application to assist the livestock farmers, consumers, and traders of Albay Province, Philippines, that is entirely functional. The web application will help the farmers to optimize their participation in the market, thereby increasing their profitability and connecting with traders and consumers more efficiently.

- User testing will be started following the web application's launch period in order to evaluate the application's effectiveness and the areas in which improvement would be beneficial. The feedback of the stakeholders will give an idea on how the application is working. Which means it will help future development and ensure that it meets the needs of the livestock market in Albay.

2.3 Definition of Terms

Agricultural Technology (AgTech/ AgriTech): It involves the use of technologies in the farm aimed at increasing productivity, and improving efficiency.

Market Integration: A process of making its components interact without any hindrances in the agricultural value chain to deliver trade, foster sustainability, and drive economic growth.

Livestock Market Integration: Markets that are assisted by farmers, traders, and consumers to reach a high level of efficiency, transparency, and accessibility in livestock sales.

Decision Support Tools (DSTs): Such tools are specialized for assistance to those involved in agriculture who care about growing, buying, and selling in agriculture. Usually, they offer a gateway to raw market facts and machine- generated forecasts.

Market Dynamics: These elements such as trade and monetary policy, which are responsible for the price changes in the livestock supply and demand framework, interpersonal factors such as customer inclinations and regulatory factors that have great influence on the livestock market.

Fragmented Markets: Well-functioning markets with disconnected or separate parts makes it difficult for smooth commerce and flows of data.

Information Channels: The means by which market information, which might include traditional media, digital platforms, and interpersonal communication, is transmitted can be identified as pathways.

DSS (Decision Support System): The computer-based tool or software which renders interactive support in decision-making activities through the usages of information, models, and analysis is called an interactive decision support system or IDSS.

Livestock Farmers: Individuals and institutions responsible for the raising and management of livestock.

Livestock Traders: Parties that receive and deliver livestock such as slaughterhouses and grocery shops might facilitate the process between farmers and the consumers.

Livestock Consumers: Whoever buys and uses meat and its products for different purposes such as food intake or further processing.

Production Data: Information encompassing the amount and quality of the livestock and livestock produce that is constantly made.

Market Trends: The recognition in the livestock market including shifts in demand, supply, and prices over time.

Pricing: Livestock goods and livestock products pricing based on factors like demand, supply, production expenses, and market environment.

Market Optimization: Efficiency maximization, transparency, and accessibility are some of the elements that consist of the livestock market process to achieve outcomes such as a high profit rate and sustainable growth.

3 OPERATIONAL FRAMEWORK

3.1 Materials

The researchers meticulously selected materials and tools to facilitate the development process of the system to ensure efficiency, security, and seamless development.

3.1.1 Software

In the selection of operating systems, Windows 10 was chosen because it is the most widely used and frequently updated version, providing more secure and stable services while continuously improving. Google Chrome was chosen as the web browser, because it is a web browser free -is the most popular Internet browser known for its fast loading times using a source rendering engine In the initial design.

During the initial design phase, Figma will be utilized for its advanced suite of tools tailored for web page creation. Meanwhile, Visual Studio code will be used as the primary text editor, taking advantage of its helpful features, especially when developing PHP projects, such as auto-complete PHP syntax, which makes the development process easier and faster.

The development process centered on the utilization of the Laravel Framework for website construction using its helper packages for optimization, security and structure. Supplemental frameworks Bootstrap and JQuery will be integrated to facilitate HTML element styling and JavaScript manipulation, thereby enhancing frontend functionality.

For data management and web server provisioning, the MySQL database management system and the XAMPP server were employed, chosen for their compatibility, user-friendly interfaces, and open-source nature.

In the realm of web hosting, Hostinger was selected for its intuitive platform, robust security measures, swift performance, and seamless integration with the

project's GitHub repository. This strategic choice facilitated efficient content management and editing processes.

Component	Used
Operating System	Windows 10
Web Browser	Google Chrome
Design Editor	Figma
Text Editor	Visual Studio Code
Programming Language	PHP
Framework	Bootstrap JQuery
Database Management System	MySQL
Local Web Server	XAMPP
Web Hosting	Hostinger

Table 3.1.1 Software Used in Developing the System

3.1.2 Hardware

The hardware components that will be used in the development process of the system are specified in the table below. These are the components available to the researchers throughout the development process of the system.

Components	Used
Devices	Desktop Computer Laptop
Processor	Intel Core i5-9th Gen
Memory	8GB RAM 16GB RAM
Disk Space	120 SSD 1TB HDD

Table 3.1.2 Hardware Components Used in Developing the System

3.1.3 Data

The Market Integration for AgTech web application will have a solid data foundation to provide a comprehensive perspective of Albay's agricultural situation. The data will be gathered both from primary and secondary sources.

Primary Data Source will be gathered directly from livestock farmers, traders, and consumers in Albay using techniques such as surveys, interviews, and even field trips, while always complying with user permission and privacy requirements. This primary data includes assessment of issues and challenges (problems) encountered in the livestock market. It also goes into livestock farmers, traders, and consumer's demographics, which includes both quantitative and

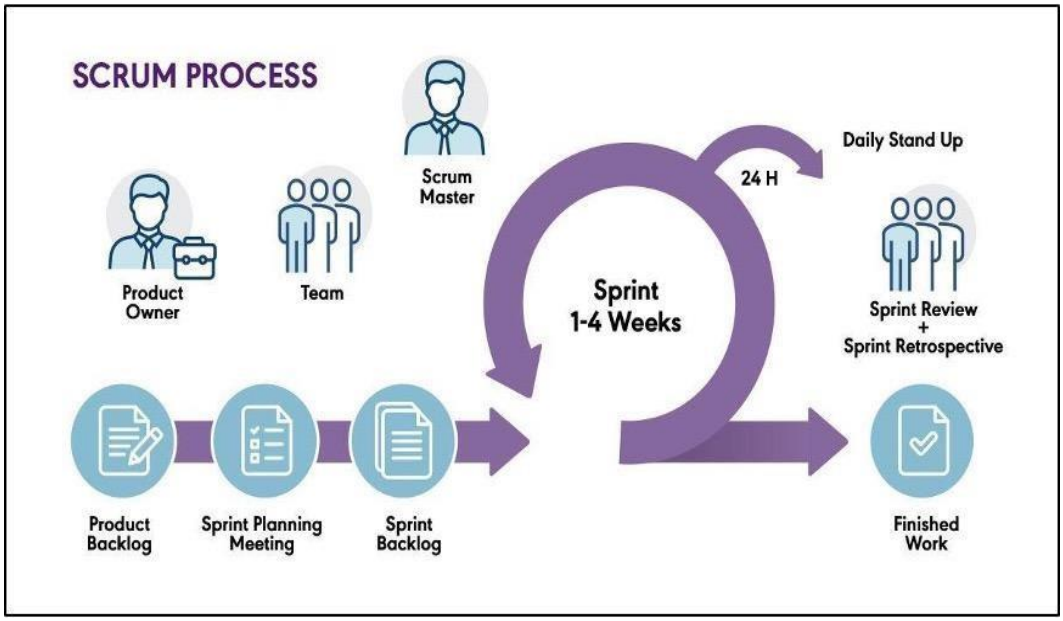
qualitative data such as age, gender, occupation and location. Furthermore, it discusses the market challenges that all the farmers, traders and consumers confront, highlighting specific concerns about market access, price, and logistics. (The survey questionnaire and interview guide used for this data collection are detailed in **Appendix C**).

Secondary Sources, on the other hand, will be obtained from credible sources such as government publications, industry reports, and academic journals. Government publications, particularly reports and data sets from the Department of Agriculture (DA) and the Albay Provincial Agricultural Office (APAO), provide insights into livestock production trends, historical and current market data (linkages, pricing, supply and demand forecasts), and best practices. Industry publications and academic journals provide more background on industry dynamics and potential solutions to the highlighted difficulties.

3.2 Methods

The methodology to be employed follows the principles of agile software development, with a central focus on the Scrum framework. Scrum is a popular agile methodology that emphasizes iterative development, collaboration, and flexibility in response to changing requirements. Within the context of this project, Scrum serves as the

guiding framework for the development and implementation of the livestock market integration and decision support features of our web application for Albay Province.



Iterative Development: *Break down the project into smaller, manageable increments called sprints, typically lasting 1-4 weeks, allowing for regular feedback and adaptation.*

Collaboration: *Foster a collaborative environment where cross-functional teams, including developers, testers, and stakeholders, work together towards a common goal, promoting transparency and shared understanding.*

Sprint Planning: Conduct sprint planning meetings to define the sprint goal and select backlog items to be completed during the sprint, ensuring alignment with project objectives and stakeholder needs.

Daily Scrum Meetings: Hold daily stand-up meetings to synchronize activities, discuss progress, and identify any obstacles or challenges encountered by team members, facilitating communication and collaboration within the team.

Sprint Review and Retrospective: At the end of each sprint, conduct a sprint review to demonstrate completed work to stakeholders and gather feedback. Additionally, hold a sprint retrospective to reflect on the sprint process, identify areas for improvement, and make adjustments for future sprints

3.2.1 Need Assessment

The Need Assessment phase of our study aims to thoroughly identify and understand all stakeholders involved in or impacted by the development and implementation of a user-friendly web application for livestock market integration and decision support in Albay Province. This phase comprises several key activities, as outlined below.

Stakeholder Analysis. To gain comprehensive insights into the needs, challenges, and expectations of various stakeholders, we will conduct interviews and surveys with the following groups: livestock farmers, livestock traders, consumers, agricultural experts. These interactions will provide qualitative and quantitative data necessary for understanding stakeholder perspectives.

Assessment of Current Systems. We will evaluate the existing tools and practices used in livestock market transactions and decision-making processes to identify any gaps, inefficiencies, and areas for improvement. This assessment

involves: Evaluation: Analyzing current tools and practices to determine their effectiveness and identify areas needing enhancement. Testing Conditions: Conducting on-site observations at farms and market locations to understand current workflows and practices. These real-world observations will ensure a thorough and practical assessment.

Market Analysis. To comprehend the evolving landscape of agricultural trade in the region, we will perform a detailed analysis of Market Trends: Identifying prevailing trends in livestock markets. Demand Patterns: Understanding the demand dynamics affecting livestock trade. Regulatory Requirements: Reviewing the regulatory framework governing agricultural trade to ensure compliance and identify potential constraints.

Validation of Findings. The findings from the Need Assessment phase will be meticulously documented and validated with key stakeholders to ensure their accuracy and alignment with stakeholder perspectives. The validation process includes: Documentation: Recording the findings comprehensively.

3.2.2 Data Gathering

A mixed methods technique will be used to collect data for the Market Integration for AgTech web application. This strategy uses both qualitative and quantitative data gathering approaches to acquire a full picture of the Albay livestock market. The techniques that will be employed are:

Textual Analysis: Written texts from diverse media stories, original research, review articles, and journal articles will be examined to acquire insight into current market difficulties, trends, and prospective solutions. These resources will also serve as the basis for the application's conception. Furthermore, relevant written materials will be regularly examined and included into the study process.

Semi-structured interviews: In-depth interviews will be performed by the researcher with livestock farmers, traders and consumers. This qualitative method will dive further into market challenges, such as worries regarding market access, price, and locations. Interviews will also go into the user's needs, revealing their recognized areas for growth. The interview guide will provide flexibility and follow-up questions to guarantee thorough data gathering.

Surveys: Structured questionnaires will be provided to livestock farmers, livestock traders and consumers in Albay. Furthermore, surveys may include questions on livestock farmers and traders demographics (age, gender, occupation and location).

Field visits (subject to user agreement and privacy regulations): On-site visits to farms can provide useful insights into present resource constraints and prospective technology intervention areas.

Government publications: Reports and data sets from the Department of Agriculture (DA) and the Albay Provincial Agricultural Office (APAO), would provide vital information for the Market Integration for AgTech application. These papers will give insights into Albay-specific animal production patterns, with the precise year dictated by data availability. They will also provide vital information on market patterns, including connections, historical and current price data, and supply and demand predictions.

3.2.3 Procedures for the different phases of Scrum

3.2.3.1 Product Backlog

Objective Definition: The Scrum Team collaborates to define the objectives for the upcoming sprint, focusing on developing and implementing a user-friendly web application for the livestock market in Albay Province. (Refer to Appendix E: Context Diagram for an overview of the system's interactions with external entities, which helps in understanding the scope and boundaries of the application.)

Product Backlog: The Product Owner leads the refinement of the Product Backlog, ensuring that items related to features such as the Price Percentage Change Dashboard, Market Graph Display, Integrated Chat Functionality, Trade Offer Management, and Review-Based Recommendations are clear, prioritized, and ready for implementation.

Stakeholder Input: Stakeholder feedback and input are collected and incorporated into the Product Backlog to ensure that the development efforts align with stakeholder needs and expectations. (Refer to Appendix F: Data Flow Diagram to visualize how data moves through the system, which aids in identifying necessary features and their dependencies.)

Timeline Management: The refined Product Backlog items and objectives are aligned with the project timeline as detailed in the **Appendix J: Gantt Chart** to ensure that all tasks are scheduled appropriately and deadlines are met.

3.2.3.2 Sprint Planning Meeting

Sprint Goal Definition: The Scrum Team, including developers and testers participates in a sprint planning meeting to define the sprint goal, focusing on delivering specific features and enhancements to the web application. (Refer to Appendix G: Use Case Diagram to understand the interactions between users and the system, which helps in defining clear and achievable sprint goals.)

Task Estimation: The team estimates the effort required for each task, considering factors such as complexity, dependencies, and available resources, to ensure realistic planning and allocation of work.

3.2.3.3 Sprint Backlog

Sprint Backlog Creation: Based on the refined Product Backlog, the team selects the highest priority items and creates a Sprint Backlog, breaking down selected items into manageable tasks that can be completed during the sprint.

Daily Stand-up Meetings: The Scrum Team holds daily stand-up meetings to synchronize activities, discuss progress, and identify any obstacles or challenges encountered during the development and implementation of the selected sprint backlog items.

Progress Reporting: Each team member provides updates on their work since the last stand-up meeting, highlighting completed tasks, ongoing work, and any impediments that may require assistance or resolution.

Sprint Review: In addition to the daily stand-up meetings, the team conducts a sprint review at the end of each sprint, where the completed work is demonstrated, feedback is gathered, and potential adjustments to the product backlog are discussed. (Refer to Appendix H: Entity Relationship Diagram to validate that the developed features are consistent with the data model and relationships defined in the system.)

Sprint Retrospective: Following the sprint review, the team engages in a sprint retrospective to reflect on the sprint process, discuss what went well, identify areas for improvement, and agree on actionable steps to enhance team performance and effectiveness in future sprints.

3.2.3.4 Finished Work

Increment Completion: Throughout the sprint, the Scrum Team works collaboratively to develop and implement the selected backlog items, focusing on delivering high-quality, functional features and enhancements to the web application. (Refer to Appendix I: Initial Designs and Forms to ensure that the developed features align with the initial design concepts and user interface forms.)

Increment Review: At the end of the sprint, the team conducts a review of the completed work, demonstrating the implemented features, including the Price Percentage Change Dashboard, Market Graph Display, Integrated Chat Functionality, Trade Offer Management, and Review-Based Recommendations.

Feedback Incorporation: Feedback is collected and incorporated into the next iteration of development, informing future refinement of the

Product Backlog and sprint planning efforts to ensure continuous improvement and alignment with project objectives.

3.2.4 Evaluation Procedure

The evaluation of the AgTech web application will be conducted using the ISO/IEC 25010 quality model, which provides comprehensive guidelines for assessing software quality. This model covers various quality characteristics, including Functional Suitability, Interaction Capability, and Security. The evaluation covers the key performance indicators aligned with the purpose of the application and user's needs. Responses of the stakeholders serve as a feedback mechanism which enables the understood effectiveness of the app in terms of the functionality of these criteria, also the overall usefulness of the application and its potential to provide better livestock farming practices, market optimizations and decision support mechanisms. [See Appendix J].

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APPENDICES

Appendix C: Interview/ Survey Questionnaire

AgTech: A Web Application for Enhancing Livestock Farming with Decision Support for Market Optimization

Livestock Market Integration Survey:

Section 1: Demographic Information

Full Name:

_____

Email Address:

_____

Age: _____

Gender: Female ☐ Male ☐

Occupation: _____

Location (Province, Municipality):

_____

Section 2: Livestock Market Challenges (underline what client type suits you)

Choose what kind of client are you? (Select all that applies to you):

☐Livestock Farmer - an agricultural professional who specializes in raising and breeding various types of domesticated animals for use or consumption. (nag-aalaga ng mga livestock na hayop)

☐Livestock Traders- a livestock trader acts as a middleman between livestock farmers (sellers) and consumers in the livestock market.(nagbebenta ng karne, itlog, manok)

☐Consumer - a consumer in the livestock market is the end user who purchases products derived from livestock farming, such as meat, chicken, or eggs. (mamimili ng mga produktong karne, itlog at manok)

As a livestock producer/consumer/trader, what are the main challenges you encounter in the livestock market? (Select all that apply):

☐Limited market access due to geographical barriers or lack of infrastructure. (limitado ang access dahil sa lokasyon at imprastraktura).

☐Fluctuating prices impacting profitability and stability. (Pabago-bagong presyo).

☐Logistics issues (transportation, storage, etc.) affecting timely delivery and product quality. (problema sa transportasyon at kalidad ng produkto).

☐Lack of information on market trends and demand, leading to uncertainty in decision-making regulatory constraints or bureaucratic hurdles.(kulang sa impormasyon patungkol sa trends at demands ng merkado).

☐Others (please specify)

_____

_____

_____

How do these challenges impact your involvement in the livestock market? (paano ito nakaka apekto sa'yo?)

_____

_____

_____

_____

Section 3: Proposed Web Application Features

Please rate the following proposed features of the web application on a scale of **1 to 5,** where ***1*** is Not Useful and ***5*** is Very Useful (circle the number):

- **Price Percentage Change Dashboard:** Access a dashboard where users can

view price percentage changes for livestock products. (makikita ang porsyento ng presyong nagbabago)

1 (Not Useful)

2

3

4

5 (Very Useful)

- **Market Graph Display:** Present graphs resembling livestock market visuals, showcasing price trends and fluctuations of livestock products to provide users with a visual representation of market dynamics and facilitate informed decision-making. (may mga graph na nagpapakita ng pabago-bagong pagtaas at pagbaba ng presyo)

1 (Not Useful)

2

3

4

5 (Very Useful)

- **Integrated Chat Functionality:** Incorporate a chat feature allowing seamless communication between farmers, consumers, and traders to facilitate trade discussions and inquiries. (pwede kang makipag chat o magtanong sa kapwa consumers, traders at farmers).

1 (Not Useful)

2

3

4

5 (Very Useful)

- **Trade Offer Management:** Enable users to create and manage trade offers for livestock products, enhancing transaction opportunities and negotiation processes.(pwede makipag palitan or tumawad ng mga produkto).

1 (Not Useful)

2

3

4

5 (Very Useful)

- **Review-Based Recommendations:** Provide recommendations based on user reviews and feedback to assist in decision-making. (pwedeng mag rekomenda ng farmers o traders base sa rebyu at rating).

1 (Not Useful)

2

3

4

5 (Very Useful)

Section 4: Additional Feedback

Do you have any suggestions or additional features you would like to see included in the web application? (may naisip ka ba o nais idagdag sa mga nasabing features?)

_____
_____
_____
_____

How likely are you to use a web application that integrates these features for livestock market

support? (gaano mo kakailanganin ang web app na ito?)

☐Very Likely

☐Likely

☐Neutral

☐Unlikely

☐Very Unlikely

What factors would influence your decision to use or not use the web application? (ano ang mga impluwensiya na pwedeng dahilan upang gamitin mo ang web app?)

_____
_____
_____
_____

For Livestock Traders and Farmers only

If you are not a livestock trader or farmer answer N/A on others. (Kung hindi ka livestock farmer o ilagay lamang ay N/A).

Which Client are you?

☐Livestock Trader

☐Livestock Farmer

☐Others:_____

Name of farm/ trading business: (ex. Piggery Farm / John's Meat shop)

_____
_____

Address of farm/ trading business: (ex. Brgy 5, 10th St. Illawod, Legazpi, City Albay)

_____
_____

For livestock farmers only: What species of livestock do you raise on your farm ? (If you are not a farmer choose other)

Para sa mga livestock farmer lamang: Ano ang iyong inaalagaan?

☐Pigs / Baboy

☐Chickens / Manok

☐Eggs / Itlog

For livestock traders only: What species of livestock do you trade/produce? (If you are not a trader choose other)

Para sa mga livestock traders lamang: ano ang iyong binibenta?

☐Pigs / Baboy

☐Chickens / Manok

☐Eggs / Itlog

Specify the breed of pig (If you don't raise or trade this animal choose other and write N/A but you can write if there's other specific breed)

Ano ang breed o uri ng baboy ang iyong binibenta o inaalagaan?

☐Native

☐Organic

Specify the breed of chicken (If you don't raise or trade this animal choose other and write N/A but you can write if there's other specific breed)

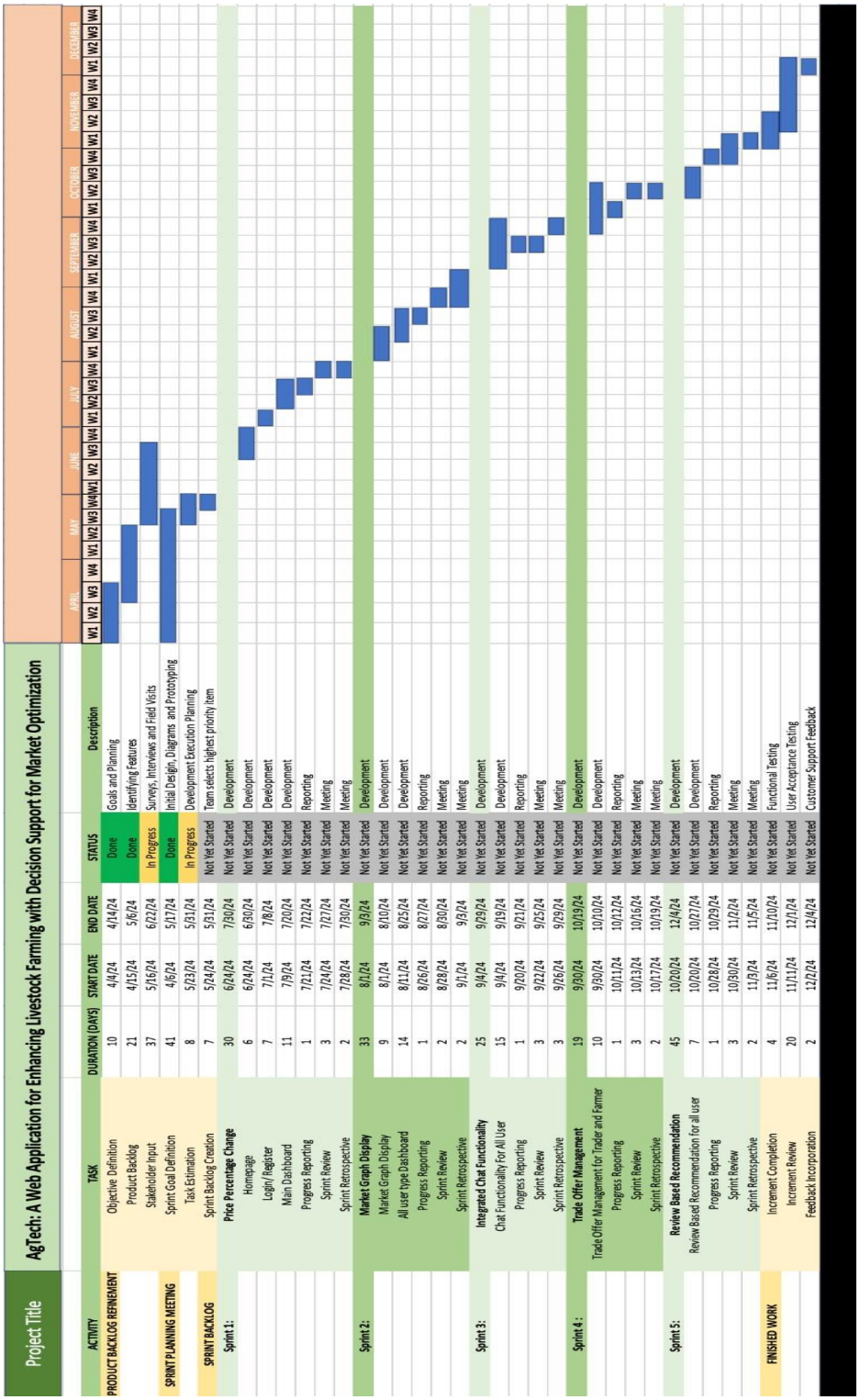
Ano ang breed o uri ng manok ang iyong binibenta o inaalagaan?

☐Native Chicken

☐Hen (Inahing manok)

☐Fighting Cock (Pangsabong)

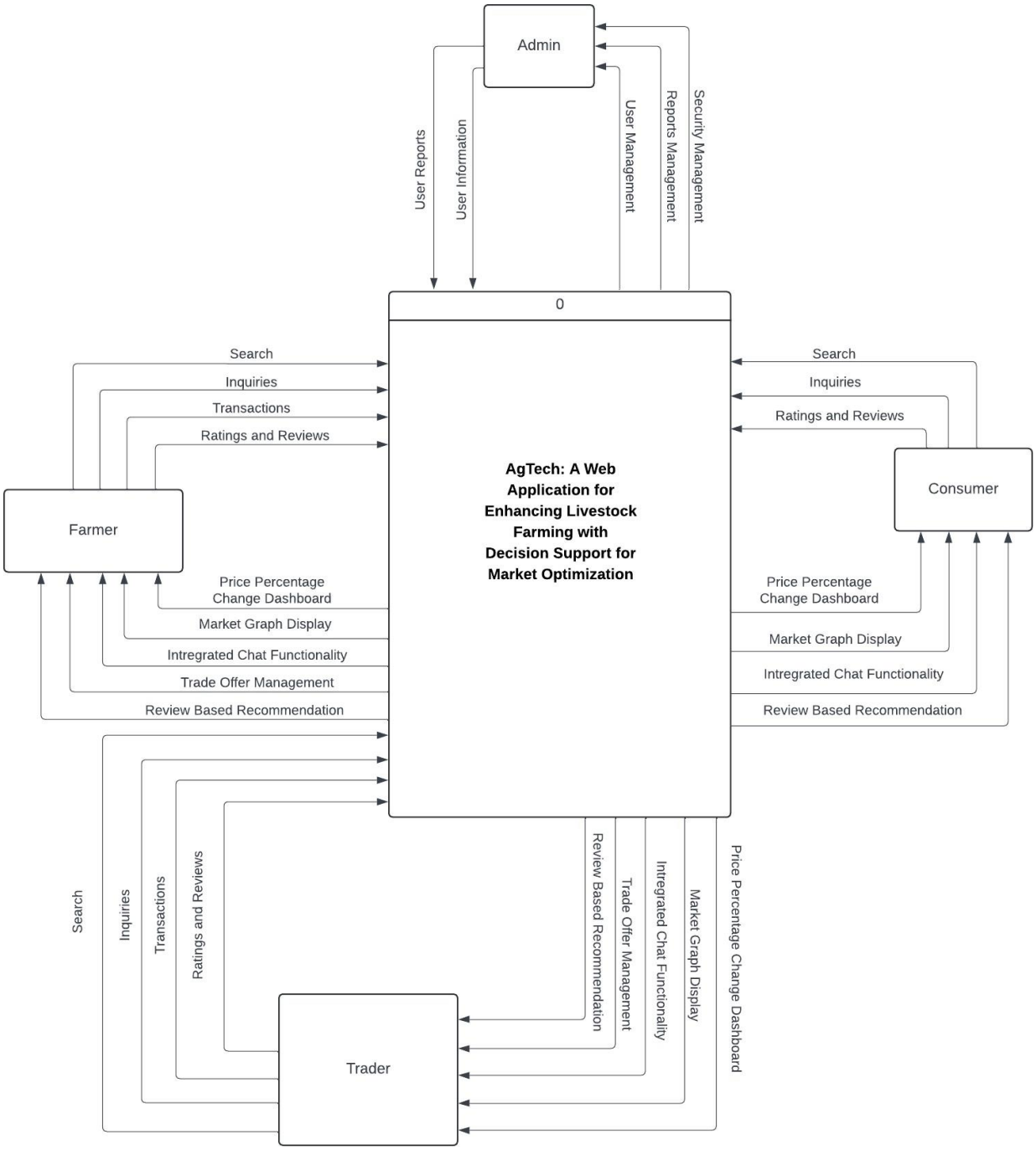
Appendix D: Gantt Chart



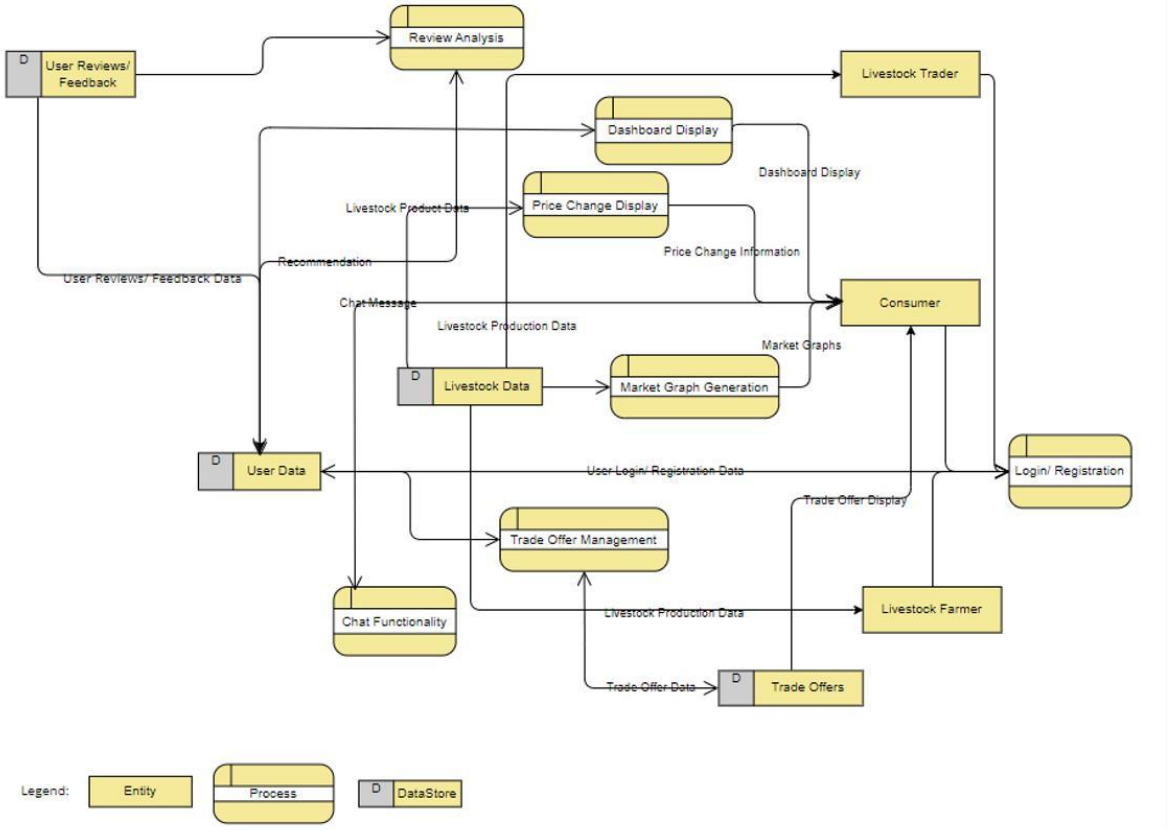
Project Title	AgTech: A Web Application for Enhancing Livestock Farming with Decision Support for Market Optimization

ACTIVITY	TASK	DURATION (DAYS)	START DATE	END DATE	STATUS	Description
PRODUCT BACKLOG REFINEMENT	Objective Definition	10	4/4/24	4/14/24	Done	Goals and Planning
	Product Backlog	21	4/15/24	5/6/24	Done	Identifying Features
	Stakeholder Input	37	5/16/24	6/22/24	In Progress	Surveys, Interviews and Field Visits
SPRINT PLANNING MEETING	Sprint Goal Definition	41	4/6/24	5/17/24	Done	Initial Design, Diagrams and Prototyping
	Task Estimation	8	5/23/24	5/31/24	In Progress	Development Execution Planning
SPRINT BACKLOG	Sprint Backlog Creation	7	5/24/24	5/31/24	Not Yet Started	Team selects highest priority item
Sprint 1:	**Price Percentage Change**	30	6/24/24	7/30/24	Not Yet Started	Development
	Homepage	6	6/24/24	6/30/24	Not Yet Started	Development
	Login/Register	7	7/1/24	7/8/24	Not Yet Started	Development
	Main Dashboard	11	7/9/24	7/20/24	Not Yet Started	Development
	Progress Reporting	1	7/21/24	7/22/24	Not Yet Started	Reporting
	Sprint Review	3	7/24/24	7/27/24	Not Yet Started	Meeting
	Sprint Retrospective	2	7/28/24	7/30/24	Not Yet Started	Meeting
Sprint 2:	**Market Graph Display**	33	8/1/24	9/3/24	Not Yet Started	Development
	Market Graph Display	9	8/1/24	8/10/24	Not Yet Started	Development
	All user type Dashboard	14	8/11/24	8/25/24	Not Yet Started	Development
	Progress Reporting	1	8/26/24	8/27/24	Not Yet Started	Reporting
	Sprint Review	2	8/28/24	8/30/24	Not Yet Started	Meeting
	Sprint Retrospective	2	9/1/24	9/3/24	Not Yet Started	Meeting
Sprint 3:	**Integrated Chat Functionality**	25	9/4/24	9/29/24	Not Yet Started	Development
	Chat Functionality For All User	15	9/4/24	9/19/24	Not Yet Started	Development
	Progress Reporting	1	9/20/24	9/21/24	Not Yet Started	Reporting
	Sprint Review	3	9/22/24	9/25/24	Not Yet Started	Meeting
	Sprint Retrospective	3	9/26/24	9/29/24	Not Yet Started	Meeting
Sprint 4 :	**Trade Offer Management**	19	9/30/24	10/19/24	Not Yet Started	Development
	Trade Offer Management for Trader and Farmer	10	9/30/24	10/10/24	Not Yet Started	Development
	Progress Reporting	1	10/11/24	10/12/24	Not Yet Started	Reporting
	Sprint Review	3	10/13/24	10/16/24	Not Yet Started	Meeting
	Sprint Retrospective	2	10/17/24	10/19/24	Not Yet Started	Meeting
Sprint 5:	**Review Based Recommendation**	45	10/20/24	12/4/24	Not Yet Started	Development
	Review Based Recommendation for all user	7	10/20/24	10/27/24	Not Yet Started	Development
	Progress Reporting	1	10/28/24	10/29/24	Not Yet Started	Reporting
	Sprint Review	3	10/30/24	11/2/24	Not Yet Started	Meeting
	Sprint Retrospective	2	11/3/24	11/5/24	Not Yet Started	Meeting
FINISHED WORK	Increment Completion	4	11/6/24	11/10/24	Not Yet Started	Functional Testing
	Increment Review	20	11/11/24	12/1/24	Not Yet Started	User Acceptance Testing
	Feedback Incorporation	2	12/2/24	12/4/24	Not Yet Started	Customer Support Feedback

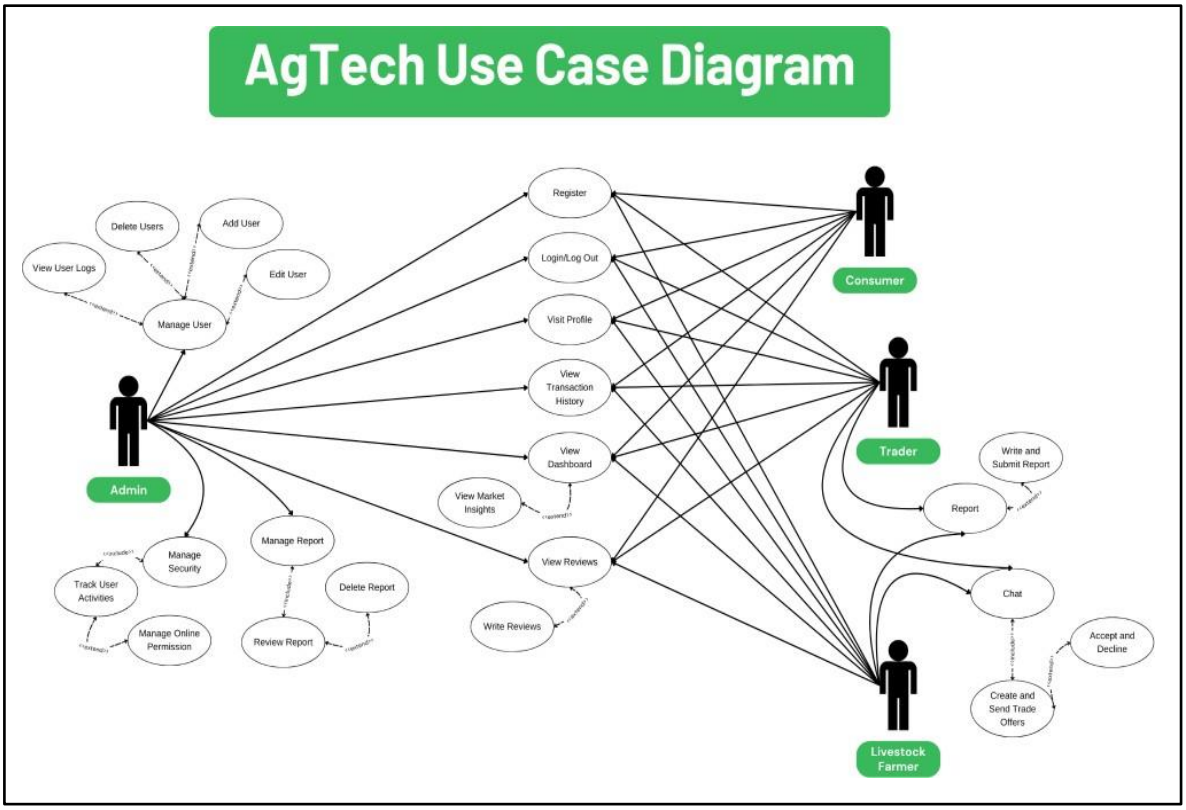
Appendix E: Context Diagram



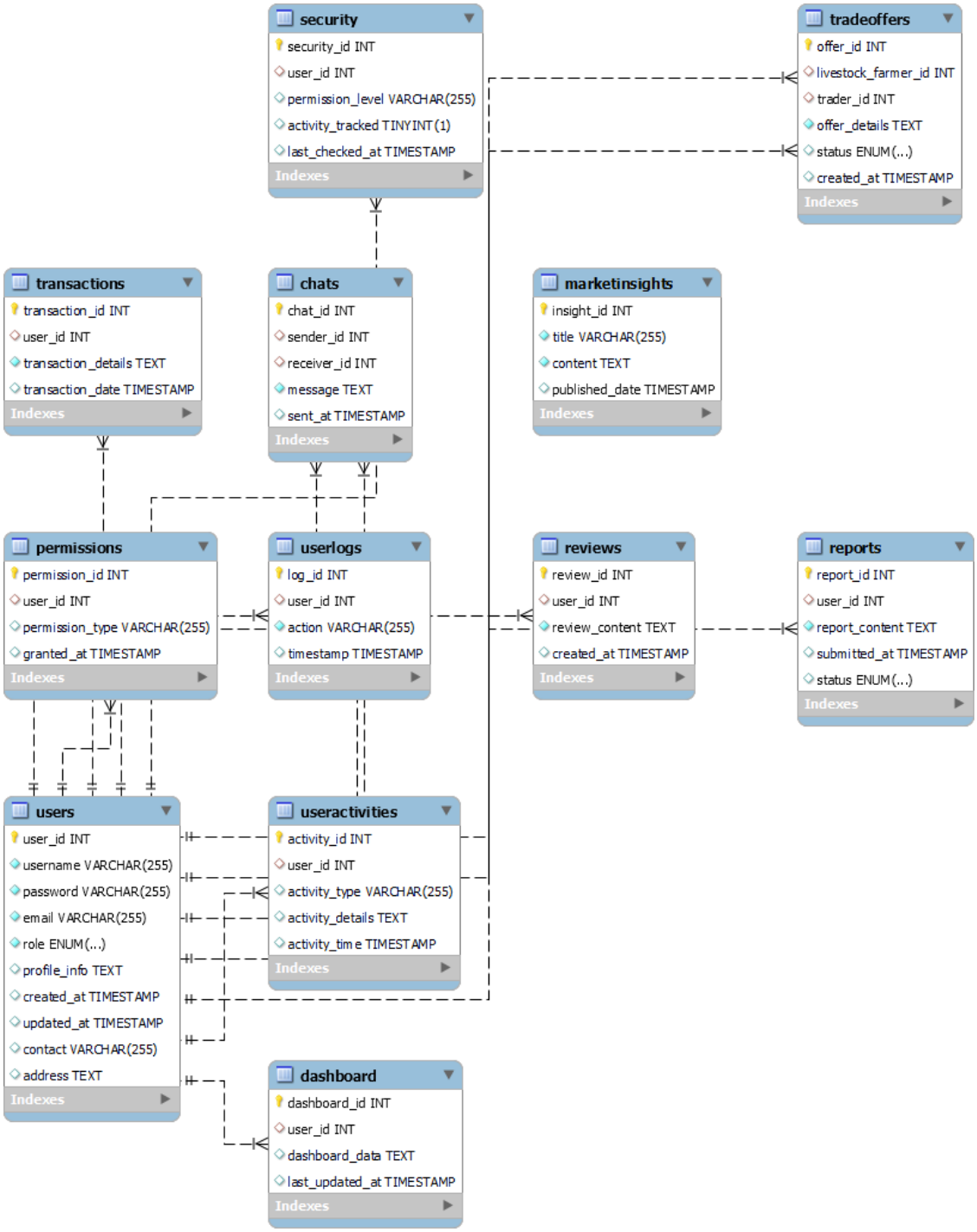
Appendix F: Data Flow Diagram



Appendix G: Use Case Diagram

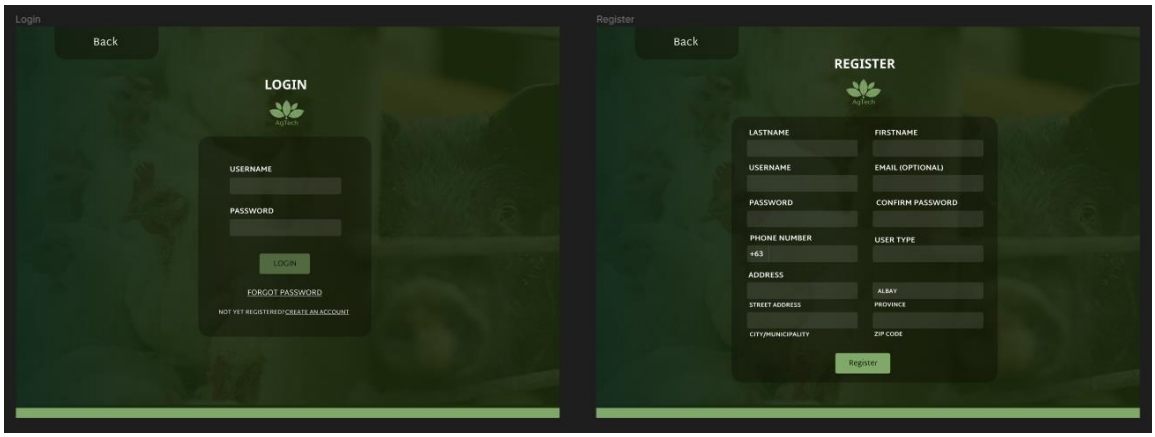


Appendix H: Entity Relationship Diagram

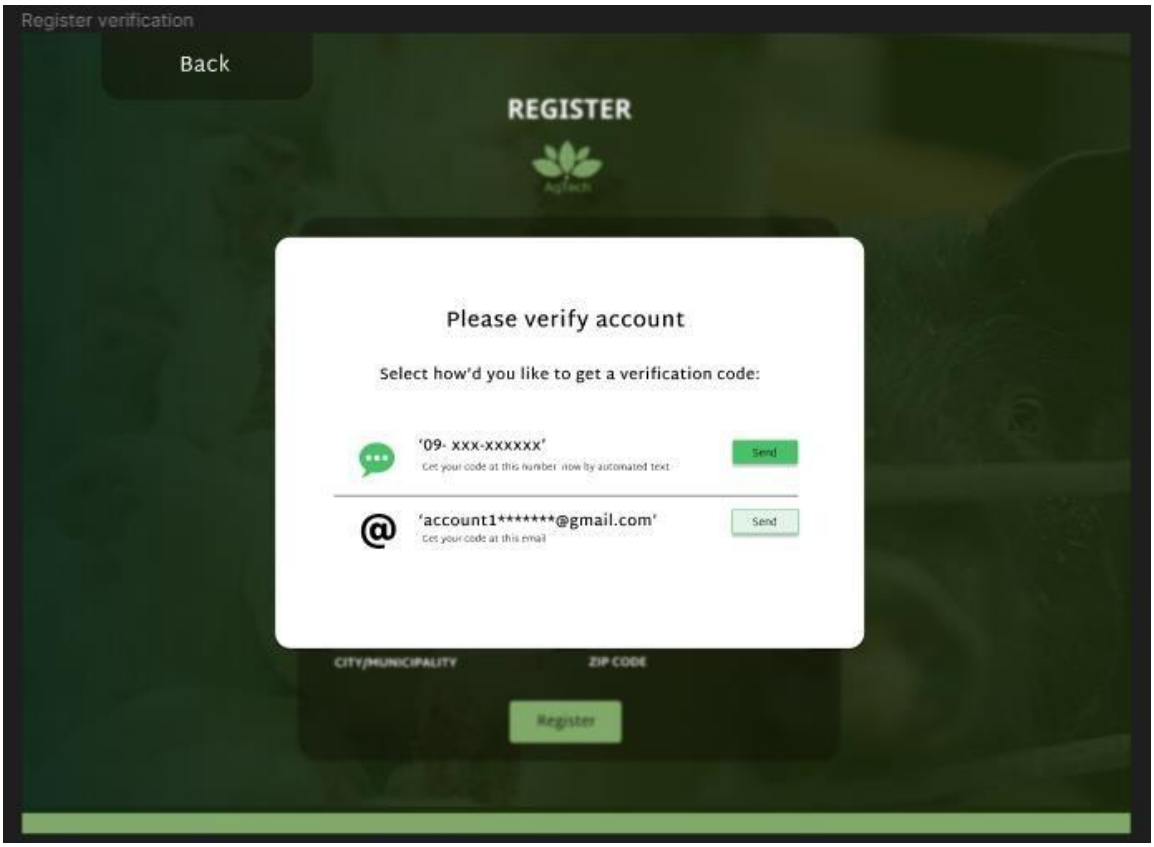


Appendix I: Initial Designs and Forms

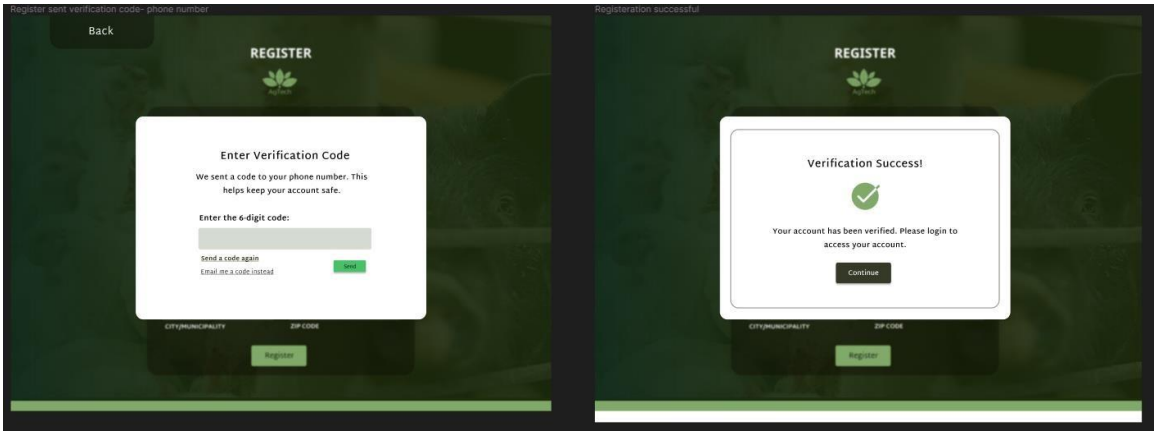
LOGIN/REGISTRATION FORM:



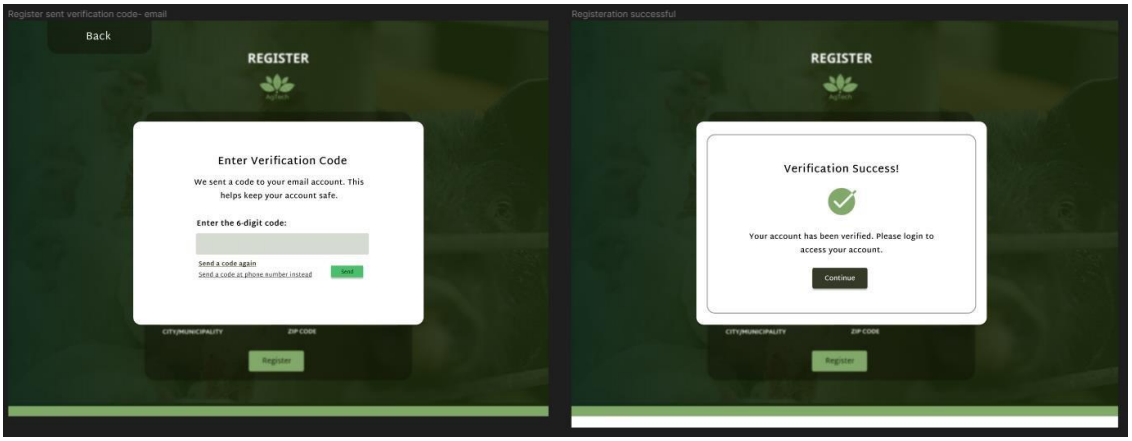
USER ACCOUNT AUTHENTICATION:



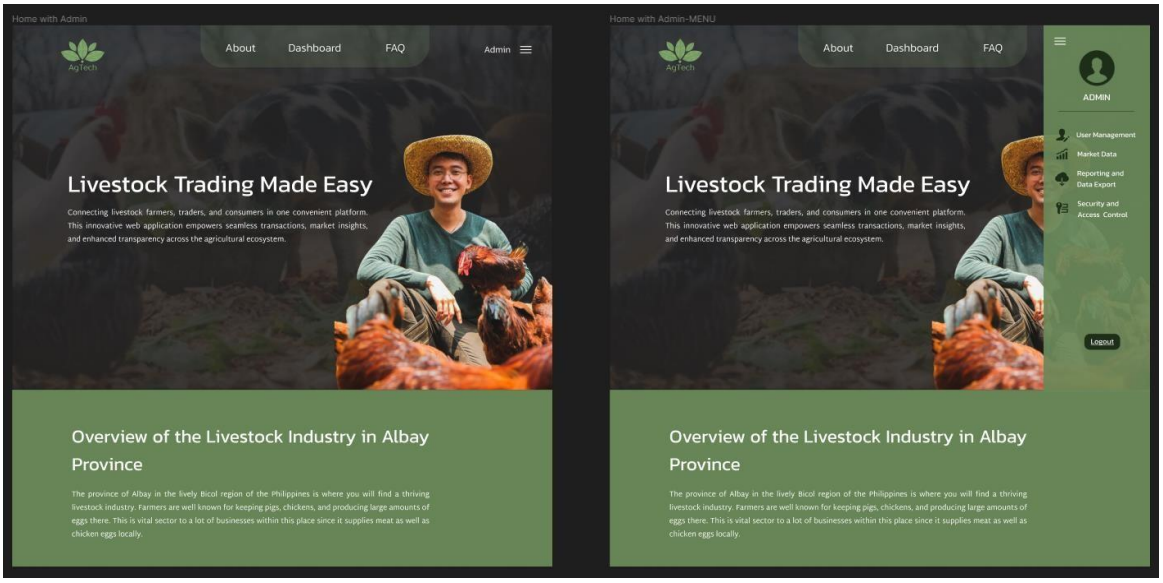
USER ACCOUNT AUTHENTICATION: *Phone Number Verification*



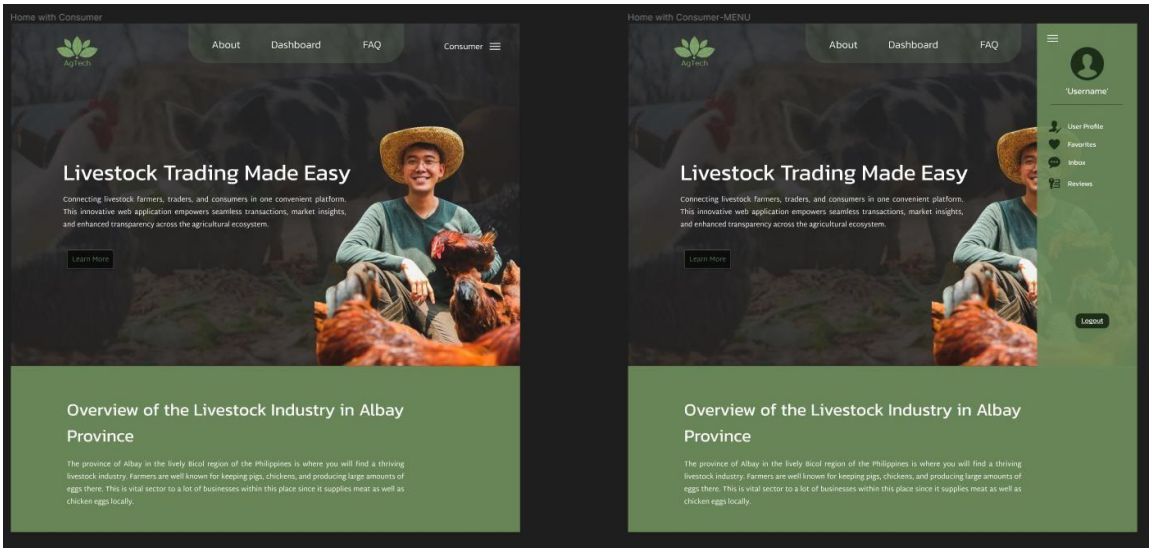
USER ACCOUNT AUTHENTICATION: *Email Verification*



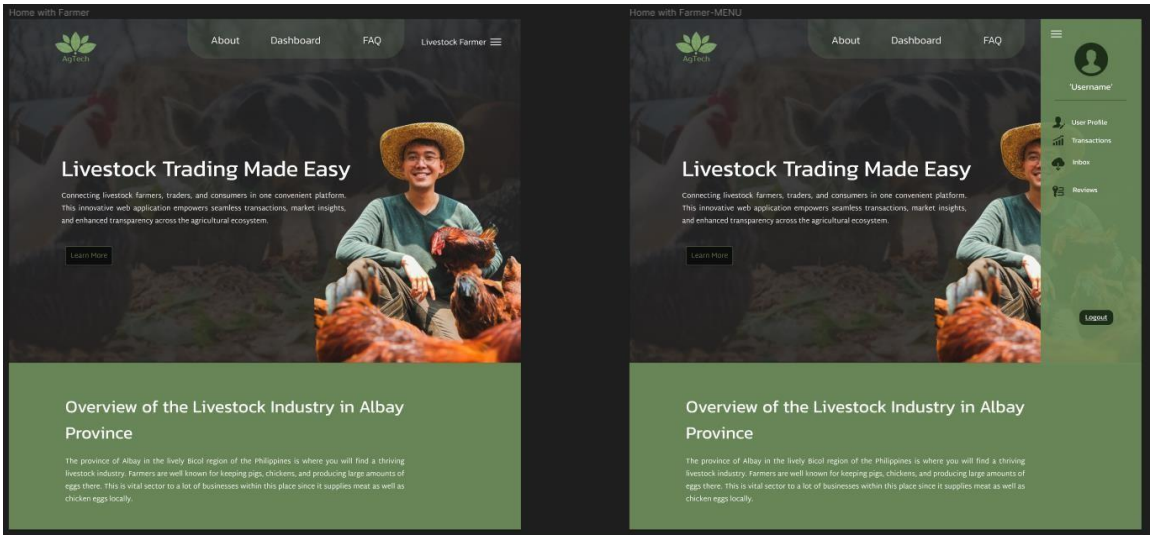
LOGIN: *Administrator Side*



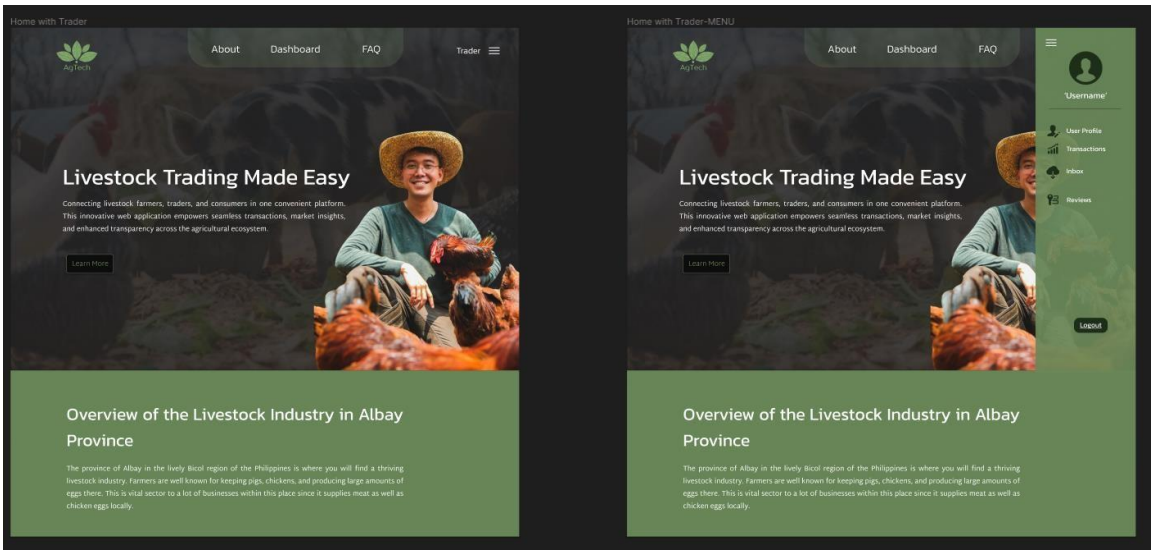
LOGIN: *Consumer Side*



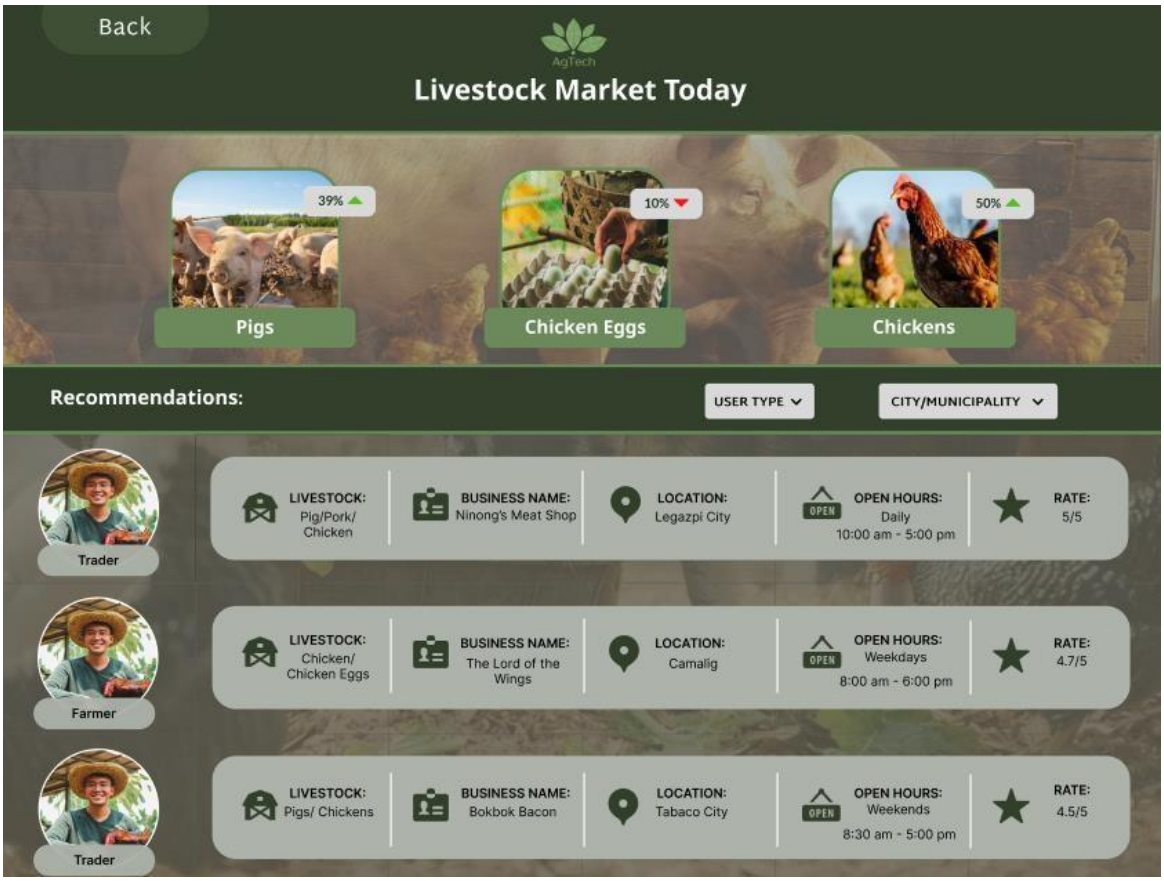
LOGIN: *Livestock Farmer Side*



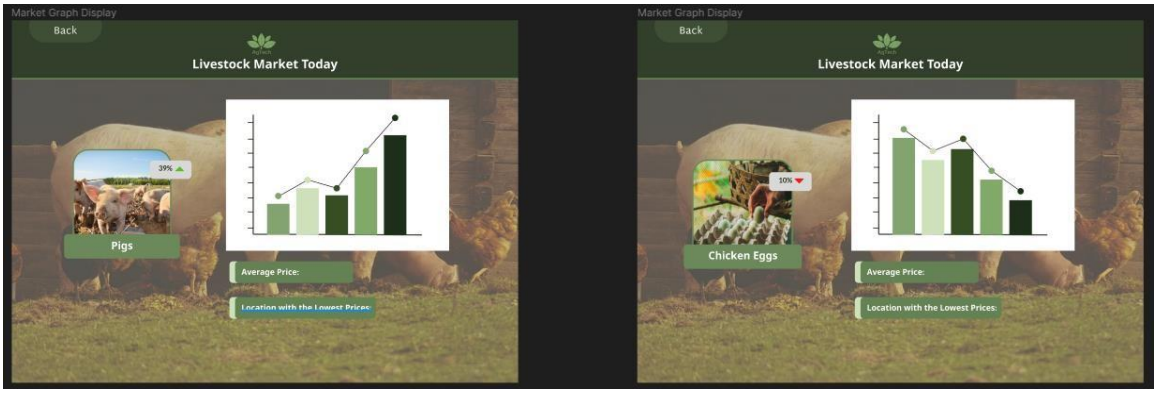
LOGIN: *Livestock Trader Side*



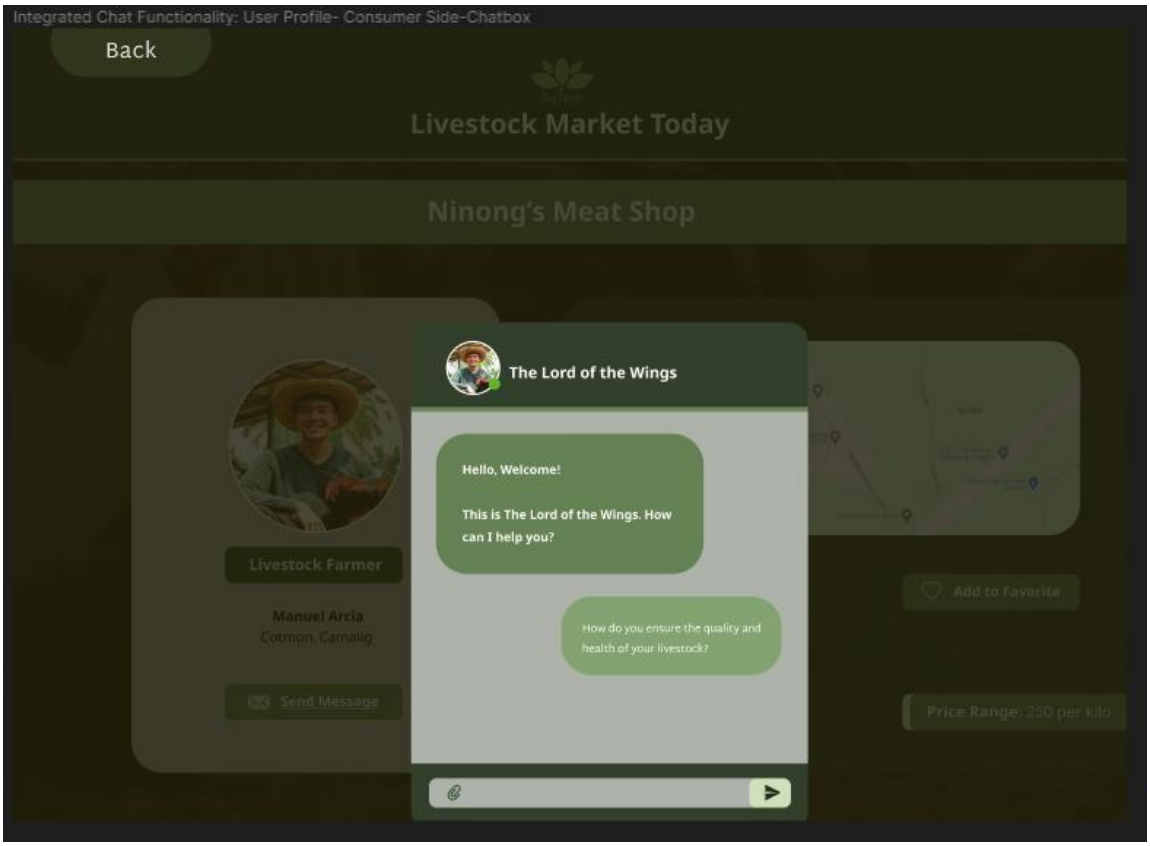
PRICE PERCENTAGE DASHBOARD: *For All Users*



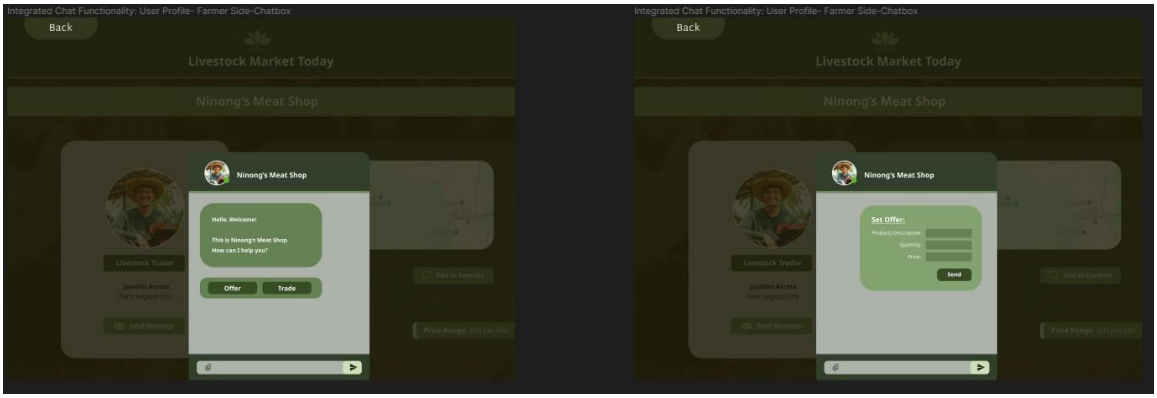
MARKET GRAPH DISPLAY: *For All Users*



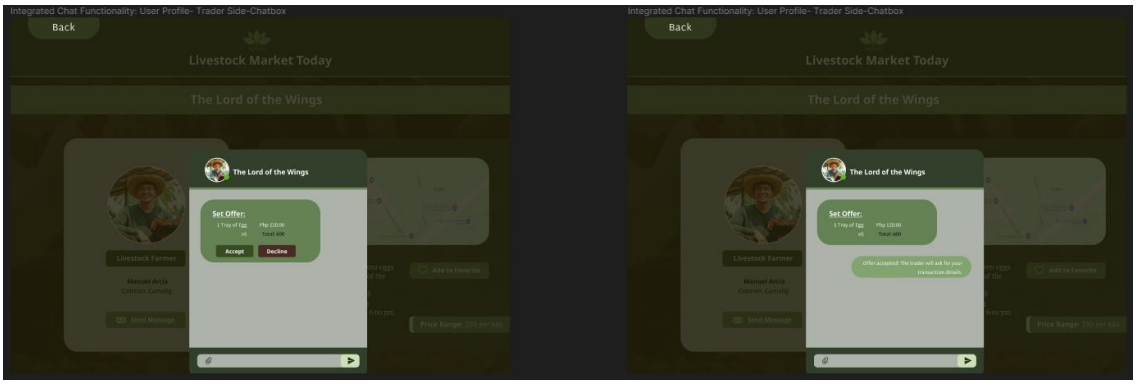
INTEGRATED CHAT FUNCTIONALITY: *Consumer Side*



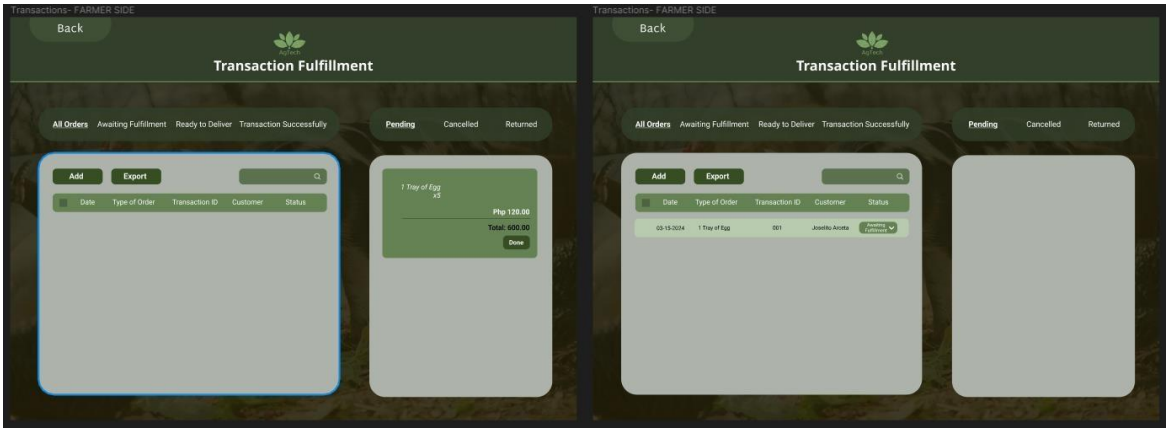
INTEGRATED CHAT FUNCTIONALITY: *Farmer Side*



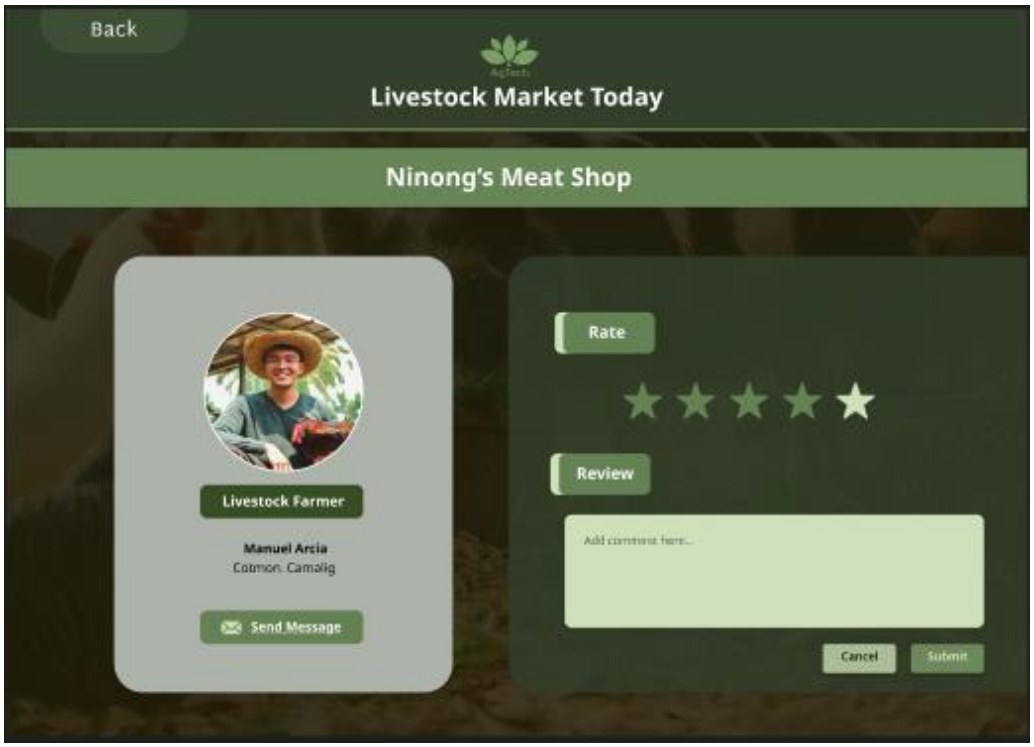
INTEGRATED CHAT FUNCTIONALITY: *Trader Side*



TRADE OFFER MANAGEMENT:



REVIEW-BASED RECOMMENDATION:



Appendix J: Evaluation Tools

QUESTIONNAIRES:

NAME _____ POSITION: _____

Please rate the following areas by indicating a CHECK (✓) based on rankings below:

5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

Functional Suitability

Functional suitability assesses how well the software or program meets the functional needs and targets providing it with the desired functionality and efficiency and guaranteeing that it accomplishes its objectives efficiently. This one concentrates on the evaluation of the factuality, consistency and quality of the organization within the interface, thus ensuring that the end-users are convinced of the data's authenticity. It is a part of it to examine the readability and grammar as well as the possible interpretation of the information both in the program and the user guide.

Functional Suitability	**5**	**4**	**3**	**2**	**1**
a. The organization is clear, logical and effective, making it easy for the user to understand.					
b. The language in the program and in the user's guide is clear to the user.					

c. AgTech effectively supports decision-making processes related to market optimization for livestock farming.					

Interaction Capability

Interaction Capability (IC) assesses the extent to which users can effortlessly move around the software, carry out tasks, and use the features smoothly. It targets ease of use with a hassle-free program interface, comprising simple operations, navigation, and task completion.

Interaction Capability	**5**	**4**	**3**	**2**	**1**
a. The individual can operate the program independently, creating his or her own sequence of presentation and review.					
b. Individuals can easily start and exit the program. It is easy to back up, change answers and give commands.					

Security

The proposed system's ability to be used in accordance with the context of the stakeholders and other possible users such as the livestock farmers, traders and consumers. It provides security control for administrator, resources and system's content and information.

Security	**5**	**4**	**3**	**2**	**1**

a. Implementation of features to ensure user safety during system operation.					
b. Adherence to safety standards and regulations relevant to the agricultural industry.					
c. The username and password has a multilevel access.					
d. The system shows security indicated on the address bar by a padlock or https.					