# Demand and Supply Analysis of Meat King

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***Abstract*—The research presents the global meat supply chain is undergoing significant transformations due to shifting consumer preferences, regulatory changes, and technological advancements. This study explores various aspects of meat production, distribution, and consumption, including demand fluctuations, sustainability concerns, and the role of technology in quality assessment. The research highlights the impact of economic and policy factors on meat markets, analyzing trade patterns, price sensitivity, and ethical considerations. Additionally, emerging trends in alternative proteins, automation, and intelligent detection technologies are examined to understand the future of the meat industry. The study integrates findings from multiple sources, presenting a comprehensive overview of the challenges and opportunities within the modern meat supply chain.**

***Keywords*—Meat industry, supply chain, sustainability, automation, alternative proteins, hyperspectral imaging, consumer behavior, regulatory policies, digitalization, food safety.**

## I. Introduction

The meat industry plays a crucial role in global food security, nutrition, and economic stability. However, it faces multiple challenges, including fluctuating demand, supply chain inefficiencies, environmental concerns, and regulatory constraints. The COVID-19 pandemic exposed significant vulnerabilities in the industry, causing disruptions in distribution channels, price volatility, and shifts in consumer preferences from food service to retail. Additionally, increasing concerns over sustainability, carbon emissions, and ethical meat production necessitate urgent innovations in meat processing, supply chain management, and alternative protein sources.Recent advancements in AI, machine learning, and smart manufacturing have revolutionized meat processing by optimizing resource utilization and improving quality control. Intelligent detection technologies such as FTIR spectroscopy and hyperspectral imaging provide faster, more accurate methods for assessing meat freshness and authenticity. Alternative proteins, including plant-based, cultured, and insect-based options, offer potential solutions to sustainability challenges. Despite these developments, barriers such as high production costs, regulatory constraints, and consumer acceptance hinder widespread adoption.Several studies have examined aspects of meat supply chain resilience, sustainability, and technological innovation. For instance, research on demand response strategies refrigeration operations has demonstrated energy cost reductions in meat processing facilities. Studies on halal meat markets highlight growing demand but emphasize challenges in certification and regulatory inconsistencies. Comparatively, research on China's livestock consumption trends forecasts increased dependence on feed imports, raising concerns about global trade stability. However, previous studies have often focused on isolated aspects of the meat industry rather than providing an integrated analysis of market trends, sustainability issues, and technological advancements.Our research provides a comprehensive overview of the meat industry, integrating insights from various domains, including supply chain management, emerging technologies, consumer behavior, and policy interventions. addressing these aspects, this research contributes to the ongoing discourse on sustainable meat production, efficiency improvements, and the transition to alternative protein sources, ensuring a more resilient and sustainable food system for the future. A detailed analysis of post-pandemic supply chain disruptions and the role of automation and digitalization in mitigating future risks. A comparative review of alternative protein sources, their impact on sustainability, and barriers to adoption. By addressing these aspects, this research contributes to the ongoing discourse on sustainable meat production, efficiency improvements, and the transition toward alternative protein sources, ensuring a more resilient and sustainable food system for the future.

## II. Literature Review

COVID-19 shifted U.S. egg demand to retail, spiking prices while food-service egg values plunged. Regulatory exemptions stabilized markets, but sustainability premiums fell, reflecting reduced consumer willingness to

*Facilitated by the Department of Computer Science & Engineering, Independent University, Bangladesh (IUB)

pay. No major price gouging occurred. [1] The analyzes soybean varietal turnover, revealing slow adoption due to seed quality concerns and limited private investment. Policy support, hybridization, and modern breeding can accelerate adoption and improve yields. [2] Halal meat markets in Europe are expanding due to diverse certification practices and rising demand. Debates on stunning drive market segmentation, while EU regulations prioritize religious freedom over animal welfare concerns. [3] Rising global dairy protein demand is driven by urbanization, income growth, and emerging markets. Advances in technology, DIAAS adoption, and fortified products ensure sustained industry growth, quality, and innovation. [4] Rising fish oil demand from aquaculture and nutraceuticals drives competition. Nutraceuticals gain market share, while supply remains stable but vulnerable. Alternatives like algae and GM plants emerge, as aquaculture shifts to vegetable oils. [5] The need for a sustainable meat production system by balancing efficiency, sufficiency, and ethical consistency. It emphasizes global convergence in meat consumption while calling for policies that integrate environmental and ethical considerations. [6] FTIR spectroscopy proves to be a powerful, rapid, and cost-effective tool for meat authentication and quality assessment. However, its widespread adoption faces challenges related to standardization and regulatory acceptance. [7] The Covid-19 pandemic exposed vulnerabilities in meat supply chains, accelerating the need for automation and digitalization. Future resilience requires balancing efficiency with flexibility to mitigate future disruptions. [8] The development about the environmental and ethical benefits of cultured meat while highlighting challenges in cost and consumer acceptance. The study emphasizes the need for further research and regulatory support for its adoption. [9] This can be analyze how meat demand varies with price and income, showing nonlinear price sensitivity. Their findings reveal that higher-income consumers prefer premium cuts, while lower-income consumers opt for processed meats. [10] The study used descriptive quantitative research through an online questionnaire targeting Muslim consumers in Singapore, Malaysia, and Australia. It surveyed 200 participants to assess buying preferences, halal supply chain awareness, and willingness to pay more for 100 percent halal compliance. Most consumers prioritized halal certification and logo, but many were unaware of halal meat storage and transportation practices. Businesses must improve transparency, governments should enforce stronger regulations, and public awareness campaigns are needed to enhance consumer trust in halal supply chains. [11] Pakistan's livestock sector contributes 11.6 percent to GDP, with meat production rising annually to meet increasing halal consumer demand. Despite being a major halal meat producer, the country exports mostly raw carcasses instead of processed products. Local slaughterhouses lack modern infrastructure and quality control, limiting global competitiveness. The government offers tax incentives, but supply chain inefficiencies remain. Comparative analysis with leading exporters like Brazil and Australia highlights gaps in processing, storage, and distribution, emphasizing the need for investment in modern meat infrastructure to expand exports. [12] China's livestock product consumption is projected to increase steadily until 2030, with beef, mutton, and dairy seeing the fastest growth. This shift in dietary preferences will escalate demand for feed crops, particularly maize and soybean meal, increasing reliance on imports. By 2030, maize imports could reach 39.8 million tons, making feed security a critical issue. To address this, China must invest in agricultural technology, enhance feed efficiency, and strengthen global trade agreements to ensure long-term stability in livestock production and feed supply. [13] Indonesia's seafood sector is evolving, with aquaculture projected to overtake capture fisheries by 2026 as the main fish supply source. Using the AsiaFish model, the study analyzes six scenarios affecting production, consumption, annd trade. Stagnant capture fisheries and slow aquaculture growth could lead to higher fish prices and lower consumption, while export-oriented aquaculture boosts trade but raises food security concerns. Disease outbreaks in shrimp and carp could severely impact supply and pricing, emphasizing the need for sustainable aquaculture policies. [14] .India's dietary trends remain cereal-dominant, but demand for protein-rich foods like pulses, milk, and eggs is rising due to economic growth and changing consumption patterns. Using national datasets and economic models, the study projects a widening gap in protein availability as supply struggles to meet demand. Without strategic interventions, protein deficiency risks will persist, particularly among vulnerable populations. Policy shifts toward agricultural diversification, improved food distribution, and nutrient-based subsidies are crucial for ensuring both food security and nutritional adequacy in India. [15] The paper introduces MESCO, an ontology for meat supply chain traceability, enhancing data integration, interoperability, and regulatory compliance. It demonstrates MESCO's effectiveness in tracking products and improving supply chain management. [16] Hyperspectral imaging (HSI) offers a fast, non-destructive method for assessing meat quality, detecting freshness, contamination, and adulteration. Machine learning enhances accuracy, making HSI a reliable alternative to traditional testing in the supply chain. [17] Meat consumption remains high, but ethical and environmental concerns drive demand for plant-based and cell-based alternatives. Consumer acceptance depends on taste, price, and policies, potentially reshaping the global meat industry. [18] Meat production in Asia is growing, with varying modernization levels. China, India, Korea, and Japan face unique processing challenges. Sustainable, innovative technologies are needed to enhance meat quality, safety, and efficiency. [19] onsumer behav-

ior toward meat is influenced by psychological, sensory, and marketing factors. Beliefs, taste, price, and labeling impact acceptance. Understanding these factors helps the industry enhance product appeal and competitiveness. [20] The study examines demand response strategies in the meat industry, focusing on cooling and refrigeration, which are highly energy-intensive. Using a mathematical model, researchers analyzed energy consumption patterns and identified ways to reduce electricity use during peak hours. A Spanish cured ham production facility implemented these strategies, achieving around 5 persentage,annual electricity cost savings. This demonstrates the potential of demand response programs in optimizing costs, reducing grid strain, and improving energy efficiency in meat processing and refrigeration operations. [21] This research analyzes the meat and dairy supply chains in the EU28 for 2016, focusing on material and energy inputs as well as greenhouse gas emissions. It maps the interconnected transformation and distribution nodes, where transformation nodes represent processes that convert inputs (like feed) into meat and dairy products. Distribution nodes allocate these outputs for further processing. The study aims to establish a baseline understanding of these flows, informing decarbonization strategies and supporting transitions to diets with lower meat and dairy consumption. [22] The authors introduce a novel method to isolate and measure demand changes in meat markets, focusing on beef, pork, poultry, and lamb. The methodology develops an index using equilibrium data to distinguish demand shifts from supply-side variations. Through simulation analysis, the proposed index is compared with traditional methods, showing more accurate results in identifying true demand changes. This improved approach provides valuable insights for agribusinesses, policymakers, and market analysts, allowing them to make better-informed decisions based on clearer demand dynamics. [23] The paper examines long- and short-term demand factors for large animal and poultry meat in Indonesia, focusing on how economic and market variables like prices, income levels, and socio-economic indicators affect meat consumption. Using time-series data, the study analyzes meat prices, income, and other relevant factors. The findings reveal a significant long-term relationship between meat demand and variables such as income levels and meat prices, highlighting the influence of economic factors on meat consumption patterns in Indonesia. [24] The paper explores the entire meat supply chain, from sourcing livestock to processing, distribution, and retailing, addressing challenges such as quality control, transportation, storage, and regulatory concerns. Using supply chain management frameworks like the Supply Chain Operations Reference model and lean management techniques, it identifies optimization opportunities in the supply chain. The paper highlights the importance of improving collaboration between suppliers, processors, and retailers to reduce lead times and enhance product quality, ensuring a more efficient and reliable meat supply chain. [25] This study analyzes the demand system for wild venison and livestock meat in Hokkaido, Japan, using the QUAIDS model and scanner data from six grocery stores. It investigates the role of venison as a substitute for pork and lamb and a complement to beef, alongside estimating environmental footprints (GHG emissions, water, and land use) under expanded venison consumption. The results suggest that increasing venison consumption may not reduce environmental impacts, as its net effect depends on the demand system and the environmental footprints of different meats. [26] This study examines future protein supply and demand, evaluating traditional (meat, dairy, plant-based) and emerging (insects, algae, in vitro meat) sources, considering nutritional, environmental, technological, and consumer factors. It analyzes global trends, socio-economic influences, and environmental challenges, integrating data from FAO, OECD, and previous studies. The results suggest that both traditional and alternative proteins will meet future demand, with livestock proteins remaining significant but environmentally taxing. Alternative sources show promise but need advances in cost, scalability, and consumer acceptance for sustainability. [27] This research explores AI and machine learning to optimize drying time prediction for meat processing in smart manufacturing. It develops a model using real-time data from IoT sensors and systems like SCADA and ERP, incorporating environmental factors, meat composition, and food processing parameters. Using an ensemble learning approach (XGBoost), the model achieved a high prediction accuracy (correlation of 0.96). It improves production planning, optimizes resources, and reduces food waste while ensuring adaptability across different meat products and drying conditions. [28] This paper focuses on intelligent detection technologies for assessing fresh meat quality, which is vulnerable to physical, chemical, and microbiological changes. It reviews advanced technologies like bionic, spectral, and biosensors that offer non-destructive, portable, fast, and accurate solutions. These methods overcome the limitations of traditional approaches, which are often subjective or time-consuming. The study highlights that intelligent detection can improve freshness and adulteration detection, offering faster, cheaper, and more reliable results, with future advancements in portable devices and non-destructive testing methods. [29] This paper explores the growing demand for protein driven by population growth, rising incomes, and urbanization, and evaluates alternative protein sources like plant-based proteins, algae, insects, and lab-grown meat. It analyzes global protein demand, environmental impact, and consumer acceptance, while discussing challenges such as nutritional balance and scalability. The study concludes that animal protein poses sustainability challenges, but plant-based and alternative proteins can help meet future demand. A shift towards

sustainable protein requires innovation, research, and policy development while balancing nutrition and economic feasibility. [30]

## III. Problem Statement

Livestock farmers often struggle to receive fair prices for their products due to the involvement of middlemen who take advantage of their honesty. These intermediaries purchase products at low prices and sell them at significantly higher rates, limiting farmers' earnings. This lack of transparency in pricing affects their financial stability. To address this, our web application will enable farmers to sell their livestock products directly to buyers, eliminating the need for middlemen. By using the platform, farmers can set fair prices for their goods, connect with suppliers and vendors, and receive immediate payments. This direct selling model ensures that they gain maximum profit while maintaining control over their transactions. Suppliers, on the other hand, face multiple challenges, such as a lack of communication with farms, limited knowledge about product origins, inventory shortages, cold storage capacity issues, and a restricted number of vendor options. Due to the presence of middlemen, suppliers are unable to establish direct relationships with farmers, which makes it difficult to verify product quality and origin. Additionally, suppliers struggle to rent storage spaces efficiently, leading to inventory mismanagement. With our web application, suppliers can directly communicate with farmers, eliminating the reliance on intermediaries. The platform will also provide real-time updates on available cold storage spaces, allowing suppliers to rent storage as needed. Additionally, they can track inventory, plan procurement efficiently, and connect with a larger pool of vendors, improving their business operations. Vendors face a shortage of supply options, relying on fixed suppliers that limit their ability to expand and diversify their product offerings. In many areas, vendors are bound to specific suppliers, restricting their access to a broader variety of livestock products. This limitation affects their ability to meet customer demands and expand their business. Moreover, vendors are often confined to specific customer bases due to geographic constraints, making it difficult to reach new consumers. Our web application will provide vendors with access to multiple suppliers, enabling them to explore diverse product options and competitive pricing. The platform will also allow them to connect with consumers beyond their immediate locality, expanding their business reach. By breaking geographic barriers, vendors can establish a more dynamic and profitable supply chain. As the primary stakeholders, consumers encounter challenges related to price transparency, product availability, and vendor exploration. In traditional markets, they do not have access to real-time price charts or a record of historical price trends. This lack of transparency makes it difficult for them to compare prices and identify the best deals. Additionally, consumers are often limited to vendors in their immediate surroundings, which restricts their options for purchasing high-quality and affordable livestock products. Our web application will allow consumers to view comprehensive product listings, compare vendor prices, and track price trends over time. This feature will empower them to make informed purchasing decisions based on historical price fluctuations. The platform will also notify users of price increases or reductions, ensuring they can take advantage of the best possible deals. By integrating all stakeholders—farmers, suppliers, vendors, and consumers—into a single digital marketplace, our web application will revolutionize the livestock supply chain. Farmers will gain financial independence by selling directly to buyers, suppliers will have better inventory management and cold storage solutions, vendors will enjoy a broader supply network, and consumers will benefit from transparency and competitive pricing. The elimination of middlemen will ensure fair trade, increased profitability for farmers and suppliers, and improved access to quality products for consumers. Through seamless communication, digital transactions, and real-time market insights, the platform will create a sustainable and efficient livestock trading ecosystem.

### *A. Existing System (Rich Picture As Is)*

In the existing supply and demand system, the process begins with the livestock farmers who raise cattle, fish, and other animals. They sell their livestock to middlemen, who act as intermediaries between farmers and suppliers. However, farmers often face difficulties as middlemen take advantage of the system and offer lower prices, preventing farmers from getting fair value for their products. This creates an unfair market where farmers struggle to earn honest profits.Once the middlemen purchase the livestock, they sell it to suppliers responsible for distributing the products to different parts of the supply chain. The suppliers face several challenges, such as a lack of direct communication with farmers, making it difficult to track the origin of products. Managing inventory is also problematic due to storage limitations, leading to supply shortages. Cold storage space is often insufficient, which affects the freshness of the meat.

Additionally, suppliers have a limited number of vendors to work with,restricting their ability to distribute products efficiently. The supplier then sells the livestock to vendors who sell meat products directly to consumers. Suppliers also store meat in cold storage to ensure freshness and provide cattle and fish to specialized cattle and fisheries huts, where they are kept, processed, and prepared for further distribution. However, vendors face difficulties in sourcing products due to the limited number of suppliers in an area. They often rely on fixed suppliers, which restricts their ability to expand their product choices. This also affects consumers, as they have limited options when buying meat, leading to a lack of competition and price variations in the market.Consumers, who are the final link in this chain, face several issues when purchasing meat products.Since there is no clear price chart or product availability information, they cannot compare prices or make informed decisions. They are also unable to track price changes over time, which makes it difficult to know if they are getting a fair deal. Additionally, consumers usually buy from the same vendors in their area, which limits their

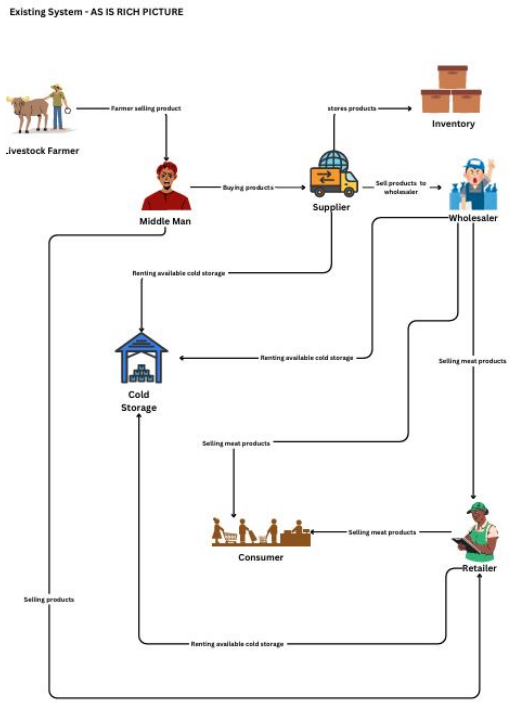


Fig. 1. Fig: As Is Picture

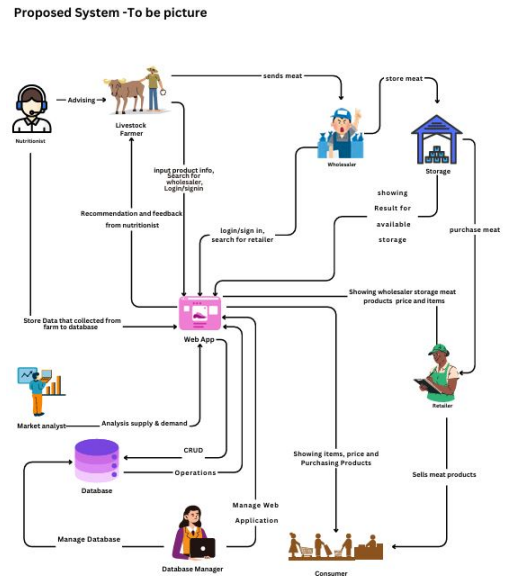


Fig. 2. Fig: To Be Picture

ability to explore different options and find better prices. Since visiting multiple vendors is difficult, they often have to settle for whatever price is set by the vendor they regularly purchase from. The current supply and demand system has several inefficiencies that affect everyone involved. Farmers do not get fair prices, suppliers struggle with storage and distribution issues, vendors face supply shortages, and consumers have limited access to better pricing and variety. Improving communication, increasing competition, and enhancing storage facilities could create a more efficient and fair market for all stakeholders.

*B. Gap analysis : Demand and supply analysis of meat product - 1. through the web application the communication gap between supplier and livestock farmer will be omitted. 2. Suppliers will be able to reach more vendors sell products in wide areas and buy livestock from farmers. Also, rent cold storage space and maintain an inventory of their own. 3. Vendors will be able to connect with more consumers and advertise meat products through the web application and sell meat products to them. 4. Consumers will be able to purchase products by seeing the item list price and many vendors that offer to sell. 5. Farmers can reach out to suppliers through web applications and sell livestock. Also, sell cattle and fisheries to the hut as well. 6. DLS (The Department of Livestock Services of Bangladesh ) will provide help for recommendations, and government services, and advises will be stored in the web application database. 7. Market monitoring will maintain the market as demand-wise supply is available to keep the market stable, and keep the price stable all over the market. Also alert the consumer, vendor supplier, and farmer about all this. 8. Market analysts will report about the supply and demand crises and stability and alert the user of the web application. Also, alert about the cold storage capacity. 9. The database manager will store all the data in the database and maintain the database by this all the information of the past to day to day will be stored and used later.*

## IV. Methodology

### A. Proposed System (Rich Picture To be)

In the existing supply and demand system, the process begins with the livestock farmers who raise cattle, fish, and other animals. They sell their livestock to middlemen who act as intermediaries between farmers and suppliers. However, farmers often face difficulties as middlemen take advantage of the system and offer lower prices, preventing farmers from getting fair value for their products. This creates an unfair market where farmers struggle to earn honest profits. Once the middlemen purchase the livestock, they sell it to suppliers responsible for distributing the products to different parts of the supply chain. The suppliers face several challenges, such as a lack of direct communication with farmers, making it difficult to track the origin of products. Managing inventory is also problematic due to storage limitations, leading to supply shortages. Cold storage space is often insufficient, which affects the freshness of the meat. Additionally, suppliers

TABLE I
GAP ANALYSIS

| Process Name | Stakeholders | Concerns (problems) | Analysis (Reason For The Problem) | Proposed Solution |
|---|---|---|---|---|
| dealing | Livestock Farmer(2nd) | Farmer not getting honest money for their products | Middleman taking advantage of farmer honesty | Through the web application, they can sell products directly no need for a middleman |
| supplying | Supplier (2nd) | 1.No communication with farm 2. Do not know product origin.3.inventory crisis 4. cold storage capacity issue.5 less vendor option | 1 for the middleman suppliers cannot communicate with the farmers 2. Middleman dealing on behalf of farmer .3 Supplier not able to rent available seats for cold storage 4. Efficient inventory .5 Can not find more new vendors | In the web application suppliers can directly communicate and deal with the livestock farmer and we can stop the service of middlemen through the web app suppliers can know the cold storage capacity and rent it even can maintain the inventory also Suppliers now communicate and deal with the vendors from different area |
| Sealing | Vendor(2nd) | 1. Shortage of supply option. fixed supplier 3. bound consumers | 1.In the area there are limited suppliers so a vendor can not expand their choice of products they get from suppliers.2 can not explore the maximum supplier to get items from. 3 in an area wise consumers as the business is stable there. | With our web application vendors can explore the maximum suppliers and consumers and sell and buy the product . |
| Buying | Consumer(primary | 1. Consumers can not see the price chart, and products available there 2. can not track the history of prices 3. can not explore maximum vendors. | Staying in one place makes the possibility of visiting different vendors hard also getting the best price is also very tied to getting | Our web application will allow the exploration of vendors despite area limitations seeing all the product chat lists and prices track them down for the analysis of which vendor giving the best price also the notification of price hikes and price down |
| .... | | | | |

have a limited number of vendors to work with, restricting their ability to distribute products efficiently. The supplier then sells the livestock to vendors who sell meat products directly to consumers. Suppliers also store meat in cold storage to ensure freshness and provide cattle and fish to specialized cattle and fisheries huts, where they are kept, processed, and prepared for further distribution. However, vendors face difficulties in sourcing products due to the limited number of suppliers in an area. They often rely on fixed suppliers, which restricts their ability to expand their product choices. This also affects consumers, as they have limited options when buying meat, leading to a lack of competition and price variations in the market. Consumers, who are the final link in this chain, face several issues when purchasing meat products. Since there is no clear price chart or product availability information, they cannot compare prices or make informed decisions. They are also unable to track price changes over time, which makes it difficult to know if they are getting a fair deal. Additionally, consumers usually buy from the same vendors in their area, which limits their ability to explore different options and find better prices. Since visiting multiple vendors is difficult, they often have to settle for whatever price is set by the vendor they regularly purchase from. The current supply and demand system has several inefficiencies that affect everyone involved. Farmers do not get fair prices, suppliers struggle with storage and distribution issues, vendors face supply shortages, and consumers have limited access to better pricing and variety. Improving communication, increasing competition, and enhancing storage

### *B. ERD*

A supplier can provide multiple products, but each product is supplied by exactly one supplier. Each supplier has attributes such as SupplierID, Name, Address (including Area, City, and ZipCode), Phone Number, and Email. The supply relationship includes additional information such as Quantity, Date, Transaction Type, Yields,

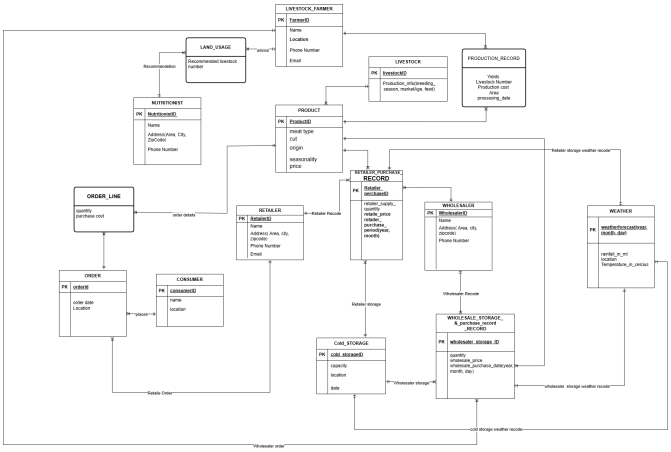


Fig. 3. Fig:ERD

Livestock Number, Production Costs, and Processing Data.A wholesaler distributes multiple products, and each product can be distributed by multiple wholesalers. The wholesaler entity includes attributes like WholesalerID, Name, Address (Area, City, ZipCode), Phone Number, and Email.Similarly, a retailer sells multiple products, and each product can be sold by multiple retailers. Retailers have attributes such as RetailerID, Name, Address (Area, City, ZipCode), Phone Number, and Email.A consumer purchases multiple products, and each product can be bought by multiple consumers. The consumer entity is described by attributes including ConsumerID, Consumption Patterns, Price Elasticity, and Regional Preferences.A livestock farmer supplies multiple suppliers, while each supplier is associated with exactly one livestock farmer. The livestock farmer entity includes FarmerID, Name, Address (Area, City, ZipCode), Phone Number, Email, Consultations, Recommendations, and Selling Details.A nutritionist analyzes multiple products, and each product is evaluated by exactly one nutritionist. Nutritionists have attributes such as NutritionistID, Name, Address (Area, City, ZipCode), Phone Number, and Working Hours.Livestock expansion is associated with multiple livestock records, and each livestock record is linked to exactly one livestock expansion entry. This relationship is essential for tracking the growth and scaling of livestock operations. The livestock entity is identified by its Livestock Number.Each product has multiple price records, with each price record belonging to a single product. The price information includes Current Price, Historical Price, and Fluctuations.Lastly, the product quantity record keeps track of the availability of products over time, ensuring accurate management of stock levels and supply chain operations.

### C. Front End of User Interface

”Meat King” is a robust and data-driven livestock and meat supply chain management software designed to streamline operations for both livestock farmers and retailers or consumers.

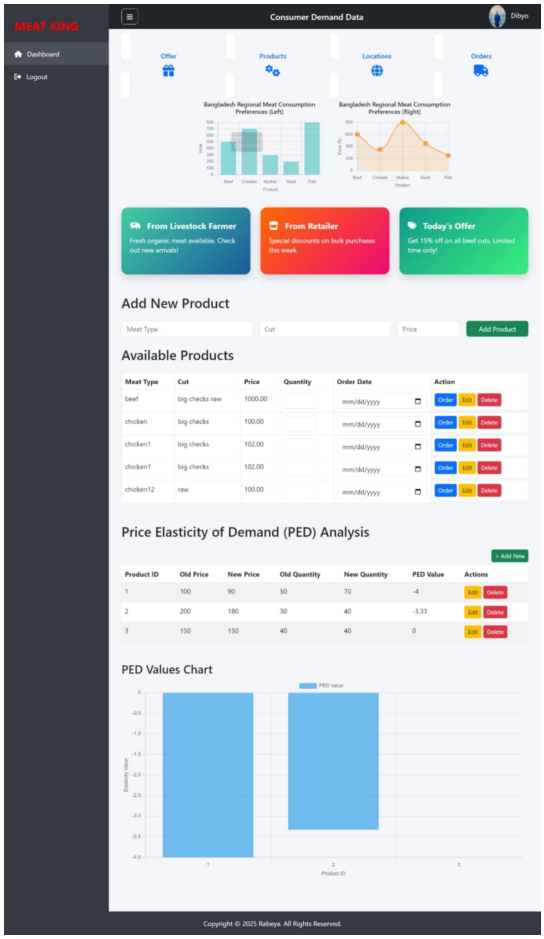


Fig. 4. User Interface 1

It offers a dual-dashboard system that supports the specific needs of each user type while ensuring efficient coordination between production and consumer demand. The platform is built to empower users with data visibility, operational control, and decision-making tools aimed at enhancing productivity, optimizing pricing, and ensuring seamless market alignment.

### D. Livestock Farmer

The Livestock Farmer Dashboard is tailored for producers managing livestock and associated yield data. It features a clean and intuitive interface with a sidebar navigation menu that provides quick access to essential modules such as Historical Production Data, Livestock, Products, Locations, Orders, Recommendations, and Logout. Farmers are greeted with a welcoming message and high-level overview tiles that visually represent core data points including the number of livestock, product types, real-time supply data, and order statistics. A central component of this dashboard is the Yield Chart, a bar graph that illustrates production output in kilograms based on livestock numbers. This visual tool helps farmers track performance over time and make informed decisions about productivity.

Below the chart, input fields allow farmers to add new records by entering yield in kilograms, livestock number, cost incurred, and area utilized in acres. These entries can be saved through an "Add Record" button, making it easy to update and manage production logs. Additionally, a comprehensive Historical Production Data table displays all past records, including yield, livestock number, cost, and processing data. Each row includes Edit and Delete options, allowing users to maintain accurate and up-to-date records. The dashboard supports operational efficiency by simplifying the process of recording, analyzing, and modifying production data, ultimately helping farmers focus on improving output and cost-effectiveness.

### *E. Consumer Demand Dashboard*

The Consumer Demand Dashboard, in contrast, is designed for retailers and end-consumers who interact with meat products post-processing. It begins with a sidebar that includes Dashboard access and a Logout option, ensuring easy navigation and secure usage. At the top of the page, dashboard tiles offer quick entry points into sections such as Offers, Products, Locations, and Orders. This dashboard places a strong emphasis on regional consumption trends, particularly focused on Bangladesh. Two graphical representations showcase meat consumption preferences by type (beef, chicken, mutton, duck, and fish), using both bar and line charts to highlight volume and demand variations across the region.

To enhance marketing and customer engagement, the dashboard features three colorful information panels: From Livestock Farmer, promoting availability of fresh organic meat; From Retailer, highlighting bulk purchase discounts; and Today's Offer, offering limited-time discounts like 15 percent off on beef cuts. These promotional sections are useful for driving sales and connecting producers directly with consumers.

Retailers and consumers can also use the Add New Product section to introduce new meat products into the system by entering the meat type, specific cut, and price. Once added, these items appear in the Available Products table, which includes detailed columns such as meat type, cut, price, quantity, and order date. Each product entry can be ordered, edited, or deleted, facilitating full inventory control. This functionality supports the dynamic nature of consumer demand and ensures the system reflects real-time availability.

### *F. Price Elasticity of Demand*

A standout feature of this dashboard is the Price Elasticity of Demand (PED) Analysis module. This section allows users to analyze how changes in price affect consumer purchasing behavior. Users input old and new prices along with old and new quantities sold, and the software automatically calculates the PED value. These values are then visually represented in a PED Values Chart, which uses bar graphs to help users quickly interpret demand elasticity for each product. This analysis is vital for making informed pricing decisions—products with high elasticity may benefit from discounts to drive volume, while inelastic products might retain higher margins.

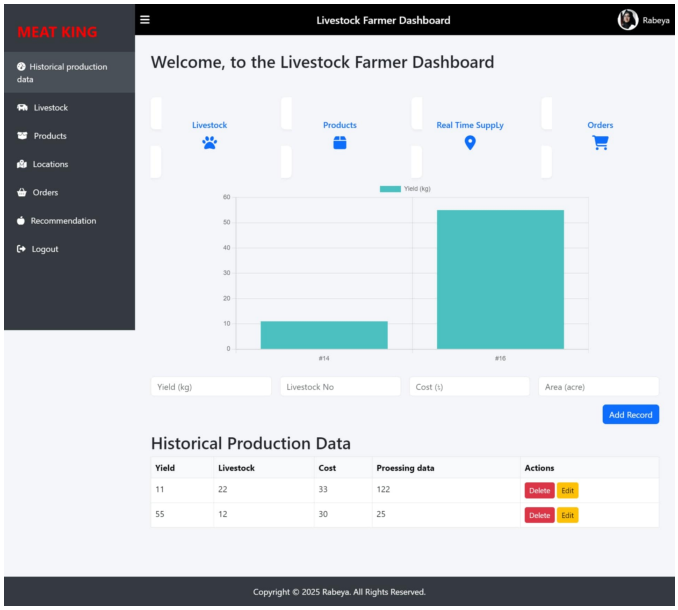


Fig. 5. User Interface 2

## V. SCHEMA DESIGN

The LIVESTOCK FARMER table maintains records of farmers, including their ID, name, location, phone number, and email. The NUTRITIONIST table captures details about nutritionists, such as ID, name, area, city, zip code, and contact number. The relationship between nutritionists and farmers is managed in the LIVESTOCK EXPANSION table, which logs recommended livestock quantities for each farmer.

Production data is organized in the PRODUCTION RECORD table, containing information like farmer ID, product ID, yield, number of livestock, production costs, and processing dates. The PRODUCT table includes product-specific data such as type of meat, cut, origin, seasonal availability, price, and associated livestock ID. The characteristics of the livestock, such as the breeding season, the age of the market and the type of feed, are stored in the LIVESTOCK table. Customer transactions are handled through the ORDER table, which logs order ID, date, consumer ID, retailer ID, and delivery location. Specific items within each order are detailed in the ORDER LINE table. Consumer profiles are maintained in the CONSUMER table, including ID, name, and address.

Cold storage operations are tracked in the COLD STORAGE table, listing storage ID, capacity, location, and date of storage. Lastly, daily climate data—such as temperature and rainfall—is collected in the WEATHER table, which is also linked to cold storage and purchase records for contextual analysis.

## VI. NORMALIZATION

In First Normal Form (1NF), attributes hold atomic values with no repeating groups. Second Normal Form (2NF) removes partial dependencies, ensuring all non-key attributes depend on the full primary key. Third Normal Form (3NF)

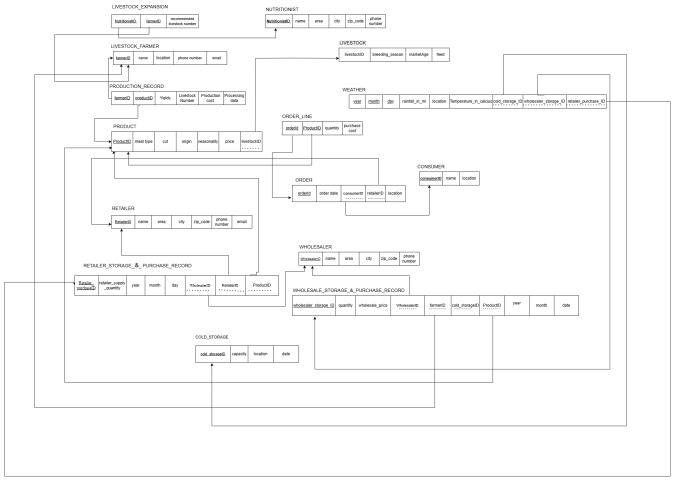

Fig. 6. Fig Schema

Fig. 7. Fig:Normalization

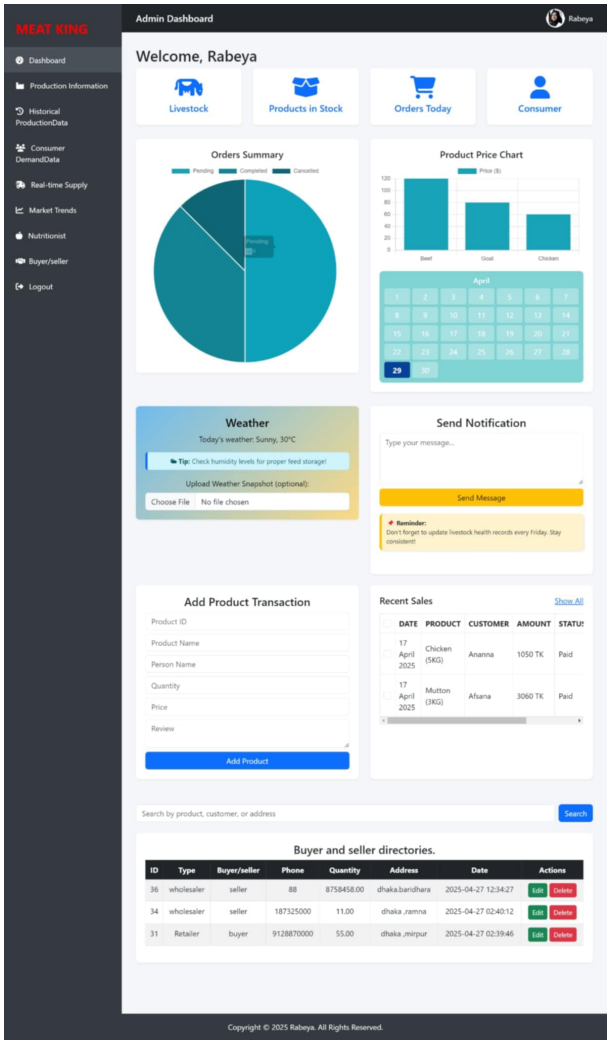


Fig. 8. Fig:Meat King Admin Dashboard

eliminates transitive dependencies, making non-key attributes rely only on the primary key. Boyce-Codd Normal Form BCNF) further ensures every determinant is a candidate key. As shown in the diagram, all tables are normalized up to BCNF, ensuring clean, efficient, and consistent data.

## VII. DISCUSSION

### A. *Meat King Dashboard*

The Meat King dashboard is a comprehensive management tool designed for Rabeya, likely an administrator or manager in a meat production and distribution business. It provides a centralized interface with multiple functionalities, including navigation options like production information, historical data, consumer demand insights, real-time supply tracking, market trends, nutritionist resources, and buyer/seller directories. The main dashboard displays a welcome message, livestock order summaries (processing, completed, and canceled), and current product stock levels. A product price chart tracks pricing trends with a calendar view, while a weather section offers real-time climate data and storage tips. Users can send notifications, add product transactions, and search records by product, customer, or address. Recent sales data is presented in a table format, showing transactions like chicken and mutton sales. Additionally, a detailed buyer/seller directory lists contact information, transaction quantities, and locations, with options to edit or delete entries. The dashboard combines operational metrics, environmental factors, and business management tools to streamline decision-making and daily operations for Meat King's operations.

### B. *Analysis of Usage*

The Meat King dashboard offers significant benefits by streamlining operations and enhancing decision-making for meat production and distribution businesses. By consolidating critical data into a single interface, it improves efficiency in tracking livestock orders, inventory levels, and recent sales, allowing managers like Rabeya to quickly assess business performance. The inclusion of historical production data and consumer demand insights enables better forecasting and plan-

ning, while real-time supply monitoring helps prevent stock-outs or overstocking. The weather integration provides actionable advice for storage conditions, reducing spoilage risks. The buyer/seller directory facilitates seamless communication and relationship management with wholesalers and retailers, and the transaction management system ensures accurate record-keeping. Additionally, the price trend visualization and market trend analysis support strategic pricing decisions. Overall, this dashboard enhances productivity, reduces operational inefficiencies, and supports data-driven decision-making, ultimately contributing to increased profitability and customer satisfaction.

## VIII. CONCLUSION

the Meat King dashboard serves as a powerful, all-in-one management tool that significantly enhances operational efficiency and strategic decision-making for meat production and distribution businesses. By integrating real-time data on inventory, sales, weather, and market trends, it empowers managers to monitor performance, optimize supply chains, and respond proactively to changing conditions. The system's user-friendly interface, combined with features like buyer-seller directories and transaction tracking, fosters better communication, reduces waste, and improves profitability. Ultimately, this dashboard not only simplifies day-to-day operations but also drives long-term business growth by leveraging data-driven insights, ensuring Meat King remains competitive in a dynamic market. Its comprehensive design makes it an indispensable asset for modern agribusiness management.

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