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Supply Chain
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Introduction

Agriculture is important for Bangladesh's economy; employing 37% of the labor force and contributing 11% to the GDP. However, it faces various challenges like seasonal variability, logistical inefficiencies, environmental disruptions, and market fluctuations.

AgrilInnovate Ltd. is a leading agricultural company that promotes sustainable farming and high-quality produce. To address these challenges, AgrilInnovate has to strengthen its supply chain with advanced technologies like AI, Blockchain, and IoT and also improve resilience.

The goal is to analyze current situation and enhance visibility, efficiency, and resilience by implementing changes, and developing robust contingency plans for a stable and resilient supply chain.

Situation Analysis

Current Situation Globally

The United Nations' Food and Agriculture Organization (UNFAO) reports about **40%** of the world's food (**1.6 billion tons**), is wasted annually. Losses during storage are: **15-20% for vegetables and 10-15% for fruits**, with additional **5-10% wasted during distribution**. This high level of wastage is primarily due to the perishability of fruits and vegetables [1].

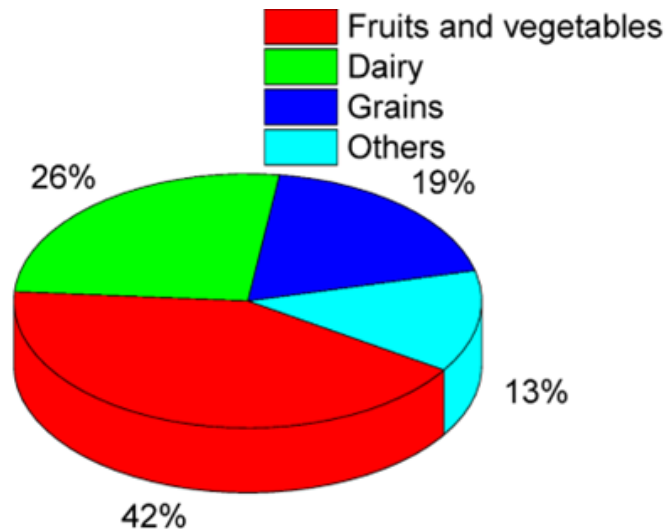


Figure 1. Percentage of different food waste [1]

The spoilage is due to inappropriate storage conditions, which accelerates deterioration, leading to significant economic losses. This also raises the risk of foodborne diseases, posing threat to human health. **Intelligent cold chain systems** can solve these issues [1]. Despite technological advancements, challenges remain in the real-time monitoring of environmental parameters and their effects on foods. Further research is needed to understand the relationship between quality changes and environmental conditions.

Current Situation in Bangladesh

Bangladesh's economy is mostly agriculture dependent. The climate and fertile soils facilitate the cultivation of wide range of crops. Multiple intermediaries in vegetable supply chain monopolize prices and profits over farmers by extending the chain without contributing value [2].

There are many significant obstacles, including inaccurate demand forecasts, weak contract monitoring, inadequate logistics, political meddling, social unrest and natural calamities. Supply chain complexity is increased by institutional problems including corruption, bureaucratic difficulties, and shortage of qualified workers [3].

Current Situation in AgrilInnovate Ltd.

Major Points:

Sourcing: <ul style="list-style-type: none">• Seasonal Variability• Environmental Disruptions	Production: <ul style="list-style-type: none">• Quality Control• Inefficient resource Utilization
Logistics: <ul style="list-style-type: none">• Transportation Delays• Logistical Inefficiencies	Distribution: <ul style="list-style-type: none">• Market Fluctuations• Demand Forecasting

Case Objectives

The figure shows the complexity of fruit and vegetable supply chain in Bangladesh:

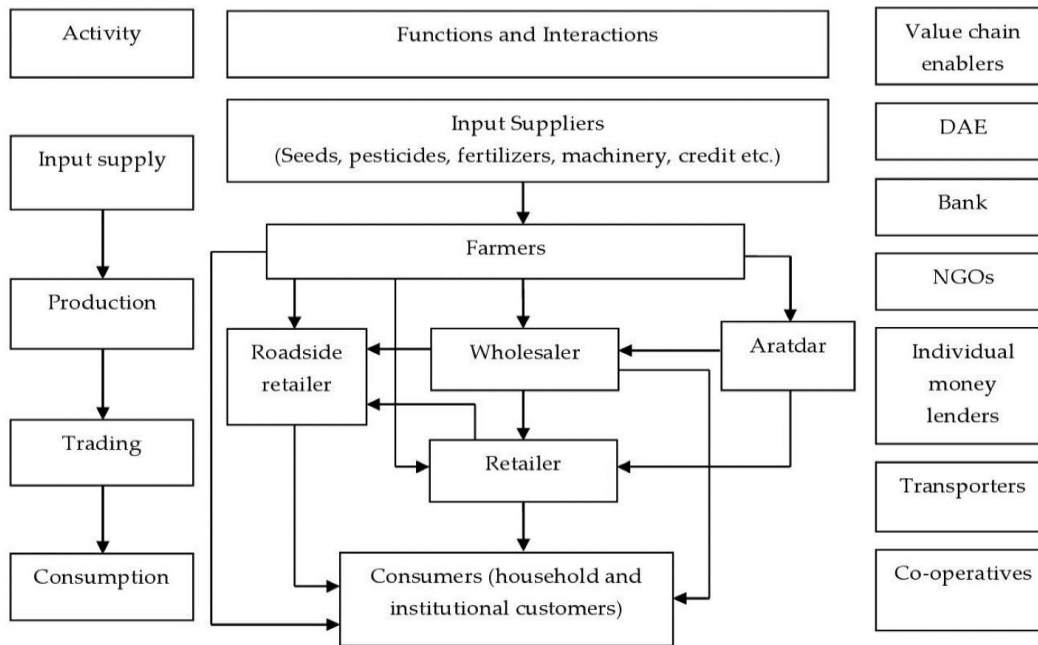


Figure 2. Present Supply Chain of fruits and vegetables [4]

As of this complexity, AgriInnovate will go for 'Project -AgriSync' to mitigate present challenges. The covered objectives are:

- I. Increase Supply Chain Transparency with Blockchain.
- II. Demand Forecasting with AI and predictive analytics.
- III. Automate Inventory Management.
- IV. Improve Logistics.
- V. Build Resilience developing plans.

Solution (Project-AgriSync)

Solution: Our proposed solution will be building up a Smart Supply Chain Management System named "**Project AgriSync.**"; thus, overcoming supply chain issues and also fulfilling the **7 R's** of Supply Chain Management.

Introduction

'Project AgriSync' will implement **Smart Supply Chain Management** within the agricultural sector. Considered two strategies are:

1. **Technology Solutions:** Using modern technologies to build smart supply chain networks.
2. **Resilience Enhancement:** Optimization of processes and internal operations.

Why Smart Supply Chain?

Supply Chain Management 4.0 or Smart Supply Chains are logistics networks that involves using different IT methods to automate the process. It enables analysis, simulation, visualization and automatic management of the complex supply chain network [5]. This involves using technologies such as Internet of Things (IoT), Artificial Intelligence (AI), Big Data, NFC (Near Field Communication) technology, Blockchain etc.

Some of the advantages include:

1. Improved Planning and Risk prediction.
2. Transparency and clarity.
3. Reducing overproduction and shortages.
4. Enabling AgrilInnovate Ltd. to make informed decisions on resource management and respond quickly to changes.

Technology Solutions

We have 3 Technological Solutions:

1. Development of Blockchain network
2. Development of AI based forecasting and demand analysis model
3. AIMS and Intelligent Cold chain management

Development of AgrilInnovate blockchain

Typical agricultural supply chains include multiple stakeholders. The inability to trace the origin and quality of produce, delayed information flow, and an overall absence of transparency resulting in the loss of transaction details are some of the main challenges.

Thus, we need to integrate advanced technologies to enhance supply chain visibility and efficiency.



Figure 3: Blockchain Technology (Ref: InfoSys)

A blockchain is an interconnected digital ledger that records transactions (in this case product and services transfer). Each block contains code (hash) from previous block and transaction data. It's **decentralized** and distributed across all the users; which makes it secure and unchangeable without altering whole chain.

Trusted stakeholders can transact amongst each other through **smart contracts**. Any activity can be documented and stored in the distributed ledger only with consensus among all stakeholders. Every stakeholder will have their own copy of the same distributed ledger.

This will:

- ✓ Enhance traceability and visibility.
- ✓ Ensure food safety and authenticity.
- ✓ Secure and transparent transactions.

Development of AI based forecasting and demand analysis model

Overproduction and shortages are two most common problems in the agriculture industry. AI driven forecasting model can predict the demand automatically based on the big data in the central ERP system. We can also use ML algorithms to monitor and ensure consistent quality across all produce.

Methodology:

We will combine two different strategies to predict the crops needed to be yield:

- **Crop modeling:** Crop modeling predicts which crop to produce in which land to get best yield as well as reducing the risk for the producer. Parameters to consider for crop modeling:
 - Suitable crops for the given land and season.
 - Water availability.
 - Soil characteristics etc.

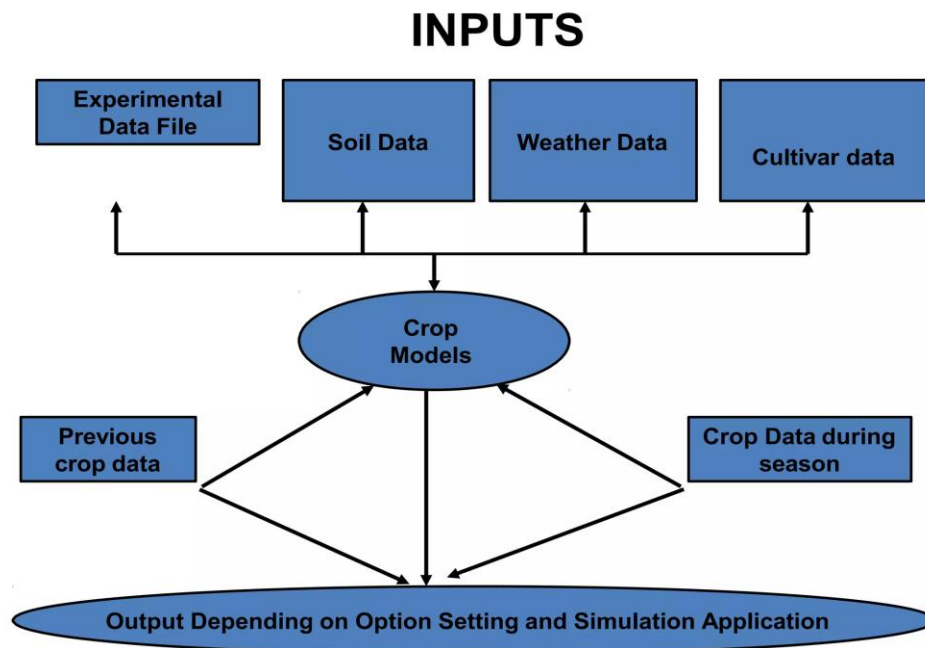


Figure 4: Crop Modelling Example Diagram [4]

- **Demand forecast:** Demand forecasting will be done to understand the demand for crops. ML algorithms will be used for forecasting. Parameters considered for demand forecasting:
 - Export-import data of agricultural products.
 - GPS tracking using satellite images data.

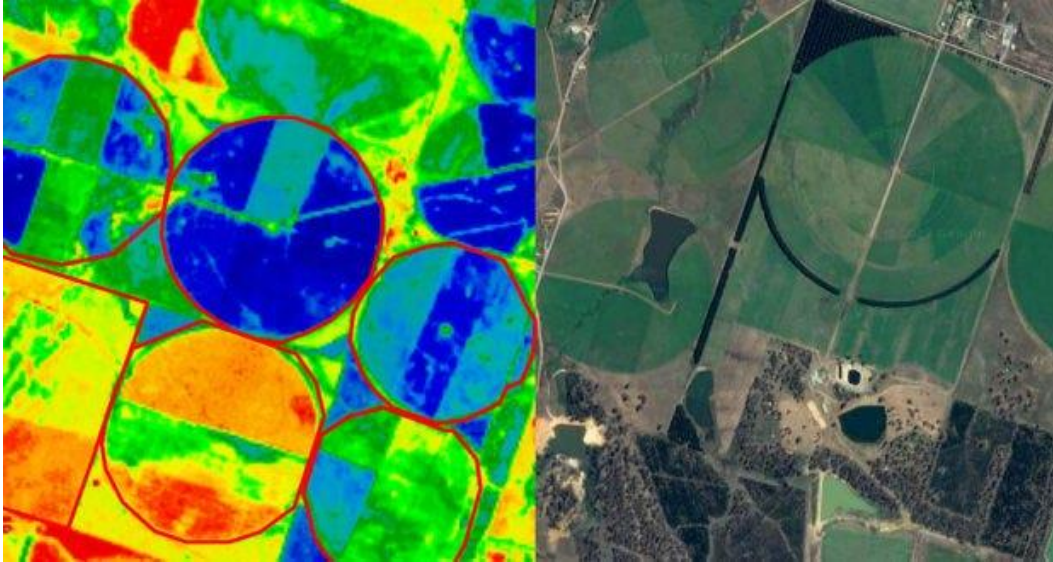


Figure 5: Satellite Imagery Tracking [ref: SpaceAmbition]

The parameter data will be collected from agricultural management authorities and real-time data from already established database using REST API.

By combining these two strategies we can eliminate the waste of overproduction as well as the risk of shortages at both ends.

AIMS and Intelligent Cold Chain Management

An Automated Inventory Management System (AIMS) enables real-time inventory control, optimize entire inventory and distribution process thus saving time.

From dropshipping to backorders, partial fulfillment, order invoicing, inventory counts everything can be automated. By integrating with POS, RFID and order management tools, accurate inventory tracking across all channels is ensured.

AgrilInnovate will deploy an AIMS for:

- ✓ Monitoring inventory levels and **availability**
- ✓ Reduce Muda/wastes and improve **quality**
- ✓ Ensuring uninterrupted supply of goods.

Current preservation technologies, such as modified atmosphere preservation, preservatives, coatings, and irradiation, do not allow for real-time environmental monitoring or adjustment. **Intelligent cold chain systems** are the solution.

This system maintains appropriate temperature and humidity levels. The integration of **IoT** allows real-time data exchange and optimization of food quality parameters throughout the supply chain, reducing waste [1].

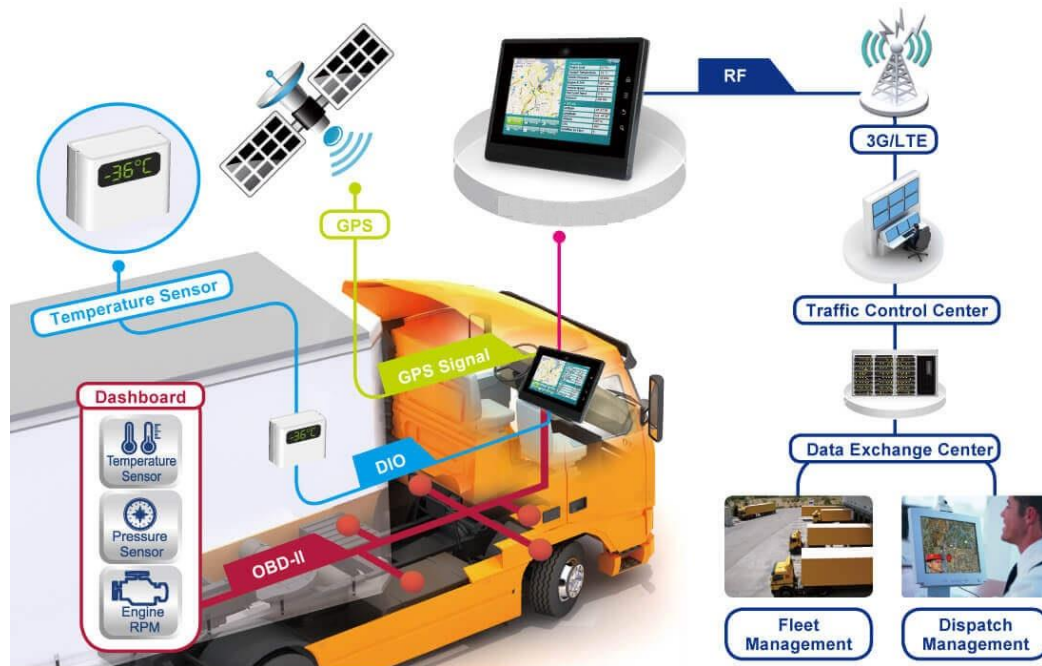


Figure 6: Intelligent Cold Chain System [ref: XenArcTech]

Resilience Enhancement

We are proposing six operational strategies to enhance resilience of the supply chain and overcoming several problems of the company.

❑ Diversifying Suppliers:

- Developing a network of suppliers from many regions will:
 - ✓ Reduce dependency on single source therefore **increasing availability**
 - ✓ Minimize the chance of **environmental disruptions**.

❑ Inventory Management Principles:

- AgrilInnovate will implement **Cross-Docking** to reduce inventory in between unloading and loading also ensuring product safety and quality in this process.
- Using **Vendor-Managed Inventory (VMI)** appropriately reduces unnecessary inventory space and cost of the company.
- AgrilInnovate will follow **Just in Time (JIT)** system to reduce inventory cost.

❑ Contingency Plans:

- Situations such as **market fluctuations, natural calamities, logistical delays** etc. can occur. Small changes in consumer demand causes larger fluctuations in demand at the wholesale, distributor, manufacturer, and raw material supplier levels. This is **Bull Whip effect**.
- AgrilInnovate will have contingency plans to overcome these situations; setting up backup logistical networks and emergency response teams.

❑ Sustainable methods:

- AgrilInnovate will encourage farmers to use sustainable methods such as crop rotation, organic farming, efficient watering systems etc. This improves the long-term **stability** of the supply chain.
- AgrilInnovate will establish sustainable and environment friendly policies within the company.

❑ Logistical Changes:

- AgrilInnovate will allocate resources towards strengthening the transportation infrastructure to minimize logistical inadequacies and losses following harvest.

- AgrilInnovate will reduce **Third-Party Logistics (3PL)** and develop our own transportation network to:
 - ✓ Decrease lead time
 - ✓ Ensure JIT
 - ✓ Overcome transportation delays
 - ✓ Ensure product quality
 - ✓ Increased control

Diverse Market:

- AgrilInnovate will investigate and enter various markets alongside the existing markets for:
 - ✓ Spreading risk
 - ✓ Reducing impact of price fluctuation
 - ✓ Maintaining supply chain stability
 - ✓ Increased profitability

Implementation Roadmap

1. **Phase 1: Inspection and Planning (Months 1-3)**

- ☐ Evaluation of the supply chain's current operations in details.
- ☐ Creation of implementation strategies.
- ☐ Analyzing Feasibility and obtaining required funding.

2. **Phase 2: Technology Integration (Months 4-9)**

- ☐ Implement blockchain Technology.
- ☐ Employ ML and AI tools for quality control and demand forecasting.
- ☐ Install IOT sensors for cold chain management and AIMS.

3. **Phase 3: Resilience Enhancement (Months 10-15)**

- ☐ Expanding network and market.
- ☐ Implementing proposed strategies parallelly.

4. **Phase 4: Kaizen/Continuous Improvement (Ongoing)**

- ☐ Maintenance and upgrading the technology and procedures regularly.
- ☐ Evaluate performance.
- ☐ Encourage an environment of continuous improvement and innovation.

SWOT Analysis

<p>Strengths</p> <ol style="list-style-type: none">1. Enhanced Visibility2. Improved Planning and Risk Prediction3. Quality Improvement4. Sustainable and Resilient Operations	<p>Weaknesses</p> <ol style="list-style-type: none">1. High Initial Investment2. Complex Implementation3. Big Data Dependency4. Resistance to Change
<p>Opportunities</p> <ol style="list-style-type: none">1. Market Expansion2. Technological Advancements3. Strategic Partnerships	<p>Threats</p> <ol style="list-style-type: none">1. Cybersecurity Risks2. Market Volatility3. Technological Obsolescence

Feasibility Analysis

Technical Feasibility

Data Availability:

- Agricultural management authorities and AgrilInnovate's extensive datasets easily accessible via REST API.
- Satellite imagery data available for land assessment.
- Data collection accuracy may vary across regions.

Blockchain and AI:

- Modern AI and ML algorithms can process large datasets to generate accurate predictions and insights.
- Developing robust AI model requires huge resources and time.
- Ensuring smooth integration between blockchain, AIMS, and external data sources brings technical challenges.

Economic Feasibility

- ☐ Large initial investment.
- ☐ Maintenance and other costs.
- ☐ High long-term ROI from improved efficiency and reduced costs.
- ☐ Funding: Internal, other sources.

Legal and Regulatory Feasibility

- ☐ Data privacy and certification standards.
- ☐ Monitoring regulatory changes and protect intellectual property.

Environmental Feasibility

- ☐ Reduced waste.
- ☐ Improved sustainability.

Conclusion

Agricultural sector in Bangladesh is an important sector, helping peoples' livelihoods and contributes to GDP. But its share of GDP has decreased over the last decade, going from 17% in 2010 to 11% in 2023 [6].

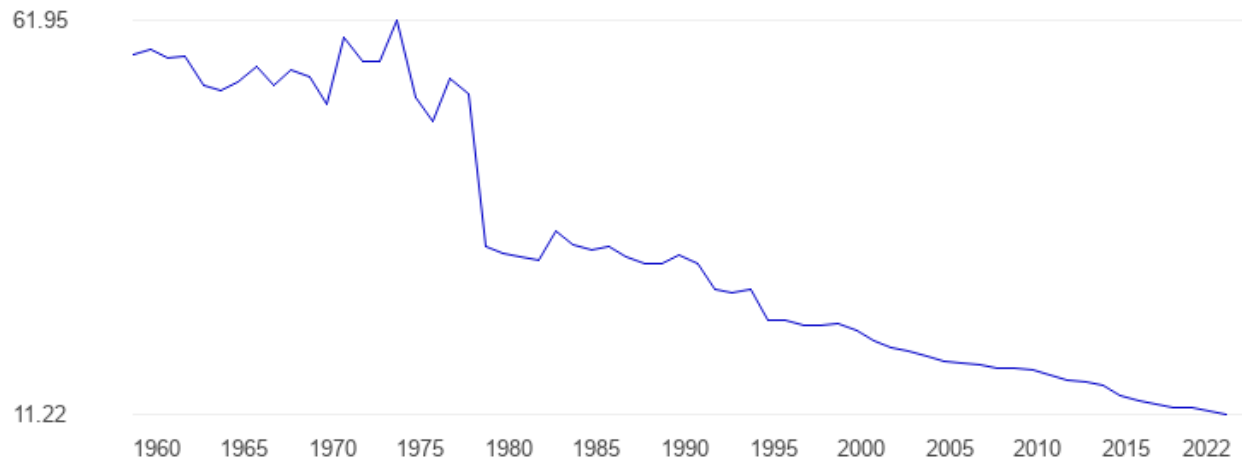


Figure: Bangladesh agricultural GDP share through years [7]

‘Project-AgriSync’ may overcome problems in agricultural supply chain of AgrilInnovate Ltd. The system guarantees improved traceability, visibility, and safe transactions amongst stakeholders by incorporating blockchain technology.

The AI-driven forecasting and demand analysis model, IoT-enabled automated inventory control and effective cold chain management will improve quality and reduce waste. Further enhancing resilience by implementing six operational measures.

By stabilizing the supply chain and enhancing sustainability, and efficiency, this all-encompassing strategy eventually profits all parties involved from farmers to consumers.

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- [7] [The_Global_Economy_:_Historical_Data_of_Bangladesh_GDP_throughout_Years](#)