Journal of Information Systems Engineering and Management
2025, 10(32s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Agricultural Process Optimization and Supply Chain Management Enhancing Sustainable Agriculture Through AI Technology

A. Angayarkanni[1], Dr. Ananthi Sheshasaayee2, Zhang YuJie[3], R. Ohmsakthi vel[4]
[1] *Ph.D. Research Scholar & Assistant Professor, Department of Information Technology,M.O.P. Vaishnav College for Women, Chennai*
[2]*Associate Professor & Head, PG & Research Department of Computer Science, Quaid-E-Millath Government College for Women (Autonomous), Chennai*
[3]*Faculty of Education, Shinawatra University*
[4]*Assistant Professor, Department of Mechatronics Engineering, Velammal Institute of Technology*

ARTICLE INFO

Received: 29 Dec 2024

Revised: 12 Feb 2025

Accepted: 27 Feb 2025

ABSTRACT

AI plays a major role in moving food from farm to consumer and maintaining the relationship between business in the supply chain . AI expands its capability in agriculture production , processing , transportation , storage, distribution and consumption of agricultural production. AI plays a crucial role in agricultural supply chain management through data-driven decision making and resource optimization, enabling sustainable practices by minimizing waste and maximizing yield and quality . Artificial Intelligence , Machine learning and IOT plays a crucial role in agricultural supply chain management by enabling data-driven decision making, resource allocation and optimization, demand forecasting and logistics management . AI revolutionize agricultural practices by promoting sustainable resource management, optimizing production, customer segmentation and enhancing food security and safety , making it a key tool in achieving long-term sustainability goals in the agricultural sector. Through agricultural supply chain management, farmers can optimize production, reduce waste, and promote sustainable farming practices, contributing to environmentally friendly food Security .

Keywords: Artificial Intelligence, Machine Learning , IoT, sustainable practices, food supply chain management, Process Optimization

INTRODUCTION

Agriculture is a vital sector of the Indian economy, contributing to the country's GDP, employment, and food security. Climatic change , population growth and resource scarcity are a major threats to Global food security. Advanced technologies such as Machine Learning ,Deep Learning , IoT, remote sensing and blockchain technologies play a significant role in enabling sustainable agriculture practices that can optimize production process and food supply chain management resilience for agricultural product delivery. By leveraging AI in agricultural supply chain management, farmers can make informed decisions to optimize production, reduce waste, and promote sustainable farming practices, contributing to a more environmentally friendly food supply chain. This research article addresses the issues within the commodity supply chain, with a specific focus on disease detection and identification to enhance quality production and enhance process optimization which twins with supply chain management to

LITERATURE REVIEW

Rice leaf diseases can cause significant losses in the amount and quality of rice produced. The reasons for rice crop Diseases are climate change , Fungus, virus, and Bacteria. One of the disease caused in rice is Leaf smut that is characterized by sori on the leaves, Brown spot disease in rice is caused by fungus Cochliobolus miyabeanus and Bacterial Leaf Blight is caused by Xanthomonas oryzae . These diseases can have a major impact rice yield loss, quality loss and can seriously have an impact on Countries economy Earlier detection of rice infection can maximize the crop yield and produce a good quality of rice. It can aid in sustainable agriculture by minimizing the use of pesticide and fertilizers and saves the environment from climatic change, soil degradation, water and air pollution enabling sustainable agriculture. .

Major rice Diseases of National Significance are 1. Rice blast 2. Bacterial leaf blight 3. Sheath blight 4. False smut and 5. Brown spot. [6] Every year, plant diseases account for 10–16% of the world's agricultural losses.

Crop disease identification is an [4] urgent need for greater agricultural sustainability and production through precise accurate plant health monitoring. Failure of traditional methods used by farmers to identify plant disease makes the [3] fertilisers ineffective and subsequently harm the plant and soil. To make the diagnosis process of rice disease automatic more effective and accessible technique is desired.

Climate change, fast population expansion,[5] rapid ecological degradation, pests, and rice diseases threaten global food security. Approximately 37% less rice is produced annually as a result of these diseases. Accurate and fast diagnosis and prompt application of pesticide management strategies are essential for disease control. Earlier detection of Rice Plant disease is possible by Automated methods . VGG16 convolutional neural network coupled with transfer learning , [1] optimizes computational resources and enhances performance through pre-trained model. Research shows a significant stride toward harnessing modern technology for sustainable agricultural practices and crop management.

Lu et al. [20] proposed the automatic identification of rice disease in China using CNN with a ten-fold cross validation strategy with 95.48% accuracy .Crop diseases can be detected in leaves, stems and flowers and other places. Leaf highlights certain aspects of natural goods and blooming throughout all of the periods across the globe [19].

Many of researchers have used CNNs for plant disease identification because of their accuracy in image identification and classification [25]. However, only a small number of studies have been carried out on the identification of illnesses in rice plants.

AI roles in moving food from farm to consumer is significant. Machine learning , Deep Learning and IOT plays a crucial role in agricultural supply chain through, resource allocation, demand forecasting and logistics management. The supply chain structural dynamics, has been extended to various sectors, such as the food industry , the manufacturing sector and the automotive industry [7]. ML algorithms enable supply chain managers to make data-driven decisions, optimize operations, reduce costs, and [23] enhance the overall efficiency and resilience of supply chain processes and can deliver products to consumers more effectively. The use of blockchain technologies for supply chain management provides transparency and increases trust between market participants.

METHOD

The objective of this research is to address the issues within the commodity supply chain, with a specific focus on rice disease detection and identification to enhance quality production. To achieve this, a framework that leverages AI and computer vision techniques for the identification and recognition of diseases in rice crops is trained and testet. These models can be integrated into the overall supply chain management process. The Deep learning CNN model is used for disease recognition for rice crop with its identification accuracy and computational efficiency. The novelty of the work lies in adopting and proposing cutting edge computer vision models, which comply with the resource-constrained environment and that may further be embedded as part of the full-fledged Agricultural process optimization and supply chain management system. The CNN model is sophisticated models with the capacity to compress images, transforming them into a format that is simpler to process while ensuring that the elements necessary for creating an accurate prediction are not jeopardized. The CNN model is a straightforward model with a reputation for quick computation times and simple output interpretation.

The methodology section provides a detailed study on the procedures, techniques and tools used to detect and predict rice crop disease by means of CNNs . CNNs employees a series of convolution and pooling layers that can extract spatial and temporal information [25] from the given image data. The picture's pixel matrix is represented by the input layer, the picture characteristics is extracted by the the Convolutional layer and the size of feature map is reduced by the pooling in Convolutional Neural Network. The Fully linked layers responsibility is to link inputs from one phase to every activation unit in the below layer . The activation function of neural network models that predict a multinomial probability distribution is taken care by the Softmax layer. Convolutional Neural Networks contains multiple pooling and activation layers inside hidden layers.

A high-level structured representation of the methodology section is denoted in Figure 1.

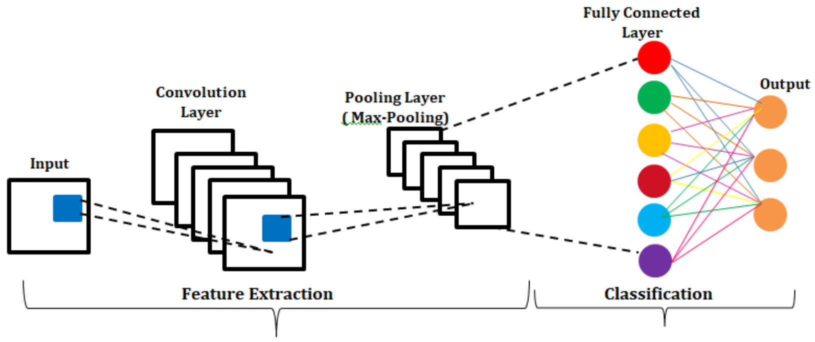

Fig. 1. Schematic of Convolution Neural Network (CNN)

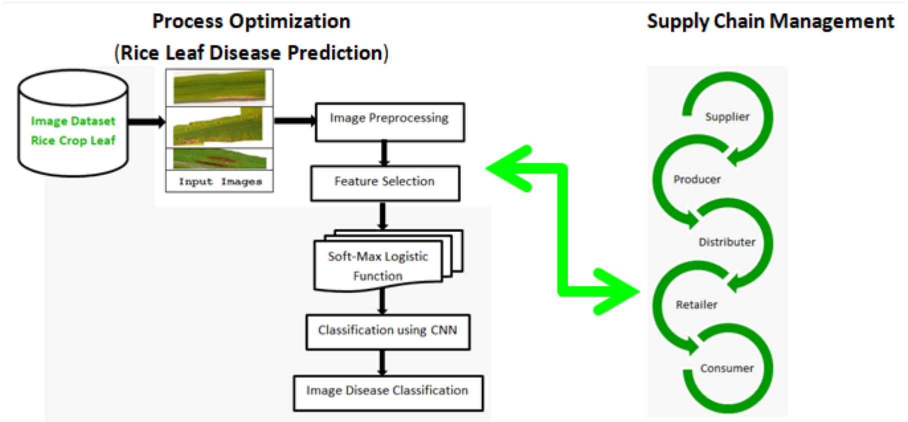

Fig. 2. Flow Diagram – Relationship between Process Optimization and Supply Chain Management

1.1 Dataset Description

The Initial step is the acquisition of a complete and diverse dataset encompassing images of unhealthy rice leaves. This work uses the rice crop dataset, sourced from www.kaggle.com/datasets, a reliable and extensive collection of high-resolution images capturing various stages of rice plant development and different indicators of diseases.

The dataset contains 1294 color images with 3 classes as shown in Figure 3: The diseases classes shown in Figure 5(a) Bacterial leaf blight 5(b), Brown spot and 5(c) Leaf smut. For testing the data from a usual environment, around 164 images are used with a dimension of 3081×897 pixels.

Table 1. Illustrates Information about division of Rice Crop Disease Input Data Set

Disease Types	Train Images	Test Images	Validation Images
Bacterial leaf blight	305	55	66
Brown spot	303	54	76
Leaf smut	303	55	77
Total	**911**	**164**	**219**

3(a) Bacterial leaf blight	
3(b) Brown spot	
c(c)Leaf smut	

Fig. 3. Rice Crop Disease belonging to three classes

1.2 Data pre-processing

Prior to training the convolutional neural network models, preprocessing was done on the collected data to ensure uniformity and model generalization. Preprocessing involved resizing images, Shearing, normalizing pixel values and addressing any potential imbalances in the distribution of diseased samples. The images are resized into 256x256 pixels.

1.3 Model architecture

This work adopts a state-of-the-art CNN architecture for the rice crop disease detection and prediction framework. The architecture consists of Convolution , Pooling and Fully connected layers. It uses a conv2d layer, max_pooling2d layer, conv2d_1, max_pooling2d_1, flatten, dense, dense_1 layers. The chosen architecture was fine-tuned to accommodate rice leaf images specific features and gradations.

1.4 Model evaluation

Accuracy metric was computed to understand the model's effectiveness in rice crop disease detection.

1.5 Experimental Results

Deep learning algorithms CNN model on the rice dataset measured an accuracy of 95.47%

The below screenshot (Fig 7) presented the training process. Whereas training and validation accuracy were shown in Fig 8, where the y-axis shows the accuracy obtained after each iteration represented in the x-axis.. Fig.9 shows the test accuracy of the model for Bacterial leaf blight ,Brown spot and Leaf smut disease prediction.

Sample input images are shown in Fig 4.

Fig. 4. Sample Input Images of Rice Crop Disease

The baseline architecture of sequential model is shown in figure 5

Model: "sequential_2"

Layer (type)	Output Shape	Param #
sequential (Sequential)	(10, 256, 256, 3)	0
sequential_1 (Sequential)	(10, 256, 256, 3)	0
conv2d (Conv2D)	(10, 254, 254, 32)	896
max_pooling2d (MaxPooling2D)	(10, 127, 127, 32)	0
conv2d_1 (Conv2D)	(10, 125, 125, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(10, 62, 62, 64)	0
conv2d_2 (Conv2D)	(10, 60, 60, 64)	36,928
max_pooling2d_2 (MaxPooling2D)	(10, 30, 30, 64)	0
conv2d_3 (Conv2D)	(10, 28, 28, 64)	36,928
max_pooling2d_3 (MaxPooling2D)	(10, 14, 14, 64)	0
conv2d_4 (Conv2D)	(10, 12, 12, 32)	18,464
max_pooling2d_4 (MaxPooling2D)	(10, 6, 6, 32)	0
flatten (Flatten)	(10, 1152)	0
dense (Dense)	(10, 64)	73,792
dense_1 (Dense)	(10, 3)	195

Total params: 185,699 (725.39 KB)
Trainable params: 185,699 (725.39 KB)
Non-trainable params: 0 (0.00 B)

Fig. 5. Baseline Architecture of Sequential Model

```
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 817ms/step - accuracy: 0.9807 - loss: 0.1529 - val_accuracy: 0.8500 - val_loss: 0.6469
Epoch 90/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 926ms/step - accuracy: 0.9186 - loss: 0.2224 - val_accuracy: 0.8000 - val_loss: 0.8148
Epoch 91/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 847ms/step - accuracy: 0.9394 - loss: 0.1455 - val_accuracy: 0.8500 - val_loss: 0.7267
Epoch 92/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 10s 810ms/step - accuracy: 0.9310 - loss: 0.1309 - val_accuracy: 0.8000 - val_loss: 1.0338
Epoch 93/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 923ms/step - accuracy: 0.9237 - loss: 0.1230 - val_accuracy: 0.8500 - val_loss: 1.0151
Epoch 94/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 10s 920ms/step - accuracy: 0.9604 - loss: 0.1489 - val_accuracy: 0.8500 - val_loss: 0.6540
Epoch 95/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 819ms/step - accuracy: 0.9014 - loss: 0.2049 - val_accuracy: 0.9500 - val_loss: 0.5796
Epoch 96/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 923ms/step - accuracy: 0.9313 - loss: 0.1497 - val_accuracy: 0.9500 - val_loss: 0.7248
Epoch 97/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 811ms/step - accuracy: 0.9425 - loss: 0.1883 - val_accuracy: 0.9000 - val_loss: 0.7938
Epoch 98/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 887ms/step - accuracy: 0.9486 - loss: 0.1166 - val_accuracy: 0.8500 - val_loss: 0.9893
Epoch 99/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 7s 879ms/step - accuracy: 0.9583 - loss: 0.1278 - val_accuracy: 0.9500 - val_loss: 0.6153
Epoch 100/100
8/8 ━━━━━━━━━━━━━━━━━━━━ 10s 822ms/step - accuracy: 0.9547 - loss: 0.0954 - val_accuracy: 0.8500 - val_loss: 1.2229
```

Fig. 6. Test accuracy of Bacterial leaf blight ,Brown spot and Leaf smut.

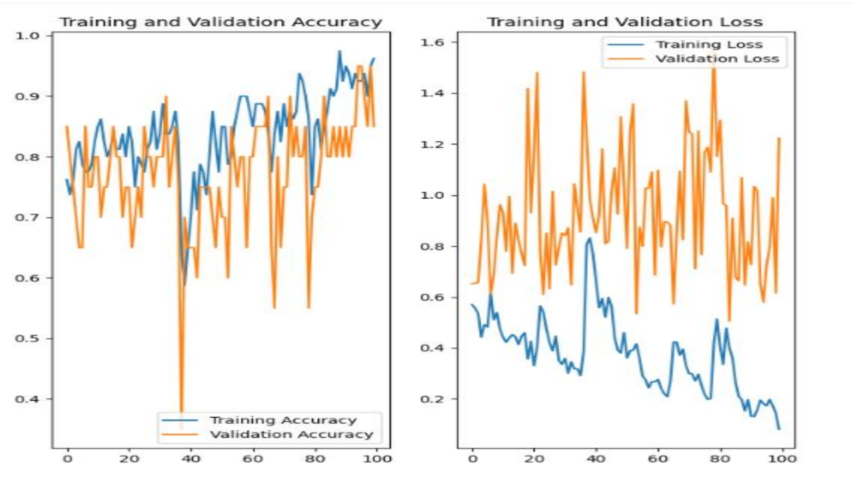

Fig. 7. CNN Model accuracy for Rice Leaf Disease Detection

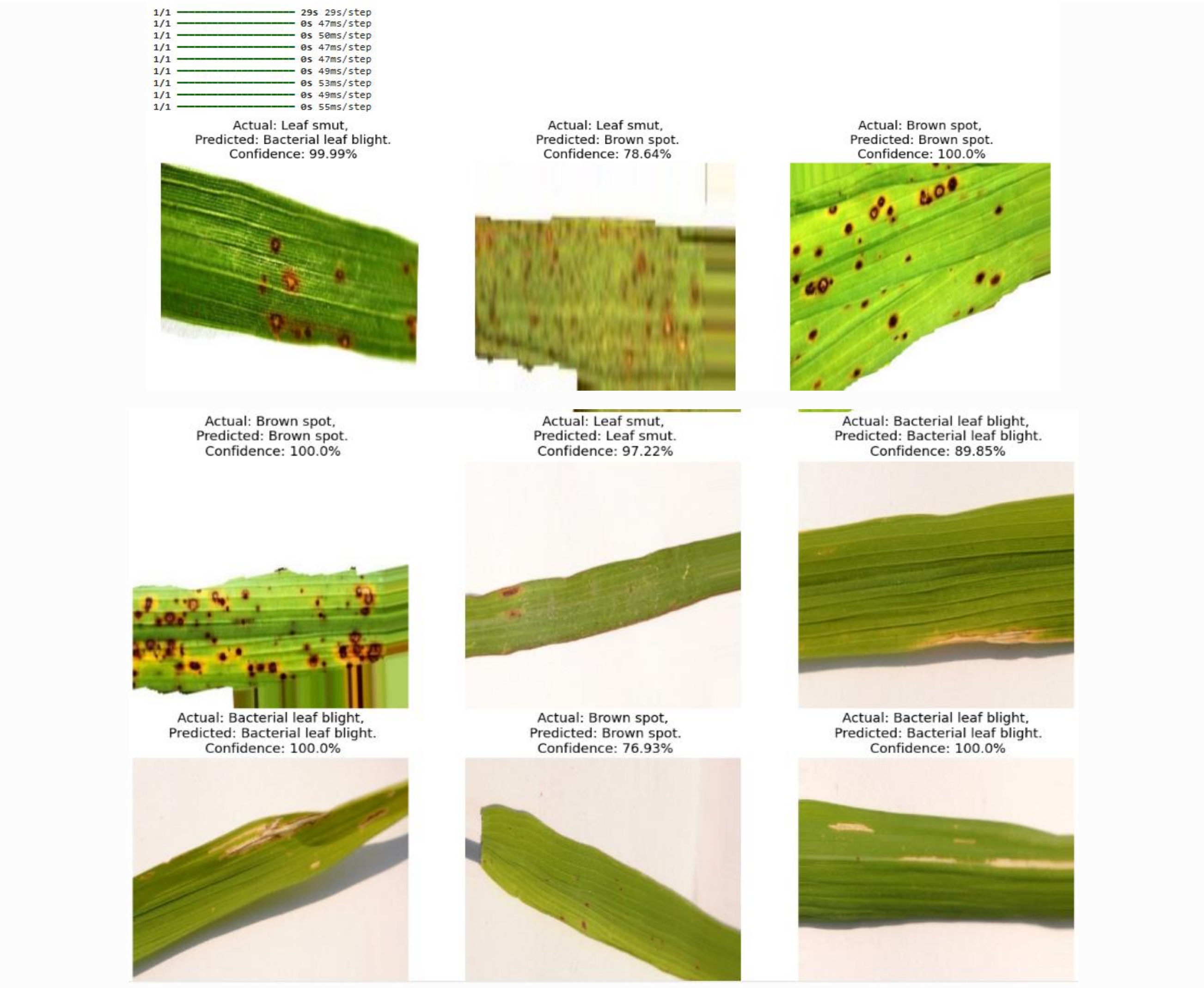

Fig. 8. CNN Model confidence for Rice Leaf Disease Detection

ROLE OF PROCESS OPTIMIZATION AND SUPPLY CHAIN MANAGEMENT IN AGRICULTURE

Agricultural process optimization is crucial to maximize crop yield, minimize resource waste (like land, water , energy, fertilizers , pesticides and labour), enhance sustainability, and improve overall economic efficiency by making informed decisions based on data analysis, allowing farmers to make informed decisions and precisely tailor their practices to specific field conditions and crop needs, ultimately producing more food with less environmental impact. . Optimization models help farmers to maximize crop yields and minimize waste by allocating resources effectively. Process optimization identifies and implements the most efficient and effective farming operations, including planting, irrigation, harvesting, and post-harvest handling, by utilizing techniques to maximize productivity, minimize resource usage, and enhance sustainability across the entire agricultural process.

Agriculture industry requires a robust supply chain for ensuring efficient movement of agricultural products from farm to consumer, minimizing waste, optimizing quality control, ,improving market access for farmers and consumers , to maximize profitability and to ensure timely delivery to meet market demands. it plays a key role in food security by connecting producers with consumers effectively.

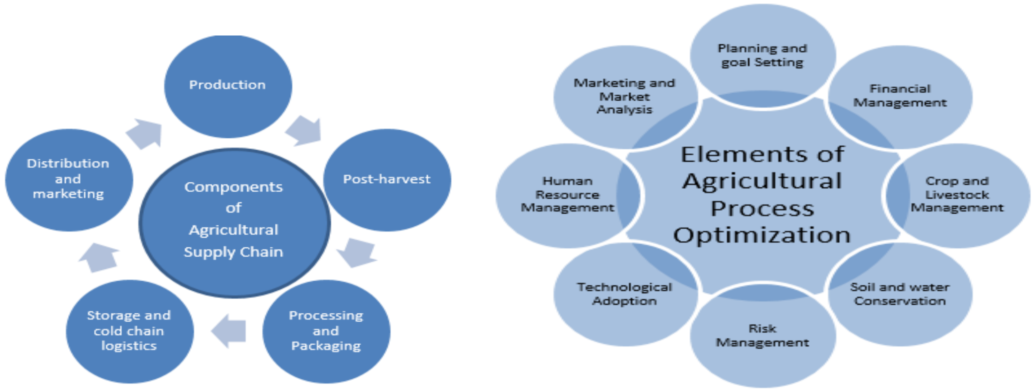

Fig. 9. Components of Agricultural Supply Chain & Elements of Agricultural Process optimization

The work-flow in Agricultural Supply chain includes Production, Post-harvest handling, Processing and packaging, Storage and logistics, Distribution and Marketing. Production involves farming activities like planting , harvesting and animal husbandry. Post-harvesting includes Sorting, Cleaning and grading of produce. Processing and packaging involves transforming raw agricultural products into consumer-ready forms. Storage involves maintaining proper temperature control during storage and transportation. Distribution and marketing is the last task in the workflow were the agricultural produce reaches the consumers through wholesalers, retailers and market channels.

Agricultural Practices involve Soil preparation, sowing, manuring , irrigation management, weeding , Harvesting , storage and Marketing and distribution of agricultural production.

IMPORTANCE OF PROCESS OPTIMIZATION IN AGRICULTURE

Applying precise amounts of water, fertilizer, and pesticides based on data analysis, optimizing resource usage and minimizing environmental impact.

Table 2. Illustrates Key Aspects of Process Optimization In Agriculture

Key Aspects Of Process Optimization In Agricultural	
Data-driven decision making	Sensors, IoT, drones and AI technologies collect real-time data on soil qualit, weather patterns, and crop health, allowing for precise adjustments to irrigation, fertilization, and other inputs based on specific field needs. Helps in informed decision making
Precision agriculture	Applying precise amount of water, fertilizer, pesticides based on data analysis , minimizing waste and maximizing crop yields enabling sustainable agriculture practice.
Optimized machinery design	Designing and adapting farm machinery to suit specific crop types and field conditions, improving efficiency and reducing operational costs.
Crop rotation and scheduling	Planning crop sequences to optimize soil health, nutrient utilization, and pest management
Irrigation system optimization	Advanced irrigation technologies like drip irrigation systems to deliver water precisely to plant roots, minimizing water usage.
Harvesting optimization	Efficient harvesting techniques and equipment to minimize crop losses and maximize yield during harvest.

Application of process optimization in agriculture include yield prediction models, automated systems, increased crop yield, reduced environmental impact and cost reduction.

INTEGRATION OF PROCESS OPTIMIZATION AND SUPPLY CHAIN MANAGEMENT IN AGRICULTURE

Integrating process optimization with supply chain management in agriculture involves using data-driven approaches to streamline operations across the entire agricultural value chain, from farm to consumer, aiming to maximize efficiency, reduce waste, enhance quality, and improve profitability by optimizing processes at each stage starting from planting to distribution, while facilitating collaboration between all stakeholders involved.

Integrating process optimization with supply chain management enables

Data collection and analysis: Enables informed decision-making throughout the process.

Precision agriculture: Optimizes resource usage and minimizing environmental impact

Inventory management: Prevents overstocking and minimizes spoilage.

Logistics optimization: Optimize transportation routes using route planning, reduce fuel consumption and delivery times

Demand forecasting: Predicting market demand to ensure production aligns with consumer needs, minimizes waste and maximizes sales.

Collaboration across the supply chain: Fosters open communication and information sharing between farmers, processors, distributors and retailers to coordinate activities and address potential issues proactively.

Integration of Process optimization and supply chain management increase productivity optimizing processes at each stage leading to higher crop yields and improved production efficiency. Reduces cost minimizing waste , improving resource utilization and streamlining logistics operations cutting operational costs. Improved quality control throughout the supply chain ensures consistent high-quality products for consumers. Improved market responsiveness by adapting production to changing market demands based on real-time data analysis. Data-driven practices reduce environmental impact through responsible resource use.

TECHNOLOGIES THAT PLAY MAJOR ROLE IN SUPPLY CHAIN MANAGEMENT

Technological innovations have become central to advancing sustainability in food and supply chain Management. Blockchain, artificial intelligence (AI), the Internet of Things (IoT), big data analytics, automation and robotics, and renewable energy technologies play a major role in enabling sustainability in food production, processing and supply chain management.

Artificial Intelligence and ML : AI algorithms analyze historic data and predict future demand that can help in avoiding over production and thus reduces waste. Forecast on demand fluctuations based on seasonal trends, promotions, and market conditions, allows industries to adjust their production schedules

The Internet of Things (IoT) : IoT devices helps in real-time monitoring and data collection such as temperature, humidity, and location, providing real-time insights for both process optimization and supply chain management, enhancing supply chain visibility and efficiency by enabling more precise monitoring of goods and reducing the risk of spoilage or loss. IoT sensors can monitor perishable goods throughout their journey and reduces waste

Big data analytics: Big data provides insights such as customer preferences, supplier performance, and operational bottlenecks. Predictive analytics uses historical data to forecast future trends and outcomes, enabling proactive adjustments to supply chain strategies . This helps to anticipate demand changes, effectively manage inventory and optimize logistics operations.

Automation and robotics :. Manufacturing robots can handle repetitive tasks with precision and speed, reducing labour cost and minimizing errors . By optimizing workflows and minimizing waste, automation reduces operational costs and energy consumption and thereby contributes to sustainability goals

BlockChain Technology : Traceability and transparency in supply chains is enhanced through blockchain technology to prevent fraud and to ensure that products are sourced ethically and to verify product or service standards and to gain consumer trust and to ensure compliance with sustainability standards.

AI FORECASTING MODELS IN PROCESS OPTIMIZATION AND SUPPLY CHAIN MANAGEMENT TO TACKLE FOOD SECURITY

ClimateForecasting Models: Seasonal variations such as heavy rain , flood, cyclone, drought due to climatic change , serve as a threat to agricultural production. Forecasting models can help in predicting weather patterns and environmental changes, and thus help farmers in making informed decisions .

• **CropYieldForecasting Models and Crop Disease Detection Model**: These models can predict yields, using data collected from farm such as soil moisture, nutrient levels, water conditions, energy use , precipitation and temperature to predict yields and take immediate actions to prevent shortages and spoilage and ensuring food security . Disease Detection Models can identify the disease at the early stage and prevent yield lose ..

• SupplyChainForecasting Models: AI-driven supply chain forecasting models can predict customer demand, identify transport and distribution logistics for food transportation from producers to consumers and provide an efficient food distribution systems.

Efficient food processing by AI applications to address food insecurity is made possible through prior Insights on plant development, resource needs, environment factors and by predicting spoilage rates , optimizing storage conditions, reducing post-harvest losses and by improving the timely distribution of food products.

AI application in agriculture include crop disease detection, automated weed control systems, predictive analysis for crop yield , drone-assisted aerial surveillance , supply chain and demand forecasting.

ROLE OF AI IN AGRICULTURAL PROCESS OPTIMIZATION AND SUPPLY CHAIN MANAGEMENT

Artificial intelligence can help supply chain managers make better decisions, reduce costs, and improve efficiency and help businesses become more resilient and sustainable. AI enables

Route optimization by analysing traffic patterns, weather, and other factors to find the most efficient routes for delivery.It enables Risk management by analyzing factors like weather and geopolitical events to help businesses anticipate and prepare for disruptions. Other benefits include Demand forecasting , Supplier management , Inventory management, Equipment maintenance and Warehouse capacity management. It increases efficiency , accuracy, worker safety , equipment reliability , reduces cost, enhances transparency and helps in informed decision making.

USE CASE OF AGRICULTURAL PROCESS OPTIMIZATION

Utilizing data analytics and technology to determine the ideal combination of factors like planting dates, crop varieties, fertilization levels, irrigation schedules, and pest management strategies to maximize crop yield while minimizing resource usage (water, fertilizer, pesticides), ultimately leading to increased profitability and environmental sustainability. Other process optimization include

1.6 Precision agriculture:

Using sensors and drones to collect real-time data on soil conditions, plant health, and weather patterns to precisely apply water ,nutrients , fertilizers and pesticides only where needed, reducing waste and maximizing crop yield.

1.7 Irrigation scheduling:

Using weather forecasts and soil moisture sensors to optimize irrigation timing and amount, preventing overwatering and conserving water and enable sustainability.

1.8 Pest and disease Deduction:

. Implementing early disease detection systems using image analysis and sensors to identify pest infestations or disease helps to take preventive action and minimizing crop losses. Remote sensing using Satellite imagery and drone technology helps to monitor large areas and identify variations in crop health.

1.9 Increased crop yield:

Farmers can get an increased crop yield by optimizing inputs and managing resources effectively.

1.10 Artificial Intelligence (AI):

Machine learning algorithms are used to analyze large datasets and make predictions about crop health, soil health, pest risks, and optimal management strategies.

FINDINGS AND USE CASES OF PROCESS OPTIMIZATION AND SUPPLY CHAIN MANAGEMENT

Optimizing the flow of goods from raw materials to finished products, ensuring timely delivery to customers , minimizing costs

by managing all stages of production, including sourcing, manufacturing, warehousing, transportation, and distribution, ultimately aiming to improve efficiency, quality control, and customer satisfaction throughout the entire supply chain process.

Amul : Amul's supply chain model is a cooperative framework that emphases on efficiency and farmer welfare. Amul is one of the first FMCG (Fast Moving Consumer Goods) firms in India to employ internet technologies to implement B2C commerce. Amul has implemented a Geographical Information System (GIS) at both ends of the supply chain (milk procurement and marketing).

Blinkit: An on-demand grocery delivery service in India. Blinkit redesigned every part of its supply chain from warehousing and inventory to logistics and fulfillment to make 10-minute delivery strategy a reality and has become the new benchmark for retail excellence .

.**Swiggy:** Indian food and grocery delivery giant use machine learning algorithms and data analytics to track and analyze various aspects of the supply chain including inventory levels , order volumes and delivery times to provide a better experience for customers.

In Khammam district, Telangana, a pilot project combined AI-powered soil testing, crop quality assessments, and a digital marketplace, boosted chilli farmers' yields by 21% and increased selling prices by 8%.

Fig. 10. Statistics on Global Agriculture Supply Chain Management Market

The global Agricultural Process Optimization and Supply Chain Management market is projected to experience significant growth, with a CAGR (Compound Annual Growth Rate) around 10-12%.

CONCLUSION

This study performs the classification and detection of various rice leaf diseases using CNN Deep Learning methods for three rice leaf diseases , the Bacterial leaf blight ,Brown spot and Leaf smut. The convolutional network accuracy to identify the diseases was nearly 95%. The better the accuracy of infections detection , it can better aid farmers to protect their crops. This model being part of agricultural process optimization can contribute to the efficiency of supply chain management. The technological growth like IoT, BlockChain and AI Data Analytics improve efficiency and traceability across the agricultural supply chain. The factors contributing to the growth of global Agricultural process optimization and supply chain management market are improved farm management , enhanced traceability , logistic optimization and market demand forecasting. End-to-end visibility, tracking and managing inventory, data sharing , demand planning and forecasting twining processing optimization and supply chain management eventually leads to higher profitability and competitive edge.

REFERENCES

[1] R. Sivaraman, S. Praveena, and H. N. Kumar, "Sustainable Agriculture through Advanced Crop Management: VGG16-Based Tea Leaf Disease Recognition," willey.online Library, pp. 121–133, Jan. 2025, doi: 10.1002/9781394280735.ch7.

[2] M, K. (2025, February 20). Optimizing the Agri-Food supply Chain - KhetiBuddy Canada. KhetiBuddy Canada. https://khetibuddy.com/ca/blogs/optimizing-the-agri-food-supply-chain/

[3] P. Seelwal, P. Dhiman, Y. Gulzar, A. Kaur, S. Wadhwa, and C. W. Onn, "A systematic review of deep learning applications for rice disease diagnosis: current trends and future directions," Frontiers in Computer Science, vol. 6, Sep. 2024, doi: 10.3389/fcomp.2024.1452961.

[4] Y. Wang et al., "A hybrid approach for rice crop disease detection in agricultural IoT system," Discover Sustainability, vol. 5, no. 1, May 2024, doi: 10.1007/s43621-024-00285-4.

[5] K. Mahadevan, A. Punitha, and J. Suresh, "Automatic recognition of Rice Plant leaf diseases detection using deep neural network with improved threshold neural network," e-Prime - Advances in Electrical Engineering Electronics and Energy, vol. 8, p. 100534, Mar. 2024, doi: 10.1016/j.prime.2024.100534.

[6] N. P. Kulkarni and N. Dr. S. Shastri, "Rice leaf diseases detection using machine learning," Journal of Scientific Research and Technology, pp. 17–22, Jan. 2024, doi: 10.61808/jsrt81.

[7] W. Wang, Y. Chen, T. Zhang, M. Deveci, and S. Kadry, "The use of AI to uncover the supply chain dynamics of the primary sector: Building resilience in the food supply chain," Structural Change and Economic Dynamics, vol. 70, pp. 544–566, May 2024, doi: 10.1016/j.strueco.2024.05.010.

[8] Atadoga, N. A., Osasona, N. F., Amoo, N. O. O., Farayola, N. O. A., Ayinla, N. B. S., & Abrahams, N. T. O. (2024). The Role Of It In Enhancing Supply Chain Resilience: A Global Review. International Journal of Management & Entrepreneurship Research, 6(2), 336–351. https://doi.org/10.51594/ijmer.v6i2.774

[9] Jaouhari, A. E., Arif, J., Samadhiya, A., Naz, F., & Kumar, A. (2024). Exploring the application of ICTs in decarbonizing the agriculture supply chain: A literature review and research agenda. Heliyon, 10(8), e29564. https://doi.org/10.1016/j.heliyon.2024.e29564

[10] Ahmed, I., Alkahtani, M., Khalid, Q. S., & Alqahtani, F. M. (2024). Improved commodity supply chain performance through AI and computer vision techniques. IEEE Access, 12, 24116–24132. https://doi.org/10.1109/access.2024.3361756

[11] Dhal, S. B., & Kar, D. (2024). Transforming Agricultural Productivity with AI-Driven Forecasting: Innovations in Food Security and Supply Chain Optimization. Forecasting, 6(4), 925–951. https://doi.org/10.3390/forecast6040046

[12] Farooq, M., & Yen, Y. Y. (2024). Artificial Intelligence in Supply Chain Management: A Comprehensive Review and Framework for Resilience and Sustainability. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-3878218/v1

[13] Hao, X., & Demir, E. (2024). Artificial intelligence in supply chain management: enablers and constraints in pre-development, deployment, and post-development stages. Production Planning & Control, 1–23. https://doi.org/10.1080/09537287.2024.2302482

[14] Adesiyan, J. S., & Raffington, A. E. (2024). AgriTech Revolution: Next-Generation Supply Chain in America's Agriculture. International Journal of Environment and Climate Change, 14(2), 254–272. https://doi.org/10.9734/ijecc/2024/v14i23943

[15] Abbey Ngochindo Igwe, Nsisong Louis Eyo-Udo, Titilope Tosin Adewale(September 2024),Technological Innovations and Their Role in Enhancing Sustainability in Food and FMCG Supply Chains, Research Gate

[16] D. K. Pandey and R. Mishra, "Towards sustainable agriculture: Harnessing AI for global food security," Artificial Intelligence in Agriculture, vol. 12, pp. 72–84, Apr. 2024, doi: 10.1016/j.aiia.2024.04.003.

[17] M. Sharifmousavi, V. Kayvanfar, and R. Baldacci, "Distributed Artificial Intelligence application in Agri-food Supply chains 4.0," Procedia Computer Science, vol. 232, pp. 211–220, Jan. 2024, doi: 10.1016/j.procs.2024.01.021.

[18] W. Wang, Y. Chen, T. Zhang, M. Deveci, and S. Kadry, "The use of AI to uncover the supply chain dynamics of the primary sector: Building resilience in the food supply chain," Structural Change and Economic Dynamics, vol. 70, pp. 544–566, May 2024, doi: 10.1016/j.strueco.2024.05.010.

[19] N. Zelisko, N. Raiter, N. Markovych, H. Matskiv, and O. Vasylyna, "Improving business processes in the agricultural sector considering economic security, digitalization, risks, and artificial intelligence," Ekonomika APK, vol. 31, no. 3, pp. 10–21, Jul. 2024, doi: 10.32317/2221-1055.2024030.10.

[20] Elufioye, N. O. A., Ike, N. C. U., Odeyemi, N. O., Usman, N. F. O., & Mhlongo, N. N. Z. (2024). Ai-Driven Predictive Analytics In Agricultural Supply Chains: A Review: Assessing The Benefits And Challenges Of Ai In Forecasting Demand And Optimizing Supply In Agriculture. Computer Science & IT Research Journal, 5(2), 473–497. https://doi.org/10.51594/csitrj.v5i2.817

[21] Jennierogers. (2024, July 24). Innovation in Agriculture: 6 Agricultural innovations that will have an impact on the management of farming. Miller Chemical. https://www.millerchemical.com/blog/innovation-in-agriculture-6-innovations-that-will-have-an-impact-on-farm-management/#:~:text=The%20technology%20that%20has%20had,conditions%2C%20and%20have%20higher%20yields.

[22] Admin. (2024, December 1). Sairone | Innovating Agriculture with AI/ML-Driven Drones. Sairone. https://saiwa.ai/sairone/blog/ai-in-agricultural-supply-chain/

[23] Komal Saxena, Dilip Jakhete, Pilli Lalitha Kumari , Mini Jain"Optimizing Agricultural Supply Chains with Machine Learning Algorithms" November 2023 DOI:10.53555/jaz.v44iS2.1546

[24] Evans, C. (2023, December 21). 37 Supply Chain Statistics, Trends, and Predictions for 2024 | Fictiv. Fictiv. https://www.fictiv.com/articles/supply-chain-statistics-you-need-to-know

[25] Udayananda, G.K.V.L., Shyalika, C. & Kumara, P.P.N.V. Rice plant disease diagnosing using machine learning techniques: a comprehensive review. SN Appl. Sci. 4, 311 (2022). https://doi.org/10.1007/s42452-022-05194-7

[26] J. Trivedi, Y. Shamnani, and R. Gajjar, "Plant leaf disease detection using machine learning," in Communications in computer and information science, 2020, pp. 267–276. doi: 10.1007/978-981-15-7219-7_23.

[27] Y. Lu, S. Yi, N. Zeng, Y. Liu, and Y. Zhang, "Identification of rice diseases using deep convolutional neural networks," Neurocomputing, vol. 267, pp. 378–384, Jun. 2017, doi: 10.1016/j.neucom.2017.06.023.

[28] Manos, B., Chatzinikolaou, P., & Kiomourtzi, F. (2013). Sustainable optimization of agricultural production. APCBEE Procedia, 5, 410–415. https://doi.org/10.1016/j.apcbee.2013.05.071

[29] Components of efficient agricultural supply chain management. (n.d.). Fairlead Inspection & Testing PVT LTD. https://www.fairlead-tic.com/blog/components-of-efficient-agricultural-supply-chain-management

[30] Stefanie Keller (seecon international gmbh) & Dorothee Spuhler (seecon international gmbh). (n.d.). Optimisation in agriculture. SSWM - Find Tools for Sustainable Sanitation and Water Management! https://sswm.info/factsheet/optimisation-in-agriculture-

[31] .https://www.researchgate.net/publication/378846351_Optimizing_Agricultural_Supply_Chains_with_Machine_Learning_Algorithms [accessed Mar 03 2025].