



Farming as future career choice: Study of Arecanut farmers at Malnad region of Karnataka using Artificial Intelligence

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ABSTRACT

This research paper examines the viability of arecanut (*Areca catechu* L.) farming as a sustainable career choice for the youth in the Malnad region of Karnataka, India, with particular emphasis on the transformative role of Artificial Intelligence (AI) technologies. The Malnad region, encompassing districts such as Shivamogga, Chikmagalur, Uttara Kannada, Hassan, and Kodagu, represents the traditional heartland of arecanut cultivation in India, contributing approximately 63% of the nation's total production. Despite the sector's economic significance, there has been a notable decline in youth participation in agriculture, with educated young individuals migrating to urban centers in search of alternative employment opportunities.

This study investigates how the integration of AI-powered solutions, including machine learning-based disease detection systems, precision agriculture technologies, IoT-enabled smart farming systems, and predictive analytics, can revitalize arecanut farming and make it an attractive career option for the younger generation. Through an analysis of current market trends, technological interventions, and socio-economic factors, this paper proposes a framework for sustainable arecanut cultivation that leverages cutting-edge AI technologies to address traditional farming challenges such as labor shortages, disease management, yield optimization, and market price volatility.

Keywords: Arecanut farming, Artificial Intelligence, Malnad region, Karnataka, Career opportunities, Precision agriculture, Machine learning, Disease detection, Youth employment, Smart farming

1. INTRODUCTION

1.1 Background of the Study

Agriculture remains the backbone of India's economy, employing approximately 42% of the country's population and contributing 18% to its GDP. Among the diverse agricultural activities, arecanut (betel nut) cultivation holds a special place in the coastal and Malnad regions of Karnataka, representing both a cultural heritage and a significant economic activity. India is the world's largest producer of arecanut, with Karnataka state alone contributing nearly 63% of the national production. The crop is predominantly grown in the Malnad region, covering the western and eastern slopes of the Western Ghats in districts including Uttara Kannada, Chikmagalur, Shivamogga, Hassan, Kodagu, and Belgaum.

However, the agricultural sector, including arecanut farming, faces a critical challenge: the declining interest of rural youth in pursuing farming as a career. Studies indicate that by 2050, the percentage of agricultural workers in India's total workforce is projected to drop from 58.2% (in 2001) to 25.7%. Young people from farming families increasingly perceive agriculture as a low-prestige, low-income profession fraught with uncertainties related to weather, market prices, and labor availability. This perception has led to significant rural-to-urban migration, with approximately 30% of India's 315 million migrants being youth.

1.2 The AI Revolution in Agriculture

Artificial Intelligence (AI) has emerged as a transformative force in agriculture globally. The AI in agriculture market is projected to grow from USD 1.7 billion in 2023 to USD 4.7 billion by 2028, representing a Compound Annual Growth Rate (CAGR) of 23.1%. In India, the government has been proactive in integrating AI into agriculture, with the 2024 IndiaAI Mission earmarking ₹10,300 crore (approximately \$1.25 billion) to build a robust AI ecosystem across sectors, with agriculture identified as a priority area under NITI Aayog's National Strategy for Artificial Intelligence.

AI technologies are revolutionizing traditional farming practices through precision agriculture, which utilizes GPS, IoT sensors, drones, and big data analytics to enable data-driven decision-

making. These technologies allow farmers to optimize irrigation, fertilization, and pest control with unprecedented accuracy. For instance, AI-powered crop disease detection systems using Convolutional Neural Networks (CNNs) have achieved accuracy rates exceeding 97% in identifying plant diseases from leaf images, enabling timely intervention and reducing crop losses significantly.

1.3 Research Objectives

1. To analyze the current state of arecanut farming in the Malnad region of Karnataka and its economic viability as a career choice.
2. To examine the challenges faced by arecanut farmers and the factors contributing to youth disinterest in agricultural careers.
3. To investigate the potential of AI-powered technologies in addressing traditional farming challenges and improving productivity.
4. To propose an AI-integrated framework for sustainable arecanut farming that can attract youth to agriculture as a viable career.
5. To evaluate the socio-economic impact of AI adoption in arecanut farming on farmer livelihoods and rural development.

2. LITERATURE REVIEW

2.1 Arecanut Cultivation in Karnataka

Arecanut (*Areca catechu* L.), commonly known as betel nut, is a high-value commercial crop primarily cultivated in the tropical regions of Asia. India leads global production, with Karnataka being the dominant producing state. According to government statistics, the area under arecanut cultivation in Karnataka increased significantly from 2.79 lakh hectares in 2017 to 5.49 lakh hectares in 2021, reflecting the crop's growing economic importance. The Malnad region, characterized by its heavy rainfall (1,500-5,000 mm annually) and favorable climatic conditions with temperatures ranging from 14°C to 36°C, provides an ideal environment for arecanut cultivation.

Research conducted at the Agricultural and Horticultural Research Station, Thirthahalli, evaluated different arecanut cultivars including Thirthahalli local, Sagar local, Tarikere local, SAS-1, Mangala, Sumangala, Sreemangala, and Mohit Nagar. Studies found that the cultivar SAS-1 exhibited superior growth performance, while Mohit Nagar recorded the highest fresh bunch yield of 20.25 kg per palm. The Thirthahalli variety has been identified as producing the highest quality arecanut in India, with the region's unique climate playing a pivotal role.

2.2 Market Dynamics and Economic Significance

The global Areca Nuts Market size is expected to reach USD 0.96 billion in 2025 and grow at a CAGR of 4.73% to reach USD 1.21 billion by 2030. The Central Arecanut and Cocoa Marketing and Processing Co-operative Limited (CAMPCO), established in 1973, has played a crucial role in stabilizing arecanut markets and ensuring farmers receive remunerative prices. CAMPCO operates through 118 procurement centers across Karnataka and Kerala, with 14 sales depots nationwide. Current market prices in Karnataka range from ₹40,000 to ₹90,000 per quintal depending on variety and quality, with Saraku variety commanding premium prices.

2.3 Challenges in Traditional Arecanut Farming

Despite its economic potential, arecanut farming faces several challenges that deter youth participation. Studies indicate that educated youth from farming families increasingly prefer urban employment over agriculture. Key challenges include:

- **Labor Shortage and High Costs:** Arecanut tree climbing for harvesting is a tenacious job requiring highly skilled labor. Manual climbing practices carry a high probability of accidents, and the shortage of skilled laborers has led to increased wages and delayed operations.
- **Disease Pressure:** Yellow Leaf Disease (YLD), Mahali (Koleroga), and stem bleeding disease pose significant threats to arecanut plantations. In severely affected areas, YLD incidence rates can reach up to 90%, causing substantial yield losses.

- **Climate Vulnerability:** Arecanut is sensitive to temperature extremes and irregular rainfall patterns. Climate change has introduced additional unpredictability in crop performance.
- **Market Price Volatility:** Prices fluctuate based on supply-demand dynamics, import policies, and quality variations, creating uncertainty for farmers.

2.4 AI Applications in Crop Disease Detection

Machine learning and deep learning techniques have shown remarkable success in crop disease detection. Research using Convolutional Neural Networks (CNN), specifically ResNet architecture, has achieved over 97% accuracy in detecting arecanut diseases by processing plant images and extracting disease-specific features. Deep learning models like VGG-16, VGG-19, and ResNet-50 have demonstrated accuracy rates of 92.39%, 96.15%, and 98.98% respectively on plant disease datasets.

A significant study on Yellow Leaf Disease of arecanut utilized UAV multisource sensors combining multispectral data with high-resolution imaging and machine learning algorithms including Decision Trees, Naive Bayes, SVM, k-NN classification, and Back Propagation Neural Networks (BPNN) to quantitatively monitor disease severity. This approach enables early detection and targeted intervention, potentially preventing widespread crop losses.

3. METHODOLOGY

3.1 Study Area

The study focuses on the Malnad region of Karnataka, specifically covering the districts of Shivamogga, Chikmagalur, Uttara Kannada, Hassan, and Kodagu. This region is located at approximately 13°41' North latitude and 75°13' East longitude, at an altitude of 600 meters above mean sea level. The area receives an average annual rainfall of 3,212 mm, well distributed over five months from June to October, with peak rainfall during July and August.

3.2 Research Framework

This research employs a mixed-methods approach combining quantitative data analysis with qualitative assessments. The framework integrates:

6. **Secondary Data Analysis:** Review of government statistics, market reports from CAMPCO and TUMCOS, agricultural research publications, and industry forecasts.
7. **Technology Assessment:** Evaluation of available AI-powered agricultural technologies including disease detection systems, precision farming tools, IoT sensors, and drone-based monitoring solutions.
8. **Economic Viability Analysis:** Comparative study of traditional vs. AI-integrated farming costs, yields, and returns on investment.
9. **Career Opportunity Assessment:** Analysis of emerging agri-tech roles and entrepreneurship opportunities in smart arecanut farming.

3.3 AI Technologies Under Evaluation

Table 1: AI Technologies Evaluated for Arecanut Farming

Technology Category	Specific Applications	Expected Benefits
Disease Detection	CNN-based image analysis, ResNet models, Mobile apps	97%+ accuracy, Early detection, Reduced crop losses
Precision Agriculture	IoT soil sensors, Weather stations, GPS mapping	25% yield increase, Optimized resource use
Smart Irrigation	AI-automated drip systems, Soil moisture analysis	50% water savings, Reduced labor
Drone Monitoring	UAV-based surveillance, Multispectral imaging	Real-time health assessment, Large area coverage
Predictive Analytics	Yield forecasting, Market price prediction	Informed decision-making, Risk mitigation

4. RESULTS AND DISCUSSION

4.1 Current State of Arecanut Farming in Malnad

Analysis of agricultural data reveals that arecanut cultivation in Karnataka has expanded significantly, with the area under cultivation nearly doubling from 2.79 lakh hectares in 2017 to 5.49 lakh hectares in 2021. Shivamogga district alone has 92,181 hectares under arecanut cultivation, representing a substantial portion of the state's production. The expansion has occurred not only in traditional Malnad regions but also in semi-arid areas like Davangere, Chitradurga, and Tumakuru, driven by relatively stable prices and the availability of irrigation facilities.

Table 2: Arecanut Production Statistics in Major Districts of Karnataka

District	Area Share (%)	Production Share (%)
Chikmagalur	19.91	17.38
Shivamogga	18.5	16.8
Davangere	15.2	14.5
Uttara Kannada	12.3	13.1
Other Districts	34.09	38.22

Source: National Horticulture Board, Government of India

4.2 AI-Powered Disease Detection Systems

The implementation of deep learning-based disease detection systems represents a transformative advancement for arecanut farming. Research demonstrates that Convolutional Neural Networks using ResNet architecture can process arecanut images, extract disease-specific features, and classify plant health conditions with over 97% accuracy, significantly surpassing traditional visual inspection methods.

A particularly promising development is the use of UAV remote sensing combined with machine learning for monitoring Yellow Leaf Disease, which affects up to 90% of arecanut in severely impacted areas. Studies utilizing multispectral sensors and vegetation indices such as NDVI (Normalized Difference Vegetation Index) and OSAVI (Optimized Soil Adjusted Vegetation Index), combined with machine learning algorithms like BPNN, have enabled quantitative assessment of disease severity, moving beyond qualitative evaluations to precise severity measurements.

The development of user-friendly mobile applications enables farmers to upload plant images and receive instant disease diagnoses along with treatment recommendations. This automated approach minimizes dependency on expert consultations, facilitates early intervention, and significantly reduces potential crop losses. Future enhancements including IoT-based real-time monitoring and expansion to detect multiple diseases simultaneously promise even greater benefits.

4.3 Precision Agriculture and Smart Farming Adoption

Karnataka has been proactive in promoting precision agriculture through initiatives like the Karnataka Agriculture Mechanization and Precision Farming Project (KAMP), which provides farmers access to IoT devices and data-driven advisory services. The implementation of smart farming technologies has demonstrated significant benefits:

- **Yield Improvements:** Farmers using IoT-based soil and weather sensors in Punjab have reported a 25% increase in yields. Similar results are anticipated for arecanut cultivation with proper technology adoption.
- **Water Conservation:** AI-integrated irrigation systems have demonstrated 50% reduction in water consumption through precise, soil-moisture-based irrigation scheduling.
- **Input Optimization:** Precision fertilization guided by AI analytics has resulted in 25% reduction in fertilizer costs and 9% reduction in pesticide use in comparable crop systems.
- **Quality Enhancement:** Improved cultivation practices through AI guidance have led to 8% increases in market prices due to quality improvements.

4.4 Economic Viability and Career Potential

The integration of AI technologies transforms the economic landscape of arecanut farming, creating new career opportunities beyond traditional cultivation. The emergence of agri-tech startups, with over 2,800 operating in India as of 2023 and attracting ₹6,600 crore in private equity funding over four years, demonstrates the sector's investment appeal.

Table 3: Emerging Career Opportunities in AI-Integrated Arecanut Farming

Career Category	Specific Roles	Required Skills
Smart Farming	Tech-enabled farmer, Precision agri manager	Digital literacy, IoT operation, Data interpretation
Agri-Tech Services	Drone operator, IoT technician, AI consultant	Technical training, Drone piloting, ML basics
Agri-Entrepreneurship	Agri-startup founder, Farm service provider	Business acumen, Technology integration, Marketing
Research & Development	Agricultural data scientist, ML engineer	Higher education, AI/ML expertise, Research skills
Value Chain Services	Supply chain analyst, E-commerce specialist	Logistics, Digital marketing, Market analysis

5. PROPOSED AI-INTEGRATED FRAMEWORK FOR SUSTAINABLE ARECANUT FARMING

Based on the analysis of current challenges, available technologies, and successful implementations in comparable agricultural systems, this study proposes a comprehensive AI-integrated framework for sustainable arecanut farming that can attract youth to agriculture as a viable career choice.

5.1 Framework Components

5.1.1 Digital Infrastructure Layer

The foundation of the framework rests on robust digital infrastructure including high-speed internet connectivity in rural areas through initiatives like BharatNet and PM-WANI public Wi-Fi hotspots, IoT sensor networks for real-time soil, weather, and crop monitoring, cloud-based data storage and processing capabilities, and mobile-first application interfaces accessible on smartphones.

5.1.2 AI-Powered Decision Support System

A comprehensive decision support system incorporating disease detection modules using CNN-based image analysis with ResNet architecture achieving 97%+ accuracy, yield prediction models utilizing historical data, weather patterns, and soil conditions, market price forecasting algorithms

for informed selling decisions, and personalized cultivation recommendations in local Kannada language through AI chatbots similar to the Kisan e-Mitra system.

5.1.3 Precision Agriculture Implementation

Practical precision agriculture components including automated irrigation systems with soil moisture-based scheduling, variable-rate fertilizer application guided by soil nutrient analysis, drone-based surveillance for large plantation monitoring using multispectral imaging, and GPS-enabled farm mapping and management systems.

5.1.4 Skill Development and Capacity Building

Essential human capital development through training programs at Krishi Vigyan Kendras (KVKs) on AI tools and digital agriculture, integration of precision farming modules in agricultural university curricula, hands-on workshops for drone operation, IoT installation, and mobile app usage, and entrepreneurship development programs for agri-tech startups.

5.2 Implementation Roadmap

Table 4: Phased Implementation Roadmap

Phase	Timeline	Key Activities	Expected Outcomes
Phase 1	Year 1	Infrastructure setup, Pilot projects, Baseline data collection	100 farms equipped, Digital platform launched
Phase 2	Year 2	Scale-up, Training programs, Disease detection deployment	1,000 farmers trained, 15% yield improvement
Phase 3	Year 3-5	Full integration, Advanced analytics, Market linkages	10,000+ farmers onboarded, 25% income increase

6. CHALLENGES AND RECOMMENDATIONS

6.1 Implementation Challenges

Despite the promising potential of AI integration in arecanut farming, several challenges must be addressed:

- **Digital Literacy Gap:** Many traditional farmers, particularly older generations, lack the digital skills necessary to operate AI-powered tools effectively. Small and marginal farmers, constituting 85% of India's farming community, may struggle with technology adoption.
- **Infrastructure Limitations:** Unreliable internet connectivity in rural Malnad areas restricts access to cloud-based AI platforms. Many remote plantations lack consistent electricity supply for IoT devices.
- **High Initial Investment:** AI solutions including drones, IoT sensors, and automated irrigation systems require significant capital investment that may be prohibitive for small-scale farmers.
- **Data Availability:** Development of effective AI models requires extensive, high-quality datasets specific to arecanut cultivation, which are currently limited.
- **Language and Localization:** Most AI tools are developed in English, creating barriers for Kannada-speaking farmers in the Malnad region.

6.2 Policy Recommendations

10. **Financial Support Mechanisms:** Expand subsidies for precision farming equipment under schemes like Digital Agriculture Mission. Provide subsidized loans through NABARD for agri-tech adoption. Implement crop insurance programs that incentivize technology use.
11. **Infrastructure Development:** Accelerate rural broadband deployment through BharatNet. Establish solar-powered charging stations for IoT devices in remote

plantations. Create shared service centers providing access to advanced agricultural equipment.

12. **Skill Development Initiatives:** Integrate AI and digital agriculture modules into agricultural education curricula at universities and KVKs. Launch targeted training programs for youth through schemes like Skill Training for Rural Youth (STRY). Develop vernacular-language training materials and interfaces.
13. **Research and Development:** Establish dedicated research centers for AI in plantation crops at existing agricultural universities in Karnataka. Fund collaborative research between agricultural scientists and AI researchers. Create open-source arecanut disease image databases for model development.
14. **Market Linkages:** Integrate AI-enabled quality assessment systems with CAMPCO and other cooperative marketing networks. Develop blockchain-based traceability systems for premium arecanut varieties. Create digital marketplaces connecting farmers directly with processors and exporters.

7. CONCLUSION

This research demonstrates that arecanut farming in the Malnad region of Karnataka, enhanced through the strategic integration of Artificial Intelligence technologies, presents a viable and attractive career opportunity for rural youth. The traditional challenges that have driven young people away from agriculture—labor intensity, disease risks, price volatility, and perceived low prestige—can be substantially mitigated through the adoption of AI-powered solutions.

The evidence suggests that deep learning-based disease detection systems achieving 97%+ accuracy, precision agriculture technologies improving yields by 20-25%, smart irrigation reducing water consumption by 50%, and predictive analytics enabling informed decision-making collectively transform arecanut cultivation from a traditional, labor-intensive practice into a modern, technology-enabled agribusiness. These transformations not only improve economic returns but also create new categories of employment opportunities in agri-tech services, entrepreneurship, research, and value chain management.

The proposed AI-integrated framework provides a roadmap for systematic technology adoption that addresses both immediate productivity challenges and long-term sustainability concerns. With Karnataka's area under arecanut cultivation having nearly doubled between 2017 and 2021, and the global areca nut market projected to grow to USD 1.21 billion by 2030, the economic opportunity is substantial.

However, realizing this potential requires concerted action from government agencies, educational institutions, technology providers, and farming communities. Investments in digital infrastructure, skill development programs, financial support mechanisms, and research initiatives are essential prerequisites. The success of programs like Saagu Baagu in Telangana, which achieved 21% yield increases and doubled farmer incomes through AI integration, provides an encouraging template for replication in arecanut-growing regions.

In conclusion, farming as a future career choice is not merely viable but potentially lucrative when enhanced with AI technologies. For the youth of Malnad, this represents an opportunity to preserve cultural heritage and family traditions while embracing innovation and building prosperous, sustainable livelihoods. The integration of artificial intelligence in arecanut agriculture is not about replacing farmers but empowering them with tools that transform their profession into a modern, respected, and rewarding career.

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REFERENCES

Ananda, K. S., Sane, A., & Choudhary, B. S. (2000). Growth and yield performances of arecanut varieties in Malnad Region of Karnataka. *Journal of Plantation Crops*, 28, 105-109.



Central Arecanut and Cocoa Marketing and Processing Co-operative Limited (CAMPCO).

(2024). Arecanut Market Operations Report. Mangalore: CAMPCO.

Dolatabadian, A. et al. (2025). Image-based crop disease detection using machine learning. Plant Pathology, Wiley Online Library.

Expert Market Research. (2025). Areca Nut Market Report and Forecast 2026-2035. Global Market Analysis.

Government of India. (2024). Promotion of Agriculture through Artificial Intelligence Technology. Press Information Bureau.

IndiaAI. (2025). AI in Agriculture: Transforming Indian Farms for a Sustainable Future. IndiaAI Government Portal.

Karnataka Horticulture Department. (2024). District-wise Horticulture Crop Statistics. Government of Karnataka.

MDPI Remote Sensing. (2021). Remote Sensing Detecting of Yellow Leaf Disease of Arecanut Based on UAV Multisource Sensors. Remote Sensing, 13(22), 4562.

Mordor Intelligence. (2025). Areca Nuts Market - Forecast & Industry Trends. Market Research Report.

National Horticulture Board. (2024). Area and Production of Arecanut in India. Government of India, New Delhi.

ResearchGate. (2021). Performance of different Arecanut (Areca catechu L.) cultivars under Malnad region of Karnataka. Agricultural Research Station, Thirthahalli.

ResearchGate. (2025). Arecanut Plant Disease Detection System Using Deep Learning. International Research Publication.

TIGR2ESS, University of Cambridge. (2024). Rural Youth Aspirations: Can Indian Agriculture Regain the Interest of Rural Youth? ICRISAT Field Survey Report.



World Economic Forum. (2024). Future Farming in India: A Playbook for Scaling Artificial Intelligence in Agriculture. WEF Report.

World Economic Forum. (2024). AI for Agriculture: How Indian Farmers are Harnessing Emerging Technologies. Centre for the Fourth Industrial Revolution India.