


# Chapter 1


# Quantum Computing for Sustainable Agriculture: Essentials and Prospects

**N. Suthanthira Vanitha**

 <https://orcid.org/0000-0002-9579-7651>

*Solamalai College of Engineering, India*

**K. Radhika**

 <https://orcid.org/0000-0003-4849-8680>

*Muthayammal Engineering College, India*

## **ABSTRACT**

*Globally due to growing population and climatic changes intensifies and ensures food security for sustainable agriculture. Traditional agriculture has several challenges like, resource allocation, precise monitoring and crop production. Quantum computing has opened up new avenue in the agricultural field. The potential use of quantum computing in transforming agriculture practices is to enhance sustainable crop management and yield, precision farming, optimizing resource and data security are set to revolutionize every aspect of farming. This innovation has bought a new perspective to integrate crop and livestock farming to high productivity, control pests and diseases and risks. The integration of quantum computing into agriculture is not only support for increasing yields and earnings rather it plays a key role in economic revolution and environmental friendly. This chapter explores the overview, optimization algorithms, applications and prospects of quantum computing for Sustainable Agriculture.*

DOI: 10.4018/979-8-3373-3957-3.ch001

Copyright © 2026, IGI Global Scientific Publishing. Copying or distributing in print or electronic forms without written permission of IGI Global Scientific Publishing is prohibited. Use of this chapter to train generative artificial intelligence (AI) technologies is expressly prohibited. The publisher reserves all rights to license its use for generative AI training and machine learning model development.

# 1. INTRODUCTION

In recent years, worldwide population is increasing significantly while preserving natural resources and extenuating environmental impact. In order to meet the growing food demands sustainable agriculture is essential. As conventional computational tools have certain restrictions in solving complex, large-scale agricultural disputes. The United Nations statistics depicts that the global population has increased from 2.5 billion in the to 8 billion. By 2050, predictions there a rise to above 9.7 billion people while in 2080 it is about 10.4 billion. In addition, Sadigov reports that the 20 percent climb in global population is due to the progress of human society, economy and healthcare, as well as a broad spectrum of factors, human lifespan, high urbanization, migration and fertility rates. Further WHO statistics says that in 2021, 2.3 billion people experienced food insecurity, with up to 828 million facing hunger. To address food insecurity and to meet the rising demand for food requires modern agriculture to increase its productivity levels (Pasupuleti, 2025).

The blending of quantum computing and agriculture has a potential to provide new solutions to longstanding problems in crop production optimization and resource management. With the rise in population farmers are in pressure to boost output while reducing resource practice. Quantum computing is a revolutionary technology rising as a transformative potential. By influencing the principles in quantum mechanics, quantum computers process infinite datasets and resolve elaborate optimization problems much faster than traditional computers. In the case of agricultural field, this is applied for climate modeling, crop yield, crop prediction, soil quality, water management, pest control and supply chain optimization. With the integration of quantum algorithms with precision agriculture, Internet of Things (IoT) enabled farming structure facilitates real-time decision-making and resource efficiency. While still in its budding stage (Maraveas et al., 2024).

The connection of quantum computing and sustainable agriculture grasp enormous promising for lashing innovation, civilizing resilience, and sustaining the development of data-driven, eco-friendly farming practice. The insertion of smart computing designs in the farming strategy extensively facilitates the curbing of challenges that contribute to poor agricultural outcomes and food shortages due to less yields. By including quantum computing in farming initiatives leverage quantum fact as entanglement and superposition that provides computing efficiency, speed and accuracy (Abbas et al., 2021).

24 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/quantum-computing-for-sustainable-agriculture/394448](http://www.igi-global.com/chapter/quantum-computing-for-sustainable-agriculture/394448)

## Related Content

---

### AI and Quantum Networks for Enhanced Organizational Performance

Meera K. L., Prithu Sarkar, K. Aravinda, G. Ajitha, Navdeep Singhand Joshuva Arockia Dhanraj (2025). *AI and Quantum Network Applications in Business and Medicine* (pp. 431-458).

[www.irma-international.org/chapter/ai-and-quantum-networks-for-enhanced-organizational-performance/366440](http://www.irma-international.org/chapter/ai-and-quantum-networks-for-enhanced-organizational-performance/366440)

### Tunable Attenuator Based on Hybrid Metal-Graphene Structure on Spoof Surface Plasmon Polaritons Waveguide

Aymen Hlaliand Hassen Zairi (2022). *Technology Road Mapping for Quantum Computing and Engineering* (pp. 154-164).

[www.irma-international.org/chapter/tunable-attenuator-based-on-hybrid-metal-graphene-structure-on-spoof-surface-plasmon-polaritons-waveguide/300522](http://www.irma-international.org/chapter/tunable-attenuator-based-on-hybrid-metal-graphene-structure-on-spoof-surface-plasmon-polaritons-waveguide/300522)

### Quantum Blockchain: A Systematic Review

Peter Nimbe, Benjamin Asubam Weyori, Jacob Mensah, Anokye Acheampong Amponsah, Adebayo Felix Adekoyaand Emmanuel Adjei Domfeh (2022). *Advancements in Quantum Blockchain With Real-Time Applications* (pp. 1-35).

[www.irma-international.org/chapter/quantum-blockchain/311205](http://www.irma-international.org/chapter/quantum-blockchain/311205)

### Quantum Approaches to Sustainable Resource Management in Supply Chains

Savitha Thiyagarajan, Solomon Thangadurai J., Mohana Priya T.and Rajesh Kanna Rajendran (2024). *Quantum Computing and Supply Chain Management: A New Era of Optimization* (pp. 187-195).

[www.irma-international.org/chapter/quantum-approaches-to-sustainable-resource-management-in-supply-chains/351822](http://www.irma-international.org/chapter/quantum-approaches-to-sustainable-resource-management-in-supply-chains/351822)

## Quantum Computing for Financial Modelling: Transforming Predictive Analytics and Trading

R. N. Ravikumar, S. Aarthi, Jamshid Pardaevand Parag Shukla (2026). *Quantum-Driven Financial Intelligence: Innovations in Predictive Analytics and Autonomous Trading Systems* (pp. 221-252).

[www.irma-international.org/chapter/quantum-computing-for-financial-modelling/393995](http://www.irma-international.org/chapter/quantum-computing-for-financial-modelling/393995)