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THE Awards Asia 2026

Research Project of the Year: STEM

AI-Driven Precision Farming System for Sustainable and Efficient Agriculture

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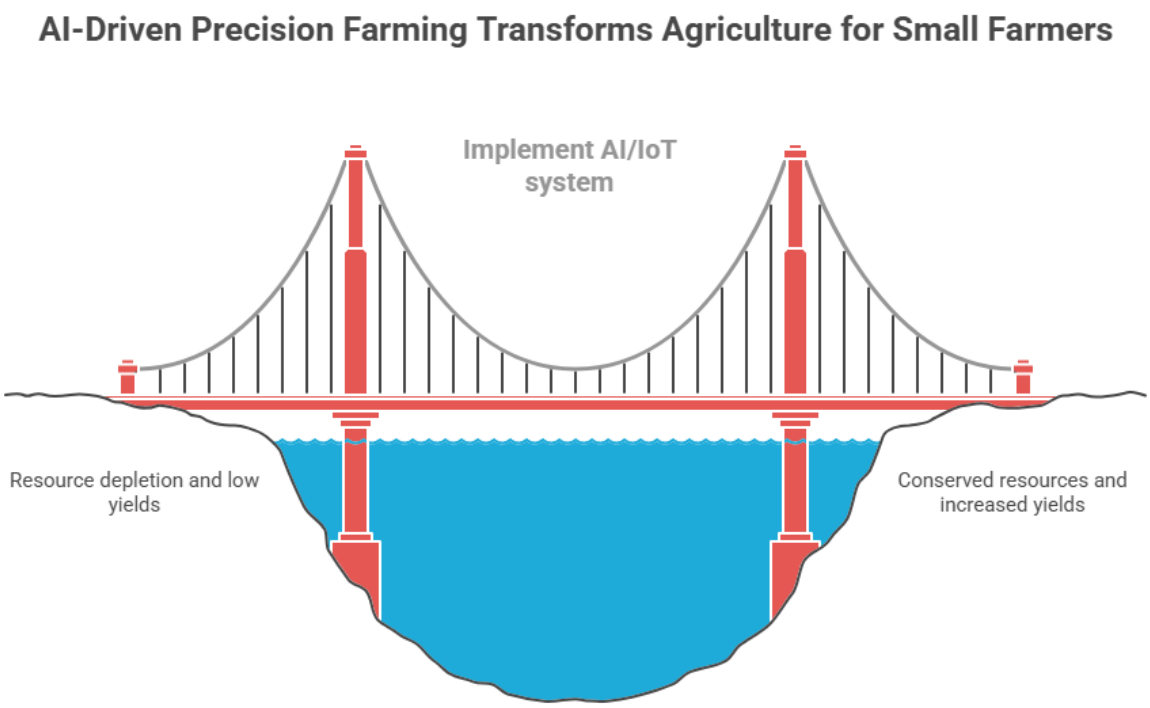
Research Project of the Year: STEM – AI-Driven Precision Farming System for Sustainable and Efficient Agriculture

Background and Necessity

Agriculture today faces pressing challenges including escalating water scarcity, unpredictable climate patterns, increasing pest outbreaks, and excessive use of fertilizers and pesticides resulting in environmental degradation and declining crop yields. In developing regions, smallholder farmers lack access to advanced technologies and real-time data, limiting their ability to optimize resource use effectively. Precision farming, leveraging artificial intelligence (AI) and Internet of Things (IoT) technologies, provides a transformative opportunity to enhance productivity sustainably.

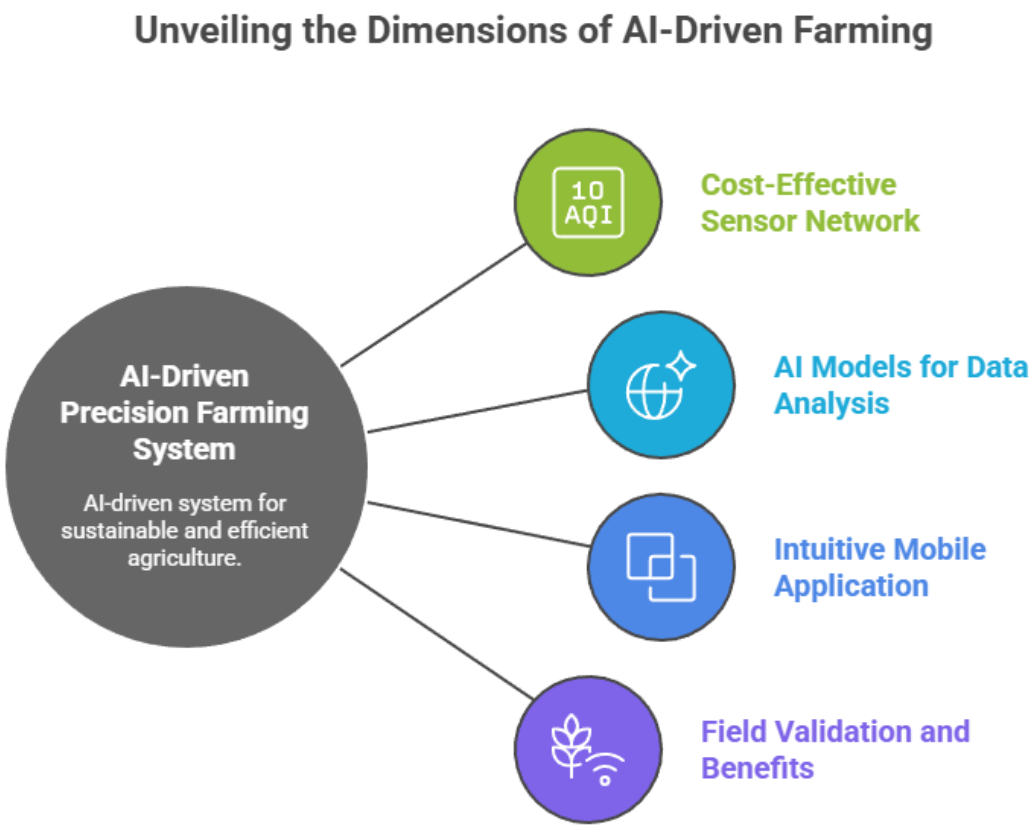
The research project was initiated to develop an integrated AI-driven precision agriculture system specifically tailored to the needs of small and marginal farmers, aiming to conserve resources, improve crop health, and maximize yields while reducing environmental costs.



Objectives

The project's primary objectives included:

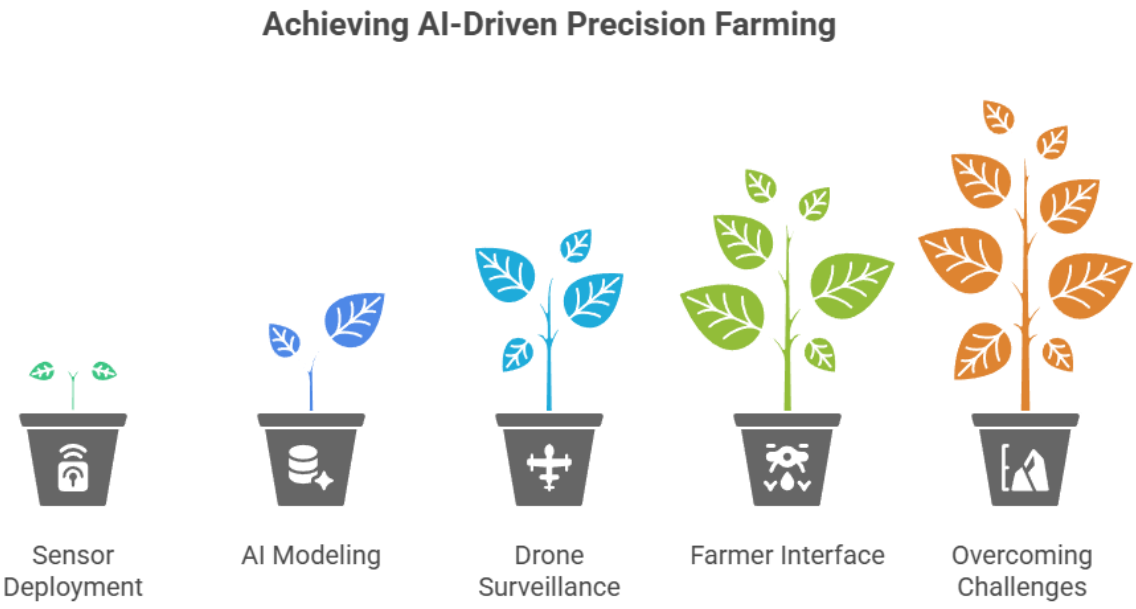
- Designing a cost-effective sensor network for soil moisture, nutrient levels, and microclimate variables.
- Developing AI models that analyze sensor and multispectral drone imagery data to provide precise irrigation, fertilization, and pest management recommendations.
- Creating an intuitive mobile application delivering real-time, actionable guidance to farmers in local languages.
- Validating field performance in diverse agro-climatic zones and demonstrating economic and ecological benefits.



Research Work and Challenges

The interdisciplinary research combined agronomy, AI, sensor technology, and rural sociology:

- **Sensor Deployment:** Developed low-power, affordable soil and climate sensors calibrated for local soil types, deployed across pilot farms.
- **AI Modeling:** Leveraged machine learning algorithms trained on historical and real-time data to predict soil moisture trends, pest risks, and nutrient deficiencies.
- **Drone Surveillance:** Used multispectral imaging to monitor crop health and detect early pest infestations invisible to the naked eye.
- **Farmer Interface:** Designed a mobile platform with voice and visual aids for easy comprehension by low-literacy users.
- **Challenges:** Included managing intermittent rural connectivity, ensuring sensor durability, training AI models with sparse regional datasets, and engaging farmers for technology acceptance.

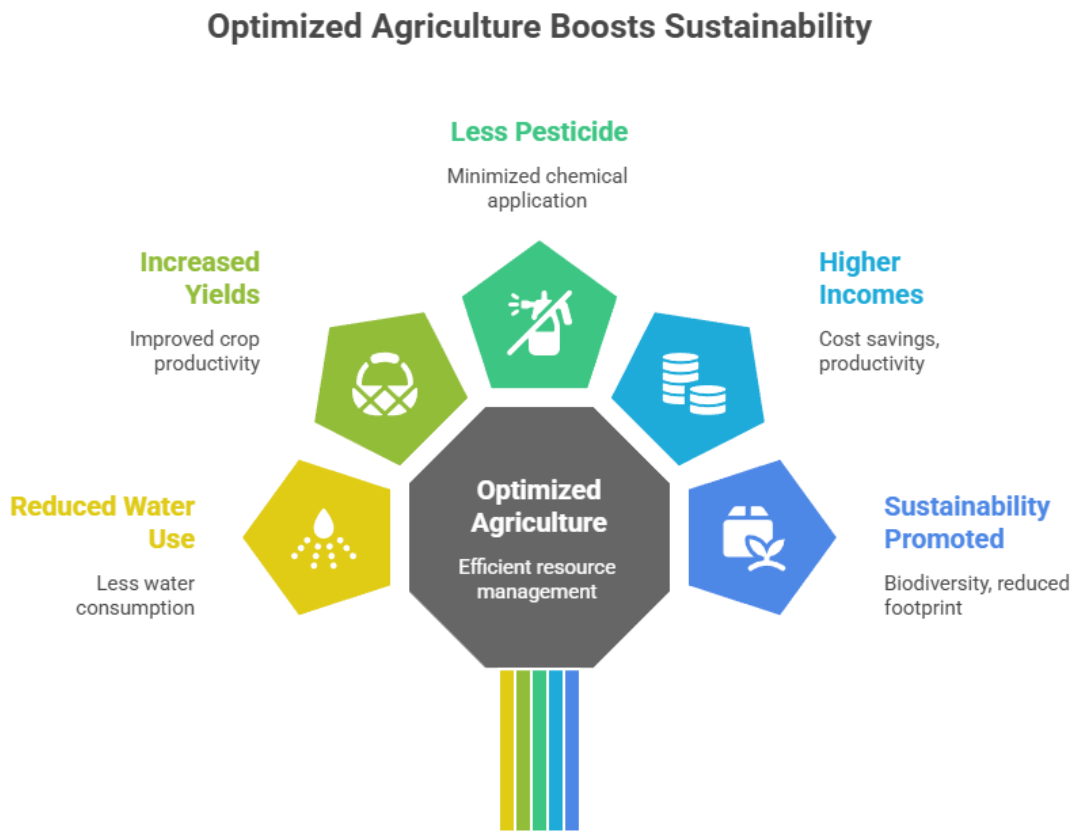


Results and Wider Societal Benefits

Pilot-scale deployment demonstrated:

- Up to 30% reduction in water consumption through optimized irrigation schedules.
- Improvement in crop yields by over 15% due to targeted nutrient and pest management.
- Significant reductions in pesticide usage minimizing environmental and health hazards.
- Enhanced farmer incomes through input cost savings and increased productivity.
- Promotion of sustainable agricultural practices contributing to biodiversity conservation and reduced carbon footprint.

By empowering smallholder farmers with accessible technology, the project is enhancing food security, promoting climate-resilient agriculture, and supporting rural livelihoods, with significant potential to scale across regions.

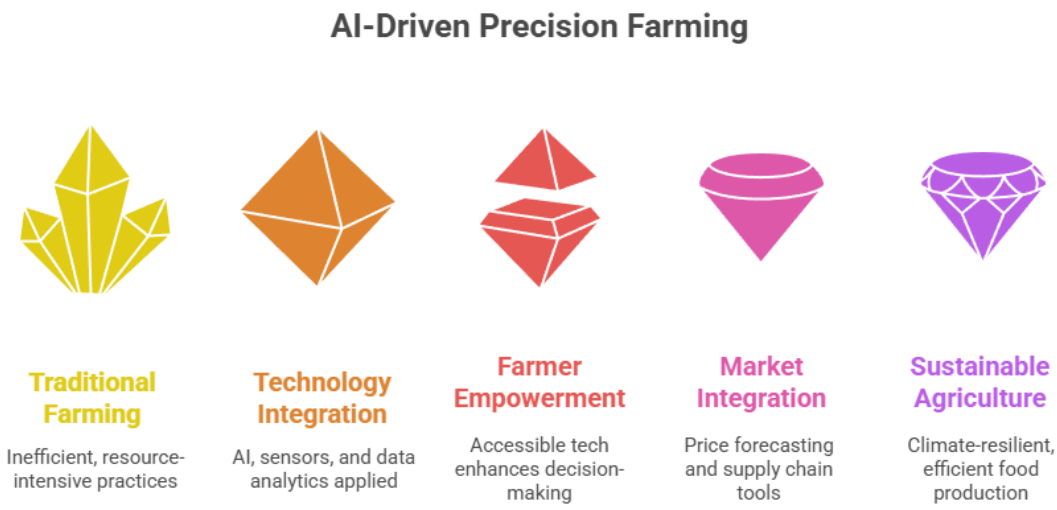


Novel Avenues and Ongoing Research

The project has catalyzed new initiatives integrating market price forecasting and supply chain management tools to further support farmers' economic decisions. Partnerships with agritech startups and government rural development programs are active to facilitate wider adoption and continuous system refinement.

Creative Collaboration and Communication

The research team consisted of experts in AI, agriculture, sensor engineering, and rural engagement, ensuring the solution was locally relevant and technologically sound. Findings have been widely disseminated through farmer field schools, academic publications, community workshops, and digital platforms, successfully translating complex research into practical societal impact.



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