

DESIGN AND IMPLEMENTATION OF AN OPERATIONAL MODEL FOR A DRONE AS A SERVICE STARTUP - A CASE STUDY OF MH AGROTECH

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ABSTRACT

Agriculture is undergoing a major transformation through the integration of advanced digital technologies. Among these innovations, Drone-as-a-Service (DaaS) has emerged as a practical and scalable solution for modern farming. Instead of purchasing expensive drone equipment, farmers can access drone-based agricultural services through specialized service providers. This model reduces financial burden while improving operational efficiency. Agricultural drones can perform crop monitoring, pesticide spraying, field mapping, soil analysis, irrigation assessment, and crop health monitoring with greater speed and accuracy than traditional methods. The DaaS model improves resource utilization, reduces labor dependency, and supports sustainable farming practices. This paper examines the role of Drone-as-a-Service in agriculture, its operational model, advantages, challenges, and future opportunities in precision farming. The study highlights how DaaS can bridge the gap between technological innovation and practical agricultural implementation, especially for small and medium-scale farmers.

Keywords

Drone-as-a-Service, Precision Agriculture, Smart Farming, Agricultural Drones, UAV, Crop Monitoring

I. INTRODUCTION

Agriculture remains one of the most important sectors in global economic development. However, traditional farming practices continue to face multiple challenges such as labour shortages, rising operational costs, inefficient resource usage, and climate uncertainty. To overcome these challenges, precision agriculture has introduced modern technological solutions that improve farm productivity and sustainability.

Drone technology has become one of the most influential tools in precision agriculture. Agricultural drones equipped with sensors, cameras, and spraying systems can collect field data, monitor crop health, and perform targeted applications of fertilizers and pesticides. Despite these advantages, the high cost of drone ownership limits adoption among many farmers.

Drone-as-a-Service (DaaS) addresses this issue by allowing farmers to use drone services without owning the equipment. Service providers manage the drone operations while farmers pay only for the services required. This service model increases accessibility and supports efficient farm management.

II. PROBLEM STATEMENT

Modern agriculture faces several challenges including rising labour costs, inefficient pesticide application, crop monitoring difficulties, and limited access to advanced technology for small and medium-scale farmers. Traditional farming methods often rely on manual inspection and blanket spraying techniques, which can lead to excessive chemical usage, uneven field coverage, and reduced crop productivity. Although agricultural drones provide a technological solution to these problems, the high cost of purchasing drones, maintenance expenses, and the need for trained operators prevent many farmers from adopting them.

The absence of affordable and accessible drone technology creates a gap between innovation and practical farm implementation. Therefore, there is a need for a service-based model that allows farmers to access drone technology without ownership. Drone-as-a-Service (DaaS) addresses this issue by providing drone operations as an on-demand service, enabling farmers to improve efficiency, reduce costs, and adopt precision agriculture practices more effectively.

III. OBJECTIVES OF THE STUDY

The major objectives of this study are:

- To understand the concept of Drone-as-a-Service in agriculture
- To analyse the operational model of agricultural drone services
- To identify the benefits of drones in precision farming
- To examine challenges in implementing DaaS in rural agriculture
- To evaluate future opportunities of drone-based farming solutions

IV. LITERATURE REVIEW

The use of drone technology in agriculture has been widely studied as part of precision farming and smart agriculture. Previous research shows that unmanned aerial vehicles (UAVs) improve farm productivity by enabling faster monitoring, accurate spraying, and data-driven decision-making.

Zhang and Kovacs explained that small UAV systems can improve crop monitoring by capturing high-resolution aerial images that help identify crop stress, pest infestation, and nutrient deficiencies at an early stage. Their study showed that drones reduce manual labour while improving operational efficiency in farming.

Hunt et al. studied near-infrared and multispectral imaging in drones and found that these systems can accurately assess plant health conditions. Their findings demonstrated that drone-based monitoring provides farmers with real-time insights that support precise crop management.

Tsouros, Bibi, and Sarigiannidis reviewed drone applications in agriculture and concluded that drones support precision spraying, crop analysis, and resource optimization. Their study emphasized that drones improve sustainability by reducing excessive chemical application and minimizing environmental damage.

Radoglou-Grammatikis et al. highlighted the role of drones in smart farming ecosystems. Their research showed that drones integrated with cloud computing and artificial intelligence can improve large-scale farm monitoring and support predictive agricultural management.

Lottes et al. demonstrated that combining drones with artificial intelligence improves crop classification and weed detection. Their work showed that automation can reduce human effort and increase monitoring accuracy.

Puri, Nayyar, and Raja introduced Drone-as-a-Service as an affordable model that allows farmers to access advanced drone technology without purchasing equipment. Their study identified DaaS as an important solution for small-scale farmers who face financial barriers to technology adoption.

Kumar and Kumar examined the challenges of drone adoption in developing countries and identified cost, regulatory restrictions, and lack of technical knowledge as major barriers. Their findings suggested that service-based drone models could improve accessibility and adoption.

Tripicchio et al. found that drones contribute to sustainable agriculture by improving water usage, reducing pesticide waste, and enhancing precision farming practices. Their research confirmed that drone technology can support both economic and environmental goals.

Although previous studies strongly support drone technology in farming, many researchers note that practical implementation remains a challenge. Most studies focus on technical performance, while fewer examine the operational structure required to deliver drone services effectively. Therefore, this study focuses on how Drone-as-a-Service can be structured as a practical agricultural service model that improves accessibility, efficiency, and sustainability.

V. RESEARCH METHODOLOGY

This study is based on a **descriptive research methodology** using both primary and secondary data.

Primary Data

Primary data was collected through:

- Observation of agricultural drone operations
- Interaction with drone service professionals
- Informal discussions with farmers

Secondary Data

Secondary data was collected from:

- Research journals
- Agricultural technology reports
- Government publications
- Company websites
- Industry articles

The collected data was analysed to understand the effectiveness of DaaS in agricultural operations.

VI. DRONE-AS-A-SERVICE OPERATIONAL MODEL

Drone-as-a-Service works on a service-based business model where farmers request drone services according to their farming needs.

Service Process

1. Farmer Request

Farmers book services such as:

- Crop spraying
- Field mapping
- Crop health analysis
- Soil monitoring

2. Field Assessment

The service provider evaluates:

- Farm size
- Crop type
- Weather condition
- Service requirement

3. Drone Deployment

Certified operators deploy drones for:

- Aerial imaging
- Precision spraying
- Data collection

4. Data Processing

Collected data is analysed to generate:

- Crop health reports
- Irrigation recommendations
- Disease detection reports

5. Farmer Decision Support

Farmers receive reports to improve:

- Yield
- Input efficiency
- Farm management

VII. CHALLENGES AND PROPOSED SOLUTIONS

S.No	Challenge	Proposed Solution
1	High initial cost of drone infrastructure	Implement a shared Drone-as-a-Service model to reduce ownership burden for farmers
2	Lack of technical knowledge among farmers	Conduct training programs and awareness campaigns
3	Regulatory restrictions on drone usage	Ensure compliance with aviation rules and certified operator licensing
4	Poor internet connectivity in rural areas	Develop offline-enabled service platforms and mobile applications
5	Weather dependency of drone operations	Use predictive weather monitoring and flexible scheduling
6	Limited battery life of drones	Introduce battery swapping systems and energy-efficient operations
7	Data privacy and security concerns	Use encrypted cloud storage and secure data handling systems

8	Resistance to technology adoption	Organize live demonstrations and farmer engagement programs
9	Maintenance and repair issues	Establish preventive maintenance and technical support systems
10	Difficulty in large-scale service expansion	Create decentralized regional service hubs for faster deployment

VIII. APPLICATIONS OF DAAAS IN AGRICULTURE

Drone-as-a-Service supports several agricultural functions.

1. Crop Monitoring

Drones capture high-resolution images to detect:

- Pest infestation
- Nutrient deficiency
- Water stress
- Crop damage

2. Precision Spraying

Drones can spray:

- Fertilizers
 - Herbicides
 - Pesticides
- accurately while reducing chemical waste.

3. Land Mapping

Drones generate:

- Farm boundary maps
- Elevation data
- Soil variation maps

4. Irrigation Management

Thermal sensors help identify:

- Dry zones
- Overwatered zones
- Water distribution issues

VII. BENEFITS OF DAAS IN AGRICULTURE

The DaaS model offers several benefits.

Economic Benefits

- Lower investment cost
- Reduced labour expenses
- Better yield potential
- Affordable technology access

Operational Benefits

- Faster field coverage
- Accurate spraying
- Real-time monitoring
- Improved decision making

Environmental Benefits

- Reduced chemical usage
- Lower water wastage
- Sustainable farming
- Reduced soil damage

IX. CHALLENGES OF IMPLEMENTATION

Despite its advantages, DaaS faces some challenges.

Major Challenges

- Limited awareness among farmers
- Regulatory approvals for drones
- Internet connectivity issues
- Skilled operator shortage
- Initial service adoption resistance

Service providers must address these barriers to improve wider acceptance.

X. FUTURE SCOPE

The future of DaaS in agriculture is highly promising. Emerging technologies can improve its capabilities.

Future developments may include:

- AI-based crop disease prediction
- Automated drone scheduling
- IoT integration
- Blockchain for farm data security
- Fully autonomous drone fleets

These advancements can further transform smart farming systems.

XI. CONCLUSION

Drone-as-a-Service has the potential to revolutionize agriculture by making advanced drone technology accessible to farmers without the burden of ownership. It improves precision, reduces cost, saves time, and supports sustainable farming practices. The DaaS model is especially valuable for small and medium farmers who cannot invest in expensive equipment. With proper awareness, training, and policy support, Drone-as-a-Service can become an important pillar of future agriculture and precision farming.

XII. REFERENCES

- [1] Zhang, C., & Kovacs, J. M. (2012). The application of small unmanned aerial systems for precision agriculture.
- [2] Hunt, E. R. et al. (2014). UAV-based crop monitoring systems.
- [3] Puri, V., Nayyar, A., & Raja, L. (2017). Agriculture drones: modern farming solution.
- [4] Tripicchio, P. et al. (2015). Smart farming and sustainable agriculture using drones.
- [5] Kumar, R., & Kumar, P. (2020). Adoption of drone technology in developing agriculture.