Proposal for the Development and Commercialization of a 15-Litre Agricultural Sprayer Drone under the Research and Commercialization Grant of National Agency for Science and Engineering Infrastructure (NASENI)

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Submitted by:

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1. Executive Summary

Agriculture remains the backbone of Nigeria's economy [1], yet persistent challenges such as low productivity, high post-harvest losses, inefficient input application, and limited access to modern mechanization continues to undermine efforts at national food security. Similarly, in the defense and aerospace domain, there is an urgent need for locally developed UAV systems that reduce dependence on imports and strengthen Nigeria's technological sovereignty [2,3]. The AUAV Laboratory's work sits at the intersection of these two critical sectors, directly aligning with NASENI's thematic areas of Agriculture & Food Manufacturing, and Defense & Aerospace.

The Advanced Unmanned Aerial Vehicle Laboratory (AUAV Lab) under the National Space Research and Development Agency has successfully designed and tested a 1-litre prototype agricultural drone sprayer. Sequel to the gains obtained from this proof of concept, the Lab is now advancing to a 15-liter capacity drone sprayer system to be deployed on a commercial scale. The 15-litre capacity UAV sprayer is capable of addressing the mechanization needs of medium- and large-scale farms across Nigeria and offers a viable alternative to the traditional methods used in pesticide application. The drone portend the following capabilities:

- ✓ Precision Agriculture: Ability to vary the rate of spraying is possible through control methods this reduces chemical wastage by up to 35%, protecting both crops and the environment[4,5].
- ✓ Dual-Sector Adaptability: Apart from agricultural usage, the platform can be adapted for surveillance, security, and logistics applications.
- ✓ Indigenous Innovation: Designed, built, and tested locally, it showcases Nigeria's ability to solve pressing problems with home-grown solutions.

- ✓ Scalable Commercialization: With modular payload capacity, the design can evolve into larger drones (30–50 litres), supporting expansion across Nigeria and ECOWAS markets.

The project has demonstrated technical feasibility, validated through field tests and has achieved Technology Readiness Level (TRL) 5–6. At this level the project is at a crucial stage where scaling up and standardization of manufacturing is both necessary and feasible. To achieve this, the UAV Lab requires support to acquire advanced fabrication equipment and smarter assembly tools that will ensure quality, durability, and competitiveness in both local and international markets.

This initiative contributes directly to the Renewed Hope Agenda by:
- Boosting national food production and security.
- Creating skilled jobs in UAV design, manufacturing, and services.
- Reducing dependence on imported agricultural machinery and foreign UAVs.
- Stimulating local industries through component fabrication and supply chain development.

This proposal seeks NASENI's support under the Research and Commercialization Programme to scale up production, standardize manufacturing processes, and acquire advanced fabrication and assembly tools. Aptly, the proposed UAV sprayer aligns with two of NASENI's thematic areas namely:

- ✓ Agriculture and Food Manufacturing
- ✓ Defense and Aerospace

The UAV sprayer project demonstrates innovative engineering, commercial viability, and scalability, with clear contributions to Nigeria's industrialization goals and the Renewed Hope Agenda.

2. Introduction

Agriculture accounts for a significant share of Nigeria's GDP and employs the majority of its population, yet productivity levels remain far below potential due to persistent structural challenges. Farmers across the country struggle with inefficient input application, pest infestations, post-harvest losses, and limited access to modern mechanization. These constraints not only affect food availability but also undermine national food security, rural livelihoods, and Nigeria's competitiveness in regional and global agricultural markets.

Unmanned Aerial Vehicles (UAVs) are emerging globally as transformative tool in agriculture, providing precision solutions that improve efficiency, reduce cost, and increase yields. Drone sprayers, in particular, enable farmers to apply fertilizers, pesticides, and herbicides in a controlled, targeted manner that minimizes wastage and environmental impact while maximizing crop health. Beyond agriculture, UAVs also play a growing role in defense and aerospace applications, serving as platforms for surveillance, reconnaissance, logistics, and payload delivery.

The UAV Laboratory has taken concrete steps in this direction with the successful development of a 1-litre prototype sprayer drone, which has undergone initial testing and validation. Building on this proof-of-concept, the Laboratory is now advancing to the design and development of a 15-litre UAV sprayer—a system specifically designed to serve the needs of medium- and large-scale farms in Nigeria. The system is engineered for rugged field conditions, with features such as:

- Smart spraying controls for uniform and efficient coverage.
- Autonomous navigation and obstacle avoidance for safe operations.
- Ruggedized frame for durability under Nigerian conditions.

This initiative goes beyond addressing local agricultural challenges; it contributes to national strategic objectives by reducing dependence on imported drones, creating skilled jobs, and building indigenous capacity in

advanced UAV technologies. By integrating into NASENI's thematic areas of Agriculture & Food Manufacturing and Defense & Aerospace, the project positions Nigeria as a continental leader in UAV innovation, commercialization , and deployment. Nigeria's agricultural sector faces persistent challenges of low productivity, pest outbreaks, inefficient input application, and post-harvest losses. Drone-based spraying offers a transformative solution by reducing chemical wastage, enhancing precision, minimizing human exposure to chemicals, and improving overall yield.

The AUAV Lab has successfully demonstrated feasibility with a 1-litre UAV sprayer prototype. Sequel to the gains of the proof-of-concept phase, the Lab is scaling up to a 15-litre capacity system, capable of serving medium- and large-scale farms, while also being adaptable for defense-related applications such as surveillance and payload delivery.

3. Innovativeness and Novelty

- Indigenous Development: First of its kind locally developed drone sprayer of this scale in Nigeria.
- Dual-Sector Application: Designed for both agricultural mechanization and possible adaptation to aerospace/defense applications.
- Customizable Payload: Can be adapted for spraying, seeding, or surveillance payloads.

4. Feasibility Evidence

- 1-Litre Prototype Success: Fully operational and tested at pilot scale.
- Demonstrations: Studies show that field tests with cassava, maize, and rice farms showed efficiency improvement of up to 35% in pesticide use [5].
- Technology Readiness Level (TRL 5–6): Prototype validated in relevant environments, now ready for pre-commercial pilot production.

5. Commercial Viability

- Market Opportunity: Nigeria has over 34 million hectares of arable farmland[6]. Adoption of UAV sprayers can boost mechanization and

reduce reliance on imported solutions.
- Unofficial sampling in states such as Benue, Nasarawa, and Kaduna indicate strong farmer interest in UAV spraying services chargeable at ₦25,000 per hectare.
- Revenue Pathways:
  1. Direct sales of UAV units.
  2. Drone-as-a-Service (DaaS) model for spraying.
  3. Strategic partnerships with agrochemical companies.

6. Alignment with NASENI Objectives

The project aligns strategically with the mandate of NASENI in the following ways:
1. Industrial Development: Indigenous UAV design reduces dependence on imported drones.
2. Agricultural Productivity: Enhances crop yield and reduces losses.
3. Defense & Aerospace Growth: Contributes to Nigeria's aerospace technology capabilities.
4. Renewed Hope Agenda: Advances job creation, technology transfer, and food security.

7. Scale-Up, Sustainability & Required Equipment

The grant will partly be used in smart fabrication and manufacturing tools to standardize UAV production and ensure quality control.

8. Potential for Scale and Sustainability

- Scalability: The design allows modular payloads, enabling easy scaling to 30–50 litre drones.
- Export Potential: Regional market expansion to ECOWAS states.
- Continuous Improvement: Ongoing R&D collaboration with universities
- Sustainability: UAV sprayer service models will ensure recurring income streams, enabling reinvestment in manufacturing.

9. Summary of Project Objectives and Costs

The table below presents a detailed breakdown of the proposed budget for the UAV Sprayer Drone Scaling and Commercialization Project under the

NASENI Research and Commercialization Programme. The proposed budget supports research, testing, training, certification, and market development

S/N	Budget Category	Description / Key Activities	Estimated Cost (₦)
1	Prototype Enhancement & Integration	Design refinement of 15-Liter UAV sprayer system; improvement in flight stability, power management, payload release systems, and nozzle optimization.	15,000,000
2	Software Development & AI Control Systems	Development and integration of autonomous flight control, variable-rate spraying algorithms, and real-time monitoring dashboard.	10,000,000
3	Testing, Validation & Field Trials	Large-scale testing across multiple crop types (cassava, maize, rice) and regions; data acquisition, calibration, and performance validation.	12,000,000
4	Standardization & Certification	Quality assurance testing, conformity with NASENI, SON, and NCAA regulations; documentation for	8,000,000

		UAV licensing and safety compliance.	
5	Personnel & Research Support	Stipends for engineers, UAV pilots,agronomists, data scientists, and research assistants.	14,000,000
6	Training & Capacity Building	Workshops for farmers, extension agents, and UAV operators; development of training manuals and video modules.	7,000,000
7	Marketing, Branding & Awareness Campaign	Branding, promotional materials, participation in agricultural expos, advertising on radio/TV/social media, and stakeholder engagement.	10,000,000
8	Intellectual Property (IP) Protection & Documentation	Patent filing, legal documentation, design registration, and preparation of user manuals and commercialization packages.	4,000,000
9	Partnership Development & Stakeholder Engagement	Collaboration with agricultural cooperatives, drone service companies, and state agricultural	6,000,000

		agencies; pilot deployment partnerships.	
10	Project Logistics & Mobility Support	Acquisition of utility truck (pickup) for field logistics, UAV deployment, maintenance transport, and outreach demonstrations across pilot states.	20,000,000
11	Contingency & Administrative Overheads (10%)	Covers project management, reporting, and unforeseen expenses.	14,000,000
	Total Project Cost		120,000,000

Total Estimated Cost: ₦120,000,000.00

10. Prototype Images and Documentation

Fig 1: Prototype Quacopter Drone for Surveillance

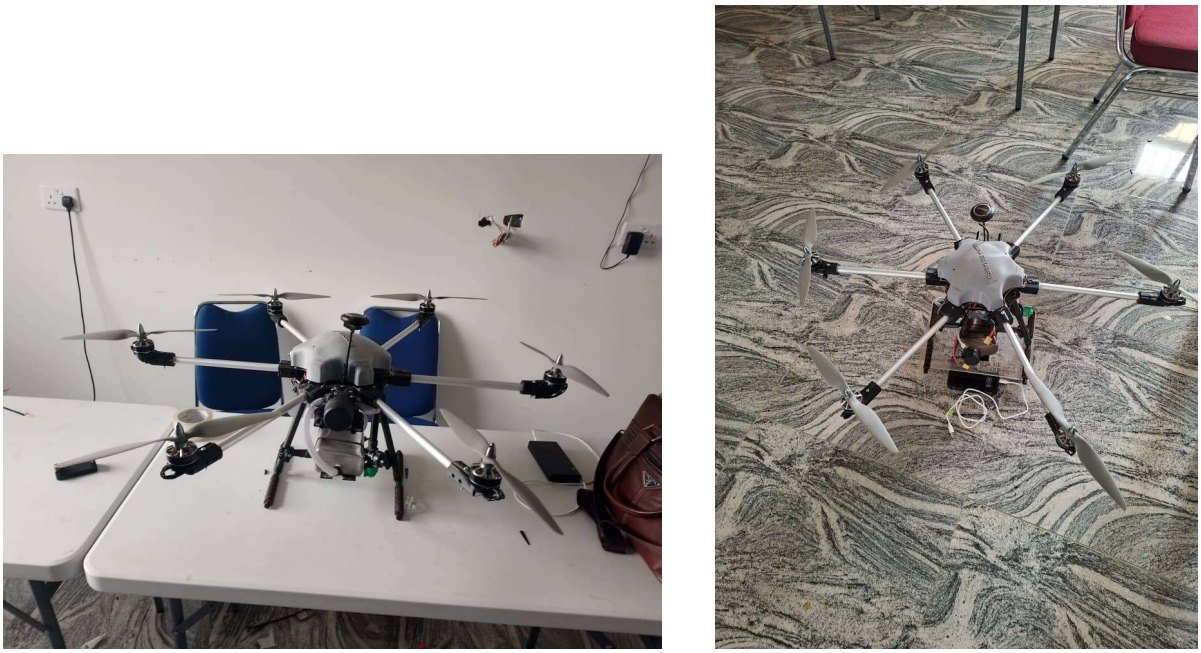

Fig 2: 1-litre prototype drone sprayer

Insert pictures show a surveillance drone prototype, 1-litre prototype drone sprayer and field test of a prototype surveillance drone developed at the drone laboratory.

9. Conclusion

The AUAV Laboratory's 15-litre drone sprayer initiative represents far more than a technical achievement—it is a strategic investment in Nigeria's agricultural transformation and technological independence. By leveraging indigenous innovation, the project directly addresses the nation's urgent need for enhanced food security, modern mechanization, and reduced dependence on foreign UAV technologies. With NASENI's support, this project will transition from prototype to scalable production, backed by standardized manufacturing processes and advanced fabrication tools. This will not only deliver a reliable, high-quality UAV sprayer for Nigerian farmers but will also stimulate local industries, create skilled employment opportunities, and position Nigeria as a hub for UAV innovation within the African continent.

Ultimately, the 15-litre UAV sprayer is more than a research outcome; it is a catalyst for industrialization, a tool for national defense readiness, and a driver of socio-economic transformation. Through NASENI's Research and Commercialization Programme, this project will set the benchmark for how science, engineering, and innovation can converge to deliver tangible impact under the Renewed Hope Agenda. Supporting this initiative means supporting Nigeria's future in agriculture, defense, and technological self-reliance.

The AUAV Laboratory's 15-litre drone sprayer project represents a novel, commercially viable, and scalable innovation that fits NASENI's thematic focus on Agriculture and Food Manufacturing and Defense and Aerospace.

Support from NASENI will enable the Lab to scale-up, standardize production, and roll out a reliable, affordable indigenous UAV sprayer for Nigeria and beyond.

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