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ABSTRACT
This research presents integrated developments in precision agriculture that combine satellite-based monitoring, IoT sensing, and data-driven analytics across both crop production and livestock systems. The WREN project focuses on drought monitoring and soil moisture estimation using a CubeSat platform, multispectral remote sensing, in-situ measurements, and AI-based modelling, enabling improved spatial resolution and decision support for water management. Complementing this, an IoT-based soil monitoring system was developed to measure NPK nutrient levels and soil moisture in

real time, integrating wireless communication and MQTT-based data transfer to support precision fertilization and site-specific management.

In parallel, livestock-oriented research addresses the need for advanced data integration in animal production. The Integrated Precision Livestock Analytics framework combines sensor data, environmental monitoring, and farm management information, applying statistical methods and machine learning to enhance productivity, animal welfare, and operational efficiency. Additionally, broader precision agriculture research activities support these developments through remote sensing applications, AI-based modelling, and strong collaboration between academia and industry, alongside educational program development.

Overall, the projects demonstrate how integrating satellite technologies, IoT systems, and advanced analytics can enable data-driven, sustainable, and resilient agricultural systems across both crop and livestock domains.