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**SPEAKER BIODATA FORM**

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Brief career highlights (less than 250 words):

I Made Anom Sutrisna Wijaya, a professor at the Department of Agricultural and Biosystems Engineering, Faculty of Agricultural Technology, Udayana University. He completed his Bachelor's degree in Agricultural Engineering from IPB University, Indonesia, in 1987; his Master's in Food Engineering from New South Wales University, Sydney, Australia, in 1994; and his Ph.D. in Agricultural Engineering from Tokyo University of Agriculture and Technology, Japan, in 2002. With advanced degrees in agricultural sciences, he has dedicated his career to enhancing the field through innovative research and education. His work focuses on sustainable agricultural practices and technology integration in farming. Prof. Wijaya actively mentors students and collaborates with international institutions to promote agrarian advancements. He has managerial experience as Head of the Land Development and Management Information System Department, Sugarcane Plantation and Factory, PT Gula Putih Mataram Lampung, South Sumatera (1988-1990), Head of Agricultural Engineering Department, Udayana University (1994-1997; 2003-2009); Assistant Director for Administration and Finance, TPDSP ADB Project (2003-2009), Vice Dean for Academic Affairs Faculty of Agricultural Technology, Udayana University (2009-2014), Secretary for Agricultural Science Doctor Program, Udayana University (2014-2019), Head of Research Centre on Food Availability for Sustainable Improvement (CFASI) Udayana University (2019-2021), and recently as Dean of Faculty of Agricultural Technology, Udayana University (2021-2025). He was also chairman of the Bali branch of the Indonesian Society of Agricultural Engineering (2010-2020).

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## ENHANCING RICE DISEASE MANAGEMENT: ESTIMATING PATHOGEN DAMAGE THROUGH MULTISPECTRAL IMAGING ANALYSIS

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### ABSTRACT

This study investigates the application of multispectral imaging (MSI) in conjunction with machine learning algorithms for the early detection and estimation of pathogen damage in rice crops, with a specific focus on Bacterial Leaf Blight (BLB) and Blast diseases. Rice plays a crucial role in global food security, yet these diseases significantly compromise its production. Traditional diagnostic methods are often labor-intensive and time-consuming, necessitating the adoption of innovative technologies. Utilizing drone-mounted MSI, this research captures spectral data from paddy fields to distinguish between healthy and diseased plant tissues. Key findings reveal a strong correlation between spectral indices, such as the Normalized Difference Vegetation Index (NDVI), and disease severity. Machine learning models demonstrated high accuracy rates exceeding 85%, effectively identifying distinct spectral signatures associated with BLB and Blast. The implementation of MSI not only enhances diagnostic accuracy but also facilitates proactive disease management strategies, promoting sustainable agricultural practices. This study advocates for the integration of advanced imaging technologies to transform rice disease management and ensure food security.

**Keywords:** Multispectral Imaging, Machine Learning, Rice Crop, Precision Agriculture, Disease Detection.

### INTRODUCTION

Rice (*Oryza sativa* L.) is a fundamental food crop, providing sustenance for over half of the global population and playing a pivotal role in ensuring food security, particularly in Asia. Despite its significance, rice cultivation faces numerous challenges from biotic stresses, among which Bacterial Leaf Blight (BLB) and Blast are the most detrimental. BLB, caused by the bacterium *Xanthomonas oryzae* pv. *oryzae*, can lead to severe yield reductions by creating lesions that hinder photosynthesis. On the other hand, the fungal disease Blast, caused by *Pyricularia oryzae*, manifests as leaf, neck, and panicle lesions, resulting in significant yield losses (Haryanto & Astuti, 2019; Jagadish & Raza, 2021). Traditional methods for disease diagnosis primarily involve visual inspections, which can be time-consuming and often lead to

delayed interventions.

Recent advancements in precision agriculture have facilitated the use of remote sensing technologies and machine learning algorithms for improved crop monitoring and disease management. Multispectral imaging (MSI) provides a valuable approach for detecting early physiological changes in plants before observable symptoms appear. By capturing data across multiple wavelengths, researchers can gain insights into crop health and identify the presence of diseases more efficiently than conventional methods (Ghosh & Ghosh, 2020). This study aims to investigate the potential of MSI combined with machine learning approaches for the early detection and estimation of pathogen damage in rice, with a specific focus on BLB and Blast.

## **MATERIALS AND METHODS**

This research utilized multispectral imagery obtained from paddy fields specifically affected by BLB and Blast during the growing season. A drone equipped with a multispectral camera was deployed to gather imagery over designated plots, capturing a comprehensive range of spectral data. The images were processed using specialized software to extract key spectral bands that can differentiate healthy plant tissues from those impacted by disease. Among the derived indices, the Normalized Difference Vegetation Index (NDVI) was calculated to represent overall plant health status, while additional indices were evaluated to enhance disease detection accuracy (Laba & Biernacki, 2022).

Ground truth data collection involved conducting visual assessments and sampling across various plot locations to quantify the severity of the diseases. Machine learning algorithms, including Random Forest and Support Vector Machines (SVM), were employed to analyze the spectral data, training models to identify and classify disease incidence based on distinct spectral characteristics (Kumar & Sahu, 2018). Regression analysis was further utilized to determine the relationship between spectral indices and disease severity ratings, providing valuable insights into the predictive capabilities of MSI.

## **RESULTS & DISCUSSION**

Initial results indicated a strong correlation between spectral indices derived from MSI and the disease severity assessed through visual inspection. The NDVI values for infected rice plants were significantly lower compared to healthy counterparts, aligning with visual symptoms such as leaf wilting and discoloration. Machine learning models achieved accuracy rates exceeding 85%, characterized by precise classification of disease categories.

Distinct spectral signatures were identified for both BLB and Blast, demonstrating the ability of MSI to recognize specific physiological changes caused by each pathogen. For instance, the spectral pattern of BLB exhibited notable reductions in NDVI, directly correlating with the extent of leaf damage. Conversely, Blast presented unique reflectance characteristics within specific spectral bands, enabling precise identification of affected plants (Shankar & Thangavel, 2020).

Regression analysis demonstrated strong predictive capability, enabling the development of a

model that accurately estimates disease severity based on spectral indices. The mapping generated indicated the spatial distribution of disease incidence, aiding in effective resource allocation and targeted management practices.

The findings of this study demonstrate the transformative impact of multispectral imaging on enhancing rice disease management. By facilitating rapid and accurate assessments of crop health, MSI shifts the traditional paradigm towards proactive disease management, allowing for timely interventions that can significantly curtail yield losses. This approach not only enhances diagnostic accuracy but also reduces reliance on chemical pesticides, promoting more sustainable agricultural practices (Reddy & Dhananjaya, 2019).

Furthermore, the integration of machine learning algorithms with multispectral imaging enhances the precision and scalability of disease monitoring, making it suitable for large agricultural landscapes. The predictive models developed in this study emphasize the importance of utilizing advanced technology in precision agriculture, addressing the urgent demands of food production amid challenges posed by climate change and biotic stresses.

Future research directions should focus on refining the analytical models, expanding the dataset to encompass diverse rice varieties and cultivation conditions. Integrating environmental factors such as soil moisture and climatic variables could further enrich the data pool, improving the robustness of predictive capabilities. Collaboration with farmers and agricultural stakeholders is essential for validating the practical applicability of these technologies, facilitating real-world implementation.

## **CONCLUSIONS**

In conclusion, multispectral imaging offers a promising solution for enhancing rice disease management by enabling the efficient detection and estimation of pathogen damage. This study advocates for the adoption of innovative imaging technologies within agricultural frameworks, fostering more resilient and sustainable rice production systems. As global food security challenges escalate, incorporating technologies like MSI will be indispensable for safeguarding rice supplies against pervasive disease threats, ultimately contributing to enhanced agricultural productivity and food availability.

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