中文摘要：

本計畫旨在建立一個具備高效能、可遷移且可增量學習的作物坵塊判釋系統，以提升農業部提供之遙測資料的應用效益。現有作物分類模型多以像素（pixel）為單位進行判釋，導致訓練與推論效率低落，且在面對不同區域或季節樣態時，常需重新訓練模型，增加標記與運算成本。為解決上述問題，本計畫採用以「整塊坵塊為分析單元」的判釋方法，並引入知識蒸餾（Knowledge Distillation）技術，開發具備增量學習與快速微調能力的模型架構。研究主軸包含兩個面向：(1) 多作物分類判釋模型與微調技術：建立高泛化性的教師模型(Teacher Model)，以多類作物資料進行預訓練，並透過知識蒸餾訓練學生模型(Student Model)，在保持高準確率的同時達到輕量化與快速部署；(2) 多階段單一作物分類模型與微調技術：針對水稻、玉米、花生、鳳梨與香蕉等作物，開發多階段特徵融合的二元分類模型，並利用知識蒸餾保留既有特徵，同時學習新樣態資料。本計畫將分階段完成教師－學生模型框架建置、增量訓練策略設計、跨區域驗證與效能分析。預期可提供具高適應性與可擴展性的農作物分類模型，顯著降低模型再訓練成本，並為後續農情監測、作物健康分析及智慧農業決策提供可持續發展的核心技術。

英文摘要：

This project aims to develop an efficient, transferable, and continuously learnable crop parcel interpretation system to enhance the application value of remote sensing data provided by the Ministry of Agriculture. Conventional crop classification models operate at the pixel level, which limits training and inference efficiency and requires frequent retraining when applied to new regions or seasons. To overcome these challenges, this project adopts a parcel-based

approach and integrates knowledge distillation techniques to build models capable of incremental learning and rapid fine-tuning. The research focuses on two main aspects: (1) Multi-crop classification and fine-tuning — developing a highly generalizable teacher model pre-trained on multiple crop types, and using knowledge distillation to train a lightweight student model that maintains high accuracy while improving deployability; and (2) Multi-stage single-crop classification and fine-tuning — creating binary models for key crops such as rice, corn, peanut, pineapple, and banana, integrating multi-stage feature fusion and distillation to retain existing knowledge while adapting to new crop patterns. The project will progressively complete the teacher–student model framework, incremental training strategy, and cross-regional validation. The expected outcomes include a scalable and adaptive crop classification system that significantly reduces retraining costs, supporting continuous development in agricultural monitoring, crop health assessment, and smart farming decision-making.