**Predicting Optimal Harvest Times in Indonesia Using Deep Learning Models**

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**1. Introduction**

Indonesia, particularly Java Island, is rich in natural resources, including fertile volcanic soils and a diverse climate, supporting a wide range of crops. However, the island's agricultural sector faces significant challenges due to highly variable weather patterns and the growing impact of climate change. Precise management of planting and harvesting times is crucial to avoid losses and maximize yields.

As highlighted by Indonesian Foreign Minister Retno L.P. Marsudi at the recent ASEAN-Canada meeting in Vientiane, Laos, food security is a pressing global and regional issue. The dynamic weather conditions complicate agricultural planning, necessitating international cooperation. Canada, with its advanced agricultural sector, is a strategic partner for ASEAN in enhancing food security through sustainable practices.

This research aims to develop a predictive model using deep learning, incorporating data from Automatic Weather Systems (AWS) and detailed land surveys. The model seeks to improve the accuracy of weather forecasts and optimize agricultural activities' timing, thereby supporting better decision-making for farmers in Java. This initiative aligns with the ASEAN-Canada Joint Leaders' Statement on Strengthening Food Security and Nutrition, promoting technological collaboration to enhance agricultural resilience and sustainability in response to crises.

**2. Problem Statement**

Java's agriculture is heavily influenced by unpredictable weather patterns, which are further exacerbated by climate change. This variability makes it difficult for farmers to plan planting and harvesting schedules effectively, leading to suboptimal yields and potential crop failures. There is a pressing need for accurate and timely weather forecasts to optimize agricultural practices and improve productivity.

**3. Purpose of the Study**

The main objectives of this research are:

* **Developing a Predictive Model:** Utilize Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks to analyze and forecast weather and land data, aiming to predict optimal harvest times in Java.
* **Enhancing Agricultural Efficiency:** Provide farmers with actionable insights to optimize planting and harvesting schedules, thereby improving crop yield and quality.
* **Adapting to Climate Change:** Develop strategies to mitigate the adverse effects of climate variability on agriculture, using advanced data analysis and forecasting techniques..

**4. Required Tools and Technologies**

* **Data Sources:** Automatic Weather Systems (AWS), satellite imagery, and agricultural surveys.
* **Software:** Python programming language, TensorFlow and Keras for deep learning model development, and GIS software for land data analysis.
* **Hardware:** High-performance computing resources for model training and data processing.

**5. Methodology**

**Data Collection:**

* **Weather Data:** Historical and current weather data, including temperature, rainfall, humidity, and wind speed, will be sourced from local meteorological stations and global datasets.
* **Land Data:** Information on soil type, topography, crop type, and land use patterns will be obtained from agricultural surveys and satellite imagery.

**Data Pre-processing:**

* Weather and land datasets will be cleaned and normalized. Spatial data will be mapped and aligned with temporal data to ensure coherent analysis.

**Model Development:**

* **CNN Component:** The CNN will process spatial data, identifying features such as soil fertility and land topography that influence crop growth.
* **LSTM Component:** The LSTM network will handle time-series data, forecasting future weather conditions and their impact on crops. The combination of these networks will enable the model to learn both spatial and temporal dependencies in the data.

**Training and Validation:**

* The model will be trained on historical data, with a validation set reserved to test its predictive accuracy. Key performance metrics will include mean absolute error (MAE), root mean squared error (RMSE), and R-squared (R²) values.

**6. Expected Outcomes**

* An accurate prediction model for planting and harvesting periods.
* Scalable models applicable to other regions and agricultural contexts.
* ⁠Enhanced agricultural productivity and efficiency.

**7. Conclusion**

This research aims to leverage deep learning and data analytics to tackle the challenges posed by Java's dynamic climate and enhance agricultural productivity. By providing precise and actionable weather forecasts, the study will support local farmers in making data-driven decisions, contributing to sustainable agricultural practices in Indonesia.

**8. References**

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