Backscatter Analysis Using Multi-Temporal Sentinel 1A Data for Monitoring Rainfed and Irrigated Rice Ecosystems

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Rice is a significant staple food crop worldwide, with over half of the global population relying on it for sustenance. In 2016, it fed 4 billion people, which is 56% of the world's population (RICE, n.d.). Rice is grown under different planting conditions and methods, leading to its diverse ecosystem. The rice ecosystem can be classified into four major types: irrigated, rainfed, upland, and flood-prone (IRRI, 1993). Accurate and reliable information on these diverse rice productions is crucial for monitoring, research and development support, and policy decision-making, such as importation. In recent years, remote sensing has proven to be an invaluable technique for monitoring and estimating paddy rice. Rice information such as area and start-of-season maps can be generated using a variety of approaches, including several algorithms and data sources. Using Synthetic Aperture Radar (SAR) data is one of these methods. Using SAR data can solve the problem of cloud cover during rainy or wet seasons when more than 70% of rice is produced (Nelson et al., 2014). The purpose of this study was to analyze the multi-temporal Sentinel 1A data to monitor two major ecosystems, irrigated and rainfed rice. Analyzing Sentinel 1A backscatter time series data and comprehending the differences can provide an opportunity to delineate the two ecosystems.

The Philippine Rice Information System (PRiSM) monitoring fields in the Philippines' provinces of Ilocos Norte and Camarines Sur were used in the study. PRiSM is an operational rice monitoring system in the Philippines that uses satellite imagery and information, and communication technology (ICT). Both provinces have irrigated and rainfed rice ecosystems, however, they have different types of rainfed ecosystems. Rainfed rice farmers in Batac City, Ilocos Norte, plant once a year during the wet season, whereas those in Pamplona, Camarines Sur, plant twice a year. Images from Sentinel 1A were downloaded and pre-processed using the mapscape program (sarmap SA Switzerland) from 2014 to 2022. Using open-source GIS software (QGIS), backscatter (dB) data were extracted from pre-processed images.

Based on the results, an irrigated rice ecosystem exhibited 2 temporal backscatter signatures of rice in a year. In contrast, the rainfed rice ecosystem can be divided into two types, with just one and two temporal backscatter signatures of rice per year. One temporal rice backscatter signature can be observed in Ilocos Norte, which farmers plant once a year during the wet season. The planting season in the Philippines is divided into two seasons, the dry season (March 16 – September 15) and the wet season (September 16 – March 15). Detection of start-of-season or flooding event in VH polarization is better compared to VV polarization. The regression analysis results of start-of-season (SOS), peak-of-season (POS), and end-of-season (EOS) backscatter values showed accuracy levels that are promising to be used in monitoring the two ecosystems.

Monitoring the two ecosystems, rainfed and irrigated rice will help provide accurate and timely data to ensure the proper distribution of government support and dissemination of appropriate technologies for each ecosystem, as each ecosystem has varied technology requirements to maximize yield.

Keywords: multi-temporal Sentinel 1A, backscatter analysis, rainfed and irrigated rice ecosystems