Integrating FORMOSAT-2 high-temporal and high-spatial imagery with field data to monitor growth and estimate yield of rice crop

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Abstract

Estimating the annual yield of rice is one of the most important applications of remote sensing in Taiwan. In the mid 1980s', at least half of the gross domestic product contributed by agriculture in Taiwan came from rice. The demand of an efficient approach to investigate and estimate crops yield in a large scale, particularly for rice crop, initiates the development of remote sensing techniques afterwards. Nowadays, taking the aerial photos of rice paddy over the island of Taiwan has become a regular task operated once or twice per year. The application of these aerial photos in estimating crop yield is limited by their low-temporal resolution, expensive cost and time-consuming data processing. Attempts have therefore been made to use various satellite images to replace the aerial photos in the recent years, with the sacrifice of spatial resolution, yet the same limitations still impede the application of remote sensing in yield estimation.

The successful operation of FORMOSAT-2 proved the concept that the temporal resolution of a remote sensing system can be much improved by deploying a high spatial resolution sensor in a daily revisit orbit. Therefore, the aforementioned limitations of remote sensing in estimating crop yield can be completely removed by employing the FORMOSAT-2 high-temporal and high-spatial imagery. This research follows the approach proposed by Yang et al. (2005) to integrate the FORMOSAT-2 observations with a comprehensive dataset collected in the field, with the intention to monitor growth and estimate yield of rice crop. The field experiments were conducted at Taiwan Agricultural Research Institute Experimental Farm at Wufeng in the first and the second cropping seasons of 2006. The leaf area index (LAI), yield data, crop development stage, and the hyperspectral reflectance (R) in the rice paddy were measured and recorded at the interval of about two weeks. A total of thirty-six multispectral images of the study area taken by FORMOSAT-2 during the growing

periods were processed by band-to-band coregistration, spectral preserved pan-sharpening, automatic orthorectification, multitemporal imagery matching and radiometric normalization. These FORMOSAT-2 images provide us the information of NDVI, and hence the LAI of rice paddy at different stages of growth. Finally, the yield of crop was estimated by accumulating FORMOSAT-2-derived LAI. The result was compared to the actual amount of yield at harvest. This research demonstrates the potential of FORMOSAT-2 high-temporal and high-spatial images in monitoring rice growth and estimating crop yield.