Mixture Analysis of Abandoned Paddies Using Multi-temporal MODIS and Landsat-8 OLI Data

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Increase of abandoned farmlands is gaining attention in Japan as a problem causing difficulties such as: expansion of breeding habitat potentially preferred by vermin; increase of small parcels where illegal dumping occurs; and deterioration of rural landscapes. To address this problem, it is important to periodically survey the extent and distribution of abandoned farmlands over a broad spatial range. However, conventional surveying methods are labor intensive and time-consuming, requiring surveyors to cover every parcels often situated in hostile locations.

Remote sensing provides us with a low cost, repeatable alternative means for broad-scale mapping of abandoned paddies. A previous study suggested that Normalized Difference Vegetation Index (NDVI) derived from remotely-sensed data could have potential to discriminate an abandoned paddy from a paddy area since the difference in NDVI becomes significant at the period s of one month after planting and two months after harvesting. Normalized Difference Water Index (NDWI) was also applied successfully to detecting changes in agricultural activity in a paddy area. However, the success of previous studies depends on acquiring data not affected by cloud contamination at the suitable timing in terms of crop calendar. To avoid adverse effects of cloud contamination and the variability of crop calendar we proposed the use of MODIS NDVI and NDWI time-series. However, the typical size of abandoned paddy is quite small when compared to the MODIS spatial resolution.

The objective of this study is to assess the detection limit of an abandoned paddy using the time-series data derived from MODIS surface-reflectance products. First we refined the MODIS reflectance time-series by removing the effects of cloud contamination based on the Savitzky-Golay filter applied to NDVI time-series. Second a simple linear mixture model was employed to estimate the reflectance time-series of pure pixel for each of the underlying end-member land-cover types using the landcover map derived from Landsat 8 OLI data as a reference. Third we simulated a set of temporal signatures of NDVI and NDWI for mixed pixels, assuming that areal fraction of abandoned paddy varied gradually from 0 % to 100 % at different end-member compositions. Finally we explored the minimum fraction of abandoned paddy in a pixel, where the signal relevant to cessation of agricultural activity might be detected. Preliminary results showed that successful detection could be limited to the pixel dominated by abandoned paddy areas.

Keywords: Mixture Analysis, Abandoned Paddy, MODIS