USING MULTI POLARIZATION AND MULTI DATE SAR DATA TO AREA ESTIMATE [1]OF IRRIGATION RICE

Thitawadee Suvachananonda[1], Thanwarat Anan[2], Yootthaphum Phothiracha[3]

Anusorn Rungsipanich[4] and Chaowalit Silapathong[5]

Geo-Infomatics and Space Technology Development Agency

120 The Government Complex Commemorating His Majesty, the King's 80th Birthday Aniversary, 5th December, B.E. 2550 [2007] Building B 6th and 7th Floor, Chaeng Wattana Roda, Lak Si District, Bangkok 10210, Thailand;Tel. +66 [0] 2141 4549 Fax. +66 [0] 2141 39605

Email: [1]thita@gistda.or.th, [2]twarat@gistda.or.th, [3]ypoti@gistda.or.th, [4]rnusorn@gistda.or.th, [5]chaow@gistda.or.th

KEYWORD: irrigation rice, Multi polarization, Multi SAR date, Rice state, C-band, supervised classification

ABSTRACT: With the advent of polarization spaceborn Synthetic Aperture Radar (SAR) system on RADARSAT-2, the interest in simple, robust and accurate polarimetric classification parameter estimation algorithms for monitoring applications is increasing.

The study area is located in Supan Buri Province where central part of Thailand which the most important agriculture is planting rice. This paper addresses the irrigation rice classification capabilities of quad polarization from C-Band frequencies of RADARSAT-2 SAR acquired in February and March 2011 respectively. A variety of polarization combinations would be investigated for irrigation rice field classification which shown the different consistent sets of C-band backscattering coefficients and temporal set. Thus, this allows optimally selecting the combination of polarizations for rice field classify at different stage. The basic classification was training sets that selected from the ground truth map. Pixels in training sets are used for supervised classifications. To evaluate quantitative classification accuracy used ground survey. The results can be use to prototype for its application in examining other areas in Thailand.

1. INTRODUCTION

Monitoring, estimating and forecasting agricultural production are very important for the management. Satellite Image from optical sensors has been expected to be used to monitor rice-growth and estimate rice-planted area. But, that hardly have been able to get necessary data at a suitable timing due to cloud cover problem during rice planting season (Suga Y.,*et al*., 2000). Therefore radar remote sensing has the potential to play an important role in agricultural rice monitoring due to its independence from solar illumination and cloud cover, besides its sensitiveness to canopy geometry and moisture content (Panigrahy S. *et a*l.,1997). Also in the advent of polarimetric SAR systems on RADARSAT-2 (C-band), the interest in simple and accurate for classification rice areas and estimated (Dirk H.,2003).

The backscatter intensity of C-band SAR from RADARSAT-2 images is rather sensitive to surface roughness condition, from non-cultivated bare soil condition and to the change of a growing period of rice. Rice growth refers to the status in the respective growth cycles of different and their changing pattern. Rice growth reflects the growth of seedlings, an early stage in rice's growth, as well as the phased of each rice and changing trends in its yield.

Therefore, rice area estimation is expected to be realized in an early stage, namely only after rice planting or earlier than one month after rice planting.

In this study, using a multi-polarization and multi-temporal classification to investigated the temporal change of SAR backscatter of RADARSAT-2 on fine resolution quad-polarization beam mode images. To estimate rice-planted area in an each stage after rice planting and evaluated the actual performance for rice area estimation and evaluated the actual performance for rice area estimation by ground truth.

2. TEST SITE AND DATA SET

The test site area located at a part of Supan Buri Province in central part of Thailand where important zone for irrigation rice planting because this area is basin and have good irrigation system. Therefore farmer are planting three or four period in each year. A total of two multi-temporal on RADARSAT-2 fine resolution quad-polarization beam mode images in incidence angle 41.23˚ (FQ22), taken on 23 February and 19 March in 2011 in ascending pass, are used as the test site data. An example of multi-temporal RADARSAT-2 images in a test site are shown in Figure 1

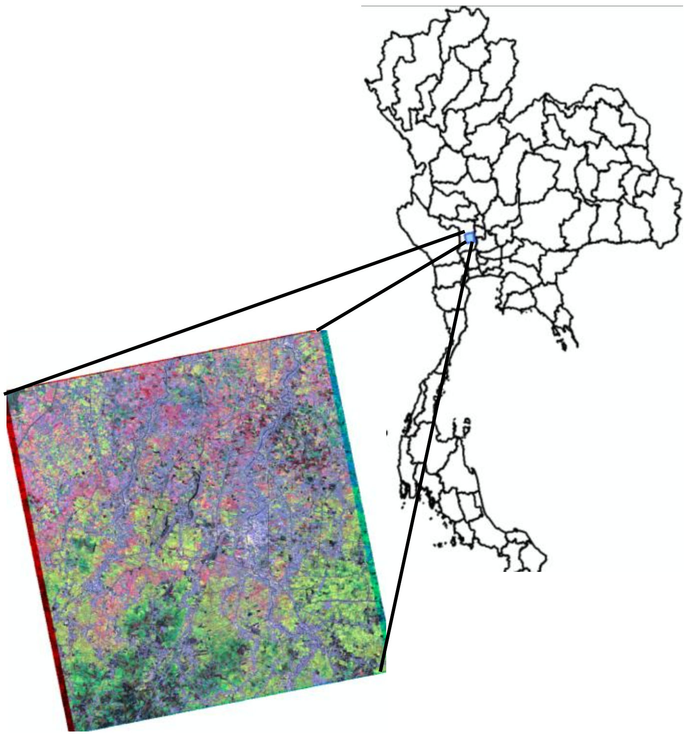

Figure 1 Images used for study in a part of Supan Buri Province, Thailand on the color composite of HH (23Feb) in red filter HH (19Mar) in green filter and HV (19Mar) in blue filter.

3. DATA PROCESSING

3.1 Processing of SAR Data

In this study was using NEST, open source software from ESA to extract the radar intensity from RADASAT-2 product. The RADARSAT-2 images were processed from Single Look Complex (SLC) product. Step of process include product reader, radiometric correction, because this step was necessary for the comparison of SAR images which acquired with different sensors, or acquired from the same sensor but at different times, in different modes, or processed by different processors (ESA2009). Then the images were filtered by using Lee filter with 5 by 5 moving window. Thereafter images merge from two input images by spatial registration and resampling to correct translational, rotational and scale differences, using automatic coregistration, the one image was selected as the master image while the others were slave images. As the SAR images are much distorted by foreshortening due to topography variations of a scene and the tilt of the satellite sensor, distances can get distorted in the SAR images. So the SRTM was used to correct.

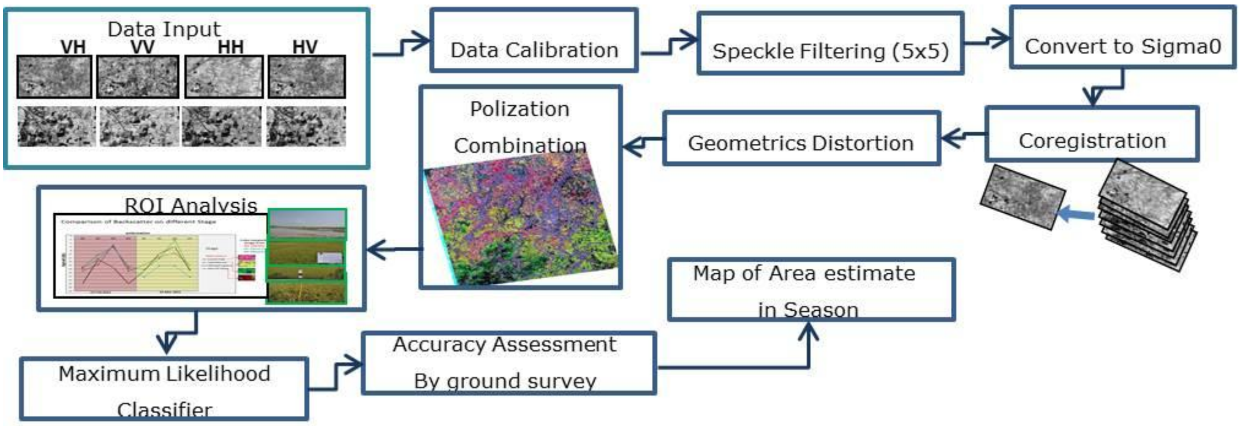

Figure 2 Flow diagram of SAR process to estimate area of irrigation rice.

3.2 Extraction of Rice Stage from SAR Backscatter

The stage changing patterns of SAR backscatter from RADARSAT-2 in several rice-planted sample areas using area of interest from field survey shows in Fig.3, The rice stage showed a significant change of backscatter in tillering to maturity stage from February to March. The backscatter changing in each period was considered due to the change of its surface condition.

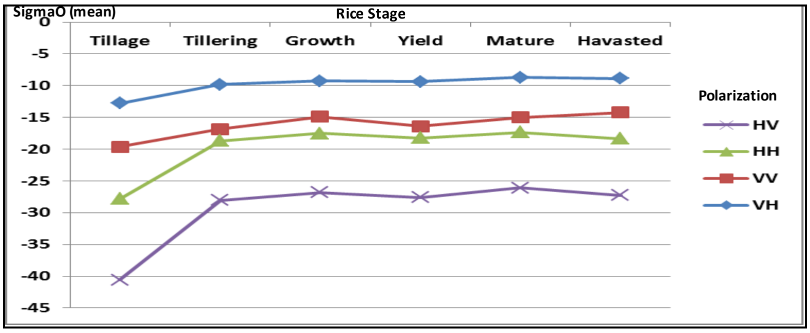

Figure 3 Comparison of backscatter on different rice stage.

From Fig.3 low backscatter in tillage stage because the field flooded or poor canopy coverage, the rice fields appeared very dark. In the next stage, tillering growth yield and mature the backscatter appeared higher respectively in the images is bright and final stage lower in harvested in the field appeared gray.

3.3 Extraction of Rice-Planted Areas

In Fig. 4 rice-planted areas was possible to be extracted using backscatter changes, from early period of rice planting season to harvest by using multi-temporal images. Therefore this study selected the color composite on multi-polarization and two temporal in HH on February HH and HV on March to classified areas. Rice-planted area were extracted using supervised classification by maximum likelihood (ML) classifier, conducted land cover classification including rice category using the merged images of two images, namely three channel images in which each channel indicates each polarize image.

The result showed estimated areas in four periods. There was the areas estimated from February to May in the color composite on red, magenta yellow and green respectively, that can be calculate to used in marketing management.

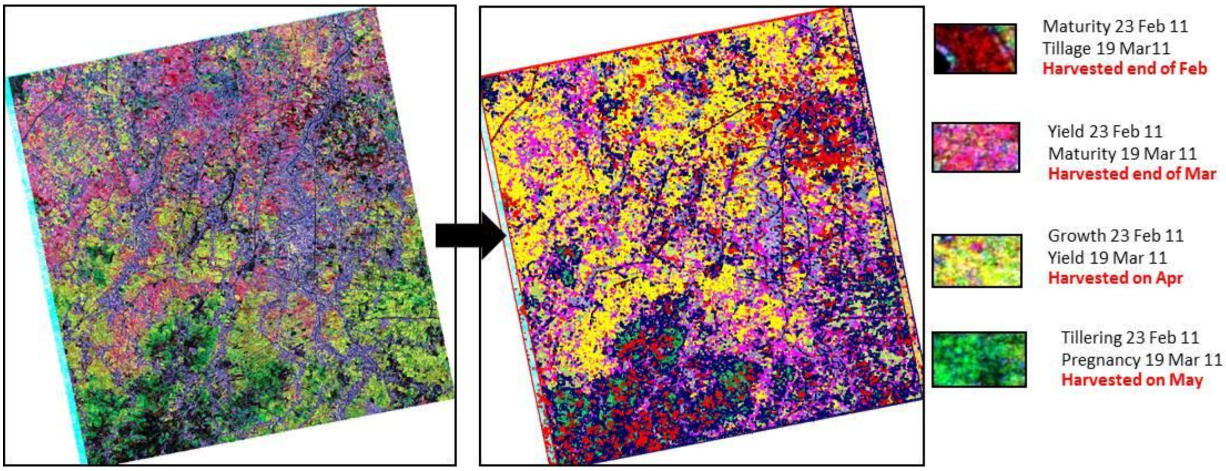

Figure 4 Result from ML classifier shows rice areas estimate in season.

4. CONCLUSIONS

Rice-planted area extraction was attempted using multi-temporal and multi-polarization from RADARSAT-2 data taken in an early stage of rice growing season. The overall rice distribution patterns extracted by RADARSAT-2 showed a fairly good coincidence with those by field survey. However, by a quantitative evaluation, the rice area estimated

REFERENCE

Dirk H. Hoekman, 2003. A New Polarimetric Classification Approach Evaluated for Agricultural Crops, pp.2881-2889.

Panigrahy S., Chakraborty M., Sharma S.A., Kundu N., Ghose S.C. and Pal M.,1997. Early Estimation of rice area using temporal ERS-1 Synthetic Aperture Radar Data – A Case Study for the Hwwrah and Hughly Districts of West Bengal, India. pp.1827-1833.

Suga Y.,et al., 2000. Monitoring of Rice-planted Areas using Space-borne SAR Data, IAPRS2000 proceedings, pp. 1480-1483