Standardizing Agriculture-related Information Scheme at Various Spatial Resolutions of Remote Sensor Data

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Abstract: This study is to present a standardized scheme for providing agriculture-related information at various spatial resolutions of satellite images including LANDSAT +ETM, KOMPSAT-1 EOC, ASTER VNIR and IKONOS panchromatic (Pan) and multi-spectral (M/S) images. The satellite images were interpreted especially for identifying agricultural areas, crop types, agricultural facilities and structures. The results were compared with the land cover/land use classification system suggested by Ministry of Construction & Transportation based on NGIS (National Geographic Information System) and Ministry of Environment based on satellite remote sensing data. The results by IKONOS image will be provided to KOMPSAT-2 project for agricultural application.

Keywords: IKONOS, agriculture, KOMPSAT-2.

1. Introduction

In South Korea, even though satellite images have been recognized to have a potential for practical use in the field of agriculture, there have been many constrains in obtaining, designing, and analyzing images because of high prices, little images of temporal series, and coarse spatial resolutions for agricultural applications. Fortunately, the government perceived the importance of earth remote sensing satellite of our own, KOMPSAT-1 (Korea Multi-Purpose Satellite I) launched at 1999 is in operation and KOMPSAT-2 is scheduled to be launched at 2005. It is expected that a lot of agriculture related information can be obtained from the 1 m resolution Pan and 4 m resolution M/S images of KOMPSAT-2, and furthermore the images will play a role to update GIS data and activate data use for agriculture. The purpose of this study is to present a standardized scheme for providing agriculture-related information at various spatial resolutions of satellite images.

2. Remote sensor data and preprocessing

Part of Gosam-myeon, Anseong-si that has a diverse agricultural environment was selected. Table 1 shows the selected images to evaluate agriculture-related information from various spatial resolutions. IKONOS

Table 1. The selected satellite images and their rectified results.

Images	Res. (m)	Date of Acquisition	GCP	RMSE(m) X / Y / Z
IKONOS Pan	1	20010525	513	3.40/3.38/1.07
IKONOS MS	4	20010525	499	1.54/1.69/0.25
IKONOS Pan	1	20011225	509	3.12/3.10/0.75
IKONOS MS	4	20011225	497	0.73/1.05/0.12
KOMPSAT EOC	6.6	20020626	32	2.50/2.73/1.05
ASTER VNIR	15	20020311	22	5.47/1.35/1.49
LANDSAT 7 ETM+ Pan	15	20010603	18	3.29/4.01
LANDSAT 7 ETM+ MS	30	20010603	18	3.23/4.01

Standard Geo Level images were ortho-rectified by using 1:5,000 NGIS digital map and GPS data acquired by Trimble GeoExplorer III. Generic Pushbroom Model of ERDAS IMAGINE OrthoBASE 8.5 was used. Other images were corrected by method of image to image based on ortho-rectified IKONOS image.

3. Comparison of field investigation and satellite imageries at various spatial resolutions

Field investigation was carried out to check the crop types, canopy status, agricultural facilities and structures at the same time of IKONOS image acquisition. The investigated results were compared with IKONOS Pan image, and evaluated items that can be identifiable in IKONOS Pan image. The items determined from IKONOS 1 m image were compared with other satellite images from 4 m to 30 m spatial resolutions (Table 2).

4. Suggestion of agriculture-related land cover classification at high spatial resolution

Results of the previous section were compared with the land use and cover classification system suggested by Ministry of Construction and

Table 2. Results of identifiable agriculture-related items at various spatial resolutions

Classified items		1 m	4 m	6 m	15 m	30 m
paddy	consolidated	●	●	●	●■	●■
	not consolidated	●	●	■◎	◎	◎
	green house	●	●	■	◎	◎
upland	mulching	●	■◎	×	×	×
	upland crop	●■◎	■◎	◎	×	×
	orchard	■◎	■◎	◎	◎	×
grass	pasture	●■	●■	■◎	◎	×
	grass land	■◎	■◎	◎	×	×
	golf course	●	●	●	■	■
reservoir	small scale	●	●	●	■◎	◎
	middle scale	●	●	●	●	●
	weir	●■◎	●■◎	■◎	◎	×
canal	main canal	●	●	◎	◎	×
	branch canal	●	●■	◎	◎	×
	offset canal	■◎	◎	×	×	×
	vegetation canal	●■	■◎	×	×	×
road	national road	●	■	◎	×	×
	rural road	●	■◎	◎	×	×

Note) (●) identifiable, (■) identifiable, but need field investigation to determine the type, (◎) presumable, (×) not presumable
1 m: IKONOS Fusion Color, 4 m: IKONOS MS, 6 m: KOMPSAT Fusion Color, 15 m: ASTER VNIR, 30 m: LANDSAT 7 ETM+ MS

Table 3. Land cover classification scheme for agriculture at 1 m spatial resolution image

Class	Code	Detailed items
Paddy	111	Consolidated paddy
	112	Green house in consolidated paddy
	121	None consolidated paddy
Upland	211	Upland crop
	212	Mulching
	221	Feed crop
Grass	311	Grass land
	312	Other grass land
	321	Golf course
Water	411	Stream
	412	Wetland
	421	Reservoir
Bare	511	Settlement and pastoral
	512	Bare ground
	513	Other bare ground
	521	National road
	522	rural road
Forest	611	conifer forest
	621	broad-leaved forest
	631	mixed forest

Transportation based on NGIS and Ministry of Environment based on satellite remote sensing data. Table 3 presents a standardized scheme for agriculture-related information at 1 m spatial resolution satellite image.

5. Conclusions

A preliminary study was conducted to use KOMPSAT-2 images without delay for agriculture purpose. IKONOS images were tested what levels of agriculture-related information can be extracted. Field investigation was carried out and evaluated items that can be identifiable at various spatial resolutions of satellite images based on IKONOS Pan image. The results were compared with the government suggested land cover/land use classification systems, and it concluded that agriculture-related items were classified to level III from IKONOS Pan image.

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