

LAND COVER CLASSIFICATION FOR FUTURE-ORIENTED DEVELOPMENT PLAN OF MULTIFUNCTIONAL ADMINISTRATIVE CITY OF KOREA

Han, Seung-Hee^{a,*}, Lee, Jin-Duk^b

^{a,*}Dept. of Civil & Environmental engineering, Kongju National University, Seoul KOREA - shhan@kongju.ac.kr

^bDept. of Civil & Environmental engineering, Kumoh National Institute of Technology, Seoul KOREA - jdlee@kumoh.ac.kr

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ABSTRACT:

In this study, land cover classification and NDVI evaluation are carried out in surrounding areas of Yeongi-gun, Chungcheongnam-do (132km²) where a project for multi-functional administrative city is promoted by the Korean government. Image acquired from KOMPSAT 2, LANDSAT and ASTER is utilized and comparative evaluation on limitation in classification based on resolution was carried out. The area mainly consists of arable land including mountains, rice fields, ordinary fields, etc thus special attention was paid to the classification of rice fields and ordinary fields. For the classification of image acquired from KOMPSAT 2, segmentation technique for classification of high-resolution image was applied. To evaluate the accuracy of the classification, field investigation was conducted to examine the sample and it was compared with the land usage and classification of land category in land ledger of Korea. Acquired results were made into theme map in shape file format and it would be of great help in decision making of policy for the future-oriented development plan of multi-functional administrative city.

1. INTRODUCTION

1.1 General Instructions

To acquire recent middle classification land coverage, coverage classification using high resolution satellite image is effective method. However, in case of applying the high resolution image to previously pixel based coverage classification method. In case of high resolution panchromatic image or multi-spectral image, necessary information shall be extracted based on spatial/spectral traits. It is trend to classify using the region of interest defined as the spatial/spectral traits and surface traits in image, namely, object based classification method.

In this study, not only classification with previous pixel based classification method regarding the Seijong-si, the multi-functional administrative city, using Aster image but also object based coverage classification using high resolution image of KOMPSAT2 was carried out. Also, it shall be compared with the result of image classification using the naked-eye distinction and spectral traits for the verification on coverage classification of high resolution image. Also, land use thematic map was created using the land category of cadastral map and it was compared with result of coverage classification.

2. OBJECT BASED CLASSIFICATION

When applying high resolution image to previous pixel based classification method, it is difficult to use with variation of each trait of pixel since it is classified in scatter. Namely, high resolution image has severe spectral variation and there is limitation for classification in unit of pixel. Ultimately, previous classification algorithm has no meaning in high resolution. (Van der Sande, et al.,2003). Therefore, it is a strategy to

classify large unit in previous unit of pixel and apply spatial classification method in unit of shape for small unit. In this study, object based classification method as Figure 1 was applied. Looking into the stage of classification in Picture 1, region of pixel is separated by determining the cluster size to classify segment regarding the image, namely resolution. Determination of resolution cannot be complete at once and it should go through trial & error process based on experience. The next stage is to calculate the attributes of each region such as spatial, wavelength, band ratio, etc and save the data to memory. Supervised classification rule based classification is processed after defining the objects within image. Rule based classification is the method to grant the attribute by rule set intervened of subjectivity of operator with form of segment, NDVI, texture, ratio of length and height.

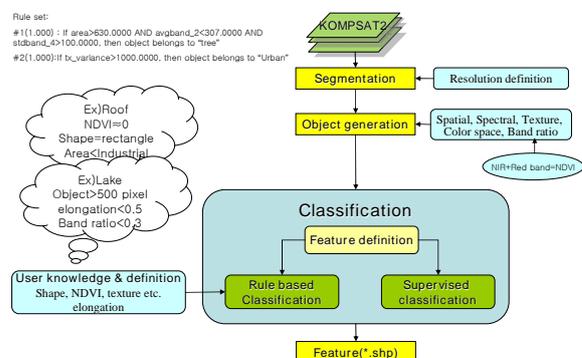


Figure 1. Workflow for Objected based classification

Target region

It is the region about 12km toward east & west and about 11km toward south & north among construction target region for multi-functional administrative city (Seijong-si) of Korea. (Figure 2) It is total 72.996 in area including Yeongi-gun (3 myeon and 28 ri) and Gongju-si (2 myeon and 5 ri) in aspect of administrative region.

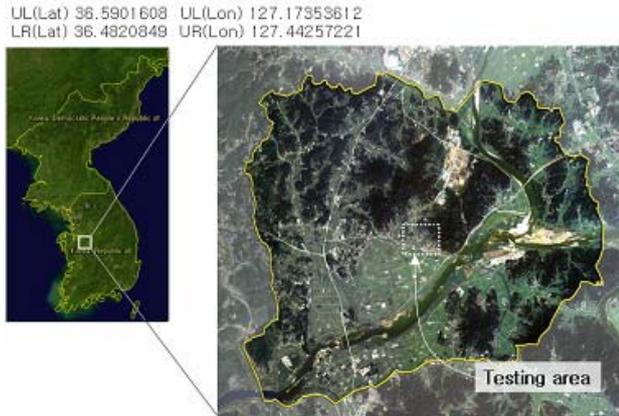


Figure 2. Testing area

3. EXPERIMENT

3.1 Image

Aster image used in pixel based classification is most high in resolution and it is VNIR image providing 15m resolution in visible range and near infrared and multi-purpose satellite KOMPSAT2 image of Korea is used for classification of high resolution image. The satellite was launched on Jul. 28th 2006 and MSC with capacity for panchromatic 1m, multi-spectrum 4m and swath width of resolution 15km in sun synchronous orbit of orbital altitude of 685km. Acquired image is *ID: msc_071005015048_06336_10811273_PS image taken on Oct. 5th, 2007 and high resolution 1 m color image is acquired with HPF image fusion method. Geometrical correction was process of affine conversion selecting the 25 points from 1:1000 topographic map. Image re-sampling was completed with nearest neighbor method. Also, ortho rectification was processed using the 1m DEM data acquired from contour line.

3.2 Pixel Based Coverage Classification

1) Low Resolution Image Coverage Classification

Supervised classification was carried out for pixel based

Table 1 Pixel based classification accuracy

Overall Accuracy = (73364/77817) 94.27%
Kappa Coefficient = 0.8664

Class	Ground Truth (Pixels)				
	Road	Forest	Cultivation	Water	Residence
Unclassified	0	0	0	0	0
Road	5437	9	14	54	30
Forest	1	29174	5	17	19
Cultivation	104	77	23114	983	300
Water	70	17	233	9367	59
Residence	211	253	208	804	6272
Total	5823	29530	23574	11225	6680

coverage classification based on Aster image. (Han.2006)

5 ROI, vegetation (cultivation), road, water, forest, residence class is set using maximum likelihood algorithm and 35 training data sets were designated. Overall accuracy of 94.27% and Kappa coefficient of 0.86 were acquired.

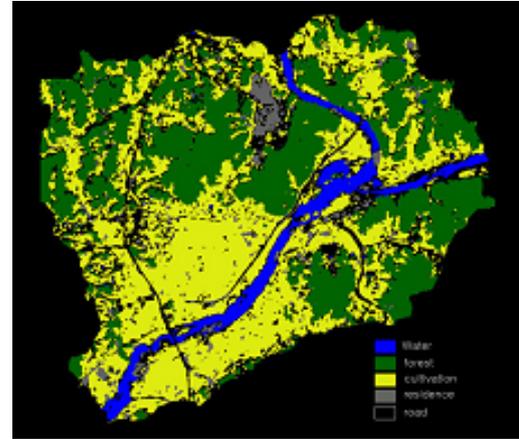


Figure 3 Land coverage map using Aster image

2) High Resolution Image Coverage Classification

To increase the accuracy of classification using high resolution image, object based classification method was applied. Land coverage map was drawn up as result of classification to compare the accuracy of classification and it is produced as raster data. Also, accuracy was compared by producing the land used map with GIS technique using land category provided in cadastral map and distribution rate for each class. Data processing work flow chart is as figure 4. RXD detector was used for extracting algorithm. RXD is the algorithm verified that it is clearly effective in detecting the opaque and non-transparent object and dead pixel or line does not have influence in detection though it is abnormally generated. (Chang et al. 2002) (Reed.I.S & X. Yu,1990)

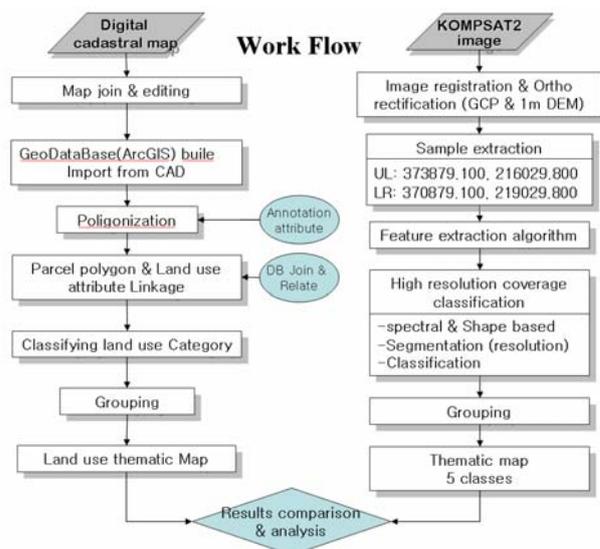


Figure 4. Work flow of study

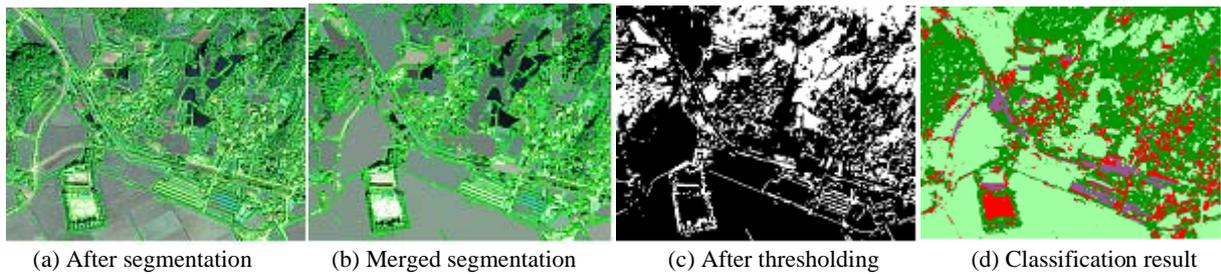


Figure 5 Result of each processing step

As explained in previous section, classification method considering the spectral trait and object-based is appropriate for classification technique of high resolution image and general process is as Picture 4. Since capacity of image for total target region is large and considerable processing time is consumed, test was carried out by sampling the housing concentrated area. In this process, determination on factor for each classification stage is attempted.

Figure 5(a) presents the test sampling region for coverage classification among target region and (b) is the image segmented by setting proper scale. As a result, road, building, forest, etc were detected. It is the image displayed with average value of segments after combining adjacent segments, Figure5(c) presents the allotted value for each segment of sample region and final classification image was sought after granting the color to each ROI after determining the threshold so that segments can be classified well.

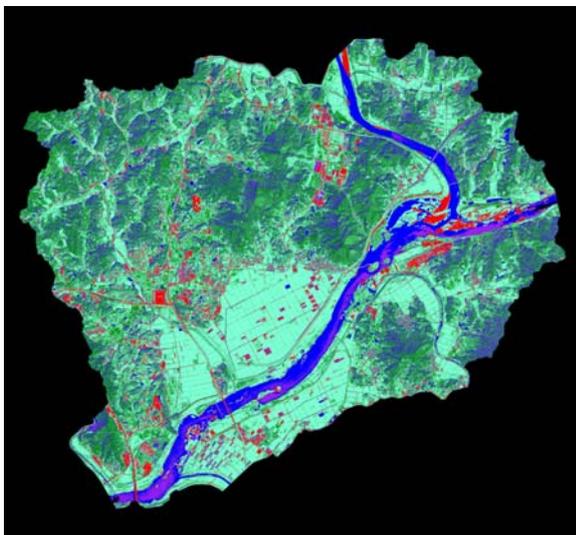


Figure 6 Final result

Land use	Ratio I
residential area +road	8.5%
cultivate site	32.2%
forest	44.5%
water	14.8%

Table 2 Classification ratio

It was classified that 8.5% was residential read and road, 76.7% was forest and cultivate site and 14.8% was water. Since it was filmed in October, agricultural products were abundant in overall cultivate site but it could be classified together in aspect of forest and vegetation index thus it was harvesting period. It was classified as 32.2% of cultivate site and 44.5% of forest.

3.4 Land Used Map

Land category was extracted and symbol color was granted for each land use using ArcGIS Desktop 9.2 from annotation



Figure 7 Land use map

among layer of 1:1000 cadastral map. Land use map was created as Picture 11 classifying 21 land categories and non-classified as null. Grouping was carried out to compare the land coverage classification using image and it was combined as 5 classes as Diagram 5.

Land use	Parcels	area()	Ratio II
residential area	4289	4482367	6.2%
cultivate site	15679	24301324	33.4%
water	2558	11440853	15.7%
forest	4757	29880693	41.0%
road	3549	2460073	3.4%
null	153	245956.6	0.3%
	30985	72811267	100%

Table 3 The number of parcel and area with respect to class

Ratio of each class was acquired as residential area: 6.2%, cultivate site: 33.4%, water: 15.7%, forest: 41%, road: 3.4% and null: 0.3% from total region.

4. COMPARISON & ANALYSIS ON ACCURACY

Seek the area by counting the number of pixel that each class occupies in land coverage classification map of figure 6 and it was compared with ratio to total area (Table 2. Ratio I) and area ratio of land use (Table 3. Ratio II). It was presented that residential area and road is +1.1% with 8.5% and 9.6%, cultivate site is +1.2% with 33.2% and 33.4%, forest is -3.5% with 44.5% and 41.0% and water is +0.9% with 14.8% and 15.7%. In case of cultivate site present the most difference, it is analyzed to be due to ambiguities in classification with forest. However, total value of two classes are 76.7% and 74.4% showing relatively small difference of 2.3%. As a result, classification method applied is determined to be reasonable presenting the difference for each class between land coverage classification map and land use map of -3.5% ~ +1.2%.

5. CONCLUSIONS

1. With the pixel based coverage classification of Aster VNIR image, fair result such as Overall Accuracy of 94.27% and Kappa Coefficient of 0.8664 was acquired.
2. Difference for each class between land coverage classification map and land use applying object based classification method and RX detector is presented to be -3.5% ~ +1.2% thus it is determined that applied classification method is appropriate.

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