ABILITY OF COMBINING REMOTE SENSING DATA AND LAND USE RIGHTS REGISTRATION RECORDS IN LAND USE DATA ACQUISITION

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ABSTRACT

Land use data is one of the core data for land administration activities. At present, land use data users in Vietnam are facing two major issues: (1) the reliability and (2) the up-to-date of data at national level.

Remote sensing technology (RS), with its increasingly improved spatial, temporal, spectral resolution, becomes a potential tool to overcome the above issues. However, these results in RS application normally not comparative with the land use data supplied officially by land department.

This study presents a framework of using RS data combined with land registration records in land use data acquisition. By doing so, land use data is acquired more reliable and more comparative to official sources.

1 INTRODUCTION

Since land was considered as the most significant resource in civilian life, it must be acknowledged and managed adequately. Land use data (LU) in Vietnam is legally captured and distributed through land administration system (LA), which is organized at four levels namely nation, province, district and commune. LU is captured at communal level then aggregated and reported to district level, to provincial level, and national level.

This LU acquisition works have brought two major issues so far: (1) the reliability and (2) the up-to-date of data at national level. Recently, in the workshop of preparation for land use inventory for the year 2005, many opinions claim that land use information generalized from communal to national levels might have information reliability between 50-70% of the total data supplied, *(RSC-MONRE, 2003a).*

Remote sensing technology (RS), with its increasingly improved spatial, temporal, spectral resolution, becomes a potential tool in LU acquisition and objectives of both scientific researches and practical projects in Vietnam. Applying RS for land use detection can partly overcome above two problems for its independence in data acquisition and reliability of the final results.

However, these attempts in RS application were, if not limited on the land cover side, is facing with the difficulties to making its results compatible with data supplied officially through LA system. A RS research application at Ca Mau province has shown in some cases, the differences between data supplied by RS and the official sources (land department) are impossible to any further analysis. For example, the total area of aquaculture use is respectively 47 000ha and 25 000ha, as supplied statistics and RS sources *(RSC, 2003b).*

There are several researches attempted to overcome these difficulties. One of them is applying RS in combination with other sources such as land registration (LR) or land use statistics at any phase in land use detection, *(Thomas B., Klaus S., 2001)*. In this direction, *(Arikan, 2004)* has used land parcel as a narrower bound to calculate the ability of each kind of land use classe ability inside after following classification. This method has increased the accuracy of classification about 10% in comparison to the traditional method.

This paper, however, tries to use as much as possible land use data from land registration sources then applying RS to make further detail for land use detection later. This framework will be discussed in section 2 below.

2 LR-aided Classification approach

It can be shown in a recent research (*Trung, 2004)* that Vietnam LA is more interested in land use management. Therefore, land use information is captured at a certain level of detail in all disciplines and applications for LA. This research also proved quantitatively that LR captures LU at the highest geometrical accuracy and thematic accuracy corresponding the level III in four levels of Vietnam land use classification system (LUCS). That means that, geometrical information of LU in LR can fulfill all technical requirements in land use demand. Additional works need to make further detailed thematic information at level IV. In this case, RS is a potential technology to be employed.

Therefore, the main idea of LR-aided method is to use as much as available information derived from LR and the rest is added by RS technology. Particularly, from land registration (LR), land use data will be abstracted, generalized and aggregated to LU at class in level III of LUCS. Then, based on this, RS applied to detect LU at class level IV. The working flow of LR-aid approach is described in figure 1.

Firstly, LU is extracted from LR and generalized at 30 classes of LUCS (correspond to level III). In the side of image processing, some work can be done like geometric correction, sigma filtering. Secondly, inside farmland, vegetation, water and other types of land cover are detected. With the help of farmland boundary derived from LR, fused image was segmented close to the objects of interest. This segmented image was also divided into 3 types of land cover above by multiply with vegetation mask that was created from sliced NDVI image. This step allows us to distinguish cropland (already known in LR), water and others in satellite image, making the classification easier. Supervised classification with maximum

likelihood algorithm was chosen using 3 bands (3,5,4) of sub-image that were calculated with the lowest correlation in correlation matrix. Thus, cropland was classified into crops rice classes and sown land or more detail which could be known as multi-resolution segmentation procedure of hierarchical objects.

By doing so, the geometrical accuracy is confirmed and enhanced in the beginning phase of land use detection. In the other hand, image classification starts from level III leading more certainty in result than from level I of LUCS. Furthermore, the final results of image classification are more persuadable when it references on official land use sources (LR, land use statistics) since the beginning of the detection.

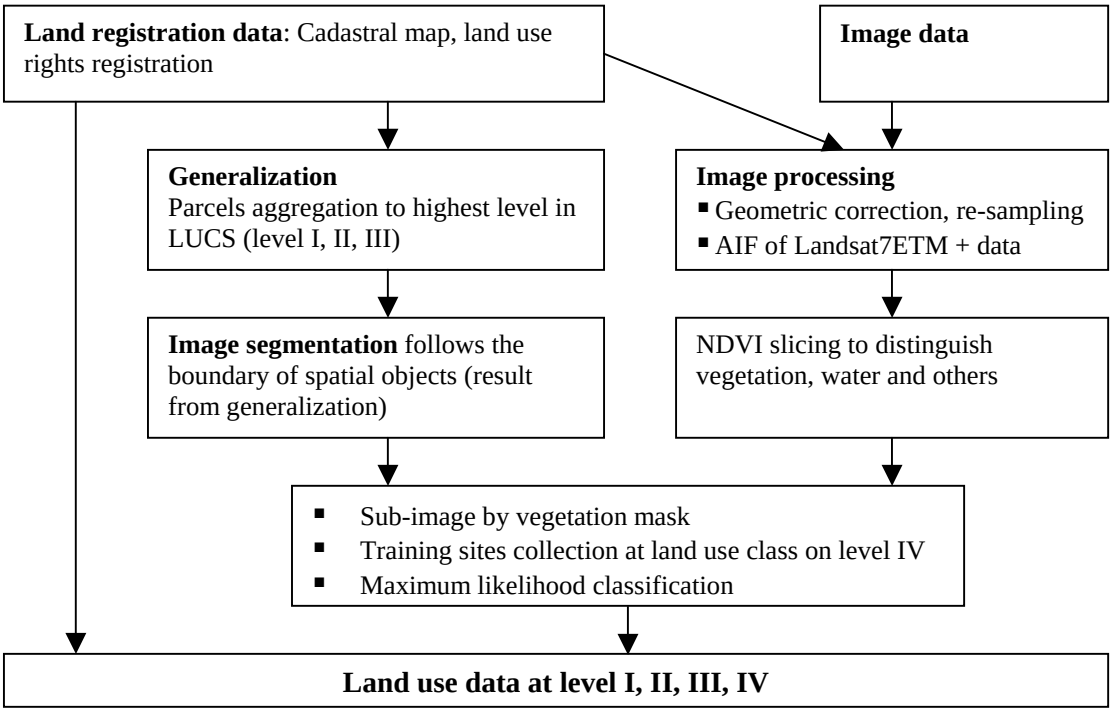


Figure 1. Working flow of LR-aid classification

3 FARMLAND CASE STUDY

3.1 Case study introduction

In order to experience with the above approach, a case study was carried out at Bac Ly commune of Ha Nam province in the Red river delta. Data used is Landsat 7 ETM+ acquired in September 2000. Land registration records, cadastral map and land use statistics are supplied by Ha Nam land administration department in the same year.

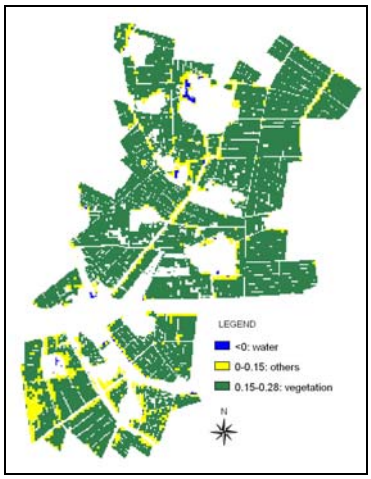
LR data is presented on map in figure 2.a. Image segmentation is in figure 2.b. Normalized different vegetation index (NDVI) image was created using band 3, 4 of Landsat 7ETM+. In order to create vegetation mask, NDVI image was sliced in 3 types: vegetation, water and others by threshold of NDVI value. Two separate sample sets of equal size selected

from these surveys, one for the NDVI signature sets for classification, and the other for the evaluation of classes.

The sub-image created by using farmland parcel boundary and vegetation mask derived from NDVI image must cover quantity of pixels enough for applying the supervised classification method. Vegetation mask was divided into crop rice and sown land according to the higher in spectral response of crop rice than sown land in the time of acquisition image. The detailed land use classes were given in the figure 3a. Meanwhile, a classification of the same area without LR data was performed for comparison (figure. 3b).

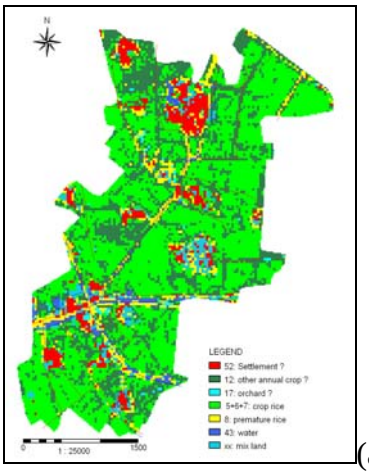
The accuracy of LR-aided classification method was calculated by confusion matrix to reach for nearly 92%, the accuracy of non LR-aided classification is around 81 %. When overlay parcel boundary on the result of non LR-aided classification, it is found that land use features scatter even in one parcel boundary while they are quite homogeneous in LR-aided classification's result. These results and verifications reveal that LR-aided classification is a feasible method to extract reliable land use data.


(a)

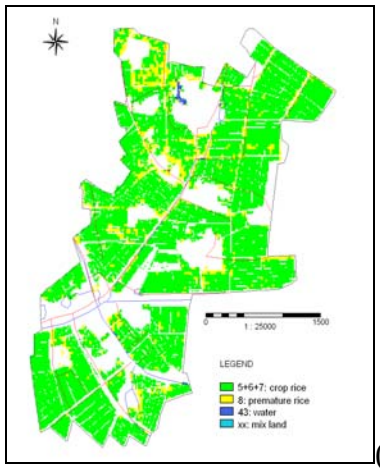


(b)

Figure 2. Cadastral map & Segmented NDVI image by threshold



(a)



(b)

Figure 3. Result of LR-aided classification (a), and non LR-aided classification

Table 1. The differences of LU from differences sources & approaches

Unit: Ha

Code	Class	Land Rights Registration	Land use statistic	RS with LR-aid	RS without LR-aid
I.1.a	Farm land	688	685	672	923
I.1.a.1-3	Crop rice	No data	615	596	717
I.1.a.4	Sown land	No data	70	76	206
	Other				16

3.2 Results analysis

The case study show that, even in official sources for land use data, one still see the differences between LR and land use statistics. Even thought, the differences in this case are not much. That means that the approach of generalization and aggregation land use from LR is a potential approach for LU acquisition.

The LR-aided approach gives more reliable data when we compare the figure for land use at class farmland and cropland in table 1. The figure of 672 ha is closer and more persuadable to land use statistic and LR than the result of the traditional approach without LR-aided classification – 923 ha.

Furthermore, LR-aided approach allows end user to see the differences of land use data at land parcel level. This ability will support the verification work for land use data, which supplied at any decision-making levels.

4 CONCLUSIONS AND RECOMMENDATION

The study reveals that: (1) LR is important geographic information for RS analyst; (2) LR-aided classification could give reliable and detailed land use information.

Although land use information is assessed to be quite precise, the accuracy of this study is limited in resolution of RS data, number of needed multi-temporal data and deeply studies on rice spectrum. Without a proper understanding of each type of land use and their behavior with RS detectors could leads to confuse and miss classification. For 60 types of LUCS, it needs to develop modern technology to completely and rapidly detect. Among these, RS with the LR-aided classification method is a typical application of modern technology. Although this study was conducted at commune, the ability of extending this study direction is available in conditions of Land Administration of Vietnam.

However, to make this idea becoming an implementation procedure in practice, more work for experience at all levels of LUCS, all kind of land use classes should be tested. Furthermore, this study has to be extended for provincial level instead of communal level. Therefore, the combination or using LA data for RS land use detection still an opening question for further researches.

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