

USAGE OF REMOTE SENSING ON CROP MAPPING IN TAIWAN

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ABSTRACT: In Taiwan, it is important to develop the agricultural land cover map for agricultural resource estimation, land use planning, agricultural environment change adaptation, rural development planning, and agricultural pollution estimation. The first land use survey program was held in Taiwan 30 years ago. The land use data in Taiwan, however, offers insufficient data in crop type and spatial distribution information for the decision maker. Remote sensing offers numerous advantages over land cover survey, because of the potential for more rapid collection of large data sets and the relatively inexpensive cost of data acquisition.

The satellite images conducted in this research were mainly derived from SPOT 4, SPOT 5, Formosat-2. The study sites were including Taoyuan, Hsinchu, Changhua, Yunlin, Chiayi, Kaohsiung and Pingtung. More than 60 species were mapped in the research by satellite images analysis and aerial photos interpretation. Multiple-temporal satellite images were conducted on rice, vegetable, fruit, green manure identification. In some cases satellite images were not suitable for crop identification because of the topology and nearby crop noising. Aerial photos interpretation was conducted to solve the problem and the technique was suitable and had high accuracy for orchards, tea plantation and bamboo identification. The results of the research were applied to garlic and vegetable yield prediction in Yunlin County, as well as to identify the land sink problem of high speed railway with respect to pumping ground water of land use. In the future, the results would be used on yield prediction of the research and carbon cycle estimation in farmland. All the result maps have been published online.

INTRODUCTION

The land use survey has been held in Taiwan for 30 years. However, the crop species and their spatial distribution are not included in this database. Thus, another agricultural land cover / land use dataset should be developed in Taiwan. The agricultural land cover survey with classification at crop species levels was successful in crop acreage estimation in United State. The results from that survey have widely used for agri-business or environmental application (Johnson and Mueller, 2010).

Remote sensing is a powerful technique for land cover survey. It takes fewer times and cost compared with ground survey. The agricultural land cover maps have a characteristic with great complexity and rapid change at the crop species level. Therefore, remote sensing is one of the best choices because it is time-saving in agriculture land cover survey. The crop distribution maps are needed to develop in Taiwan. The immediate agricultural cropland mapping is needed to be developed in Taiwan. It is fundamental information on agricultural resource planning, yield estimation, climate change adaptation. The goal of our project is to build the crop distribution geodatabase in Taiwan.

MATERIALS AND METHODS

1. Survey Area

The survey area is located in the western Taiwan between 120°02' to 121°28' East and 21°55' to 25°07' North including Taoyuan, Hsinchu, Changhua, Yunlin, Chiayi, Kaohsiung and Pingtung Counties. Topographically, there are alluvial plain in the western parts, hills in the eastern parts in each counties and the altitude is ranging from 1 to 2,000 m. In the plain parts of each county, the major crops are rice, vegetables, beans and orchards. Vegetables, bamboo and orchards are the major crops in the hill parts. Two crops of rice were grown per year and the vegetables were growth between the crops or rotation with other crops.

2. Satellite Image

The satellite images in the project were mainly collected from SPOT 4, SPOT 5, Formosat-2. It is necessary to select the date of image for crop classification especially for that growth in short period. The date of the image were selected depend on the crop status; for example, the periods of flooding and sowing were adequate for rice mapping. Supervised maximum likelihood classification (MLC) was conducted to obtain the spatial data from remote sensing images. Training samples of each crop were collected from field visiting with survey map during the active growth period. The classification process would be repeated until the final classifications meet the expected results.

3. Aerial Photo

Because of the topography effect, the satellite images were not adequate for crop mapping. Stereo pair of aerial photo images, therefore, become another choice in this study area. The identification of different crops or orchards was based on stereo interpretation of panchromatic aerial photographs. The ground truth data collected from field survey was used as training samples.

RESULTS AND CONCLUSIONS

Over 60 crops were identified in our project. The remote sensing with satellite images were suitable for rice, peanut, corn, pineapple, water chestnut, carrot and bean. The accuracy were varied depend on crop species. Aerial photo interpretation provides good accuracy but slower than satellite image classification. In Taiwan, the timely aerial photos are quite expensive compared with the timely satellite images. Thus, the aerial photo interpretation is suitable for the crops with long growth period. In our research, it was the major classification technique for perennial crops such as orchard, bamboo and tea plantation in the hill sites. For the reasons that topology effect and inter cropping would lower the accuracy of satellite image classification.

The garlic prices were changed dramatically every year due to the difficulty of garlic yields estimation. The timely crop mapping in garlic, therefore, is a good source for garlic yield estimation. The Yunlin County is one of the most important counties for garlic growth in Taiwan. In 2009 relay cropping, the total garlic land-cover area in our results is about 93% to the total area according to the statistical data from Agriculture and Food Agency (AFA). In town degree, a simple regression model shows that there is a positive correlation with $r^2 = 0.85$ between these two data sets.

The central and toe region of Chousui River alluvial fan in Yunlin County are consist of clay and fine sand. This soil consistence cause low strength and permeability. Land subsidence, therefore, is a severe problem in this region from groundwater pumping without surface water supply (Liu et al., 2004). The high speed railway pass to the region land subsidence happening.

Crop distribution data in this region from our results provided the information about agricultural water resource problem such as land sink stopping.

The results of our research are released with WMS. The crop mapping would be conducted in Mioli, Taichung and Nantou Counties. The crop mapping in Changhua, Yunlin and Chiayi County would be refreshed this year for these counties are the major growth area. In the future, the crop mapping would be conducted in other counties. Then, the agricultural land cover geodatabase in whole Taiwan would become the fundamental database for climate change adaptation, environmental planning, and yield estimation.

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