

LIS Combined With RS For A Long Term Sustainable Land Use In Karst Terrane, South Western China

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Abstract

The largest karst region in the world is located in South Western China. Soil loss and barren karst were serious due to deforestation and increasing of population in the past decades. Land resources inventory by using TM data classification and GIS/LIS are the basic assessment of a long term sustainable land use. SKset is the software for the land information system (LIS) developed in the last decade by author's group. Zhenyun county, Guizhou province in the eastern of karst terrane was chosen as the test area. County level LIS was constructed successfully for decision making in protecting soil loss, suitable analysis, land use management etc. . 14 city/county in karst terrane are being extended to construct LIS combined with RS in the term 1994—1997.

INTRODUCTION

Karst is the terrane with soluble rocks deferring to the other terranes for the weakness of ecosystem environment. The word karst can be traced back to Pro—Indoeuropean origins and derives from “Karra” meaning stone. In Northern Yugoslavia is also a regional name for a district near the border of Trieste.

Karst is widespread in China, covering one third of whole country and exposed to the surface over one million square kilometers. One of the largest karst region is located in south western China with an area of about

540,000 square kilometers and 79 million population (Fig. 1).

Soil loss and desertification (barren karst) were serious due to deforestation and increasing of population in the past three decades in the karst terrane. Land resources inventory and management by Remote Sensing (RS) and GIS/LIS are the basic assessment of a long term sustainable land use. Zhenyun county in the Eastern of Guizhou province was chosen as the test area because it located in the slope from Yunan — Guizhou plateau to Hunan hills with different karst geomorphologies and

elevation ranging from 344m to 1332m above sea level. The total area is about

1800 square kilometers with carbonate rock distribution more than 50%.

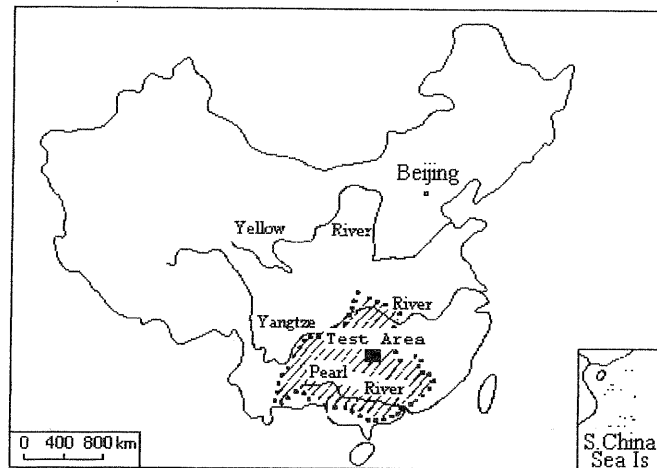


Fig. 1 Test Area in Karst terrane, Southwestern China

CLASSIFICATION ANALYSES

The land use inventory was obtained from field work and aeriaphoto — interpretation in 1 : 10000 scale taken place two times in 1980's. As a result, the errors of farmland between two times are ranging from 80% (irrigated) to 140% (nonirrigated) which are so serious that could not to be used by authorities. Three reasons caused errors are as following :

1、The sharp karst topography is not easy to be got through every where in the field.

2、The cultivated land is too small to be drawn and calculated by hand acculate-

ly.

3、The persons in several groups are of different experiences and knowledges.

Landsat TM data was instead of to inventory land use in the early of 1990's in the test area by authors group (table 1). In this case, only 0.5 percent of field work was enough to select the training area for the supervised classification in the micro computer by maximum likelihood classifiers. Image 2/Earth View 3.0 is the image process software developed by Institute of Oil & Gas Development in Beijing and some modified by authors especially in the classification. The accuracy of this

type of classification for areas in Zhenyuan county is 90% roughly. Some problems are still left after automatic land use inventory such as shadow, mixture pixal etc. which should be treated by artificial classi-

fication on the terminal using existing survey data and other georeferenced data in the GIS/LIS. Then the accuracy of inventory could be increased ranging from 5% to 10% again.

Level. I	Level. I
1. Built-up Land	21 Rice Paddy
2. Agriculture Land	22 Crop Land
	23 Vegetable Land
3. Range Land	31 Herboceous Land
	32 Shrub Land
4. Forest Land	41 Deciduous Forest Land
	42 Coniferous Forest Land
5. Water	43 Spacing Forest Land
6. Barrenland	

Table. 1 Land use and Land Cover Classification system for use With TM Data in Zhenyuan County Guizhou province, China.

TOPOGRAPHIC ANALYSES

Space data is the main information sources for GIS/LIS. Land information system (LIS) in Zhenyun county were consisted of not only TM data but other georeferences data such as geology, soil, topography, transportation, population, administrative boundary, land use inventory etc.. The GIS/LIS software South Karst set (SKset) for micro computer 486/66 was developed by authors group in the last decade with both raster and vector data structure including the functions of environment dy-

namic detection, topographic analysis, overlay, multielement analysis, measurement, management of land use and covers. Zhenyun county is consisted of 12 villages. One of the biggest village is in the vicinity of town called Wuyan. The cropland (non-irrigated) distributed in the different elevations and slopes in Wuyan village overlaid by topographic elements analysis and land use inventory (table. 2). The slopes of cropland exceeding 15 degree occur 36.4% of total cropland. This parts are easy to be soil loss obviously, the authorities made

the decision to construct terrace field instead of nature slope step by step according to the information output from LIS and

stop cultivation in the slopes exceeding 35 degree and recovered forest as well, later occur 0.2% of total cropland.

elevation (meters above sea level)	degree of slope							
	0-4°	5-9°	10-14°	15-19°	20-24°	25-29°	30-34°	>35°
0-399	0	0	0	0	0	0	0	0
400-499	2585*	343	46	3	0	0	0	15
500-599	1897	2207	1544	2330	953	298	124	28
600-699	3001	2202	1199	2282	840	186	62	12
700-799	359	531	446	1029	386	74	11	0
800-899	389	427	410	640	317	51	1	0
900-999	105	123	162	286	254	97	9	0
1000-1099	20	61	45	111	45	18	5	6
1100-1199	0	0	0	0	1	3	0	0
>1200	0	0	0	0	0	0	0	0

* Mu(15Mu=1Hectare)

Table. 2 The cropland distributed in different elevations & slopes in Wuyan village, Zhenyuan county, Guizhou province, China

INTERGRATED ANALYSES

The rangeland in Zhenyun county occurred more than one-third of total area due to deforestation in the past three decades. It is interested for government to find out by LIS where the rangeland is suitable for farming coincided with five conditions as following:

1. The elevation is less than 1000 meter above sea level.
2. The slope is less than 20 degree.
3. The slope exposed to the sun.
4. The soil belongs to the aluminous

siliceous and iron-siliceous yellow soil.

5. Non karst area.

In this case, analysis was concerned multiple spatial and non-spatial data sets in an integrated manner by LIS deferring to the function of Automap or CAD. As a result, 27 thousand Mu (15Mu = 1Hectare) of rangeland is suitable for farming in Wuyan village which corresponds 11% of total rangeland.

LAND USE MANAGEMENT

Land use are smaller and separated each

other mostly due to the traditional farming and land scape of karst terrane. LIS provide the methods for planning and management every piece of land use in such manner. Which could be chosen on the monitor by cursor, for example the location of county government, a series data would be

shown on the side immediatcly (Fig. 2), such as inventory of land use, area, elevation, slope, soil type, bed rock geological unit etc.. It is very useful for sustainable land use not only to increase products in the traditional manner but for intensive farming in the future.

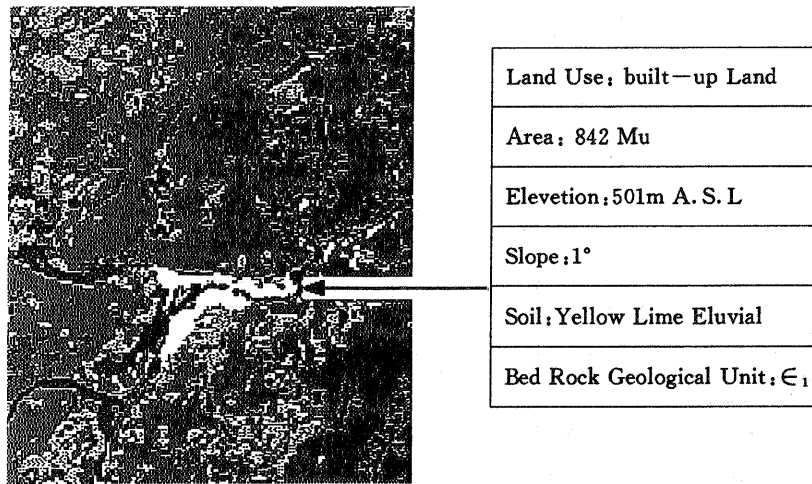


Fig. 2 Land use management on the monitor

CONCLUSIONS

In the past decades, the problem of environments in karst terrane of south-western China had been become more serious due to population exploded and less investment both economic and scientific. Land resources inventory and management by RS & GIS/LIS are the basic assessment of a long term sustainable land use. The GIS software SKset was developed in the last decade by author's group, especially new

editor SKset 3.0 for windows is suitable for county level land information system (LIS). Zhenyun county was the model of LIS constructed two years before. Environment dynamic are being detected in 14 city/county in karst terrane to measure the change of forest, farmland and built-up land etc. in the term between 80s-90s by using TM data and LIS to understand more information of environment tolerance and ecosystem in karst terrane.

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