Journal of **Kim Il Sung** University (Natural Science)
Vol. 3 No. 3
Juche103(2014)

The Relationship between the Landscape Structure and the Landform Developing Process

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Abstract In this paper we calculated 7 indices of landscape structure such as diversity, dominancy, identity, evenness, shape index, fractal dimension, fractionality and relative concentration on the landscape mosaic map that we distinguished from TM images of Landsat and studied the relationship between these values and the landform developing characteristics of Ulim gully. As the values of those indices are regularly varied according to the young, mature and old period of landform development, the analysis of the landscape structure indices makes it possible to clarify the landform developing characteristics.

Key words landscape structure, landform development

Introduction

The great leader Comrade **Kim Il Sung** said as follows.

"**Only when we exploit all that is within our reach for building the national economy and develop the natural resources on a wide scale, according to scientifically-substantiated data about our natural environment, can we rapidly push forward our national economy.**"
("**KIM IL SUNG** WORKS" Vol. 7 P. 163)

The spatial component of landscape consists of patch, corridor and matrix and their temporal and spatial arrangement makes up the mosaic structure [1, 3]. The mosaic structure of landscape regulates the function of the landscape ecosystem and affects on the flow processes and styles of matters, energy and information in it. So the quantitative study on the landscape structure is the way to clear the relations between the structure, process and function of landscape and its dynamics. Recently the development of remote sensing technology makes it possible to get easily landscape information of more rapidly updated and broader area. Therefore it can clarify the landscape processes and functions by analyzing the landscape structure information. In the past researches, many landscape structure indices were suggested and used much in landscape assessment, but those were not considered in the relation with the landscape processes [1－4].

Ulim falls was developed in the first year of 21st centry and the Echo of Ulim falls is well known as one of 13 scenic spots in Songun Era. The formation of this echo of Ulim falls associates closely with the generation and developing characteristics of Ulim gully where takes its place on the upper and down part of Ulim falls.

In this paper we studied the relationship between the landscape structure and the landform developing process of Ulim gully through the structure analysis on the landscape figure clarified from TM images of Landsat.

1. Calculation of Landscape Structure Indices

The landscape structure indices are quantitative indices reflecting the main components and spatial allocation by implying the landscape structure information.

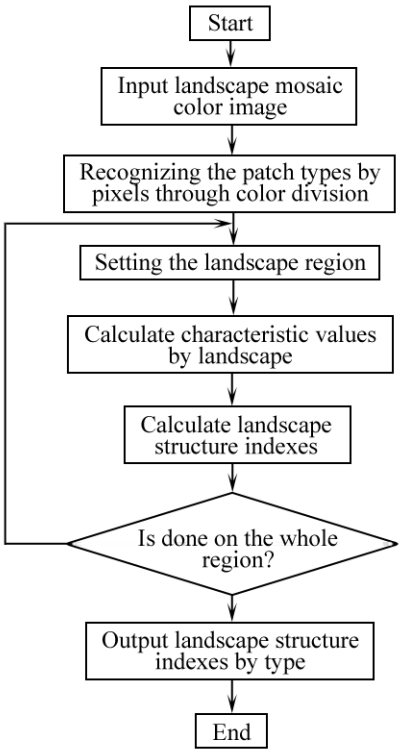

Fig. The process calculating the landscape structure indices

The landscape structure indices consist of indices assessing the identity of patches(Diversity (SHDI), Dominancy(D), Evenness(SHEI)), shape analysis indices(Mean shape index(MSI), area weighted mean shape index(AWMSI), mean patch's fractal dimension(MPFD), mean patch's fractal dimension(MPFD), fractionality(FS)), indices characterizing the direction and the distance of distribution of figures and indices reflecting the landscape adjacency(Relative concentration(Rc), complexity(C)).

The process calculating the landscape structure indices is as follows (Fig.).

In general, the distinguished patches of landscape are divided and represented as mosaic color images. So firstly it must input the color imagine and recognize the patch types by pixels. Then it should calculate the characteristic values such as area of each figure of landscape in the considering regions, perimeter, the whole area, the whole perimeter and etc by the patch types.

Following the formula in reference [3], the landscape structure indices are calculated. Through repeating these processes on all the considering region, the result is output by the landscape regions.

2. Relationship between the Landscape Structure Indices and the Landform Developing Processes

In order to clarify the relationship between the landscape structure indices and the landform developing process, we divided 4 landscape types in the studying region based on the vegetation and soil indices from the color composite image of TM images of 5, 4, 3 band. The area proportions by every type on the whole region are shown in table 1. And table 2 shows the value of landscape structure indices on the studied region.

Table 1. The area proportions by every landscape patch type

No.	landscape patch types	area proportion/%
1	Shrub land	21.8
2	Forest land	15.2
3	Bared rock land	31.1
4	Valley, floodplain	31.8

Table 2. The value of landscape structure indices on the studied region

No.	Position	Landscape structure index							Landform developing character
		Diversity	Dominancy	Evenness	Shape index	Fractal dimension	Fractionality	Concentration	
1	Upstream of six pools	1.082 8	0.917 2	0.451 4	5.729 1	1.749 1	0.851 9	0.729 3	
2	Upper gully of waterfall	1.368 0	0.632 0	0.604 1	6.113 1	1.667 9	0.867 0	0.654 9	Early
3	Upper district of gully	1.429 8	0.570 2	0.645 0	6.020 1	1.710 5	0.847 0	0.625 1	
4	Lower part of waterfalll	1.883 1	0.116 9	0.898 0	7.886 8	1.677 9	0.880 0	0.435 9	Middle
5	Downstream of Jonthan River 1	1.783 2	0.216 8	0.827 0	6.647 0	1.647 3	0.855 3	0.476 1	The last
6	Downstream of Jonthan River 2	1.801 0	0.199 0	0.836 0	6.534 3	1.646 6	0.851 4	0.536 4	The last

This shows that the landscape mosaics in the whole region are rather evenly and identically distributed.

On the other hand, from the field investigation data, the landform developing characters are individually distinguished at the upper and down part of waterfall, valley of Jonthan River, and upper and down part of gully. The valley of Jonthan River belongs to the old period of landform development but the down part of waterfall is on the active developing period of landform that the slope is retreating in parallel long times after the cavern was broken. In the upper part of waterfall, the cavern was broken a moment ago and the landform develops insufficiently, but this district becomes a dangerous area by landslide and collapse.

We can recognize that the values of evenness, diversity and shape index have maximum on the mature period and the values on the old period are greater than the values on the young period. On the contrary the dominancy and relative concentrations have minimum value on the mature period. The fractionality and fractal dimension are not nearly changed by the developing period of landform. These mean that the differentiation of landform is insufficient because the interaction between the endogenic and the exogenic processes of relief formation is small on the young period, but the differentiation is much increasing and the diversity comes to maximum on the mature period. On old period of landform development, that keeps certain values in the balancing relations.

Then it can clarify the landform developing characters by analyzing the landscape structure indices such as diversity, dominancy, shape index and relative concentration. It means that, when the diversity and shape index reach to maximum, it means mature period of relief development and when the diversity and shape index are less than it and evenness is small, it's related to young, but on the contrary case it means old period. Then the diversity and shape index in old period is a little higher than young period.

Conclusion

In this paper, the process of calculating the landscape structure indices from imagine are established and clarified that the landscape structure in the various regions of Ulim gully areas relates closely with the landform developing period. So it can clarify the landform developing characters by analyzing the landscape structure indices. Especially, the diversity, dominancy, relative concentration, evenness and shape index reflect well the relief developing processes.

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