DEVELOPING PREDICTIVE METHOD FOR FOREST SITE DISTRIBUTION USING SATELLITE IMAGERY AND TPI (TOPOGRAPHIC POSITION INDEX)

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ABSTRACT ... Due to the remarkable development of the GIS and spatial information technology, the information on the national land and scientific management are disseminated. According to the result of research for an efficient analysis of forest site, it presents distinguishing of satellite image and methodology of TPI (Topographic Position Index). The prediction of forest site distribution through this research, specified Gyeongju-si area, gives an effect to distinguishing honor system through Quickbird image with the resolution 0.6m.

Furthermore it was carried out through TPI grid that is abstracted by DEM, slope of study area and type of topography, as well as it put its operation on analysis and verification of relativity between the result of prediction on forest site distribution and the field survey report.

It distinguishes distribution of country rock that importantly effects to producing of soil, using 1: 5000 forest maps and grasping distribution type of soil using satellite image and TPI, it is supposed to provide a foundation of the result on prediction of forest site.

With the GIS techniques of analysis, inclination of discussion, altitude, etc, and using high resolution satellite image and TPI, it is considered to be capable to provide more exact basis information of forest resources, management of forest management both in rational and efficient.

KEY WORDS: , Forest site, TPI, Quickbird, Land type, Soil species, GIS

1. INTRODUCTION

With recent development of geospatial information technology, forest industry requires increased demand of spatial information analysis for the efficient resource management. For the quick and scientific analysis of enormous amount of forest information, satellite image and GIS analysis technique is utilized to extract forest information.

In addition, topographic information classification and integrated system for forest control system via GIS, GPS, and satellite image receives the attention for development and its utilization.

Most of soils are the product of interaction between biological world and geological aspect under the influence of weather and geographical features. It will be the foundation for forest life form and tree along with supplying nutrition and moisture.

Therefore, forest site is based on comprehensive evaluation through country rock, weather, geographical feature, and satellite image. Its conditional environment and soil evaluation will determine the classification, site index, etc.

In addition, geomorphological classification of forest is important for not only studying geological feature but also provision of fundamental information for efficient utilization and development of forest.

In this study, satellite image and TPI is utilized to estimate the distribution of forest site, and correspondence analysis with field work is conducted for verification. In addition, usability of methodology in this study on future estimation of national and regional forest site is provided through cross referencing and comparison of TPI and satellite image.

For this purpose, unsupervised classification is conducted via Quickbird image with 0.6m of resolution. Extracted geographical features like inclination, level, etc from DEM are utilized.

2. STUDY METHOD

2.1 Study area

Target area for this study is Gyeongju city area, which is completed on the preparation of thematic map such as digital and site map according to national GIS project, and is expected to be actively applied to forest research. In addition, this area is located at the bottom of Taebaek mountain range, and is abundant with sandy soil weathered from granite and clay soil form gneiss.

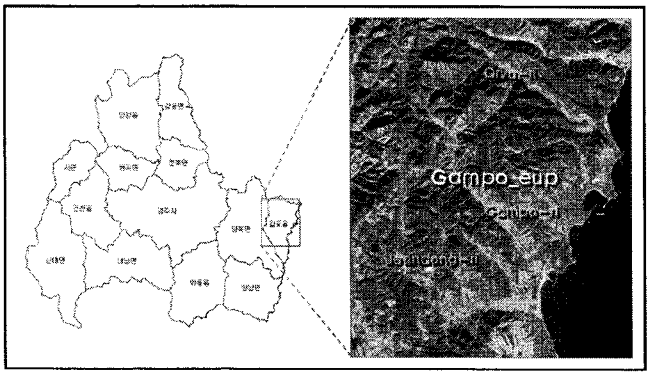

Figure 1. Study area (30.5 ㎢)

2.2 Technical study trend

Domestically, study on new classification method according to scale factor determination and TPI was conducted (Jang, Gwang Min, et. al., 2007). There were attempts to classify geographical feature based on formation factor of topography. (Kim, Taeho, 2003; Park, Soo Jin, 2004). In addition, the relevance study on existing swamp and estimated possible location was executed along with TPI methodology for predicting possible location of mountainous swamp (Park, Gyeong Hoon, et. al., 2007). After conducting TPI analysis with digital map of landslide location at 2006, correspondence was analyzed by comparing estimated landslide by classifying topographic information (Woo, Chung Sik, et. al., 2008).

Topographic classification method using TPI divides landscape by two separate scale factor, and every geographical features can be easily quantified (Weiss, 2001). Recently, TPI applied geographical classification is actively studied (Michael Judex et al, 2006).

2.3 Collection Data

Field work evaluation was collected for relevance analysis and verification with 1/5,000 of digital forest site on Gyeongju city. In addition, DEM (Digital Elevation Model) with 5m of resolution and Quickbird image with 0.6 m of resolution was collected.

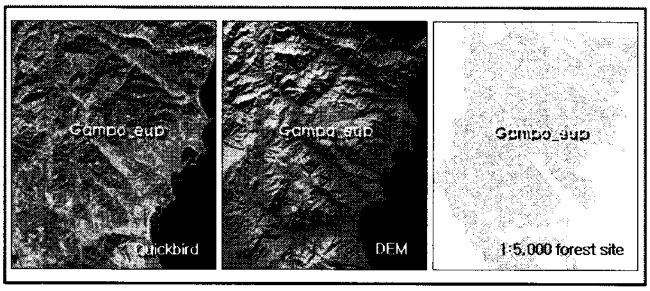

Figure 2. Collection Data

3. PREDICTED OF FOREST SITE DISTRIBUTION

3.1 Analysis process

The preparation of processing for forest site distribution map extracted TPI and slope at 500m and 1,000m using DEM data. Through this, mountainous geographical feature was classified, and unsupervised classification via Quickbird Image was executed. In addition, the preciseness was verified with comparison and analysis on forest site.

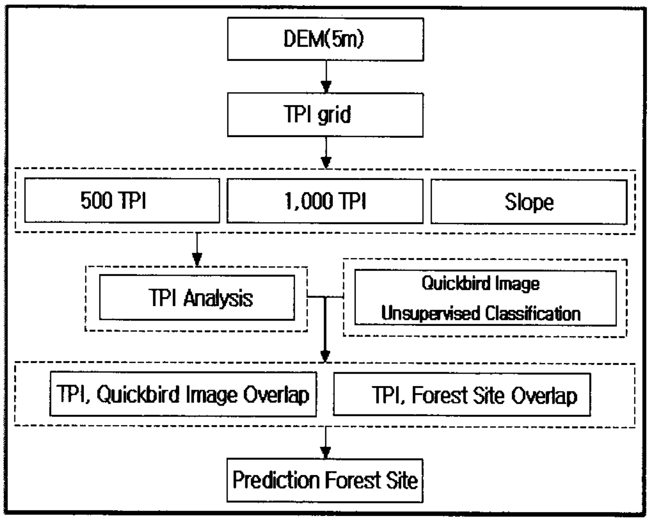

Figure 3. Processing chart for prediction forest site

In this study, DEM data on Gampo-eup Gyeongju city was utilized according to Generate TPI analysis for 500m and 1,000m. Geographical feature was different by inclination.

TPI (Topographic Position Index) value is divided by the difference between standard altitude and surrounding altitude. Positive value of TPI indicates higher value than surrounding altitude. Negative TPI value exhibits lower than the surrounding. That is, higher TPI value means closer to peak, and lower value stands for valley. Through this principle, two TPI with different scale is associated to subdivide further.

3.2 Landform classification by TPI

In order to generate TPI grid on target for geographical classification, TPI grid with 100m for minimum and 2,000m of maximum is created using DEM. Finally, 500m TPI grid is selected according to small-neighborhood slope position classification that can sufficiently express the geographic feature of target. In addition, 1,000m TPI grid is chosen by large-neighborhood slope position classification.

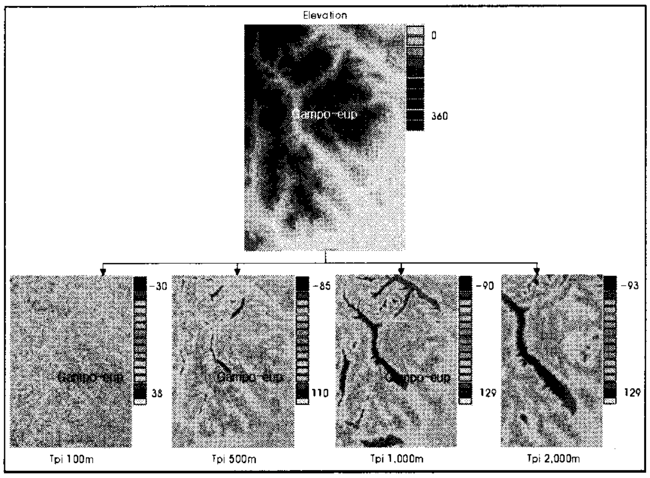

Figure 4. TPI gird by a circular neighbourhood

Geographic classification is conducted by using TPI grid from DEM and slope, and configuration and other aspects are referred Weiss (2001).

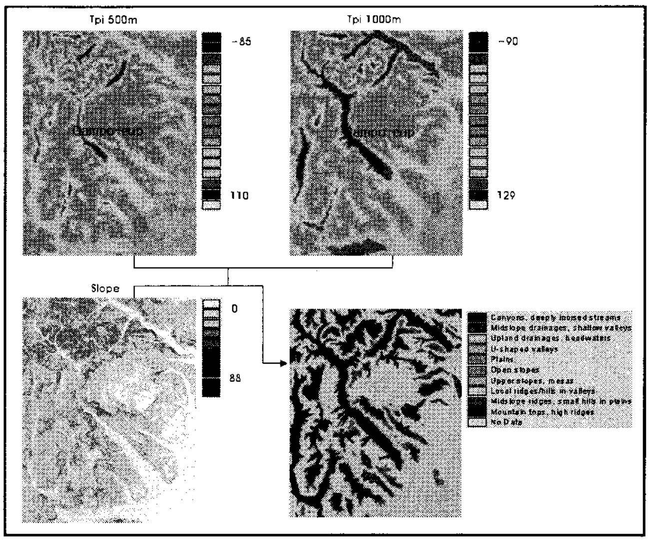

Figure 5. Landform Classification

As shown in <Table 1>, open slope classification (43%) takes the largest portion, and the next are plain, canyons, and mountain tops.

Table 1. The area of Landform classification

Topography	㎢	%	Topography	㎢	%
Canyons, deeply incised streams	3.9	12.8	Open slopes slope>5°	13.4	43.8
Midslope drainages, shallow valleys	1.5	4.9	Upper slopes, mesas	1.4	4.6
Upland drainages, Headwaters	-	-	Local ridges/hills in valleys	-	-
U-shaped valleys	1.2	4.0	Midslope ridges, small hills in plains	1.1	3.7
Plains slope≤5°	4.2	13.8	Mountain tops, high ridges	3.8	12.5
Total	30.5	100	-		

By superimposing on and analyzing with TPI and digital forest site (1/5,000), its preciseness is verified.

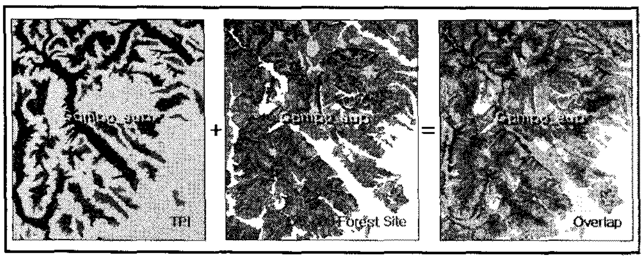

Figure 6. Overlap TPI and Forest Site

<Table 2> for estimated geographic classification and site data shows dominance of silty loam. Sandy loam and loam is the next.

Table 2. The area of predicted forest soil species

Topography	㎢	%	Soil species	㎢	%
Canyons, deeply incised streams	1.7	8.3	SL	0.2	11.9
			L	0.1	5.2
			SIL	1.2	70.7
Midslope drainages, shallow valleys	1.0	5.1	SL	0.2	17.0
			L	0.0	4.5
			SIL	0.7	64.5
Upland drainages, Headwaters	-	-	-	-	-
U-shaped valleys	0.5	2.6	SL	0.1	13.9
			L	0.0	3.0
			SIL	0.4	78.6
Plains slope≤5°	0.5	2.3	SL	0.1	22.1
			L	0.0	1.0
			SIL	0.3	55.1
Open slopes slope>5°	11.0	53.9	SL	2.1	19.1
			L	0.3	2.6
			SIL	7.1	64.4
Upper slopes, mesas	1.1	5.4	SL	0.3	26.8
			L	0.0	1.6
			SIL	0.7	59.4
Local ridges/hills in valleys	-	-	-	-	-
Midslope ridges, small hills in plains	1.0	5.1	SL	0.4	39.3
			L	0.0	0.6
			SIL	0.5	48.8
Mountain tops, high ridges	3.6	17.4	SL	1.2	33.0
			L	0.0	0.9
			SIL	1.8	49.6
Total	20.4	100	-		

※※SL:Sandy Loam, L:Loam, SIL:Silty Loam

3.3 Landform classification by GIS

In this study, satellite imagery classification is tried for more efficient evaluation on distribution estimation for forest site.

Based on the definition of forest that shows concentrated population of tree regardless of location, forest and farm is classified using Quickbird and unsupervised classification.

In addition, classification results were used as fundamental data for field work, which is used as comparison and verification.

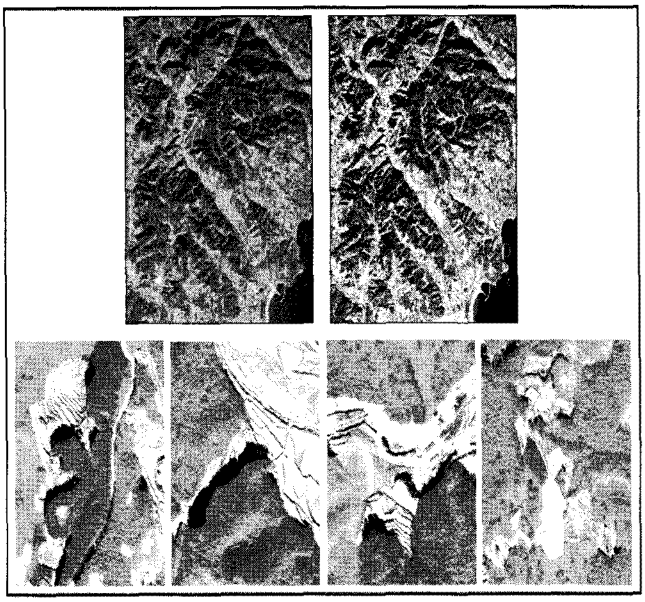

Figure 7. Predicted forest site boundary

GIS method and digital map is utilized to analyze inclination, orientation, altitude, etc, and each result are compared and analyzed according to soil texture.

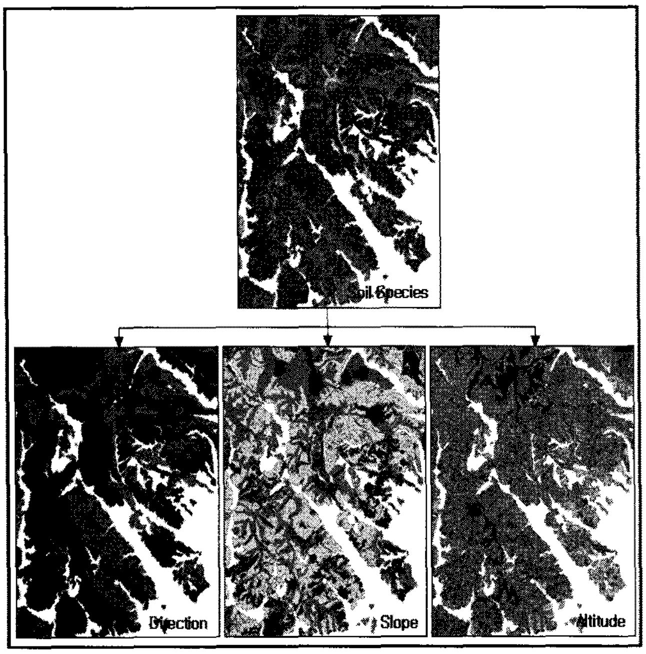

Figure 8. GIS analysis

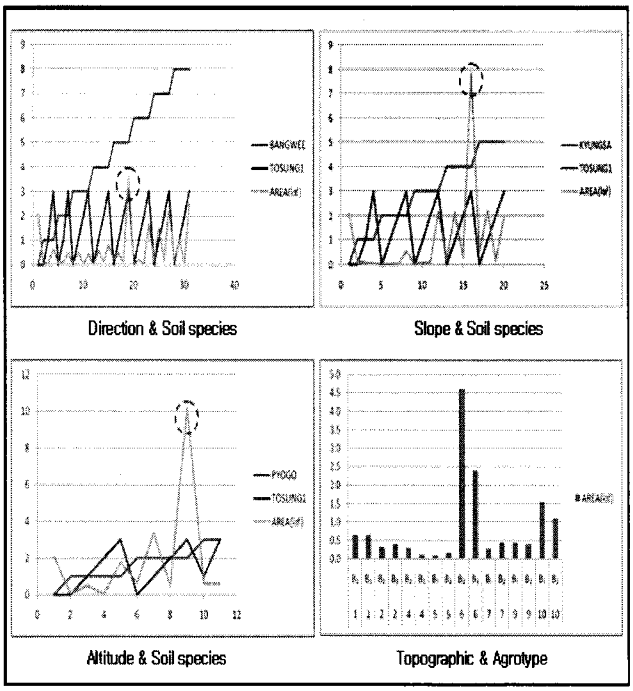

Figure 9. Comparative study of area

4. CONCLUSION

This study attempts the estimation on forest site distribution based on satellite image, GIS, and TPI analysis methodology, which are treated as the most efficient spatial information technology. In addition, via comparison and verification, the possibility of estimating site distribution is provided.

Through quick and precise data analysis and processing of forest information can implement efficient management of information on forest information. The following is the summary of research.

Firstly, DEM (5m) was utilized to create TPI grid for 100m as minimum and 2,000m as maximum.

Secondly, superimposition and analysis of TPI results and digital forest site (1/5,000) verified the preciseness, and showed the dominance of silty loam followed by sandy loam and loam.

Thirdly, classification via satellite image analysis was attempted for efficient investigation of distribution estimation on forest site.

Based on the definition of forest that showed concentrated population of tree regardless of location, forest and farm was classified using Quickbird and unsupervised classification. In addition, classification results were used as fundamental data for field work, which is used as comparison and verification.

As shown above, distribution estimation on forest site was conducted along with integrative analysis on geographical aspect.

However, classification criteria suggested by Weiss (2001) is different from the domestic classification standard. Therefore, direct application shows the limitation. If the proper classification criteria that correspond to domestic geographical feature were provided, the more precise classification could be made.

In addition, implementation of biological and scientific condition, which is related to growing of tree (geographical, geological, soil, atmosphere) and productivity of soil, can realize realistic distribution estimation on forest site.

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