Implementation of the virtual reforestation system using spatial data

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Abstract : In this study the spatial distribution characters of burnt forest site was first considered by analyzing spatial data and monitoring forest landscape before/after fire to restore the site. Then suitable tree species on each forest site should be selected through the weighted score analysis of GIS analysis methods. Finally, the best forest stand arrangement method could be simulated on the system for the advanced reforestation technology in Korea.

For this purpose, the virtual reforestation system was implemented by using the concept of virtual GIS and CBD (Component Based Development) method. By use of this system the change of forest landscape of burnt forest area some years after reforestation practice could be detected and monitored by applying the site index and 3D modeling method.

Keywords: the virtual reforestation system, the best forest stands arrangement, 3D modeling method

1. Introduction

Recently, the restoration technology for the forest fire damaged area has been focused on only the forestation technologies while the number of forest fire and a large damaged area in Korea have been increased very dramatically.

However, the construction of firebreak for the strong fire resistance of forest, the best forests stand allocation method, the scientific management for the density of forest are still rare.

In addition, there is a greater need of proper DSS (Decision Supporting System) based on GIS to provide the important information when establishing the domestic forestation policy.

In Korea there are several studies about the forest fires such as Classification of forest fire occurrence hazard region using GIS in Uiseong-gun by Si-Young Lee (2004) and the development of landscape analysis method for forest fire damaged area restoration using virtual GIS by Myung-Hee Jo (2004).

In this study the methodology for the best forest stand allocation and the forest density management has been performed to select the suitable tree species against forest fire and promote the fire resistance of forest considering the characteristic of forest fire and the environment of forest fire area, the characteristic of local meteorology especially along east coast area where is called as Sam-chuck in Korea.

For this, the approach of spatial information technologies such as virtual GIS and 3D GIS using satellite images and aerial photos are regarded to simulate the best forest stand allocation in visual.

Also, the information system for forest stand allocation was deigned and constructed to manage all related data and integrate all information to restore a damaged area.

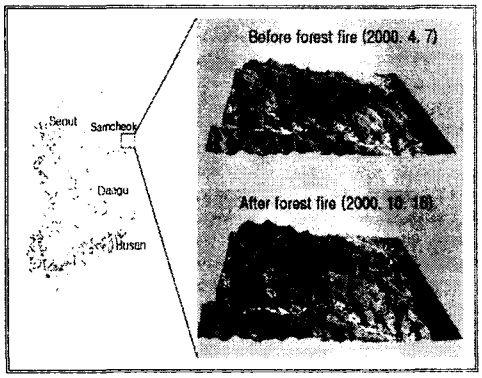

Fig. 1. The Study area, Sam-chuck, Korea

2. Materials and method

In order to construct GIS DB, 21 satellite images such as Landsat TM, ETM and 23 aerial photos before forest fire and 25 aerial photos after forest fire and topography map scaled on 1:5,000 and 1:25,000 were used through Arcview 3.2 and IMAGINE 8.5. In addition, to process the aerial photos and present three in 3D Adobe 7.0 was used.

This system was implemented based on Windows 2000 by using object-oriented language such as Visual Basic 6.0 and GIS component such as Map Object and DBMS (Data Base Management System) such as Access2000 as shown in Fig. 2.

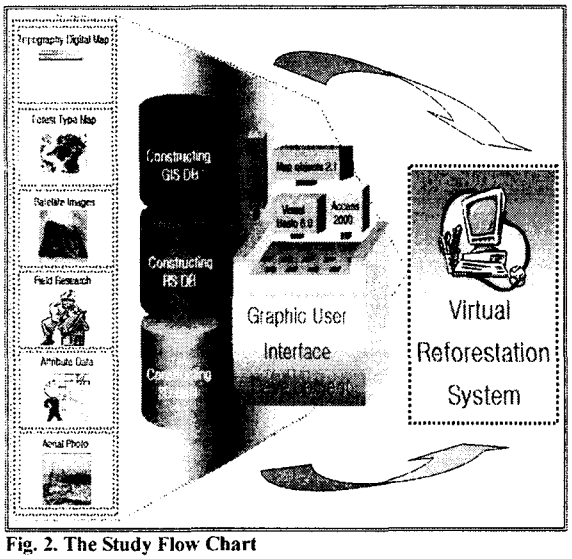

Fig. 2. The Study Flow Chart

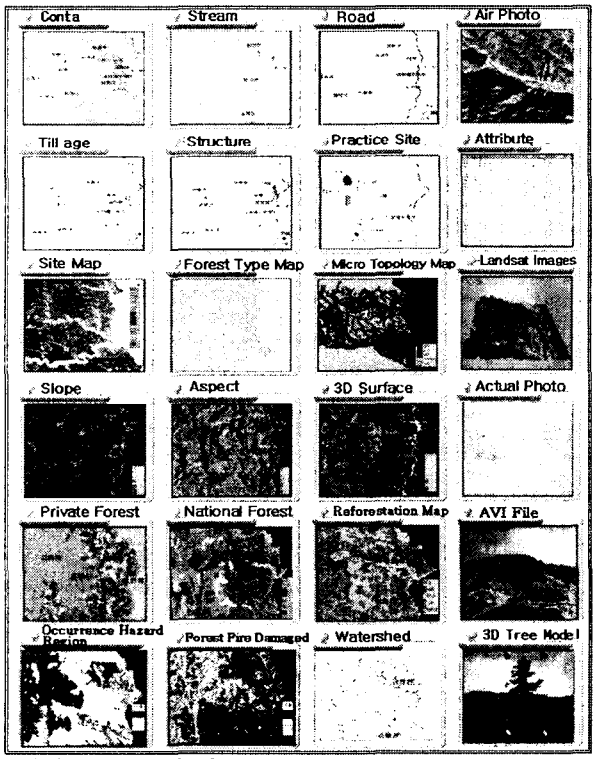

Fig. 3. GIS database for the system

3. Developing of virtual reforestation system

3.1 The fundamental GIS interface

For the efficient user interface and convenience the main interface it expects to have tool bar having the functions such as print, zoon in/out, pan, measuring distance and area, overlaying various thematic maps, map window, retrieval window, coordination bar, scale bar, layer controller and index map.

Especially, the spatial charter, the hazard maps and satellite images, which are related to forest fire, could be retrieved through this system and overlaid as shown in Fig. 4.

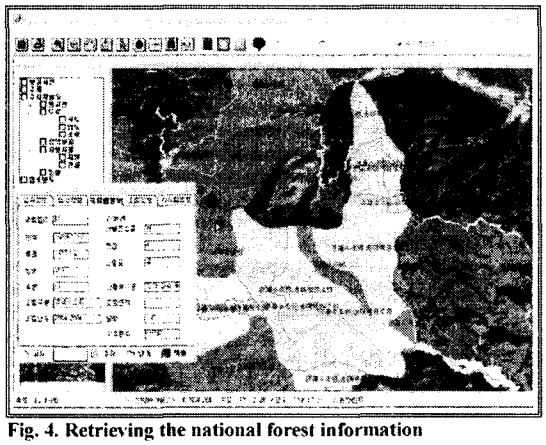

Fig. 4. Retrieving the national forest information

3.2 The best forest stand arrangement method and 3D analysis

The main function of this virtual reforestation system is to analyze the spatial charter in a forest fire damaged area and to select the suitable tree species against forest fires and simulate on computer.

■ ***Interface of the best forest stand arrangement method***

To possibly implement best forest stand arrangement function, the weight score analysis was first performed. For this, the main factors, which are considered importantly, such as soil depth, topography, soil moisture contents, slope, deposition type, eroded soil, soil hardness and soil texture has each weight score.

Finally, this system could regard the Suitable tree on a site and make a great role as DSS (Decision Supporting System) for the domestic Reforestation policy as shown in Fig. 5.

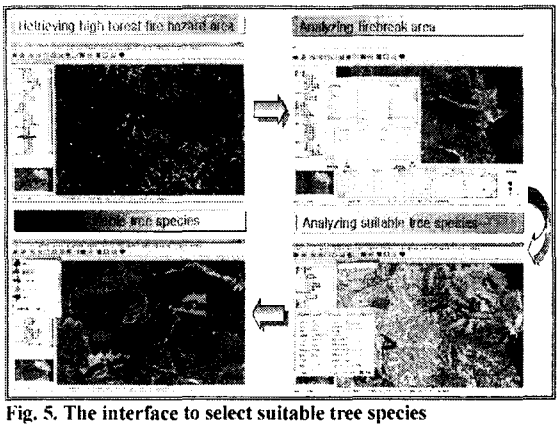

Fig. 5. The interface to select suitable tree species

■ *Interface to monitor a forest Landscape*

In order to monitor a forest landscape and predict the future advanced forestation, this system present the tree growth on passing years referencing site index of KFRI (Korea Forest Research Institute) as shown in Fig. 6.

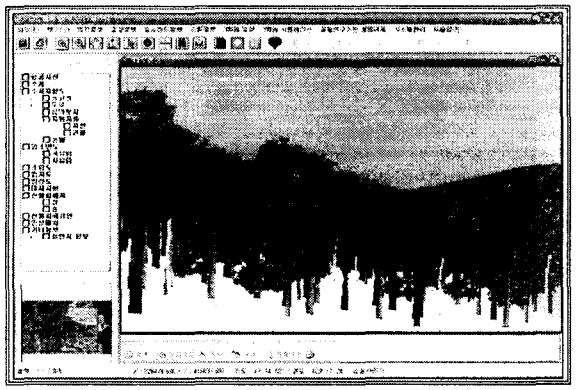
Fig. 6. The interface to view a tree growth

■ *The function for 3D tracking simulation*

3D tracking simulation could be performed after constructing virtual environment by overlaying Firebreak on 3D topography. Also, the reforestation statue, which is before and after a forest fire, could be monitored and compared by using aerial photos.

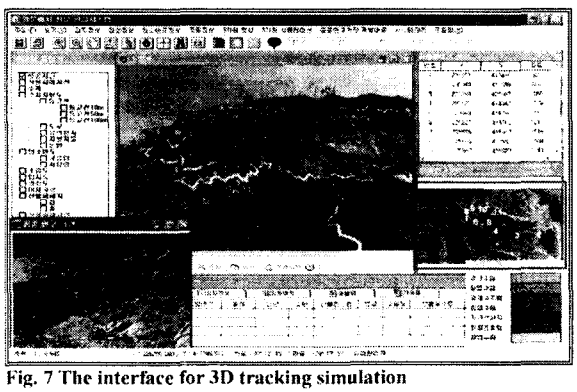
Fig. 7 The interface for 3D tracking simulation

4. Conclusion

In this study, the spatial technique for landscape ecological analysis performed constructing GIS data based on satellite images and aerial photos and implementing the system based on virtual GIS.

1. This system can monitor and predict a domestic forest landscape by passing years and then possibly helps the related officials to establish the best reforestation policy.

2. This system is expected to perform an important role as the DSS (Decision Supporting System) for the domestic reforestation technology.

3. This study show the possibility that GIS and remote sensing technology could help to increase the high quality of domestic reforestation technology.

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