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# Selection Technique for Honey Plant Complex Area Using Landsat Image and GIS

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**ABSTRACT:** Satellite image and GIS spatial analysis were used to analyze the habitation of Acacia honey plant and its spatial distribution characteristics. As a result, the most suitable areas for Acacia honey plant were selected through the integration analysis of transparent overlay. Also, the variables for spatial analysis such as topography, soil, drainage, distance from urban area, land use, meteorological elements were considered.

Finally, satellite image and GIS are considered as significant methods for suitability analysis of honey plant complex area. In addition, GIS DB construction of honey plant area and network analysis through minimum distance path were clarified as efficient and scientific methods in the honey industry if they will be provided with internet GIS in real time.

## 1. INTRODUCTION

Honey plant means all the plants from woody to herbaceous, which secrete honey, produce pollen, and provide honeybees with their food. Honey plant is one of important resources for bee culturing production. Thus the regions rich in seasonal honey plants are suitable for bee culturing. The territory of Korea takes a long shape reaching the south end from the north, and so it shows drastic climate differences according to regions.

The distribution of honey plants and their blooming periods regionally greatly are different form one another because of its complex topographies. The result of examining both seasonal and monthly blooming periods of the major honey plants shows the fact that the most blooming months a year are May, April, June, and July in order, and seasons are Summer (52.0%), Spring (44%), and Autumn (3.6%) in order.

In Korea, bee culturing highly depends on Acacia honey, and this clearly reveals the fact that Korean bee culturing industry is very weak by its constitution. Honeys take the largest proportion of the whole profits of bee culturing, and especially Acacia honey occupies an overwhelming part of them. Young-chon city was selected as the area for this study on the basis of the original factors of locations resulted from the research on the established literatures, and it belongs to the typical temperate climate. The average yearly rainfall was 1,093.5? , and the yearly

clear days were 122. Young-chon city has suitable climate and topographical conditions for constructing Acacia honey plant complex area.

This study selected Young-chon city as a training area for a case study using GIS and satellite image that recently have been introduced as scientific spatial information technologies. Then this study constructed GIS DB of its original factors of locations for honey plant complex area and made the spatial distribution map of Acacia honey plant areas in the city. This study selected the best suitable areas for Acacia honey plant by using GIS spatial analysis on these researches and considered the possibility of scientific bee culturing and the degree of using spatial information technologies for it. Thus this study aimed to construct a basis for the advanced and scientific information processing in the field of bee culture technology.

## 2. MATERIALS AND METHODS

This study used GIS tools such as ArcView 3.2 and Arc/Info 8.01 for NT and a satellite image processing software, ERDAS Image 8.4 to construct GIS DB of the focus(training) area, which is located in longitude from 128 °41´41 ?to 129 °08´42 ?and in latitude from 36 °00´48 ?to 36 °03´08 ?. This study made 1/25,000 digital topology map, satellite images (Landsat TM May 17, 1997) and 1/25,000 soil map, and as well, constructed GIS DB of Acacia inhabitation areas in Young-chon city. Then this study satellite image analogized as well as GIS analysis method on the inhabitation areas of Acacia honey plant and extracted the best suitable areas. The field survey and the ground observation data of the bee culturing industry issued by Young-chon city agriculture technology center verified the results. Figure 1 shows the study flow chart for suitability analysis on Acacia honey plant areas.

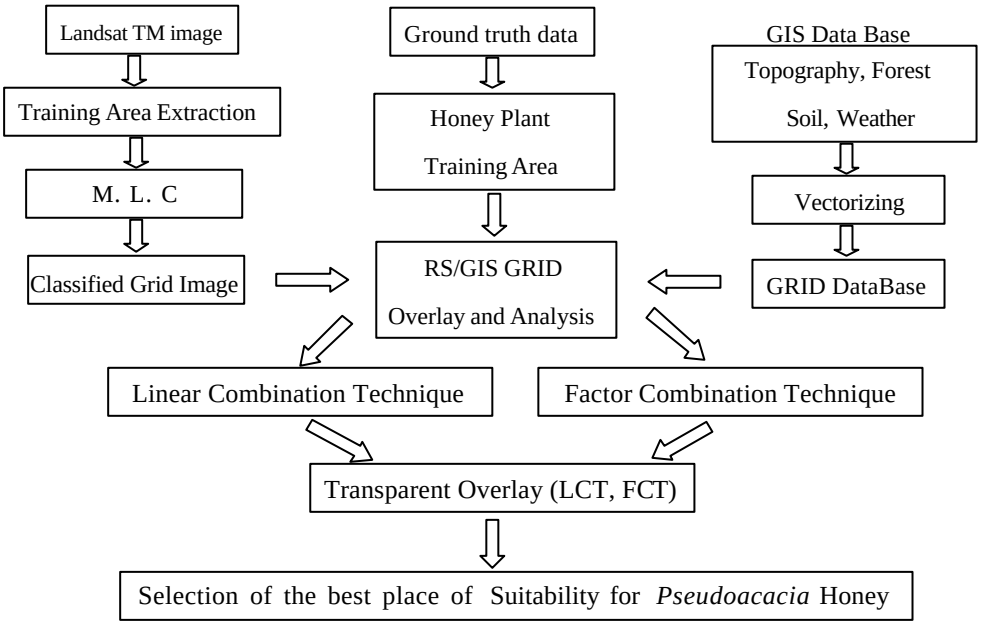


Figure 1. The study flow

### 2.1 Materials

This study extracted honey plants (Acacia trees) stock areas in Young-chon city with using the satellite images

photographed by Landsat TM on May 17, 1997, when Acacia flowers were nearly in full bloom. By 1/25,000 topography map this study selected five training sample areas including Young-chon city as well as its surrounding area. Also we worked on digital topology map, digital forest type map, field survey data, and the meteorological data of bee culturing industry of Young-chon city for the selection of the suitable areas.

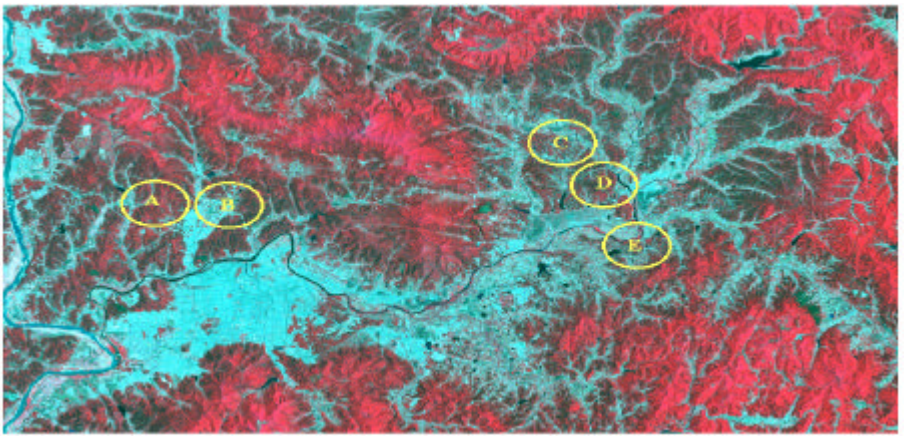


Figure 2. Training sample for classification

**2.2 Methods**

This study prepared thematic layer of the study area such as 1/25,000 topology map, soil type map, and forest type map by GIS Tool, Arc/Info on GIS DB construction and their spatial analysis.

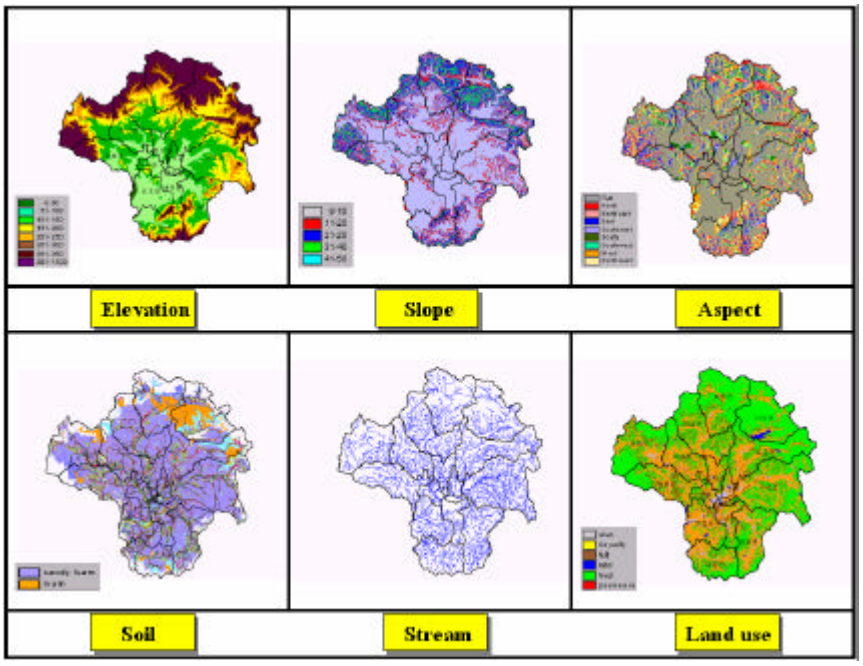


Figure 3. Thematic maps of the study area

This study accomplished worked geometric correction by Unix Erdas Imagine 8.4 on the satellite images that were Landsat TM (band 4/3/2) images, and carried out supervised classification on them by the collection of the training areas from the field honey plant complex areas.

This study extracted Acacia stock areas in and around Young-chon city by the application of Maximum Likelihood Classification method among supervised classifications and prepared a spatial distribution map of

Acacia honey plant. This study extracted the best suitable areas for honey plant by means of transparent overlay techniques such as linear combination technique and factor combination technique and verified the results by the field survey and the primary statistic data.

## 3. The selection method of the best suitable area by GIS

### 3.1 Increment conditions or growth conditions of Acacia honey plant areas

The Acacia is one of typical honey plants of *Leguminosae* and it produces a great deal of honey. It blooms in May, and its full blooming periods are relatively short for from 3 to 4 days while its flowers can last for 10 days. Nevertheless the Acacia has a great quantity of honey secretion and very high adaptability, and it is a species growing rapidly.

Though Acacia is a great resource of honey plants its flowers are so weak in the wind or the rain that can grow better in rather low and gentle slopes and dry southern bottoms of mountains.

Acacia flowers can secret honey actively at the temperatures over 25? , and at from 26 to 28? their secretion quantity is the most. However at the temperatures over 30? the honey secretion quantity becomes less and its flowers quickly wither away because of being lack of moisture. At the temperatures below 23? the honey secretion quantity decreases and the consistency of honey becomes low.

### 3.2 Selections of Suitability analysis methods and the best suitable areas

? Selection of suitability analysis methods

This study selected the best suitable places for honey plant by working on spatial analysis with linear combination technique and factor combination technique.

Linear combination technique first accesses the degrees of the relative importance among the various original factors of locations, and then it comprehensively evaluates lands by means of mathematics operation on them. It has an assumption that categories with more than 2 original factors of locations do not interact mutually. The technique standardizes the categories with qualities of the original factors of location into the proportion between 0 and 1, then multiplies and overlays the degrees of the importance, and finally marks their scores. It can access over the whole training areas without any exclusion and compare the degrees of advantages and disadvantages among the most suitable places.

Factor combination technique restructures maps by excluding certain areas or by combining them into one according to each standard of original factors of locations and then overlays them. It simultaneously combines the factors and the categories with considering the interaction of factors in combination, then measures and analyzes the suitable places for uses. It can simply apply to and is very understandable, whereas it is difficult to set up the standard for restructuring maps. In addition, it needs a lot of works to do in the case including many factors and categories.

? Selection of the best suitable places for honey plants

This study first selected the most suitable places by means of factor combination technique to exactly and effectively selects the best suitable place. Then this study extracted the best suitable places of honey plant by applying linear combination technique to the selected candidate places. Table 1 presents relative weight scores per

variables for conditions of suitable places.

Table 1. Relative weight score per variables for *Pseudoacacia* honey plant suitability

| Criteria | | Term | Gravity | Weight Score | | Highest Score |
|---|---|---|---|---|---|---|
| | | | | LCT | FCT | |
| Topology | Elevation | 101~200 | 25 | 1 | 1 | 25 |
| | | 201~300 | 20 | 0.75 | 0 | |
| | | Below 100 | 15 | 0.5 | 0 | |
| | | Over 301 | 10 | 0.25 | 0 | |
| | Aspect | SW, South | 20 | 1 | 1 | 20 |
| | | Flat, S, NE | 15 | 0.67 | 0 | |
| | | Other direction | 10 | 0.33 | 0 | |
| | Slope | 0~10 | 15 | 1 | 1 | 15 |
| | | 11~30 | 10 | 0.67 | 0 | |
| | | Over 31 | 5 | 0.33 | 0 | |
| Soil | | Sandy loam | 15 | 1 | 1 | 15 |
| | | Others | 10 | 0.5 | 0 | |
| Stream | | Within 2km | 15 | 1 | 1 | 15 |
| | | Except 2km | 10 | 0.5 | 0 | |
| Urban | | Except 2km | 10 | 1 | 1 | 10 |
| | | Within 1km | 5 | 0.5 | 0 | |
| Total | | | | | | 100 |

The factors used for linear combinations are as the followings:

([Class of Aspect]) + ([Class of Slope]) + ([Class of Elevation]) and ([Class of Soil]) + ([Class of stream]) + ([Class of Urban])

## 4. The results of the suitability analysis for Acacia honey plant areas in Young-chon city

Figure 4 shows the results of the suitability analysis. The analysis result means of transparent overlay indicate that while the best suitable areas were Go-kyung, Ha-nam, Im-go, Buk-an and Hwa-san.

As considered their area the places larger than 5? were Go-kyung, Ha-nam, Im-go, Buk-an, Chung-tong, and Dae-chang.

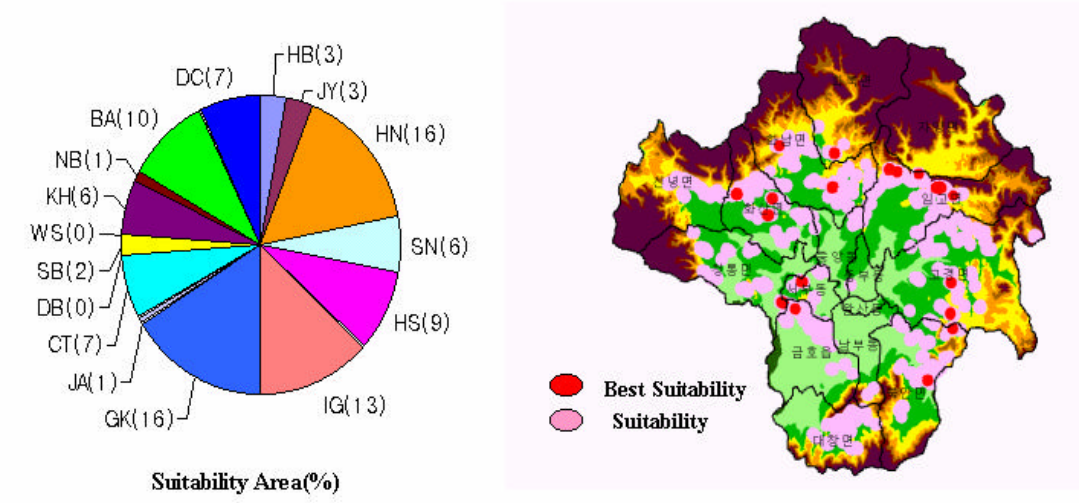


Figure 4. The suitable spatial distribution map of *Pseudoacacia* honey plant

As the above results it was examined that Young-chon city has suitable climate and topographical conditions for Acacia honey plant complex areas as well as for fruit culture. This study can be used reference data for the selection

of honey plants types such projects as constructions of honey plant complex areas and erosion control forest.

## 5. CONCLUSIONS

This study developed an effective method of suitability selection for Acacia honey plant areas by using satellite images and GIS and it is summarized as followings.

First, the standard variables that should be considered in the selection of honey plants areas by GIS and satellite images are natural environments data on topography (altitude, slope, slope direction, and hydrosphere), soil, forest types, land use, and meteorological elements (temperature, humidity, and rainfall) and human environments data on city and road.

Second, as a result of the analysis of suitability selection spatial analysis integrated by linear combination technique and factor combination can be an ideal method for the suitability selection of location. But it needs to be supplemented by standardization of each factor score and its related form to compare it mutually according to a fixed standard.

Third, more accurate results will be achieved if we carry out the accurate field survey, change detection of Acacia trees by multi temporal satellite images, and specifically identify the present honey plant areas and seasonal and periodical changes of weather environments by use of GIS.

In addition, it will be effective on the bee culturing industry to provide the minimum distance path of migratory bee culturing on internet GIS in real time by means of construction of honey plants areas DB over the nation and of network analysis on them.

Decision making on suitability selection for honey plants areas and on priority of primarily suitable candidate areas will be very useful for bee culturing to construct the best suitable areas for Acacia honey plant. Moreover the standards on each factor of the original locations in selection of honey plant areas and the ranking standard on the selection of suitable candidate areas should be provided in near future.

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