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### DEVELOPMENT AND USE OF A WEB-GIS-BASED INFORMATION SYSTEM FOR THE MANAGEMENT AND SUPPLY OF HICKORY ENVIRONMENT CONDITION DATA

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**ABSTRACT** Hickory is a kind of deciduous tree, belong to Juglandaceae Carya, China is hickory's origin. Its fruit has been the favourite of consumers for high nutritional value and the unique taste. Hickory needs suitable environmental conditions and must be planted at an altitude of 300 meters to 700 meters on hills. In this paper, we import Web-GIS to manage hickory environmental conditions based on the date. The system can analyze the date and offer direct-viewing, it can also give advises to the farmers on where it is best for hickory growing. The data included longitude; latitude; altitude; PH value; hydrolysable nitrogen; Olsen P and available K which was measured by every 5 kilometres in Lin'an (a city in Zhe-Jiang province in China) were used. This data was converted into map file format--shp by ArcView. And then geo-spatial interpolation techniques --- Kriging were applied to infer the value of unknown points in Lin'an's map. While the Web-GIS-Based Information System was developed by Mapserver (one of the open source WebGIS) and C# in Visual Studio 2008. In which farmers can click the points on the map to find the environmental conditions and if the place is suitable for hickory's growing.

**Keywords:** Hickory , Web GIS , information system , Mapserver , C#

**INTRODUCTION** Hickory nuts is a kind of dried fruit, belong to Juglandaceae Carya (Carya Nutt.), there are 18 species and 3 varieties in the world (Lv FangDe, Huang Jing et al. 2005). In China, Hickory mainly grow in Zhejiang and Anhui provinces at the junction of Tianmushan area, located in north latitude 29 ° -31 °, longitude 118 ° -120 °, with particular reference to Lin'an hickory-based. Hickory is a kind of neutral to slightly overcast plants, has high demands to the climate of growth environment, hi cool and humid climate, require an altitude of 200 to 900 meters of hills, slope less than 25 °, between the soil pH 5.5 ~ 7 (slightly acidic to neutral) as well as the appropriate content of organic matter. (GUO Chuan-You et al. 2008; Yangwen Jia, Hongli Zhao et al. 2009; XIE Hong-en et al. 2008)

Carry out the hickory WebGIS Management Information System has become a concern of society and the focus of government who is eager to carry out research and the important issue to be addressed. The system's research has contributed to increasing the

production of hickory, making raising income of the farmers in hickory-producing areas, and promoting the local government's fiscal revenue ,balancing the expected benefits between social and environmental which can effectively minimize the natural factors harm on the hickory .So to carry out the hickory WebGIS Management Information System really has a broader application prospects.

At present, WebGIS has been widely used in various areas, including wetlands(V. Mathiyalagan et al.,2005), landslide monitoring(Yangwen Jia, et al.,2008), and the regional air quality observations(Kostas Karatzas et al.,2003). There are many WebGIS platforms such as ARCIMS, GeoMedia, MapServer , OpenMap,and GeoServer, etc.So it is easy for us to develop this idea for hickory WebGIS Management Information System.( David A. Cobb et al.,1997)

**THE TECHNICAL SUPPORT FOR THE HICKORY WEBGIS MIS** In our hickory Web-GIS MIS ,three main technical support were used ,which refers to the developer platform—MapServer , the geo-spatial interpolation technique --- Kriging and the web developer platform---Visual studio 2008 with C#.

**the developer platform—MapServer** MapServer is a open-source WebGIS developed by University of Minnesota (university of Minnesota, UMN) in the 20th century in 1990s,the core is programmed by C script, which can be easily used in Windows, Lunix, MacOSX and other operating systems. MapServer has many advancements : ①advanced graphics capabilities; ②supporting a variety of popular scripts and application environments, including PHP, Python, C #, Perl, Ruby, Java, and. NET, etc.; ③ supporting for the operating system interoperability; ④ supporting for multiple open Geospatial Consortium OGC (Open Geospatial Consortium) standards such as WMS (C / S), non-operational, WFS (C / S), WMC, WCS, Filter of decoding (Encoding), LD, GML, SOS, and OM, etc.; ⑤ supporting a variety of vector and raster data sources, and supporting sub-block vector and raster data; ⑥ support projection transformation and the standard TrueType fonts. Is precisely because of the strong MapServer portability, openness and security, has been widely used in the industry.

**the geo-spatial interpolation technique --- Kriging** The kriging technique is a linear interpolator which belongs to the best linear unbiased estimator (BLUE) family estimators. Thus, the main purpose of the kriging technique is to estimate a certain unknown variable  $X^*$  as a linear combination of the known values  $X_i$  :

$$X^* = \sum_i \omega_i X_i \quad (1)$$

In this formula  $\omega_i$  being the weights computed by the kriging equations.

## **THE DESIGN FOR THE HICKORY WEBGIS MIS**

**Data sources** The data primarily get from our research and the survey data by Zhejiang Forestry College in China . including the altitude, soil hydrolase N, quick-K, the effective P, organic matter, pH value in Lin'an area by every 5 kilometers; Lin'an's 2002-2007 hickory production; 2007 hickory production in the towns of Lin'an regions; the kownledge of hickory diseases and insect.

**The Flow of THE HICKORY WEBGIS MIS** In this MIS we used vector file as the format of data source, it can be ensure the hickory WebGIS MIS's basic information, as well as the efficiency of system implementation. The system flowchart is shown in Figure 1. To achieve the functions of different modules, we have established 9 layers : 3 polygon layers which used to achieve production distribution, weather warning, administrative divisions; 5 point layers which according to altitude, soil hydrolase N, quick-K, the effective P, organic matter, PH value and one line layer (administrative boundaries).Some attribute parameters' format is shown is Table 1.

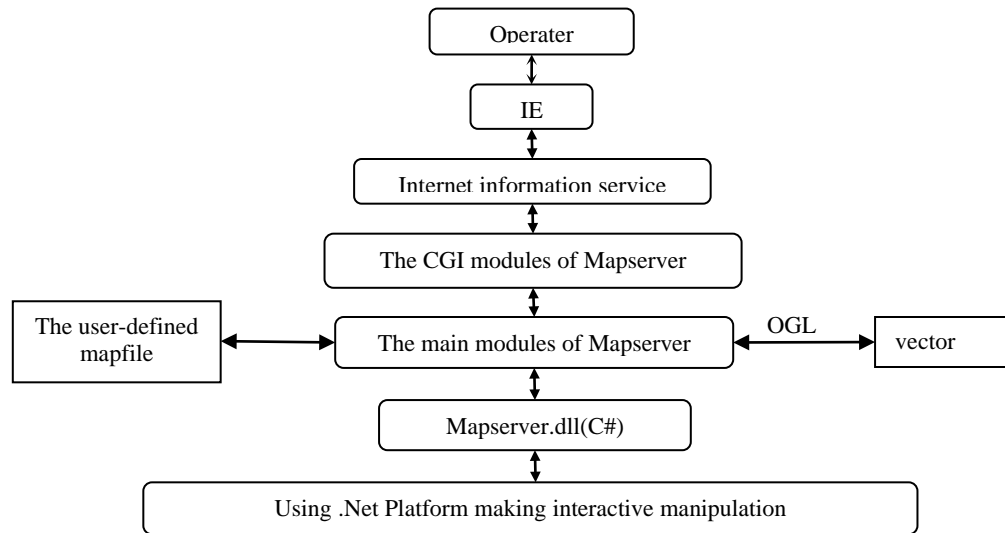


Figure 1. The flowchart of hickory WebGIS information management system

Table 1. The Parameters In hickory WebGIS information management system

Parameter	formate	caption
soil hydrolase N	Floating-Point Types	Units--mg/kg
the effective P of soil	Floating-Point Types	Units --mg/kg
soil quick-K	Floating-Point Types	Units --mg/kg
PH value of soil	Floating-Point Types	National Standard GB
organic matter of soil	Floating-Point Types	Units --g/kg
altitude	Floating-Point Types	Units --meter
production	Floating-Point Types	The production in 2007 in rural as a unit

**System architecture for hickory WebGIS MIS** System mainly includes hickory plant

suitable analysis system, weather warning system, yield forecasting system, pest and disease expert decision-making system.

Hickory plant suitable analysis system, that is, mainly make analysis of altitude and soil organic matter to ensure if the surroundings is suitable for hickory plant , through the operator entered the region to assess whether it is a large area suitable for planting hickory cultivation.

Weather warning system, that is, according to the season and the region to give an advice of early warning forest protection rating, and warning levels for different suggestions for actions.

Pest and disease expert decision-making system, that is, the operator depending on the chosen forest hickory tree symptoms may be given to the prevalence of pests and diseases, and to give treatment advice.

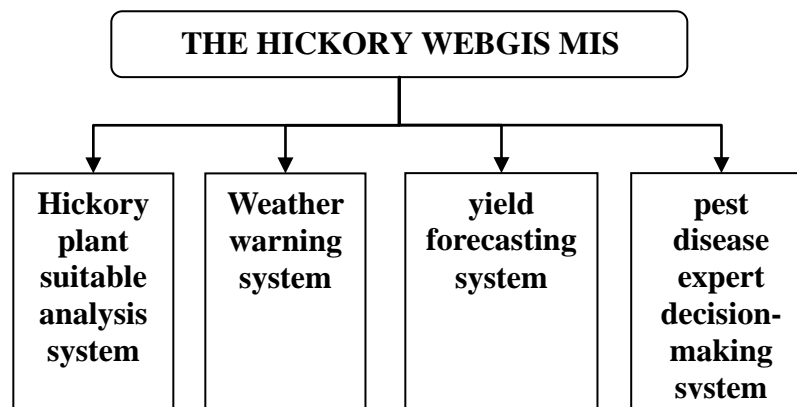


Figure 2. The overall structure of hickory WebGIS information management system

### THE HICKORY WEBGIS MIS

**Hickory plant suitable analysis system (Figure 3)** From this sub-system, in addition to the basic operation of the map such as zoom, the alternative view different properties of the distribution of parameters which include altitude, soil hydrolase N, quick-K, the effective P, organic matter, PH value and so on. Operator can also after enter into the sub-system, click on the map in any one area, the left column will also be prompted to give information to the point of information and the results of the analysis given to whether suitable for planting hickory rating criteria.



Figure 3. Hickory plant suitable analysis system

**Weather Warning System (Figure 4)** From this sub-system, Operator can find the current season, and then the system will give different temperature grades warning.



Figure 4. Hickory Weather Warning System

**Yield forecasting system** From this sub-system, operator can fill the in the need to the year, and click OK, Figure 5(a) will show the results. Clicking the button of view or view the graphical trend charts can show the historical data of Linan hickory in different ways, Figure 5(b).



(a)

(b)

Figure 5. Hickory yield forecasting system

**Pest and disease expert decision-making system** From this sub-system, the operator clicks on the incidence of symptomatic plants in different locations, and selects it, then clicks Next to start the decision-making, or chooses to re-select the Empty the contents and re-select the previous selection. Figure 6(a). The second part to enter into the decision-making system, chooses probability of occurrence of disease, and clicks Start Diagnostics. Figure 6(b). The system will give diagnostic results. Figure 6(c).



(a)



Figure 6. Hickory pest and disease expert decision-making system

**CONCLUSION** This article was based on WebGIS, using .Net platform and the open-source WebGIS- Mapserver to achieve the Hickory WebGIS management information system .Make an implement on the remote control of hickory production and the protection of cultivation; a networked system for information transmission and dissemination; an information analysis and processing model; the visualization of information services and decision-making;

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