DESIGN OF DECISION-MAKING SYSTEM ABOUT WHEAT SURVEY AND DIRECTIONS FOR SOIL BASED ON GIS IN COUNTY

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Abstract: With consideration of the decentralization of wheat fertilization management and status in quo in Henan province, the paper mainly designed county wheat decision-making System of survey and directions for soil Based on GIS. By collecting 3773 records of survey and directions for soil in 976 vilages, Hua county, protracting all kinds of vectorgraphs about villages, towns and the soil survey points, and using nutrient balance and model of survey and directions for soil and wheat fertilization directions, the paper had analysed and designed the system of survey and directions for soil and wheat fertilization directions integrating OOP, software component technique, GIS and so on, realized query for information of soil survey points and estimation for soil nutrient distribution and decision-making for wheat fertilization directions, and provided technology support for application of crop survey and directions for soil in Henan province.

Keywords: survey and directions for soil, county wheat fertilization, crop nutrient balance, fertilizing decision-making system, GIS

1. INTRODUCTION

Survey and directions for soil is one of important technologies of precision agriculture, and developmental direction of scientific fertilization in agriculture production currently, and also an enriching engineering of agricultural science and technology to farm generalized by Ministry of Agriculture (Yang Bin et al., 2007; Liu Yan et al., 2007).

With consideration of the decentralization of wheat fertilization management and status in quo in Henan province, the paper mainly designed county wheat decision-making System of survey and directions for soil Based on GIS. Making administrative villages the units and survey and directions for soil and wheat fertilization the research object, the paper adopted the nutrient balance model and survey and directions for soil model, researched wheat precision fertilization, and realized wheat fertilization management system by using computer technology、GIS and net database, which realized special subject analysis for monitor points fertility and county wheat decision-making fertilization application and played a very important instructional role to agriculture production (Wu Haoxiang et al., 2007).

2. DATA SOURCE AND RESEARCH METHOD

Taking Hua county as an example, the paper had collected 3773 soil nutrient records of each village's 4 azimuth in 22 towns by using GPS and rapid test instrument of soil nutrient, and constructed soil nutrient database. According to traditional agriculture production, the system adopted the nutrient balance model and survey and directions for soil model.

3. SYSTEM DESIGN

3.1 System hiberarchy

Introducing Client/Server/DBMS which separates the logic service from the user connection , the system is made up of database service level, function components level and intergration components level (Xi Lei et al., 2005; Xi Lei, 2003; Zhang Hao et al., 2007). Fig.1 shows the system hiberarchy. Function components which is based on system service level consist of standalone function component in logic each other. Function components of the system is made up of information query model, information statistic model, information summary model, special subject analysis model, manuring decision-making model, and information collecting model. Accordingly intergration components level is made up of information query intergration model, information statistic intergration model, information summary intergration model, special subject analysis intergration model, manuring decision-making intergration model, and information collecting intergration model.

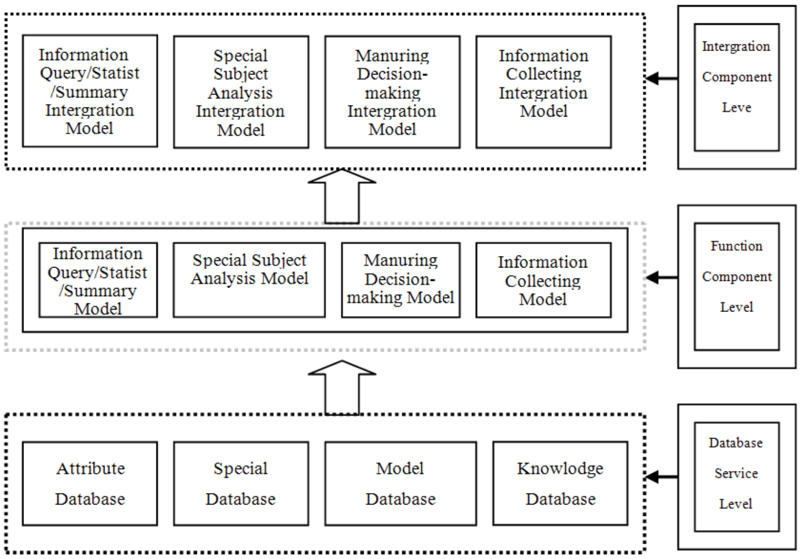

Fig.1: System hiberarchy

3.2 Design of System Function

A The system function includes data management, information statistic and summary, special subject analysis, wheat manuring decision-making, wheat manuring recommend program and print, user permission management and system help, and so on. Fig.2 shows the system function structure.

- Data management

Management of system running data which includes spatial information and attribute information.

- Information statistic and summary

Including vectorgraph and attribute value query each other, statistic and summary of all kinds of information.

- Special subject analysis

Special subject analysis including microelement such as Cu, Ca, Mn, and so on, macroelement such as N, P, K, and so on, organic matter, and so on.

- Management of wheat manuring decision-making model
- Wheat manuring recommend program and print

According to monitoring point nutrient information and wheat output target, the system arrives at unit manuring recommend program and advice output of manuring measurement and fertilizing technology.

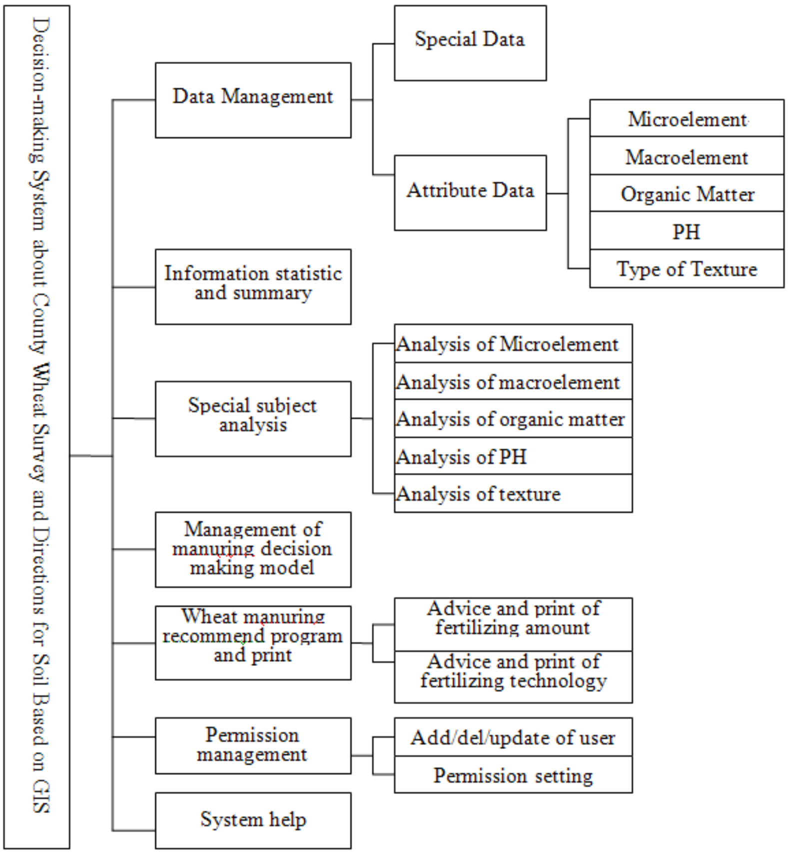

*Fig.2:*System function structure

3.3 Design of wheat recommend manuring model

Routine crop fertilizing models include ASI nutrient grade (Yang Liping et al., 2000; Xiong Guiyun et al., 2007), nutrient balance (Sun Mengjun et al.,

1989) and land capability subtraction (Zhou Shangzhi et al., 2003). The system used nutrient balance model. Recommand fertilizing result includes fertilizing program, fertilizer class choice and main nutrient content convertation of fumure organique. In practice, in order to fertilize expediently, the paper only considered N, P and K element. Formula 1 shows the nutrient balance model (Xie Gaodi et al., 2005; He Liyuan et al., 2007):

$$M=(U\times T-S)/P/C \quad (1)$$

Where: *M* is manuring measurement; *U* is nutrient element sorbability pre 100kg crop, which is queried from table of crop nutrient sorbability ; *T* is target output, which is divided into 3 grades: 450～500kg/acre, 500～550kg/acre, and above and beyond 550kg/acre, according to the soil output capability; *S* is soil nutrient supply, which equals to soil nutrient value multiplied by 0.15; *P* is fertilizer absorptivity, which is queried from table of fertilizer class; *C* is fertilizer nutrient content, which is queried from table of fertilizer class.

3.4 Data Collection and Database Structure Design

3.4.1 Data Collection

System Data includes attribute data and spatial data. Attribute data table includes soil monitoring point, wheat variety, administration regionalization and farmer information. Soil information of monitoring point is made up of soil texture, total nitrogen, alkali-hydro nitrogen, P_2O_5, K, Organic matter, PH, and so on. Administration regionalization table is made up of 22 towns and 976 administrative villages. By 1:10,000 scale, the system used ArcView to build spatial database.

3.4.2 Database Structure

Database design is the key of effective working and function implement of GIS (Yang Bao-zhu et al., 2005). This system database designed by adopting E-R model mainly includes the spatial character database, the attribute characteristic database. Fig.3(a) shows the system database structure. Fig.3(b) shows the database structure of attribute character, and Fig.3(b) shows the database structure of spatial character.

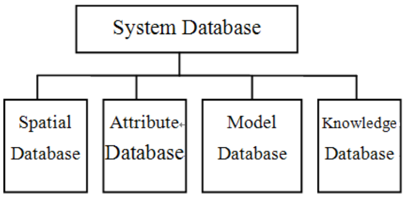

*Fig.3(a):*System database structure

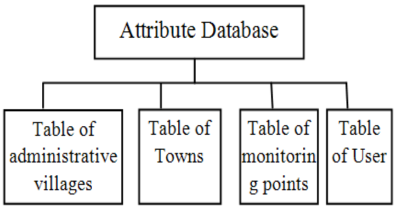

*Fig.3(b):*Attribute database

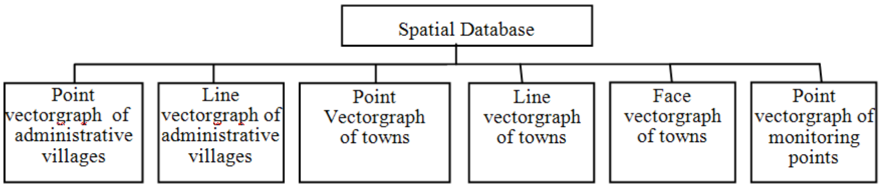

*Fig. 3(c):*Spatial database

3.4.3 Attribute database Design

Attribute database is mainly made up of administrative village table and monitoring point table. Table 1 and Table 2 show the data table design of administrative village and monitoring point.

Table 1 Design of administrative Village

Field Name	Field type	Primary/Foreign key or No	Repeated or No	Empty or No	Index or No	Explanation
ID	Char 10	Primary key	No	No	Yes	Village ID
Village_Name	Char 10	Foreign key	No	No	Yes	Village Name
Town_Name	Char 10	Foreign key	No	No	Yes	Town Name
Longitude	Float 8	Foreign key	Yes	No	Yes	Longitude
Latitude	Float 8	Foreign key	Yes	No	Yes	Latitude
Soil_Area	Float 8	No	Yes	No	Yes	Soil Area
Soil_Potential	Float 8	No	Yes	No	Yes	Soil Potential
Input_Time	Datetime	No	Yes	No	No	Input Time
Recorder	Char 10	No	Yes	No	No	Recorder

Table 2 Design of monitoring point

Field Name	Field type	Primary/Foreign key or No	Repeated or No	Empty or No	Index or No	Explanation
ID	Char 10	Primary key	No	No	Yes	Point ID
Uni_ID	Char 20	Foreign key	No	No	Yes	Uniform ID
Labouratory_ID	Int 4	Foreign key	No	No	Yes	Labouratory ID
Longitude	Float 8	No	Yes	No	Yes	Longitude
Latitude	Float 8	No	Yes	No	Yes	Latitude
Village_name	Char 10	Foreign Key	Yes	No	No	Village Name
Orientation	Char 10	No	Yes	No	No	Orientation
Soil_Texture	Char 10	No	Yes	No	No	Soil Texture
Organic_Matter	Float 8	No	Yes	No	No	Organic Matter
Total_Nitrogen	Float 8	No	Yes	No	No	Total Nitrogen
Rapid_Avail_P	Float 8	No	Yes	No	No	Rapid Available P
Rapid_Avail_K	Float 8	No	Yes	No	No	Rapid Available K
Slow_Avail_K	Float 8	No	Yes	No	No	Slow Available K
PH	Float 8	No	Yes	No	No	PH
Input_Time	Datetime	No	Yes	No	No	Input Time
Recorder	Char 10	No	Yes	No	No	Recorder

4. SYSTEM REALIZATION

The system is realized by using data driven as method, Visual Basic 6.0 as development, MapObjects as component (Chen Zheng-jiang et al., 2005; Chao Zhang, 2007; Mchael Zeiler, 1999), and SQL Server 2000 netdatabase, soft-component, following development standard of COM/DCOM and OOP. The realized system can be set up and run on Win 20000/2003、Win XP、Win NT in PC and touch screen system.

Considering distributed continuity of soil and easy acquisitiveness of soil information, the research of the system made each administrative village the units, collected soil point information of 4 trends of each village, produced soil monitoring point vectorgraph with Arcview. After selecting points on the system(Fig 4), the system makes buffer analysis on selected point. Farmers can select the nearer points close to the selected point from the buffer, and make formula fertilizing amount decision and fertilizing technology decision(Fig 5).

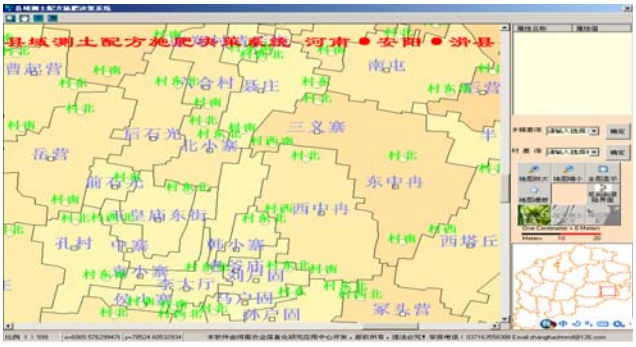

*Fig.4:*System point selection interface

*Fig.5:*Wheat decision-making fertilizing interface

5. CONCLUSION

The system had been applied in Hua county agriculture production. Base on the principle of systematization, friendly operating, expansibility and easy application, the system made use of high technologies, and realized scientific management on wheat survey and directions for soil and decision making analysis on wheat production, which has provided technology support for application of crop survey and directions for soil in Henan province.

According to the situation of the soil fertility distribution differentiation at the same trend, the collected soil monitoring point maybe does not represent all plots at the corresponding trend. To resolve the question, it is feasible to select 6-10 representative soil monitoring points at each trend, analyze them on density based on GIS, filter representative and precise monitoring points, and make variable farmland nutrient vectorgraph finally, so that the system increases the wheat decision-making precision of survey and directions for soil.

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