Application of Information Technology in Soil Testing and Formula Fertilization

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Abstract: This paper discussed the characteristic of information technology applied on soil nutrient man-agement and fertilizing technology in occident, analyzed the requests of soil determination and prescription fertilization for information technology and it developing trend in china, pointed out the requests, tasks and content so information processing in it at present in our country and analyzed the existing problems agriculture technology extension station in counties. The application of information technology in soil determination and prescription fertilization was mainly concluded as follow. (1) applying the data base technology and GIS, and processing the data about soil and fertilizer and the maps connected according to the standard, to establish the attribute database and space database, and management system. (2) using GIS database, combining the application, to establish application system such as tilth estimate system applying decision system. (3) utilizing network technology to realize database sharing and long-distance applying decision on web.

1. Introduction

Information technology is a new field of science and technology that applies the principles and methods of information science to study the production, collection, storage, transformation, transmission, processing and utilization of information. It integrates communication, computer and control technologies. It is also called “3c” technology abroad. Its contents include information receiving technology, information transmission technology, information processing technology and information control technology. Since the 1950s, information technology has become one of the fastest growing fields of science and technology in the contemporary world with its strong vitality.

At present, the application of information technology in agriculture mainly refers to the application of 3S technology (GIS, Geographic Information System, GPS, Global Positioning System, RS. Remote Sensing) and expert system in agricultural production management, resource management and agricultural decision-making. Since the 1990s, precision agriculture with 3S technology and computer automatic control system as the core technology has become a hot area of global agricultural concern, and triggered a new agricultural technology revolution, which has become the direction of the global agricultural science and technology revolution in the 21st century.

2. Soil Testing and Formula Fertilization and Application of Information Technology

Formula fertilization by soil testing is a scientific fertilization technology to coordinate the relationship among crop yield, agricultural product quality, soil fertility and crop environment. Based on soil testing and fertilizer field experiment, according to the law of crop fertilizer demand, soil fertility performance and fertilizer effect, and on the basis of rational application of organic fertilizer, it is put forward. Number, period and method of application of nitrogen, phosphorus, potassium and medium and trace elements fertilizers. Since 2005, China has paid unprecedented attention to soil testing and formula fertilization, and started to promote it throughout the country. So far, the implementation area has reached 1.87-107 hm2.

The application of information technology in soil testing and formula fertilization mainly refers

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to the collection, storage, transmission, processing, analysis and utilization of information related to soil formula fertilization, the establishment of database of soil nutrients and fertilization information, and decision-making and application systems of formula fertilization. Information technology will play an important role in the efficient management and fertilization decision-making of farmland nutrients by comprehensively and reasonably utilizing and analyzing the data of soil, crop and fertilizer obtained from soil testing and formula fertilization.

3. Application of Information Technology in Soil Testing and Formula Fertilization

3.1 Overseas Application

Information technology in foreign countries started early, applied in agriculture earlier, and developed rapidly. At present, the application of information technology based on “3s” has involved fertilization, sowing, tillage, water management and other related fields, and formed a relatively mature set of techniques, including precision soil testing, precision seed engineering, precision balanced fertilization, precision sowing, precision irrigation, crop dynamic monitoring and accurate harvesting. Precision agricultural technology system, including others. Precision agriculture has also gradually become known and familiar with the mockery of farm operators. Take the United States as an example, in 1998, 77% of farmers used precision agricultural technology, 82% of them used GIS technology to carry out soil sampling, 74% of farmers used GIS mapping, and 61% of farmers used yield analysis.

In developed countries such as Europe and the United States, precision agriculture technology is the most mature, and its core technology is the application of GIS. Precise fertilization technology is based on the specific conditions of each operation unit in the field. In the field of soil nutrient management, relevant information such as soil type, soil productive potential, yield-increasing effect of different fertilizers, fertilization modes of different crops, fertilization and yield over the years are input into the computer to form complete information of soil nutrients. Under the guidance of chemical management system, the field fertilizer applicator equipped with modern communication receiving device completes the fertilization operation concretely. For example, in the field of soil nutrient management and fertilization technology in the United States, relevant information such as soil type, soil texture, nutrient content, fertilization and yield over the years has been input into the computer by using GIS. In many areas and farms, such information has been made into soil nutrient GIS layer, forming a complete information of soil nutrient and fertilizer information. Information system, fine management, make fertilizer input more scientific. Farmers in North America usually take only three days to get soil and fertilizer from their fields.

The Internet in developed countries in Europe and America started first. Virtual agriculture and precision agriculture based on artificial intelligence system and 3S technology have achieved practical results. In 1996, the United States Congress passed a new Agricultural Act requiring government departments, the transportation and marketing of agricultural products, and agricultural production means supply companies to provide information services to farmers free of charge on the Internet. The United States has formed a national, regional and state-level agricultural information network.

3.2 Domestic Application

Under the influence of agricultural informatization in developed countries, China has carried out systematic engineering since the 1980s. The application of database and information system, expert system, decision support system, remote sensing technology, geographic information system and global positioning system in agriculture, resources, environment and disasters has been achieved. Many important achievements have been made. China has introduced global positioning system from abroad; the research level of remote sensing and geographic information system technology is close to that of developed countries; the coupling of 3S technology has also developed in China. The computer management decision-making model and system based on the process of agricultural production have been extensively applied and introduced abroad. Some achievements have been

demonstrated and applied in production.

Soil testing and formula fertilization technology has been demonstrated and popularized in China for more than 20 years since 1980s, and has achieved obvious results. However, this technology has not been widely used. Before 2005, the national coverage rate was only about 30%. This is related to the limited factors such as small and scattered plots, low level of agricultural mechanization, limited economic strength and low level of social services in China. In China's underdeveloped areas, soil testing and fertilization are difficult to apply due to the lack of necessary soil testing equipment. Although economically developed areas have instruments and equipment for soil testing and fertilization, they often lack effective information processing and crop decision-making fertilization system, which results in balanced fertilization only in local areas.

In recent years, the application of information technology in soil testing and formula fertilization research has been gradually carried out. For example, Dai Shiming and other artificial intelligence technology and traditional data processing technology are organically combined to develop an expert system for soil formula fertilization decision-making. Sheng Jiandong and others developed regional soil nutrient management and crop recommendation and fertilization information system by using integrated development technology of database system and geographic information system. Chen Chenghuang's Application Based on GIS Based on the soil nutrient management and recommended fertilization system at county level in Xinjiang, a nutrient zoning management system of Xinjiang Autonomous Region based on WebGIS was proposed.

In Anhui, the application of information technology in soil testing and formula fertilization has also achieved a series of research and application results. In 2001, the soil database system of Hefei City was established with the help of personal computer, Visual Foxpro 6.O, Windows 98 and other software, using the data obtained from the national soil census, land use survey and some related graphic data. In 2003, the application system of land and resources database in Anhui Province was designed and established. In 2004, aiming at the current situation of soil sulfur deficiency in China, based on the Chinese WINDOWS98 platform, the agricultural sulfur information system of China was developed on the basis of MAPGIS and Acces database, which provided a soil sulfur, plant sulfur nutrition and sulfur for agricultural technology extension, fertilizer production and marketing departments and agricultural scientific research departments. Fertilizer effectively manages such information so that these departments can easily understand the local soil sulfur information, and allocate or allocate the proportion and quantity of nutrients to suit the local soil conditions and crop needs of sulfur fertilizer, which is convenient for farmers to adopt and carry out balanced fertilization. In the same year, the information system of soil fertilizer and agrochemical service in Anhui Province was established. The whole system is divided into nine parts. It provides information on soil nutrient, fertilizer experiment, crop planting, agrochemical service, new fertilizer development and production, fertilizer market, fertilizer management information, industry departments and fertilizer enterprises in Anhui Province. It can also be based on the information of Anhui Province. The input of N, P and K fertilizers in farmland is determined by toponym, crop species and yield on the map. It has the function of recommendation decision support of compound fertilizer formula and decision-making of compound fertilizer ingredient. In 2005, an inquiry system of formula fertilization was established in Qiucun Town, Guangde County, Anhui Province, and the recommended fertilization formula was realized with the farmer plot as the management unit. In 2004, Anhui Soil and Fertilizer Information Network was established based on ASP technology, aiming at scientific fertilization consultation, soil fertility monitoring, cultivated land quality evaluation, assistant agricultural decision-making and promoting information exchange of soil and fertilizer, and gradually realizing uploading and updating of soil data and decision-making of online formula fertilization.

It can be seen that the establishment of fertilization decision-making system combined with database technology, geographic information technology and other information technologies, and the realization of online decision-making function are the development trend of Chinese information technology in soil nutrient management and fertilization decision-making. At present, the application of information technology in soil testing and formula fertilization needs continuous

development, such as database sharing, database management, fertilization decision-making and digital processing of results.

4. Requirements, Tasks and Contents of Information Processing of Soil Testing and Formula Fertilization in China

4.1 Requirements for Information Processing of Soil Testing and Formula Fertilization

On the basis of the village-level soil testing and formula fertilization, a decision-making information system for farmland fertility evaluation and formula fertilization on the Internet is established by combining geographic information technology, database technology, decision-making system technology and network technology. The system realizes the sharing of data results of soil testing and formula fertilization, the efficient management of database and the convenient and fast implementation. Fertilizer decision-making.

4.2 Task of Information Processing of Soil Testing and Formula Fertilization

GPS technology is used to collect information of soil testing and formula fertilization; database technology and geographic information technology are used to establish database and manage and maintain the database; then the evaluation model of cultivated land fertility is applied to establish the evaluation system of cultivated land fertility, and the recommended formula fertilization system of crops is established by applying formula fertilization model. Finally, combining with the network information technology, the evaluation of cultivated land fertility and the decision-making of formula fertilization on the network are realized. Using information technology to promote the implementation of soil testing and formula fertilization and its scientific research achievements sharing and promotion.

4.3 Information Processing of Soil Testing and Formula Fertilization

Establish database and management system, apply database technology and geographic information system, arrange and process soil and fertilizer data and related maps according to standard, establish attribute database and spatial database and connect them. Through database management system, realize database operation, visual query and analysis, and data. Update and maintenance of library. This is the basic content and work of information processing of soil testing and formula fertilization.

(1) Attribute database. The content of attribute database includes field experiment demonstration data, soil and plant test data, field basic situation and household survey data. After sorting, processing, coding and standardization, the database of soil testing and formula fertilization was established. The database includes several sub-databases, such as soil fertility data, crop nutrient data, fertilizer survey data and fertilization test data.

We can collect and collate the historical data, including the second Soil Census data, all kinds of experimental data, soil nutrient location monitoring data, and establish the county cultivated land resources database. On the basis of establishing County attribute database, provincial and national cultivated land resource database is established.

(2) Spatial database. Using geographic information technology, the paper maps such as soil map, land use map, administrative division map, sampling point bitmap and so on are digitized, and spatial databases of different types and regions are established.

(3) Establishment of cultivated land productivity evaluation system. Based on the topographic and geomorphological features, the natural attributes of cultivated land such as parent material, soil physical and chemical properties, farmland infrastructure, and the contribution rate of this attribute to cultivated land productivity obtained by analytic hierarchy process (AHP) or expert direct evaluation, a model of cultivated land productivity index for cultivated land productivity evaluation is established.

Based on the GIS platform and the basic database of cultivated land resources and the model of cultivated land productivity index, the evaluation system of cultivated land productivity at county

level is established to manage cultivated land resources, adjust agricultural structure and synthesize nutrient resources at different scales.

Problems of Information Technology Application in Soil Testing and Formula Fertilization in Agricultural Technology Extension Departments of Five Counties and Municipalities

At present, the project of soil testing and formula fertilization is carried out in the county as a unit, so the work of county and municipal agricultural technology extension departments and the application of information technology play an important role in the promotion and popularization of soil testing and formula fertilization in the whole country, but there are still some problems.

4.4 Insufficient Hardware and Software Configuration

The application of information technology in soil testing and fertilization requires certain hardware and software configuration, such as GPS used in information collection, computer used in data input and analysis, and GIS platform. Due to insufficient investment, there are only one or two computers in general configuration, but GPS and GIS basically do not. There is a gap between hardware and software configuration and the requirements of information technology in soil testing formula. Only by subsidizing funds in pilot counties promoting soil testing formula fertilization can this problem be solved to a certain extent.

4.5 Network Construction is Not in Place

The introduction of computer technology in agriculture began in the early 1980s. In the 1990s, with the development of the Internet, China's agricultural network is also in a period of rapid development. The Ministry of Agriculture established the China Agricultural Information Network (CAINN) in 1994, and now it has taken shape, with more than 1000 counties running online. In October 1997, the China Agricultural Science and Technology Information Network Center was established. It has been able to connect with the global Agricultural Science and Technology Information Network, and also with the domestic agricultural networks. A census conducted by the Ministry of Agriculture on the national agricultural website in the second half of 2001 showed that. Up to February 31, 2000, 2200 agricultural websites were included in China, among which the websites sponsored by governments at all levels accounted for a large proportion, about 40%, but the number of agricultural grass-roots websites was not large, especially at the township level, less than 4%.

4.6 Aging of Knowledge Structure of Existing Personnel

China carried out two national soil surveys in 1958 and 1979 respectively, and then conducted a large number of field experiments on fertilizer effects. The data were scattered in the agricultural technology extension departments of counties and cities, and could not really be used for production. The traditional Soil-testing formula fertilization is paper-based for data recording and preservation, and data processing is also manual. The efficiency of data utilization and analysis is low, and this situation still exists till now. The main reason is that the knowledge structure of the personnel in the agricultural technology extension departments of counties and cities has not been updated. Current agricultural scientists and technicians have basically participated in the national soil census, conducted fertilizer effect field test, mastered the basic theory and technology of soil testing and formula fertilization skillfully, and have rich agricultural expertise, but they are accustomed to using traditional paper and manual methods, which reduces their mastery of computer knowledge and technology. Some application software operation requirements, therefore, mostly lack of computer expertise, the use of Internet and professional software will not be or not familiar, making the use of GPS, as well as the use of computers and related software to establish databases and other aspects are difficult, but also restrict the further improvement of previous technological achievements. And one of the reasons for promotion.

4.7 Lack of Computer Science and Technology Personnel

At present, there is a shortage of computer technicians in the agricultural technology extension departments of counties and cities. Because of some compilation reasons, it is difficult for

professionals who have mastered computer knowledge and information processing to enter the county and municipal agricultural technology extension departments. Therefore, for the computer security maintenance, network technology, professional data management, especially for the use and secondary development of some complex tools and software requirements, these agricultural technology promotion departments will show shortcomings in technical strength.

In view of the above problems, on the one hand, county and municipal agricultural technology extension departments need to invest part of the funds, increase hardware and software configuration, strengthen network construction, on the other hand, they need to train existing agricultural technology extension personnel in computer and information technology, hire a number of computer and software development professionals, or add Strong cooperation with scientific research institutes can solve the application of information technology in soil testing and formula fertilization, and improve the efficiency of soil testing and formula fertilization and the sharing and promotion of technical achievements.

5. Conclusion

In the construction of network infrastructure, according to the questionnaire survey, the implementation of soil testing and formula fertilization in 2001 can improve the efficiency of fertilizer use and reduce it. Agricultural non-point source pollution to achieve high quality, safety and high yield of agricultural products and agricultural production

Save cost and increase efficiency. In soil testing and formula fertilization, through the combination and integration of geographic information technology, database technology, decision-making system technology and network technology, the management of soil nutrient data, database sharing, real-time fertilization decision-making and visualization of its results can be realized. This will promote the popularization and implementation of China's soil testing and formula fertilization project, and the sustainable utilization of its scientific research achievements, improve China's soil nutrient management technology, as well as macro-control and micro-decision-making capabilities in agricultural production, and further promote China's agricultural informatization.

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