

Development of Soil and Fertilizer Information System in China

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Abstract

The outstanding strategical target of the Chinese agricultural policy for the upcoming decades can be summarized as follows: producing enough agricultural products under sustainable economic and environmental conditions. One important instrument to address this challenge is the Soil and Fertilizer Information System of China (SOFISC). SOFISC is a GIS-supported computer system especially designed for decision-makers and researchers involved in agricultural and all related industrial and environmental areas of the economy. It provides information about the development of soil fertility and productivity as well as fertilizer application and efficiency in all the 30 provinces and 2,300 counties of China. Future effects of decisions about fertilizer use can be analyzed and evaluated on a national and regional scale.

Introduction

While fertilizer consumption in developed countries stagnated or even decreased in the last decade, it increased substantially in China which has to increase his food production for an increasing population with decreasing land resources. The average annual N-fertilizer application was still lower than 80 kg N/ha at the beginning of the 1980s. Now the N-fertilizer rates for arable land and cropping areas are 219 and 134 N kg/ha, respectively (Anonymous, 1995). Along with the large increase of fertilizer input in a relatively short period of time, there is little improvement of the farming management scale, educational level of farmers and fertilization technologies. Thus fertilizer utilization efficiency is decreasing (Soil and Fertilizer Institute of CAAS, 1986; Pi & Dan, 1995). Since it is still very difficult for the majority of the Chinese farmers to adopt improved farming practices such as routine soil testing for fertilizer recommendation, a suitable approach to improve fertilizer efficiency will be to supply farmers with crops and regionally specified fertilizer compounds or mixed fertilizers. Namely, fertilizer planning has to be carried out by agricultural advisors and fertilizer producers and traders at regional levels instead of by farmers at the field level. In order to promote fertilizer planning and allocation at the regional level efficiently and scientifically, the Soil and Fertilizer Information System of China (SOFISC) has been developed.

System description

System purpose

SOFISC is a GIS-supported computer system especially designed for decision-makers and researchers in agriculture, fertilizer industry, environment, food, agricultural resources and materials and other related areas to monitor variations in soil fertility and productivity and fertilizer efficiency in all the 30 provinces and 2,300 counties of China. It provides also an important tool for agricultural advisors and fertilizer-producing and trading

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companies to optimize regional fertilizer planning and allocation.

Software priorities

- Simple operation through user's menu
- Search of information through screen maps or catalogues
- Information displayed in maps, graphs, figures, tables and texts
- Annual update-data registration

Soft- and hardware requirement: WINDOWS 95, WINDOWS 98, Pentium 586, RAM Memory: 16MB, Screen memory, Disc capacity: 1 GB.

System data

To evaluate soil fertility and productivity and their interactions comprehensively, different data were included. The total volume of the system data is about 1GB.

- Experimental data: fertilizer trials that were carried out in 29 provinces since 1980 up to now
- Soil survey data: To analyze the spatial and temporal changes of soil fertility, data from the first and second soil surveys were collected. The first soil survey was carried out in the 1950s. The second soil survey was initiated in 1979 and completed in the 1980s. These reports contain classification, distribution, profiles, fertility, chemical and physical characteristics of about 2,200 soil types from the whole country. Also data from a nationwide investigation to determine recent soil nutrient status that consisted of 8,000 soil samplings from 29 provinces were included.
- Map data: These include administrative boundaries, soils, topography, vegetation, crop distribution, agricultural climate regions, river and water systems.
- Soil and agriculture-related data: data which are closely related to soil and crop production such as crop rotation systems in different regions, long-term climate data from 500 stations and others were also included in the system
- Statistical data: Statistical data related to soil productivity and fertilizer efficiency in 30 provinces and 2,370 counties were used. The database contains about 200 items for county level and 800 items for province level and covers the time period from 1980-1996.

Models

For the evaluation of regional soil nutrient status and for fertilizer recommendation, different models such as nutrient balance sheet models, non-linear prognosis models, optimization models as well as expert systems were included in the system.

System modules

There are 6 main modules:

- [SoilInfo]: Supplies information concerning soil productivity and fertility in 30 provinces and 2,300 counties.
- [FerInfo]: Contains information of current fertilizer production, consumption and data concerning fertilizer efficiency.
- [Change]: Displays the development of fertilizer consumption and efficiency.
- [Prognosis]: Supplies fertilizer requirement prognosis and describes the environmental influences of these changes.
- [SoilExpert]: Provides regional fertilizer recommendations and knowledge of soils and fertilizers.
- [AgrMap]: Includes maps concerning soils, fertilizers, crops and resources for agriculture.

Sub-modules of different main modules are listed in Table 1.

Table 1 User's menu of Soil and Fertilizer Information System of China (SOFISC)

SoilInfo	FerInfo	Changes	Prognosis	SoilExpert	AgrMap
Soil productivity	Consumption	Fertilizer consumption	Fertilizer consumption	Fert. recommendation	Fertilizer maps
Yield level	Application rate	Nutrient balance	Nutrient balance	Crop nutrient expert	Soil maps
Yield stability	Nutrient balance	Nitrogen	Crop distribution	Fertilizer expert	Crop maps
Soil types	Nitrogen	Phosphate	Agricultural economy	Soil dictionary	Agricultural resources
Soil nutrient status	Phosphate	Potash	Agricultural resources		Arable land
Summarized info	Potash	Soil fertility	Population		Population
Organic matter	Fertilizer efficiency	Organic matter	Arable Land		Water resources
Nitrogen	WorldInfo	Soil nitrogen	Agricultural materials		Meteorological conditions
Phosphate	Total fertilizer	Soil phosphate	Agricultural production		Precepitation
Potash	Nitrogen fertilizer	Soil potash	Grain		Temperature
Micronutrients	Phosphate fertilizer	Micronutrients	Cotton		Sunshine hours
Cropping conditions	Potash fertilizer	Agric. economy	Oil		Frost-free period
Land resources	Agriculture	Crop distribution	Meat		Geomorphology
Water resources		Agricultural resources	Fruit		Glacier
Population		Population	Aquatic products		Desert
Agric. mechanization level		Arable land			Vegetables
Agric. economic level		Agricultural materials			Topography
Animal husbandry, sideline and fisheries		Production			Swamp
Meteorological conditions		Grain			Landslip
		Cotton			Agric. Materials
		Oil			Agric. machinery
		Meat			Rural electricity consumption
		Fruit			Agric. output values
		Aquatic products			Forestry, Animal husbandry, Fisheries
		WorldInfo			

Results

Example 1

Fig. 1 shows a map of current fertilizer consumption in different counties in China. This map was obtained from the sub-module [Consumption] of [FerInfo]. Users just need to click the sub-module [Consumption] listed on the user's menu and will then open the map. Detailed information concerning different counties can be obtained by clicking the corresponding counties from the map or catalogues (Table 2).

Table 2 Detailed information on fertilizer consumption of counties surveyed

Counties	Ningjin County	Fuping County	Jiangxian County	Jinhua County
Provinces	Hebei	Hebei	Shanxi	Zhejiang
Current fertilizer consumption (tons)	39,541	5,769	9,846	15,395
Current N-fertilizer consumption (tons)	22,929	3,350	5,082	10,764
Current P-fertilizer consumption (tons)	6,956	1,021	2,388	1,982
Current K-fertilizer consumption (tons)	1,777	255	416	857
Current fertilizer consumption per capita(kg)	60	30	40	30
Current N-fertilizer consumption per capita (kg)	35	17	20	20

Example 2

Fig. 2 shows the changes in the nitrogen and potash fertilizer application rates in different provinces from 1987 to 2001. These maps were obtained from the sub-module [Fertilizer Maps] of [AgrMap]. The fertilizer application rates in 2001 are forecasted values using prognosis models. It appears that high nitrogen rates were applied in the coastal regions and high potash rates in the southeastern provinces. However, there was a

significant increase in the potash application rates in central and northern China. Maps of NPK-ratio of fertilizer consumption in 1980 and 1996 show that the NK ratios were significantly improved in southern and central China (Fig. 3)

References

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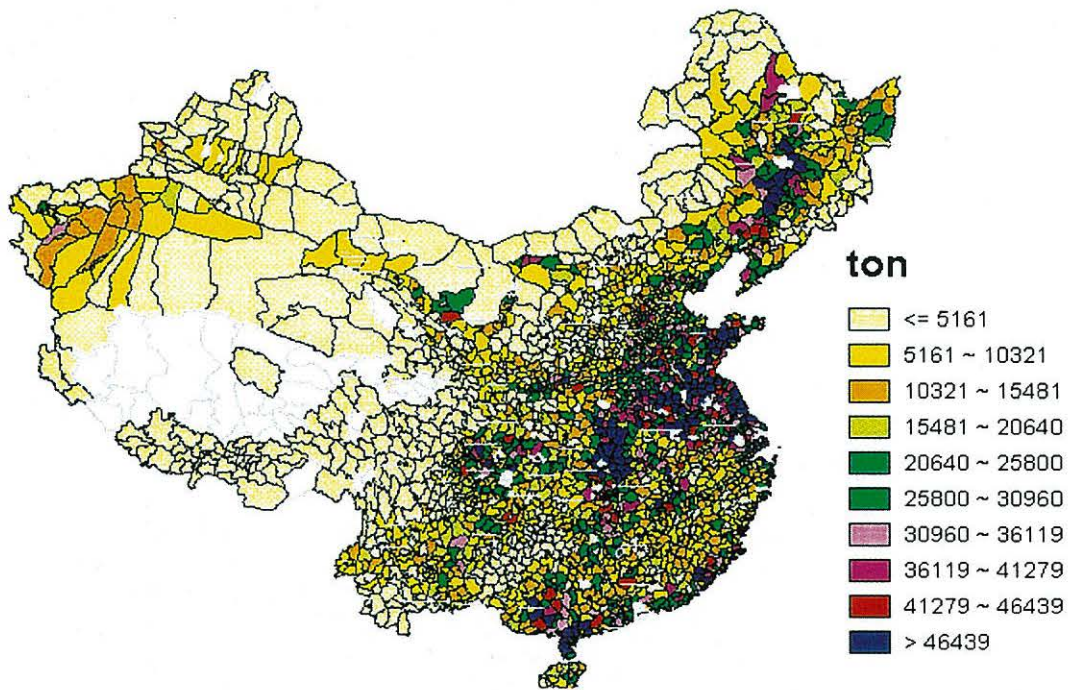


Fig. 1 Map of current fertilizer consumption in 2,370 counties in China

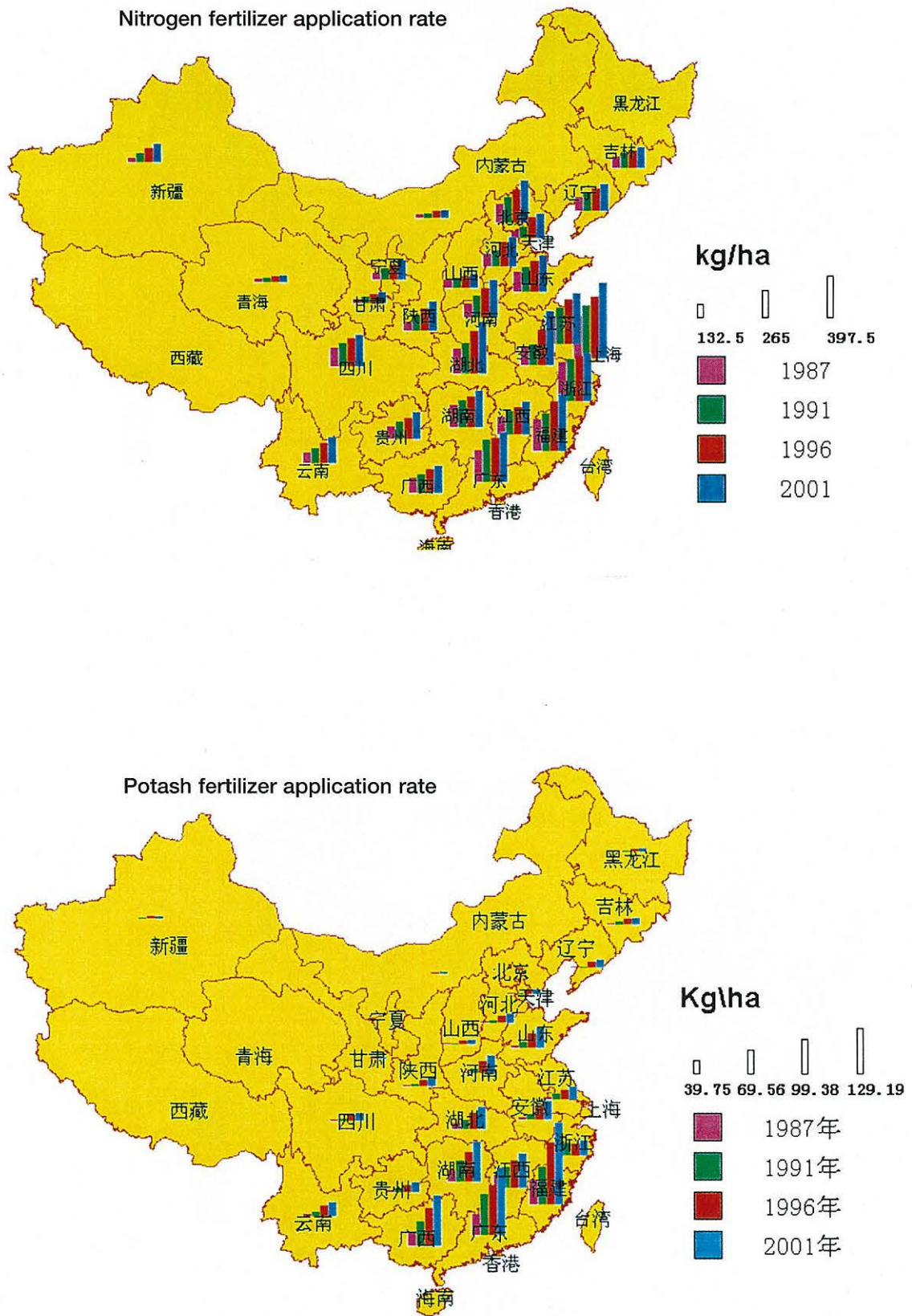


Fig. 2 Nitrogen and potash fertilizer application rates from 1987 to 2001

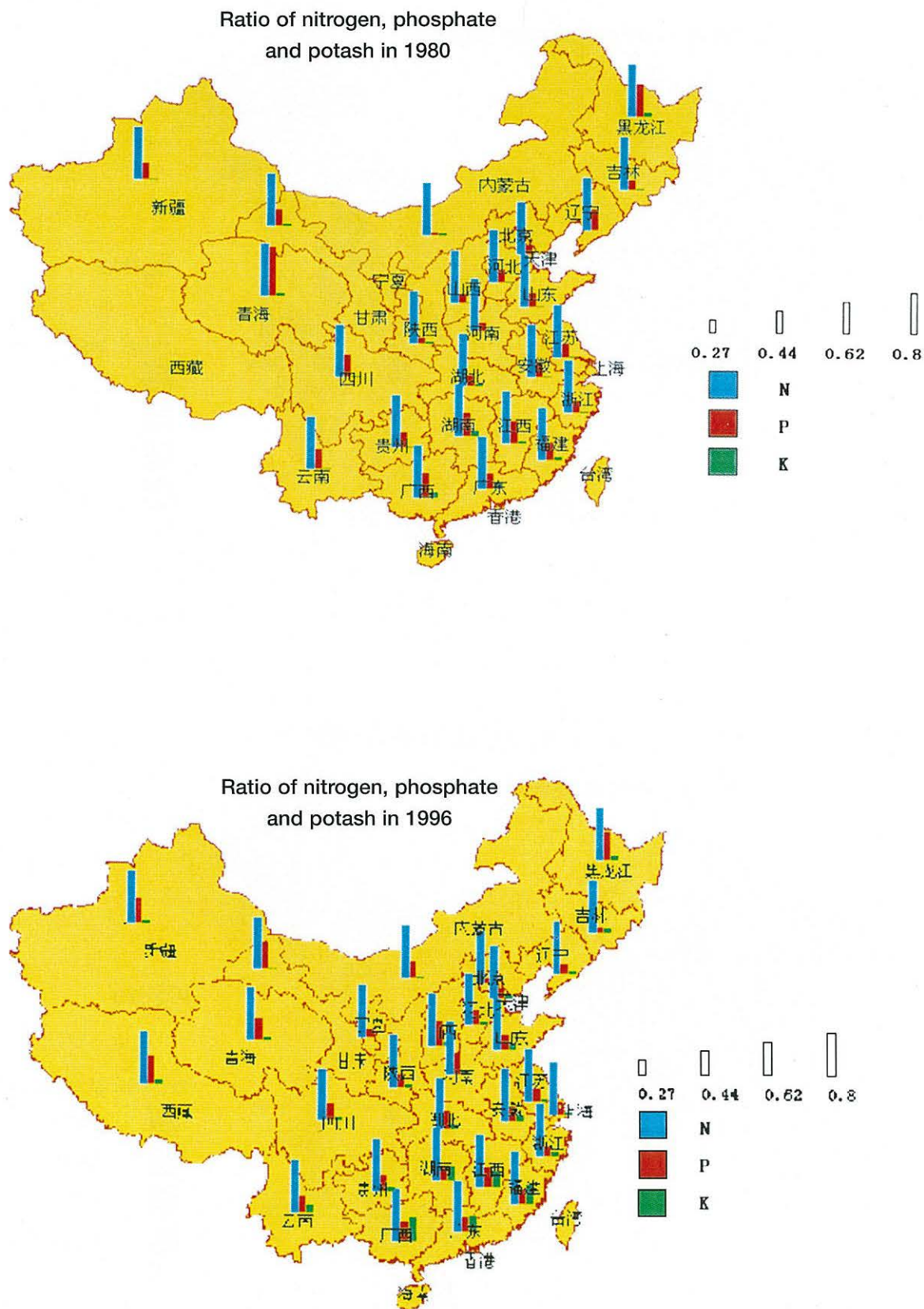


Fig. 3 Maps of NPK-ratio of fertilizer consumption in 1980 and 1996