LARGE SCALE GIS FOR A SUBURBAN TOWNSHIP OF BEIJING TO MODEL STRATEGIES FOR SUSTAINABLE AGRICULTURE ON FIELD LEVEL

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ABSTRACT

The Sino-German Project between the China Agricultural University and the University of Hohenheim, Germany, focuses on sustainable agriculture in the North China Plain. In the first phase of the project, an experiment field has been established near Beijing to investigate different agricultural practices and their impact on harvest and environment. Researchers from several departments are involved in the project: Agricultural Economics, Agricultural Informatics, Vegetable Science, Landscape Ecology, Phytomedicine, Plant Nutrition, Plant Production and Soil Science. Apart from the field experiment, the project focuses on regional modeling. For the township of Dongbeiwang, where the experiment field is situated, a GIS is established containing base geodata, statistical data, remote sensing data and the project database of the field experiment. This GIS enables the modeling of strategies for sustainable agriculture with large scale data. This paper reflects the experiences of data collection in China and presents the problems and the method of the set up of a large scale GIS for a township in China.

INTRODUCTION

The Sino-German Project focuses on the development and implementation of sustainable strategies in agriculture. Therefore, spatial modeling and regionalization for policy support as well as field studies are essential. For a suburban township of Beijing, Dongbeiwang, a large scale GIS is necessary to extrapolate the results of the field studies to estimate the impact of the research. Furthermore, a large scale township GIS enables the modeling on field level to simulate sustainable scenarios for agriculture. Based on our own experiences in China, the set up of a spatial information system in a large scale in China for modeling environmental aspects faces three major problems:

- Information about large scale data
- Access to large scale data
- Information about map projections and coordinate systems

The information about large scale data in China is very limited. Especially for foreigners or sino-foreign co-operations, such data are restricted due to data policy and are hardly accessible even so they are available. But also for Chinese it seems very difficult to get access to any spatial or statistical large scale data. The biggest problem is that there are no central institutions for data and information delivery. Therefore, the whole process of "What can I get where?" is like a puzzle work and needs an immense amount of time for driving around and asking people. After you finally acquired some data, there are still major problems to face. For spatial data, the most serious problem is that paper maps in large scale sometimes come without the information about coordinate systems and map projections and this information is almost impossible to get. So, it is finally impossible for sino-foreign projects to work on a large scale in China or are there still possibilities for large scale modeling of environmental aspects for sustainable development? The latter is very apparent in Chinese press.

GIS DATABASE

The acquisition of large scale data in China is, as already mentioned, very difficult. Some sort of land register maps exist in a scale of 1:2,500 and 1:10,000 including points of elevation and general topographical information. The date of the maps differs widely. On the basis of the 1:10,000 map, a soil and land use map is available as well, but the information quality is rather poor. In Fig.1, this digitized soil and land use map for the township of Dongbeiwang is shown. For the digitization, ArcView was used. The attribute tables of this map are still not finished due to translation problems. The different colors of the map indicate the different administrative units (villages) of the township. The polygons with the black outlines indicate the land use units for which it is described if the land use is agriculture, residential etc.. These land use units carry vague soil information as well. This map represents the spatial base information and is also used for the field campaigns. The problem due to the lack of information of xy-coordinates and map projection was solved by a DGPS field campaign. The results of the first DGPS campaign are represented in Fig.1 as red lines and points. The DGPS information which has an accuracy of around 2m is described in more detail in the second contribution of the MDGIS'01 (Bareth 2001). Additional information of the DGPS mapping is the elevation with an accuracy of around 5m.
Fig. 1: Soil and land use map 1:10,000 for Dongbeiwang (CAU = China Agricultural University)

The land use information in the available sources is very vague. More detailed data is needed. Therefore, an IKONOS2 image (SpaceImaging©, www.spaceimaging.com) was acquired covering most parts of Dongbeiwang. The 1 m panchromatic and 4 m multispectral resolution of this image enables the classification of large scale land use data (Bareth 2001). The results of the DGPS mapping were used for geo-rectifying the image and for a supervised land use classification by using IDRISI32 (www.clarklabs.org). In Fig. 2, the IKONOS2 image is displayed with the land use map 1:10,000.

Fig. 2: IKONOS2 image (Credit: SpaceImaging©) covering most of Dongbeiwang township
Another source for elevation data is not in large scale. It derives from the digital China National Topographical Database 1:250,000. From the elevation line layer, a DEM was created by using ArcInfo2.1 (www.esri.com). The result for the area of Dongbeiwang is shown in Fig.3. The DEM enables the analysis of slope aspect, exposition, inclination etc. For the information system of Dongbeiwang, it will mainly be used for visualization of maps and 3D-views of the area. If a more detailed DEM is needed for the study region it could be created by using the elevation information of the 1:10,000 maps mentioned above.

Fig.3: DEM of the area north of Beijing

Finally, general data about agriculture for the township of Dongbeiwang are needed. Most of these data will derive from the field experiment of the Sino-German Project (www.uni-hohenheim.de/chinasproject). The main experiment is about different fertilizer and irrigation treatments in wheat/maize rotation. Furthermore, there are experiments with vegetables. A weather station provides various climate data for the township. A farm questionnaire is in process to evaluate the farm economics and soil profiles were investigated. Additional soil analyses are done in several fields in the township. The data of the project database enables the use of existing plant growth, soil (water) and greenhouse gas emission models as well as the economic-ecological modelling of farms. The key data of our project are and will be stored in a GIS based project database by using ACCESS or DBF tables and ArcView (Bareth et al. 2000). Using the organized folder system (Fig.4) it is possible to link the result tables of each sub-project to a GIS field map (Fig.5) for analysis, query or display. More information about the project database is available on our project homepage (www.uni-hohenheim.de/chinasproject/georog2.htm).

Even so meetings with the township officials were organized, it was impossible to collect official data about agriculture in the township. Therefore, the economic sub-project is working on a farm survey. The only statistical data, which were available, are about the Haridun district in the statistical Yearbook of Beijing. We are still trying to get official data, but there will be little chance to improve the situation.

CONCLUSIONS AND PERSPECTIVES

The set up of a GIS in large scale in China for environmental modeling is very difficult and sensitive because of data restriction and policy for spatial as well as for statistical data. Therefore, independent data sources like commercial satellite image distributors and own investigations are most important. Additional field surveys have to be done to ensure and evaluate the quality of the spatial data sources. The additional DGPS; soil and land use field surveys are essential to establish a large scale GIS for environmental modeling on field level and to create scenarios for sustainable agriculture on town level. The next steps are further field surveys to enlarge the available data of the GIS for the township of Dongbeiwang and the integration of available models to create different scenarios of sustainable agriculture.

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**Fig.4: Structure of the project data base**

**Fig.5: ArcView**

**REFERENCES**


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Fig.5: ArcView user interface of the project database

REFERENCES
