An Overview Of Current GIS Based Systems In The Field Of Agriculture

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Abstract:

Geographic Information System (GIS) is the technology that collaborates with spatial informationsystems [1], and is a young area of information technology. This spatial information technology allows to examine and analyze a wider range of agricultural related resources such as soil, weather, hydrology, various socio-economic variables simultaneously and more accurately. Simultaneous examination of these variables in a GIS environment leads to a better understanding of how agricultural systems function and interact over space and time. This understanding leads to developing stable and sustainable dynamic agricultural technologies. This paper tends to focus on various GIS based researches in agriculture and some practical applications.

1. An introduction to Geographic Information System (GIS):

Making decisions based on geography is basic to human thinking. By understanding geography and people's relationship to location, we can make informed decisions about the way we live on our planet. A geographic information system (GIS) is a tool for comprehending geography and making intelligent decisions based on analysis.

A good GIS based program is able to process geographic data from a variety of sources and integrate it into a map based system. Many countries have an abundance of geographic data for analysis, and governments often make GIS datasets publicly available. Some data is gathered in the field by global positioning units that attach a location coordinate (latitude and longitude) to a feature such as a pump station.

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2. Need of GIS in Agriculture:

Balancing the inputs and outputs on a farm is fundamental to its success and profitability. The ability of GIS to analyze and visualize agricultural environments and workflows has proved to be very beneficial to those involved in the farming industry. From mobile GIS in the field to the scientific analysis of production data at the farm manager's office, GIS is playing an increasing role in agriculture production throughout the world by helping farmers increase production, reduce costs, and manage their land more efficiently. While natural inputs in farming cannot be controlled, they can be better understood and managed with GIS applications such as crop yield estimates, soil amendment analyses, and erosion identification and remediation.

3. GIS based system in Agriculture:

1.Agricultural Environment Management Expert System:

The Agriculture Research Institute (ARI)under the Council of Agriculturein the past one hundred years had devoted great efforts to increase the yields and qualities of grains, special crops, fruit trees, vegetables, and flowers and to improve the economic developmentof

farming villages. As a result, a great number of research performances are presented.
ARI has field surveyed the soil resources in Taiwan for many years and has already collected a great amount of records in very detail. To have these records be used effectively with its utmost value, ARI plans to construct an Internet Service GIS Query System, so the general public can query the characteristics of soil in every district in Taiwan on an online platform. With the system, research units such as the Agricultural Research and Extension Stations are allowed to rapidly and conveniently access complete soil characteristics and associated environmental information. More, the researchers and farmers are able to manage farms with more efficiency and obtain information on agriculture producer services. As a result, agricultural products produced can be of increased quality and the impact on environment during developing can be reduced.
The project uses SuperPad and SuperWebGIS as the tools to perform field surveys, inspections and building the Internet Service GIS platform.
With a characteristic of being able to be installed on hand-held devices, SuperPad is capable of reading several data formats for overlapping purposes and is equipped with many other functions such as edit, data query, GPS spatial positioning and so on. With it, surveyors can perform field surveys on-the-spot or reconfirm the data that were collected to strengthen the correctness of data and to increase the applications.

2.Horticultural Crop Wild Relatives Information System:

Plant Genetic Resources for Food and Agriculture (PGRFA)are the motivations to modify the species of crops and also are the basics of sustainable agricultural development. Crop Wild Relatives (CWR) refer to the original species of cultivation crop or the wild species of the relatives with close genes, which are disease-resistant, insect-resistant, resistance to the environmental stress, and also the sources of important economic traits. CWR also increases the productions and quality and decreases poverty.
In order to deal with the global crisis, Chiayi Experimental Branch Station, Central Research Institute in Taiwan wanted to apply a WebGIS system to have long-term monitor on the habitats of horticultural crop wild relatives in Taiwan and observe the evolution trend.
Geographic Information System for Horticultural Crop Wild Relatives is a query system which includes database management and WebGIS. The system applies the internet map server, SuperWebGIS, to be an internet GIS platform and Microsoft SQL Server 2008 Express to be the database platform. It contains the database of species list and survey data as well as GIS technologies, which provides the related staffs with the integrated data of species' characteristics and distribution space as references for conservation.

3.Environmental and Land Information System (E.L.I.S.):

Since 1990 the Autonomous Province of Trento has been equipped with an Environmental and Land Information System (E.L.I.S.) [3] technology-based (Arc-Info) consisting of operating units distributed by the structures using and managing land data. One of these operating units has been stationed for a few years now at the Agricultural Department.
The E.L.I.S. operating unit for the agricultural sector directly depends from the foremost structure (Agricultural Department) so as to ensure support to all subordinate operating structures.
It comprises technicians specialized in the use of GIS technologies through:

- RISC workstation as graphic server on a local network
- Differential GPS system
- GIS Arc-Info server and Arc-View client software
- Oracle DBMS server.

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4. Citrus GIS Inventory:

For more than 40 years, a primary mission of the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS)/Florida Field Office (FFO) has been to produce a biennial census of Florida's commercial citrus trees. The Florida Department of Agriculture and Consumer Services cooperate on this task sponsored by the Florida citrus industry. The number of trees in production, along with acres utilized, variety, and year planted, is tabulated. The data is aggregated and published at the county level.
The building of the citrus GIS inventory was completed during spring 2006. Citrus enumerators still rely on paper maps but are now using improved ones created from ArcInfo software's ArcMap application, utilizing the grove layer overlaying current digital orthoimagery, the Public Land Survey System grid, and roads data. They are able to modify map layouts to suit cartographic needs and benefit from the increased detail the new maps afford compared to the former ozalid reproductions. Aerial photointerpretation and delineation of grove changes continue via visual inspection of before-and-after images (2005 imagery flown via the USDA's National Aerial

Imagery Program is now being analyzed against the 2004 imagery) but are now performed digitally within ArcInfo.The biggest advantage of the citrus GIS, however, is the ability to more quickly document and publish rapid changes to the tree numbers. Citrus growers in Florida have had many negative impacts to their livelihood in recent years, including large losses in capacity from disease (especially citrus canker), storm damage (increased hurricane prevalence), and rising land values (groves becoming urbanized). NASS believes the GIS will help transition the census to an annual cycle allowing the Florida citrus industry to better monitor changes and, thus, improve on policy decision making and citrus production forecasting.

5. Web Interface for GIS in Agriculture:

JAVA-enabled Web interface [5] for GIS applications was tested with which user can communicate interactively through Internet. This interactive Web interface for GIS application offers typical map display functions like zoom, pan and drag as well as functions of displaying attributes. It primarily runs on the shape file format generated by ARC/View for map display. Shape files were concatenated to reduce its size and project files were modified to accommodate only necessary parts such as legend-related contents.GIS Lab. of NIAST (RDA, Korea) has created a suite of national soil vector maps with attribute data for most of the southern Korean peninsula. They supplied vector and attribute data for Yangpyong watershed for a demonstration purpose of this study. Other sample data from ESRI has been also used to test this interface.

6. AEZ Database System:

GIS in agriculture field of Bangladesh [11] is a pioneer system, introduced in Bangladesh for agricultural development through Bangladesh Agricultural Research Council (BARC). BARC initiated a GIS project in 1996, as leaders in the database, known as the Agro ecological Zone (AEZ) database system [10] of Bangladesh which has been developed using reconnaissance soil resource information generated by the Soil Resources Development Institute (SRDI), flooding and hydrological information of Bangladesh Water Development Board (BWDB), weather related data of Bangladesh Meteorological Department (BMD) and crop related data of the National Agricultural Research System (NARS) institutions, to agricultural information and are involved with application of new technology to dissemination of research findings and to the extension process.

The application of GIS as a computer assisted spatial information system in Bangladesh started only a few years back in early 1990s. By 1991, there were only five operational GIS used by various organization in Bangladesh.

Since the introduction of GIS at BARC, the following activities are done using GIStechnology AEZ database system. The AEZ database system is the core information base for use by the decision makers and implementers for land evaluation, land use planning, agricultural research, crop production planning and post disaster rehabilitation program development. The activities are mentioned below:

- Soil maps, produced by Soil Resources Development Institute (SRDI) were digitized using GIS technology.
- The Land Resource Inventory (LRI) of AEZ database system was not geographically referenced. The digitized soil map was linked to the LRI database to produce following national map outputs: suitability of major crops, inundation land type, economically depressed thanas and agro ecologically constrained region, climatic variability, soil reaction soil moisture zones, drought area delineation and nutrient deficiencies etc.
- Using GIS technology, BRAC also prepared outputs to reflect the effect of incessant rainfall during November 1998 caused by depression in the southern belt of Bangladesh.This output was to assist in taking up crop-rehabilitation and post flood mitigation activities.
- The potential suitability of 15 different Farming System technology generated at different places of the country has been extrapolated for the whole country using the AEZ/GIS database.

4. Conclusion:

This paper briefly describes the ideas behind different GIS based systems currently used in Agriculture field. It modestly glances over the ideas behind the systems for a very basic understanding.

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