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Web-based Agricultural Support Systems

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Abstract

Agriculture is a complicated system, related to a wide range of environments, which is difficult to deal with perfectly. Web-based agricultural support system (WASS) has been proposed to applicable support agricultural activities, which combines web technologies and agricultural systems. In this paper we analyze the basic characters of the web-based agricultural support system and then describe the functionalities of the system.

1. Introduction

Advances in computer technologies have profoundly influenced the use of computerized support in various activities [1]. With the unlimited growth of the Internet and ever expansion of information on the Web, we have come to a new information era [2]. The Web provides new medium for storing, presenting, gathering, sharing, processing and using information. The benefits of the Web technology have been shown as following: [1].

1. The Web provides distributed infrastructure for information processing.
2. The Web is used as a channel to discuss one of the most popular support systems, DSS.
3. The Web can deliver timely, secure information and tools with user friendly interface such as Internet Explorer and Netscape.
4. The Web has no time or geographic restrictions. Users can access the system at any time, any place.
5. Users can control and retrieve results remotely and instantly.

With the rapid development of web technology, Computerized support systems are emerging more and more diverse groups, such as learning support system [3], education support system [4], research support system [2,5], etc.

Agriculture plays a vital role in human development. In the developing countries, agriculture must multiply its productivity for food security and keep the people from undernourishment or outright famine; in the industrial countries, agriculture must continue to increases its productivity to provide enough raw material for the textile, plastics, and other industries, and fulfill the need for expanding populations [6].

There are many definitions of agriculture:

"Agriculture means the science or art of cultivating the soil, growing and harvesting crops, and raising livestock. The art of making land more productive is practiced through the world—in some areas by methods not far removed from the conditions of several thousands of years ago, and other areas, with the aid of science and mechanization, as a highly commercial type of endeavor." [7]

"Agricultural science, the science dealing with farm production, including soil cultivation, water control, crop growing and harvesting, animal husbandry, the processing of plant and animal products, engineering, economics, and other related matters. The agricultural industry that is the focus of study includes farming, concerned with production; service industries, concerned with making or supplying machinery, buildings, fertilizers, and pesticides; and the first purchasers of farm products, such as processors, distributors, and marketing boards." [7]

"Agriculture is the systematic raising of useful plants by human management. Food production is the main reason for agriculture, but cultivated plants also furnish substances useful as textile fibers, dyestuff,

medicines, and ornaments. Gathering wild plants for food or other purpose is not agriculture. In a broad sense, 'agriculture' often includes animal husbandry." [8].

"Agriculture encompasses production of food, fiber, wood products, horticultural crops, and other plant and animal products and includes: financing, processing, marketing, and distribution of agricultural products; farm production supply and service industries; health, nutrition, and food consumption; the application of science; the use and conservation of land and water resources; development and maintenance of recreational resources; related economic, sociological, political, environmental, and cultural characteristics of the food and fiber system."[9]

We can concluded from above discussion that agriculture is a complicated system, closely related with natural systems and social systems. Agricultural system exchanges substance, energy and information with natural system, and has great effect on society progress, natural environment. In order to understand the agricultural system and the relationship with human beings, Hu Yuegao (2000) proposed that the agricultural system be comprised of three subsystems: production-subsystem, management-subsystem and research-subsystem, and each one can be divided into more specific subsystems, as shown in figure 1[10].

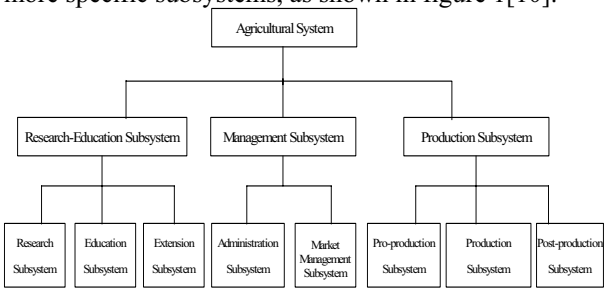

Figure 1. The structure of agricultural system

Due to the complexity of agricultural system, we found it very difficult to deal with it correctly and perfectly. We have confronted series of challenges due to the frequent and unexpected fluctuation, shortage of resources within systems:

- Lack of resource: water, arable land, forestry resource, energy, and fertilizer;
- Ecology degradation: soil degradation;
- Pollution: water pollution, soil pollution, air pollution;
- The weather warmer;
- Gap between poverty and rich enlarged;
- The frequency of agricultural disaster;

Generally speaking, the agricultural system encompasses more than namely education system, research system, learning system etc. We aim to study the issues and challenges brought on by the Web technology for various support systems and try to find out how applications and adaptations of existing methodologies on the Web platform can benefit our decision-makings and various activities in agriculture.

This paper briefly summarize the initial and basic ideas about WASS. We will focus on specific objectives: we will discuss the basic characters of the agricultural support system in section 2; we will give a depiction about the function of the web-based agricultural support system in section 3.

2. The Basic Characters of the Support System

I try to discuss several interrelated characters one by one as the follows:

2.1. Research-education subsystem:

2.1.1. Agricultural research subsystem. Agricultural research focuses on more diverse objectives than other science research, including to crop production, animal husbandry, water management, soil cultivation, pesticide /herbicide application, nutrition of nitrogen, etc. The research model proposed by Yao [5] is suggested applicable to agricultural research subsystem, we lay out the whole research process into 7 phrases:

Idea-generating phase. The phase aims to identify a study topic of interest. It may also be referred as the preparation or the exploration phase. Literature search and reading plays important roles in this phase.

Problem-definition phase. The objective is to precisely and clearly define and formulate study question from general observation generated from the previous phase. Problem definition involves careful conceptualization and abstraction. Precisely defined problem renders. It easier to find related and solved problems, as well as potential solutions.

Procedure-design/planning phase. The objective is to make a workable research plan by considering all issues involved, such as expected findings and results, available tools and methodologies, experiments designs, system implementation, time and resource constraints, and so on. This phase deals with planning and organizing research at strategic level.

Observation/experimentation phase. The objective is to observe real world phenomena, collect data, and carry out experiments. Depending on the

nature of the research disciplines, various tools and equipment, as well as different methods, can be used.

Data-analysis phase. The objective is to make sense out of the data collected. So we can extracts potentially useful information from data. Statistical software packages can be used.

Results-interpretation phase. The objective is to build rational models and theories that explain the results from the data-analysis phase. It is necessary to investigate how the results help answer the research question, and how this answer contributes to the knowledge of the field. The connections to other concepts and existing studies may also be established.

Communication phase. The objective is to present the research results to the research community. Communication can be done in either a formal or an informal manner. Books and scientific journals are the traditional communication media. Web publication is a new tool of communication. Oral presentation at a conference, or discussion with colleagues, is an interactive means of communication.

2.1.2. Agricultural education subsystem. Agricultural education means training people to produce, process, and distribute food or fiber, and spreading scientific and technical information related to all phases of such work. It strives to help the people of the world improve the quantity and quality of products indispensable to human life. Agricultural education covers different levels from children's class in village schools to graduate study in universities [6]. Education and training are widely acknowledged as important contributors to national economic development and social well-being [11].

In general, agricultural education is divided into three level: higher agricultural education, for example education in universities and institution; vocational agricultural education, including various kinds involved knowledge and skills in agriculture; and the agricultural training for the adults or the youth. So a agricultural support system should fulfill all such needs.

2.1.3. Agricultural extension subsystem. The agricultural extension subsystem plays key role for agricultural development. The main function of extension is to disseminate useful information, including the research results in agriculture, home economics, and related subjects. As well as to helps families to apply such knowledge to real problems at farm, home, and community level [12]. Such function are shown as the follows [9, 13]:

First, it is medium between the agricultural research institutions, universities and farmers;

Second, it fills the gap between agricultural technology into real practice;

Third, it transfers the skills and knowledge to the farmers as to improve their living standard and agricultural practices;

Forth, it helps farmers to make decision.

Firth, it helps extension agents or organizations effectively and efficiently identify the goal and which decision it tries to help its farmers,

Last, extension managers can effectively deal with administrative affairs.

2.2. Production subsystem

Agricultural production subsystem is the core and basis component of agricultural system, which can be further divided into three levels: pre-production system, production system, and post-production system.

2.2.1. Pre-production and post-production subsystem. The agriculture pre-production subsystem includes all various departments, which provide production material and service for agriculture. The main tasks include the manufacture and maintainents of farm machineries and other agricultural facilities; the production of chemical products such as fertilizers and pesticides, the production of agricultural construction materials, and supplementary materials, the production of agricultural transportation facilities, the processing of seeds and feed; the circulation, transportation, information and finance service, and etc.

The agriculture post-production subsystem deals with processing the primary products such as grain, oil, food, feed,etc.

2.2.2. Production subsystem. Production subsystem is a main component, which directly supplies food to human being and raw material to industry. It is comprised of five parts: planting, forestry, animal husbandry aquaculture, etc. The production may effected greatly by soil, weather, water etc. Farmers need to overcome all kinds of constraints due to resources limits, etc., in order to get higher yield and better quality products. A combination the web-technology and agricultural expert system or agricultural decision support system will be very helpful to farmers so that they can get to under certain latitude and soil type. Which is suitable for specific crop, how to control the insects, what kinds of

feedstuff to be feed on the livestock etc.

2.3. Agricultural management subsystem

2.3.1. Agricultural administrative subsystem. Agriculture administration is a concept that the government and the ministry of agriculture should formulate guidelines, provisions, plans, strategic decisions, and policies of agriculture development and be responsible for carrying out policies for different purposes, such as, production, distributing, financial, credit, labor, etc.

2.3.2. Agricultural market-management subsystem. Though the transformation from planning-economy to market-modulated economy has taken place since 1980,s, some major conflicts have occurred. One most outstanding contradiction is that circulation channels of the primary products can't meet the demands of market. Market-management by the governmental macro-manipulation can help to stock and protect the crucial primary products which related to the national economy and the people's livelihood. For example, under the market economy, some crucial primary products may overstock largely due to the years' bumper harvest, quantity and quality problems. The price will decrease too much once the primary products can't sell successfully, which leads to the loss of farmers' interest to produce in next year. Under such condition, the government should generate the protective prices to ensure the farmers' essential income. On the other hand, when the farmers are faced with serious natural disasters that they reject to sell their agricultural products, some agricultural products will be in serious shortage and result in panic buying and high-rising prices, which can't be accepted by the consumers. In order to deal with such problems, governments should have enough stock of crucial agricultural products to stabilize prices in the market.

It is obvious that good management will be of great benefit not only to nation but also to farmers and others. So WASS should be able to help decision makers for better solution.

3. Functionalities of the web-based agricultural support system

In order to support a large spectrum of agricultural activities, WASS must be flexible and has many functionalities. This section summarizes the functionalities and required computer technologies.

3.1.Decision support or expert system:

There are many factors, which can affect the agricultural activities. It's not an easy thing to deal with all kinds of agricultural problems effectively and correctly no matter to the producers or the governors or others related. Agricultural decision support system can serve as an important and very useful tool for farmers and decision-makers for solution to various problems. They can reach an optimal decision based on many considerations. For example, farmers can get information about what kind of crop should be grow under different soil type and how to choose the crop varieties, how to fertilize, how to irrigate, how to prevent the diseases and insects, etc.

3.2. Collaborative work support:

Collaborative work support provides a sound environment where all experts for agriculture in different areas can work together virtually, and significantly promote agriculture development.

Collaboratory is one kind of collaborative work support, which is an open meta-laboratory that spans multiple geographical areas with collaborators interacting via electronic means [14]. It gives a good chance to scientists to share research instruments, data and information, to exchange experiences, and to accelerate the development and dissemination of knowledge [14].

Audio/video conferencing is another kind of collaborative work support. The virtual conferencing greatly supports interaction between scientists, farmers, governors, extension agents and any others who are engaged in agriculture, and it provide a friendly environment to communicate with each other. Lots of the agricultural problems can be communicated and solved effectively and efficiently with such conference. And the audio/video conferencing can act as a virtual classroom for agricultural education too.

Chat room is another component of the collaborative work support, which will facilitate the communications between the users. In the agricultural support system there are various chat rooms in accordance with the difference of subsystem, for examples education chat room for education subsystem, extension chat room for extension subsystem etc. The users who want to communicate with the extension agents can enter the extension chat room.

Bulletin Board System (BBS) is integrated into

the Collaborative work support system. The same as the chat room, it is comprised of education BBS, the extension BBS and so on, so the users can easily keep a track of previous discussion contents in which they are interested.

Furthermore, e-mail is a essential tool suitable for exchanging information too.

3.3. Information support

Information support includes information collection, management, retrieve or searching, exchange of for agricultural usage.

Agricultural production is closely involved with many factors a great matter, such as soil, precipitation, temperature, altitude, price of the products, transportation etc. So it is very essential to continuously collect information in different aspects and construct database, which is easy for searching and reuse later on.

Good searching support is very important for scientists, farmers, governors, and others. The scientists can find information of interest efficiently by researching support [2, 5]. With searching support, the farmers can get to know information about crops varieties, livestock, price of agricultural products etc. The extension agents can collect new information of agricultural technology by searching.. The governors and other decision makers can also benefit greatly from the searching support..

Exchange of information allows users to experiences, skills, data etc, thus to promote agriculture development. Researchers can upload research papers, others can share such information by downloading this; and government or administrator can publicize agricultural policies, rules; Extension agents can disseminate and popularize new technology through the system, at the same time farmers can keep up with the progress of new agricultural technology.

4. Conclusion:

Agricultural system is a complicated huge-system, comprised of three subsystems namely research-education subsystem, production subsystem and management subsystem, and there are distinct different characters for each subsystem.

Web-based agricultural support systems are based on the combination of agricultural science and computer science. By synergizing computer technology and agricultural science, we examine the characteristics of agricultural support systems with focus on the assembling and integration of existing computer systems to agricultural support system. Some preliminary and scattered ideas on the topic were discussed. The WASS may play a significant role in agriculture development in future.

Web-based agricultural Support Systems will be a very important research topic in the domain of Web Intelligence. Web-based agricultural support system can be used by researchers, producers, farmers and decision makers, etc., for various activities. Web-based technologies make the WASS easy to use and access.

The functionalities of the WASS are decision support, collaborative work support, and information support.

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