A Study on the Technical Schemes of Water-Soil Conservation and Rainwater Monitoring in the Yellow River Drainage Areas

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Abstract: This article discusses the system structure, monitoring objects, Information resources and relevant computer Integration technology about water-soil conservation and rainwater monitoring in the Yellow River Drainage Areas The result shows that when we dynamically monitor land resources information, we must not demand the highest precision but only need the precision which can fulfill the demands through adopting TM, SPOT or aerial photos as information sources according to the precision and depth of different monitored objects. The system not only establishes all-around database system, aided design system and decision making support system based on LAN, but also integrates the rainwater, water-soil conservation and soil moisture monitoring into one operation platform, improving the capability of system share and using efficiency of information resources.
Keywords: Yellow River, monitoring , water-soil conservation, system

1 General description

The Yellow River drainage area is one of economy centers in western exploration of our country and play an important role in safeguarding two hundred million people's life in Beijing,Tientsin, Shantung and Henan province. But the Yellow River drainage area is also one of areas where natural calamities often happen, especially in up and middle reaches of the Yellow River drainage area, droughts are frequent. Lower reaches are fed up with "aboveground river" harm, which usually seriously affects the development of economy throughout country, strategically.

In the course of the Yellow River drainage area's water-soil Conservation and calamities resistance, science and technology have vital roles, providing instant ,exact and first-hand datum for national macro-decision and scientific management .But because our technologies relatively drop behind, our country is on lower level in the disaster's monitoring and forecasting. Especially for the instantly monitoring in a drainage area class, we nearly can't conduct scientific and systemic monitoring, and foresee full alert time, which make the preventing disaster and decreasing disaster usually lie in passive status, and in some degree it restricts the ability of the Yellow River drainage area's flood control and disaster decreasing.

Therefore, building modern "The rainwater and disaster dynamically monitoring system in the Yellow River drainage areas for decisions making" can fill up the technologic blank of high precision dynamic monitoring and assistant decision in small or middle scale of drainage areas. It make the decision-maker instantly grasp the dynamic changes and trends of rainwater and disaster, supporting yellow river drainage area's flood-control career with good technology, and greatly enhancing the ability and potentiality of preventing disaster and decreasing disaster in the drainage areas.

2 The technology routes of water-soil conservation and rainwater monitoring system

It is very common that using space and aerial remote sensing information conducts national land resources dynamic monitoring, compartment, layout and management. For example, Badeng, Futeng bao continent has adopted remote sensing information to interpret and classify objects on lands in

investigation and compartment of geography and vegetation resources in early seventy age. They have worked out a series of maps of land resources throughout the continent and then inaugurated an international well-known method—“Badeng, Futeng bao method”. With greatly development of “3S” (RS,GIS,GPS) and computer technology, their application scopes are constantly enlarged. Now they have become the most important information resource and processing measure in civil domains such as weather, geology, water conservancy, agriculture, forestry, land resource etc. It has given play to huge benefits in the areas.

For the technology of obtaining information sources, the development of multispectral camera technology such as visible spectrum, infrared spectrum, microwave spectrum etc. increases the amounts of information in the aerial and satellite images, the development of photographic instrument constantly enhances the resolving power. Infrared spectrum satellite image 's pixel precision has reached 10m level, aerial photo's pixel precision has reached less than 1m level.

For software and hardware of remote sensing information analysis and handling, analog-information interpretation has gradually been replaced by digital information analysis, and raster-data processing has gradually been replaced by vector data, which automatically process data. No matter PC platform whether computer workstation, their work interfaces become more and more simple, but their resolution, capability of information processing and automation become more and more advanced , and functions also become stronger. User can establish remote sensing information model and monitor and research water-soil loss intensity, distribution rule, mud-rock flow, regional geology, water resources, rainwater, landslip, etc. User also can make work interface customized, satisfy the need of dynamic monitoring and remote sensing information analysis and server in depth.

This system should become the mostly information supporting platform for “digitized soil and water conservation”, because not only it is an information source, but also it includes database supporting system such as scientific research database one, soil and water conservation and management one, hydrograph database one, hydraulic engineering management database one etc. Also, it includes other systems for management, scientific research, schedule, world bank item etc. , such as user's statement analysis system,conceptual design assistant and supporting system, MIS, supporting decision system, demonstration system .These systems based on high speed LAN provide different users with sharing information and report forms and can take full advantage of the information resources provided.

The System update is as important as system building. User must build an economical, doable and credible data-update mechanism for the system so as to ensure the system be in real-time running status not to provide out of date information sources.

3 The scheme researches of Monitoring system building

3.1 Monitoring contents and scope

The object of the system dynamic monitoring is the circumstance of environmental change in soil and water loss areas during the period of monitoring. Its contents of monitoring are as follows:

(1) The dynamic monitoring of ecological agriculture measures change;

(2) The major monitoring area's land using and dynamic change, the forecasting of double cropping area and crop output, and the thematic investigation , research and dynamic monitoring in other the earth's surface resources ;

(3) The dynamic monitoring of the solid wastes and newly added water-soil loss change and water-soil conservation situation in the basic construct items of the monitoring areas;

(4) The dynamic monitoring of soil erosion distribution and intensity;

(5) The dynamic monitoring of geologic hazard such as debris flow, sliding mass etc.;

(6) The dynamic monitoring of mud and sands change , silts change, regime of river ,rainwater and disaster situation etc.in the main streams and important branches or lakes;

(7) Irrigated area's soil moisture monitoring in the Yellow River drainage areas, providing decision and putting heads together reference for water resource allocation.

3.2 The depth and precision for different monitored objects

To big drainage areas as monitoring an object, its depth belongs to the big scale and macro monitoring. Its pixel precision should be controlled from 50m to 100m and its monitoring cycle is one year. Its information sources are TMCCT data from American LandSat .For the major area's dynamic monitoring, pixel precision should be controlled from 10m to 30m, and its information sources are from high- precision Gallo's spot satellite ,Indian CCT satellite and aerial remote sensing information. Finally an analysis system of high precision is built, providing credible dynamic monitoring data and thematic maps. The monitoring cycle needs half one year or one year.

The modes of information sources selecting and using

This system is a big-area, short-cycle, multi-information dynamic monitoring system. It need the reliable data and timely comprehensive information. At the same time the monitored objects by this system are dispersed in many areas and its level information is complicated, so it bring out high demand in such aspects as resolutions, the amounts of information and the update of information sources. The major information sources are CCT data of aerial remote sensing or photos and TMCCT,CCT,MSS data or images from satellite remote sensing because the former has more higher costs with high resolution than the letter .

In the course of dynamic monitoring of land resources information, we must not demand the highest precision but only satisfying the requests of the precision decided early. In the branches' layout which is being carried, the map scale must reach 1:100000, and the least plots on the maps must reach 2*2mm, the highest map precision must reach 200*200m. Now for the civil satellite remote sensing information sources, the highest ground resolution has reached 10*10mm, For adopting information sources, we can take satellite remote sensing information sources as the major ones, and take aerial remote sensing information and full field annotation data in topical areas as a making up. The modes of their uniting and using are as follows:

(1) Taking aerial remote sensing information sources as a reason for precision checking and building integration of remote sensing data and image background information.

(2) Taking aerial remote sensing information sources as the correcting parameters of remote sensing data mode so as to enhance the resolutions and reliability of automatically integration of satellite remote sensing dynamic information.

(3) To major areas and major executable projects , the fully field annotations, microcosmically dynamic monitoring with aerial remote sensing as well as the severe the situation of the disasters and succors in the disaster areas should be conducted.

3.3 The modes of Information processing mode and the supporting systems of software and hardware

The dynamic monitoring system based on "3S" and remote signaling, The Fig. 1 shows the modes of information processing.

3.4 System structure

This system is LAN structure (as Fig. 2 shows),supported by server and disk array, forming powerful Intranet LAN in functions composed of graph workstation and pc terminals .

This system units the graph workstation and pc platform into one net, make the functions of the system more strong, and it is a dynamic monitoring system with high information integration. Its characteristics should be wide extent of information collection ,high precision of processing, quickly data updating. Therefore, basing on introducing into, digesting, absorbing the foreign advanced technology and instruments, we should fully make use of the functions and resources provided by the foreign technology and instruments to develop the software with information integration and multimedia functions , which make operation platform customized.

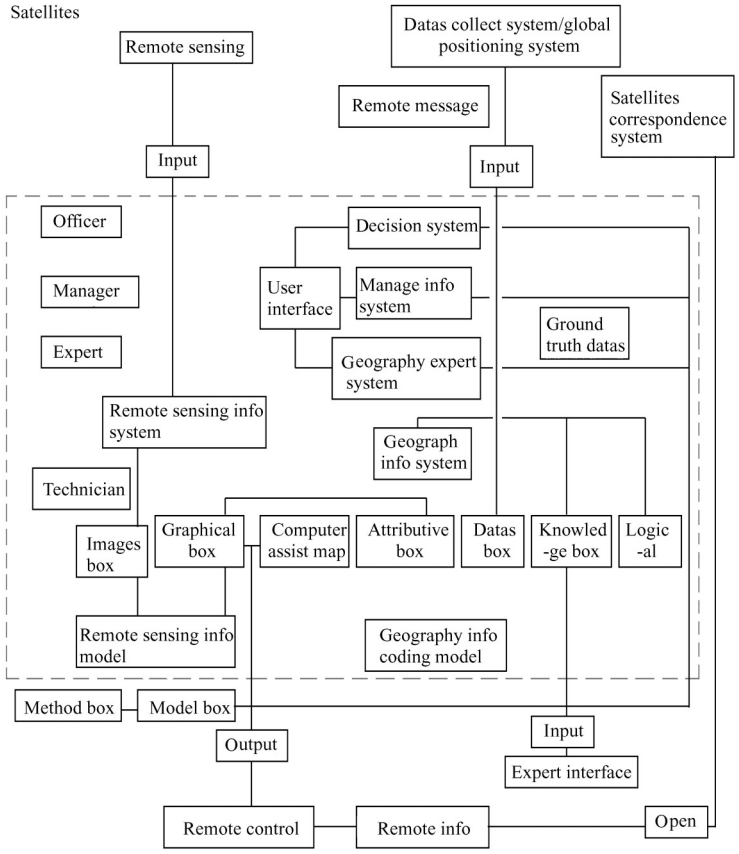

Fig. 1

3.5 The system functions of dynamic monitoring

The scanning system of high precision platform type, which physical resolution y is 0.5μm, geometric accuracy is 2μm(rms), pixel dimensions are 5, 7, 14, 28, 56, 112 and 224μm, has the function of a entire volume scanning and can scan black,color,positive,negative(including aerial, satellite and all classes of thematic maps and relief maps) only once a time. Its data format belongs to a standard raster one.

The high precision scanning is a necessary base of information sources because the dynamic change in ecological environment ,harnessing measures and situations of rainwater and disasters in various areas is not different, and the distinguished elements on ground surface is very complex. Only can the high-precision information sources and distinguished elements be read, can the dynamic monitoring whit the reliable precision be done. The digitalizing of scanning information not only produce the high precision resources but also assure the high technology for building the system of information processing .

Information processing network based on UNIX operation system can realize the following fundamental functions:

(1) Digital images' compression , storing and re-displaying;

(2) Raster data's stereo roaming, thereby realizing image data's processing rapidly and integration;

(3) Supported by GPS, the inner coordinate system is built and can inter-change with local coordinate system each other. It can manage coordinate system at high precision level to the digital information of aerial-and-space image and can timely pick up images' information in all areas at various periods. The system can realize real-time roaming of stereo image with true-color, and has the function of color images' three-dimension stereo overlay. User can pick-up three-dimension stereo images to screen

edit and observe at terminal;

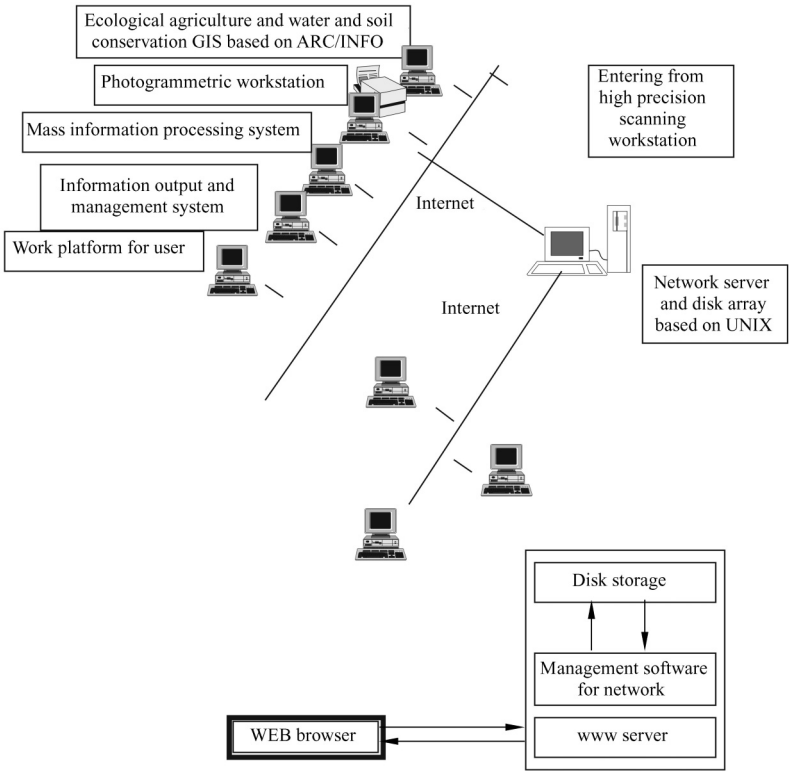

Fig. 2 The structure of the dynamic monitoring system

(4) Supported by GIS, relevant math models and remote sensing models are built bade on the raster and vector of digital images ,automatically and effectively creating DTM,DEM and changing information of the ground surface in any areas, such as, soil-erosion distribution and intensity, all classes' classification system(1-4 class), the thematic maps etc. These information can be created on host computer but can be picked-up at any terminals. Moreover, the monitoring information www homepages can directly be sent to the determiners' browser via the internet , providing credible first-hand data for the decision maker;

(5) Through remote sensing and remote signaling measures, we can real-time monitor rainfall dynamic changing information in all drainage areas (through receiving the cloud map from NOAA satellite and other remote sensing information),and real –time information of the hydrologic situation and disasters in the middle or lower reaches of river areas (if it comes to the pinches monitoring area can be extended to all drainage areas).According to the monitoring precision, information sources can be classified into aerial remote sensing, American TM and Gallo's SPOT data (TMCC,CCT).Their resolutions is 1m level,10m level and 30 level;

(6) Supported by GIS,RS,GPS and photogrammetry etc. spatial information technology, according to all drainage area's background spatial database, remote sensing information database and encoding database etc, this system can analyze possible flood areas, land use in flood areas and disasters evaluation as soon as disasters happen, and can provide the corresponding assistant decisions. Moreover it offers tech support for the disaster areas layout and rebuilding , the designing of the banks etc;

(7) On the ground of the overall flood-prevention planning in the Yellow River drainage areas,the spatial database for the flood-prevention decisions and expert assistant decision database should be built step by step in the drainage areas, which can offer the detailed and really first-hand data and the technologic supporting and, enhance the sci-tech contents and rapidly reactibility for the flood

prevention .At the same time ,for the top dams the high-precision GPS monitoring should be carried out during the period of flood;

(8) The system should have the functions of photogrammetric measurement and information service from aerial photos and satellite image, which be able to create the topographical maps in special areas, the orthographes of aerial photos and statellite images and the three-dimensional diagram or all kinds of thematic maps;

(9) Supported by the dynamic system , basing on remote sensing information sources and models, we can deeply research the changing of soil moisture and forecast crops yield in the special areas crop yield. At the same time, we also research the distribution of ground surface water and underground water in desert areas.

A structural figure on water-soil conservation and rainwater dynamic monitoring system in the Yellow River drainage areas :

Frame of water and rainfall condition and water and soil conservation **dynamic monitoring** & **making decision supported** system in Yellow River valley

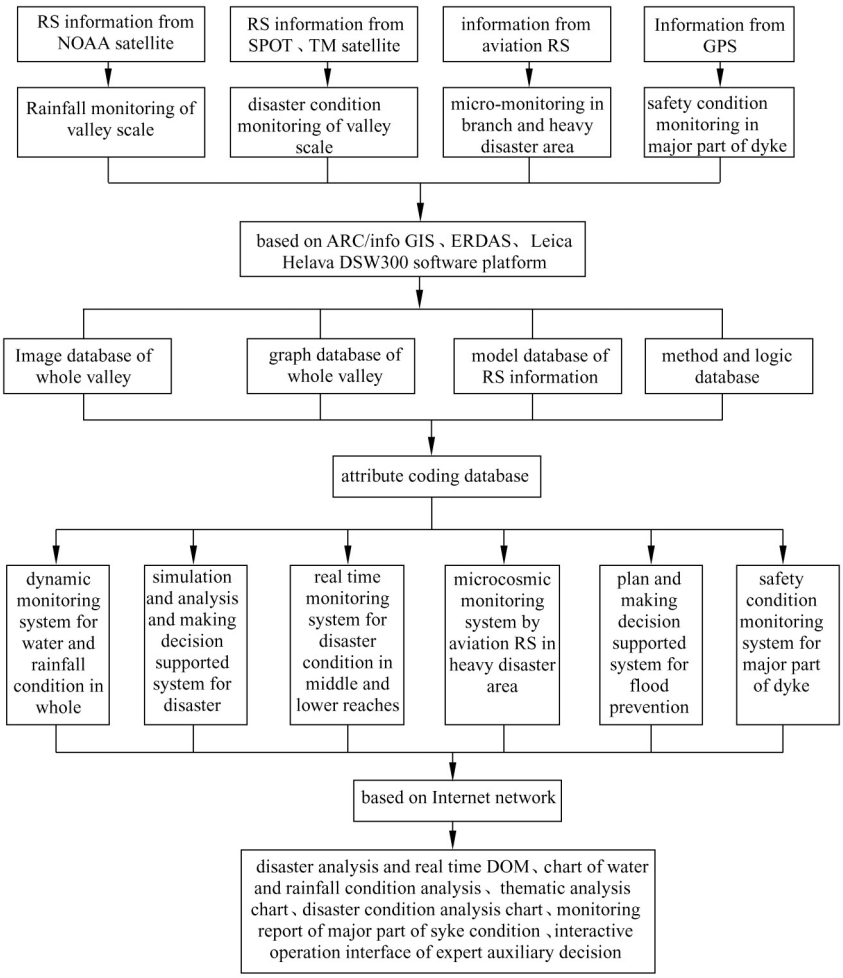

Fig. 3

4 Application foreground

Buiding of this system will make decision-making departments be able to grasp detail information at any moment about ecologic environment changing and situations of rainwater and disaster in drainage areas. In this way decision-makers can much better make the policies and their decisions have more

pertinence and scientificaalness. It is doubtless that the system would evidently enhance the actulizing efficiency in the “ecologic agriculture and soil and water conservation stride century majestic project” and the construction progress in the foold-prevention areas. Moreover, it offers tech support for the various harnessing measures, thereby, guaranteeing the carrying out of harness criterions, enhancing the harnessing quality, promoting the economic containable development in the region. At the same time , this project is one of the research bases on ecologic environment and flood prevention. It make such research fields as the analysis of ecologic agriculture benefit, the developing modes on ecologic environment harnessing in the various type areas , the forecasting and monitoring of newly added water-soil loss , the classifying of soil erosion types as well as flood prevention decisions and scientific dispatching etcs. This will be useful to increase sci-tech contents in the construction of the “A majestic project of striding century” , the research of dynamic monitoring and the construction of the flood prevention system .

The dynamic monitoring system is a technologic guarantee of the managing and decision and a basis of building normalized, scientific, standard management and decision-making. It will create distinct society benefits.

The system has a good foreground of popularizing and applying :

(1) Supporting the reliable, detailed and real, prompt dynamic data in ecologic environment, rainwater and disasters situations in the drainage areas ,ecologic agriculture, land using, basic farm construction and crops yield, soil erosion etc. However, it is a tech support system of the “the majestic project of striding century t”.

(2) Offering the reliable tech support for long- middle - time layout or blue print drawing in areas, drainage areas and branches ;

(3) Offering the strong tech support and services for the research institutes of ecologic agriculture, water conservancy, environment renovation etc.

(4) Offering remote sensing information on the ground surface and extending the technology domains.