

## The Application of '3S' Integration Technique in Carrying out the Plan of Environment Rehabilitation and Water and Soil Conservation

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**Abstract:** On the base of space information technology, according to the characteristics and demand of the plan of environment rehabilitation and water and soil conservation, the article bring forward the method and approach of carrying out the plan of environment rehabilitation and water and soil conservation by using '3S'(remote sensing、system、geography information system) integration technology. In this integration system, the Global Positioning technology is mostly apply for real time locating, supplement surveying of plot and attribute updating; Remote sensing image treatment technology is mainly apply for the geometry rectification, geometry treatment of remote sensing image data ; Full digital photogrammetry system is apply for the scanning , orientation of the images, and the collection of Digital Terrain Model (DTM) ; Data collection system is apply for classing by computer, extracting the information of ground coverage and land composition, and status of information of water and soil conservation; GIS will treat graph data which is in vector form, carry out drawing analysis; Authority analyze system is apply for forecasting and carrying out the plan of environment rehabilitation and water and soil conservation, Graph and image export systems apply for the displaying, plotting, printing of multifarious results. The approaches will cover collection and analysis of basic data, setting up the GPS control net in planned area, full digital photograph surveying of representative area, treatment and information collection of remote sensing image, collection of slop and gully density factor, design and management of GIS database, confirmation of plan, design of small scale structure such as silt structure, maps drawing and achievement exporting.

**Keyword:** '3S' technology, water and soil conservation, plan, apply

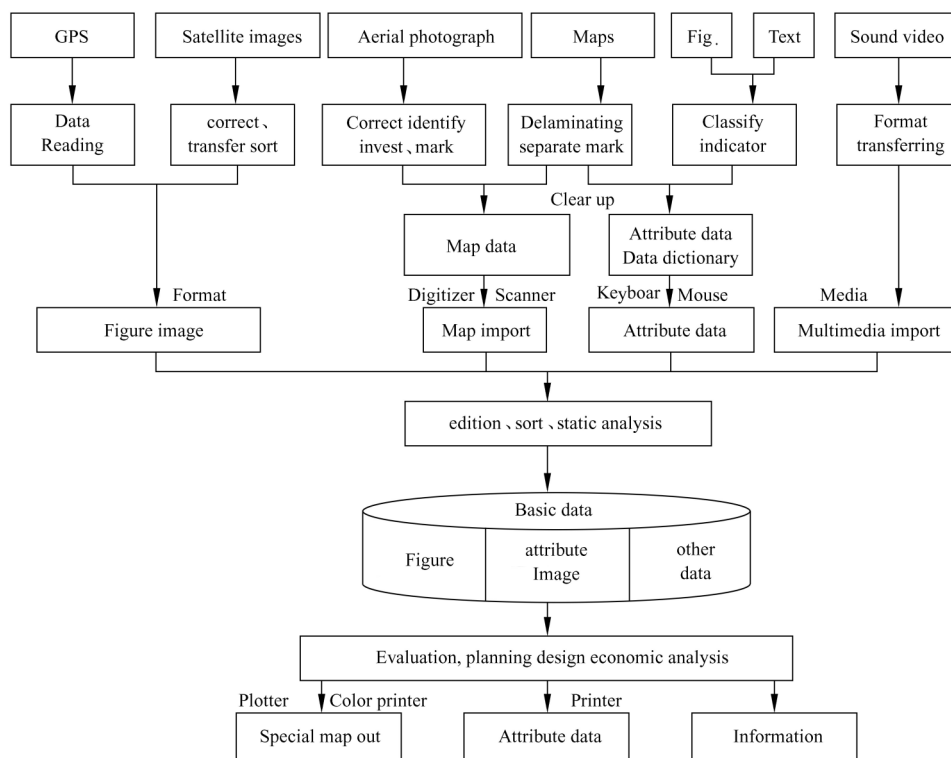
'3S' represents the global position system, geography information system and remote sense, these techniques and their integration form the basal and essential technical core of system of geospace information science. Digital photograph system and export system also can be closed in '3S' techniques.

The planning of soil and water conservation is a complex systems engineering, it involves the knowledge, data and information technology of various science. Its scientific nature determine the achievement of environment construction and harassment of soil and water erosion, and in an extent, it determine succession or not of the project of environment rehabilitation. Especially in loess plateau, where there is so many gullies, and morphology is scattered, and water and soil erosion is very serious, it is much difficult to lay out the plan of environment rehabilitation of water and soil conservation. In old-timey works of planning, general methods were applied to investigation and analysis of basic data, also to planning, design and benefit evaluation, some of these method contain less technique, they bear much workload, of course too costly. As result of development of technology of space information, especially the development of technique of integration of '3S', it can be semi automatic or automatically to collect, edit, manage, analysis the data and map. The application of '3S' technique will prompt the planning work of environment rehabilitation and water and soil conservation to a new developing stage.

### 1 Technical principle of integration of '3S' in planning of environment rehabilitation and water and soil conservation

The integration of '3S' is to mechanism combining three observation techniques, GPS, GIS, RS and relevant technique, making use of their technical specialty, to provide required information correctly, economically and rapidly. The basic suppose is to use the newest image information from RS, the 'key' position information from GPS, the technical method for images processing, data analysis, result applying from GIS. The data flow of integrated '3S' technique in planning of environment rehabilitation and water and soil conservation is shown bellow.

In this figure, GPS, GIS and the image processing system is the core, added with the systems of meteraging, data collection, expert and export. In which, the role of GPS is the real time position, additional plot survey, and attribute updating; the function of RS image processing system includes radicalizations rectification, geometry rectification, geometry treatment, data transferring and compressing, format transferring, image enhancement, image identifying; the full digital photogrammetry system is mainly used for aerial photograph scanning, orienting, diorama establishing, DTM collecting, land type information collecting etc; GIS carries out the mapping analysis by processing the vector map data, it can carries out the pile up analysis to grid data; The ES, on the basis of further development, and making the pile up analysis and network analysis by certain type or model, carries out the planning, forecasting of planning of environment rehabilitation and water and soil conservation; The output system will finish the task of printing, displaying and plotting of all the results. Analysis above show that the '3S' used in planning of water and soil conservation must be provided with: self-contained and consistent systems of observation and data collection, systems of storage, editing, processing, analysis, forecasting and decision of image and figure; output systems of document, decision scheme and forecasting result.



## 2 Steps in accomplish the planning of environment rehabilitation and water and soil conservation by means of integrated '3S' techniques

The planning of environment rehabilitation and water and soil conservation general divided into 6 steps: First, surveying in field, collecting data and calculation, information collecting and clearing up; Second, investigation of present status of land usage and measures of water and soil conservation; Third,

planning of land usage; Fourth, planning of measures of water and soil conservation, Fifth, determine the physical schedule and financing arrangement; Sixth, Analysis of benefit of water and soil conservation<sup>[2]</sup>. Among the six steps, first and second cost most time and money, its speed and precision can improve by using '3S'. Followed text will briefly explain the main steps of completing plan of environment rehabilitation and water and soil conservation by '3S'.

## **2.1 Collection and clearing up of basic information**

In planning area, collecting the recent morphology map with certain scale, the RS image data (such as TM, SPOT), aerial photograph and other relevant special information, establishing the index map. It is need to clear up the collected special data according to the requirement of plan and data base, put it in computer and found the basic data base.

## **2.2 Establish the control net of GPS of the region**

Especially for the planning of small watershed, this part work is extraordinary meaning. By control net of GPS, coordinate of control point of image can be gained, it is not only used for photo orienting in digital photogrammetry, and also used for updating, extra-measuring, extra-drawing of plot of land usage. When planned in a large area, GPS control net can get the coordinate of image characteristic to compile geometry rectification of RS image. Steps of net establishment include: region analysis, spot selection according to the requirement of environment rehabilitation and water and soil conservation and mapping, mark stone making, mark burring, GPS observation, leveling, calculating, control net check, etc.

## **2.3 Full digital photogrammetry**

Full digital photogrammetry is the most simple and most accurate way to collect the information of topography, physiognomy, land usage of planned area, especially in planning of small watershed, design of small scale engineering of water resource and water and soil conservation, or the plot planning in macro planning. Lets take the Full digital photogrammetry software developed by Intergraph Company as a sample to explain the process. First step, navigate photo scanning, to transfer image information to fig information. Generally large and medium scale photo is satisfy, because that planning of environment construction and water and soil conservation requires less accurate than measuring the relief map. In scanner selecting, high precision scanner of Intergraph can be adopted, and common scanner with less precision can also be used (must be A<sub>3</sub>). Second, obtaining coordinate of control point of photo by GPS measuring in field, using the software of Full digital photogrammetry to do the interior orienting, relative orienting and absolute orienting of aerial photograph. Third, automatically aetrotriangulation densitification (semi automatically densitification also can be used, especially in hilling area or mountain area), then establishing diorama; Fourth, establishing DEM automatically (or semi-automatically); Fifth, collection the information of land using, water and soil conservation, eco-agriculture measure, water system, road, residential area on diorama, specifying attribute code for each, all the indicators should be stored in relevant layer according their types; Sixth, Processing positive rectification of images and graph combination on finished DEM.

## **2.4 RS image processing, and information sorting**

This part of work depend mainly for macro regional planning. First of all, approximately rectification the RS images by software of image analysis and treating. Then, accomplishing the geometry rectification of images by coordinate of key ground point gained from GPS or topographic map in large or media scale. Sorting the information by information obtaining techniques such as Tasseled Cap transferring and key element transferring. Identifying the borderline of other land using by combining the image classifying techniques with visual interpretation. In the same way, all the information should be stored in relevant layer according their types.

## **2.5 Sorting of slop degree information and gully density indicator**

Slop degree is a key indicator for planning of water and soil conservation, especially for planning of moving slop land to forest and grass. Slop degree is defined as the tangential value of horizontal and land surface. It can be directly obtained from DTM by using usual GIS software (such as ARCGIS, MGE). If lack of DTM, it need manually drawing on topographic map, the get the data by scanning it into computer and transferring it to vector.

Gully density is defined as the total length of gullies in a specific region. Obtaining gully density indicate from DTM can adopt the method of hydraulic analysis, or measuring on topographic map.

## **2.6 Design and management of GIS database**

GIS data base design is a complex and cockamamie process. Database of plan of environment rehabilitation and water and soil conservation has much specializing but singleness, so it is relatively simple. Main task include: determining the data in data base, selecting proper data model (there are three types reticulation, layer connection type), organizing the data in data base, and the development of decision making assistant system and design assistant system of small scale engineering of water and soil conservation.

Finished GIS database manage the three type basic data files, vector configuration map files, grid files, attribute data files. When call for the data, the system will automatically transfer corresponding file.

## **2.7 Confirmation of plan scheme**

On the basis of managing ES, by using senior computer language, accomplishing comprehensive analysis of data managed by system in planning of linearity and non-linearity, dynamic and static and multitarget, to identify the decision making assistant system or plan model applied for planning. System transfer the corresponding data in data base, combine with present land use, principle of land use, requirement of environment rehabilitation and developing orientation of plan, lay out a set of scheme, then the ES will analysis the schemes, and identify the best one.

After identification of best scheme, planning data will send back to attribute data base and storing according the land plot, mapping system fold the corrected attribute data, operate illogical and space, finish specific map making. Specific maps include two type maps of present and planned.

## **2.8 Design of small-scale engineering of water and soil conservation such as warping structures**

The DTM of small watershed form the foundation for design of small scale engineering of water and soil conservation, by using the subprogram of design of warping structure in system, lay out a series of scheme according the planning principle and design requirement, identify the best one by ES comprehensively analyzing, evaluating.

## **2.9 Result output**

Formatting the present and planed tables of social and economic situation, land using, water and soil erosion, measure of water and soil conservation, according to the plan result. Then printing and plotting the finished tables, maps, designs, orthography images of small watershed by printer and plotter.

## **3 Conclusions**

The application of '3S' technique leads the planning of environment rehabilitation and water and soil conservation getting rid of the situation of non-scientific and no guidance that comes from the classic method that mainly is experiment and survey. It directs for a road of scientific, automatic and practical

steadily. The application mentioned above is at the stage of combination, not integration, and the decision making assistant and ES are in the phase of developing and trying. Following the development of '3S' and practical module, '3S' will strictly, closely, systemically integrate, bring more guidance and practice to plan result, and play a more important role in environment rehabilitation and water and soil conservation.

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