

ESSENTIAL COMPONENTS OF MONITORING SOIL AND WATER CONSERVATION IN CHINA

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Abstract

Soil erosion is widely distributed in China and can be classified into 4 types (ie. water, gravitational, freeze-thawing and wind erosion) according to the eroding forces. The specific nature of the soil and water erosion influences the installation and monitoring requirements (eg. objective, duty, scope, principles, and technological systems). For macroscopic monitoring, the indices consist of the volume and mass of soil and water loss and its control, area or cover rate of vegetation, land use, erosion modulus, population, GDP and grain yield. For the middle scale of monitoring, the indices include sediment discharge from rivers and runoff. At smaller scales, the main monitoring data is obtained from aerial photos and investigations into mini-watersheds or villages, and the indices are soil and water loss, time and economic loss associated with either floods, waterlogging and drought, and the inputs, outputs and income derived from farming, forest, herd, sideline, fish, industry and businesses, as well as measures of the population, levels of living, culture and education.

Additional Keywords: techniques

Introduction

The monitoring of soil and water conservation includes inspection, checking, examination and reviewing to soil erosion and its control. Soil erosion distributed widely in China, and could be classified into 4 types, i.e., water erosion, gravitational erosion, freeze-thawing erosion and wind erosion according to the eroding forces. It is found that the types of water and wind erosion take place mainly in hill of mountainous areas, and the latter is mostly from natural landslide, dilapidation and earth debris slide, the freeze-thawing erosion is seen in high and tremble mountain, and in the north of the Great Wall, sandy soil area of panplain of the loess plateau and oceanfront often occurs the wind erosion. The water and wind erosion are the major types of soil loss in China, in it water erosion is the prevalent with severe extent. It is observed that the loess plateau in the northwest, Yungui plateau in the southwest, earth-stone mountain in the north, hills in the south and black land in the northeast, etc., are the typical areas of water erosion.

It is thought that soil loss is different from the process of natural erosion, the arises and development of it is closely correlated with human activity, which of vegetation damage such as reclamation on steep slope, overloading on land or heavy grazing, slashing and deforestation and other unreasonable movement or transform condition of land surface unbendingly including mining, road building and quarry may bring on or accelerate soil loss. On the other hand, the soil and water conservation measures, such as forestation and grass growing, terrace construction and optimization of land use guided with science and technology can control soil loss, protect water and soil resource, improve ecological environment and raise land productivity effectively.

But due to the complexity and multiformity of economy and natural condition in China, the modality, extent and range of soil loss varies greatly in areas. It is rather difficult for the relater agencies and department in management and policy-making to hold the state of soil loss and its control accurately as it is short of the data of dynamic change for long term in geography, landform, climate and human activity. Thus, when both the country and local governments constitute social and economy development policy or plan, there would be deficient in quantified or integrated data, which will impress the accuracy of policy-making, plan and scheme (Gil, 1979; Lixian, 1995).

Objectives and Role of Monitoring on Soil and Water Conservation

Based on the practical condition of nature and production it is thought that the objective to monitor soil and water conservation is to investigate, observe and record the actuality of soil and water loss and its control periodically, to study the dynamics and development trend, provide basic data for the country, local government including the province, municipality, county, commune and village to establish policy and program and to execute the plan to optimize the production structure of farming, forestry, animal husbandry and sideline production, which aims to control soil and water loss, protect, improve and us rationally of the soil and water resources, improve the ecological environment and production and living conditions of the people, and to realize the strategy of sustainable development.

To realize the objective the primary duty of the monitor on soil and water conservation should be the following. The first is to monitor the area, extent and intensity of soil and water loss, actualities of land use, vegetation, land

productivity and people's economy periodically of the country and the regions with related data and graphs. The second is to monitor actuality of soil and water loss control, including controlled area, reduction of sediment concentration of rivers, number of engineering, increase of vegetation cover rate, optimized land use of farming, forest and grass land, raise of land productivity and the improvement of farmer's economy condition, the comparison of soil and water conservation results with the last ones. The third is to provide the monitored data and graphs to the related departments in management periodically on nature, economy and social development in the major areas of soil and water loss or control in the country or a region according to the requirement and condition. The fourth is to analyze the relationship of soil and water loss with various factors quantitatively, to establish model of regional social and economical development with soil and water conservation measures, predicting soil and water loss as well as the impacting from human activity, to make optimization of development plan for the stressed area or watershed.

Monitoring Scope and Objectives in China

Monitoring scope

In accordance with the prescription of the second item of "the Law of Soil and Water Conservation in the People's Republic of China" that the soil and water conservation is to prevent and control soil and water loss from natural factors and human activity. Therefore, the monitoring scope of soil and water conservation could involve the state of soil and water loss, prevention, control and the measures accepted.

Monitoring objective

It could be determined along the lines of the scope, necessity and feasibility (Yue, 1994). In the macroscopic view, the monition objects should include great three types area of soil and water loss in the country, i.e., wind erosion area including Xinjiang, Gansu corridor, Caidam Basin in Qinghai, Ningxia, north Shaanxi, Inner Mongolia and the west part of the northeast China; freeze-thawing erosion area including the plateau and high mountain distributed with living glacier Qinghai-Tibet plateau in Qinghai-Tibet plateau, Xingjiang, Gansu, Sichuan and Yunnan; water erosion area is mainly distributed in mountainous hills, the severe erosion area of which is over 1.5 million km², covering the east of Great Xing'an Mountains-yingshan Mountain-Helan Mountain-Qinghai-Tibet Plateau, which includes the loess plateau in the northwest, low mountainous hill and rolling hill in northeast, mountainous hill in the north and the south, Sichuan Basin and the surrounding hill and six second-grade areas such as Yunnan-Guizhou plateau.

In the middle scope view, the watersheds of great rivers could be considered as the monitoring objects, which includes the watersheds of the Yellow river, the Yangtze River, the Pear River, the Songari River and the Haihe River, among which the watershed of the Yellow River is the major area of soil and water loss due to deep layer of loess, frequent rainstorm, deficient of vegetation and unreasonable human activity. It could be seen that the land surface is fragmented with vertical and horizontal gullies, forming the landform of mound and ridge.

In the microscopic of view, the mini-watershed is regarded as the basic unit to make up the ecological and economical system in mountainous areas and hills; each of the watersheds is a complex system from many factors of ecology, economy and society. Accordingly, the mini-watershed is the primary microscopic object to be monitored. The common character of the mini-watersheds in China is with extruding contradiction among population, grain, resource and environment, in urgent need of comprehensive control of soil and water loss as the ecological environment is deteriorated with accelerated soil and water loss from reclamation and extensive cultivation on steep slope.

Principles

The final goal of the monitoring is to provide data and information periodically for the use of management and policy-making; thereby the preferential mating, requirement and effectiveness must be considered fully in the monitoring work. Based on the study and practice, it is thought that the monitoring of soil and water conservation should keep to the following principles:

- (1) Necessity. Requirement is the prerequisite to determine specific objectives and methods, to work out scheme, to select staff members and to co-locate instrument and equipment.
- (2) Standards. All of the methods, index and mode to monitor should be unified, the description to the monitored object should be standardized with national or international criterions. For a specific type area of soil and water loss the monitoring method is unified.
- (3) Comprehensibility. In allusion to various kinds of monitoring object, the monitoring index should be picked from multiple aspects such as nature, economy and society. The monitoring method should be the combination of high and new technology with conventional investigation methods for the entirety and completeness of the results.

- (4) Dynamics. The monitoring should be made with time, i.e., at a fixed time or periodically. The results from inspection, observation, examination and others should be analyzed comprehensively to establish mathematical models for the index, the prediction is realized.
- (5) Stratification. It is related to the monitoring of macroscopic, middle scope and microscopic view. Because of the limit in necessity and technical conditions, the monitoring could be conducted in different layers, such as whole area, major areas or typical sampling points (one watershed or plots).

Methods

In recent years, a lot of exportation works have been made in the monitoring on soil and water conservation and the benefit from shelterbelt forest in China and other countries such as American, Japan Indian and Thailand, from which good results and experiences were obtained. However, there has not been matured systematic and universal method to monitor due to lot of reasons. It is known that the current method to monitor implementation of watershed project is starting with norms of yield, effect and benefit, it is concise and with strong maneuverability.

In China, the monitoring for mini-watershed is set forth from the point of ecological economy system view, the content to be monitored includes local factors of the watershed, soil and water conservation measures, society and economy conditions, current use of land, production of farming, forestry, animal husbandry and sideline, some new contents are related to the investigation of living quality and cultural and education conditions for the population. The advanced technology accepted is information management system based on GIS, both satellite and aerial photos and thematic maps of kinds could be used (Bicheng, 1995; Zhongkui, 1996). However it is thought that the common fault of the existing monitoring methods is with less utility, inadequate completeness and specification of the system, weak time efficiency of the results provided, as a whole the unification and coordination are awaited.

It is thought that for the monitoring of soil and water conservation in China the existing and matured advanced theory of science and technology should be applied fully, the applicable monitoring system should be established in allusion to different objects, the accurate data and information should be provided with less input; and the national system and technological net of monitoring should be set and the monitoring level is raised using the current returns and advanced measures of technology from the related professional areas, which would well serve the soil and water conservation, regional renovation and sustainable development.

Technological System

Frameworks

Firstly, the macroscopic objects to be monitored should be delimited according to the characteristics of climate, geomorphology and hydrology, etc.; further the great rivers are considered as the middle scope objects. Within the macroscopic and middle scope objects, the microscopic objects---mini-watershed or village is determined. For all objects the stratification is defined in accordance with necessity and feasibility, which includes entire, prior and typical monitoring. The entire monitoring is the investigation, analysis, examination and record to the ecological, economical and social factors connected to soil and water conservation by 3S technology, that includes these of totality and complex of factors; prior monitoring mainly refers to that of major areas, or of undetermined factors in a area; the typical monitoring is to observe soil and water loss or/and soil and water conservation benefits in fixation at typical sites with monitoring station.

Monitoring indices

For the macroscopic monitoring the statistical data from province, ministry and committee level and remote sensing is used, the indices consists of the actuality of soil and water loss and its control, area or cover rate of vegetation, land use, erosion modulus, population, GDP and grain yield, etc. For the middle scope monitoring, both 3S technology and data on hydrology, geology, biology, society and economy are needed, the indices consists of sediment discharge of river and runoff besides of the indices from the microscope. As to the microscopic monitoring the main data is from aerial photos and investigation in a mini-watershed or village, the indices are soil and water loss amount, time and economy loss of flood, water logging and drought, input, output an income from farming, forest, herd, sideline, fish, industry and businesses, population, levels of loving, culture and education, etc.

The indices for macroscopic monitoring should be unified among the three great typed-areas of soil and water loss or in the country; also these for the middle scope monitoring should be unified among the watersheds of the great rivers, and for the microscopic monitoring should be unified in a typed area or a large watershed.

Technologies

Different technologies would be accepted for different objects and stratification of monitoring. In total, the monitoring of soil and water loss could use he technologies of 3S, ground survey, specific test, quantification and

prediction, etc. comprehensively. Among it 3S refers to RS---remote sensing, GPS---Global Positioning System, GIS---geographical information system, RS is to obtain ground information, GPS is to determine and obtain geographical information and GIS for the storage and treatment of the information.

Technical lines

The National Center of Soil and Water Conservation Monitoring has the responsibility for macroscopic monitoring, to coordinate and organize middle scope monitoring. The general stations of monitoring should be set in the watersheds of the great rivers, providing information obtained to the center and organizing, coordinating and managing the works of monitoring stations in min-watersheds or villages; the major tasks of the stations are taking charge of monitoring of local soil and water conservation, providing information to the general station and the superior departments. The monitoring center, general station and station are connected with telecommunication, personnel training and visit, as well as bulletin and newsletter.

Results

Through monitoring on soil and water conservation the following results should be obtained:

- (1) digital and photo data on soil and water loss and its control state of the great three typed areas, watersheds of great rivers, mini-watersheds or villages in provinces, districts, counties and communes. It should be revised in control every 3 to 5 years by monitoring results of satellite photos.
- (2) Annual data and maps or drawing from prior and typical monitoring.
- (3) Universal information management systems on soil and water conservation of China, established in the center or watershed, they are connected through internet.
- (4) Annual monitoring report of national soil and water conservation and special report from entire, prior and typical monitoring. For every 5 years one general report would be produced by the general stations and centre.

Opinion on the Installation of Monitoring Organization

- (1) Based on the National Monitoring Center of Soil and Water Conservation, one general station could be established in the watershed of each great river;
- (2) In each of the second typed areas in the great river watershed one station could be established;
- (3) The National Monitoring Center could be composed of the departments of expert consulting, ground remote sensing, weather remote sensing, collection of ground survey, calculation and charting and coordination-integration.
- (4) The structure of the general station should be corresponding to that of the center with some special variation.
- (5) The monitoring station consists of persons taking charge of specific works such as observation, investigation, calculation, examination, communication, etc.

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