WASWAC

HOT NEWS

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WASWAC

CONTENTS

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The 5th WASWAC World Conference will be held in June 19-23, 2023

June 19-23, 2023

Palacký University, Olomouc, Czech Republic

Czech Society of Soil Science (CSSS)

World Association of Soil and Water Conservation (WASWAC)

Palacký University Olomouc (PU), Brno University of Technology (BUT)

Research Institute for Soil and Water Conservation Prague (RISWC)

and Societas Pedologica Slovaca (SPS)

in cooperation with

International Union of Soil Sciences (IUSS) and

European Society for Soil Conservation (ESSC)

under the auspices of

both the Ministers of Agriculture and of the Environment of the Czech Republic

present

The 5th WASWAC World Conference

on the topic

ADAPTATION STRATEGIES FOR SOIL AND WATER CONSERVATION IN A CHANGING WORLD

The conference aims are:

- ◇ To analyse the present and future situation of soil and water conservation on a worldwide scale while taking local specifics into consideration.
- ◇ To analyse the effects of population growth, human activity and climate change on soil and water in the context of the demands of sustainable farming, water and food supply.
- ◇ To promote and increase collaboration between scientific organisations, policymakers, the general public and practitioners.
- ◇ To design goals, strategies and directions for conservation of soil and water as basic irretrievable natural resources for current exploitation and the needs of future generations.

Scientific committee:

Luboš Borůvka (CSSS)
Jose Luis Rubio (WASWAC)
Edoardo Costantini (IUSS, ESSC)
Carmelo Dazzi (ESSC)
Miroslav Dumbrovský (BUT)
Beata Houšková (SPS)
Jana Konečná (RISWC)
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Ministry of Environment (representative)
Lillian Øygarden (IUSS)
Jana Podhrázská (RISWC)
Jaroslava Sobocká (SPS)
Bořivoj Šarapatka (PU, CSSS)
Radim Vácha (RISWC, CSSS)
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Modelling of water erosion, its hydrological and geochemical impacts

World Association of Soil and Water Conservation (WASWAC) together with Lomonosov Moscow State University is arranging online seminar series by leading World experts on water and soil modeling.

The School for Young Scientists "Modelling of water erosion, its hydrological and geochemical impacts" will be held online on December 1-6, 2022. Everyone can join the broadcast and learn about modelling of water erosion, its hydrological and geochemical impacts from various continents and river systems.

The program of the School: lectures by scientists - leading experts from China, Belgium, Iran Italy and Russia on the problems of water and soil erosion modeling, machine learning application and health assessment in hydrology:

- Seyed Hamidreza Sadeghi (Tarbiat Modares University, Iran)
- Ivan Lizaga (Ghent University, Belgium)
- Zhengzheng Zhou (Tongji University, China)
- Michael Maerker (Pavia University, Italy)
- Andrey Zhidkin (V.V. Dokuchaev Soil Science Institute, Russia)
- Paolo Porto (University Mediterranean of Reggio Calabria, Italy)

The working language of the School is English.

Registration deadline is 28 November, 2022 (10:00 CET)

All participants will receive the certificate of attendances upon for request.

The participation is free of charge based upon registration which should be done until December 1, 2022: https://megapolis2022.ru/register/. A link to the broadcast (zoom and YouTube interface) will be sent to registered participants.

The School for Young Scientists is organized in collaboration with the International Association of Hydrological Sciences (IAHS), WASWAC, Lomonosov Moscow State University with the support from Russian Science Foundation project – "Technology for assessing the environmental condition of the Moscow metropolis based on the analysis of the chemical composition of microparticles in the system "atmosphere-snow-road dust-soil-surface water" (MegaPolis; grant No 19-77-30004); the Russian Federation Government Megagrant – "Megapolis - heat and pollution island: interdisciplinary hydroclimatic, geochemical and ecological analysis" (grant No 075-15-2021-574).

Lomonosov Moscow State University

Russian Science Foundation

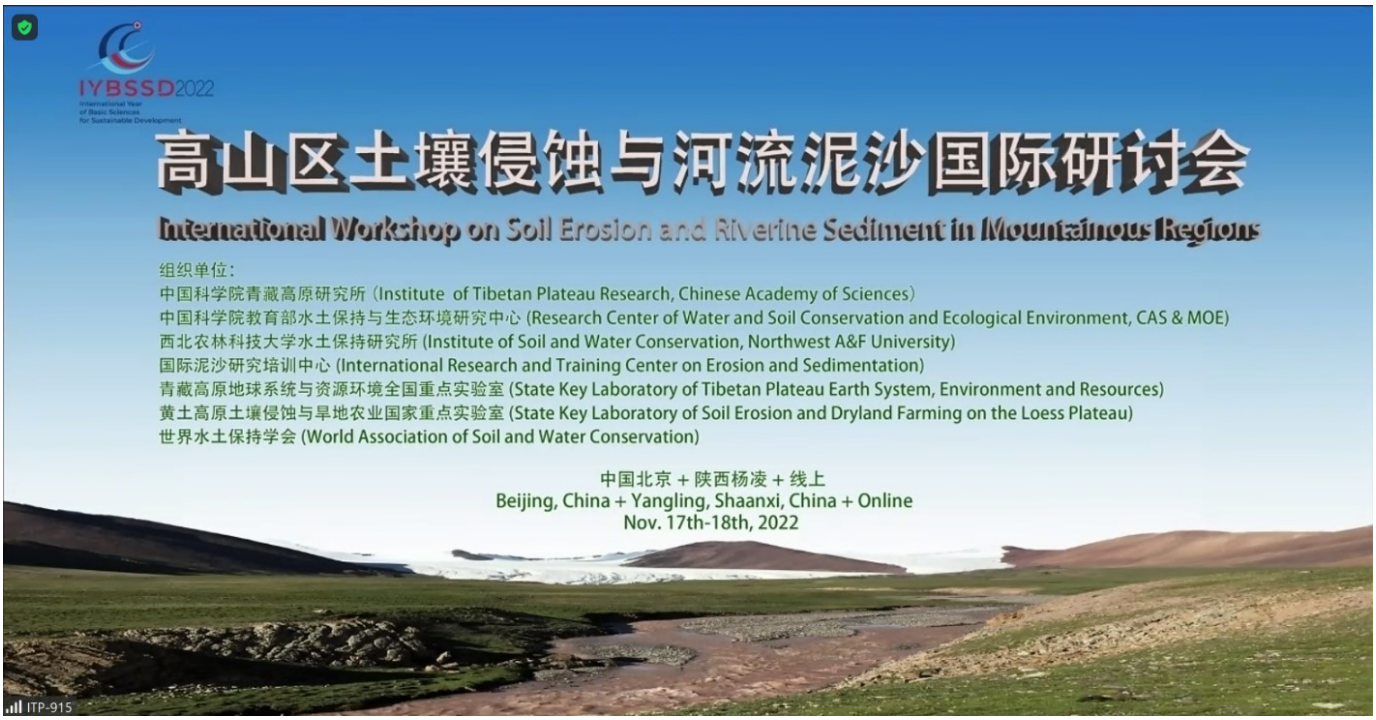
International Association of Hydrological Sciences IAHS

World Association of Soil and Water Conservation WASWAC

An international scientific cooperation program Mega-grants

Website: *https://megapolis2022.ru/* E-mail: *megapolisschool@gmail.com*

International Workshop on Soil Erosion and Riverine Sediment in Mountainous Regions was held successfully



Organized by Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Research Center of Water and Soil Conservation and Ecological Environment，CAS &Ministry of Education, Institute of Soil and Water Conservation，Northwest A&F University, International Research and Training Center on Erosion and Sedimentation, State Key Laboratory of Tibetan Plateau Earth System, Environment and Resources, State Key Laboratory of Soil Erosion and Dryland Farming on the Loess Plateau, and the World Association of Soil and Water Conservation, the International Workshop on Soil Erosion and Riverine Sediment in Mountainous Regions was held successfully on line during November 17-18th, 2022. The goal of this workshop is to invite well-known experts in related fields to exchange the latest research results, identify the current opportunities and challenges, and discuss the strategies to deal with climate change through online and offline means.

In the opening ceremony, Prof. Fahu Chen, from Institute of Tibetan Plateau Research, CAS, Prof. Hao Feng, from Research Center of Water and Soil Conservation and Ecological Environment, CAS & MOE, and Prof. Qingbin Pan, from the International Research and Training Center on Erosion and Sedimentation were invited to give opening speech.

Totally 24 scientists were presented and provided the online participants very interesting,

valuable and inspiring reports. The topics including:

- ◇ Soil erosion assessment in Pan-Third Pole (Baoyuan LIU)
- ◇ Impacts of Asia water tower changing and countermeasures (Liping ZHU)
- ◇ Scaling soil erosion estimates in time and space (Richard Cruse)
- ◇ Soil conservation and ecosystem rehabilitation on Loess Plateau, benefit and Prospective (Guobin LIU)
- ◇ Representing global soil erosion and sediment flux in Earth System Models (Zeli TAN)
- ◇ Impact of modern climate change on fluvial sediment delivery in High Mountain Asia (Dongfeng LI)
- ◇ Freeze-thaw erosion landscape and subsurface flow observation in cold alpine critical zone on the Qinghai-Tibet Plateau (Xiaoyan LI)
- ◇ Sediments contribution to soil contamination and loss of nutrients in EU agricultural soils (Panagos Panos)
- ◇ The response of soil erosion to vegetation restoration and rainfall events in the loess hill and gully region (Juying JIAO)
- ◇ Steep-Slope Viticulture and Climate Change: Threats, Monitoring, Sustainable Management (Paolo Tarolli)
- ◇ Effects of Ecological Engineering Projects on Soil Erosion and Sediment Yields in Southern Tibetan Plateau, China (Donghong XIONG)
- ◇ Policy implications of multiple concurrent soil erosion processes in European farmland (Pasquale Borrelli)
- ◇ Soil organic matter losses: d13C to disentangle erosion and decomposition (Yakov Kuzyakov)
- ◇ Soil Erosion and Riverine Sediment over the Tibetan Plateau (Fan ZHANG)
- ◇ Recent sediment budget changes in a large high mountainous drainage basin (Khawaja Faran Ali)
- ◇ Glacial erosion and GLOFs exacerbate riverine sediment (Yong NIE)
- ◇ Impact of river-bed freeze-thaw process on bed load sediment transport (Le WANG)
- ◇ Quantitative attribution of riverine sediment to hydrological, cryospheric and vegetation effects (Xiaonan SHI)
- ◇ Numerical simulation of morphodynamic processes of braided pattern in the Yarlung Zangbo River (Jian SUN)

- ◇ Sediment sources tracing in the high erodible watershed of the Northern Loess Plateau (Guangju ZHAO)
- ◇ Watershed sediment and nutrient process on the Loess Plateau (Guoce XU)
- ◇ Soil erosion quantification in the crisscross region of the Chinese Loess Plateau using radionuclide tracing (Jiaqiong ZHANG)
- ◇ Source apportionment of eroded soil organic matter on the Loess Plateau of China (Chun LIU)
- ◇ Effects of soil and water conservation measures on flood process under extreme rainstorms (Jianqiao HAN)

Some online presentations

Introduction of Jiangxi Academy of Water Sciences and Engineering

江西省水利科學院
Jiangxi Academy of Water Science and Engineering

1, About JAWSE

Jiangxi Academy of Water Sciences and Engineering was merged to establish by the former Jiangxi Provincial Institute of Hydraulic Sciences (founded in 1954) and the Jiangxi Provincial Institute of Soil and Water Conservation Science (founded in 1964) in 2020. Jiangxi Academy of Water Sciences and Engineering, affiliated to Water Resource Department of Jiangxi Province, is a public welfare provincial institution integrating scientific research, technical services and achievements promotion of water conservancy, hydropower and soil and water conservation.

Jiangxi Academy of Water Sciences and Engineering mainly undertakes scientific research on major water issues, technical services of water conservancy, hydropower and soil and water conservation, research and evaluation on water resource related policies, technical specifications and standards, support services of water conservancy related pre-planning and project establishment demonstration, technical solutions and industry technical management, and carry out soil and water conservation monitoring, water conservancy related scientific and technological achievements transformation, promotion and application, popularization and science education, etc.

There are more than 350 employees in Jiangxi Academy of Water Sciences and Engineering, including more than 90 full-time scientific research personnel, and about 65% of employees has master's degree (including more than 30 doctors).

Jiangxi Academy of Water Sciences and Engineering has three large-scale scientific research bases in as follows: Poyang Lake Model Experimental Research Base (located in Gongqing City, Jiangxi Province, China, covering an area of 500 mu, Fig. 1), Jiangxi Soil and Water Conservation Ecological Science Park (located in De'an County, Jiangxi Province, China, covering an area of 1,200 mu, Fig. 2), and Rural Ecological Water Conservancy Research and Demonstration Base (located in Nanfeng County, Jiangxi Province, China, covering an area of 536 mu, Fig. 3).

Fig. 1 Poyang Lake Model Experimental Research Base.

Fig. 2 Jiangxi Soil and Water Conservation Ecological Science Park.

Fig. 3 Rural Ecological Water Conservancy Research and Demonstration Base.

It has six scientific research platforms, including Poyang Lake Water Resources and Water Ecology and Environment Research Center of the Ministry of Water Resources, Jiangxi Key Laboratory of Poyang Lake Water Resources and Environment, Jiangxi Provincial Key Laboratory of Soil Erosion and Control, Jiangxi Provincial Hydraulic Safety Engineering Technology Research Center, Postdoctoral Scientific Research Workstation, and Poyang Lake Basin Ecological Water Conservancy Technology Innovation Center. It has a provincial superior scientific and technological innovation team for soil and water conservation and water resources protection and utilization.

Jiangxi Academy of Water Sciences and Engineering has 10 Grade A qualifications for dam safety identification, reservoir water storage safety identification, sluice safety identification, geotechnical engineering testing, concrete engineering testing, measurement testing, metal structure testing, mechanical and electrical testing, water resources demonstration, hydrological and water resources investigation and evaluation. In addition, it has the highest level (5 stars) evaluation certificate for both program preparation and monitoring of production and construction projects soil and water conservation.

Jiangxi Academy of Water Sciences and Engineering can provide technical services for the industry and society in flood and drought disaster prevention, hydraulic project planning and design, physical model testing, engineering quality and building materials testing, hydraulic engineering safety monitoring and evaluation, comprehensive regulation and management of water resources, water ecological environmental protection and comprehensive management, rural water conservancy, smart water conservancy, soil erosion prevention and control, land consolidation planning and design, etc., which has been fully affirmed by all stakeholders.

2, Scientific research and technical services of soil and water conservation in JAWSE

In Jiangxi Academy of Water Sciences and Engineering, scientific research and scientific and technological services of soil and water conservation are mainly carried out by Institute of Soil and Water Conservation, Institute of Rural Water Conservancy, Institute of Water Conservancy Planning and Development, the relied Jiangxi Provincial Key Laboratory of Soil Erosion and Prevention, and the attached Jiangxi Provincial Soil and Water Conservation Monitoring Center.

At present, Jiangxi Academy of Water Sciences and Engineering has 98 scientific research and technical services and related support

personnel for soil and water conservation, including 7 senior engineers, 21 associate senior engineers and 41 engineers. Among the fixed personnel, there are 2 experts who enjoy the special allowance of the State Council, 6 candidates for the Jiangxi Province New Century Talent Project, 1 provincial innovation and entrepreneurship youth, and 3 provincial 100 outstanding youths.

In recent years, the scientific research and technological services of soil and water conservation of Jiangxi Academy of Water Sciences and Engineering are as follows:

Scientific research projects: We have approved the National Natural Science Foundation of China for 12 consecutive years. Since 2016, we have achieved breakthroughs in project approval of the National Key R&D Program topics, National Natural Science Foundation of China, China Postdoctoral Fund General Project, and local standard projects. As the research project host institution, we have completed the research task of two National Key R&D Program topics on the restoration and protection of typical fragile ecology and the efficient development and utilization of water resources respectively, and have completed more than 100 scientific research projects such as the National Natural Science Foundation of China, the special project of local science and technology development guided by the central government, the special project of public welfare industry scientific research of the Ministry of Water Resources etc. A number of scientific research achievements have reached the international advanced level or the leading level in China, and have been widely used to produce significant benefits. We have won 32 provincial, ministerial and other science and technology awards, among which Key Technologies and Applications for Soil Erosion Prevention and Control on Red Soil Slopes under the Influence of Agricultural Activities won the first prize of Jiangxi Province Science and Technology Progress Award in 2018, achieving a breakthrough of zero provincial and ministerial first prizes for water conservancy field in Jiangxi Province, China.

Innovation platform: At present, a scientific experiment and research system composed of 1 provincial key laboratory (Jiangxi Provincial Key Laboratory of Soil Erosion and Control), 1 national soil and water conservation science and technology demonstration park (Jiangxi Soil and Water Conservation Ecological Science and Technology Park, Fig. 4), 1 provincial superior scientific and technological innovation team (Knowledge Innovation Team for Soil and Water Conservation and Water Resources Protection and Utilization), 1 postdoc-

toral scientific research workstation and field experimental base that radiates the whole Jiangxi Province, have been built, giving full play the role of scientific research, demonstration and promotion, popular science publicity and talent training. For example, Jiangxi Soil and Water Conservation Ecological Science and Technology Park has become a beautiful business card of Jiangxi's soil and water conservation undertakings, not only giving birth to a number of high-level scientific research projects such as National Key R&D Program topics, but also attracting more than 500 batches and more than 20,000 people to visit and study.

Fig. 4 Experimental plots in Jiangxi Soil and Water Conservation Ecological Science Park.

Scientific research progress: Since 2016, our soil and water conservation science and technology innovation has focused on scientific and technological frontiers and prominent issues in the fields of soil and water conservation and ecological environment, and has made important progress in the following three aspects. First, important progress has been made in the study of soil erosion processes and mechanisms, key technologies and mode of soil and water conservation, ecological restoration measures and environmental effects in typical red soil erosion areas such as slope arable land, orchards, landslides, and rare earth tailings; Second, important progress has been made in integrating ecological and productional function synergy and efficient agricultural and forestry industry development technology, building an ecologically clean small watershed governance mode, and improving the ecological service functions of fragile ecosystems. Third, important progress has been made in research and construction of multi-scale, multi-level and multi-target dynamic soil erosion monitoring, and in realizing the portability, precision and rapidity of soil erosion monitoring.

Science and technology promotion: Since 2016, we have explored and summarized five sets of soil and water conservation technical technol-

ogy systems specially for China red soil erosion control, such as soil and water conservation and pollution control of sloping cultivated land abbreviated as One Control Two Conservation; High efficient use of rainwater resources, low erosion and low pollution of hilly orchards abbreviated as "One High Two Low"; Utilization type, ecological protection type and ecological restorative type for collapse governance abbreviated as "Three Types"; Understory soil erosion control for coniferous forest and economic fruit forests abbreviated as "Two Categories"; Soil and water conservation for barren mountains and mounds with erosion level at strong or more severe erosion abbreviated as "Two Barrens". Besides, 7 technologies have been selected into the Key Promotion and Guidance Catalogue for Advanced Practical Technologies of Water Conservancy by the Ministry of Water Resources. Additionally, we have built three series of local standards for slope cultivated land erosion control technology, small watershed soil erosion control technology and water ecological civilization village construction. These scientific and technological achievements have been widely accepted and applied in Jiangxi Province, and 16 technology transformation, promotion and application have been completed successively, providing important scientific and technological support for the ecological construction of water and soil conservation in Jiangxi Province and even in the South China.

Technical services: Since 2016, adhered to demand-oriented, oriented to the main economic battlefield and oriented to the major needs of water conservancy, we have provided scientific and technological support and technical services for soil and water conservation planning and design, program preparation, monitoring and acceptance, consultation and training for water administration departments as soil and water conservation administration departments at all levels, and related enterprises. It has provided strong support services for infrastructure construction, economic and social development, ecological environmental protection and water ecological civilization construction in Jiangxi Province, China. For example, the Jiangxi Provincial Water and Soil Conservation Plan from 2016 to 2030 was approved by the Jiangxi provincial government, and guiding technical documents such as the Evaluation Measures for the Construction of Water Ecological Civilization Villages in Jiangxi Province were implemented.

Technical support: Based on the high-quality development of water and soil conservation, guided by the technical needs of fine manage-

ment of water and soil conservation, we have provided all-round scientific and technological support for soil and water conservation of Jiangxi Province in recent years. We mainly undertake the technical work of planning and preparation related to soil and water conservation monitoring, the construction and operation management of water and soil conservation monitoring network, the collection, analysis and reporting of monitoring data, dynamic monitoring of soil erosion, and the summary, analysis and evaluation of soil erosion monitoring results. Besides, we also prepare Jiangxi Provincial Soil and Water Conservation Bulletins, conduct the research of water and soil conservation monitoring technologies and methods, as well as domestic and foreign scientific and technological cooperation and exchanges, and the technical support services of soil and water conservation management in Jiangxi Province.

3, Main progress of soil and water conservation research in JAWSE

The research on soil and water conservation of Jiangxi Academy of Water Sciences and Engineering is based on the red soil area in South China, focusing on supporting the construction of the ecological Poyang Lake basin and creating a beautiful China "Jiangxi mode". We focus on major scientific issues and common key technologies, such as the efficient utilization of water and soil resources in red soil area and their pollution prevention and control, and the improvement of ecological functions of the Poyang Lake basin. There are 3 major research areas as follows: red soil erosion process and vegetation restoration effect, ecological environment and ecological service function of watershed, and key technology and informatization of soil and water conservation monitoring.

3.1 Red soil erosion process and vegetation restoration effect

In this research area, we have mainly carried out research and application of theories and technologies related to soil erosion process and simulation, water and soil conservation and ecological restoration, vegetation restoration and environmental effects, soil restoration and control, optimal allocation and efficient utilization of agricultural water and soil resources. Since 2016, the major research progress is as follows:

(1) Key technologies and applications for soil erosion prevention and control on red soil sloping farmland under the influence of agricultural activities

In this study, the characteristics of slope soil, near-surface hydrological processes and the associated output of nitrogen and phosphorus

of sloping farmland under the conditions of cultivated culture and the climate of drought and flood, were firstly clarified in red soil area (Fig. 5). The driving factors and mechanisms of soil erosion and non-point source pollution of agricultural activities on red soil sloping farmland were clarified. Six categories of key technologies for prevention and control soil erosion and nonpoint source pollution from sloping farmland, including plant engineering measures, surface biological cover measures, slope reconstruction, nitrogen and phosphorus loss prevention and control, soil nutrient enhancement and nonpoint source pollution ecological purification at the end of slopes, have been integrated and developed. Based on above key technologies, a protective governance model with soil and water conservation and pollution control of sloping farmland and economic fruit forests abbreviated as One Control Two Conservation has been constructed, which has solved the major problem of coordinated improvement of agricultural and forestry production and ecological protection. Based on the application and promotion mode of "concentrated demonstration - typical promotion - comprehensive radiation", 9 demonstration bases with an area of 183,000 mu have been built, and the radiation application and promotion area in Jiangxi Province, Hunan Province, Fujian Province, Guangdong Province and other red soil areas have reached 33.23 million mu, where the amount of soil erosion has decreased by more than 70%, and the ecological, economic and social benefits are significant. The achievement won the first prize of Jiangxi Province Science and Technology Progress Award in 2018.

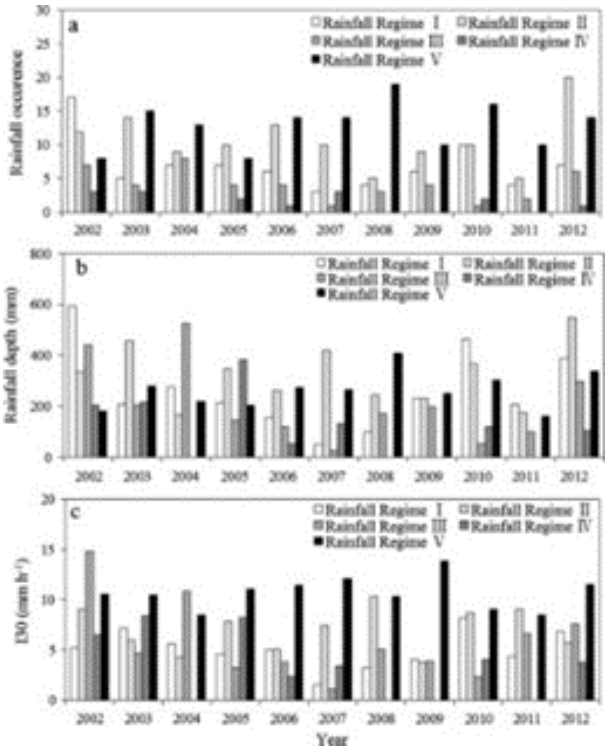


Fig. 5 Runoff coefficient, soil erosion amount and subsurface flow rate of three land cover types under five rainfall regimes.

(2) Water and soil conservation control technology and application of rainwater and runoff resources in red soil hilly area

In view of the dual impacts of soil erosion and seasonal drought on agricultural production in the red soil hilly area, this study

carried out relevant research on solving the problems of soil erosion in the rainy season and drought and water shortage in autumn at the same time, developed some key regulation and control technologies such as in-situ rainwater interception to promote seepage, runoff confluence storage, and runoff collective storage for irrigation, and integrated the technical system of soil and water conservation control of rainwater runoff resources in sloping farmland and economic fruit forests (Fig. 6). Taking the small watershed as the unit, a technical model of soil and water conservation with rainwater and runoff regulation and utilization in the hilly area of red soil in Jiangxi Province, with woodlands on the top of the mountain, fruit orchards on the mountainside, farmlands at the foot of the mountain and ditches at the bottom of the mountain, was constructed. These technologies have been widely used in 18 administrative departments, 8 enterprises, 3 national water conservancy research institutions, 2 engineering project departments and 1 society in 9 provinces or municipalities directly under the Central Government or autonomous regions, (cities and districts), and 6 demonstration bases have been established in 5 counties in Jiangxi Province, including Qingtang Small Watershed in Nankang District and Huan'an Small Watershed in Ningdu County etc. Besides, they have been also promoted and applied in the national key water and soil conservation projects, sloping farmland soil erosion comprehensive control projects and enterprise agricultural and forestry development projects in 17 counties in Jiangxi Province with remarkable results. The achievement won the second prize of Dayu Water Conservancy Science and Technology in 2020.

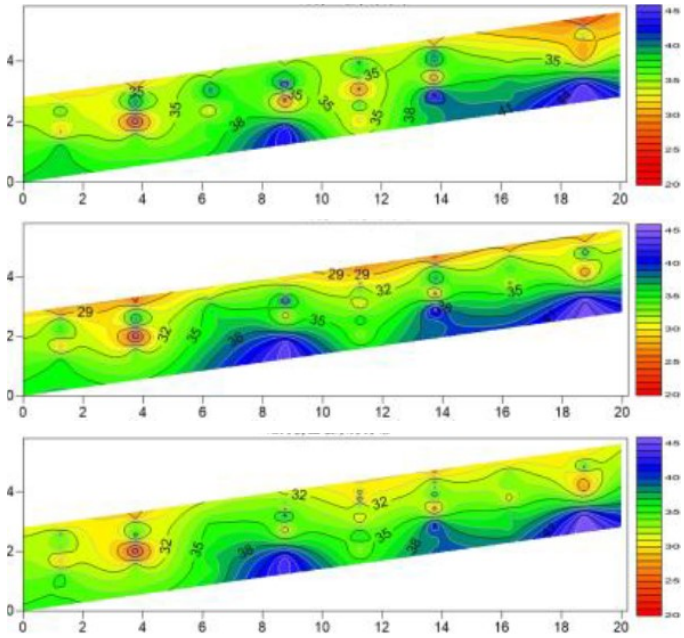


Fig. 6 Soil moisture distribution in soil profile along the slope of experimental plot in March, June, December

(3) Nitrogen and phosphorus loss process and regulation of red soil slope driven by subsurface flow

Based on the soil water leakage system and experimental soil tank, natural rainfall in situ observation, artificial rainfall simulation experiment, ^{15}N stable isotope tracing and

process mechanism model simulation were conducted in this study. The characteristics of surface/subsurface runoff and the rule of nitrogen and phosphorus loss in red soil slope were studied. The source of nitrogen loss and the fate of fertilizer nitrogen in red soil slope were analyzed, and the process of nitrogen loss in red soil slope driven by subsurface flow was simulated. Aiming at the key ways and main forms of nitrogen and phosphorus loss in red soil slope driven by subsurface flow, the idea of combining "source reduction, process control, and end treatment" was put forward to prevent and control nitrogen and phosphorus loss in red soil slope (Fig. 7). Combined with the nitrogen and phosphorus regulation effect of typical soil and water conservation measures on red soil slope, the technical mode of nitrogen and phosphorus loss prevention and control on red soil slope was summarized. The achievement won the third prize of Dayu Water Conservancy Science and Technology Award in 2018.

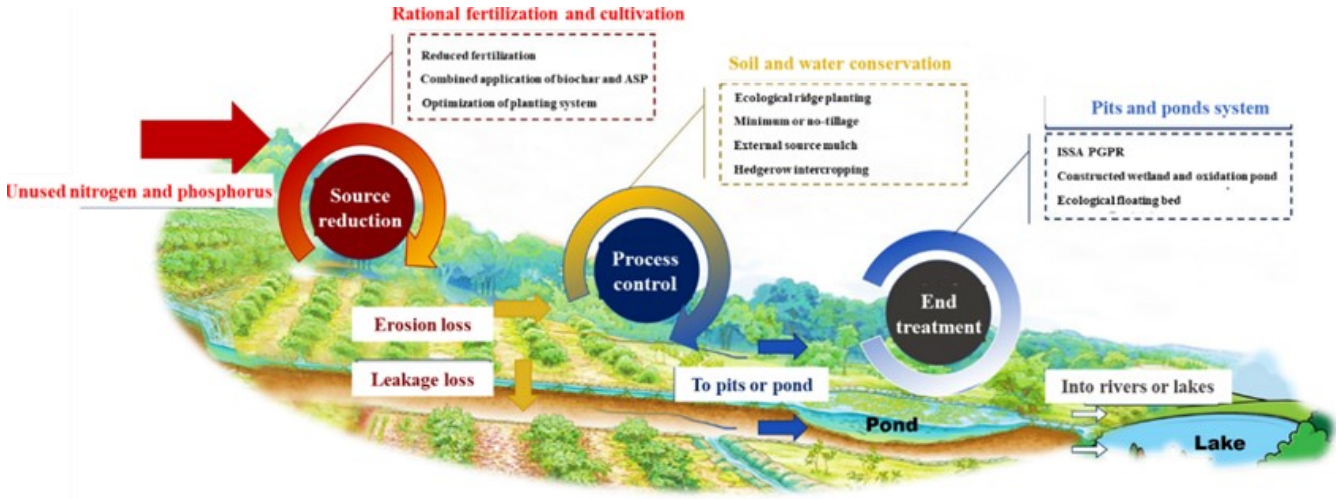


Fig. 7 Comprehensive prevention and control framework for nitrogen and phosphorus loss.

(4) Key technologies for prevention and control of water and soil loss and nonpoint source pollution in the initial stage of economic fruit forest development

In this study, characteristics of water and soil loss and nonpoint source pollution in the initial stage of economic fruit forest development were clarified, and a number of key prevention and control technologies for water and soil loss and nonpoint source pollution in the initial economic fruit forest were summarize and propose. Results indicate as follows: At the initial stage of economic fruit forest development, the soil suffers serious erosion, about 55.8% of the total area with a strong degree soil erosion. In the following 2-3 years, the amount of soil erosion decreased sharply, and after the fifth year, the soil erosion tended

to be relatively stable (Fig. 8). Extreme rainfall events play a leading role in water induced soil erosion of economic fruit forest, with 7% extreme rainfall yielding 42% of sediment (Fig. 9). Rainfall intensity and fertilization amount are important factors affecting soil nitrogen and phosphorus loss in economic fruit forest, and there are serious water and soil loss and nutrient loss caused by interplanting and stair wall exposure under limited extreme rainfalls, during which yield about 59% and 65% sediment of the whole year, so that nonpoint source pollution induced by soil and water loss caused by interplanting and stair wall exposure under extreme rainfall should be paid attention to. Interplanting combined with grass belt or crop straw covering on the spot, terraced fields equipped with front ridges and back ditches and terraced walls planted with grass are effective technologies for controlling extreme rainfall water erosion and nonpoint source pollution.

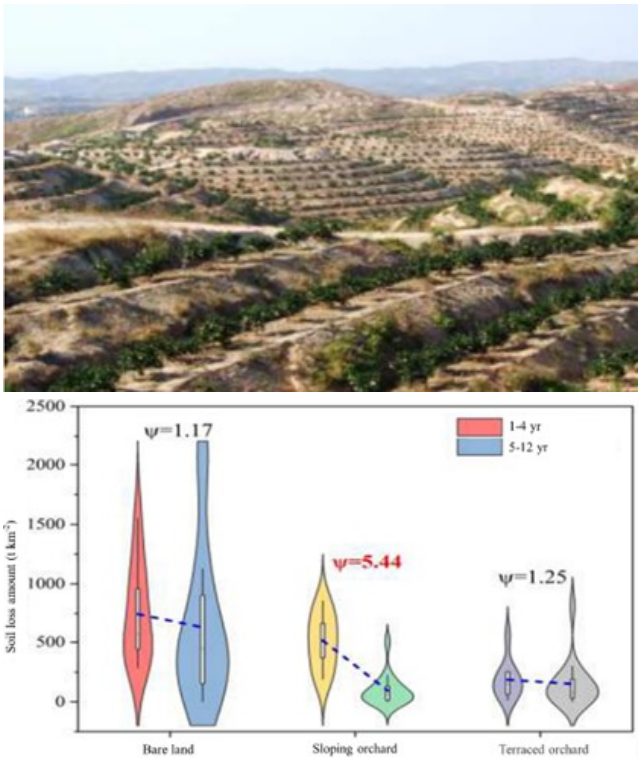


Fig. 8 Large area cultivated orchard and difference of yearly soil loss amount of different orchards between 1-4 years and 5-12years after cultivating

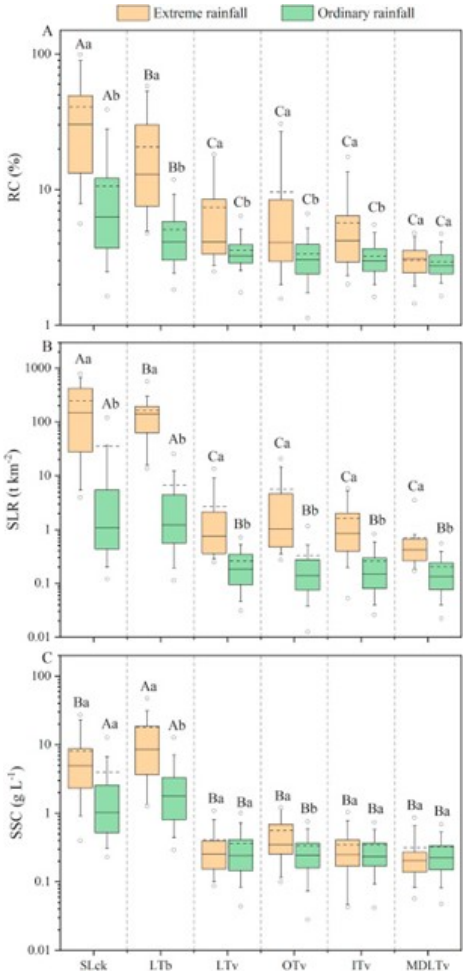


Fig. 9 Surface runoff coefficient (A), soil loss rate (B) and soil sediment concertation (C) of two rainfall types under different orchard terraces. RC, SLR and SSC are runoff coefficient, soil loss rate and soil sediment concentration, respectively. SLck, slope land as control; LTb and LTv, level terrace with bare and vegetation taluses, respectively; OTv and ITv, outward and inward terrace with vegetation taluses, respectively; and MDLTv, level terrace having front mounds and back ditches with vegetation taluses.

(5) Research and demonstration of ecological protection technology of soil slope near the river of Xiajiang Water Conservancy Project

In view of the technical difficulties in ecological protection of the water facing slope of the reservoir bank of the water conservancy project, combined with the analysis of the water level change and slope stability in the reservoir area, this study proposes the idea of dividing the water facing slope into soil fixation and erosion resistance areas, wave dissipation and erosion reduction areas, and erosion resistance landscape areas for zonal protection. Based on the characteristics of different ecological functional areas and the protection needs, slope protection plants such as centipedegrass, bermuda grass and vetiver grass were selected and applied, and the technologies of stem sowing of centipedegrass (Fig. 10) and wave dissipating hedgerow (Fig. 11) were independently developed. The technologies of impact resistant blanket, ecological bag and matrix free planting concrete were introduced and improved. Based on the site conditions such as different water scouring speeds, the cascade ecological protection mode adapting to water level changes was integrated. The achievements have effectively solved the technical problems of the fixed protection and ecological greening of the water facing slope in the reservoir area of the water conservancy project, effectively reduced the cost of ecological slope protection, stabilized the slope, reduced non-point source pollution, achieved remarkable benefits in ecological landscape and vegetation greening, greatly improved the efficiency and level of the treatment of the water facing slope in river and lake waters, and provided technical support for the treatment of river and lake embankments and the construction of water ecological civilization in Jiangxi Province.

Fig. 10 Techniques of centipedegrass stem sowing and wave dissipating hedgerow.

Fig. 11 Growth of bermudagrass used for bank slope protection of river embankment.

(6) Effect on red soil erosion inhibition and non-point source pollution control of AM fungi

In view of the difficulties in vegetation establishment and orchard non-point source pollution in eroded badlands in red soil region of Southern China, the most extensive plant symbiotic fungus arbuscular mycorrhizal fungi (AM fungi) in the soil was used for studying the effect on red soil erosion inhibition and non-point source pollution control of AM fungi, and results were as follows. In red soil, AM fungi can significantly promote the growth of the aboveground and underground parts of typical slope protection grass species, such as white clover, Bahia grass, bermuda grass and paspalum crusgalli, improve their resistance to soil splash, and improve the stability of soil aggregates and the slope protection benefit of typical slope protection grass (Fig. 12). The natural and artificial grass growing measures have changed the diversity and community composition of arbuscular mycorrhizal fungi in the soil and roots of citrus orchards and oil tea plantations respectively, and improved the soil fertility of the corresponding orchards (Fig. 13). The grass growing measures improve the content of large aggregates of soil water stability by regulating the soil microbial community, which promote the sustainable development of the orchards (Fig. 13).

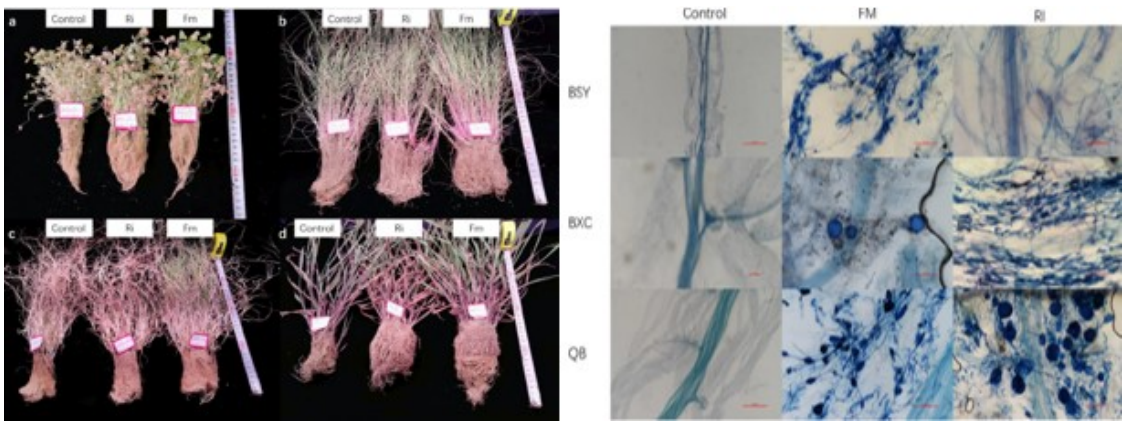


Fig. 12 Effect of AM fungi on the growth of typical slope protection grass (left) and AM fungal structure in typical slope

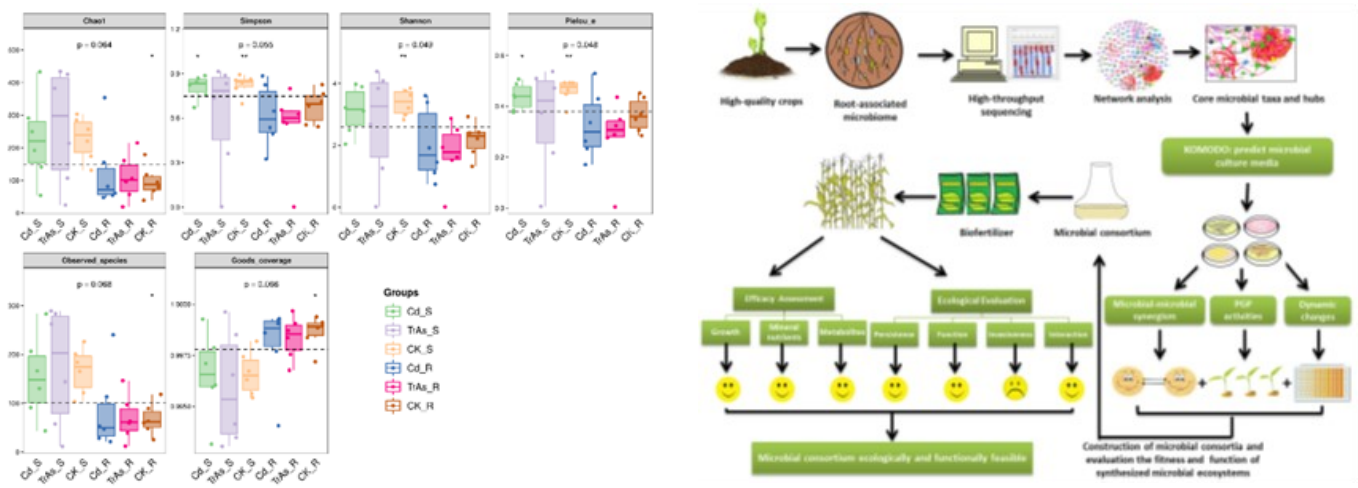


Fig. 13 Diversity of AM fungi in soil and roots under different grass species (left) and synthesis strategy of AM fungal flora (right).

3.2 Ecological environment and ecological service function of watershed

In this research area, we have mainly carried out research and application of theories, technologies and policies related to watershed erosion and sediment yield and regulation, watershed ecological environment and protection and restoration, ecological watershed management and construction, and improvement of ecological service functions. Since 2016, the major research progress is as follows:

(7) Research on the governance mode of ecologically clean small watersheds in soil erosion areas

In this study, firstly the classification method of ecological clean small watersheds was studied, then different types of ecological clean small watersheds were inducted and analyzed, and the benefit of various measures and their spatial layout in ecological clean small watersheds were analyzed and evaluated. The ecological clean small watersheds in Jiangxi Province were divided into four types: water source protection type, ecological agriculture type, livable environment type, leisure tourism type. Fourteen indicators reflecting soil, water, biology and human being in the small watershed were selected, and the evaluation index system and evaluation method of the ecological clean small watershed were constructed, which then were applied in actual cases. The key technologies and layout methods of ecological clean small watershed management in soil erosion areas were refined, and two ecological clean small watershed management modes were put forward, namely, "protect water via controlling hilly area - control pollution by reducing sources, intercept sewage and purify water - ecological restoration" and "protect water via protecting hilly area - protect water via controlling slope

– purify water flowing to villages – maintain clean water quality while developing" (Fig. 14).

Fig. 14 Ecological clean small watershed management mode.

(8) Integration of soil erosion control technology for watershed efficient development

Aiming at the serious soil erosion, single industrial layout and low ecological function of sloping farmland and economic fruit forest development in the low hilly area of red soil, the research on key technologies of soil erosion in the process of sloping farmland and economic fruit forest development is carried out, and the spatial optimization layout of soil and water conservation measures is taken as the core to develop the allocation technology and optimization scheme of soil and water conservation measures under the development scale of slope-subwatershed-watershed-region, based on regional hydrothermal resources and soil conditions, combined with water and fertilizer efficient utilization technology and vegetation composite management technology. The adaptive technology for soil erosion control developed by characteristic economic fruit forest such as citrus, navel orange and camellia oleifera is proposed, the adaptive technology system of soil erosion control, landscape pattern optimization and efficient industrial development is integrated. Then a demonstration base for comprehensive soil erosion control with ecological-production function coordination and efficiency is established to provide technical support for the comprehensive control of soil erosion and watershed efficient development in the hilly red soil areas of Southern China (Fig. 15).

Fig. 15 Changes of demonstration area with efficient development soil erosion comprehensive control.

3.3 Key monitoring technology and informatization of soil and water conservation

In this research area, we have mainly carried out research and application of theories and technologies related to dynamic monitoring of regional and project water and soil loss, technical standards of water and soil conservation, informatization and intelligence of water and soil conservation monitoring, etc. Since 2016, the major research progress is as follows:

(9) Research and application of integration of multi-dimensional soil and water loss dynamic monitoring technology

In view of the informatization of soil and water conservation monitoring and the realistic needs and normalization trend of "reinforce weak points of water conservancy projects and strengthen supervision of water conservancy industry", this study has been conducted for 7 years to explore the monitoring principles and advantages of each single technology from the perspective of the integration of key technical advantages, and to carry out the integrated research and application of multi-dimensional soil and water loss dynamic monitoring technologies in the form of introduction, improvement and integration. The portability, accuracy and rapidity of dynamic monitoring of water and soil loss was achieved by exploring and developing a dynamic monitoring test platform for water and soil loss that integrates monitoring at different time and space scales. The dynamic monitoring of multi-scale, multi-level and multi-target soil erosion and ecological environment was achieved with the integrated research and development of a multi-dimensional spatiotemporal monitoring technology system integrating "3D laser measurement- close range photogrammetry- UAV telemetry-model simulation". The achievements have been popularized and applied in the fields of dynamic monitoring of soil erosion, soil and water conservation, collapse control, flood control and drought relief (Fig. 16), which have greatly saved manpower and time costs and achieved remarkable results. The core technology was also successfully included in the 2018 National Water Conservancy Advanced Practical Technology Promotion Guidance Catalog. The achievements won the third prize of the 12th Science and Technology Award of China Soil and Water Conservation Society, and were recommended and demonstrated at the 15th International Water Conservancy Advanced Technology Promotion Conference and the Jiangxi Provincial Water Conservancy Advanced Technology Promotion Conference.

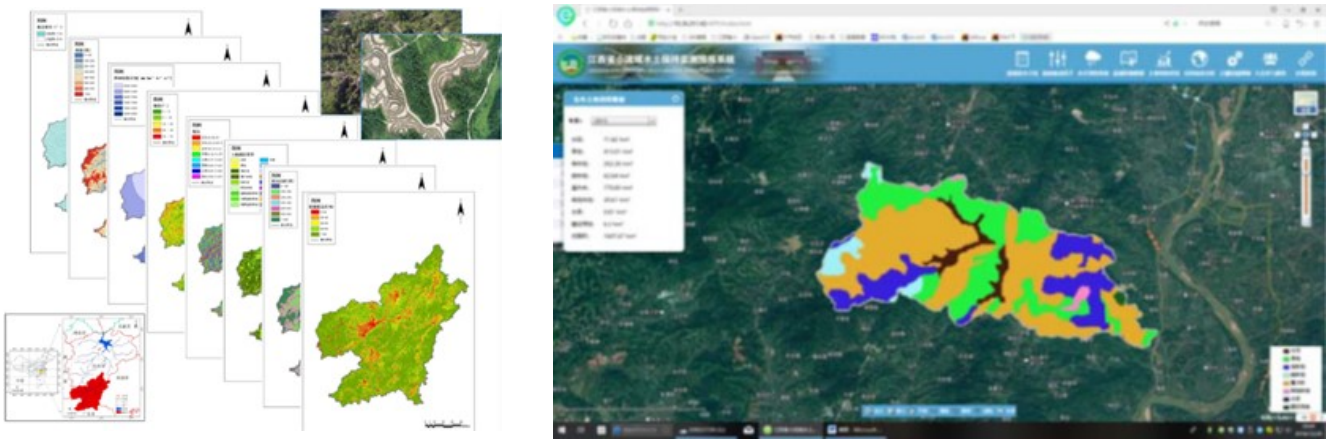


Fig. 16 Application of integration of multi-dimensional soil and water loss dynamic monitoring technology.

Innovative Initiatives for Prevention and Control of Red Soil Erosion in Ganzhou

Ganzhou, a typical red soil hilly area in Jiangxi province, is a pilot area for high-quality development of soil and water conservation in China. Through a series of following innovative initiatives, soil erosion in Ganzhou has been effectively prevented and controlled.

To strengthen the construction of smart water conservancy, Ganzhou has improved the ability to supervise soil and water conservation and to prevent human induced soil erosion. With the support of big data, cloud computing and other related information technologies, Ganzhou has established a "sharing and co-governance" regulatory mechanism, explored the "quasi real-time + refinement" regulatory mode, created an information sharing platform for soil and water conservation of production and construction projects, implemented the "joint review, joint approval and commitment" system for hilly economic fruit forest development. For soil and water conservation of production and construction projects, Ganzhou has promoted the commitment system of soil and water conservation plans, and carried out information based on supervision of soil and water conservation in both regional and key production and construction projects in all jurisdictions, achieving full coverage, normalization and standardization of soil and water conservation supervision for production and construction projects.

By summarizing the construction experience of Shangyou County Yuancun (Fig. 1) and Ningdu County Goudaozui (Fig. 2) National Ecological Clean Small Watershed, Ganzhou has explored a new pattern for the construction of ecological clean small watersheds: governing a clean small watershed, revitalizing a village, creating a demonstration project, cultivating a green industry, and making people rich. Through the construction of ecologically clean small watersheds, the soil and water loss control and regional economic development have been achieved in a coordinated way to better benefit the local people.

Ganzhou is a concentrated distribution area of collapses. Bank loans and government bonds have been comprehensively used to raise funds for collapse control, and the open competition mechanism to select the best candidates has been established, and also the substituting awards for subsidies have been used to efficiently allocate collapse control bunds. In addition to ecological protection type and engineering restoration type collapse control mode, the creative collapse control mode with efficient development has also been put forward for concentrated continuous

Fig. 1 Overview of Yuancun National Ecological Clean Small Watershed in Shangyou County, Jiangxi Province, China. Picture source: https://news.cri.cn/20190712/c017d1c7-1a4b-7952-a417-3278549ed38d.html

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Fig. 2 Overview of Goudaozui National Ecological Clean Small Watershed in Ningdu County, Jiangxi Province, China. Picture source: https://www.sohu.com/a/140733937_803279?_f=v2-index-feeds

collapses control (Fig. 3). By demonstrating and promoting from point to area, the collapse control has become a kind of hot investment projects, which attracted the participation of social capital, realizing the diversification of control fund sources and investors. The control measures are gradually becoming systematization, and the control effects are realizing integration.

Fig. 3 Terraced orchard landscape after the efficient development control of concentrated continuous collapses area in Ganxian District, Ganzhou, Jiangxi Province, China.

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