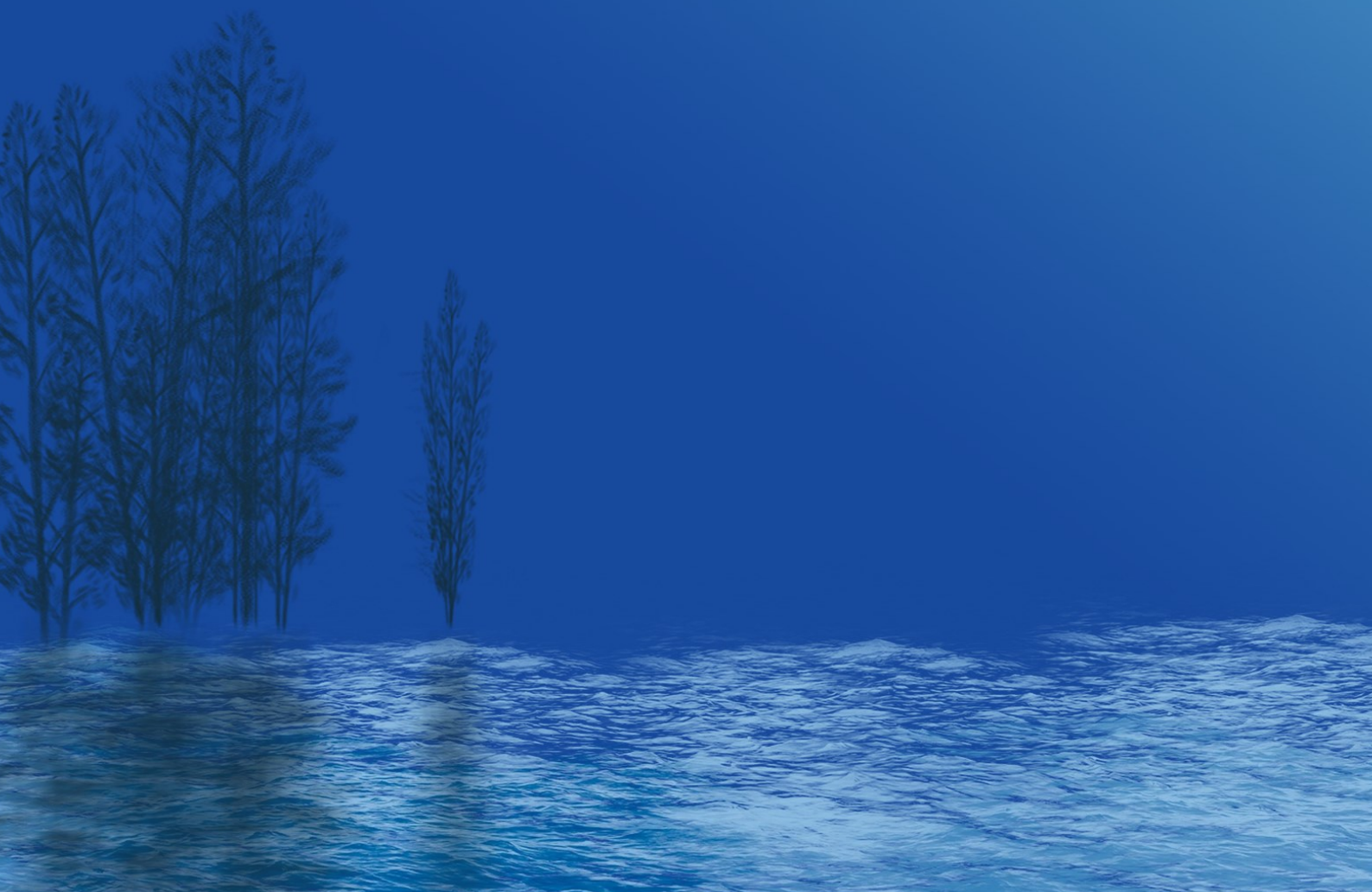
WASWAC

HOT NEWS

ISSUE 10, 2022



HOT NEWS

ISSUE 10 2022

WASWAC

CONTENTS

Editors: Dr.Pengfei DU & Dr. Li LI

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

June 19-23, 2023

Palacký University, Olomouc, Czech Republic

The 5th WASWAC World Conference, with the topic of "Adaptation strategies for soil and water conservation in a changing world" will be held during June 19-23, 2023 in Palacký University, Olomouc, Czech Republic.

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.

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Please pay your attention to our detailed announcement that will be released in January, 2023.

Welcome to attend this conference onsite in beautiful Czech, see you there then!

COP14 calls for joint efforts on wetland protection

The 14th Meeting of the Conference of the Contracting Parties to the Ramsar Convention on Wetlands (COP14), held in China's Wuhan and Switzerland's Geneva, concluded on November 13 with 21 resolutions.

In Wuhan Declaration, mobilizing more resources was committed to take more effective actions for wetlands protection by 2030. The declaration indicated that international technical institutes and committees should enhance cooperation in knowledge sharing among wetland conservationists worldwide. Officials said they expect more cooperation in technology and science between the parties to protect and restore wetlands. In addition to technical cooperation, the declaration encourages prioritizing conservation and management of vulnerable ecosystems including peat land, coral reefs and sea grass beds, mangroves, highland wetlands and groundwater systems. The declaration also calls for the promotion of legislation and enforcement for the protection, restoration, management and sustainable use of wetlands.

About the Ramsar Convention: named after the city of Ramsar in Iran, where the convention was signed in 1971, is an intergovernmental agreement dedicated to the conservation and rational use of wetland ecosystems. To date, it has 172 contracting parties.

Details at: *https://govt.chinadaily.com.cn/index/specials/cop14*

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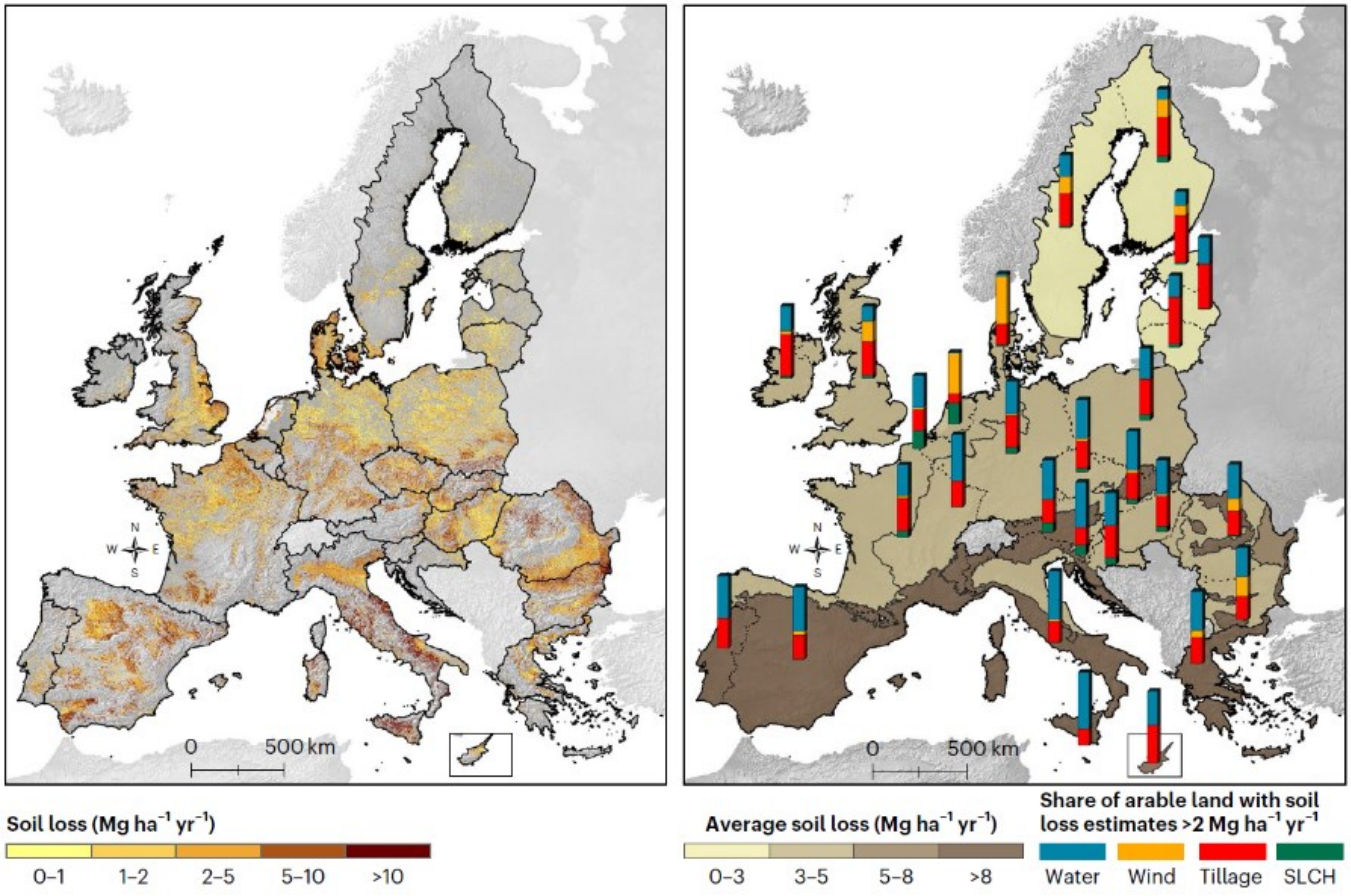
Multiple concurrent soil erosion processes

The spatial risk of soil erosion by water, wind, tillage and harvesting and where the co-occurrence of these different processes is observed by using a multi-model approach in the newly published paper "Policy implications of multiple concurrent soil erosion processes in European farmland ". Moreover, the authors analysed where these locations of multiple erosion co-occurrence are likely to intersect with the projected increase of dry/ wet climate conditions. Of the ~110 million hectares (M ha) of arable land in the European Union, our estimates show that 43 M ha are vulnerable to a single driver of erosion, 15.6 M ha to two drivers and 0.81 M ha to three or more drivers. About 3.2 M ha of arable land are vulnerable to the possible interaction of increased flood, drought, water and wind erosion.



Potential multi-process soil displacement modelled for the EU and UK

Title:

Multiple concurrent soil erosion processes

Description:

This dataset A first-ever assessment at European scale combines the threat of water, wind, tillage and harvesting to reveal the cumulative impact on arable land. We present the datasets for each of the erosion process (water, wind, tillage, harvesting root crops) and their cumulative effect at 100m resolution for EU arable lands (110 Million ha). In addition, we make available the Tillage Erosion assessment and the spatial distribution of erosion by harvesting root crops.

Spatial coverage:

EU & UK arable lands (110 million ha)

Pixel size:

100m

Measurement Unit:

t ha-1 yr-1

Projection:

ETRS_LAEA

Temporal coverage:

2010-2020

Reference: Borrelli, P., Panagos, P., Alewell, C., Ballabio, C., de Oliveira Fagundes, H., Haregeweyn, N., Lugato, E., Maerker, M., Poesen, J., Vanmaercke, M. and Robinson, D.A., 2022. Policy implications of multiple concurrent soil erosion processes in European farmland. *Nature Sustainability*. DOI: 10.1038/s41893-022-00988-4.

The data includes 5 raster files:

- ◇ All Erosion process. Multiple concurrent soil erosion processes
- ◇ Water erosion due to interill and rill. This is part of the soil loss by water erosion
- ◇ Wind erosion. This is part of the soil loss by wind erosion
- ◇ Tillage erosion. This dataset is estimated for first time using the Water and Tillage Erosion Model and WaTEM/SEDEM
- ◇ Soil loss by harvesting root crops (SLCH). This takes the aggregated data of soil loss by harvesting root crops spatialized by using the pan european map of crop distribution

Request form here:

https://esdac.jrc.ec.europa.eu/content/multiple-concurrent-soil-erosion-processes#tabs-0-description=1

Soil Erosion Research Under a Changing Climate

Soil Erosion Research under a Changing Climate

A decadal ASABE soil erosion research symposium, organized by ASABE, will be held during **January 8-13, 2023** in **Punta Borinquen Resort, Aguadilla—Puerto Rico, USA.**

PURPOSE:

Soil erosion caused by wind and/or water is a continuing problem throughout the world that threatens the capacity of the Earth to produce food, fiber, and renewable sources of energy for an ever-increasing population. Additionally, eroded sediment and agricultural chemicals are major water and air pollutants, causing many detrimental off-site impacts. Compounding the erosion problems are the effects of climate change. Warmer air temperatures also increase ocean water temperatures, that can result in larger and more severe storms and hurricanes. For example, Puerto Rico was devastated by Hurricane Maria in September 2017, with over 2900 fatalities, as well as infrastructure and erosion damages across the island. This symposium provides a forum for participants to discuss the status and future of soil erosion research.

The planned program has been released, details can be found here:

https://www.asabe.org/Portals/0/Events/2021%20Soil%20Erosion/Erosion_Symposium-Full-Program.pdf?ver=cy7Gm2IVldl9_Z5Sv8-qdg%3d%3d

NRCS USDA

METER

COASTAL RESILIENCE CENTER

Introduction of Soil and Water Conservation Department of Changjiang River Scientific Research Institute

1, Introduction of CRSRI

Changjiang River Scientific Research Institute (CRSRI), as one of the four largest state-owned non-profit research institute subordinated to the Ministry of Water Resources (MWR), was founded in 1951. CRSRI is dedicated to providing technical support for China's water industry and the protection, utilization and administration of Changjiang River (also known as Yangtze River). It also aims to offer technical service for industries involved in China's economic construction.

CRSRI now has more than 800 employees, of which 60% are qualified with senior professional titles or above, and 67% with master's or doctoral degree. More than 80 research scientists are authorized national, provincial, or ministerial experts, and more than 60 experts have won the title of national, provincial, or ministerial level talents. The headquarter of CRSRI is settled at No. 23 Huangpu Street in Wuhan (Fig. 1a), and the research base is at No. 289 Huangpu Street (Fig. 1b). The Yangtze River flood control model, as the largest river flood control physical model in Asia, is at Zhuankou experimental base (Fig. 1c). Other offices and research bases are located in Wuhan, Yichang, Chongqing, Danjiangkou, and Zaduo. They totally cover an area of 900 thousand m^2.

Figure 1(a) the headquarter of CRSRI; (b) the research base at Jiuwanfang; (c) the Yangtze River flood control model.

CRSRI now has four national research platforms, including "International Science and Technology Cooperation Base for River & Lake Protection and Water Security", "National Base for Foreign Talent and Intelligence Introduction", "National Center for Dam Safety Engineering Technology Research", "National Base for Scientific Popularization and Education". Other platforms, such as "Key Laboratory of River & Lake Regulation and Flood Control in the Middle and Lower researches of Changjiang River, Ministry of Water Resources", "Key Laboratory of Geotechnical Mechanics and Engineering, Ministry of Water Resources", "Center for Water Engineering Safety and Disaster Prevention Research, Ministry of Water Resources", "Center for Mountain Torrent and Geological Disaster Prevention Research, Ministry of Water Resources", "Field Scientific Observation Station of Water Ecosystem in the Changjiang River Source Region, Ministry of Water Resources", "Hubei Key Laboratory of Water Resources & Eco-environmental Science", "Center for Changjiang Economic Belt Protection and Development Strategy Research of CWRC", "Wuhan Center for Engineering and Technology Research of Intelligent Basin", are also based in CRSRI.

Over the last seven decades, CRSRI has undertaken large amount of research work for hundreds of large and medium-sized projects concerning integrated basin management and hydropower, including the Three Gorges Project (TGP), the South-to-North-Water Diversion Project and the Yangtze River protection legislation. The innovative achievements significantly contribute to the Yangtze River ecological civilization, the eco-social development and the progress of water science and technology. In 2019, CRSRI won the special award of the National Award for Science and Technology Progress with the "Three Gorges Project of the Yangtze River" for its contributions to such a crucial national project, ranking first among all the engaged counterparts.

Since the 1950s, CRSRI has carried out a great amount of research work on the middle route of the South-to-North Water Diversion Project, the Danjiangkou Dam heightening project and the Yellow River crossing project, and overcame such problems as expansive soil, crack and seepage prevention of super large tunnels crossing the Yellow River, regime and flood control of hyperconcentrated sediment wandering river, and seepage prevention for the old-and-new concrete interface of the Danjiangkou Dam.

In cooperation with the Ministry of Water Resources and the Changjiang River Commission, CRSRI carried out preliminary research on the Yangtze River Protection Law in areas

of legislative evolution, legal review, analysis of existing problems and countermeasures, special research, legislative demonstration, institutional framework design, legislative investigation, and expert consultation. From 2016 to 2019, CRSRI presided over more than 10 special research studies on Yangtze River protection legislation, covering the design of legal systems in key regions and fields such as the Hanjiang River Basin, Danjiangkou Reservoir, Basin Water Ecology and Environment, and River-Lake Relations.

In recent years, CRSRI has undertaken more than 50 cooperation projects (sci-technical) with partners from UK, Japan, Switzerland, Spain, Cambodia, etc. Some examples of cooperation projects include "China-Swiss, Integrated Water Resources and Risk Management in the Jinsha River Basin Under Climate Change", "China-UK, Urban Flooding Research Impact Project", "China-Cambodia, Planning for discipline development system and supporting facilities of Cambodian National Institute of Water Resources".

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

In CRSRI, scientific research, scientific and technological services of soil and water conservation are mainly carried out by the Soil and Water Conservation Department (DSWC). Founded in July 2003, the DSWC now is a director unit of the China Society of Soil and Water Conservation, a vice chairman unit of the Southern Soil and Water Conservation Research Association, and a vice chairman unit of the Hubei Provincial Society of Soil and Water Conservation, and mainly engaged in basic and applied research study on soil and water conservation and mountain torrent geological disaster prevention, providing technical support for industry authorities, and carrying out relevant technical consulting services nationwide.

Research Personnel: At present, DSWC has more than 50 employees, including 13 professor-level senior engineers, 24 doctors (including postdoctoral fellows), more than 60% with associate senior or above professional titles, and more than 90% with master's degree or above. More than 10 employees have been awarded Hubei Province May Day Labor Medal, the Yangtze River Committee Major Achievement Award, the Outstanding Contribution Award of the Chinese Society of Water and Soil Conservation, the Youth Science and Technology Award of the Chinese Society of Water and Soil Conservation, the third and fourth levels of the 5151 Talent Project of the Ministry of Water Resources, the third level of the Hubei Province New Century High-level Talent Project, the Shaanxi Province Hundred Talents Program. DSWC has more than 20

PhD or master's supervisors and has trained more than 50 doctoral and master students.

Research Equipment and Platforms: DSWC has built a soil erosion simulation laboratory and a physical and chemical analysis laboratory of soil and water conservation, and independently designed and developed the first mobile soil erosion laboratory in China. DSWC has more than 50 sets of advanced instruments and equipment such as laser raindrop spectrometer, isotopic mass spectrometer, X-band rain radar, UAV-borne miniature hyperspectral imager, terrain micro-deformation monitoring system, low-altitude remote sensing monitoring system for regional soil erosion characteristic factor, soil erosion nuclide tracing system and so on. Moreover, DSWC is running the Chishui River Water Ecosystem Field Scientific Observation and Research Station, and carries out a series of observation and research on water ecological environment such as soil erosion, non-point source pollution, meteorology and hydrology, and water ecology in the river basin, and provides scientific and technological support for the protection of the Yangtze River and the green development of the Yangtze River Economic Belt. Since 2014, DSWC is the main responsible unit of Research Center on Mountain Torrent & Geological Disaster Prevention of the Ministry of Water Resources. The main research and development directions of the center include mountain torrent geological disaster mechanism and risk assessment technology, monitoring and early warning technology, engineering governance technology, emergency rescue technology, non-engineering measures and decision support technology, etc., and will promote and apply the research and development results.

Scientific Research and Service: DSWC has undertaken nearly 200 national, provincial and ministerial scientific research projects, and made a series of progresses in the principle of soil erosion, the relationship between soil erosion and sediment in rivers and lakes, the regulation and control of soil erosion and non-point source pollution, the prevention and control of mountain torrent geological disasters, urban soil and water conservation, the prevention and control of engineering soil erosion, regional ecological environment restoration, and the research of water and soil conservation informatization. Also, DSWC undertakes to complete the supervision of the "fine patches" of the national key water and soil conservation projects in the Yangtze River Basin, the technical support work of water and soil conservation supervision of production and construction projects in the Yangtze

Basin, Anhui Province, Hubei Province, Wuhan City, Hongshan District, Jianghan District and other regions and provinces and cities (districts) for many years, and to complete the technical demonstration project of the Ministry of Water Resources "Demonstration of Water and Soil Conservation Supervision Technology of Major Water Conservancy Projects Based on UAV Images", which has been recognized by water administrative departments at all levels. Moreover, DSWC has undertaken nearly 200 mountain torrent disaster investigation and evaluation, monitoring and early warning, and risk assessment projects in more than 60 counties (cities and districts) in Guizhou, Hunan, Yunnan, Shaanxi, Hubei, Xinjiang and Gansu provinces (autonomous regions).

International Cooperation: DSWC is highly engaged in international cooperation. Since 2003, more than 100 employees have been sent abroad to carry out academic exchanges, and DSWC hosts (undertakes and co-organizes) a number of international (overseas) training and exchange seminars. DSWC has undertaken more than 20 projects, including "the Intergovernmental Cooperation Project of the National Key R&D Program", "the Seventh Framework Project of the European Union", "the Project Funded by the Sino-German Science Center", "the Special Fund for Asian Cooperation", "the Special Fund for Lancang-Mekong Cooperation", "the Training Course Project for Developing Countries of the Ministry of Science and Technology", and "the Project of Introducing Foreign Technology and Management Talents". Nearly 100 experts and scholars from more than 20 countries (regions) and international organizations, including the United States, Germany, the United Kingdom, Switzerland, Japan, Laos, Myanmar, and the Global Water Partners, were invited for academic exchanges. Nearly 200 people have been trained in the prevention and control of mountain torrent geological disasters in Lancang-Mekong countries.

3 Main progresses of soil and water conservation research in DSWC of CRSRI

3.1 Mobile high-precision slope erosion rapid assessment system

In view of the problems of long data acquisition cycle, low data accuracy, and high human and material investment in traditional soil erosion monitoring methods both at field and laboratory, the first mobile high-precision slope soil erosion rapid assessment system in China was developed, which mainly includes the following two aspects: (1) developing a mobile soil erosion laboratory that taking slope soil erosion process experimental data collection

as the starting point, building a modern soil erosion process experimental collection system, successfully simulating rainfall devices, to investigate erosion processes at variable slope gradients (Fig. 2a). The integration of high-pressure water supply device and soil physical and chemical property analyzing device realizes the integration of mobile and simulation experiments, and its novel experimental process and rapid acquisition of soil erosion parameters have attracted widespread attention from the society; (2) Using HDS3000's high-precision information acquisition technology to study spatiotemporal slope erosion morphology (Fig. 2b). By collecting data from real-time, dynamic and high-precision scanning of the eroded slope, a three-dimensional model and the plane and cylinder section model of the eroded slope are generated. By analyzing the slope digital spatial information, combined with CYCLONE 3D data processing and modeling software, analysis of the spatial distribution of soil erosion is feasible. It has the advantages of high precision, fast speed, high efficiency, also can clearly reproduce erosion and sedimentation information of different parts of the eroded plot with wide application range, which provides a powerful technical means for high-precision soil erosion research.

Figure 2. (a) The mobile soil erosion research laboratory; (b) the use of HDS3000 three-dimensional laser scanning system to study soil erosion process at field scale.

3.2 Theory of dual hydrological processes of cultivated land on the slope of middle and upper reaches of the Yangtze River and regulation of erosion and sediment production

In view of the serious soil erosion and frequent seasonal drought, insufficient supporting infrastructure, low level of agricultural machinery and labor productivity in the middle and upper reaches of the Yangtze River, through nearly 20 years of research, the prev-

alence of interflow is demonstrated for the first time. By analyzing the slope erosion characteristics under the influence of the dual hydrological processes of surface runoff and interflow, the role of the interflow playing in slope erosion and sediment production is clarified, the formation and movement characteristics of the interflow are revealed, and the dynamic model of the soil interflow is established. Taking the effects of interflow on soil erosion into considerations, we first proposed a new concept of water and soil conservation in the middle and upper reaches of the Yangtze River. The principle is "drainage and soil preservation", which is different with traditional concept of "soil and water conservation". We further summarized a 24-character strategy for soil erosion control, and have made a breakthrough in the discipline of regional soil and water conservation. The new technology that can not only intercept and drain surface runoff, but also drain and guide the soil interflow, and the layout and optimization technology of the field road network of slope cultivated land integrated with road and ditch are developed, which fills the gap of the design and optimization of the road network in the slope cultivated land (Fig. 3a). The paradigm of soil erosion control with cascade regulation of slope cultivated land runoff and field roads as the framework was constructed, which enriched the regional soil and water conservation technology system (Fig. 3b).

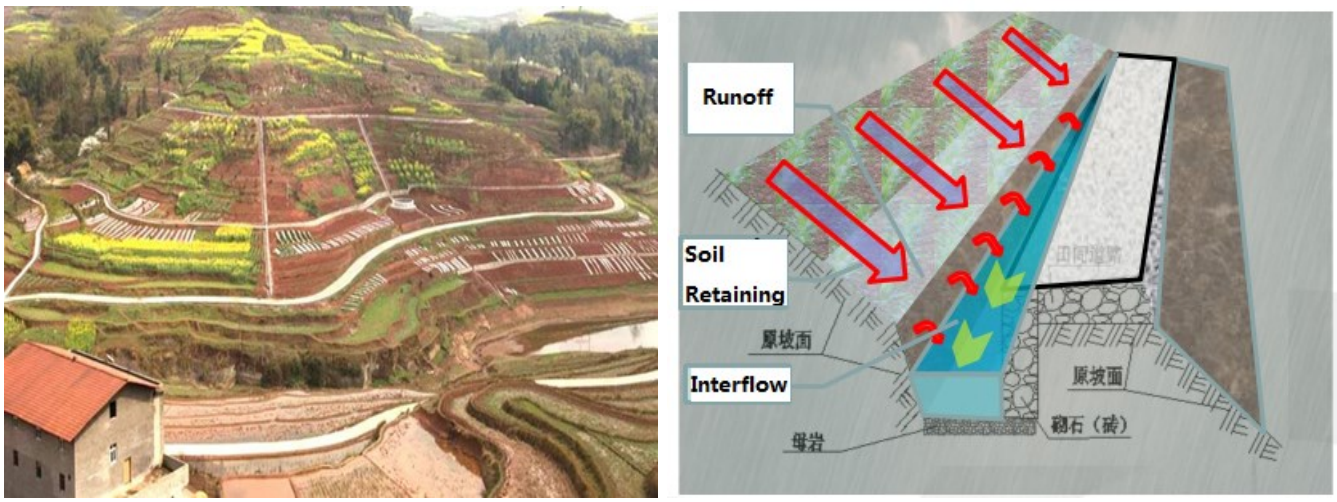


Figure 3. (a) The layout and optimization technology of the field road network of slope cultivated land integrated with road and ditch; (b) The framework of soil erosion control with cascade regulation of slope cultivated land runoff and field roads.

3.3 Key technologies for ecological restoration and comprehensive monitoring of large-scale slag heaps based on in-situ identification

The in-situ identification technology of slag dump based on UAV, ground penetrating radar and high-density electrical method was developed, and a complete ecological restoration technology system of large-scale slag heaps was integrated, and the key technology of comprehensive monitoring of large-scale slag heap was constructed, which greatly enriched the theoretical system of effective monitoring and ecological restoration of soil erosion of engineering slag heaps. The in-situ identification technology of slag heaps combined with UAV, ground penetrating radar and high-density electric method can easily, quickly and accurately measure the shape, slag amount, material composition and seepage field distribution of the slag heap, and accurately formulate the optimization scheme of the waste slag heap to ensure the safety and stability of the slag heaps. Research and development of "slope foot reinforcement, internal enhancement, surface erosion reduction, vegetation optimization", as one of the engineering waste slag soil erosion prevention and ecological restoration technology systems, effectively ensure the safety and stability of the slag yard, reduce soil erosion hazards, landslides, debris flows and other geological disasters, and improve the ecological environment of the project construction area. The large-scale intelligent network management platform of "in-situ identification + waste slag allocation information platform + UAV dynamic supervision + video real-time transmission" was built, which reduces the generation of engineering waste from the source, realizes the whole-process supervision and monitoring of engineering waste slag, and improves the resource utilization of waste slag.

3.4 Research and application of intelligent information technology for soil and water conservation under the background of big data

A series of key technologies such as diversified collection of soil and water conservation data, massive data system processing, intelligent information extraction, storage retrieval and release application have been developed, and a complete information technology system for soil and water conservation under the background of big data has been formed. It has outstanding innovations in the following four aspects: the integration of diversified high-precision telemetry technology for soil and water conservation, the development of a software platform for processing massive data systems for soil and water conservation, intelligent identification and quasi-real-time monitoring of disturbed land surface based on deep learning, and the establishment of a plat

form for the application and release of soil and water conservation information results that can provide customized services, which greatly improves the efficiency of data collection and processing, information extraction and application.

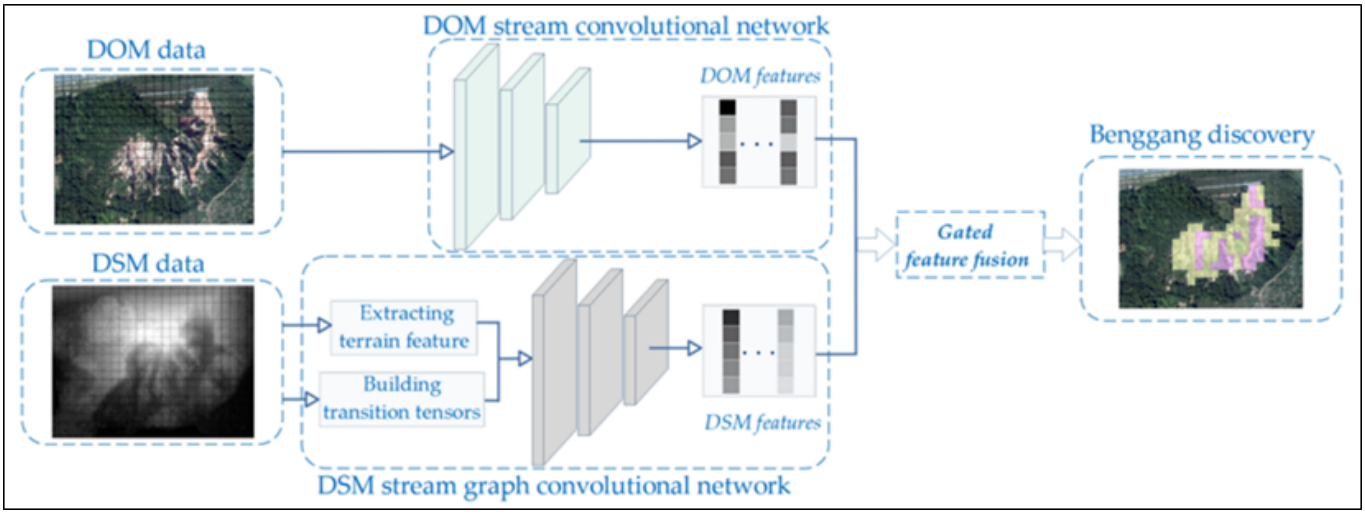


Figure 4 The framework of using machine learning algorithms to identify Benggang.

3.5 Assessment of rocky desertification hazard and soil health in the middle and upper reaches of the Yangtze River

Based on the scientific and technological innovation project of the Ministry of Water Resources "Research on the Rocky Desertification Process of Slope Based on In-situ Test of Soil Erosion Resistance Characteristics", the evaluation index system of the risk of rocky desertification in the middle and upper reaches of the Yangtze River was constructed for the first time. Combined with GIS technology and BP neural network model to the risk degree of rocky desertification in the middle and upper reaches of the Yangtze River, the middle and upper reaches of the Yangtze River were divided into non-rocky desertification hazard, rocky desertification mild hazard, rocky desertification moderate hazard, and rocky desertification intensity danger area, and the preliminary discussion of the prevention and control principle was proposed, which provided an important reference for the future national soil erosion and rocky desertification prevention and control in the middle and upper reaches of the Yangtze River.

Based on the national key R&D program project "R&D and demonstration of land rocky desertification process and comprehensive treatment technology in karst trough valley area" special topic "Health Assessment of Soil System Restoration in Karst Groove Valley", the ecological evolution sequence of cultivated land returned to farmland in karst rocky des-

ertification area in the past 50 years from 1970~2020 was established by the method of "space instead of time", and the evolution of vegetation succession law and soil physical, chemical and biological properties were clarified, and it was found that the soil-vegetation system of cultivated land in the karst rocky desertification area in the early stage of farmland return (0~ 15 years) was developed in the direction of xerophilization, 15~20 years there was a turning point of soil health improvement, and then with the rapid improvement of soil health with vegetation succession. A healthy soil benchmark state was established according to the evolution law, the minimum set of soil health evaluation index in karst rocky desertification area was selected, and a soil system health evaluation system for 0~50 years of restoration of karst rocky desertification area was constructed, which provided a scientific basis for future restoration of soil health assessment and karst rocky desertification area governance.

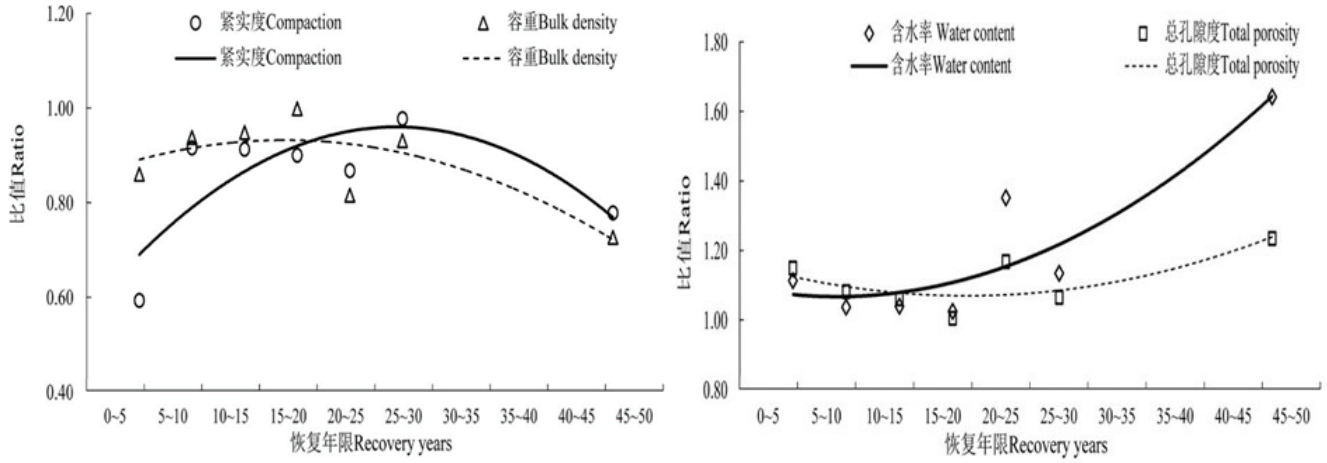


Figure 5. The relationship between the normalized soil physical properties and restoration years.

3.6 Soil erosion measurement of engineering excavated slopes and accumulated spoil heaps

Engineering excavated slopes and accumulated spoil heaps are one of the main sources of anthropogenic soil erosion, and it is of great practical significance to measure the amount of soil erosion of excavated slopes and accumulated spoil heaps accurately and quickly. Based on the special scientific research projects of the Ministry of Water Resources "Research on Soil Erosion Measurement Technology of Engineering Excavated Slopes and Accumulated Spoil Heaps" and "Research on Common Technology of Soil Erosion Measurement of Production and Construction Projects", a new classification system of excavated slopes and accumulated spoil heaps was pro-

posed on the basis of the investigation of excavated slopes and accumulation volume of different engineering types in four major areas of China. Through field natural rainfall observation, indoor artificial simulated rainfall experiment, water scouring experiment, three-dimensional laser scanning and other methods and technical means, the process and mechanism of soil erosion of various engineering excavated slopes and accumulated spoil heaps were studied, and the universal soil erosion prediction model and model parameters of engineering excavated slopes and accumulated spoil heaps were constructed for the first time, and was included in the water conservancy technical standard "Guidelines for Soil Erosion Measurement of Production and Construction Projects" (SL773-2018), directly serving the prevention and supervision of soil erosion in production and construction projects.

Figure 6. Field rainfall simulation experiments on spoil heaps resultant from construction activities.

3.7 Risk assessment and classification prevention and control of collapse erosion

In the project of "Research on Key Technologies of Collapse Erosion Risk Assessment and

Control", DSWC introduced risk assessment theory for the first time, defined the connotation of collapse erosion risk, proposed a systematic collapse erosion risk assessment procedure, established a risk evaluation index system, and developed the risk assessment method. Bivariate and multivariate statistical analysis methods were used to comprehensively assess the erosion of collapse in seven southern provinces according to the risk assessment procedures and risk evaluation index systems, and a new classification system and distribution map of southern collapse erosion prevention and control based on risk levels were proposed. The technologies of collapse erosion control are systematically summarized, combining the poverty alleviation and prosperity of local residents with the prevention and control of collapse erosion, and the key technologies and comprehensive prevention and control models of different risk types are proposed.

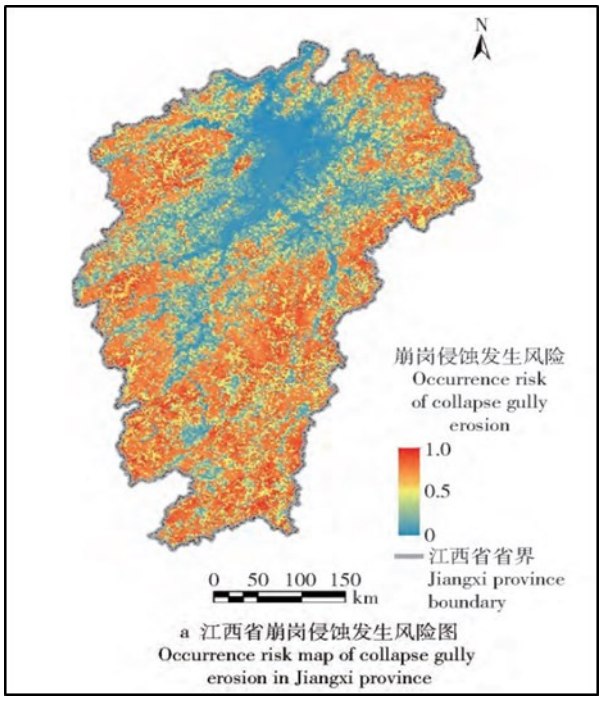


Figure 7. The occurrence risk map of collapse gully erosion in Jiangxi province.

3.8 Comprehensive control of soil erosion in the red soil area of the southern China

The southern hilly red soil area is one of the most serious areas of soil erosion in China, and due to the unique and complex natural conditions, the characteristics of soil erosion are very different from other areas. On one hand, based on the basic scientific research fund of the central public welfare scientific research institute "Research on the Mechanism and Forecast Model of Slope Erosion and Sediment Production in the Southern Hilly Red Soil Area", different grass species, different planting methods, different agronomic farming methods, different land use structures and different soil and water conservation measures were designed in the field of typical red soil areas, and the characteristics of slope erosion were studied through natural rainfall observation, and economical and practical soil and water conservation measures and combinations in the southern hilly red soil area were proposed, and the mechanism of slope erosion

and sediment production was discussed. A prediction model of erosion-induced sediment yield in the southern hilly red soil area was established, which provided scientific basis and technical support for the prevention and control of soil erosion and the rational utilization of red soil water and soil resources in the southern hilly red soil area. On the other hand, the experience and characteristics of soil erosion control in the southern hilly red soil area were comprehensively summarized, and the water conservancy technical standard "Technical Standard for Comprehensive Control of Soil Erosion in the Southern Hilly Red Soil Area" (SL 657-2014) was published and DSWC was the editor-in-chief. This standard is of great significance to promote the process of soil erosion prevention and control in the hilly red soil area of southern China and the construction of regional ecological civilization.

3.9 Green spraying technology in engineering soil erosion control

Soil erosion prevention in engineering construction site is a new research field in the field of soil and water conservation. Relying on the projects of agricultural scientific and technological achievements transformation fund project "New Variety of Centipede Grass (Hanyu No. 1) Technology Transformation and Demonstration", the application of greening spraying technology in vegetation restoration and slope protection engineering was studied through indoor simulation experiments and specific engineering practice applications. The technology mainly uses the unique spraying combination machinery to add water, mixed dry materials such as soil, organic matter, water-retaining materials, plant seeds, adhesive materials, long-term fertilizers, etc. and then directly sprayed those materials onto the rock surface under certain maintenance conditions. Such that, shrubs and herbaceous seeds can germinate and grow in the soil void, creating more favorable conditions for the growth and natural succession of plants, so as to achieve the purpose of rapid restoration of vegetation, improvement of landscape and protection of the environment. At the same time, we actively study new materials and measures. On the basis of collecting wild centipede grass in different regions, field planting experiments were carried out and its biological characteristics and ecological characteristics were comprehensively evaluated. The results show that the centipede grass "Hanyu No.1" has the advantages of long green period, fast pacing speed, strong stress resistance, developed root system and simple maintenance. This centipe-

de grass has been widely used in reservoirs, embankments and other water conservancy projects.

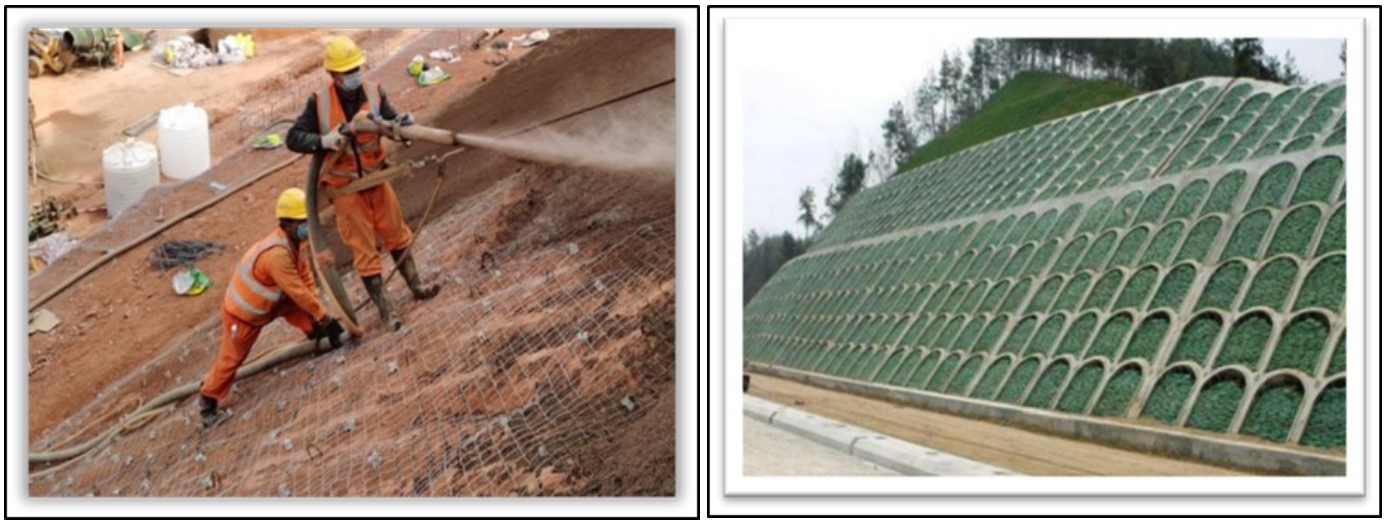


Figure 8. Example of application of greening spraying technology in vegetation restoration and slope protection.

3.10 Top-level design of national mountain torrent disaster prevention and control

At the beginning of the 2002 National Plan for the Prevention and Control of Mountain Torrents, DSWC was involved in the work and was responsible for planning the first research topic and was one of the main units preparing the plan. In the following ten years, DSWC participated in the completion of the "Guidance for the Design of the Mountain Torrent Disaster Monitoring and Early Warning System", the "Special Plan for the Prevention and Control of Mountain Torrent Geological Disasters", the "Implementation Plan of the National Mountain Torrent Disaster Prevention and Control Project (2013-2015)" and the "Implementation Plan of the National Mountain Torrent Disaster Prevention and Control Project (2017-2020)".

In the national mountain torrent disaster prevention and control plan, the zoning theory is applied to the field of mountain torrent prevention and control for the first time, and the national mountain torrent disaster is divided into three first-class areas, namely the eastern monsoon region, the Mengxin arid area, the Qinghai-Tibet alpine area, and 12 secondary areas, and we put forward prevention and control countermeasures and planning measures for each area. It provides a foundation for the comprehensive management of mountain torrent disasters, achieves the purpose of disaster prevention and mitigation, and enriches the theory of mountain torrent disaster prevention and control. In 2007, the "National Research on Key Technologies for

Mountain Torrent Disaster Prevention and Control" team won the second prize of Dayu Water Conservancy Science and Technology Progress Award.

The zoning of national mountain torrent disaster risk is a combination of natural disaster risk theory and national mountain torrent disaster prevention and control zoning. By selecting the indicators of natural environmental conditions and economic and social indicators that reflect the risk and vulnerability of mountain torrent disasters, the risk and vulnerability analysis of mountain torrent disasters are carried out, the national mountain torrent disaster risk assessment is completed, and the national mountain torrent disaster risk zoning units are divided within the framework of the primary and secondary zoning areas of the national mountain torrent disaster prevention and control, in order to provide technical support for addressing the national scale of mountain torrent disaster risk and formulating corresponding macro planning for mountain torrent disaster prevention and control.

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