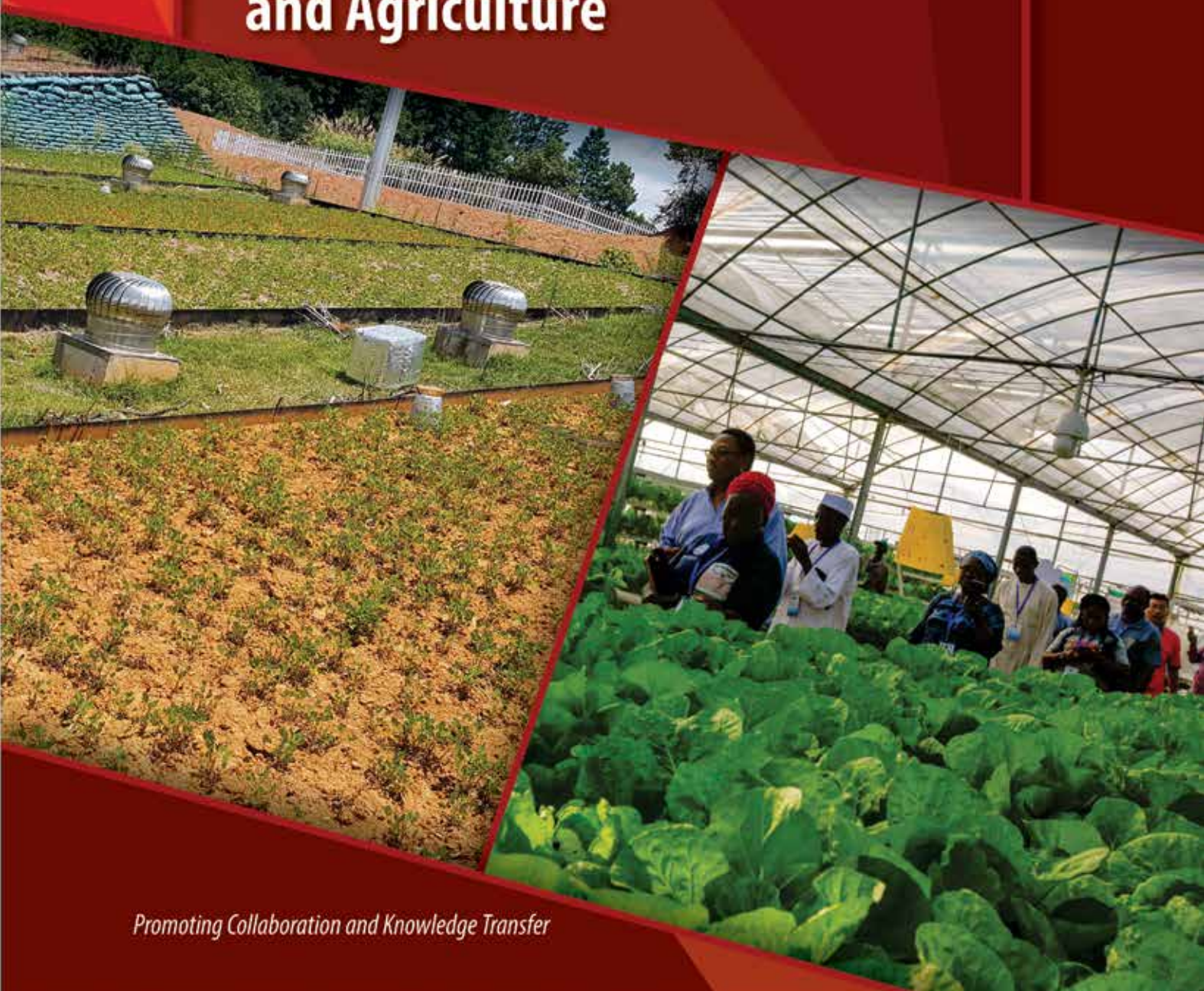
South - South Knowledge Exchange (SSKE) for Watershed Management, Infrastructure and Agriculture



Promoting Collaboration and Knowledge Transfer

Foreword

Drawing on the experiences of foreign countries and building on available realities, The South-South Knowledge Exchange (SSKE) platform with the help of the World Bank group brings to fore wealth of knowledge from two giant developing economies to the doorstep of the two flagship projects in Nigeria; to work together and explore a pathway to sustainable development tapping on the available innovative ideas, cutting-edge paradigm, approaches and successful experience for these countries In key areas of watershed management and climate smart agriculture, road infrastructure design; gully formation reduction and the application of satellite technologies. This will further enhance the output of these federal Agencies.

Key successes so far include:

I believe bringing together some of the rich presentations of knowledge shared in this publications is another way of knowledge sharing and a veritable opportunity for others to have insights to like issues in other economies. For instance, China Institute of Water Resources and Hydropower Research (IWHR) is a national research institution under the Ministry of Water Resources of China, and is engaged in almost all the disciplines related to water resources and hydropower research. With over 50 years of development, IWHR has grown into an indispensable think tank of the Chinese government for decision making and a backbone technical consultant in water related areas. It is at the same time the host of multiple international organizations or their Chinese branches, including WASER, WASWAC, ICOLD, ICID, IAHR, GWP, IHA, ARRN, the great experience of this great institution is therefore worth reading.

To study and address severe water resources and environmental problems facing the country, the rich example of the Chinese in the Hai Basin, with joint efforts of relevant departments in China and the assistance of the World Bank, is worth noting. The Hai Basin Integrated Water and Environment Management Project (hereinafter referred to as the GEF Hai Basin Project) was implemented with a grant from the Global Environment Facility (GEF). The Project aims to promote and enhance integrated management of basin water and environment, mitigate water pollution in the basin, and improve water environment quality in the Bohai Sea.

The paradigm of integrated water and environment management prompted and outcomes achieved by the GEF Hai Basin Project meet the requirements of China's regime for implementing the strictest water management. In particular, integrated management, knowledge management (KM), Evaportranspiration (ET) management, total pollution load control, "three-element-based" (water withdrawal, consumption and release) water rights management, remote sensing ET technology, new approaches towards integrated management and planning, incentives for wastewater treatment and management in small cities and towns highlighted by the Project now provides a strong support to China's river basin authorities in establishing the "three regimes" for total water consumption control, water use efficiency control and pollutant load control in water function zones and in defining "three red lines" for these three aspects while taking into consideration the three elements of water availability, water use efficiency and water quality. All these have significant impacts on China's future efforts relating to water and environmental protection and sustainable water utilization, including practical water-related collaboration among multiple departments, improvements in water-related regulatory systems and institutions, enhancement in knowledge-based management of river basin water and environment, establishment and betterment of grassroots level water management and service systems, and enhancement in the participation awareness of the general public, among others.

Currently, the SSKE has entered into crucial cooperation that will open up modernization, great progress Watershed Management, Infrastructure and Agriculture, building an all-round well-off society.

Systematic project and a long-lasting challenging mission. With the assistance of this album of pictures in reviewing and summarizing the implementation process, the concepts and methodologies prompted, the outcomes achieved and the innovations and impacts of GEF Hai Basin Project, we hope that innovative methods, advanced concepts and technical methodologies could be provided for establishing a resource-saving and environment-friendly society in China and an excellent model could be provided for implementing the strictest water resources management regime and achieving "three-red-line" control. Meanwhile, it will provide a useful reference for conducting integrated water and environment management in arid and semi-arid regions both in the world and elsewhere in China.

Water conservation and stringent management for both total water consumption and development intensity are fundamental to address water shortage and reverse the trend of environment deterioration in Nigeria, therfore its good to note that some of these presentations define the objectives of water governance and control. Being a major consumer of water, agricultural irrigation plays an important role for efficient use of water resources thus, comprehensive measures must be taken to save water in irrigation by implementing whole process conservation, including monitoring and control in water abstraction, utilization, consumption and drainage and we should continue our efforts for the increase of water use efficiency and comprehensive benefits.

In this publication insights has been provided into other like World Bank Projects: Conception; implementation and winding modes for others to learn from. From 2001-2005, water conservation project I financed by the World Bank loan has been successfully implemented in Beijing, Hebei, Shandong and Liaoning under the organization of Ministry of Water Resources (MWR). In order to systematically learn new concepts and experiences of water conservation in other countries, China Water Conservation Project II (WCPII) financed by the World Bank loan had been carried out in Hebei, Ningxia and Shanxi from 2012 to 2016. The guiding principles of the project focus on control of water consumption and resource saving. Systematic approaches for water conservation in irrigation has been taken with comprehensive measures of structural and non-structural as well as agricultural practices. Meanwhile, emphasis has been placed on monitoring, evaluation, feedback, control and correction during the entire process of project implementation.

The policy of soil and water conservation in watershed management which has been presented in two parts, to include: The policy of soil and water conservation evaluation and monitoring of production and construction projects as well as Impacts of Soil and Water Conservation on Stream Flow and Sediment Flux Changes in China will be of great value to our catchment management approach in NEWMAP, and perhaps will need further cooperation in the following areas as occasioned from the study visit:

1) Data sharing and the use of Sensors in monitoring livestocks could be explored with minimum costs since the services could come free under the SSKE.

2) Developing water-saving irrigation systems is a smart move towards Smart Agriculture and protection of the watershed; technical expertise of the CAAS under the SSKE should be explored towards this gain.

3) NEWMAP to explore further cooperation with Soil & Water Conservation and Catchment management institute Dean county, Jiujiang city, Jiangxi province on water conservation, Watershed/Catchment Management solutions.

Truly the two projects involved in the SSKE has achieved great milestones from the time of their effectiveness; FADAMA transmuted to FADAMA II, FADAMA III and now Additional Financing(AF). Same with NEWMAP since 2013 and now. NEWMAP Project has improved physical environment and living conditions in the project states. Through its activities the project has had wider impact on the affected communities by providing economic livelihoods to the poor and affected people, addressing flooding and poor management of solid wastes. Today the Project Development Objective (PDO) indicator reveals that the project

is doing very well. The two Projects must keep up the good works!!

I am pleased to reiterate to you our collective obligation to support the government of Nigeria towards ensuring food security and sustainable management of the environment in support of national growth and development. In this regard, Iam optimistic that the Federal ministry of Agriculture and its agencies, especially FADAMA will further promote increase in beneficiary incomes, enhance food security, reduce rural poverty and contribute to the achievement of key Millennium Development Goals MDG) likewise the ministry of Environment will continue to focus on three key issues, namely; Ogoni Clean-up; Desertification; and Erosion Control. Firstly, we need to clean up the oil pollution in Ogoni land so that the people can resume their farming and fishing activities again. Secondly, with respect to Desertification which is of grave concern to this Administration, we would put a lot of pressure on the National Agency for Great Green Wall to deliver results. And thirdly, we will be relying on NEWMAP to take care of Gully Erosion and restore degraded lands nationwide, especially with added support of the wealth of experiences derivable from the SSKE

Looking ahead into year 2018, we will build on our existing efforts and hold the hands of our international partners more firmly on the joint adventure to the future. The ship of SSKE can never sail without the support and driving of all its international friends, and the National coordinating officers to whom we would like to extend our heartfelt appreciation. Hope we could do more to better the future, with Food security greater water and soil conservation and sustainable environment in our great country Nigeria and in the whole world!

Ibrahim Usman Jibril
Honourable Minister (of state) Federal Ministry of Environment, Nigeria

Contents

4: Climate Smart Soil & Water Plant Cultivation; Technologies and Methodologies

5: Improving Degraded Land and Sub-catchment Watershed Management

Background

South-South Learning and Knowledge-sharing for watershed management, infrastructure and agriculture

World Bank task teams secured financing of USD 433,000 over 2.5 years from the China-World Bank Group Trust Fund, to enhance South-South knowledge-sharing between China, India, and Nigeria. The Trust Fund is supporting important knowledge-sharing and learning between China, India and Nigeria, focusing on infrastructure development associated with major land and gully restoration, agricultural development and climate-smart agriculture on restored lands, and applications of remote sensing, GIS, and Decision Support Systems (DSS) for more effective project management and Monitoring and Evaluation (M&E). These activities would primarily benefit the outcomes of the Nigerian Erosion and Watershed Management Project (NEWMAP), the new Neeranchal National Watershed Project in India and the FADAMA project in Nigeria.

Activities of the South-South knowledge sharing will inform critical activities including: a) gully restoration design, construction, physical works, and vegetative interventions; b) landscape restoration and agricultural and pastoral improvement in arid, rainfed areas; application of remote sensing, GIS, and DSS for more effective project management and M&E; and c) urban and peri-urban road design and management of surface water runoff (the main cause of gullies in southern Nigeria). The activities would also support the transfer of applied research and development results in key areas, for example on the economics of gully restoration and adopting innovative and climate friendly practices, drawing from Chinese and Indian experiences.

Areas of focus

Watershed management, is the application of land resource management systems, considered to be one of the most appropriate approaches to ensuring the preservation, conservation and sustainability of all land-based resources, and improving the living conditions of people in the uplands and lowlands. Integrated watershed management with participation of all the relevant key actors has become widely accepted as the approach best suited for sustainable management of renewable and non-renewable natural resources in upland areas, most importantly for ensuring environmental sustainability.

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Repeated Matter Para-2

Cooperation to gain from relevant experiences

There is a wealth of accumulated knowledge and experience in China (and India) on addressing similar issues. These include, for example, World Bank-supported Loess Plateau Projects, the Ningxia Desertification Control and Ecological Protection Project, and a range of road improvement projects in China. In India, the Karnataka Watershed Development Project (2012-2018) in India is demonstrating cutting-edge technology to help plan, prioritize, monitor and assess interventions in nine predominantly rain-fed districts. Both China and India have a long history of successful Bank-supported sustainable land management programs, designed to improve water management, agricultural productivity, rural livelihoods, and build resiliency to climate change. At the same time, the NEWMAP project is piloting presented innovative examples to gully restoration and watershed management, drawing on India and Chinese

experiences and comparatively sharing knowledge with Nigerian experts and other stakeholders on good approaches that can provide useful technical inputs.

Objectives

- To escalate the research of agricultural management practices within the landscape, as opposed to focusing on traditional small plot experiments in a controlled environment.
- Environmental and economic analysis – integrating both the environmental and economic analysis for optimum effectiveness.
- Community of practice – brings together a wide range of experts from various government, academic, watershed and producer groups.
- Leveraged resources – secure significant additional project resources by providing a platform for partnerships, thus creating an increased capacity for high-quality applied research and appreciable successes.

SSKE: NEWMAP and FADAMA

The World Bank all over the world is known as a veritable institution and vanguard for sustainable development. It is also referred to, by critical stakeholders, as a great Agent for "positive change" with the promotion of gender equality and improved standards of living, towards good quality of life. This is why in all continents and almost all countries of the world the World Bank group is involved in one development project or the other.

In Nigeria, the Nigeria Erosion and Watershed Management Project(NEWMAP) and the FADAMA III Project are two World Bank sponsored projects with positive impacts on the socio-economic status and livelihoods of the people concerned. NEWMAP is primarily a concept to address erosion, land degradation, while the FADAMA initiative seeks to support the government in the area of promoting new innovations in agriculture and cash crop farming to address food shortage.

The two projects performed creditably and impacted enormously to earn the acronym of "Flag ship Projects" as fondly referred to by stakeholders.

The performance of these projects, considered as very satisfactory by the Bank , became very instrumental to the Task Teams further explorations into a South-South Knowledge Exchange (SSKE) program between China, India and Nigeria on technical partnership and infrastructure development associated with major land and gully restoration, agricultural development and climate-smart agriculture on restored lands, and applications of remote sensing, GIS, and Decision Support Systems (DSS) for more effective project management and M&E.

At the onset the objective was to escalate the research of agricultural management practices within the landscape, as opposed to focusing on traditional small plot experiments in a controlled environment. And to enhance technology support, training, exchange learning and information dissemination between China, India and Nigeria in the following thematic areas:

a. Watershed Management and Gully Restoration;

b. Climate-smart Agriculture;

c. Managing Surface Run-off in Urban areas;

d. Application of Geo-spatial Technologies for Erosion Control, Watershed Planning and Management.

Project Components	Expected Outputs
1. Knowledge sharing of field experiences • South-South exposure visits between China, India and Nigeria on specific topics	• Improved knowledge base of field experiences to support piloting and scaling-up of new approaches for gully restoration and prevention, climate-smart agriculture, and landscape-scale management for agriculture and livestock development land use objectives
2. Technology transfer of R&D results • Collaborative transfer of R&D results on specific topics between Chinese, Indian and Nigerian tertiary institutions/bureaus/research centers • Knowledge fairs/workshops	• Improved scientific knowledge on specific topics such as: the economics of gully restoration; comparative assessments of drones, satellites imagery and high resolution ortho-photos for M&E; costs and benefits of improved surface water management in urban areas, etc.
3. Dissemination • Printing and distribution of reports • Production of training videos • Web site design and management • Dissemination workshops	• Tools and materials developed for dissemination to local stakeholders and wider global audience (simple "how to" brochures; field guides; short videos; etc.) translated into appropriate languages
4. Management and coordination	• Effective Trust Fund management and operation

Introduction

From June 18 to 29, 2018, under the joint efforts of the World Bank, and China Irrigation and Drainage Development Center (CIDDC), relevant personnel of Government of Nigeria(Federal and States Ministries of Environment), NEWMAP and FADAMA projects Specialists were on a special study tour on Climate-Smart Agriculture; and Integrated Watershed Management training in Beijing and Nanchang – China. The study tour under the auspices of SSKE focused on watershed management and ravine restoration, climate-smart agriculture, urban surface runoff management, and geospatial technology applications.

Participants went through technical training in agricultural water-saving, water resources integrated management, water and soil conservation, small watershed comprehensive management, and smart agriculture. Participants also visited the relevant scientific research institutions and organizations, and participated in many field events related to the contents of the Study exercises: for example, visits to agriculture facilities and green houses, soil and water conservation and ecological restoration institutions. The training and inspection topics were targeted, abundant in content and high-level diversified.

With consideration to the needs of the two projects (NEWMAP and FADAMA) the trainings and knowledge sessions were tailored towards the desired objectives: To ensure that participants understand:

i. Smart agriculture and its various concepts

ii. Water and integrated environmental management

iii. Modern agricultural practices in adaptation to climate change

iv. Advanced technologies in watershed management and ravine restoration, climate-smart agriculture, urban surface runoff management, and geospatial technology applications

v. Policies and regulations in related fields and;

vi. Shared successful experiences of implementation of World Bank Projects in China.

The methodology employed was very structured; from special introductory meetings to lectures and presentations and finally, practical field exercises. Training and field activities in China were divided into two phases – in Beijing and Nanchang respectively.

This book therefore includes the various presentations made during the trainings and all the field visit exercises for the duration of the entire exposure visit.

At the end of the study visit the participants agreed that the package met the actual needs of the two projects. Through this study tour, the technical awareness of the participants has been greatly improved, understanding of the relevant concepts deepened, enterprises in the related fields opened up, mutual communication and understanding of the personnel strengthened, and most importantly, the mechanism of cooperation promoted.

Major Take-aways: The main findings and experiences of the SSKE study tour are reported below.

i. Scientific planning according to local conditions

In carrying out the construction of water-saving projects, China adheres to the principle of "according to local conditions, highlighting key points, comprehensively saving water and seeking practical results", through in-depth investigations and research, summing up experiences and lessons. The government of China scientifically determines water-saving irrigation projects which are suitable for local characteristics: Water-saving irrigation projects such as canal-lining, pipe irrigation, sprinkler irrigation and drip irrigation, timely, suitable and according to different natural geographical conditions, economic development levels, planting structure and other factors.

ii. **Provision of laws and regulations with strict enforcement system in place**

The Chinese government has the following laws in place to control and regulate the utilization of water. These laws are strictly enforced and managed under what is called three Red Lines: <Water Law>, <Law on Flood Control>, <Law on Prevention and Control of Water Pollution> and <Law on Water and Soil Conservation> etc.

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iii. **Extensive public awareness programs to improve consciousness of the people on all government policies**

Through various forms of government organizations, public opinion guidance and educational interventions, the publicity and the awareness about the need for water and soil conservation of the whole society and the whole nation is aroused, and an atmosphere of understanding that everyone is responsible for soil and water conservation is formed.

iv. **Mass production of food is enhanced through "Intelligent Agriculture." The integration of agriculture and modern information technology**

In the background of the new era of "Internet", China is actively advocating the development of Internet-thinking in agriculture, therefore strengthening the wide application of Internet technology in agricultural development, so as to realize the upgradation and transformation of traditional agriculture and promote the development of intelligent agriculture. Participants thus agreed that technology is the key and "smart agriculture", provides a boost for agricultural production

v. **Strict water resources management**

By drawing on the experience of foreign countries and building on China's realities, the GEF Hai Basin Project set a platform for water resources and environment protection authorities to work together and explore a pathway of Chinese characteristics for sustainable development of river-basin water resources and the environment, This has provided innovative ideas, cutting-edge paradigms, approaches and successful experiences for the Government of China to build a water-sector development and water pollution control strategies to achieve the strictest water resources management in China. It has also provided useful reference for carrying out integrated water and environment management strategies in international waters and in regions with water shortages. This could be replicated in Nigeria.

vi. **Promoting the development of rural e-commerce, constructing the network of agricultural production and supply and marketing**

"Intelligent agriculture" is of great significance in eliminating the obstacles of agricultural and rural information services and the difficulties of market circulation; also in solving the balance of agricultural supply and demand, market balance and in improving the competitiveness of agricultural and rural economies. By accelerating the development of rural e-commerce, the Chinese government has deeply integrated agricultural information technology and improved the circulation efficiency of agricultural products. At the same time, through the road of standardization and branding, a distinctive brand of agricultural products will be created, and the farmers' income in the new era could be increased.

The two projects stand to benefit immensely from the possible cooperation between China and Nigeria, in the following areas:

vii. The use of sensors in monitoring livestock could be explored with minimum costs since the services could come free under the SSKE.

viii. Water-saving irrigation systems is a smart move towards Smart Agriculture and

protection of the watershed; technical expertise of the CAAS under the SSKE to be explored towards this gain.

ix. Nigeria also have great institutions like CAAS such as IITA etc., therefore it becomes imperative for the government to support such institutions by bringing up and implementing the strictest possible farmland protection and water resource management systems, just like China.

x. We should draw on the successful practices in China and allow compensation systems for farmland protection. At the same time, step up efforts to upgrade low and medium-yield farmland and increase the share of high-yield farmland.

Chapter 1

全球环境基金
海河流域水资源与水环境综合管理
Global Environment Facility
Hai Basin Integrated Water Resources and Environment Management

中国灌溉排水发展中心

China Irrigation and Drainage Development Center

2018年6月/June 2018

By drawing on the experience of foreign countries and building on China's realities, the GEF Hai Basin Project set a platform for water resources and environment protection authorities to work together and explore a pathway of Chinese characteristics for sustainable development of river-basin water resources and the environment. This has provided innovative ideas, cutting-edge paradigms, approaches and successful experience for the Government of China to build a water sector development and water pollution control strategies thereby achieving the strictest water resources management in China. It has also provided a useful reference for carrying out integrated water and environment management in international waters and in regions with water shortages.

Overview

As one of the water bodies in the world which has great ecological significance and is under severe threat, the Bohai Sea provides significant fishery to China, Japan, South Korea and North Korea, for which it bears global significance. The Hai Basin, one of the important basins converging into the Bohai Sea, faces sharp demand-supply conflicts of water resources, with the existence of a series of ecological and environment problems, such as groundwater over-exploitation, serious water pollution, wetland contraction and estuary siltation – all of which endangers sustainable socio-economic development in the basin.

♦ *Map of Hai Basin*

Implementation period: September 2004 to June 2011.

Project objectives: (1) Prompting Hai Basin integrated water and environmental planning and management; (2) Providing mechanism support for achieving effective basin-level and local level water resources and environmental planning and management; (3) Promoting water resources and water environment knowledge management and implementation capacity-building; (4) Reducing waste-water discharge from small cities and towns along the Bohai Sea.

Project Components: (1) Integrated Water and Environment Management; (2) Knowledge Management and Development; (3) Tianjin Municipality Coastal Area Wastewater Management; (4) Project Management, Training and Evaluation.

Implementation Strategy

Project Organization and Management

Capacity-Building

(1) Panel of International Consultants

(2) Panel of National Consultants

(3) Project Monitoring and Evaluation

(4) Supervision and Guidance of the WB Mission

(5) Domestic and overseas Study Tours and Training

♦ *Project Monitoring and Evaluation*

Innovations employed to achieve the mission

♦ 建立了水资源与水环境综合管理新模式

Established the new pattern of integrated water and environments management

♦ 实践了耗水控制（ET管理）的水资源管理新理念

Implemented the new paradigm of water consumption control (ET management)-based water resources management

应用了遥感监测ET新技术

Applied the new technology of remote-sensing ET monitoring

开发了知识管理（KM）系统新工具

Developed the new tool of knowledge management system

采取了水资源与水环境综合规划新方法

Adopted innovative approaches to planning integrated water and environment management

创新了小城镇污水处理与管理新机制和农业非点源污染综合防控新技术

Achieved the new mechanism of township sewage treatment and management, and the new technology of agricultural integrated non-point source pollution control

Impact/Outcome

促进了水利、环保部门在涉水事物上的务实合作

Facilitated pragmatic cooperation on water-related affairs between water resources and environment protection departments

促进了水资源水环境综合管理法规体系和制度建设的不断完善

Catalyzed improvements in the regulatory system and related institutions for integrated water and environment management

促进了水资源水环境综合管理科技水平的不断提高

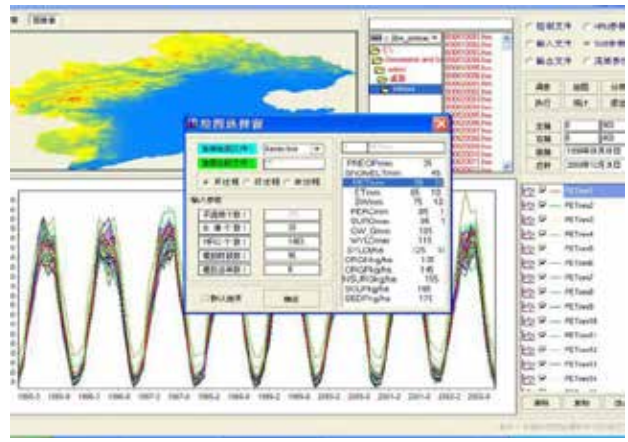
Promoted enhancement of integrated water and environment management capacity

促进了区域最严格水资源管理制度的有效实施

Contributed to effective implementation of the strictest water resources management regime in local areas

促进了基层水管理服务体系建设的不断完善

Accelerated improvements in grassroots level water management service systems



- ***Above:*** *Basin ET production and management system*
- ***Below:*** *Wastewater management for costal areas of Tianjin*

Chapter 2

Shared Experiences by the CIDDC in Water Conservation Projects

世行贷款节水灌溉二期项目

China Water Conservation Project II Financed by World Bank Loan

中国灌溉排水发展中心

China Irrigation and Drainage Development Center

2018年6月/ June, 2018

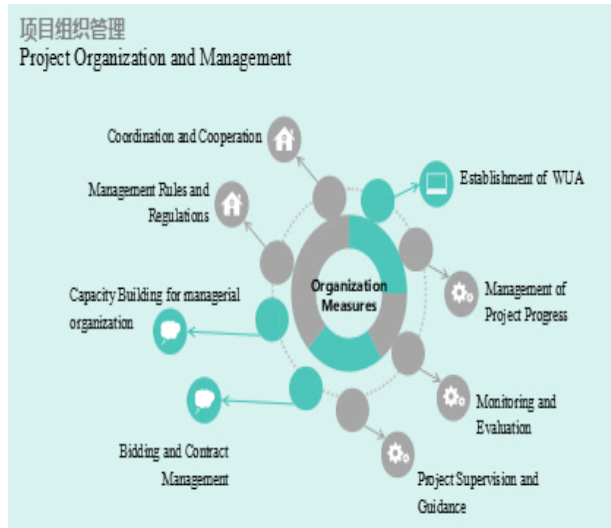
Overview

The Project areas are located in typical zones of water scarcity in China which often suffer from drought due to lack of precipitation. Imbalance of water demand and supply, insufficiency of irrigation water and low income of farmers are common features of these areas.

HEBEI	Shanxi	Ningxia
• 276 million RMB • Main task: to save groundwater • 10 counties • Developed 26,456 hectares of water-saving irrigated land	• 401 million RMB • Main task: to build key water works for water saving • 5 counties • Developed 10,636 hectare of water-saving irrigated land	• 408 million RMB • Main task: to save surface water • 8 counties • Developed 22,232 hectare of water-saving irrigated land

Project Creative Points	Project Achievements
• Created water-saving structural measures	• increased grain and crop yield
• Provided agricultural water-saving measures	• Increase in farmers' income
• Management measures	• improve ecological and environmental situation

Project organization and management



- *Rubber Dam in Shanxi Province*

- *Branch Canal in Hebei Province*

Chapter 3

Technology and Methodology of Catchment Water Resources Management in China

A paper presented by Yangwen JIA
Department of Water Resources,

China Institute of Water Resources and Hydropower Research (IWHR)

In this report, the status and existing main problems of water resources in China is first introduced, then the 7 key technologies of catchment water resources management are explained, and finally the 7 challenging issues at present and their solutions are discussed.

Paper outline

- Introduction
- Key Technology of Catchment Water Resources Management
- Challenging Issues and Solutions
- Summary

1. Introduction:

Basic Information of Water Resources in China

Characteristics: Low value per capita, uneven temporal-spatial distributions, unfavorable combination with social-economy.

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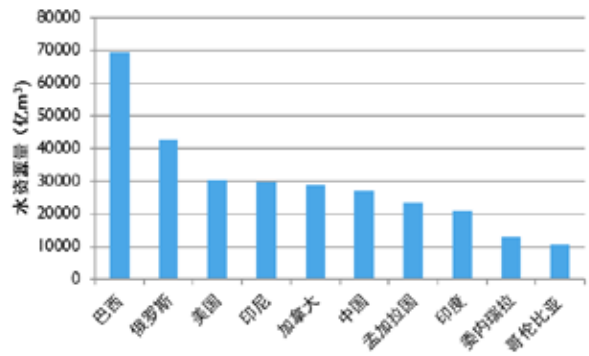
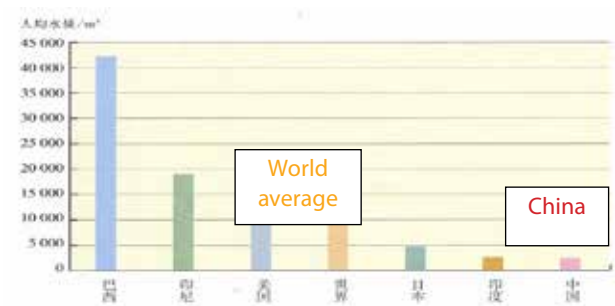
Precipitation: Annual-average is 649 mm. 47%, 62%.

Water resources: Annual-average is 2840 billion m^3.



- *Water resources per capita is 2100 m3, less than 1/3 of the world average.*



- *Comparison of total water resources with other countries. Comparison of water resources per capita between the world and China*

Water Supply

Increased from 103.1 billion m^3 in the 1950s to 610.3 billion m^3 in 2015 (6 times, annual averaged increase rate is 1.03%).

Water Use

After 1997, the increase rate became lower.

1.2 Current Main Water Problems

Under the impacts of human activities and climate change, China is currently facing the following four main water problems:

- Flood and inundation: 自然水循环过程演变
- Water shortage: 自然水循环–社会水循环演变失衡

- Water pollution：伴生的水化学过程演变失衡
- Hydro-ecology degradation生态过程演变失衡

Flood and inundation: China is one of the countries facing the most frequent floods and inundation: the affected share of national land is 10%, people is 0.5 billion, farmland is 0.5 billion mu, and over 100 large or medium scale cities.

mu
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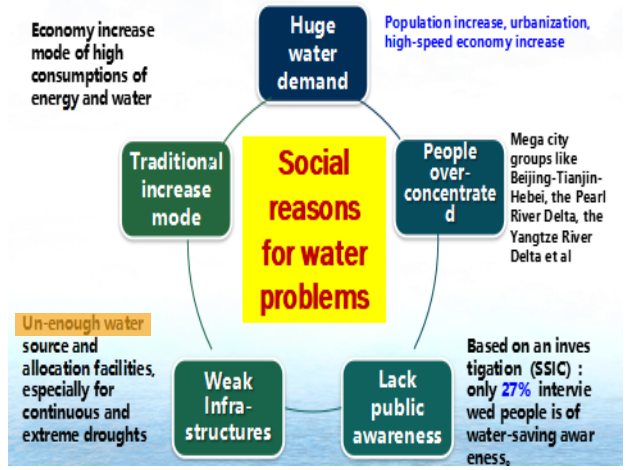
Water shortage: In a normal year, the total water shortage is 50 billion m^3, especially in cities of the Haihe river basin, the Yellow river basin, the Liaohe river basin, the North-West inland region and the eastern coastal areas.

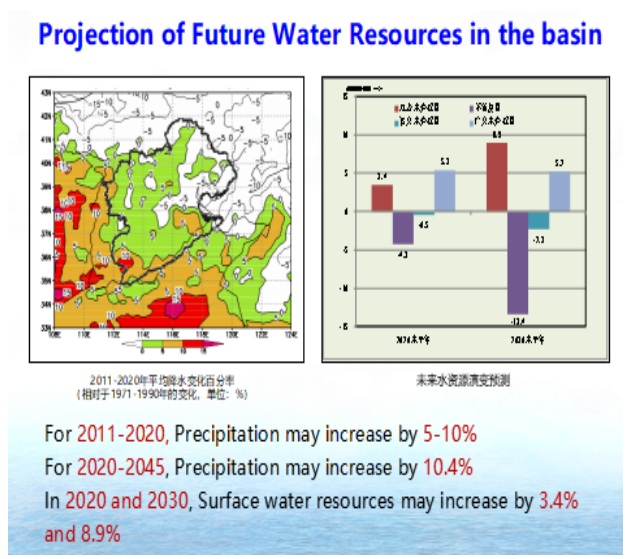
Water Pollution: While the point pollutants are partially controlled, the non-point sources are not. The satisfactory rate for water quality targets of water function zones is 51.8% in China in 2014.

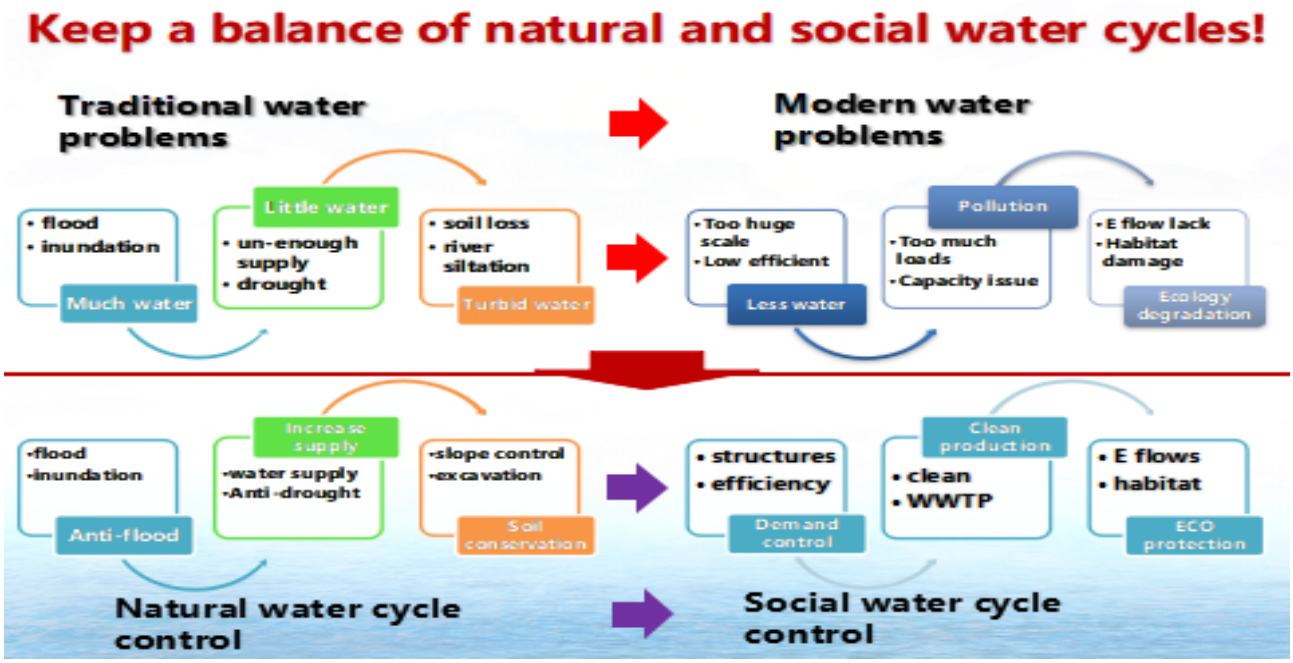
Hydro-ecology degradation: The freshwater ecosystem presents the trend of "partial improvement, the overall degradation". In the northern plains, the ground-water is still in a status of over-exploitation.

1.3 Key Technology of Water Resources Management



Un-enough should be changed to Inadequate





Key Technology of Catchment Water Resources Management:

a. **Hydrological Simulation:** This is the basis of water resources management. However, the hydrological cycle has been changed from the natural mode in the past to the dualistic mode at present under the impacts of human beings.

b. **Water Resources Assessment:** Water resources assessment is the determination of quantity, quality, as well as temporal and spatial distribution characteristics, utilization status and development tendency, of regional or basin-wide water resources by survey and analysis, to provide foundation for water resources planning and pre-conditions for water resources development, utilization, saving, conservation and development, and basis for social and economic development planning.

Case Study: Full scale water resources assessment in the Haihe River Basin.

Full scale: Surface water/soil water/groundwater assessment on basis of full scale rainfall;

?? hierarchy:

Availability → Generalized water resources

Controllability → Specialized water resources

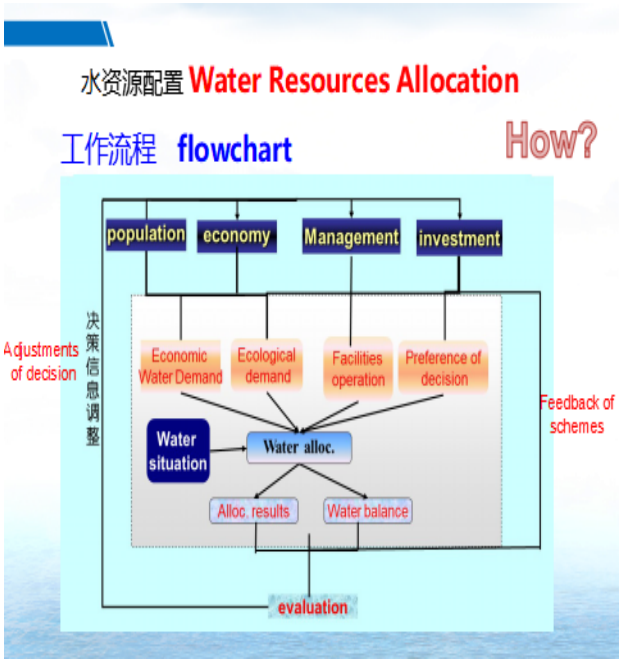
Renewability → Minimum ecological water demand, available water for social and economic development

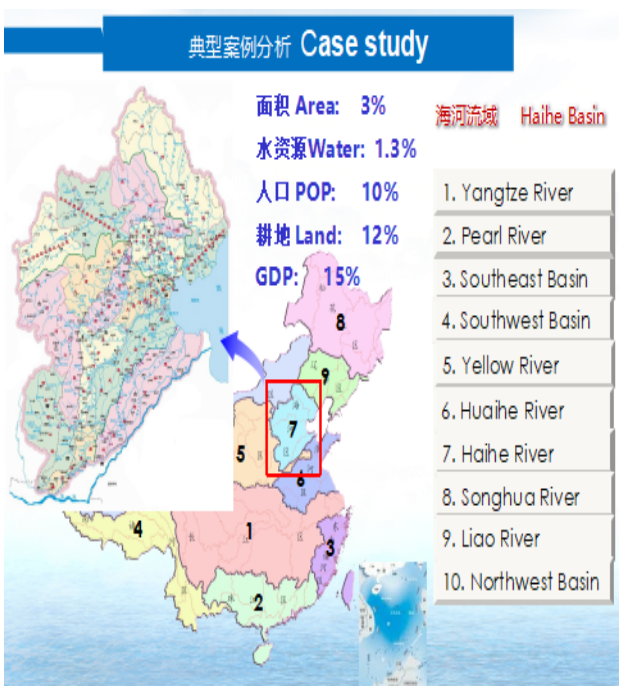
Dynamic assessment: Assess water resources under changing environment by varying parameters

Efficiency assessment: identify high efficiency and low efficiency according to the effectiveness of generalized water resources on economic and ecological construction

Joint assessment of water quantity and quality: Assess water quantity of different water quality class

c. **Water Resources Allocation:** According to pre-defined principles (Principles: Fare or Fair ???, efficient, sustainable) to curb the water demand, enlarge water supply and guarantee eco-environmental demand by physical and non-physical means, distribute different water sources to various sectors and meet demand-supply balance in a specific regions or basins.





Water Resources Regulation includes the followings:

1) 水库群调度多目标解析优化理论与方法 **Theory and Method for Multi-purpose Analysis and Optimization** (this recognizes the intrinsic nature of the "curse of dimensionality" in multi-purpose optimization from three levels, including decision variables, searching space and system simulation).

2) 水库群调度多维效益与风险协同调度

Multi-dimensional Benefit and Risk Synergistic Scheduling (the concept of a short-term multi-risk and benefit-synergistic optimization model by regarding the expected water level process as the variable. Propose the best risk and benefit-synergized reservoir water level control method and decision interval about electric output and water discharge).

3) 河渠水力学水质精细模拟 **Accurate simulation of water quality and hydraulics of canals** (this includes construction of water quality and hydraulics model, and a general numerical simulation model for water quality and hydraulics of canals).

4) 闸/泵/水电站群经济运行 **Economic operation of gate/pump/hydropower station group** (Multi-level nested optimization of 'group-station-unit' based on accurate simulation of hydrodynamics of channels).

5) 闸/泵/水电站群应急控制 **Emergency control of Gate/pump/hydropower station group water resources protection** (this includes: Pollution source reduction, processed blocking and end treatment).

源头减排 **Source reduction (Methods used)**	过程阻断 **Process blocking**	末端治理 **End treatment**
• Rain and sewage separation	• Decentralized sewage treatment plant	• Decentralized sewage treatment plant
• urine-faeces separation	• Soil osmosis purification technology	• River and lake ecosystem restoration technology
• Garbage disposal	• Buried unpowered sewage station	
• Wastewater reduction by water conservation in agriculture	• Buried silica sand honeycomb biofilter technology	
• Livestock and poultry breeding pollution treatment		
• industrial pollution control		

Water Resources Management Policy: this is the main water resource management system in China: the policy seeks to uphold the following regulations:

a. The strictest water resources management system

   This has **3 RED** lines and 4 Control Systems:

   - Red line of water development and utilization
   - Red line of water use efficiency
   - Red line of water function zones pollution load.

These Red lines leads to four Control Systems:

- Water use total quantity control system
- Water use efficiency control system
- Water function zones pollution load control system, and;
- Responsibility and assessment system

b. Water quantity allocation and water rights

c. Water withdrawal licensing and paid water use

d. The constitution of a water-saving society and national campaign on water conservation

e. River-chief and lake-chief systems: In 2016, the Chinese Government released the Guidance on the Full Implementation of the River Chief System and proposed to designate river-specific chief with defined responsibility for river management, which will be completed by the end of 2018. Issued the Guidance on Implementing the Lake Chief System in 2018.

The water resources management policy in China has the strictest water resources management system.

- ♦ Targets volume for total water use nationwide
- ♦ Control target for water usage per 10,000 Yuan of industrial added value
- ♦ Target rates for water function zones to meet the standards
- ♦ Control targets for effective utilization coefficients of irrigation water

Water Resources Information Technology (use of remote-sensing): The technology uses satellite remote-sensing to monitor rainfall, snow cover, soil moisture, evapotranspiration, surface and groundwater water levels and storages, irrigation water and water quality in river basins. It aims to solve the problem of water resources information acquisition in the regions without on-site and spatial distribution information acquisition.

Key Take-aways

The background of the Project and its importance reveals the Haihe River discharges into the Bohai Sea which adjoins the Yellow Sea. Both seas contain globally important ecological resources that provides significant fishery benefits to China, North and South Korea and Japan.

The Hai River is also a major source of irrigation and drinking water for tens of millions of people who live in its basin. However, the river and its tributaries are severely polluted (most above Class V, the worst category), and the basin's groundwater resources are in some cases polluted

and being rapidly depleted. Invariably addressing the river basin's twin problems of water pollution and depletion is critical to the health and well-being of its inhabitants and to the environmental sustainability of the Bohai and Yellow Seas and the livelihoods of the many people who depend on their natural resources.

The project's overall objective is to catalyse an integrated approach to water resource management and pollution control in the Hai River Basin in order to improve the Bohai Sea and Yellow Sea environments. Specifically, the Project will:

(i) improve integrated water and environment planning and management in the Hai Basin,

(ii) promote institutionally-coordinated and effective local, municipal/provincial, and basin-wide water and environment planning and management,

(iii) enhance local capacity in water and environment knowledge management and implementation, and

(iv) reduce waste water discharges from small cities along the rim of the Bohai Sea.

The project approach was also to demonstrate new technologies and management approaches and to apply the lessons learned throughout the Hai Basin and in other basins bordering the Bohai and Yellow Seas.

issues

- Water availability in Hai Basin is only 340m^3 per capita, placing the Basin among the most water-scarce areas in the world, on par with North African countries such as Tunisia and Algeria.
- Groundwater management is the Basin's most pressing issue;
- Surface and groundwater quality in the Hai basin, as in the rest of China, has been seriously degraded due to lack of effective pollution control combined with increasing population, industrial output, and intensification of agriculture and livestock production.
- The Haihe River Basin, with less than 250 m^3 water resources per capita, faces severe problems of water shortage, water pollution and ecological degradation due to intensive population, developed production, severe competition of sectoral water use, and water resources reduction in the last 30 years. During the 11th five-year plan, IWHR carried out full-scale water resources assessment research with the study case of the Haihe River Basin.

Approach and Methodologies Employed

a. Strategic studies

b. Integrated Management Planning and Strategic Action Plan

c. Use of new pattern of integrated water and environment management

d. Application of new paradigm of water consumption control (ET management) based water resources management

e. Application of new technology of remote-sensing ET monitoring

f. Application of developed new tools of knowledge management system

Solutions / Approach Employed by the Chinese Government

a. Community Mobilization •to popularize the concept of "real water savings," from both a water use efficiency and an overall resource perspective.

b. Development of mechanisms to ensure the financial sustainability of water resource management activities. Combination of "management fees" associated with water abstractions or discharges, special taxes on activities impacting water management.

c. Incentives: support and reward to those who use the water wisely while those who do not use wisely get punished

d. Promote the use of conjunctive water use, artificial groundwater recharge, and treated waste water irrigation.

Implementation of priority actions through sustainable financing, supervision, and monitoring of municipal, industrial, livestock, solid waste, and agricultural sources of pollution.

Impact Achieved

a. Facilitated pragmatic cooperation on water-related affairs between water resources and environment protection departments

b. Catalyzed improvements in the regulatory system and related institutions for integrated water and environment management

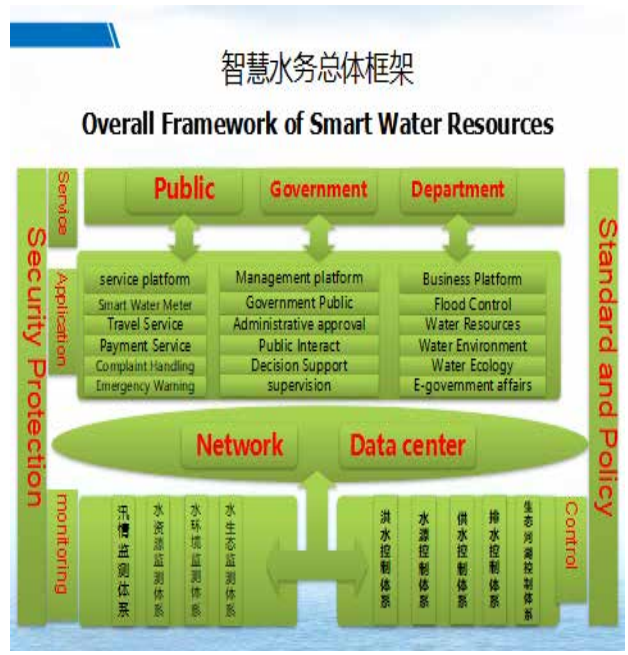
c. Promoted enhancement of integrated water and environment management capacity

d. Contributed to effective implementation of the strictest water resources management regime in local areas

e. Accelerated improvements in grassroots-level water management service systems

Challenges /Solutions

- Climate change and water resources adaptive management: water-saving; remote sensing monitoring and ET management; reusing of water; Beijing has reached 26%; treatment of groundwater overexploitation : 3.87 billion cubic meters of groundwater reduced in Hebei Province
- Water-Food-Energy nexus and comprehensive water saving:" 3-element driving" : Government restriction, economic regulation, public participation
- Groundwater over-exploitation: Measures include – Water diversion across basins and water system connection within basin.
- Agricultural structure adjustment, reducing high-water-consuming food crops.
- Wide application of efficient irrigation methods including pipe irrigation, sprinkler irrigation and drip irrigation.
- Utilization of unconventional water resources including brackish water, reclaimed water and sea water desalination.
- Changing the wheat-corn double cropping system to crop dominated planting system, and changing groundwater irrigation to rainwater-fed agriculture and wheat planting area reduced by 0.13 million ha, about 5% of total wheat area, as demonstrated in the case study of Hebei plain
- Urban water problem and Sponge Basin
- Smart water resource management: Smart water resource make full use of new information technology, deep mining and extensive use water information resources, through collection, transmission, storage, processing and service for water information, to enhance the efficiency and effectiveness of water management, achieve more comprehensive perception, more active service, more integrated resource, more scientific decision-making, more automatic control and more timely response.



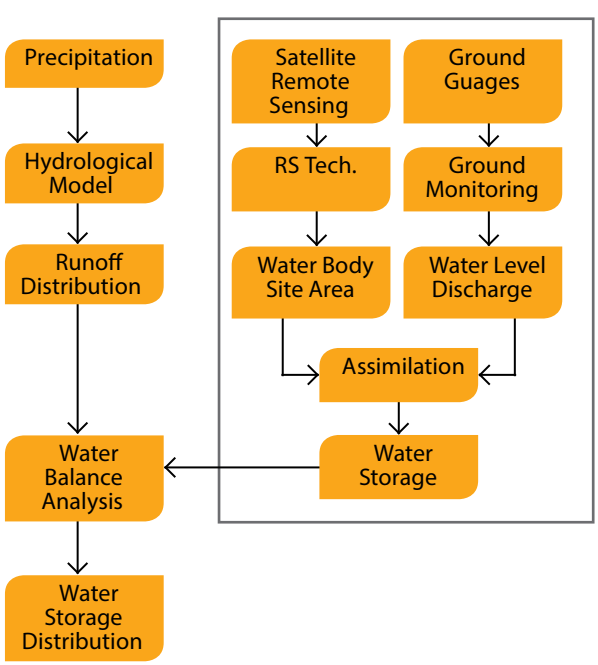
Management policy issues and reform: In January 2016, the general office of the State Council issued the opinions on promoting the comprehensive reform of agricultural water price. In July 2016, the regulations on farmland irrigation and drainage came into effect and put forward a clear regulation on the comprehensive reform of agricultural water price.

In 2016, the Chinese Government released the Guidance on the Full Implementation of the River Chief System.The organizational system has been established, and there are about 300000 river and lake chiefs in the whole country.

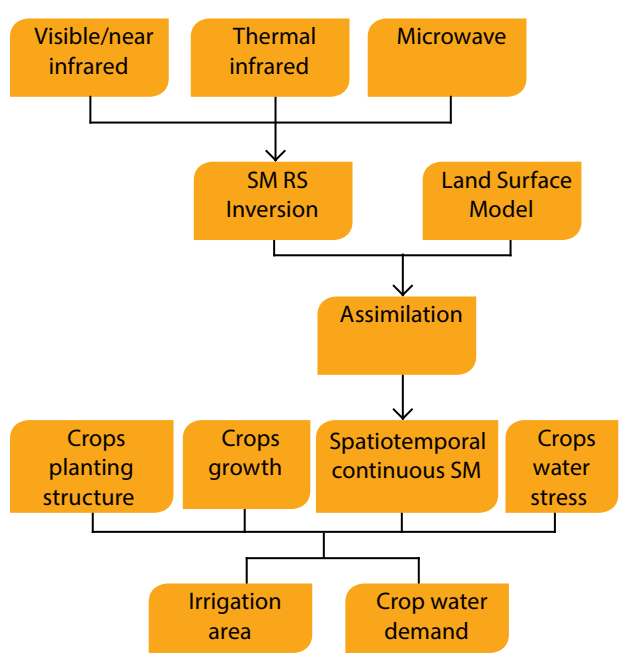
In 2015, the State Development and Reform Commission, the Ministry of Finance and the Ministry of Water Resources issued the suggestions on encouraging and guiding social capital to participate in the construction and operation of major water conservancy projects, which promoted the PPP mode. At present, PPP has been implemented in 5 major water conservancy projects.

Diagram below shows Water resources information via Remote Sensing

Surface Water Storage Monitoring



Irrigation Mornitoring



Chapter 4

IOT and Sensor Technology Application for Irrigation Automation

Department of Irrigation and Drainage
China Institute of Water Resources and Hydropower Research (IWHR)

Introduction:

Over the last three decades, China's agriculture sector has been transformed from the traditional to modern practice through the effective deployment of Information and Communication Technologies (ICTs). Information processing and dissemination have played a critical role in this transformation process.

The paper reviews and analyzes the development stages of China's agricultural information dissemination systems and different mechanisms for agricultural information service development and operations. Seven ICT-based information dissemination models are identified and discussed. Successful cases are presented. The findings provide useful direction for researchers and practitioners in developing future ICT-based information dissemination systems.

With the introduction of agricultural informatization, traditional agriculture has been reformed by advanced ICTs, eventually contributing to the significant improvements in agricultural productivity and sustainability. Agricultural informatization is a long-term stimulus for agricultural development and also an important indicator of agricultural modernization. The agricultural information dissemination service is one of the critical missions in implementing agricultural informatization. China is seeing a rapid growth in its economy, and farmers are achieving a dominating role in the economic development. To improve agricultural productivity, farmers have an ever increasing demand for information because accessing information and knowledge is essential for improving their productivity and income. In particular, since China became a member of World Trade Organization (WTO), its agricultural industry has been strongly affected by markets, resources, and environments. Facing the fierce competition both in the domestic and international markets, Chinese farmers and agri-business managers must be fully aware of the available emerging technologies as well as markets and sales information to maximize economic benefits. Therefore, over the last three decades, the Chinese government has invested substantial amounts of effort and money to develop and deploy ICT-based agricultural information dissemination systems nationwide.

Background:

Drip and sprinkler irrigation are remarkable water-saving technologies first developed decades ago. Today, that is commonly used all over the world in agriculture – nurseries, greenhouses, landscapes and a variety of industrial applications.

The demand for drip/sprinkler irrigation has grown rapidly and still keeps growing in China due to irrigation water scarcity.

In recent years, IOT and Sensor Technology has been introduced into the irrigation automation field to make large-scale irrigation systems run much more efficiently.

Full form reqd.

Irrigation Scheduling Methods

a) Weather-based: Schedule irrigation based on the amount of water lost by plant ET and the amount of effective rainfall and irrigation water entering into the plant root zone.

b) Soil moisture-based: Measure soil moisture levels in the plant root zone and apply water, if there is water shortage for plants

c) Plant-based: Directly detect plant responses to water stress and initialize irrigation as plants indicate suffering from water stress.

Radio Irrigation System Field Deployment

a) Based on Lora network, Radio systems run stably, but is not appropriate for crop canopy shields.

b) Low power design without solar panel, easy installation.

Irrigation Cloudy Platform

a) The platform can calculate ET based on environmental monitoring system.

b) The password-protected web site allows the grower to remotely start/stop the irrigation system, schedule an irrigation/fertigation event, water discharge pressure and temperature high/low tolerances, etc.

c) Additionally, when the system is running, the grower can monitor the pipe pressure, flow rate, solenoid on/off status, and run it for hours.

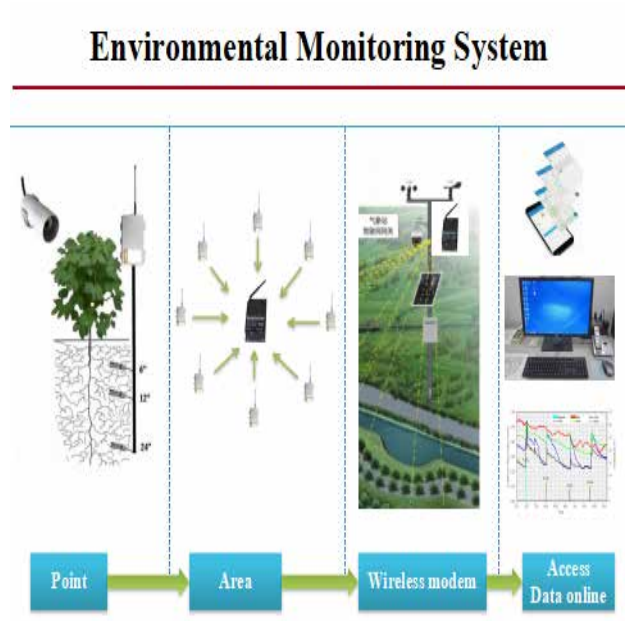
Highlights of this Presentation

- Irrigation automation is a critical component of Smart Agriculture.
- 55% of the farmlands in China are irrigated systems.
- But in China, 30% of the arable land is water-rich while 30% falls in water scarcity areas.
- Water distribution in China is similar to the situation in Nigeria.
- However, in China there is an enforcement of the regulation on ground water extraction and and incentive for water conservancy and management (compensation system).
- There is strict monitoring of use of water and waste water in China. This means polluters are punished. While those who manage water very well and conserve, get compensated.

How was compliance achieved ?

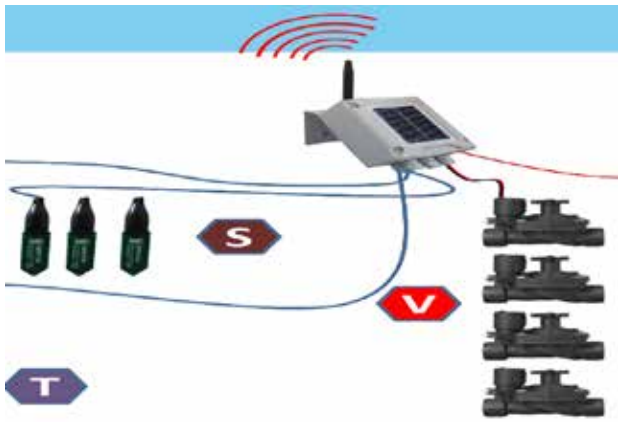
Community mobilization: Farmers are mobilized to manage the water system within the grassroots

- Property reform was instituted: spelling out the rights and ownership / status
- Compensation /or Incentivization system entrenched as part of reform
- Regular advice on seedlings / crops selection

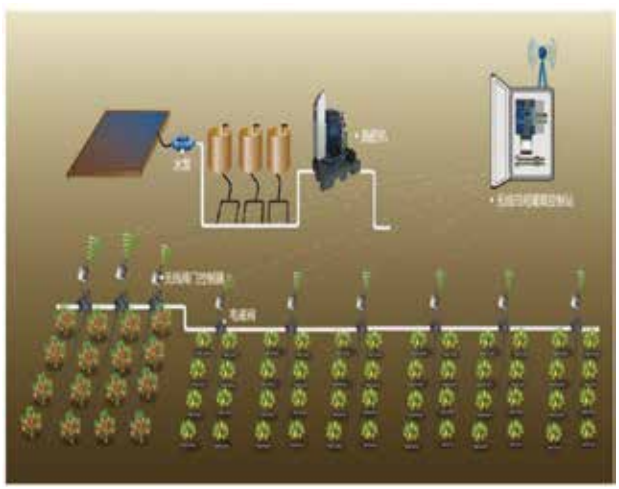


Crop water status and the amount of irrigation needed can be assessed by measuring soil moisture and plant physiological responses to water stress. ARS scientists in Stoneville, MS (Mississipi, USA) developed and deployed a Wireless Sensor Network (WSN) in fields for irrigation scheduling. The WSN consists of multiple soil moisture sensors, weather sensors, radio data loggers, a wireless modem and antenna mounts. The WSN has the capability to measure, collect, and wirelessly transmit soil moisture data and weather information from fields onto the internet to make the data accessible online in real time.

- *Above (left) Monitoring Sensor (installed in Agric greenhouse-right)*



- *Above(and below)IWHR Radio irrigation System ---for seasonal crop*



Summary

IOT and Sensor Technology is capable of automatically measuring and wirelessly transferring soil moisture and weather data online, enabling remote access of the data, which is then used for irrigation scheduling.

A series of successful Smart Irrigation systems based on internet control have proved that the both of the Radio and TW irrigation systems performed well.

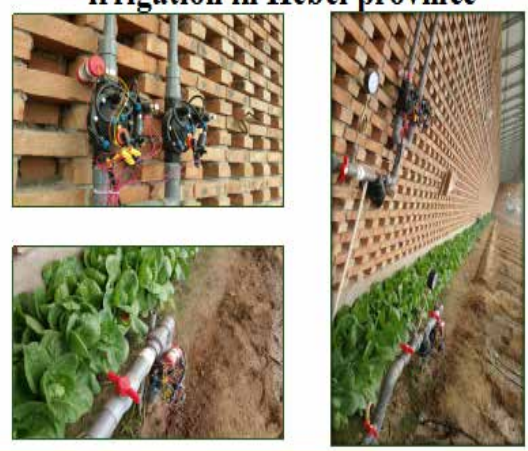
Overall, the grower are very pleased with the systems and see irrigation automation as a critical component of their operations.

As for the conventional irrigation events during the growing season, water and fertilizer usage were the biggest savings with automated systems, and at the same time, the growers were also able to save on labor.

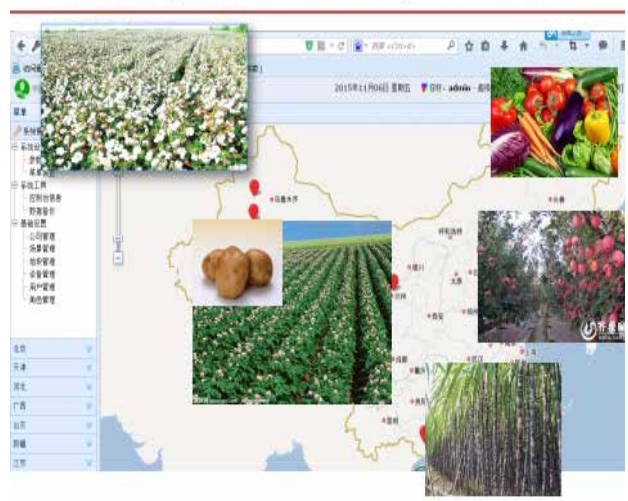
Collection of large amounts of data in irrigation field is not an easy job…

There is need for more and more irrigation controllers to exchange data and share data with China irrigation cloudy platform (www.cncid.net) .

Engineering case-Greenhouse vegetable irrigation in Hebei province



IOT irrigation automation system in China



Engineering case-cotton and red dates irrigation automation project in Xinjiang

Chapter 5

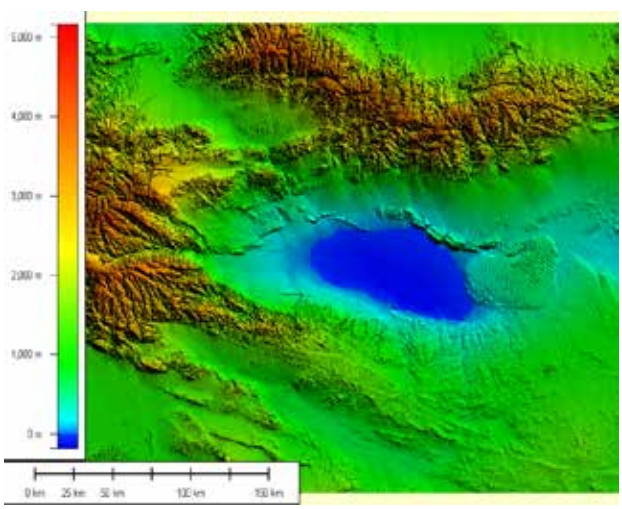
The Application of Remote Sensing Technology in Monitoring Ground Water Extraction in Xinjiang Turpan

Liping Jiang, World Bank

Bingfang Wu, RADI of CAS
June 21, 2018

Background/Introduction

Due to rapid expansion of irrigated agriculture by overuse of surface and groundwater resources, most Karez systems died due to the non-availability of running water; and Lake Aiding dried up with serious ecosystem degradation.



The objectives of the Xinjiang Turfan Water Conservation Project for China was to mitigate the risk of flooding, reduce groundwater overdraft, increase industrial and domestic water supply, and raise farmers' income from irrigated agriculture in the arid Turpan basin of Xinjiang Uyghur autonomous region. This zone also has similarities with the many states in the north east and north west Nigeria.

There are five components to the project, the first component being Evapotranspiration (ET)-based integrated water management in the Turpan Basin. With the aim of facilitating the prefecture government's decision to improve water allocation in the Turpan Basin and reduce groundwater overdraft, an innovative, integrated basin-wide water management program was developed and applied that closely linked targets for consumptive use of water at the basin-level with the respective targets for consumptive use of water at the county, township, and water users association (WUA) levels.

The second component is the increase of upstream storage capacity. This component includes: construction of the Alagou dam; the Meiyaogou dam; and the Ertanggou dam.

The third component is the real water savings in irrigated agriculture. Carrying out of irrigation management measures in the Turpan River Basin include the following

(i) engineering measures such as construction or rehabilitation of the main canals delivering water from the three new reservoirs to water-users downstream, a switch from furrow to drip irrigation, land levelling, canal-lining, and improved drainage;

(ii) agronomic measures such as cropping pattern changes, plant breeding, soil fertility and fertilization, soil salinity control, plastic-culture with mulching, tunnels and greenhouses, and tillage and weed control; and

(iii) irrigation management measures such as irrigation scheduling, volumetric water charges, increase of water charges, and the conjunctive use of surface and groundwater.

(iv) The fourth component was to finance the rehabilitation of 2.8 kilometers of the Karez water system, the local water system in Turpan City;

(v) The fifth was for technical assistance and support through providing training,

workshops, and study tours to build capacity in different areas such as integrated water resources management, ET management concept, management of irrigation measures with ET-based irrigation water rights etc. and project management.

Expansion of Irrigated Area with Help of Modern Irrigation Technologies:

- From 1970 – 2000 for economic development rapid expansion of irrigated land by 33% from around 60,000 ha to 80,000 ha has greatly increased pressure on the Basin's groundwater reserves;
- From 2000 to 2008 for irrigated agricultural water savings by application of modern irrigation technologies

The irrigated land in Turpan Prefecture expanded by 34% – from 80,000 hectares to 107,000 hectares with modern irrigation technologies. Unfortunately it was not accompanied by the expected water savings as more area was irrigated, resulting in an increase in total basin water use.

The groundwater levels continued to steadily decline by 1.5–2 meters per year, most Karez systems had fallen into disrepair, and by the year 2008, groundwater in the basin was being over-exploited by more than 230 million cubic meters per year.

- *Increase irrigation efficiency without controlling water consumption - Trees in Turpan were dying !*

- *Increase irrigation efficiency without controlling water consumption - Lake Aiding was drying up !*

ET reduction is the real water saving

Facing a long-term water crisis, the municipal district in California, USA, has been filling its reservoirs with thousands of black balls in an effort to reduce evaporation. This same method became a major practical solution employed in the Turpan Basin

Key Elements of the Project Model

- To conduct water balance analysis at the river basin level to find out the sustainable cap for water consumption;
- To reduce actual water consumption to meet the cap by growing higher value crops within smaller irrigated areas, which could be achieved through application of modern irrigation technologies;
- To increase water use efficiency or water productivity;
- To use remote sensing technology to monitor implementation of the cap; and,
- To use a tiered water pricing model to enforce water use at the farmer level.

Five Tasks implemented in Turpan Project

Task 1 - To find out ET Target at the river basin level

Task 2 - To allocate ET Target

Task 3 - To conduct irrigation planning and design with allocated ET Target to each of the WUAs

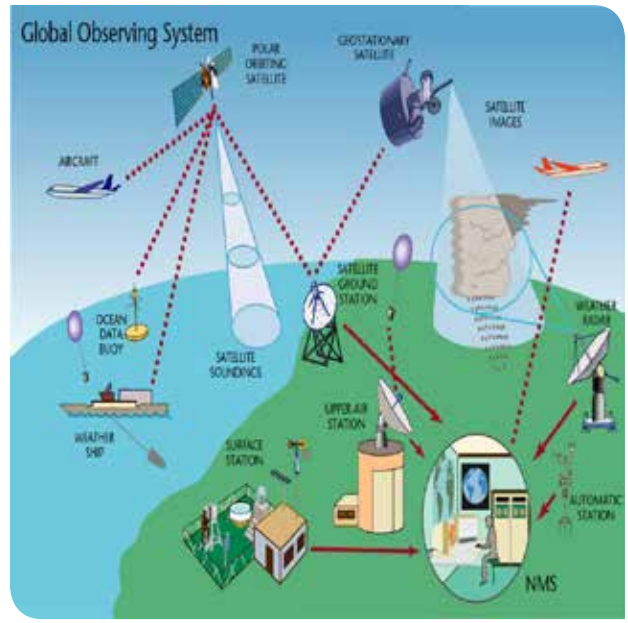
Task 4 - To monitor actual ET for each WUA or village with remote sensing technologies

Task 5 - To make improvements for increasing farmer income and lowering ET

The outcome achieved led to an increase in the number of people with improved flood protection from zero in 2009 to 260,000 in 2017, achieving the target.

Economic losses from flooding decreased from RMB 15.48 million in 2009 to zero in 2017 due to the construction of the three reservoirs. And how was this achieved?

- An ET management center was established and staffed, and ET management and knowledge management systems were set up, achieving the target.
- 43 Operational Water User Associations (WUAs) were created and/or strengthened, achieving the target. All WUAs achieved their targets for reductions in ET.
- 21,021 members of WUAs were trained in the ET-based Irrigation water rights system, surpassing the target of 2,650 members.
- 323 government officials were trained in the ET management concept, achieving the target.



- *The best tool used to monitor ET over an irrigated area is the remote sensing technology !*

- *Reservoirs with thousands of Black Balls In an Effort to reduce Evaporation.*

Chapter 6

China Food Safety Improvement Project

By: Sitaramachandra Machiraju,
Senior Agribusiness Specialist

This chapter analyzes the problems of food security in Asia, most especially China and enumerate how the World Bank has been working with the Chinese government to maximise food safety and availability with constant engagement in Food Safety Issues.

Introduction:

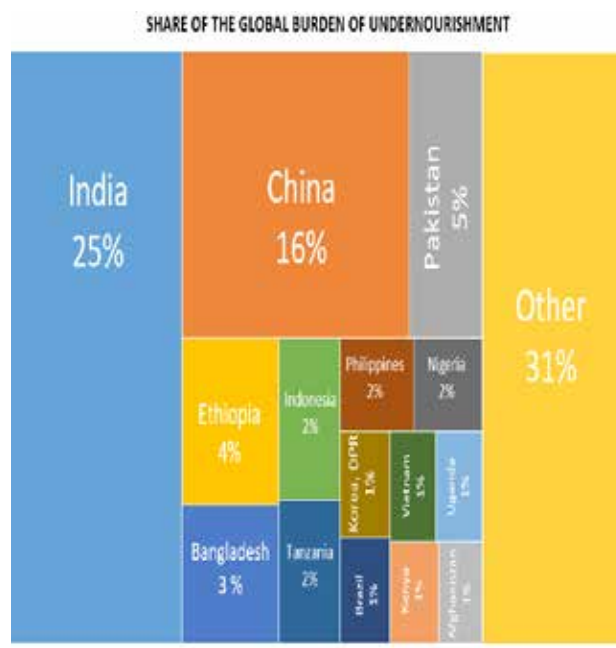
Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences, for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern. On the other hand food insecurity exists when people do not have adequate physical, social or economic access to food as defined above.

Measurement is based on food balance sheets and national income distribution and consumer expenditure data. Linking hunger and sub-nutrition with inadequate food intake allows the measurement of food insecurity in terms of the availability and apparent consumption of staple foods or energy intake.

Contents:

Hunger and hidden hunger still burden the Asia Region

A global comparison of country estimates of chronic food insecurity which reflects cross-sectional patterns and trends in food production, supplemented by what is recorded about trade in basic foodstuffs (effectively cereals) as incorporated into national food balance sheets. These comparisons showed broad differences in food security between the development categories of low, middle and upper income countries, as well as considerable variance within categories.



- *Changes in global agri-food systems*

Food security is a multi-dimensional phenomenon. National and international political action seems to require the need for setting of targets, thus necessitating the adoption of single, simplistic indicators for policy analysis.

Three important changes in global agri-food systems:

i. Rising incomes resulting in shifting dietary preferences and eating habits;

ii. Rapid urbanization is challenging food production and stretching supply chains;

iii. Climate change is affecting ability to produce food and will hit future yields;

Trends driving change in Food industry

i. Globalization of food supply chain

ii. Integration of supply chains

iii. Scandals and increasing scrutiny

iv. Rising regulatory standards

v. Shifts in global economic power

vi. Technological /scientific breakthroughs

vii. Changing food demands

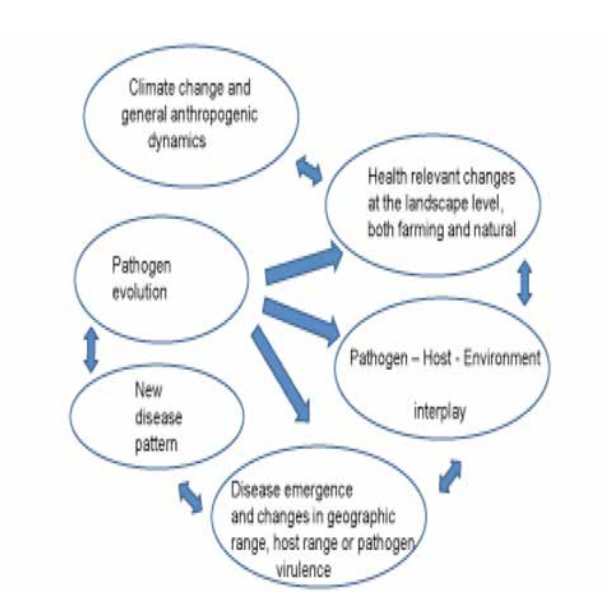
viii. Empowered consumers

ix. From compliance to competitive advantage

x. Population growth and resource scarcity

Climate Change effects

i. Climate change is already affecting Asia's ability to produce food and will hit future yields



The major reason for food shortages are the rejection of some of the imports or exports of some food stuffs due to multiple problems and different emphases in the following 3 different end markets.

S/N	Market	Reasons for some food rejections
1	European Union	Mycotoxins Veterinary Drug Residues Food and Feed Additives
2	United States	Labelling Hygienic Conditions Adulteration/Missing Documentation
3	Japan	Bacteria Contamination Veterinary Drug Residues Pesticide Residues

Shifting dietary patterns and its effects

i. Shifting dietary patterns leading to higher consumption of animal products, fruits and vegetables and processed foods, plus out-of-home eating is a growing trend. Statistics (FAO 2016) shows that;

Growth in per capita consumption of processed foods in Asia, 1999-2017:

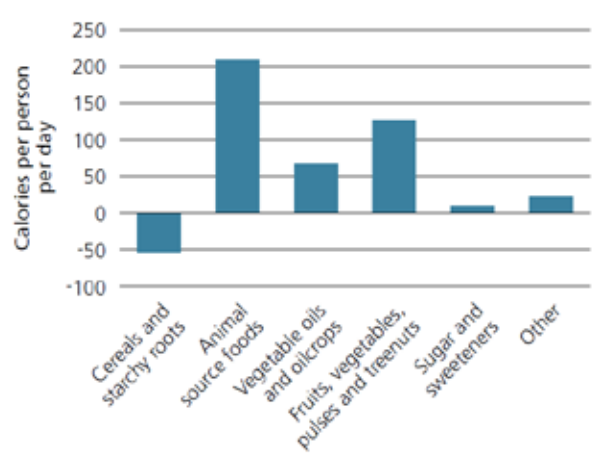
Large increases in China (9.4%), Vietnam (7.8%), Indonesia (5.5%), India (5.5%), Thailand (4.4%) and Pakistan (4.2%)

Slight decreases in Japan (-0.5%) and Philippines (-0.1%)

ii. Dietary patterns are shifting to higher consumption of animal products, fruits and vegetables and processed foods, plus out of home eating is of growing importance

?? Repeat of (i)

- Table below shows change in contribution of various food groups to diets in Asia, 1990-2011



?? Repeat Text of (i)

Growth in per capita consumption of processed foods in Asia, 1999-2017:

Large increases in China (9.4%), Vietnam (7.8%), Indonesia (5.5%), India (5.5%), Thailand (4.4%) and Pakistan (4.2%)

Slight decreases in Japan (-0.5%) and Philippines (-0.1%)

Engagement in Food Safety Issues in China

To rebuild public trust, the Chinese government consciously commenced the implementation of improving the food safety management at the national and targeted sub-national levels. This also reduced food safety risks in selected value chains:

Key Measures

- Increased public confidence in Chinese food
- Reduced food safety risks along value chains
- Improved enterprise compliance levels with food safety regulations

This project was of the value of USD 250 million. Implementation was carried out in the following areas:

Chengdu Municipality, Sichuan Province – Pork Value Chain

Yantai Municipality, Shandong Province – Seafood Value Chain

World Bank Support Modalities

Jilin Agriculture Product Quality and Safety Project (2010-2017)

Institutional Grant for CFDA Capacity-building (2014-2107)

China Food Safety Improvement Project (2018)

Entry Points

Strategic: study alternative regulatory control models from OECD countries; China capacity needs assessment; CFDA strategic plan

Diagnostic: food safety research; environmental hazard mapping; surveillance database development

Applying good regulatory practice: central and provincial regulatory capacities, procedures and training

Infrastructure investment: laboratories; cold chain infrastructure

Applying good food operator practice: GAP/GMP demonstrations; value chain initiatives

Risk communications: public awareness campaigns; consumer education.

How World Bank Group helps upgrade food safety regulations and infrastructure

a. Reform of food safety regulatory frameworks and support the implementation of those reforms at global, regional, national, and value chain specific levels;

b. Promote, at scale, the adoption of better management practices among farmers, food manufacturers, and other food operators;

c. One health approach: Support programs which jointly address the challenges of animal health, environmental health and food safety;

d. Upgrade the physical infrastructure needed to protect and assure safe food.

Strengthening Food Safety Regulation (in China)

Key Investments

1. Support to Legal and Regulatory Frameworks
2. Training of Food Safety Inspectors
3. Food communication to consumers

Food Safety Supervision Process Model

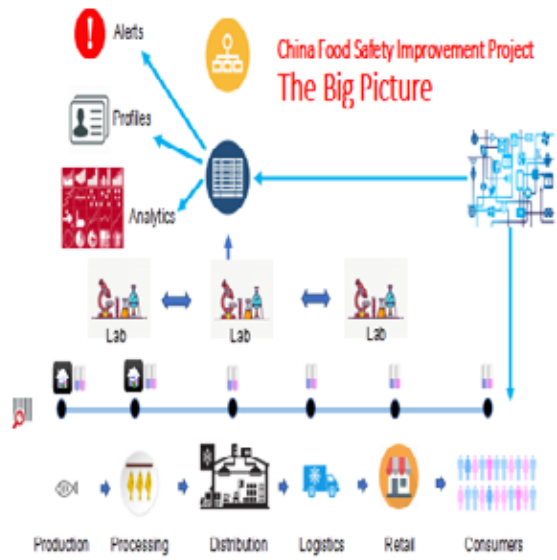
Key Investments

1 Big-data Analytics

2 Food Safety Investigation and Laboratory Services

3 Food Safety Traceability Systems

4 Food Communication to Consumers



Whole Value Chain Food Safety Control Model

Key Investments

- Matching grants
- Lines of credit and partial credit guarantees

Food safety investments in production and processing enterprises

Business process improvements for tracking and fixing food safety

Cold chains, storage/logistics for preserving food safety

Retail/wholesale chains for delivering safe food

Chapter 7

Adaptation to Climate Change In Irrigated Agriculture Projects in China

Illustration of World Bank-Supported Programs on Agriculture and Water Management

By Qun Li
Sr. Agriculture Economist, GFAO3,

The World Bank
June 21, 2018

Introduction

In 2008, a World Bank study was launched to assist the Chinese Government in better understanding the multiple impacts of climate change in the 3H region.

Results and recommendations of study were integrated into the investment program.

This chapter discusses the approach that China employed to combat Challenges for China's Agriculture and Water Resource Management. The challenges in part were;

a. Extreme weather events, water shortages, droughts and

b. The Impact on food security and economic development

This chapter focuses on the 3H (Huang, Huai, Hai) Region where the World Bank supported a program from analysis to piloting and implementation.

The situation

- By 2030, projected average annual temperature to increase by 1.4-1.6°C (vs. 1961-90 average)
- Drought conditions to become more severe—with variation across seasons
- Flood risk to increase—occurrence of major (20-year) flood to increase by 50%
- Due to increased evapo-transpiration (ET) from crops, irrigation water demand to increase by up to 14%
- Average agricultural yield of main crops to decline by up to 12%
- 3H Region to be in serious water crisis unless measures are taken

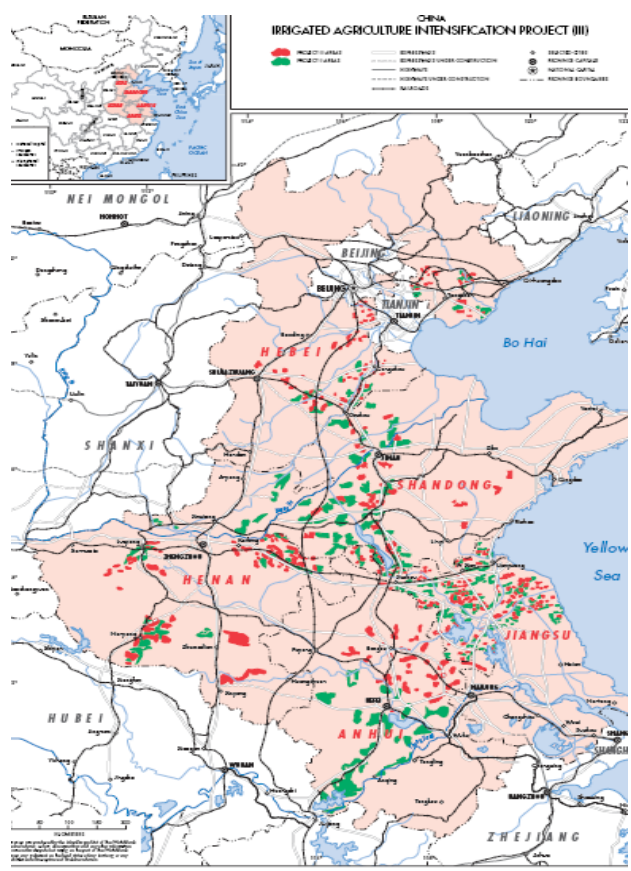
Contents:

i. Integrated Agriculture and Irrigation Project (IAIL3) Background

ii. Water Management in the 3H River Basin

iii. Pressures in the 3H Region

iv. Mainstreaming Climate Change Adaptation into Integrated Agriculture and Irrigation Project



- *3H Basin*

i. Integrated Agriculture and Irrigation Project (IAIL3) Background

Coverage:

10 provinces: Anhui, Hebei, Henan, Jiangsu, Shandong (in the 3H Basin), and Ningxia, Inner Mongolia Yunnan, Chongquing, and Jilin

505 thousand ha low and medium-yield farmland
1.3 million beneficiaries

National Government counterpart:

State Office for Comprehensive Agricultural Development (SOCAD)

Project cost

Total investment: $463m

World Bank loan amount: $150m, GEF 5m

Components:

- Water Saving Irrigation and Drainage
- Agricultural Modernization and Organization Development
- Agro-ecological Environmental Protection and Management

ii. Water Management in the 3H River Basin

- High water demand
- China's "breadbasket"— 50% of national agricultural output (on 18% of China's cultivated land)
- 35% of national industrial output
- Serious water shortage
- Per capita availability of water 1/3 of the China's average (less than 500 m3/capita— absolute water scarcity level)
- Water withdrawals >40% of annual flows (extreme water stress level)

iii. Pressures in the 3H Region that affect agriculture

- Rapid population growth, socio-economic development and ecological requirements put increasing stress on water management
- Grain production has been stagnant due to climate variability
- Increasing frequency and intensity of extreme climate events as a result of climate change

iv. Mainstreaming Climate Change Adaptation into IAIL3 Project

This involved Implementation of Climate Change adaptation measures in selected demonstration areas to help reduce vulnerability to CC in the 3H basin.

The project co-sponsored by GEF operates in 6 provinces: Jiangsu, Anhui, Henan, Hebei, Shandong, and Ningxia. The project adopted new measures, listed below, to achieve the desired results:

i. Engineering water-saving measures, including optimizing various water-saving irrigation and drainage technologies and infrastructures.

ii. Agronomic water-saving measures, including land-leveling, deep plowing, balanced fertilizer, use of crop residues, introduction of adaptive varieties and high quality seeds, etc.

iii. Water-saving management measures, such as supporting the development and expansion of water-user associations (WUAs), volumetric water charges and scientific irrigation schedule implemented by high quality WUAs;

Examples of Adaptation Measures in Water Management

- Combined allocation, regulation and management of multiple water sources to upgrade overall water-use efficiency
- Reduction of non-productive or other improper agricultural water consumption
- Upgrading the utilization efficiency of precipitation

- Use of remote sensing based on ET measurement
- Implementation of ET-based groundwater management plans in 19 counties in Hebei
- Development of alternative water sources
- Upgraded drainage system standards
- Establish water storage for flood water

Examples of Adaptation Measures in Agriculture

- Adjusting cropping system to reduce water consumption
- Adjusting sowing date and application of adaptive cultivation
- Adopting new drought-resistant crop varieties. Other measures: greenhouses, plastic film mulching etc.
- Increased Water Harvesting
- Technical and Management Innovation(via remote sensing and volumetric water charging.

Printed Information and Face-to-Face Interaction Between Experts and Farmers/community mobilization

- *Discussion with Farmers of Wancheng District, Henan Province.*

- *Face to face interaction between Experts and Farmers*

The WB/GEF Project enabled the government to:

i. identify priority adaptation needs

ii. test/demonstrate cost-effective adaptation measures

iii. support institutional capacity building and public awareness

iv. create a favourable environment for integrated water management

v. replicate good agriculture adaptation practices

vi. identify adaptation gaps in ongoing national investment program

Illustration of Implementation Results

i. Ningxia: construction of over 200 small rainfall catchment works

ii. Total water storage over 15,000 m^3 resolved the problem of drinking water and water supply for livestock, mitigated drought

iii. Jiangsu (Gaoliu Township): water-stopping wall as a water-saving measure

iv. Increased irrigation water storage by 850,000 m^3 each year

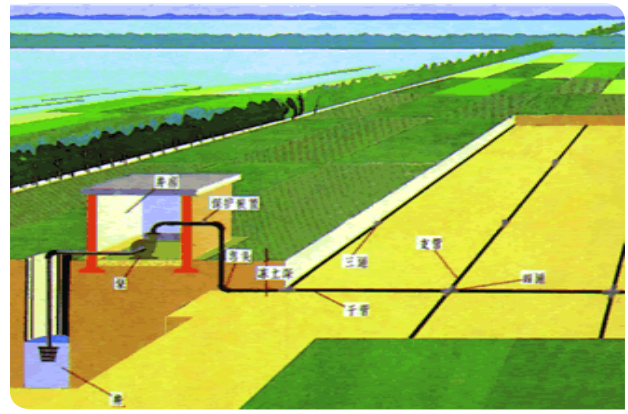
v. Increased the water production rate from 1.14 kg to 1.5 kg/m^3

vi. Jiangsu: semi-winter/spring wheat variety ("Xuzhou Wheat No. 31") selected

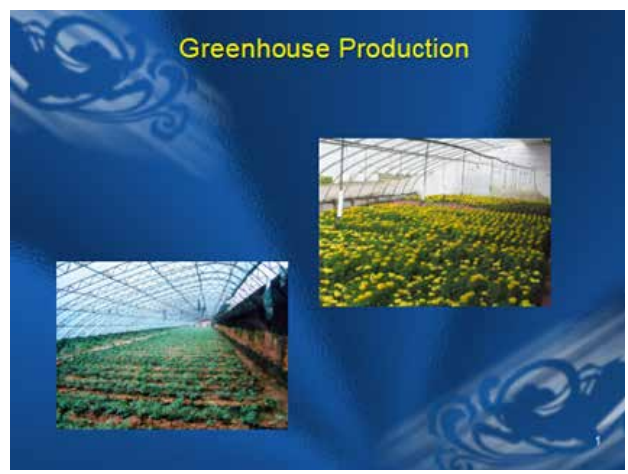
vii. Unlike conventional crops, new variety had no failure following high levels of precipitation

viii. Jiangsu (Caoqiao project area): built 135 ha of greenhouses in 2009

ix. Per capita income of farmers increased significantly



- *Adaptive Water Saving Engineering Measure*



- *Remote sensing*

Chapter 8

Water Resources Governances in Yellow River Basin

Dr. & Pf. PENG Shaoming
Yellow River Consulting Co.ltd

June,2018

Introduction:

This chapter presents backround knowledge of the "Yellow (Huang) River Basin (YRB) management." it covers topics ranging from characteristics of the YRB, water resources allocation, regulations for water resources in the Basin and the overall National Resources Management system. Yellow River flows through the 9 provinces in northwestern and northern China, where most areas are arid and semi-arid.

The YRB is considered as the mother river of China, the devastating flood of 1938 – accompanied by severe siltation (which caused the river level to rise to about 8m) and soil losses made the Chinese government take serious steps towards the management of the Basin, more so as the YRB is known to have large deposits of coal, petroleum, natural gas etc. The demand for the water exceeded supply, while runoff was 58 billion m^3, available water was only about 37 billion m^3. With the integrated water regulation of the YRB in place, a Water Resources Bureau was established with commissions established in 9 provinces that are along the river.

The flood-prone area covers 24 cities in Hebei, Shandong, Henan, Anhui, and Jiangshu situated downstream of YR, the total area is about 1.2x109 km^2, affected agricultural area is 1.12x108 mu, influenced population is 9.064x108. 1.895x1011 people live in the floodplain area downstream, where the frequent small-medium floods cause huge economic losses for the floodplain's residents.

The comprehensive and integrated management of the river has grossly reduced sedimentation and presently it is an example of a well-managed river for the world to follow.

Content

i. Main Characters and Problems of Water Resources in YRB;

ii. Water Resources Allocation in YRB

iii. Water Integrated Regulation in YRB

iv. Water Resources Management in YRB

Characteristics of the Basin

- More than 60% of the river is upstream
- The river takes care of up to 21 power stations
- Annual mean precipitation is less than Nigeria
- River flow is intercepted when appropriate with water content pollutants such as debris being rejected. The water is also released to areas needed or for continued flow

The above method has seen to the continuous flow of the Yellow River, in and out of season.

Achievements

1) Desilting of the YRB with the objective to:

   a. Guarantee no zero-flow in Lower YR and sufficient water supply for domestic water use

   b. Ensure water supply for production and environment .

2) Spatial and temporal distribution mainstream of YR non-flood season

3) Water and Sediment Relationship Regulation. Regulation first, to shape the density flow; second, to establish the relationship between water and sediments in the river course; third, to control the increase of flood peak.

From 2002~2015, YRCC has undertaken 19 Water and Sediment Relationship Regulation programs, had sent more than 600Mt sediment to the sea, the channel of down stream had been lowered by 0.6m, flood capacity from 1800 m^3/s up to 4000 m^3/s

位置 **Location**	河长 **Length (km)**	面积 **Area(km2)**
上游 Upstream	3472	4.28x105
中游 Midstream	1206	2.3x105
下游 Downstream	786	2.3x104

4.) Annual regulation plan(hydrological year, from July 1 to June 30 the next year), monthly and ten-days regulation scheme and real-time regulation orders are comprehensively used during regulation.

5.) Annual regulation plan is prepared by YRCC in consultation with the provincial water administration departments and reservoir operation organizations, and approved by Ministry of Water Resources.

6.) Monthly and ten-days regulation scheme is informed by YRCC. Ten-days regulation is conducted during the peak water use time of April and June in the upper reaches and March and June in the lower reaches.

7.) Safeguards measure implemented according to the request for Corregidor (corrective) responsibility system in each province,

- refine the water regulation indicator,
- reinforce the management of water consumption,
- adoption of multiple effective measures,
- the execution of the water regulation and meet the request for the flow in province and some important control fracture surface of main stream.

8.) Water resources management

Basin authority does direct management of key water control projects.

So far, YRCC has been able to manage water resources in downstream and water utilization projects directly. There is a significant effect on the flood protection, water allocation, water use control and other aspects.

Combination of basin management and administrative region management

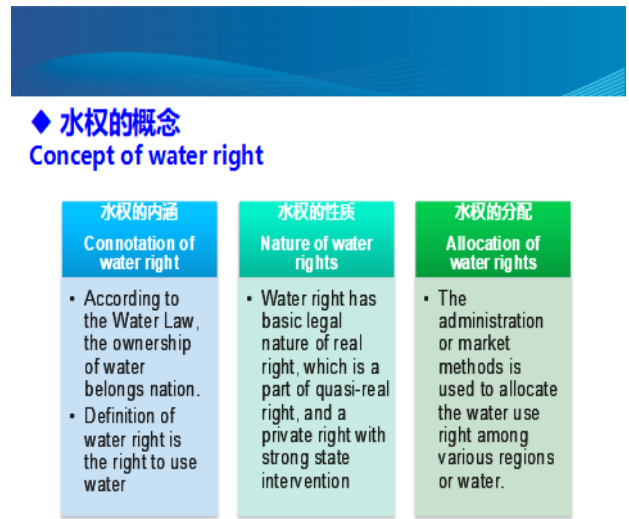
Responsibility and diversion of work for water regulation of mainstream of YR

Application

- According to the Yellow River Water Regulation, the multi-year average ecological water consumption in non-flood season should be 5 billion m^3, the satisfactory degree of water emptying into the sea should be 76.5% and the satisfactory degree of annual water in Lijin should be 17.1%
- Creation of Basin Authority: known as, Yellow River Conservancy Commission是水利部在黄河流域的派出机构，统一管理黄河流域水资源，负责流域综合治理，促进水资源综合开发、利用和保护。
- The authority administrated by Ministry of Water Resources in YRB for unified management of water resources, YRCC is responsible for basin comprehensive treatment, and promoting development, utilization and protection of water resources.

- Yellow River Water Resources Collaborative departments (these are Ministries of the State Council) that are involved in the water resources management of the Yellow River Basin: namely,
  - National Development and Reform Commission
  - Ministry of Environment Protection
  - Ministry of Land and Resources
  - Finance Ministry
  - Agriculture Ministry
  - Ministry of Science and Technology
  - Other relevant departments
- Other innovative Management / Administration Approach to YRB
- Application of comprehensive measures
- Development and transfer of water rights in the Yellow River Basin
- Participation of water users in water rights transfer
- 3 Red lines to control water resources utilization

9.) Concept of water rights



Chapter 9

Agriculture under Changing Climates: Concepts, Effects, and Adaptation

By: Guomin Huang, PhD
Nanchang Institute of Technology

June 2018, Nanchang

Introduction

The Chapter reflects on the overview on climate change, effects and adaptation methods. In introducing the topic he explained climate change, causes of global climate change and effects of climate change. He also discussed on melting ice and rising sea levels as well as changes in precipitation patterns, all which have effects on agriculture and emphasized the need to work on processes for the adaptation of agriculture to climate change. To deal with global climate change, he posited the following actions, which has helped the Chinese society tremendously:

Evidence for Climate Change

- 11 of the 12 years between 1995 and 2006 were among the twelve warmest years since the mid-1800s
- Phenological spring in N. hemisphere now comes 6 days earlier;
- Warming is not due to natural causes;
- Human produced greenhouse gases are most plausible explanation

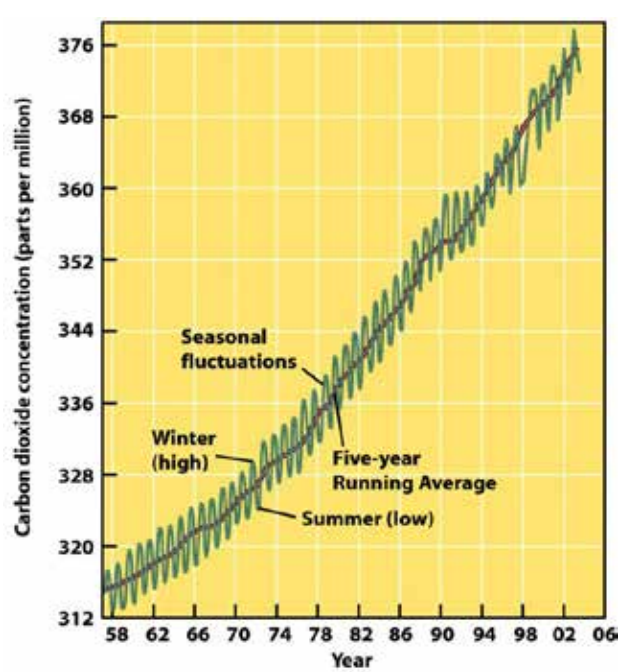
Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods. On the other hand he noted that agriculture contributes to climate change both by anthropogenic emissions of greenhouse gases and by the conversion of non-agricultural land such as forests into agricultural land.

Content

- Introduction to Climate Change
- Causes of Global Climate Change
- Effects of Climate Change
- Melting Ice and Rising Sea Levels
- Changes in Precipitation Patterns
- Effects on Agriculture
- Adaptation of Agriculture to Climate Change

Causes

- Increased concentration of CO_2
- Burning fossil fuels in cars, industry and homes
- Deforestation
- Burning of forests
- Radiation forcing by emissions from diverse sources



- *Greenhouse gas concentrations increasing*

Table 21.1 Increases in Selected Atmospheric Greenhouse Gases Preindustrial to the Present

Gas	Estimated Preindustrial Concentration[1]	2006 Concentration[5]
Carbon dioxide	288 ppm[2]	382 ppm
Methane	848 ppb[3]	1,783 ppb
Nitrous oxide	285 ppb	320 ppb
Chlorofluorocarbon-12	0 ppt[4]	535 ppt
Chlorofluorocarbon-11	0 ppt	249 ppt

[1] The preindustrial value is for the 17th and 18th centuries. There have been significant variations, as, for example, over the course of the ice ages.
[2] ppm = parts per million.
[3] ppb = parts per billion.
[4] ppt = parts per trillion.
[5] 2006 annual average.
Source: Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory.

Effects

Effect of global climate change : sea level will rise due to thermal expansion and melting of land ice. Climate change is ongoing and caused by increased greenhouse gases. Climate change has variable impact on agriculture as changing climate factors are inter-related and have variable effects. He said there are two broad way of dealing with global climate change:

- Mitigation: Reduce causes and sources of global climate change
- Adaptation: Cope with and live with the situation

Effect of Sea Level Rise

Loss of land. Lands will be submerged by a rise in sea level. This translates to farmlands.

Effect of Extreme Precipitation

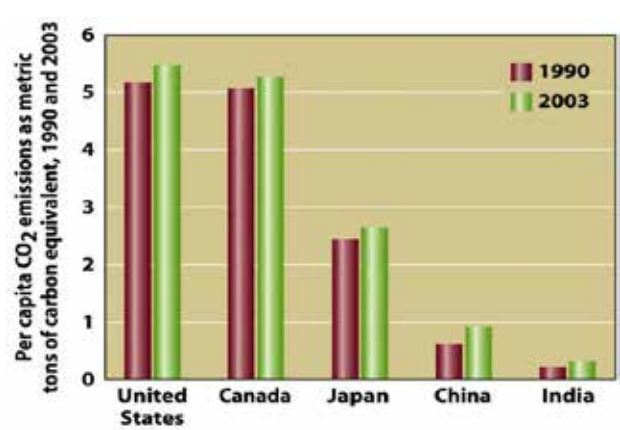
More weather-based disasters will be experienced. Hurricanes will occur more frequently and strike harder. More typhoons.

Effects on Agriculture

- Difficult to anticipate
- Productivity will increase in some areas and decrease in others;
- Rise in sea level will inundate flood plains and river valleys (lush farmland);
- Effect on pests is unknown
- Warmer temperatures will decrease soil moisture – requiring more irrigation, re-location (i.e. elevation and altitude) where certain crops can be grown may have to change

International Implications of Climate Change

- Developed vs. developing countries
- Differing self-interests
- Differing ability to meet the challenges of climate change
- Productivity will be disturbed and there will be positive and negative impacts.
- Positive:
  - Increased production from warm temperatures.
  - Possibility of growing new species and varieties of crops
  - Longer growing seasons
- Negative
  - Increased insect attacks
  - Crop damage
  - Planning and management difficulties due to uncertainties
  - Elevated levels of carbon dioxide
  - More extreme temperatures
  - Warmer temperatures will decrease soil moisture in some areas



Suggested Solutions

To avoid the worst of climate change, CO_2 levels must be stabilized at 550ppm

50% higher than current levels

Two ways to attempt to manage climate change

- Mitigation

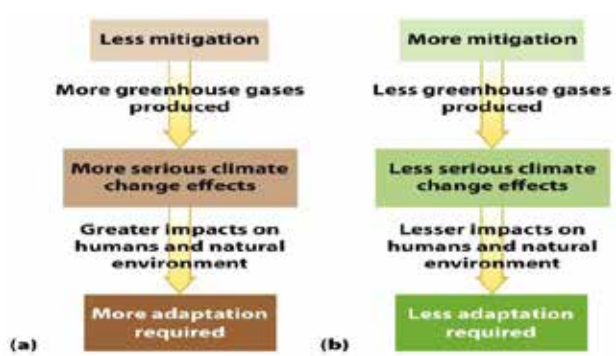
  Focuses on limiting greenhouse gas emissions to moderate global climate change

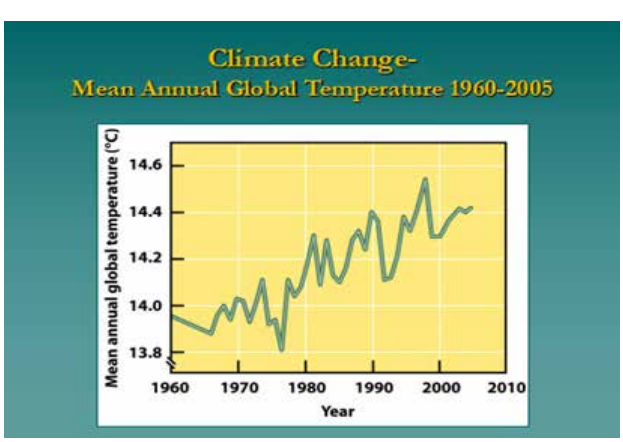
- Adaptation

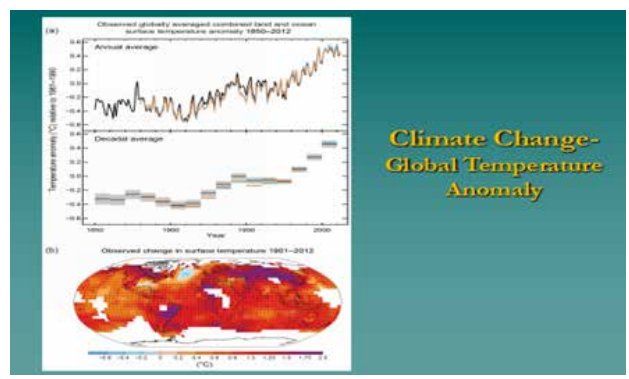
  Focuses on learning to live with the environmental changes and societal consequences brought about by global climate change

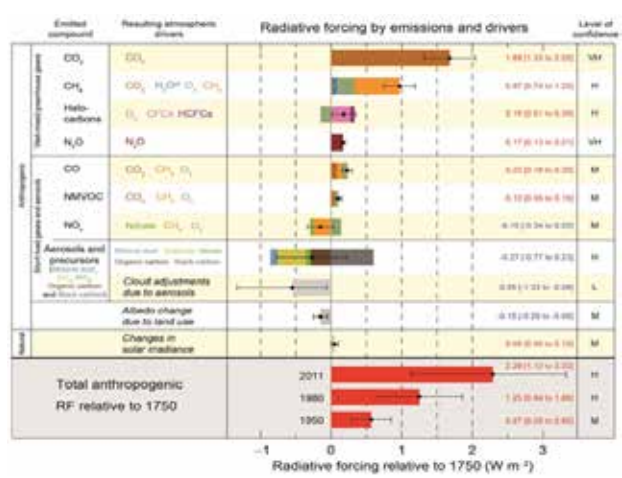
Dealing with Global Climate Change – Mitigation

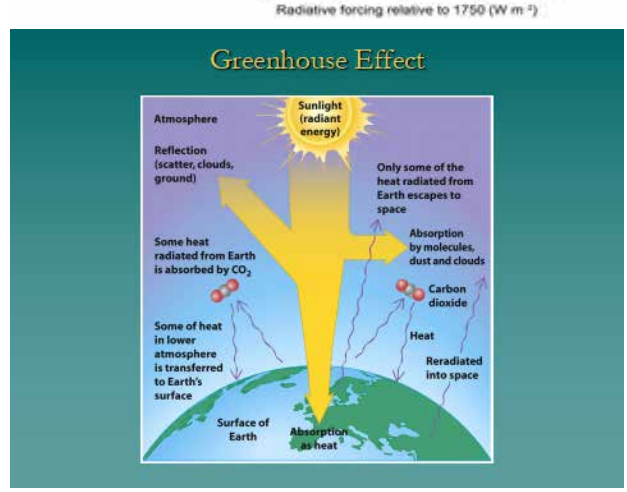
- Locate/invent alternative fuels to fossil fuels
- Increase efficiency of cars and trucks
- Sequestering carbon before it is emitted
- Plant and maintain trees to naturally sequester carbon











Chapter 10

Climate-smart Agriculture and Water Management: A Case Study in California

Guomin Huang, PhD
Nanchang Institute of Technology

June 2018, Nanchang

Introduction

Dr. Guomin in this chapter presents a case study of Climate-smart Agriculture in response to the extreme weather in California USA. California climate is full of extremes, which led to the US government shifting to Climate-smart Agriculture (CSA) strategies. According to him, under CSA and water management, efficient use of water and optimizing water storage are very essential. As we are to later see, it is evident that CSA considers water management very important for optimum output. This therefore suggests that the irrigation methods contribute to success in CSA.

Contents

California Climate: Full of Extremes

- Mediterranean Climate
  - Dry Summers
  - Wet Winters
- Atmospheric Rivers

Atmospheric Rivers

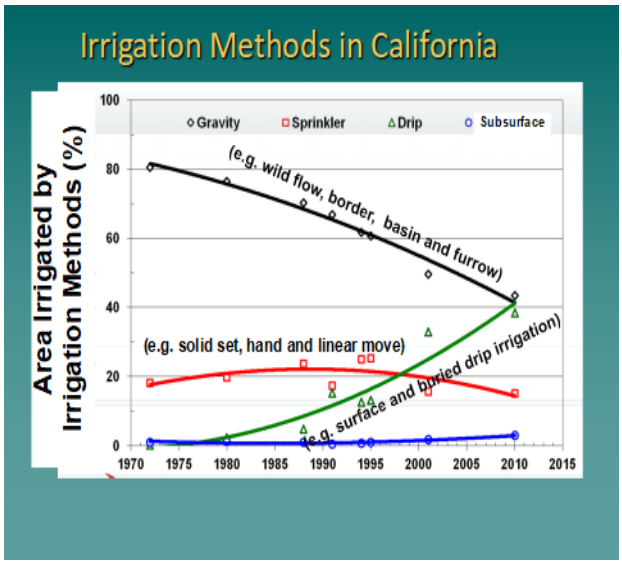
- Water Supplies
  - Mostly in North
  - Mostly in Wet Season
- Water Demands
  - Mostly Central and South
  - Mostly in Dry Season
- Aqueducts, reservoirs and groundwater use

CSA Strategy: Irrigation Efficiency

Increase in irrigation efficiency water use. Prior irrigation methods were sub-surface. This was not that effective because of blocked ditches from the weather beaten underground pipes.

Using the following types of irrigation methods: Sub-surface Irrigation, Surface Irrigation,Sprinkler Irrigation and Drip Irrigation an Irrigation Survey was conducted in 1972, 1980, 1991, 2001 and 2010 using about 20 crops: Corn, cotton, dry beans, grains, safflower, sugar beet, field crops, alfalfa, pasture, cucurbit, onions and garlic, potato, tomato, truck crops, almond and pistachio, deciduous, subtropical trees, turf grass and landscape, vineyards.

- Sub-surface Irrigation
  - underground pipes
  - ditches blocked
- Surface Irrigation
  - wild flow, border, basin and furrow w/o sprinkler wheel line and hand-held sprinklers followed by furrow
- Sprinkler Irrigation
  - solid set, hand and linear move
  - wheel line, hose pull
- Drip Irrigation
  - micro and mini sprinklers
  - Surface and buried drip irrigation



Application Effectiveness

Effective vs not that Effective Irrigation Methods

Surface irrigation methods and the drip irrigation methods

The drip /Macro irrigation method looks more Advantageous:

- Reduced crop stress,
- more efficient crop fertilization
- Increased yields, improved crop quality
- More food grown per unit of water and land

Consequences:

- Less groundwater recharge
- Irrigation "inefficiency" is a major source of groundwater recharge!
- More reliance on groundwater than surface water for drip/micro-irrigation (timing, sediment)

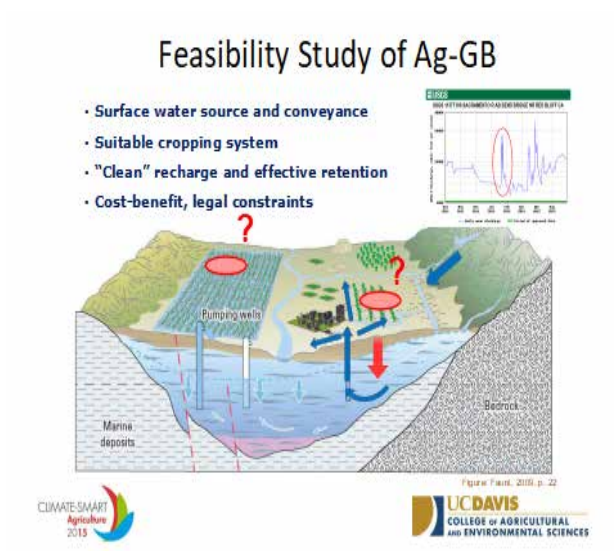
CSA Strategy: Groundwater Banking (GB)

What is groundwater banking?

This is the active and intentional recharge of groundwater aquifers during years when rainfall is abundant, to increase water supply reliability during drought years.

Agricultural groundwater banking (Ag-GB):

Infiltrate/percolate water on agricultural fields to recharge groundwater. GB gives deep percolation, Root-zone residence, topography salinity and nutrient surface condition guaranteed.



Chapter 11

大型灌区节水改造理论与方法
Theory and Method of Water-Saving Reforms in Large-scale Irrigated Areas

江西省灌溉试验中心站　刘方平
Jiangxi Province Irrigation Experiment Station
Liu Fangping

Introduction

This chapter explore an overview of Landscape Irrigation Management. The goal of good irrigation management in the landscape is to supply the plant materials with the correct amount of water at the proper time. This is very important because In areas where water costs are high and supplies limited, the irrigation manager must maintain irrigation systems for peak performance and make careful decisions on when and how much to irrigate.

Content

- Current situation of large-scale irrigated areas
- Characteristics that modernization restructuring of large-scale irrigated areas should have
- Discussion on the content and standard of modernization restructuring of large-scale irrigated areas;
- Strategies on modernization of large-scale irrigated areas

There are 456 large scale irrigation areas above 300,000 Mu in China.

Current irrigated area is about 278 million Mu and that amounts to about 30.2% of irrigated land in mainland China and that also accounts for about 33% of total irrigated water used in mainland China.

In spite of this, the expectation of these areas vis à vis modern agriculture is quite high.

Challenges: The many developing challenges large-scale irrigated areas are currently facing:

- Extreme weather events. Food production is facing longer time for growth and harvesting.
- Against expectation of water rationing, arable land area is becoming smaller.
- Long pipes leading to too many users as well as difficulty in water distribution.
- Large scale areas have artificial ecosystems, which play an important role in the entire matter, resulting in water pollution.

To handle these challenges, the following must be considered;

- People's livelihood and irrigation areas: clean water should be produced and wealth increased on yield basis.
- Water saving irrigation: Develop water saving and water friendly agriculture.
- Ecological irrigation: Pollution prevention and control, balanced dynamics of underground water, combine the simple goal of high yield with water saving and promote sustained yield.
- Smart irrigation: (the overall idea of remote telemetry, drone-assisted harvesting, optimal water consumption, which is equal to ET for the same plant, must be considered as smart irrigation)
- Harmonious irrigation between man and nature: There must be harmony between man and water and man and man.

- *Extreme weather conditions affects food productions*

♦ Engineering facilities: There are 383.8 thousand irrigation channels over 0.2m^3/s, with a total length of 519.5 thousand km; 23.7 thousand channels of and above 1m^3/s, with a total length of 147.7 thousand km and 420.8 thousand canal buildings. Irrigation and drainage facilities can meet the basic requirements of agricultural production.

Increasing number of people and reducing quantities of water

The contradiction between the increasing number of people and reducing quantities of water is still very prominent. The effective irrigation area accounts for 14.4% of the total cultivated land, and its grain production accounts for 26% of the total grain output of the whole country. The task of grain production had become heavier for large-scale irrigated areas.

Irrigated areas have problems such as long pipelines, too many users, difficult water distribution, relatively backward management, weak service capability and low management efficiency, thus making it lag behind the requirements of "optimizing allocation and using water efficiently" and modern agricultural development.

Solutions/methodology

In response to the above challenges and the accelerating pace of economic and social transformation, scientific planning for future construction and development of large-scale irrigated areas; realization of the necessity of turning traditional irrigation modes to efficient and water-saving modes and promotion of reformation in agricultural production modes are all requirements for improving the comprehensive agricultural production capacity, peasants' income and the ecological environment as well as promoting the modernization of water conservancy industry.

1. Modernization of water conservancy: The modernization of irrigation and water conservancy with Chinese characteristics mainly lies in the modernization of irrigated areas, bearing in mind the five characteristics that modern irrigated areas should have such as:

   a. Safe and Reliable flood resistant people's livelihood irrigated areas;

   b. Water-saving irrigated areas; all kinds of water-saving techniques should be adopted according to local conditions. Develop water-saving and water-friendly agriculture, use agricultural water resource allocation effectively, fully store rain and block snow, use non-conventional water irrigation, protect water quality, jointly allocate surface water and underground water

- *Water Saving irrigation method*

c. Ecological irrigated areas; from the aspect of water ecology in irrigated areas, we should prevent or reduce pollution and soil, water erosion. The groundwater level in the irrigated areas should be dynamically balanced, and the wetland, grassland and woodland should be protected. In the techniques of field irrigation and drainage, we should combine the simple goal of high yield and water-saving with improvement of fertilizer efficiency and water environment, in order to achieve a comprehensive aim of sustained high yield, water-saving, efficiency, pollution prevention and reduction.

d. Smart irrigated areas; the use of hi-tech and the establishment of a modern information management system will enable the irrigated areas to achieve optimal allocation of water, precision irrigation, forecast irrigation and automatic irrigation.

- *Example of smart Irrigation areas (up and below)*

The information system is based on the need of more reliable basic information, such as the condition of local water resources, distribution of lakes and wetlands, terrain and soil conditions, the area, distribution and yield of various crops, hydrogeological conditions, weather forecast conditions, canal system and farmland engineering conditions, irrigation methods, social economy and irrigation management.

e. Harmonious irrigated areas to attain harmony between man and water and harmony between man and man, firstly, farmers should be able to get quality water supply service; secondly, water supply must be reliable, fair and flexible.

2. Organizational management:

a. Have an effective management system in line with national conditions;

b. Have a good operation mechanism and scientific decision-making procedure;

c. Have a reasonable water price system and levying method;

d. manage water in a lawful and scientific way;

e. Have a high quality management team;

f. Establish a fairly complete irrigation and drainage service and promotion system

3. With reference to the standards and requirements of water conservancy modernization in developed countries worldwide and developed areas in China, the modernization of large-scale irrigated areas should incorporate the following content and meet the corresponding standards: five aspects concerning safety guarantee, irrigation and drainage, management and service, efficiency and benefit and ecological environment.

Safety Guarantee:

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- The standard of waterlog control in villages and towns exceeds 10a in reappearance period of drainage design, and 20a in important towns.
- Farmland flood control projects meet the design specifications. Such projects in irrigated areas are able to sustain for 20 years, in areas of importance or above 3 million Mu reach 50~100 years.
- The early warning system of natural disasters (flood, drought, storm, hail and so on) is set up in irrigated areas, with fairly complete disaster prevention and mitigation scheduling decision and emergency response system to meet the demands of disaster prevention and reduction in agricultural production.

Irrigation and drainage:

- All effectively controlled irrigation acreage in the irrigated areas should meet the area standard of ensuring stable yields despite drought or excessive rain, and the acreage of water-saving irrigation projects reaches 90% of the total effective irrigation area.
- The water source project meets the supply requirements for designed irrigation areas. The project is in good condition, the allocating means are advanced, and the water quality meets the irrigation standards.

The water transmission and distribution works of the canal (pipe) are complete and the matching rate is over 98%.

- Conduct reasonable prevention measures in serious water shortage and seepage areas and canal sections, thus improving water transfer efficiency while not affecting the ecology and vegetation; in sections with abundant water and shallow underground water, adopt eco-friendly techniques for canal improvement and slope protection. Reduce the adverse impact of canal engineering and harmonize with local environment. The water utilization coefficient of canal system in irrigated areas is not lower than 0.55.

4. With sound drainage works and farmland drainage standards that last for more than 10 years, it can effectively regulate and control the farmland water condition, avoid the crops from being flooded and prevent soil salinization. Ditch artificial wetland or water purification facilities are built according to needs and possibilities. The farmland retreating or draining water will have no negative impact on the downstream ecological environment. Taking into account ecological conservation and the landscape in line with local conditions, requirements of drainage, and with the aim of benefiting from water, interacting with water, enlivening water, and conserving water.
5. The layout of the field project is reasonable and complete; the farmland is flat and the field is moderate; the irrigation technology is advanced, and the water-saving irrigation standards for the field is achieved. It can provide necessary water for crops at the right time and amount to ensure stable and

high-yield with high quality and efficiency. The supporting rate of the field project is more than 95%, and the field irrigation water utilization coefficient is not less than 0.90.

6. When the management and supporting water distribution and drainage control facilities in irrigated area are complete, key water distribution and drainage control facilities achieved, as well as automatic and remote control systems in place. Pipe water inlets of head ditch and above, branch pipe and above should be equipped with irrigation metering facilities and the last stage of fixed canal metering facilities should meet the management requirements.

7. Irrigation road, bridge and other agricultural production facilities meet the agricultural mechanization and modern production requirements; Field road and forest belt arrangement are coordinated with irrigation and drainage ditches, farmland shelterbelts in sandstorm areas are arranged to meet relevant national standards. The life expectancy of irrigation and drainage engineering designs should be 30 years and above.

8. Management and service: Fine management system. A modern management system, specialized and group management organizations that bear clear responsibility for the project and operation management of the irrigated areas will be established, so as to realize seamless coverage. The number of Wanmu specialized personnel is less than or equal to the fixed and permanent number of authorized personnel; under the guidance of specialized organizations, Water Users Association and other group organizations will realize self-management on farmland projects and irrigation water in the irrigated areas which covers 100% of the acreage.

   Complete regulatory framework. For engineering and water management, management regulations, bye-laws or methods should be formed; and regulations on "control the total, manage the quota" for irrigation water use should be carried out. Water price and water fee collection system is reasonable.

9. The management ability meets the requirements of modern management. 3S technology and Internet technology are used on irrigated areas to realize informatization on engineering and water use management. It has an irrigation management decision supporting system that can perform irrigation forecast and water supply allocation based on weather changes, crop water requirements, etc. Implement the principle of "control the total, manage the quota" of irrigation water; the technical and management specialized personnel accounts for more than 90% of the total number of employees. Institutionalize techniques of irrigated areas and manager training.

10. Timely and efficient service. The irrigated areas are able to duly provide high quality services for irrigation and drainage in accordance with the requirements of agricultural production, set up a website for management and information disclosure to offer timely information on irrigation forecast, irrigation plan, water fee collection and so on, therefore, the management of irrigation area is open and transparent.

11. Efficiency and benefit: The effective utilization coefficient of irrigation water reached or exceeded the standard of water-saving irrigation (above 0.5), and the water productivity was above 1.4 kg/m^3.

Chapter 11

Systematic Agricultural Water-saving in Watersheds

Mr. ZHAO Xinyu, Associate Professor

Nanchang Institute of Technology

Introduction

The concept of Water-saving in agriculture

Agricultural water saving is an agricultural method that improves the efficiency of water use. It is a systematic project for the comprehensive development and utilization of water, soil and crop resources. The standard of water-saving agriculture is crop yield and quality, water use efficiency and productivity. Water-saving agriculture includes water-saving irrigation agriculture and dry-land agriculture. Water-saving irrigation agriculture refers to the rational development and utilization of water resources and the use of engineering, agricultural and management techniques to improve the efficiency of agricultural water use. Early agriculture refers to agricultural production with less precipitation and limited irrigation conditions.

Content

i. Methods of Saving Water in Agriculture

ii. Water-saving in Agriculture in China

iii. Systematic Agricultural Water-saving in domestic Watershed Haihe River Basin as an example

iv. Current Situation of Water-saving in Agriculture in abroad

v. Case Study of Agricultural Water-saving in Israel

Application

♦ Water-saving in Agriculture

China is a country with severe water shortage. The distribution of water resources is not balanced, which is reflected in the uneven distribution of space and time. Agricultural water consumption accounts for a high proportion of the total water consumption in China, and the utilization rate of water is low, and water resources are wasted seriously.

Methods

The water-saving methods include four aspects: agricultural water-saving, physiological water-saving, management water-saving and engineering water-saving.

Agricultural water-saving

Water saving in agronomy, such as adjusting agricultural structure, crop structure, improving crop distribution, improving tillage system (adjusting cropping system, developing intercropping, etc.), improving tillage techniques (land preparation, mulching, etc.).

Physiological water-saving

Plant physiological areas of water-saving, such as the cultivation of drought-resistant crop varieties and so on.

Management water-saving

Water saving in agricultural management includes management measures, management systems and organization, water price and water fee policy, control and regulation of water distribution, popularization and application of water-saving measures and so on.

Engineering water-saving

Water saving in irrigation works includes water saving measures for irrigation projects and water-saving irrigation technologies, such as precision irrigation, micro-sprinkler irrigation, drip irrigation and Yongquan root irrigation.

Research significance

As the core part of improving the utilization rate of water resources in China, agricultural water-saving needs to consider the factors of climate conditions and actual terrain, combining advanced agricultural technology with drought-resistant and water-saving varieties, improving crop water productivity under the premise of reducing agricultural water use, and the realistic two aspects of agricultural water-saving targets.

To study water-saving from crop physiology itself, to enhance the characteristics of drought resistance and stress resistance of crops, and to make them adapt to the environment better.

The rational water management via allocation of irrigation water resources and the optimal regulation of irrigation systems can be realized, the purpose of saving water and increasing production can be achieved, and the maximum benefit from limited water resources can be obtained.

Research significantly shows in the engineering water-saving method that the drip irrigation for example, saves the land; the economic benefit is good, the yield is increased and the income is increased; the workload of irrigation and water conservancy construction has been reduced and the development of agricultural modernization has been promoted; and is favourable for protecting the environment.

Current situation of water resources in China

China is a country with severe drought conditions and considerable water shortage. The total fresh water resources in China are 280 million m^3, account for 6% of global water resources and Second only to Brazil, Russia and Canada, ranked fourth in the world. But, China's per capita water resources is only 2300 m^3, which is only a quarter of the world average, and is one of the poorest countires in the world. However, China also has the most water consumption in the world. In 2002, the national fresh water intake reached 549.7 billion m^3, Approximately 13% of the world's annual consumption. By 2030, when China's population rises to a peak of 1.6 billion, per capita water resources will fall to 1760 m^3, therefore, China is listed as one of the 13 poorest countries in the world.

Distribution characteristics

China is located on the west coast of the Pacific Ocean, with a vast territory, complicated topography and a very prominent continental monsoon climate, which results in two characteristics of uneven spatial distribution of water resources.

Spatial distribution imbalance

Due to the great distance the between east and west to the sea and a great difference in latitude between the north and the south, the distribution of precipitation and run-off in China is extremely uneven. The general trend is decreasing from the south east coast to the northwest inland.

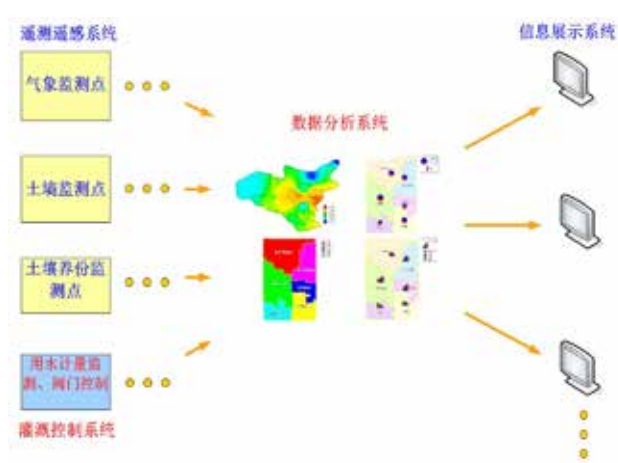
Time distribution is uneven

The time distribution of water resources in China changes greatly, and the flood and drought disasters occur frequently. In general, there is more precipitation in summer and autumn, less precipitation in winter and spring.

Water-saving technology

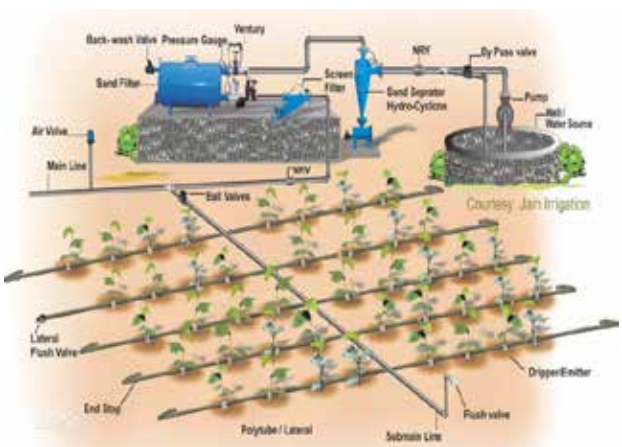
- Engineering water-saving technology

  Water-saving in irrigation engineering, including water-saving measures and water-saving irrigation techniques such as precision



- *Precision irrigation system diagram*

- *Microspray irrigation*



- *Drip irrigation*

- *Bubbler irrigation*

irrigation, micro-sprinkler irrigation, drip irrigation, Bubbler irrigation, etc.

Current water-saving irrigation management in China

- Management system and organization
- Water price and water fee policy in place
- Control and regulation of water distribution in place
- Popularization and application of water-saving measures, in place.

Water-saving technology: Based on precipitation, to adopt engineering and non-engineering measures to rationally develop and utilize and scientifically manage agricultural water resources, and to improve the utilization rate of water resources, so as to realize the sustainable development of agriculture.

Development course of water-saving in Agriculture in China

- 1950s–1960s

  The aim was to popularize the channel lining technology aimed at increasing the water utilization coefficient of canal systems. Subsequently, the research and extension of surface irrigation technology aimed at increasing the utilization ratio of irrigation water in the field were carried out.

- 1970s

  To popularize advanced irrigation techniques such as spraying and micro-irrigation in the areas of the north and the southern cash crop areas where water is scarce.

- 1980s–1990s

  The technique then was of low pressure pipeline irrigation, popularized in the whole country, and great progress has been made in the field of agronomic water saving technology.

- 1990s–now

  Starting to gradually form a complete set of technologies based on the combination of engineering water-saving, agronomic water-saving and water-saving management.

Achievements

Engineering water-saving technology situation:

The construction of 300 key water-saving and production-increasing counties and water-saving well irrigation districts has been completed throughout the country.

115 million Mu of new irrigation area has been added in the Ninth Five-Year Plan. Among them, canal seepage control: 63.47 million Mu, pipeline water delivery; 27.66 million Mu, sprinkler irrigation 21.69 million Mu, micro-irrigation: 2.18 million Mu. At present, engineering water-saving irrigation area has occupied 34.1 Mu of effective irrigation area in China.

Agronomic water-saving technology situation

The construction of more than 80 demonstration and extension areas was completed, and 45 agronomic techniques were popularized, such as suitable water production, drought resistance and water-saving breeding, water-saving irrigation systems, water-saving and moisture conservation. Supplementary irrigation techniques also have been developed.

Current situation of agricultural water use in Haihe River Basin

From 2000 to 2011, agricultural water consumption accounted for more than 65% of the total water consumption, and the correlation coefficient between agricultural water consumption and total water consumption was more than 0.9.

The agricultural water consumption shows a decreasing trend year by year, and the proportion of agricultural water consumption to the total water consumption has also decreased year by year, from 2000 to 2011, the proportion of water use has decreased by 5.29%.

Current situation of irrigation water use in Haihe River Basin

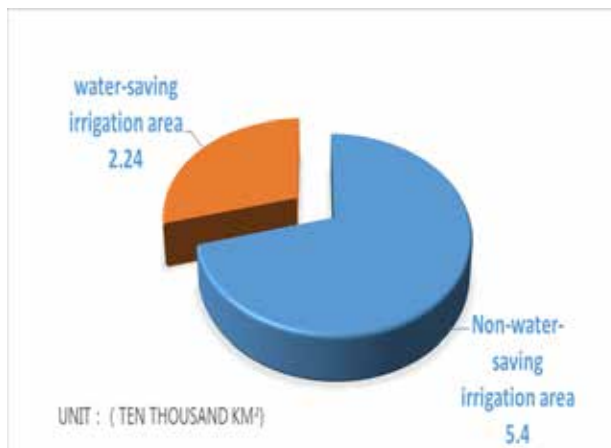
From 1979 to 2011, the actual irrigated area of the Haihe River Basin showed an overall increasing trend, and the actual irrigated area increased from 60400 km^2 in 1979 to 68200 km^2 in 2011.

Under the condition that agricultural water consumption is relatively fixed or even gradually reduced, the increase of irrigation area means the popularization of water-saving irrigation measures and the development of agricultural water-saving technology.

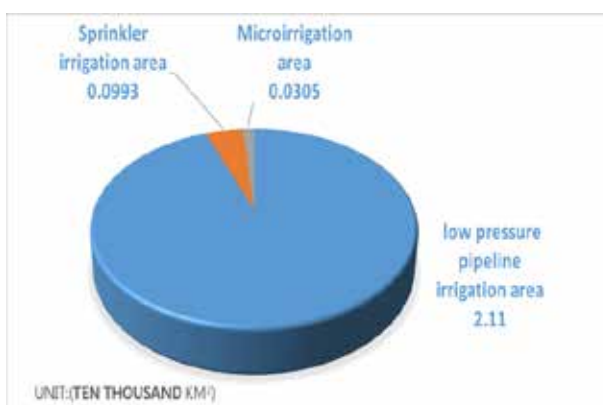
Current situation of water-saving irrigation in Haihe River Basin

In 2011, the effective irrigation area of Haihe River Basin was 76400 km^2, of which the water-saving irrigation area was 22400 km^2, accounting for 29.32% of the effective irrigation area.

In water-saving irrigation, the irrigation area of low-pressure pipelines is 21100 km^2, the proportion is 94.20%, the area of sprinkler irrigation is 993 km^2, the proportion is 4.43%, and the area of micro-irrigation is 305 km^2, the proportion is 1.36%.



- *Proportion diagram of irrigation area in Haihe River Basin in 2011*



- *Utilization ratio of three types of water-saving irrigation methods in Haihe River Basin in 2011*

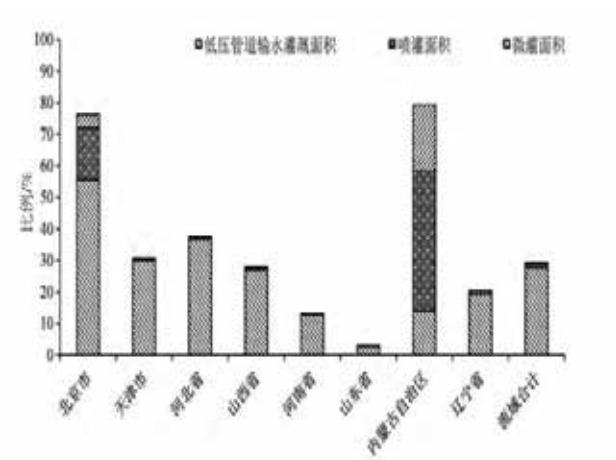
Types of Water-saving Irrigation in Haihe River Basin

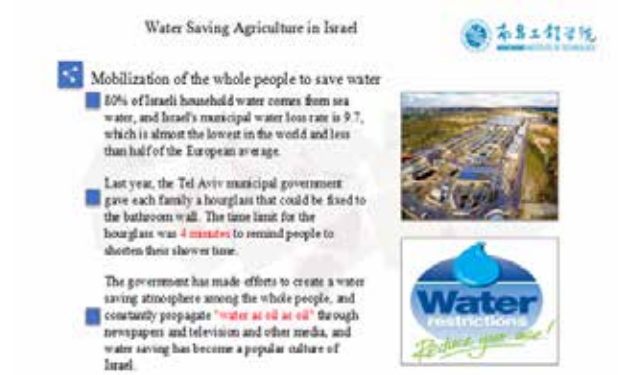
The irrigation area of low pressure pipeline in Beijing is 55.50% of the effective irrigation area in the basin, the proportion is the largest, and the smallest, in Shandong Province is 2.85%.

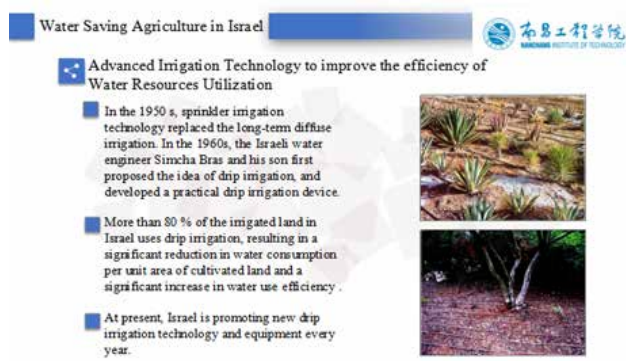
In Inner Mongolia Autonomous region, the area of sprinkler irrigation accounted for 44.30% of the effective irrigation area in the basin, and the proportion of sprinkler irrigation was the largest. The smallest in Shandong Province is 0.02%.

The area of micro-irrigation in Inner Mongolia Autonomous region accounted for 21.21% of the effective irrigation area in the basin, and the proportion was the largest. In case of Shandong Province and Henan Province, both were 0.02%.

The proportion of water-saving irrigation area in Inner Mongolia Autonomous region and Beijing was 79.39% and 76.23%, respectively, while the proportion of water-saving irrigation area in Shandong Province was the lowest.







Chapter 13

Basic Introduction of Jiangxi Red Soil Research Institute; Special Introduction to Testing Base

Jiangxi Red Soil Research Institute was founded in 1963, and is affiliated to Jiangxi province agriculture department of the provincial agricultural scientific research institutions. It is the only red soil research professional institute in China,and mainly engaged in the subtropical red soil resources, comprehensive development and application of regional agricultural resources theory, using the technology research and technology promotion. The registered office is in Nanchang City, the experimental demonstration base is located in Zhanggong town, Jinxian county, while the experimental demonstration base is located in Zhanggong town, Jinxian county.

There are 1,800 residents, 740 employees and 463 retirees in the region.

This is a scientific research institute, talent-nurturing institute, and industrial development institute, all in one.

Development objective: to take "the red soil research of Silicon Valley, smart agriculture model, leisure agriculture paradise, science popularization education class" as the starting point, and strive to achieve "scientific and technological red soil, ecological red soil, and civilized red soil".

The Team

正高6人：二级岗位1人，三级岗位2人。

There are 6 people in senior level 1, one person in senior level 2posts and two people in senior level 3

副高11人。

11 people in Subtropical — please complete

博士学位5人

5 people with doctorate degrees

硕士学位25人

25 people with Master's degrees

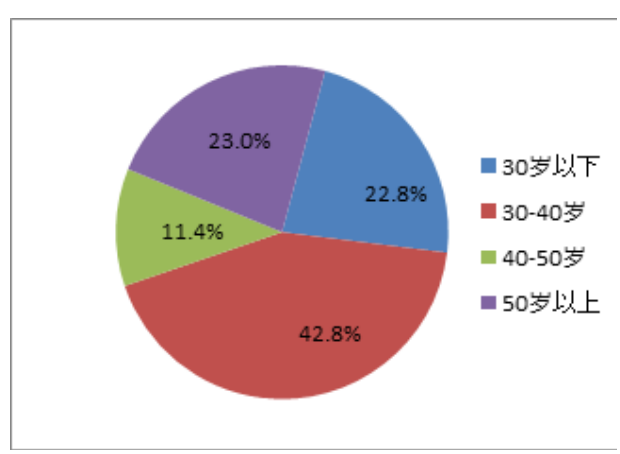
在职博士生2人，在站博士后1人

2 people in-service with doctoral degres, 1 post-doctoral at the station

享受国务院和省政府津贴专家2人，省百千万人才工程人选5人

Two experts are entitled to subsidies from the state council and the provincial government.

- *Jiangxi Red Soil Research Institute*
  There are more than 40 researchers now



The research area

i. Research on tillage breeding

- Breeding of new crop varieties in red soil dry land, breeding of fine varieties and efficient cultivation models
- Study on the breeding of early maturing rapeseed varieties and the high yield cultivation model of three-ripening system
- Study on reasonable rotation and synergistic fattening technology

ii. Plant nutrition research

- Quality monitoring and fertilization technology of farmland in red soil
- Crop nutrient management techniques based on soil formulation and crop yield response
- Diagnostic and repair techniques of secondary agricultural obstacle factors
- Monitoring, evaluation and restoration of heavy metal pollution in soil in major grain-producing areas
- Reclamation and utilization of agricultural waste and clean rice production technology

iii. Resource environmental research

- Monitoring, analysis and efficient utilization of hilly red soil
- Research and promotion of key technology of soil and water conservation in low hilly red soil slope
- Control and comprehensive improvement of red soil and dry land acidification
- Ecological environment monitoring and control technology of farmland source pollution in Pyongyang lake area

Achievements

♦ Research projects

- More than 60 projects were approved in the 11th five-year plan and 12th five-year plan
- The national science and technology support program has 9 projects covering water, soil and fertilizer crops
- The Agency is working on two projects for the State Natural Science Foundation on microbial stability mechanism of agglomerates in red soil under biomass water conservation measures Soil soluble organic matter in paddy fields influence the microbial mechanism of methane production
- One Subtopic lesson of 973 Plan project covers the current situation and evolution characteristics of farmland basic earth force;
- Pilot demonstration of a new variety of high quality and high yield black sesame "GanZhi No. 7" in group 1 of the national agricultural research achievement conversion fund project;
- Home to a major scientific and technological innovation project of Chinese Academy of Sciences study on intercropping technology of cassava peanut in main peanut producing areas in hilly red soil;
- More than 30 provincial-level scientific and technological suppor, achievements promotion and other projects

♦ Nine research projects of national science and technology support of projects or special projects and industry:

i. Research and integrated demonstration on the remediation technology of secondary obstacles in red soil

ii. Research on key technologies for controlling soil and water loss in red soil

iii. Research on key technologies of soil and water conservation in red soil area, and

optimization of erosion prevention and crop allocation model

iv. Plant hedgerow protection and crop allocation optimization

v. Integrated research on integrated water and soil erosion control technology in umbilical orange orchard

vi. Study on efficient and simplified fertilization technology of rapeseed

vii. Technical indexes for constructing reasonable tillage layer of slope farmland

viii. Cultivated land fattening and reasonable agricultural production system in the two ripe areas of paddy field

ix. Cultivated land fattening and reasonable agricultural production system in Sanshu district

国家级科研平台National scientific research platform

number		Approval department or co construction unit	the year
1	National red soil improvement engineering technology research center	technology centre	2010
2	Postdoctoral research stations	The personnel department	2012
3	The state introduces foreign demonstration bases for display and promotion of intellectual achievements	Foreign experts bureau	2000
4	Field scientific observation station of red soil quality and environmental cover in poyang lake area	Agricultural ministry	2007
5	Agricultural ministry jiangxi farmland conservation field scientific observation experimental station	Agricultural ministry	2011
6	National youth agricultural science demonstration base	Agricultural ministry	2013
7	National agricultural science and technology innovation and integration demonstration base	Agricultural ministry	2014
8	National agricultural science experimental station	Agricultural ministry	2017
9	Jiangxi planting industry new professional farmer training base	Agricultural ministry	2017

♦ Awards for Soil Research and Technology Promotion

Institute has received more than 40 awards for all kinds of scientific and technological achievements. These include:

The National Science Conference Award – 2

The National Scientific and Technological Project Award – 2nd Prize

Progress Prize in Science and Technology in Jiangxi Province: 1st Prize – 1; 2nd Prize – 6; 3rd Prize – 13

National Agriculture, Animal Husbandry and Fishery Harvest Award: 1st Prize – 1; 2nd Prize – 1

Since 2000, it has won 8 provincial and ministerial awards for scientific achievements.

♦ 3 local standards of Jiangxi Province were formulated: planting of Baixi grass solid soil and slope protection technology on orchard ladder wall, planting green manure and white clover technology on orchard row, and planting technical regulations on light simplification of rapeseed with live broadcast of second-season evening rice cover.

♦ Published monograph 5 department: long-term fertilization red soil of farmland soil fertility evolution characteristics, the low yield paddy soil improvement and management theory, method, technology, "high-yield, high-quality and high-efficiency rice production practical technology", "green organic tea production and practical technology", "southern slope to ramie industrialization of ecological system construction". Published 135 articles, including 10 SCI articles

- Signed cooperative R&D agreement with 4 companies to jointly carry out technical research.

Selected 20 scientific and technical personnel to serve as provincial science and technology correspondents to help key industries in the province

- Collaborative innovation base established with China Academy of Agricultural Sciences

Application/TEST site Presentation

i. Effect of Long-term Application of Chemical Fertilizer on Red Soil Paddy Soil:

To comprehensively evaluate the characteristics of long-term effect of different fertilizer application patterns of double-cropping paddy fields in red soil, soil fertility levels and physical, biological and chemical properties.

Set 10 processes（1）氮（N）；（2）磷（P）；（3）钾（K）；（4）氮磷（NP）；（5）氮钾（NK）；（6）氮磷钾（NPK）；（7）2倍氮磷钾（HNPK）；（8）氮磷钾+有机肥（NPKM）；（9）不施肥（CK）；（10）磷钾（PK）。
1) Nitrogen (N); (2) Phosphorus (P); (3) Potassium (K); (4) Nitrogen and Phosphorus (NP); (5) Potassium Nitrogen (NK); (6) Nitrogen, Phosphorus, Potassium (NPK) (7) 2 times Nitrogen, Phosphorus and Potassium (HNPK); (8) NPK + organic fertilizer (NPKM); (9) no fertilization (CK); (10) Phosphorus and Potassium (PK).

The treatment was repeated three times. The area of the plot was 46.6 m^2 and was randomly arranged.

Planting System-Early Rice - Late Rice - Winter.

Test data storage

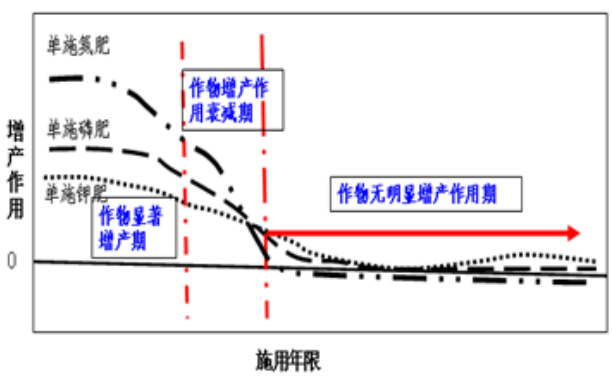
- More than 120 original soil data Rice grain and straw yield and nutrient data 5000;
- Nearly 4000 soil chemical data at different stages of the experiment;
- 4200 soil physical index data at different stages of testing;

- Soil biological data 3000; and
- Complete test site weather data.

Sample preservation: There are more than 500 plough layer soil samples: more than 500 samples of soil plough layers at different stages of the experiment;

More than 150 soil samples: More than 150 soil samples with different profile levels in 1985, 2002, 2003 and 2013.

Preliminary conclusion



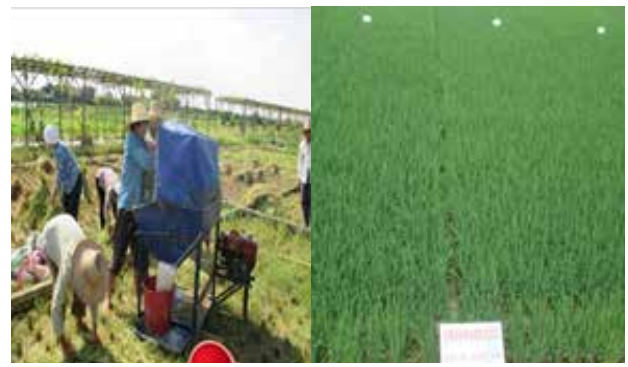
The phenomenon of "zero growth" in agronomic efficiency occurs after 15-20 years of continuous single application of chemical fertilizers.

Long-term fertilizer application alone or partial application will also lead to unbalanced soil nutrient deficiency, severe degradation of cultivated land quality, and this degradation will be difficult to repair in the short term.

ii. Effect of long-term application of organic fertilizer on red paddy soil:

The Objectives:

Comparing the differences of fertilization between the main organic manure sources in the south, monitoring the long-term changes in yield, stability, and physico-chemical and biological properties of soils in double cropping paddy soils under different organic manure management patterns, and analyzing the potential of chemical manure substitution under different organic manure management models



The experiment went through 9 processes:

1) Early-season rice was treated with 22.5 t/hm^2 (M1);

(2) Early-season rice was applied twice with Ziyun Ying 45t/hm^2 (M2);

(3) Early rice was applied with 22.5t/hm^2 of purple Yun Ying and 22.5t/hm^2 (M3) of pig manure;

(4) Early rice was applied with 22.5 t/hm^2 of Ziyunying and 22.5 t/hm^2 (M4) with pig manure;

(5) Early rice was applied with 22.5 t/hm^2 of Ziyunying, 22.5 t/hm^2 with pig manure and 4.5 t/hm^2 (M5) with winter straw cover;

(6) Early rice was applied with 22.5 t/hm^2 of Ziyunying and 4.5 t/hm^2 (M6) of winter straw cover;

(7) Early rice was applied with 22.5 t/hm^2 of Ziyunying and 4.5 t/hm^2 (M7) of rice with straw;

(8) NPK fertilizer (NPK);

(9) No fertilization (CK).

Repeat three times for each treatment. The plot area is 60 m^2 and randomly arranged.

Test data storage

- More than 120 original soil data;
- 4800 data on rice grain and straw yield and nutrient content;
- Nearly 3,600 soil chemical data at different stages of the experiment;

- Soil physical index data 4000 at different stages of the experiment;
- Soil biological properties data 2800;
- Complete test site weather data.

Sample preservation

- There are more than 480 samples of soil plough layers at different stages of the experiment;
- There are more than 140 soil samples in the section with different profile levels in 1985, 2002, 2003 and 2013.

Preliminary Conclusion: The management methods of organic fertilizers in double-season rice paddies are suitable for green manure + pig manure, pig manure + straw, and green manure + straw.

Double cropping paddy fields can continuously use organic fertilizer instead of fertilizer in the proportion of up to 20%. Continuous double seasons can apply organic fertilizer instead of chemical fertilizer up to 30%-40%.

iii. Effect of Long-term Application of Chemical Fertilizer on Dry land in Red Soil

Objectives:

Comprehensive evaluation of crop yields, soil fertility levels, and physical, biological, and chemical properties of the long-term red soil under different nutrient management practices.

10 processes

(1) Control (CK); (2) Organic Manure (OM);

(3) Nitrogen (N); (4) Phosphorus (P); (5) Potassium (K);

(6) Nitrogen and Phosphorus (NP); (7) Nitrogen and Potassium (NK);

(8) Nitrogen, Phosphorus, Potassium (NPK);

(9) Two-fold Nitrogen, Phosphorus, Potassium (HNPK);

(10) Nitrogen, Phosphorus, Potassium+ Organic Fertilizer (NPKM).

Each treatment was repeated three times, with an area of 22.2 m^2 and randomly arranged. Planting system early corn - late corn - winter leisure.

- *Dry Red soil*

Test data storage

More than 120 original soil data:

Data on the production and nutrient content of corn grain and straw 4000:

Nearly 3,600 soil chemical properties were tested at different stages:

4000 data on soil physical indicators at different stages:

2,000 soil biological data: complete test site meteorological data

Sample preservation:

- There are more than 500 plough layer soil samples;
- more than 500 samples of soil plough layers at different stages of the experiment;
- There are more than 150 soil samples in the section;
- more than 150 soil samples with different profile levels in 1985, 2002, 2003 and 2013.

Preliminary Conclusions

i. Double-season paddy field "soil crop synergy efficient carbon fixation" nutrient management technology model.

   Taking the annual cooperative management of organic fertilizers and balanced fertilization as the core, the problems of low organic matter content, imbalance of nutrients, large fluctuations in output, and low fertilizer use efficiency in the double-cropping paddy fields are mainly addressed.

ii. Red Soil Dryland: "Reducing Acid and Sequestration Carbon and Increasing Efficiency" Nutrient Management Technology Model

   Taking the "uplift of organic matter, acid reduction, and nutrient balance" as the core, it focuses on solving problems such as slow accumulation of organic matter, poor soil structure, acidification, and low nutrient availability in dryland of red soil.

Smart agriculture water and fertilizer integration

Significance: Water and fertilizer integration adopts intelligent facilities and technologies, and utilizes an advanced nutrient solution circulation system, temperature control system, and solution automatic ratio system. The nutrient utilization rate is over 90%, and the water utilization rate is over 70%.

At present, leafy vegetables and fruits are the focus of research and development and configuration for the Ministry.

The equipment for water and fertilizer integration was designed and installed in June 2016. It was completed and put into production in August. The greenhouse has an area of 2880 m^2, among which: 1680 m^2 of melon and fruit cultivation area and 1200 m^2 of water-cultured leafy vegetable cultivation area. At present, the types of vegetables cultivated include cherry tomatoes, fruit cucumbers, and string peppers. The types of water-cultured leafy vegetables include whitening, lettuce, Suzhou blue, and spinach.

- *Smart Agriculture in temperate control solution*

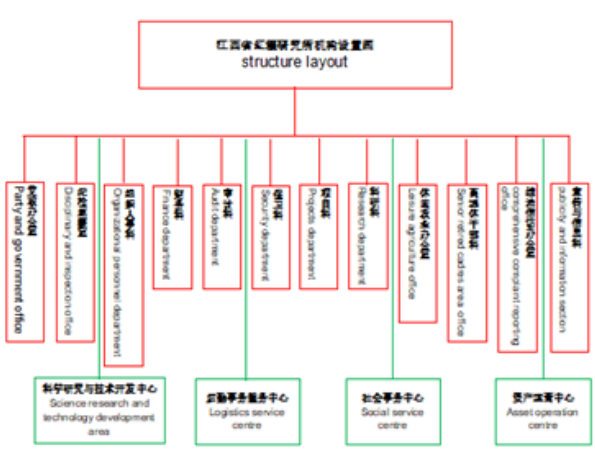
Economic benefits:

- Leafy vegetables: The production cycle is about 28 days, and 6.7 plants are planted at 666.7 m^2. Each batch yields 2,440kg, net income is 4,000 yuan, 10 batches a year, and the income is 40,000 yuan.
- Fruits: Fruit cucumbers are planted twice a year, in early March and mid-August respectively, with a production cycle of 4 months. With 1400 strains on 666.7 m^2, an average yield per plant of 16 pounds, a total yield of 22,400 kilograms, and an annual net income of Ten thousand Yuan from 2.43 acres.
- The tomatoes were planted at the end of August. The production cycle lasted for 9 months and the results at the beginning of October showed that 1400 strains were planted at 666.7 m^2. The yield per plant was 25 kg, the yield was 35,000 kg, and the net income was 32,700 yuan.

Flower production base

The construction started at the end of 2016 with an area of 120 Mu. There are 3 conjoined greenhouses and 16 small arches. This is a tour and purchase base with the theme of urban planting of flowers.

At present, there are 27 kinds of flowers that are mainly produced: South African marigold, Wuchunhua, Four Seasons Begonia, Ocean Impatiens, Snapdragon, Senecio, Sanbeth, Peacock Grass, Musk, Fraxinus, Petunia, Hollyhock, Periwinkle, Red, Geranium, Five-star flower, Foxglove, Cardinal chrysanthemum, Amaranth, Cockscomb, Dianthus, Pink chaff, Grass, Plant lips, Violet, Pansy, Primula, Horned Owl and so on. The annual production of flowers exceeds 5 million pots and the sales volume exceeds 20 million yuan.



Chapter 14

中国农产品质量安全监测与风险评估
China's Agricultural Product Quality Safety Monitoring and Risk Assessment

Institute of Agricultural Products Quality Safety and Standards, Jiangxi Academy of Agricultural Sciences

By: Zhou Yaoming
2018.6.24 Nanchang

Introduction

Dr.Zhou Yaoming in this chapter takes readers through the meaning and features of agricultural product quality safety, China's agricultural products' quality and safety development process, China's agricultural products' quality and safety supervision system, the overall situation of the quality and safety of agricultural products in China, and the definition and characteristics for quality and safety defined within the context and provision of Chinese law.

Main Contents

i. The meaning and features of agricultural product quality safety;

ii. China's agricultural products quality and safety development process;

iii. China's agricultural products quality and safety supervision system;

iv. The overall situation of the quality and safety of agricultural products in China

Main influencing factors determining quality and safety

Safety is a basic and minimum requirement, achieved by a series of management systems such as certification, inspection, and access under certain standard requirements.

Quality is to achieve refined superiority, to satisfy consumer's pursuit by providing high quality, and through good price.

i. Production and management methods: production environment and agricultural inputs, especially the use of agricultural and veterinary drugs. Maintaining the level of processing, storage and transportation: The processing, storage and transportation of fresh agricultural products directly affect the quality and safety of agricultural products

ii. Market circulation system: logistics system, sales channels and storage facilities determines the safety and quality standards. Likewise, the level of technological development: science and technology is a double-edged sword for the quality and safety of agricultural products.

iii. Concept of consumption: scientific, reasonable and correct consumption concept helps improve the quality and safety of agricultural products. Management system: management system, laws and regulations, management measures, etc.

The Characteristics of the Quality and Safety of Agricultural Products

i. Directness of hazards

ii. Concealment of hazards

iii. Accumulation of hazards

iv. Complexity of hazards

v. Management complexity

The scope of agricultural product quality and safety system

The quality and safety system of agricultural products includes the producers and sellers of agricultural products, as well as agricultural product quality and safety managers and corresponding inspection and technical institutions and personnel; furthermore, it also

includes the production environment, the rational use of agricultural inputs, and the standardization management of pre-production, mid-production and post-production of agricultural products, as well as packaging, labeling, marking, and market access management of agricultural products.

Development Process of the Quality and Safety of Agricultural Products in China

Three development stages

(I) The phase of pursuing quantitative growth (1949-1991)

（二）数量质量并重发展阶段（1992–2000）

(II) The phase of equal development of quantity and quality (1992-2000)

（三）质量安全全面提升阶段（2001–现在）

(III) The phase of comprehensive improvement of quality and safety (2001-present)

Comprehensive improvement of quality and safety (2001-present)

In 1998, China's grain output began to exceed 1 trillion kilograms, indicating that China's agricultural product supply and demand have entered a new phase of basic balance and surplus, and strategic adjustment of the agricultural structure is needed. Improving the quality and safety of agricultural products is an important part of strategic adjustment.

Three phases of pollution-free action plan was:

(I) Pilot start-up phase

(II) Comprehensive promotion phase

(III) In-depth pilot phase

Effects of pollution-free action plan

a. Since the implementation of the pollution-free food action plan, the level of the quality and safety of agricultural products has been significantly improved, basically helping ordinary people ensuring food security and availability laying a good foundation for ensuring the quality and safety of agricultural products under the framework of modern market systems.

b. Practice has proved that the proposed and implemented action plan is forward-looking and strategic, which is in line with the actual stage of agricultural development. It has played an extremely important role in accelerating the supervision of the quality and safety of agricultural products, and has also effectively improved the level of the quality of agricultural products.

c. China's original Food Safety Supervision System

   i. Previously, the implementation of food safety in China was a system of phased supervision and comprehensive coordination. The responsibilities between departments were not clear and it was difficult to coordinate.

d. In March 2018, the State Council's agency reform program established the State Market Supervision and Administration Bureau, which is directly affiliated to the State Council and officially listed on April 10, 2018.

e. Ministry of Agriculture: It is mainly responsible for agricultural product production and supervision before entering the wholesale market, retail market, and processing enterprises. Meanwhile, it has assigned the duty of designated pig slaughtering supervision to the Ministry of Agriculture, which was previously under the Ministry of Commerce, Besides, supervision of acquisitions, trafficking, and storage of agricultural products before entering the market is required. Supervision of inputs, veterinary drugs, feed and feed additives, seeds and seedlings (including aquatic product seedlings) is under the responsibility of the Ministry of Agriculture, while pesticides, and fertilizers are still subject to existing regulatory authorities and is supervised respectively.

f. Established Agricultural and Rural Products Quality and Safety Supervision Bureau to:

(1) Draft laws, regulations, and rules concerning the supervision of the quality and safety of agricultural products and propose relevant policies; formulate strategies, and plans for the development of quality and safety of agricultural products, and organize their implementation.

(2) Organize agricultural product quality and safety-risk assessments and propose technical trade measures; organize the research, promotion, publicity and training of agricultural product quality and safety technology.

3) Lead the work of agricultural standardization, organize the formulation of plans for the development of agricultural standardization, and conduct performance evaluation of agricultural standardization; organize the formulation or preparation of national standards for the quality and safety of agricultural products and related agricultural production materials and supervise their implementation; organize the formulation and implementation of agricultural industry standards.

(4) Organize agricultural product quality safety monitoring and supervision, as well as organize spot checks on agricultural production materials that may jeopardize the quality and safety of agricultural products, and be responsible for the early warning analysis and information release of the quality and safety of agricultural products.

(5) Guide the construction of agricultural inspection and detection systems and the assessment of institutions, be responsible for the construction and management of inspection and testing institutions for the quality and safety of agricultural products, be responsible for the examination, approval and daily management of quality inspection agencies at the ministerial level.

(6) Guide the certification management of agricultural quality system; be responsible for the management of pollution-free agricultural products, green food and organic agricultural products, implement certification and quality supervision; be responsible for the approval, registration and supervision of geographical indications of agricultural products.

(7) Guide the establishment of a quality and safety traceability system for agricultural products; guide the implementation of the agricultural product package labeling and market access management.

(8) Organize agricultural product quality and safety law enforcement; take responsibility for the emergency treatment of agricultural product quality and safety emergencies; take the lead to rectify and standardize the agricultural capital market order; organize and carry out anti-counterfeiting work; supervise the investigation and handling of major cases; guide the construction of the agricultural credit system.

(9) Prepare basic construction plans for the quality and safety of agricultural products, suggest project proposals and organize their implementation; prepare special financial plans for the sector, propose departmental budgets and special transfer payment arrangements, and organize or guide their implementation; propose scientific research and technology promotion projects in this field, undertake the selection and implementation of major scientific research and promotion projects.

(10) Carry out international exchanges and cooperation in the quality and safety of agricultural products.

g. Established Agriculture and Rural Product Quality and Safety Center to:

(1) Participate in the formulation and implementation of laws, regulations, plans, and policies concerning the quality and safety of agricultural products (agricultural inputs);

undertake the construction of agricultural product quality and safety supervision systems and technical guidance.

(2) Undertake the organization, implementation, publicity and training of agricultural national standards, industry standards and related technical specifications and project plans.

(3) Undertake relevant work on the inspection systems for agricultural product quality and safety, and the construction and management of relevant inspection institutions, and undertake the organization and implementation of national agricultural product quality safety monitoring project plans and capability verification.

(4) Undertake the construction and management of the national quality and safety traceability systems for agricultural products, undertake the work related to the construction of the agricultural credit (integrity) system, and contract the creation and evaluation of agricultural products' quality and safety, standardized production, and certificate of origin.

(5) Undertake relevant support work for the enforcement of quality and safety of agricultural products, special rectification, random inspections to prevent counterfeiting of agricultural materials, and supervision and inspection, and investigation into infringement of intellectual property rights.

(6) Conduct investigations on the quality and safety of agricultural products for emergency response and application complaints. Organize forums on the issues of the quality and safety of agricultural products and undertake scientific publicity on quality and safety of agricultural products, production guidance, and consumption guidance.

(7) Undertake the work related to the construction and management of agricultural product quality and safety supervision and information platforms, carry out statistical work on the information of agricultural products quality and safety, promote the quality and safety technology of agricultural products, and promote the management of farm product package labeling.

(8) Undertake the daily work of the expert group on the quality and safety of agricultural products of the Ministry of Agriculture and Technical Committee on standardization of agricultural products.

(9) Carry out international cooperation and technical exchanges related to the quality and safety of agricultural products, study on the assessing of technical trade measures of the quality and safety of agricultural products, and be responsible for the daily work of the Liaison Office of the Codex Alimentarius Commission.

China's Agricultural Product Quality and Safety Supervision System

i. Adherence to law supervision, ensures and gradual improvement of laws and regulations and institutional mechanisms

ii. Adherence to production, source control, and further promotion of agricultural standardization

iii. Adherence to the principle of prevention, risk prevention, monitoring, early warning and emergency response: Routine monitoring: 152 cities, 117 varieties, 94 indicators; Special monitoring: covering major cities in China, as regards pesticides, veterinary drugs, feed, and aquatic drugs; Risk assessment: 100 risk assessment laboratories and 145 risk assessment test stations in China, conducting risk assessment of 16 agricultural products such as vegetables, grain and oil, livestock and poultry, dairy products, and environmental pollution

iv. Adherence to a sound team, a solid foundation, and a rapid increase in supervision capabilities; Supervision system: all provinces, 88% of prefectures, 75% of counties and 97% of towns have established regulatory agencies and implemented 117,000 full-time and part-time management personnel. Law enforcement system: 99% of counties have carried out agricultural law enforcement work, and 28,000 law

enforcement officers are on the job. Technical support: Organize and carry out monitoring skills competition, formally incorporate agricultural product quality and safety inspectors into the Occupation Classification Code of the People's Republic of China.

The Overall Situation of Quality and Safety of Agricultural Products in China is steady and good

Steps taken:

- The first was the basic formation of the regulatory pattern according to law.
- The second is to effectively curb serious problems.
- The third is the strong protection of major events.
- The fourth is the solid advancement of agricultural standardization.
- The fifth is to strengthen the system construction.
- The sixth is to timely dispose of sudden problems.

Chapter 15

Green Agriculture Integration and Demonstration

Institute of Agricultural Products Quality Safety and Standards, Jiangxi Academy of Agricultural Sciences

By Zhou Yaoming

2018.6.24 Nanchang

The concept of green agriculture:

It refers to a pollution-free type of agricultural development that coordinates agricultural production and environmental protection, promoting agricultural growth and increasing the income of farmers while protecting the environment and ensuring the greenness of agricultural products. Green agriculture involves ecological material recycling, agricultural biotechnology techniques, comprehensive management techniques of nutrient, wheel cultivator techniques and so on. It is a very broad and comprehensive concept.

Features of Green Agriculture

i. Open and Compatible: Green agriculture makes not only full use of all the outstanding achievements of the progress of human civilization, especially the development of science and technology, it also enhances the comprehensive production capacity of agricultural products by relying on scientific and technological advancement and material investment. It attaches great importance to the quality, health and safety of agricultural products in order to meet human requirements of the quantity and quality of agricultural products,which reflects the characteristics of openness and compatibility.

ii. Sustained safety : Sustained safety means that under the premise of rational use of industrial input products, attention should be paid to the natural flow and cyclic shift of energy in biological systems among plants, animals and microorganisms to minimize losses in energy conversion and material recycling processes. Attach great importance to the sustainable use and protection of resources, and maintain a good ecological environment to achieve sustainable development.

iii. Comprehensive efficiency: Comprehensive and highly efficient, that is, the social, economic, and ecological benefits of green agricultural development are highly organically. Green agriculture not only pays attention to the rational development and utilization of resources, protection of the ecological environment, and the safeguarding of human food safety, but it also pays attention to the development of the agricultural economy, especially to the development of agricultural and rural economies in developing countries.

iv. Standardization: The normative criterian is that green agriculture clearly proposes that agricultural production should be controlled and managed in a systematic manner, with particular emphasis on the standardization of green agricultural products as a terminal product. The standardization of green agricultural products is to better the image and price of products as well as the standardization of market order, in an effort to achieve “higher prices for better quality” and improve the international competitiveness of green agricultural products.

Development Strategy of Green Agriculture in China

The Chinese Government in promoting the culture of Green Economy postulated the following strategies; to:

创新绿色农业发展科技，增强绿色农业发展科技支撑。

(1) Innovate green agriculture to develop science and technology and strengthen the support of green agriculture in science and technology.

（二）完善和创新绿色农业市场体系，发挥市场对绿色农业

有效调节作用。

(2) Perfect and innovate the green agricultural market system and give play to the effective regulation of the market for green agriculture.

(3) （三）加强绿色农业发展生态环境保护，增强绿色农产品附加值。

Strengthen green agriculture to develop ecological environmental protection and increase the added value of green agricultural products.

（四）发挥政府在绿色农业发展中的宏观调控职能，弥补绿色农业市场发展缺陷。

(4) Give play to the government's macro-control functions in the development of green agriculture and make up for the deficiency of the development of the green agricultural market.

Government pronouncements and policy that fostered Green Agriculture:

i. 2015 年 3 月 24 日，习近平总书记在政治局会议上关于发展现代农业的重要讲话中，提出了“绿色化”发展新观念。On March 24, 2015, General Secretary Xi Jinping proposed a new concept of “green” development in his important speech on the development of modern agriculture at the Political Bureau meeting.

ii. 2016 年国务院发布 《关于落实发展新理念加快农业现代化实现全面小康目标的若干意见》特别提出“加强资源保护和生态修复，推动农业绿色发展，推动农业可持续发展，必须确立发展绿色农业就是保护生态的观念，加快形成资源利用高效、生态系统稳定、产地环境良好、产品质量安全的农业发展新格局”。 In 2016, the State Council issued the Several Opinions on Implementing New Ideas and Accelerating Agricultural Modernization to Achieve a Comprehensively Well-Being Target. Particularly the State Council proposed “To strengthen resource protection and ecological restoration, promote green agricultural development and sustainable agricultural development, we must establish the concept of developing green agriculture is to protect the ecological environment, and accelerate the formation of a new pattern of agricultural development with efficient use of resources, stable ecosystem, good production environment, and product quality and safety.”

iii. 党的十九大报告明确指出要加快生态文明体制改革，建设美丽中国，“也要提供更多优质生态产品以满足人民日益增长的优美生态环境需要”，“加快建立绿色生产和消费的法律制度和政策导向”。The report of the 19th CPC National Congress clearly pointed out that we should speed up the reform of the ecological civilization system, build a beautiful China, and also provide more quality ecological products to meet people's growing needs of picturesque ecological environment and accelerate the establishment of the legal system and policy guidance of green production and consumption.

In April 2017, the main contents of Ministry of Agriculture's Circular on Implementing the Five Major Actions of Green Development of Agriculture are as follows:

(1) Livestock and Poultry Manure Pollution Resource utilization action. We will strive to basically solve the problem of the use of manure resources in large-scale farms by 2020.

(2) Fruit and vegetable tea organic fertilizer in replacement of chemical fertilizers. We will strive to reduce the use of chemical fertilizers in the advantageous production areas of fruit and vegetable tea by 20% or more by 2020, as well as in core production areas and well-known brand production bases.

(3) Straw processing operations in Northeast China. It is expected that by 2020, the comprehensive utilization rate of straw in the northeast region will reach over 80%, and the utilization of straw will increase by more than 27 million tons.

(4) Agricultural film recycling operations. We will strive to achieve more than 80% of agricultural film recycling rate by 2020.

(5) Actions for aquatic life conservation with the Yangtze River as the focus. It is expected that by 2020, the decline in the aquatic life of the Yangtze River Basin, deterioration of aquatic ecosystems, and declining aquatic biodiversity will be effectively curbed, and the aquatic biological resources will be restored. The total marine fishing will be coordinated with the total carrying capacity of the fishery resources.

Recent Achievements

In September 2017, the General Office of the CPC Central Committee issued the Opinions on Innovating the Institutional Mechanism to Promote Green Agricultural Development and the main opinions include:

1. Optimize the main functions and spatial layout of agriculture

   二、强化资源保护与节约利用

2. Strengthen resource protection and conservation

3. Sstrengthen the environmental protection and control of production areas

   四、养护修复农业生态系统

4. Conserve and restore agricultural ecosystems

   五、健全创新驱动与约束激励机制

5. Improve innovation-driven and constraint incentive mechanisms

   六、保障措施

6. Safeguard measures

Latest Technology Agriculture:

A. Dustless farming:

Features:

1) In terms of thinking methods and concepts, “dustless agriculture” should not only consider pollution prevention, but also consider from the source on how to avoid or reduce the generation of waste and pollutants. In concept, it involves the integration and sustainability of products, people, and nature.

2) For the control of pollutants, in general, pre-medication, end-of-pipe treatment and the adoption of a passive approach to governance will be utilized in agricultural production. “Dustless agriculture” is to start from the source, and strive to complete the process of zero emissions or reduced emissions.

3) In the prevention and control of diseases, pests and weeds. The general agricultural industry focuses on the diagnosis when animals and plants are harmed, and then considers what medicine to use for treatment. “Dustless agriculture” focuses on the problems that have arisen in the past and how to correct and prevent them from recurring.

- *Dustless fruits and vegetables plants in Nanchang. During the entire process, from the fruits and vegetables' being planted to being harvested, dust is nowhere to be seen."*

B. "Runway" fish farming

生态渔业生产模式是采用现代生物技术和工程技术，按生态规律进行生产，保持和改善生产区域的生态平衡，

I. The ecological fishery production model is a green fishery production model which adopts modern biotechnology and engineering technology, carrying out production according to ecological rules, maintaining and improving the ecological balance of the production area, ensuring that the water is not polluted, maintaining the dynamic balance of various aquatic organisms, and a reasonable food chain network structure. The "runway" fish culture currently being promoted in Zhejiang Province has opened up new methods for fishery green production.

ii. Fish farming not only increases the breeding density, but more importantly reduces farming pollution. At the other end of the "runway", sewage collection equipment was built to push water and oxygen to allow the water in a pond to hydrostatically flow. The fish manure and residual feed produced during the cultivation process flow into the sewage path along the circulating water stream, most of which could be recovered to be made into organic fertilizer and the remaining manure was recycled into a purification zone outside the cement tank. Not even a drop of water will flow to the outside during the entire cycle.

iii. Compared with other new models, the "runway fish farming" recirculating aquaculture technology model reduces the time for adult fishes to enter market to half. It not only saves costs, but is also easy to manage. The most important thing is that it can also make the fish ponds efficiently purify themselves, while improving the quality of the fish.

iv. The "runway fish farming" recirculating aquaculture technology model achieves zero discharge of tail water through centralized breeding, centralized suction and centralized treatment, and thus promotes a greener and more efficient development of fishery industry.

C. Precision agriculture

The core technologies are the application of Geographic Information System (GIS), Global satellite Positioning System (GPS), Remote sensing Technology (RS) and computer automatic control system in agriculture. These systems are used to finely and accurately adjust soil and crop management measures, optimize agricultural inputs, and achieve high yields and benefits while protecting agricultural natural resources, in accordance with the specific conditions of each operation in the field.

D. Packaging agriculture

In order to meet people's desire to purchase high-quality, high-nutrition products, new agricultural industrialization projects were launched outside the market. In order to gain the love of consumers, more attention must be paid to packaging of agricultural products while emphasizing product quality and scale.

E. Tourism agriculture

With the increase of income, basic living being met already, and the increase of leisure time and improvement of various material conditions,

people have increasingly felt the narrowness and discomfort of urban space, so they need to experience the feeling of being embraced by nature while requiring food freshness and safety. The rise of tourism agriculture not only satisfies these requirements, but also exerts its functions of leisure and holidays, ecological protection, and enrichment of life. The mutually exclusive and antagonistic relationship between urban and rural areas will become complementary and integrated.

Research /demonstration cases:

The main research methods for the green production and efficiency enhancement of agricultural products include:

（一）强化顶层设计，制定详细工作方案

(1) To strengthen top-level design and formulate detailed work plans

（二）开展协同攻关，加强技术集成与创新

(2) To carry out collaborative researches, strengthen technology integration and innovation

（三）注重基地建设，充分发挥示范带动作用

(3) To pay attention to the construction of bases and give full play to the exemplary driving role

（四）强化组织管理，创新工作机制

(4) To strengthen organizational management and innovate work mechanisms

（五）强化保障措施，加强宣传推介

(5) To strengthen safeguard measures, publicity, and promotion.

Through many years of collaborative researches and demonstrations, a number of technologies have been integrated, and significant yield, efficiency, ecological, and environmental benefits have been achieved. Presently, the results of the current researches on the main modes of green agricultural products in China are demonstrated as follows:

- 集成高产优质新品种、养分专家系统配方施肥、化控抗逆、生物疫苗、籽粒收获、收储减损和信息化管理等18项技术，形成区域性玉米生产技术模式，即“农机农艺八配套、科学播种六融合、绿色防控四结合”。
- Integrating 18 technologies that include new high-yield and high-quality varieties, nutrient expert systems for formula fertilization, chemical resistance control, biological vaccines, grain harvesting, storage and depletion, and information management and forming a regional corn production technology model, which comprises, “eight sets of agricultural machinery and agronomy, a combination of six scientific sowing techniques, and a combination of four green prevention and control measures.

Effects of wheat model research

在河南、山东、安徽、江苏、河北5省建立试验示范基地5个，集成高产优质抗逆小麦新品种、测土配方施肥、节水栽培、蓄水灌溉、墒情监测与灌溉预报、病虫草害综合防治等多项技术。

Five experimental demonstration bases were established in five provinces of Henan, Shandong, Anhui, Jiangsu and Hebei to integrate new high-yield, high-quality, stress-tolerant wheat varieties with soil testing, formula fertilization, water-saving cultivation, impounded irrigation, flood monitoring and irrigation forecast, comprehensive prevention of pests and weeds and other technologies.

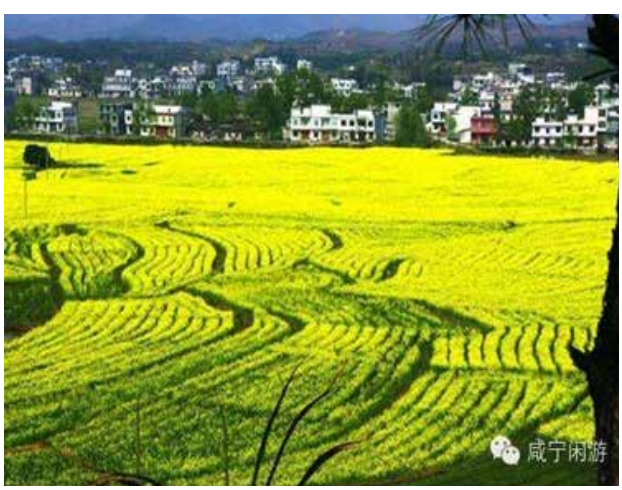
Effects of rice model research

在江西、浙江、湖南、安徽、湖北等地建立12个试验示范基地，集成高产优质品种、“麦畦式”湿种栽培、机插无图基质育秧、绿色防控等11项核心技术。

- Twelve pilot demonstration bases were established in Jiangxi, Zhejiang, Hunan, Anhui, and Hubei province, integrating 11 core technologies including high-yield and high-quality varieties, “Maiji-style” wet seed cultivation, machine-injection-free substrate breeding, and green prevention and control measures.

Effects of rape seed research

Three high-yielding and high-efficiency demonstration bases have been established in the main production areas of the Yangtze River Basin. Eight advanced technologies involving new varieties, full mechanization, efficient utilization of fertilizers, and rapid decomposition of stalk sclerotia have been integrated to overcome some key technology problems in the cultivation of high-yield mechanized varieties of rape seed, efficient mechanized cultivation of rape seed, combined harvest of rape seed and so on.



Effects of soybean model research

Nine demonstration bases were established in the Huang-Huai-Hai, Northeast and Northwest China, to integrate nine key technologies, namely new high-quality and high-yield varieties, grain-pea rotation, straw-return, shallow deep-swapping, decrement and efficiency fertilization, green prevention and control of pests and diseases, safe application of herbicides, and full mechanization, quality control and food processing.

Effects of cotton pattern research

Intensified demonstration bases for core production in Xinjiang, Hebei, Inner Mongolia, and other five key demonstration bases integrate 14 new core technologies, including new cotton varieties, drone defense, and integrated pest management, to study new types of biodegradable plastic film and lightweight machine tools for picking up cotton. As a result 5% to 8% productivity gains have been achieved, which meets water-saving and ecological environmental requirements.

Effects of cow model study

Three core demonstration bases and seven radiation-driven demonstration zones were deployed in Shandong, Heilongjiang, Inner Mongolia, and Ningxia province, integrating nine key technologies, which are the management of demonstration high-performance counter-measures for dairy cows, early weaning of yaks, supply and evaluation of fully-mixed daily rations, comprehensive control of mastitis, and waste treatment and recycling.

Sheep technology integration mode

Three demonstration bases were established in the northwest mutton predominance area, the dominance area of mutton sheep in the middle and eastern agricultural-pastoral zone, and the mutton dominance area of Central Plains. The integration of alpine Merino breeding and crossbreeding techniques, multi-fetal genetic testing and efficient breeding techniques, and linear formulas Fattening technology, feed processing modulation, major disease prevention and control, mutton ice temperature preservation, mutton traceability, waste treatment, "ten-unification" high-quality fine wool standardized production technology, all of which has produced a remarkable effect.

Study on potato model

In Zhangjiakou, Hebei Province, the demonstration base will integrate seven core technologies: high-yield and high-quality varieties, rapid propagation of virus-free seed crops, integration of water and fertilizers, efficient water use, mechanized cultivation, and staple food processing.

Final suggestions for the development of green agriculture

The report of the 19th CPC National Congress pointed out that "we must establish an all-green carpet economic system for cyclic development, build a market-oriented green technology innovation system," and "fully promote resource conservation and recycling," and thus realize a circular link between the production systems and the living systems. In response to the current situation of China's agricultural development and the requirements of green agriculture, the following suggestions are made:

- Construct the green consumption value system and advocate the concept of green agriculture ecological development concept.
- Construct the agricultural production technology system characterized by the export of "green, high-quality and safe" agricultural products.
- Build an efficient resource utilization technology system characterized by ecological cycles.
- Construct a multifunctional ecological security system for agriculture.
- Build an assessment system for agricultural development based on green agriculture.
- Build a demonstration area for green agricultural development, foster brands and advantageous enterprises, and promote the development of industrialization.

Chapter 16

Introduction to China Base Construction, Management and Operation Services

Background

In August 2011, the provincial government transferred nearly 6,000 Mu of land from the original Dudu Farm to our Institute for the creation of a demonstration base for scientific and technological innovation.

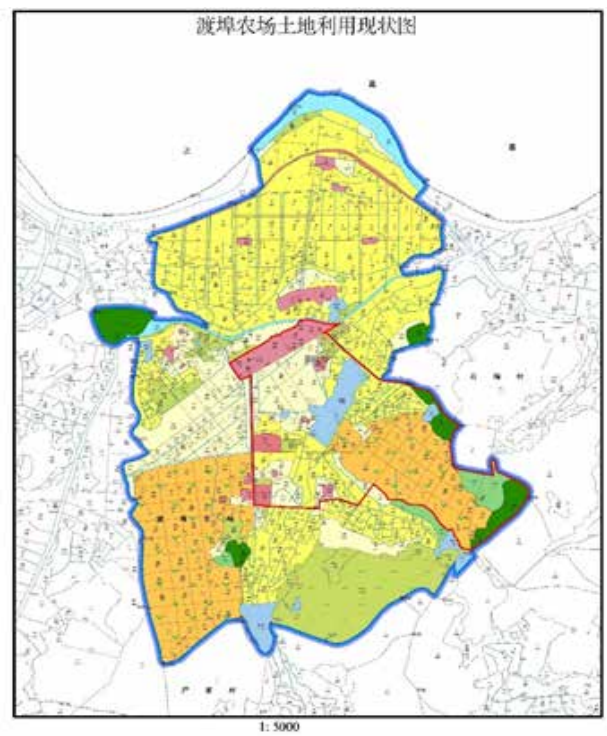
The Chinese base center is located in Xiangcheng town of Gaoan City, surrounded by mountains on three sides and facing rivers on one side. The region covers 2,800 acres of paddy fields, 1,000 acres of dry land, 900 acres of tea gardens, 800 acres of mountainous region, in addition to buildings and roads. The landscape, fields and gardens, forests and grass of the base are all typical of the Jiangnan region.

The Center adheres to the "management is service" slogan. "The core is to serve the scientific research and demonstration" concept of the Peoples Republic of China. Up to now, there are around 50 scientific research projects at the national, provincial, and ministerial levels that have taken the lead in setting up bases.

In 2017, the base successfully held approximately 20 academic conferences and about 30 industry training sessions. The total number of people receiving training was more than 1,400.

The Chinese Center Management institution also informed how it has been instrumental in setting up corporate platforms to focus on the overall layout of the "3 (Scientific Research, Demonstration, Education) +N (Tourism, Product)" base. This "trinity" of the company's operating platform, innovation and entrepreneurship platform, and achievement transformation platform, constitutes the main body frame of the base's long-term development.

Contents



Overview

In May 2012, the provincial government and the Chinese Academy of Agricultural Sciences signed a Letter of Agreement on the Cooperation and Construction of Modern Agricultural Science and Technology Innovation Demonstration Base in the Poyang Lake Ecological Economic Zone.

In December 2012, the construction of Gaoan Base was approved by the Provincial Development and Reform Commission, with a construction fund of RMB 1.24 billion, which comes from the State and Provincial Project Construction Funds, Land Transfer of Jiangxi Province Academy of Agricultural Sciences and investment promotion programs.

In July 2014, Gaoan Base successfully applied for the National Agricultural Science and Technology Innovation and Integration Demonstration Base (100 bases in China and 3 bases in Jiangxi province).

Achievements

A total of 19 projects have been completed and accepted, and nearly 300 million yuan has been invested in eight projects that are under construction.

The base possesses global intelligent monitoring and wireless WIFI coverage.

Fifty scientific research projects at the national, provincial, and ministerial levels have taken the lead in setting up bases.

In 2017, the base successfully held approximately 20 academic conferences and about 30 industry training sessions. The total number of people who received training was more than 1,400.

- *aerial photography of the Retrofitted standard grainfield*

- *Irrigation systems*

Chapter 17

Climate-smart Soil and Water Conservation Plant Cultivation
Technologies & Methodologies

By: Prof Wang Jiawen

Introduction

Prof Wang discussed the theories Climate of change, challenges and solutions as well as how China has coped and is still coping. In summary he disclosed that the best way for all economies to embrace Climate-smart Agriculture (CMA):

i. By ensuring the provision of Sustainable Food Production (SFP) Income

ii. Sustainable Adaptability to Climate Change

iii. Reducing and Removing GHGs Emissions

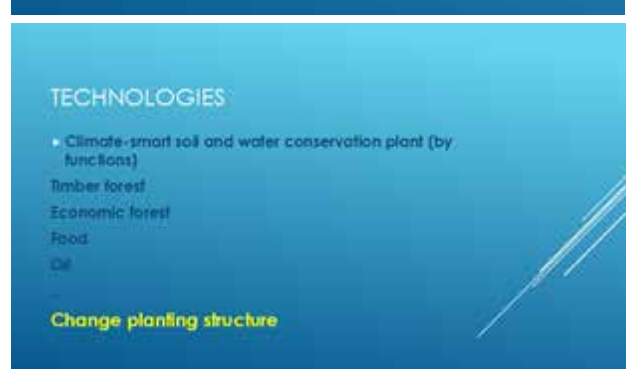
He enumerated the available technologies for tackling degraded lands and climate-smart soil and water conservation and mitigation practices: for example, vegetation restoration – perennial vegetation, land improvement – drainage, nutrients, soil cultivation – rotation, fallow, cover. He also concluded that China would be willing to assist other countries in this direction.

Contents

Challenges of Climate Change

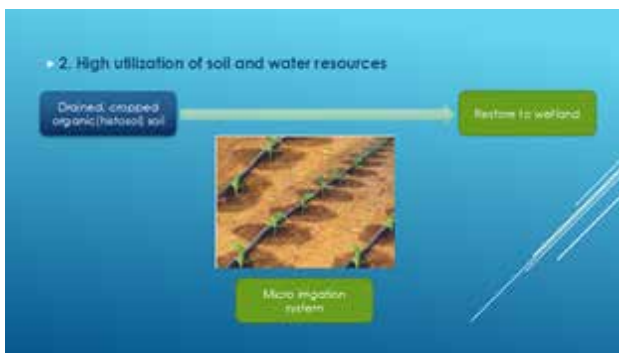
- Food and Livestock Reduction
- World's Population Explosion
- Starvation
- Vanishing Vegetation

Relationship between Soil and Water Conservation and Climate-smart Agriculture

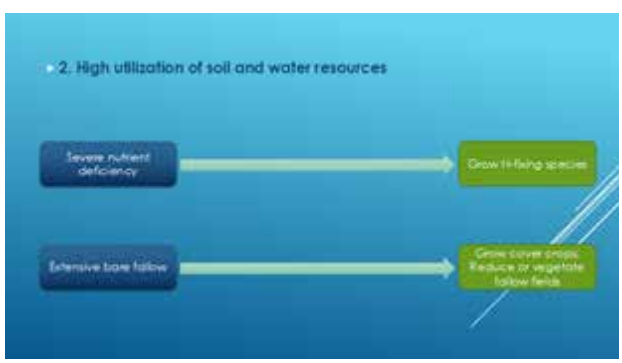


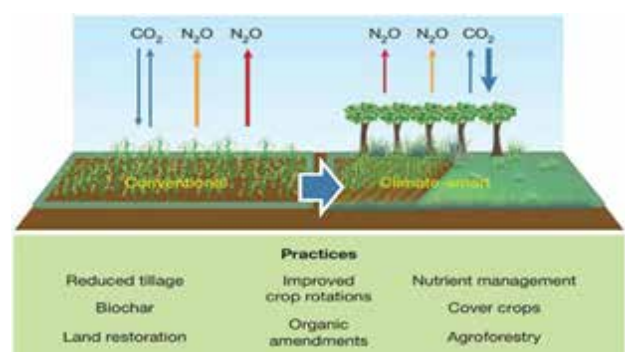

TECHNOLOGIES & METHODOLOGIES
2. High utilization of soil and water resources
Degraded or marginal land
Convert to perennial vegetation
Bunds/ a type level furrow


2. High utilization of soil and water resources
Forest-grass system
Agroforestry


2. High utilization of soil and water resources
Drained, cropped organic (histosol) soil
Restore to wetland
Micro irrigation system


Conserve
Improve
Stabilize


2. High utilization of soil and water resources
Severe nutrient deficiency
Grow N-fixing species
Extensive bare fallow
Grow cover crops. Reduce or vegetate fallow fields


CO_2 N_2O N_2O
N_2O N_2O CO_2
Conventional
Climate-smart
Practices
Reduced tillage
Biochar
Land restoration
Improved crop rotations
Organic amendments
Nutrient management
Cover crops
Agroforestry


2. High utilization of soil and water resources
Intensive tillage
Reduce or halt tilling; residue retention
Residue retention


2. High utilization of soil and water resources
Fallow paddy field
Grow potato in rice straw

Chapter 18

Analysis on Watershed Ecological Water Requirements: Theories, Methods, Practices

By: Prof Wang Jiawen

Introduction

Prof Wang Jiawen introduced to the basic characteristics of river ecosystems:

Concept, composition, structure and function as well as the reasons for ecosystem imbalance. Theories on watershed ecological water requirements and types were also discussed. This included:

i. Ecological effects of water cycles
ii. Ecological water requirements – type and divisions
iii. Analytic hierarchy of river water requirements
iv. Supporting effects of groundwater on ecology

The paper discussed the various applications and theories which includes Schumm's Geomorphic Theory of:

i. Water loss and soil erosion control in slope land system
ii. Judgement of river type conversion
iii. River delta system evolution

This presentation also discussed the geomorphic index of river minimum ecological water requirements as a method in minimum river water requirement, analysis theory on runoff and riverbed morphology, hydrologic station section representative with river reach calculation steps via hydrologic station data and characteristics of runoff and river bed geomorphology analysis methods, with the conclusion that key index and reliability analysis of river ecological water requirement will rest on Method of Reliability analysis and Algorithm and test.

The general practice is guided by the following steps:

- General situation
- Analysis on control section
- Calculation and analysis on minimum ecological water requirements
- Calculation and analysis on minimum ecological water requirements
- Comprehensive analysis on key index of ecological water requirements
- Preliminary evaluation of river ecological water consumption and Summary

Theories on watershed ecological water requirements and types

- Ecological effects of water cycles
- Ecological water requirements – type and divisions
- Analytic hierarchy of river water requirements
- Supporting effects of groundwater on ecology
- Minimum river water requirement; methods

Applications of Schumm's Geomorphic Theory

i. Water loss and soil erosion control in slope land system
ii. Judgement of river-type conversion
iii. River delta system evolution

Geomorphic index of river-minimum ecological water requirements

iv. Water and sand motion equation
v. Threshold of river existence

vi. Analysis on geomorphic critical exponents of river minimum ecological discharge

Applicable condition of various river section

vii. River section morphology classification and characteristics

viii. Analysis of critical index of various river section

River minimum non-biological water requirements calculation

i. Analysis theory on runoff and riverbed morphology

ii. Hydrologic station section representative with river reach

iii. Calculation steps via hydrologic station data

iv. Characteristics of runoff and river bed geomorphology analysis method

Steps for other types of analysis

Analysis on optimum river ecological water requirements:

Structure and Function

i. River ecological system's structure

ii. Characteristics

iii. Integrity and stability

iv. Ecological significance of fish in river system

Key index and reliability analysis of river ecological water requirement

Integrity Analysis

i. Hierarchy

ii. Integrity analysis theory

iii. Integrity analysis method

Key index

i. Determination principle

ii. Evaluation of watershed river ecological water requirements

iii. Extending analysis on key index

Reliability Analysis Evaluation

i. Method of Reliability analysis

ii. Algorithm and test

Practice

- General situation
- Analysis on control section
- Calculation and analysis on minimum ecological water requirements
- Comprehensive analysis of key index of ecological water requirements
- Preliminary evaluation of river ecological water consumption
- Summary

Chapter 19

The Policy of Soil and Water Conservation in Watershed Management

Introduction

This is an important policy in watershed management in China. The adoption of a holistic approach for conserving mountains, rivers, forests, farmlands, lakes, and grasslands.

In the report of 18th Central Committee of the CPC to the 19th National Congress President Xi Jinxing said that we should ensure harmony between humans and nature…

- "We will adopt a holistic approach to conserving our mountains, rivers, forests, farmlands, lakes, and grasslands,"….
- "Implement the strictest possible systems for environmental protection, and develop eco-friendly growth models and ways of life."

The highlighted principles which have guided the various polices of China through the periods of Reforms, are now going to be applicable on soil and water conservation in watershed management. In an attempt to speed up reform of the system for developing an ecological civilization, and building a beautiful China, the Central Committee has decided to:

i. promote forestation, with comprehensive steps to control desertification, stony deserts, and soil erosion,

ii. strengthen wetland conservation and restoration, with better preventive and control measures.

iii. Rigorously protect farmland and expand trials in crop rotation and land fallowing, while;

iv. It improved systems for regeneration of crop lands, grasslands, forests, rivers, and lakes, and set up diversified market-based mechanisms for ecological compensation.

Law and regulation system for watershed management

Law: By the National People's Congress of People's Republic of China(PRC) and its Standing Committee:

- Water law
- Soil and water conservation law
- Flood control law
- Prevention and control of water pollution law
- Land management law
- Forest law
- Grassland law

The Law and regulation system for watershed management was also been instituted. More important was the policy of natural forest conservation (participatory planning) and turning marginal farmland into forests and grasslands by forestry administrative agencies. This is useful for soil and water conservation, flood control and for ecological protection.

The policy of soil and water conservation is based on the following concept: to tackle changes of soil and water loss and its influence factors in a region; Soil and water of production and construction project with the component of evaluation and monitoring of production and construction projects as well as environmental impact assessments:

According to the scale of project management, the Ministry of Water Resources was in charge while administrative agencies took charge in the provincial, district and county levels of government.

- *The policy of soil and water conservation in watershed management*
  流域管理中的水土保持政策

- It is an important policy in watershed management to adopt a holistic approach towards conserving mountains, rivers, forests, farmlands, lakes, and grasslands. In the report of 18th Central Committee of the CPC to the 19th National Congress, President Xi Jinxing said that we should ensure harmony between humans and nature; other Highlights of the report includes the followings:
- We will adopt a holistic approach to conserving our mountains, rivers, forests, farmlands, lakes, and grasslands.
- Implement the strictest possible systems for environmental protection, and develop eco-friendly growth models and ways of life.
- Speed up the reform of the system for developing an ecological civilization, and building a beautiful China.
- We will promote forestation, take comprehensive steps to control desertification, stony deserts, and soil erosion.
- Strengthen wetland conservation and restoration, and prevent and control geological disasters more effectively.
- We will improve the system for protecting natural forests, and turn more marginal farmland into forests and grasslands.
- We will rigorously protect farmland and expand trials in crop rotation and keeping land fallow.
- We will improve systems for regeneration of croplands, grasslands, forests, rivers, and lakes, and set up diversified market-based mechanisms for ecological compensation
- The mountains, water and lake are geographic concepts:
- Mountains are the source of rivers and where it is easy for soil erosion
- Water includes surface water and ground water, rivers are the path of water transferring

Law and regulation system for watershed management

Law instituted by the National People's Congress of People's Republic of China (PRC) and its Standing Committee:

- Water law
- Soil and water conservation law
- Flood control law
- Prevention and control of water pollution law

- Land management law
- Forest law
- Grassland law
- Guidelines in soil and water conservation law

The main job is preventing soil and water loss, the priority job is protection ecological environment.

Comprehensive planning and to control soil and water conservation.

Adapt to local conditions and highlight key points.

Scientific management and benefit is important.

Administrative regulations : by the central government of PRC

Local law and administrative regulations are formulated by the local people's congress and government at the:

- Province level
- District level
- Minority autonomous county level

Administrative management systems for watershed management

- Central government
- A certain vice-premier in charge of affairs of agriculture forestry water resource and ecological environment
- Ministry of Water Resources
- Ministry of Natural Resources
- Ministry of Environmental Protection
- Ministry of Agricultural and Rural Development
- Ministry of Emergency management (flood control)

In the central government, there is the department of soil and water conservation in the Ministry of Water Resources, whose duty is policy-making and management of soil and water conservation

Administrative management systems for watershed management

- local government
- Province level
- District level
- County level

Administrative management systems for watershed management

River basin management agencies:

- Vice-minister level agency from Ministry of Water Resources
- SL: Song-Liam Water Resources Commission
- Hai: Haihe River Water Resources Commission
- Ye: yellow river conservancy commission
- Huai: Huaihe River Water Resources Commission
- Yz: Changjiang Water Resources Commission
- Zh: Zhujiang River Water Resources Commission
- Tai: Taihu Basin Authority

The Policy of Natural Forest Conservation

- Forests in China mainly in the south and northeast part
- Natural forests mainly in the southwest and northeast part

The Policy of Natural Forest Conservation

The policy of natural forest conservation and turning marginal farmland into forests and grasslands is in the charge of forestry administrative agencies, which is useful for soil and water conservation, flood control ecological protection

- Started 1999, after the big flood in Yangtze and Songhuajiang-Nenjiang river in the upper reaches in the Yangtze river and the middle and upper reaches of the Yellow river and other forest region especially in the

northeast of China With the policy of Natural Forest Conservation, Forestry workers no longer cut trees and instead became the workers protecting forestry, employed by the government.

The policy of River Chief System

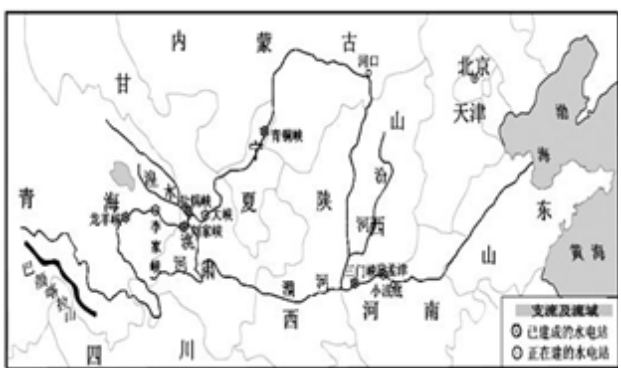
- The river chief system determines the responsibilities system of the local chief.
- The feature of cross-watershed affairs shows that a single water-related department can not handle it, hence the problems of failure of watershed treatment coordination and fragmentation of watershed treatment were faced.
- The river-chief mechanism, an approach of inter-departmental coordination, can effectively solve the problem of lack of authority and has an obvious effect in the short run.

Chapter 20

The Impact of Soil and Water Conservation on Stream Flow and Sediment Flux Changes in China

Nanchang Institute of Technology

A case study in north China



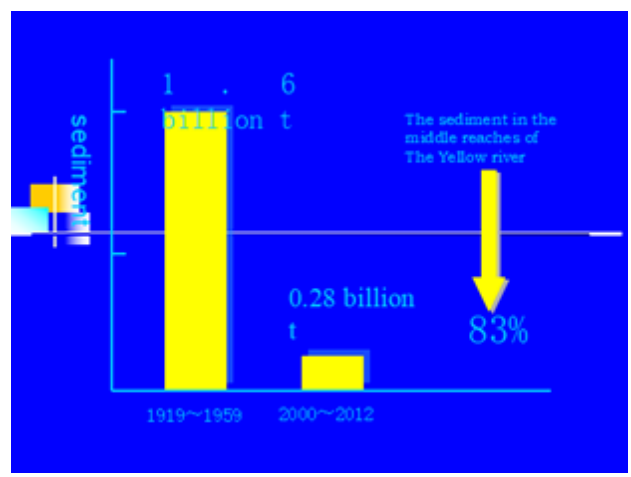
Introduction

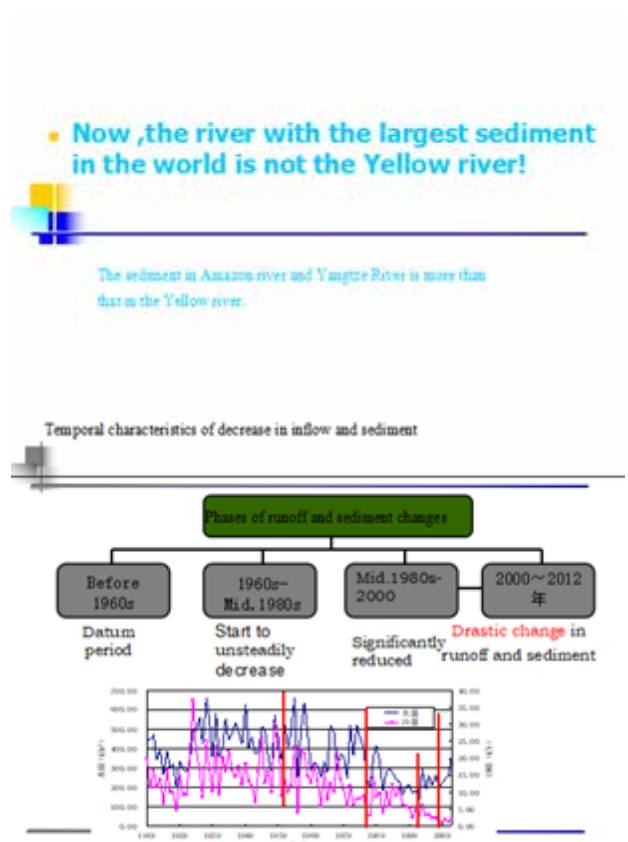
The paper is subdivided into 2 parts: The Changes of Stream Flow and Sediment Flux in the Yellow river: A case study in north China and The Changes of Stream Flow and Sediment Flux in the Yangtze river: A case study in south China. The paper also addressed the evaluation of soil and water conservation on stream flow and sediment flux.

With the decrease in flood and erosion, water utilization for transferring sediment would reduce, water resources would increase which could be utilized. After soil and water conservation, a part of flood water was changed into soil water evaporation in farmland grassland and forest, which is useful as virtual water in the products of agriculture, livestock and forestry.

Historically, the Yellow river, called the mother river of China has similarity with river Niger. This is because both Niger and Yellow River have similar upper reaches; rainy plateau; Middle reaches: desert and lower reaches: rainy plains. The lecture informed that the length of the Yellow River is x 27 cycle of the Earth. The Yellow river was called the river with the largest sediment in the world with about 1.6 billion tons of sediment. But has over the years undergone de-silting processes.

Now ,the river with the largest sediment in the world is not the Yellow river! The sediment in Amazon River and Yangtze River is more than that in the Yellow river.





- In the Yellow river and most rivers in the north China there has been a significant decrease in inflow and sediment; The decrease in sediment is more significant than that of inflow ;

Flood decreased, the difference between maximum and minimum discharge was reduced.

The reasons for inflow and sediment changes

- The inflow and sediment changes because of both climate (rain) changes and human activity
- In the past decade, the rainfall not changed
- The inflow changes were mainly due to water use, especially for irrigation purposes
- The other reason for inflow changes is soil water conservation and land use changes
- The sediment changes were mainly because of soil water conservation and land use changes
- The other reason for sediment changes is reservoir storage

The reason of inflow and sediment changes

- After soil and water conservation
- More rainfall infiltrated into soil and ground water
- Surface runoff and flood decreased
- Soil erosion decreased
- Some flood water and sediment was stored by soil and water conservation engineering
- There were no significant changes of inflow in the Yangtze river, which is the difference of inflow and sediment changes between rivers in north and south China
- In other word , in south China there is no clear impact of soil and water conservation on river inflow amounts
- In the humid climate zone, the actual evaporation can achieve evaporation potential, which is determined by climate conditions
- The increase in soil water does not mean increase in soil water evaporation, which is different in arid and semi-arid regions such as north China
- Where actual evaporation usually is less than evaporation potential, if soil water increases, the evaporation will increase
- So after soil and water conservation, although surface runoff decreases, the annual runoff does not decrease
- The increase in rainfall infiltration supplements underground water, which will form the base flow of the river
- In most stretches of the Yangtze river, sediment formation has decreased from 1990 onwards, due to soil and water conservation
- The significant decrease in sediment in the middle of the Yangtze river after 2003 is related to the storage of water in the Three Gorges reservoir.

The evaluation of soil and water conservation on stream flow and sediment flux:

- After the 1990s, sediment in most rivers in China decreased because of soil and water conservation, reservoirs and other human activity.
- After soil and water conservation, runoff decreased in the arid and sub-arid region of China, the main problem is floods.
- While the annual runoff has not decreased in the wet part of China, but soil and water conservation can change surface flood into ground water and base water of river.
- With the decrease in flood and erosion, water utilization for transferring sediment would reduce, and so utilizable water resource can increase.
- After soil and water conservation, a part of flood water was changed into soil water evaporation in farmland grassland and forest, which becomes the virtual water in the products in agriculture, livestock and forestry.

The increase in virtual water by soil and water conservation

- Virtual water: The water utilization embedded in production of goods and services

Enhanced Water Saving Capacity by Optimizing Technical Options

This section focuses on presentations from 9 provinces of China. The presentations relate experiences of prior precarious situations, and offer knowledge-sharing on important World Bank-supported landmark projects that have addressed situations of Watershed Management, Agriculture and Water Conservancy.

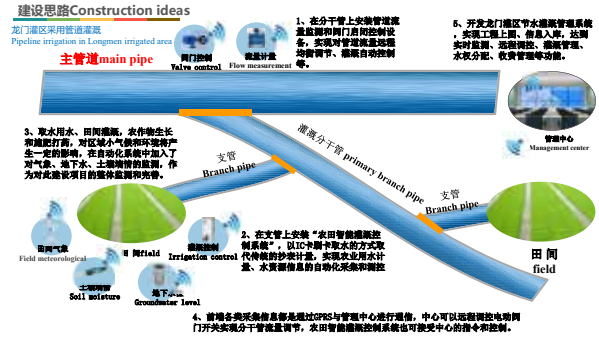
The presentations also described the various stages of pre-project planning, as well as the World Banks' best practices as regards implementation activities during project implementation. The World Bank sheds light on project construction management with many advanced construction management experiences. Many multi-industry experts participated in the various preliminary works of consultation, comprehensive measures were adopted to promote the concept of water-saving irrigation. The importance of a regular on-site inspection system, tender procurement, construction management, community mobilization, strategic communication and information system were emphasized. The entire process of an independent monitoring and evaluation system, payment methods for withdrawals and reimbursements, multi-sectoral and multi-industry cooperation and coordination mechanisms, etc., all these management measures, reflect the rationalization of the bank's development projects, and the scientific system management norms, to ensure the fundamental realization of all project objectives.

山西省世行贷款节水灌溉二期项目交城县龙门灌区信息化技术与应用

Shanxi Province World Bank loan water saving irrigation project II (WCP II)
Information technology and application
in Jiaocheng Longmen irrigation area

交城县世界银行贷款节水灌溉二期项目领导组办公室
Jiaocheng county PMO

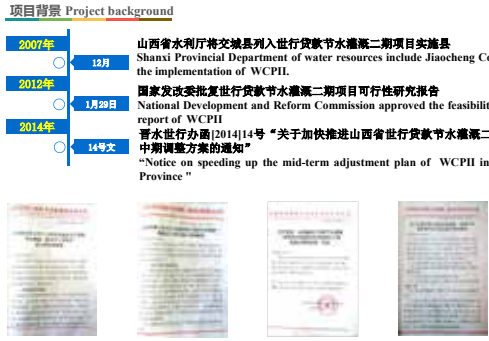
建设思路Construction ideas



建设目标Construction objectives

目录 CATALOG

项目背景 Project background

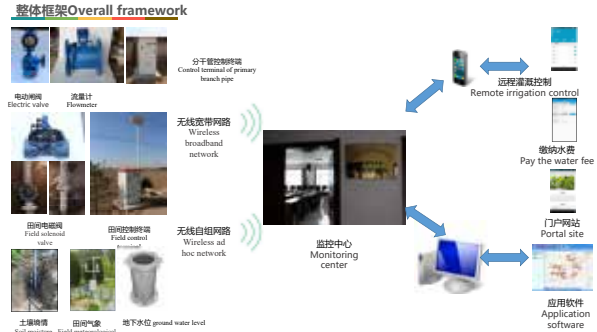


山西省水利厅将交城县列入世行贷款节水灌溉二期项目实施县
Shanxi Provincial Department of water resources include Jiaocheng County in the implementation of WCPII.

国家发改委批复世行贷款节水灌溉二期项目可行性研究报告
National Development and Reform Commission approved the feasibility study report of WCPII

晋水世行办函[2014]14号“关于加快推进山西省世行贷款节水灌溉二期项目中期调整方案的通知”
“Notice on speeding up the mid-term adjustment plan of WCPII in Shanxi Province ”

整体框架Overall framework



项目背景Project background

项目区节水灌溉面积5.299万亩：其中汾河灌区2万亩，龙门灌区3.299万亩。

龙门灌区主要分布于交城洪相乡、天宁镇和夏家营的15个村。

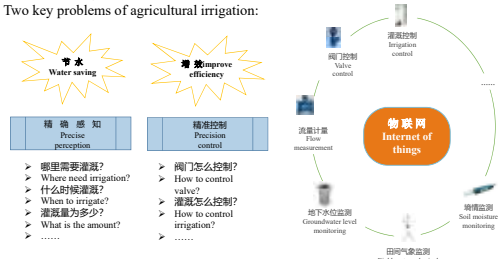
The water saving irrigation area in the project area is 52990 Mu: Fenhe Irrigation Area 20000 mu, and Longmen irrigation area 32990 mu.

Longmen irrigation area is mainly distributed in 15 villages of Jiaocheng Hong Xiang, Tianning town and Xia Jiaying.

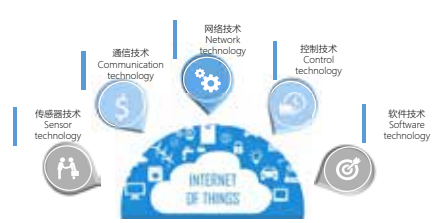
建设内容 Construction contents

建设思路Construction ideas

农业灌溉两大核心问题：
Two key problems of agricultural irrigation:



实现技术



典型设计Typical design

流量计量 flow measurement
阀门控制 Valve control

分干管测站
Measuring station of primary branch pipes

- 测站功能function of measuring station
  - 电动闸阀控制分支管道上的水流的开通和关断，管道式超声波流量计对管道中流过的水流量进行计量。
  - The movable gate valve controls the opening and closing of the flow on branch pipes, and the pipe type ultrasonic flow meter measures the flow of water flowing through the pipe.
  - 配置一套PLC控制系统，对现地流量进行采集，并根据累计流量对闸阀进行自动控制。
  - A set of PLC control system is configured to collect the current traffic and control the gate valve automatically according to the cumulative flow rate.

典型设计Typical design

取水自动计量 Automatic measurement
IC卡控制 IC card control

支管测站
Measuring station of branch pipes

- 测站功能functions
  - 灌溉刷卡取水（IC卡控制）
  - Irrigation and water intake (IC card control)
  - 自动用水计量（卡片式管段流量计）
  - automatic water metering (card type pipe flow meter)
  - 阀门控制
  - Valve control
  - 防盗报警（开门报警）
  - Burglar alarm (opening the door to the alarm)
  - 远程监测Remote monitoring

典型设计Typical design

田间气象 Field meteorological
土壤墒情 Soil moisture
地下水位 Groundwater level

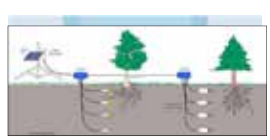
自动控制系统
automatic control system

- 数据采集和处理 data collect and manage
- 连续工作 work non-stop
- 自动报警 automatic alarm
- .....

典型设计Typical design

田间气象 Field meteorological
土壤墒情 Soil moisture
地下水位 Groundwater level

自动控制系统
automatic control system



- 监测目的Monitoring purpose
  - 对灌域的土壤墒情实时监测，掌握旱情及灌溉情况，
  - Real time monitoring of soil moisture in irrigation area, and master drought and irrigation conditions.
  - 通过土壤水分传感器获取土壤水分数据、通过土壤温度传感器获取土壤温度数据监测参数
  - Obtaining soil moisture through soil moisture sensor and obtaining soil temperature data monitoring parameters through soil temperature sensor

典型设计 Typical design

田间气象 Field meteorological
土壤墒情 Soil moisture
地下水位 Groundwater level

自动控制系统
automatic control system

- 监测目的Monitoring purpose
  - 长期过量的超采地下水，会引发地面沉降、地表塌陷、土壤盐碱化等问题。
  - Excessive overexploitation of groundwater can cause land subsidence, soil stalinization and other problems.
  - 考虑到设备安全问题，建议采用一体化地下水监测站结构进行安装。
  - Taking into the safety of equipment into account , integrated groundwater monitoring station structure is suggested to be installed.
  - 一体化监测站将遥测终端RTU、压力水位计、供电电源及防雷等都有效的整合在一起，外表美观、防水防尘，特别适合野外无人值守的安装。
  - The integrated monitoring station integrates the telemetry terminal RTU, pressure water meter, power supply and lightning protection together effectively. The exterior appearance, the waterproof and the dustproof are especially suitable for installation in the field.

典型设计Typical design

县级信息管理中心 County-level information management center
用水者协会管理分中心 Water users association management sub center
应用软件 Application software

节水灌溉管理平台
Water saving irrigation management platform

典型设计Typical design

县级信息管理中心 County-level information management center
用水者协会管理分中心 Water users association management sub center
应用软件 Application software

节水灌溉管理平台
Water saving irrigation management platform

- 每个用水者协会配置工作站电脑、打印机、读写卡器、移动售水终端、自动售水机、微型票据打印机等
- Each WUA is equipped with station computer, card reader and writer, mobile water selling machine and micro receipt printer.

典型设计Typical design

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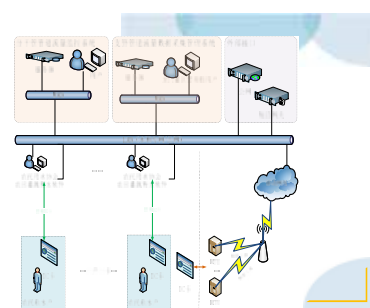

典型设计Typical design

县级信息管理中心 County-level information management center
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应用软件 Application software

节水灌溉管理平台
Water saving irrigation management platform

- 分干管管道流量监控系统
- Flow monitoring and control system of primary branch pipes
  - 监控系统（远程控制、地图展示）
  - Monitoring system(remote control, map display)
  - 查询统计Query statistics
  - 基础信息basic information
  - 系统管理system management

典型设计Typical design

县级信息管理中心 County-level information management center
用水者协会管理分中心 Water users association management sub center
应用软件 Application software

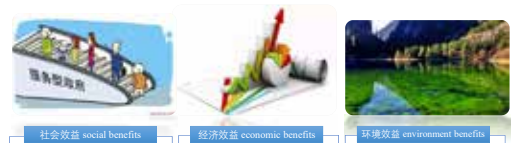
节水灌溉管理平台
Water saving irrigation management platform

- 支管管道流量数据采集管理系统
- Data collection and management system for branch pipe flow
  - 监控系统（远程控制、地图展示、报警管理）
  - Monitoring system(remote control, map display, Alarm processing)
  - 信息发布information publish
  - 查询统计Query statistics
  - 基础信息basic information
  - 系统管理system management

典型设计 typical design

- 农民用水协会农田灌溉售水软件
  Irrigation water selling software of WUAs
  - 售水管理
  - Water selling management
  - 查询统计
  - Query statistics
  - 基础信息
  - Basic information

效益体现 Benefits



社会效益 social benefits

- 水资源利用效率的提高
- Improve utilization efficiency
- 农业防御水旱灾害能力大幅提高
- Improve ability of agricultural industry to defend water and drought disaster
- 灌区管理效率的提高
- Improve management efficiency of irrigation area
- 适时适量灌溉，农作物增产增收
- Timely and appropriate irrigation to increase crop yield and income
- 通过设施节水，管理节水和行为节水，力争节水最大化
- realize maximize water saving through water-saving facilities, management and behavior saving.

经济效益 economic benefits

- 明显改善灌区农业生产条件，保障粮食安全和农产品供给，促进经济可持续发展
- Obviously improve agricultural production conditions in irrigation area, ensure food security and agricultural products supply, and promote economy sustainable development.
- 促进集约化、专业化新型农业经营体系建立，促进农业增长方式转变与现代农业发展
- Promote the establishment of intensive and specialized new agricultural management system, transformation of agricultural growth mode and modern agriculture development.
- 提高生产效率，提升作物品质，促进农业增产、农民增收
- Improve production efficiency, crop quality, agricultural production and farmers' income.

环境效益 environment benefits

- 有效的缓解水资源紧缺矛盾
- Effectively alleviating the shortage of water resources
- 提高灌区工程效益的发挥，避免盲目、超量灌溉，实行地表地下联合调度
- Improve the efficiency of irrigation area, avoid blind and excessive irrigation, and implement underground and underground joint operation.
- 控制和降低地下水位，减轻土壤盐碱化
- Control and reduce groundwater level and reduce soil salinization
- 调节田间小气候，有效遏制水土流失，保持土壤肥力
- Regulate the field microclimate, effectively curb soil erosion and maintain soil fertility.

项目亮点 Project highlights

农业灌溉定额供水
Agricultural irrigation quota water supply

1 水权约束 water rights constraint
农业灌溉初始水权
均匀分配到每块农田上

2 总量控制 total amount control
支管上安装“农田智能灌溉控制系统”
以IC卡刷卡取水的方式取代了传统的抄表计量，
实时掌握各灌溉支管的总用水量、年用水量、瞬时流量

3 定额供水Quota water supply
供水定额：200m³/亩·年
用水量超过20%加价供水
用水量超过40%系统拒绝供水

4 优化配置Optimal allocation
分干管上安装管道流量监测和阀门启闭控制设备，
辅助实现龙门堰区水资源调配，优化种植结构
单一种植玉米转为省会城市的菜篮子和现代农业观光产业园

5 阶梯水价 ladder water price
定额内水价0.35元/m³
超定额20%时超出部分0.70元/m³
超定额20%-40%时超出部分1.40元/m³
超定额40%时系统拒绝供水

6 合理控制 reasonable control
实时掌握电磁阀运行状态、
电源供电状态、箱门状态
以及用水户用水情况

拓展方向 development direction

节水增效
water saving and efficiency improving
水资源优化配置、全管道阀门联合控制、高标准农田整治、水肥一体化、种植结构优化、专业化管理等

用水安全 water use security
水权约束、总量控制、定额配水、丰增枯减、超罚节奖、合理流转、实时监测与预警、减少面源污染、抵御极端灾害等

生态健康 ecology health
面源污染、土壤盐碱化、水土保持、旱情监测、山洪灾害、海绵农田（雨洪利用）等

可持续发展 sustainable development
土地规模化集约化、信息化自动化手段、节水奖励及培训、阶梯水价及分类水价等

项目亮点Project highlights

农业水价综合改革
Comprehensive reform of agricultural water price

阶梯水价 ladder water price

精准补贴 Precision subsidy

节水奖励 Water saving reward

NO POINT SOURCE (NPS) POLLUTION AND CLEAN SMALL WATERSHED MANAGEMENT

非点源污染及清结小流域管理

NPS POLLUTION

☐Livestock (牲畜)

Urine, stools and waste water from livestock farm
（牲畜养殖场的尿液、粪便和废水）

NO POINT SOURCE (NPS) POLLUTION

☐No point source (NPS) pollution

is a worldwide problem (Novotny 1999), which is primarily caused by： （非点源污染是一个全球性的问题，主要由以下几个方面引起）

- Local agricultural activities（当地的农业活动）
- Livestock's manure （牲畜粪便）
- Domestic livings （家庭生活）
- Atmospheric sedimentation （大气沉降）

NPS POLLUTION

☐Atmospheric sedimentation
（大气沉降）

- Acid rain（酸雨）
- Dry deposition（干沉降）

NPS POLLUTION

☐Local agricultural activities

- Fertilizers （化肥）
- Pesticides （农药）

Fertilizers and pesticides is very important for the increase in grain in China（化肥和农药对中国粮食的增长非常重要）

☐Atmospheric sedimentation

DDT (Dichlorodiphenyltrichloroethane) was found in body because of atmospheric sedimentation pollution
由于大气沉降，在动物体内发现了杀虫剂DDT

☐Local agricultural activities

With land use tillage management and irrigation a large amount of soil and water with fertilizers and pesticides loss from farmland
(随着土地利用的耕作管理和灌溉，农田中大量的化肥和农药随着水和土发生流失)

Airplane used in spreading pesticides

☐Atmospheric sedimentation

- NPS not only polluted water but also polluted atmospheric, such as dusty storm
- （NPS不仅污染了水，而且污染了大气，如沙尘暴）
- Lots of greenhouse gas come from land use change、agricultural production and livestock
- （大量的温室气体来自土地利用的变化农业生产和家畜）

◘ Domestic livings （家庭生活污染）

- Waste and sewage （垃圾和污水）
- Especially toilet water

NPS POLLUTION

◘The effects of NPS pollution

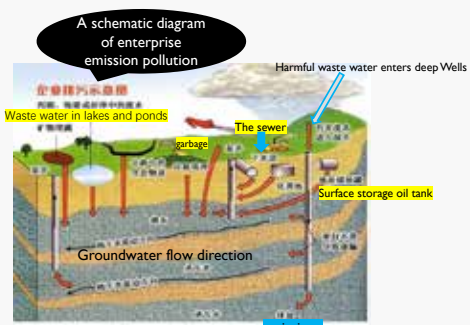
（非点源污染的影响）

- Soil pollution, such as soil acidity, heavy metal pollution, persistent organic pollution（土壤污染，如土壤酸度、重金属污染、持久性有机污染等）
- Threaten of food safety through agricultural eco-system
- （通过农业生态系统威胁食品安全）

- In the traditional agriculture, livestock urine and stools, domestic living waste and sewage were usually fertilizers used in farmland, such as in African
- （在传统农业中，牲畜的尿液和粪便、生活垃圾和污水通常是农田中的肥料，例如非洲）

◘The effects of NPS pollution

- Ground water pollution, NPS pollution into ground water through rainfall or irrigation water infiltration（地下水污染，NPS污染通过降雨或灌溉渗入地下水）



NPS POLLUTION

- In the modern agriculture, with the utilization of chemical products no point source (NPS) pollution become more and more serious Especially in the EU and USA

（在现代农业中，随着化学产品的使用，非点源(NPS)污染变得越来越严重）

NPS POLLUTION

The dead zone in Mexico bay due to the NPS pollution from the maize belt in Mississippi plain

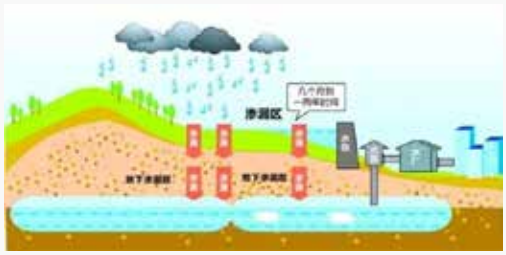
（由于密西西比平原玉米带的NPS污染，墨西哥海湾的死亡区）

◘The effects of NPS pollution

- surface water pollution, dissolved NPS pollution in surface or ground runoff and sediment in surface runoff

☐The transferring of NPS pollution

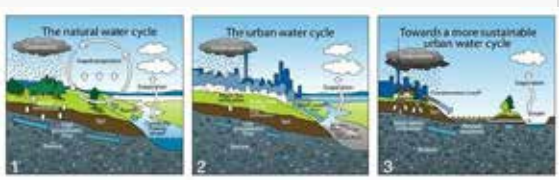
（非点源污染的转移）



NPS POLLUTION

☐The transferring of NPS pollution

（非点源污染的转移）



CONTROL OF NPS POLLUTION

- With the increasing importance of pollution prevention and the protection of natural water resources, many studies have been conducted on the control of agricultural no point source (NPS) pollution (Ouyang et al. 2010).
- Best management practices (BMPs) have been widely used in managing no point source (NPS) pollution at the watershed level, especially in Europe and American.
- Most BMPs are related to land use, tillage management, and fertilizer levels.

☐The transferring of NPS pollution

- Infiltration into ground water through rainfall or irrigation water, （透过降雨或灌溉用水渗入地下水）
- dissolved NPS pollution in surface runoff and ground water （在地表径流和地下水中溶解的NPS）
- with sediment in surface runoff （地表径流中的沉积物）

CONTROL OF NPS POLLUTION

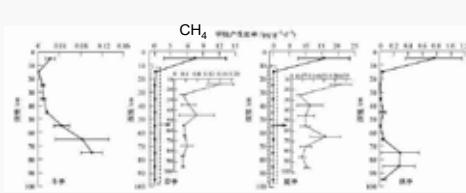
- **The purpose of (BMPs)**

  Reducing the application of fertilizers and pesticides , as well as the agricultural production decrease as little as possible

- The model such as **SWAT and AGNPS** often used in BMPs

☐The transferring of NPS pollution

- Absorbed by plant（植物吸收）
- Volatilization into the atmosphere or wind erosion
- （挥发到大气中或风蚀）



CONTROL OF NPS POLLUTION

☐An example of Controlling NPS pollution in China：

Clean Small Watershed Management

CLEAN SMALL WATERSHED MANAGEMENT

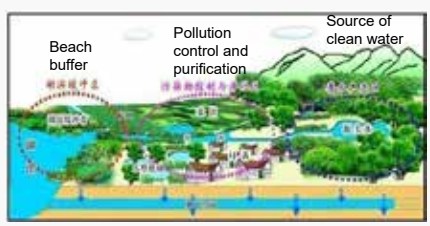
- Small watershed management in mountain

CLEAN SMALL WATERSHED MANAGEMENT

☐Middle reaches (hill slope)

- Changing slope into terrace
- Planting economic fruit forest
- Water saving irrigation
- Ecological agriculture
- Reducing the source of NPS pollution

CLEAN SMALL WATERSHED MANAGEMENT



- Small watershed on the coast of lake

CLEAN SMALL WATERSHED MANAGEMENT

☐ lower reaches (bottom of hills

- Sedimentation tank
- Artificial wetland water purification
- River bank management
- river regulation

CLEAN SMALL WATERSHED MANAGEMENT

CLEAN SMALL WATERSHED MANAGEMENT

☐ soil and water conservation ecological agriculture

- **BMPs of** fertilizers and pesticides
  - ✓ application **of** fertilizers and pesticides in appropriate amount and time
  - ✓ Ecological controlling pest and disease

CLEAN SMALL WATERSHED MANAGEMENT

☐Upper reaches (top of hills)

- Forestation and planting grass
- Reducing human activity
- Vegetation Restoration
- Water conservation

CLEAN SMALL WATERSHED MANAGEMENT

☐ soil and water conservation ecological agriculture

- **BMPs of** fertilizers and pesticides
  - ✓application **of** fertilizers deeply

CLEAN SMALL WATERSHED MANAGEMENT

- soil and water conservation ecological agriculture
  - straw or grass mulching

Reduce water and wind erosion

Reduce the NPS pollution in runoff and water infiltration

CLEAN SMALL WATERSHED MANAGEMENT

- soil and water conservation ecological agriculture
  - Improve soil Increment in water holding capacity and CEC
  - Horizontal tillage
  - Contour hedgerow

Reduce the sediment and NPS pollution in slope runoff

CLEAN SMALL WATERSHED MANAGEMENT

- Water saving irrigation

Reduce the NPS pollution with irrigation water infiltration and loss

CLEAN SMALL WATERSHED MANAGEMENT

- Terrace
  - Flat slope: soil conservation tillage
  - Gentle slope: terrace or economic fruit forest
  - Steep slope(> 25°) :soil and water conservation forest

CLEAN SMALL WATERSHED MANAGEMENT

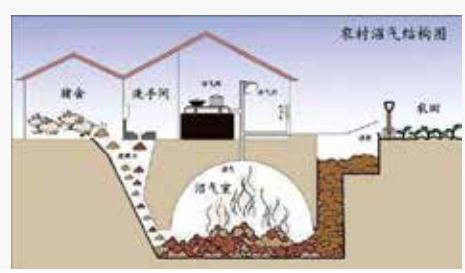
- Village and town environment management
  - Sedimentation tank

CLEAN SMALL WATERSHED MANAGEMENT

- Village and town environment management
  - Garbage tank

CLEAN SMALL WATERSHED MANAGEMENT

- Village and town environment management
  - Biogas tank: household garbage and wastes from agriculture and live stocks used in making biogas



CLEAN SMALL WATERSHED MANAGEMENT

- River and banks management

CLEAN SMALL WATERSHED MANAGEMENT

- Artificial wetland water purification

Dissolved pollutants absorbed by wetland plants

Volatilization into the atmosphere in the form of gas

CLEAN SMALL WATERSHED MANAGEMENT

- Artificial wetland water purification

CONTROL OF NPS POLLUTION

- An example of Controlling NPS pollution in China:

Sponge city

The green land and soil layer not only holding water from the city runoff

But also absorb the pollution in the water

The Impacts of Soil and Water Conservation on Stream Flow and Sediment Flux Changes in China

南昌工程学院
Nanchang Institute of Technology

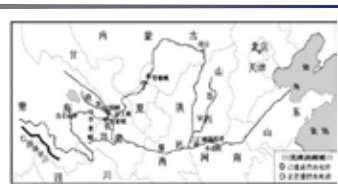
2018. 6

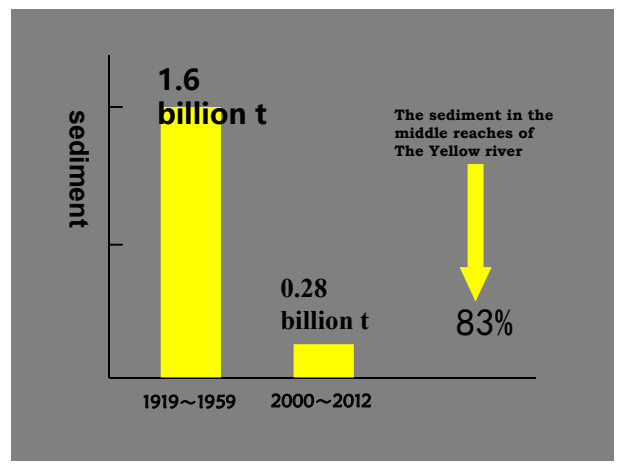
27 cycles

- The Yellow river was called the river with the largest sediment in the world

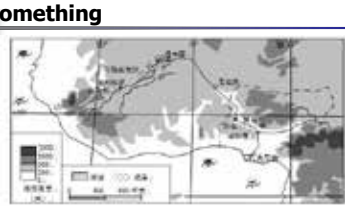
1.6 Billion tone

The Changes of Stream Flow and Sediment Flux in the Yellow river: A case study in the north China





- The Yellow river called mother river of Chinese
- Which is similar to Niger river in something



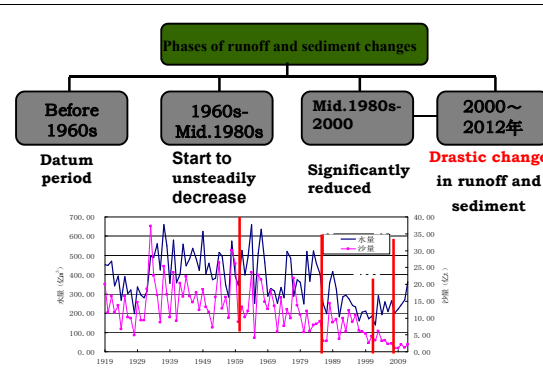
- Now ,the river with the largest sediment in the world is not the Yellow river!

- The sediment in Amazon river and Yangtze River is more than that in the Yellow river.

- Both the Yellow river and Niger river

- Upper reaches :rainy plateau
- Middle reaches: desert
- Lower reaches: rainy plain

Temporal characteristics of decrease in inflow and sediment

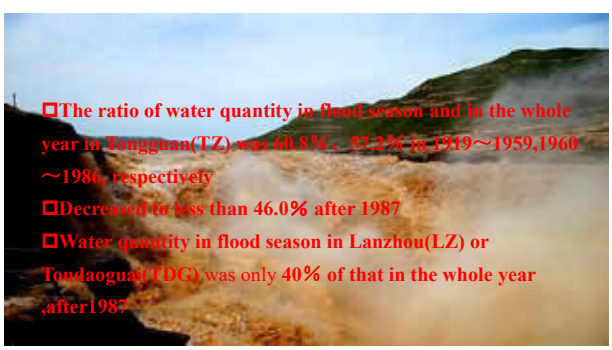


Decrease in Inflow and Sediment

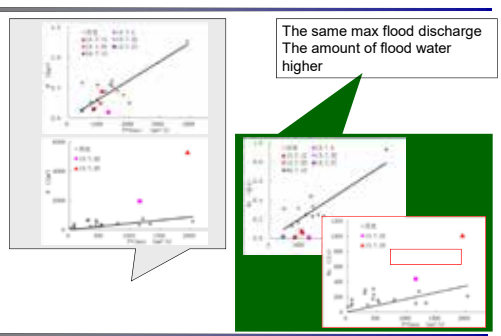
The Inflow and Sediment in Tongguan(TG) Station

Period	Inflow (10^8m^3)	Sediment (10^8t)	Content (kg/m^3)
1919-1959	426.14	15.92	37.4
1960-1986	402.78	12.08	30.0
1987-1999	260.62	8.07	31.0
2000-2012	231.23	2.76	12.0
1954-1969	448.29	16.60	37.0

Decrease in Flood



Decrease in flood



Decrease in Flood

- Decrease in the **daily average water discharge** > 2000m³/s which is useful for transferring sediment

after 1987 compared with before1987

- The period of Daily average water discharge > 2000m³/s in the flood period 62.2% ↓ 10.5%
- The inflow of that period in the flood period: 75.8% ↓ 27.7%
- The sediment of that period in the flood period : 87.2% ↓ 46.8%

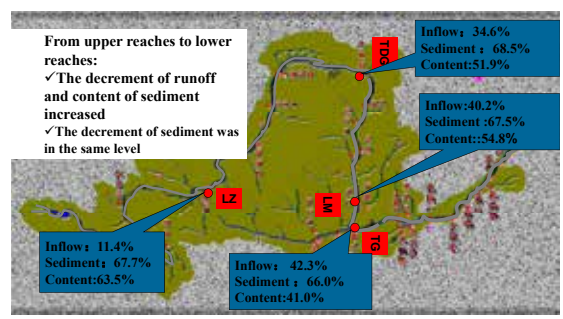
Decrease in Flood

- Decrease in the **daily average water discharge** > 2000m³/s which is useful for transferring sediment

2000～2012 compared with 1987-199

Period length ↓ 8.8%

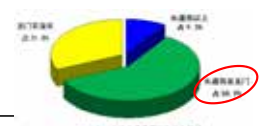
Inflow、ssediment ↓ 24.6% and 31.2%



The decrement of runoff，sediment and content of sediment in 2000-2012 from the average annual value

The spatial heterogeneity of decrease in inflow and sediment

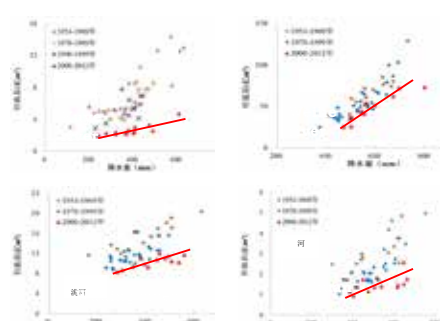
The runoff mainly decreased in the upper reaches



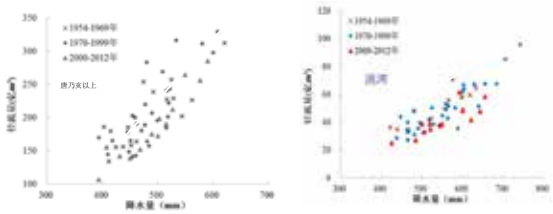
The sediment mainly decreased in the middle reaches from TDG to LM

The spatial heterogeneity of decrease in inflow and sediment

- ***runoff coefficient*** **changed in most watershed**



The spatial heterogeneity of decrease in inflow and sediment

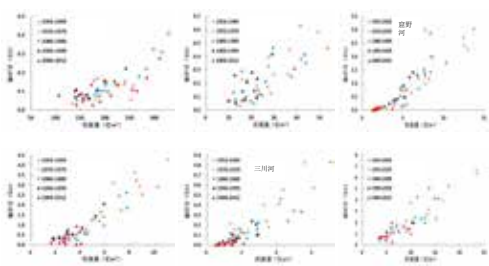


In some region in the upper reaches, runoff coefficient not changed, due to different land use and climate

The reason of inflow and sediment changes

- The inflow and sediment changes because both climate (rain) changes and human activity
- In the past decade, the rainfall not changed

The spatial heterogeneity of decrease in inflow and sediment

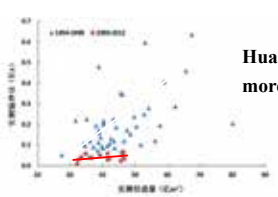


- In most watershed, relationship between runoff and sediment not changed

The reason of inflow and sediment changes

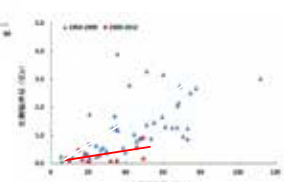
- The inflow changes mainly because water use especially irrigation
- The other reason for inflow changes is soil water conservation and land use changes
- The sediment changes mainly because soil water conservation and land use changes
- The other reason for sediment changes is reservoir storage

The spatial heterogeneity of decrease in inflow and sediment



Some river such as Weihe and Huangshui decrease in sediment was more than decrease in runoff .

Complex spatial heterogeneity



The reason of inflow and sediment changes

- **After soil and water conservation**
  - ✓ More rainfall infiltrated into soil and ground water
  - ✓ Surface runoff and flood decreased
  - ✓ Soil erosion decreased
  - ✓ Some flood water and sediment was stored by soil and water conservation engineering

- **In the yellow river and most rivers in the north China**
  - ✓ Significantly decrease in inflow and sediment;
  - ✓ The decrease in sediment is more significantly than that in inflow ;
  - ✓ Flood decreased, the difference between maximum and minimum discharge reduced.

The reason of inflow and sediment changes

The reason of inflow and sediment changes

The Changes of Stream Flow and Sediment Flux in the Yangtze river:
A case study in the south China

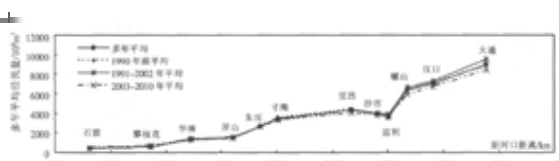


图 2 长江干流主要控制站径流量沿程变化

Fig.2 The runoff variation at the main hydrologic stations on the Yangtze river

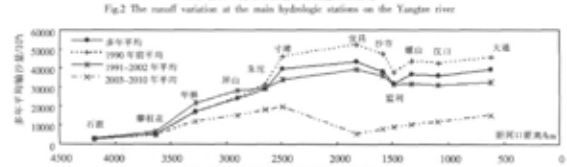


图 3 长江干流主要控制站输沙量沿程变化

Fig.3 The sediment discharge variation at the main hydrologic stations on the Yangtze river

- **There was not significant changes of inflow in the Yangtze river, which is a difference of inflow and sediment changes between rivers in north and south China.**
- **In other word , in south China there is not a clearly impact of soil and water conservation on river inflow amount.**

- **In the humid climate zone, the actual evaporation can achieve evaporation potential, which is determined by climate conditions.**
- **The increase in soil water does not mean the increase in soil water evaporation, which is different from arid and semi-arid regions such as north in China.**
- **Where actual evaporation usually is less than evaporation potential. If soil water increases, the evaporation will increase.**

- **So after soil and water conservation ,although surface runoff decreases, the annual runoff does not decreased.**
- **The increase in rainfall infiltration supplies underground water, which will form base flow of the river.**

- **In most part of the Yangtze river, sediment decreased from 1990, due to soil and water conservation.**
- **The significantly decrease in sediment in the middle of Yangtze river after 2003 is related to the storage of the Three Gorges reservoir.**

The evaluation of soil and water conservation on stream flow and sediment flux

- After 1990s, sediment in most rivers in China decreased because of soil and water conservation, reservoir and other human activity.
- Usually , after soil and water conservation runoff decreased in the arid and sub-arid region of China, the main part is flood.
- The annual runoff does not decreased in the wet part of China, but soil and water conservation can change surface flood into ground water and base water of river.

- With the decrease in flood and erosion, water utilization for transferring sediment would reduce, utilizable water resource can increase.
- After soil and water conservation, a part of flood was changed into soil water evaporation in farmland grassland and forest, which is useful the virtual water in the products in agriculture, livestock and forestry.

The increase in virtual water by soil and water conservation

- Virtual water:The water utilization embedded in production of goods and services

The increase in virtual water by soil and water conservation

The increase in virtual water by soil and water conservation


The increase in virtual water by soil and water conservation in loess plateau

Increase in virtual water	Grain	74.9
	Fruit	96.0
	Meat	2.8
	Wood	52.7
Decrease in water for transferring sediment		46.1
Runoff		14.5

□Unit:$10^8 m^3$

□Impacts of soil and water conservation on water resources carrying capacity in Yellow River basin

□Zhao J M, Chen C H , Li J(2010)

The policy of soil and water conservation in watershed management

流域管理中的水土保持政策

- We will improve the system for protecting natural forests, and turn more marginal farmland into forests and grasslands.

China Forestation Day

- It is an important policy in watershed management to adopt a holistic approach to conserving mountains, rivers, forests, farmlands, lakes, and grasslands.
- In the report of 18th Central Committee of the CPC to the 19th National Congress President Xi Jinxing said that we should ensure harmony between human and nature.

- We will rigorously protect farmland and expand trials in crop rotation and keeping land fallow.
- We will improve systems for regeneration of croplands, grasslands, forests, rivers, and lakes, and set up diversified market-based mechanisms for ecological compensation

- We will adopt a holistic approach to conserving our mountains, rivers, forests, farmlands, lakes, and grasslands,
- Implement the strictest possible systems for environmental protection, and develop eco-friendly growth models and ways of life.

The mountains, water and lake are geographic concepts:

- Mountains is the source of river and where it is easy for soil erosion
- Water include surface water and ground water, rivers are the path of water transferring

In speeding up reform of the system for developing an ecological civilization, and building a beautiful China

- We will promote forestation, take comprehensive steps to control desertification, stony deserts, and soil erosion,
- strengthen wetland conservation and restoration, and better prevent and control geological disasters.

- Lake is where water inflow collected
- Mountain –river-lake project in Jiangxi province has held for more than 30 years

The forestry, farmland and grassland are different land use:

- Forestry is the biggest eco-system in the word
- Grassland is the other vegetable cover except forest and farmland
- Farmland is very important for human living

Law and regulation system for watershed management

- Administrative regulations : by the central government of PRC
- Local law and administrative regulations: by the local people's congress and government
  - ✓ Province level
  - ✓ District level
  - ✓ Minority autonomous county

National Farmland Day(6.25)

Protection of farmland is protecting our lifeline

- Basic farmland protection
- The red line of farmland as much as 0.12 billion hectares

Law and regulation system for watershed management

- Technical specification

Made by expert (such as china association of soil and water conservation), passed and carried out by government

Law and regulation system for watershed management

- Law :By the National People's Congress of people's republic of China(PRC) and its Standing Committee
  - *Water law*
  - *Soil and water conservation law*
  - *Flood control law*
  - *Prevention and Control of Water Pollution law*
  - *Land management law*
  - *Forest law*
  - *Grassland law*

Administrative management system for watershed management

- Central government

A certain vice-premier in charge of affairs of agriculture forestry water resource and ecological environment

- ✓ Ministry of Water Resources
- ✓ Ministry of Natural Resources
- ✓ Ministry of Environmental Protection
- ✓ Ministry of Agricultural and Rural
- ✓ Ministry of Emergency management (flood control)

Law and regulation system for watershed management

- Law :

guidelines in *Soil and water conservation law*

- The mainly job is preventing soil and water loss, the priority job is protection ecological environment.

(预防为主、保护优先)

- Comprehensive planning and control soil and water conservation.(全面规划、综合治理)
- Adapt to local conditions and highlight key points.(因地制宜、突出重点)
- Scientific management and benefit is important.(科学管理、注重效益)

Administrative management system for watershed management

- In the central government, there is the department of soil and water conservation in the ministry of water resources, whose duty is the policy and management of soil and water conservation

Administrative management system for watershed management

- local government
  - ✓ Province level
  - ✓ District level
  - ✓ County level

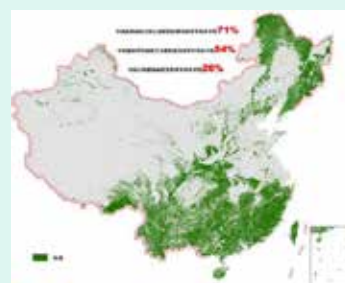
- The policy of natural forest conservation and turning marginal farmland into forests and grasslands is in the charge of forestry administrative agencies, which is useful for soil and water conservation, flood control ecological protection

Administrative management system for watershed management

- Usually, soil and water loss is directly dealt with by the administrative agency in the county level government

The Policy of Natural Forest Conservation

- Forest in China mainly in south and northeast part
- Natural forest mainly in southwest and northeast part



Administrative management system for watershed management

- River basin management agency

The Policy of Natural Forest Conservation

Administrative management system for watershed management

- Vice-minister level agency from Ministry of Water Resources
- SL: Song-Liam Water Resources Commission
- Hai: Haihe River Water Resources Commission
- Ye: yellow river conservancy commission
- Huai: Huaihe River Water Resources Commission
- Yz: Changjiang Water Resources Commission
- Zh: Zhujiang River Water Resources Commission
- Tai: Taihu Basin Authority

The Policy of Natural Forest Conservation

- Start: 1999, after the big flood in Yangtze and Songhuajiang-Nenjiang river
- In:
  - ✓ The upper reaches in the Yangtze river and the middle and upper reaches in the yellow river
  - ✓ Other forest region especially in the Northeast of China

The policy of Natural Forest Conservation

The Policy of Natural Forest Conservation

- With the policy of natural forest Conservation,
- Forestry workers no longer cut trees, who became the workers to protect forestry, fed by the government

The Policy of Natural Forest Conservation

- Lots of forestry farm turned into nature reserve

The policy of turning marginal farmland into forests and grasslands.

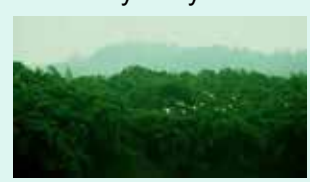
- Start: 1999, after the big flood in Yangtze and Songhuajiang-Nenjiang river, by the government of president Jiang Zemin and premier Zhu Rongji

The policy of turning marginal farmland into forests and grasslands

- 退耕还林（草）
- ✓ turning marginal farmland into forests and grasslands
- ✓The marginal farmland includes farmland in steep slope, sand land, where the yield of grain is low and it is easy for water or wind soil erosion and desertification

The policy of turning marginal farmland into forests and grasslands

- 封山绿化
- greening the hills or sand land by enclosure and cultivation of vegetation
- Reduce the vegetation destroyed by human activity



The policy of turning marginal farmland into forests and grasslands

- 以粮代赈
- Give grain and allowance as relief to the farmer who turned marginal farmland into forests and grasslands
- As a green subsidy in agriculture

The policy of turning marginal farmland into forests and grasslands

- 个体承包
- Expect state-owned land, the owner of other land is village collective organization
- individual farmers contract land from village collective organization
- turning marginal farmland into forests and grasslands in the contracted land by individual farmers

The policy of river chief system

- The river chief system is responsibility system of local chief
- The feature of cross-watershed affairs shows that a single water-related department cant finish it, hence the problem of failure of watershed treatment coordination and the problem of fragmentation of watershed treatment come out.
- The river-chief mechanism, an approach of inter-departmental coordination, can effectively solve the problem of lack of authority and has an obvious effect in the short run.

The policy of river chief system

☐The duty of river chief

- Water resources protection
- Bank and beach of rivers and lakes management and protection
- Water pollution controlling and prevention

The policy of river chief system

- The river chief system is the responsibility system of local chief executive on water resources management and water environmental protection

The policy of river chief system

☐The duty of river chief

- Water environment management
- Water eco-system rehabilitation including soil and water conservation
- Supervise and Executive

The policy of river chief system

The feature of watershed management affairs shows that a single water-related department cant finish it, hence the problem of failure of watershed treatment coordination and the problem of fragmentation of watershed treatment come out.

The policy of river chief system

☐The three red line of water resources management

- Water utilization amount
- Water use efficient
- Water pollution capacity

The policy of river chief system

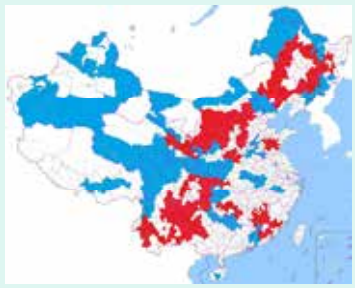
- The river-chief mechanism greatly improves the cooperative efficiency by the coordinative mechanism at the horizontal level and vertical level.
- This is a hierarchical model of coordination based on a new type of hybrid authority.

The policy of river chief system

☐there are five levels of river chief in a certain province

- Province level (chief river chief)
- District level
- County level
- Town level
- Village level

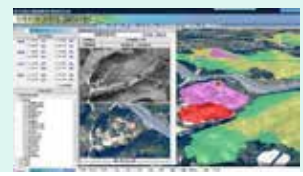
The policy of preventing soil and water loss in key regions



- The blue part is the national key regions of preventing soil and water loss

The policy of preventing soil and water loss in key regions

- In the key regions of preventing soil and water :
- Strength the protection of vegetation and soil and water conservation measures
- Strength the monitoring and supervise of soil and water loss



The policy of preventing soil and water loss in key regions

- Except national key regions of preventing soil and water loss, there are provincial key regions of preventing soil and water loss in different province.

The policy of soil and water conservation in small watershed

- Area: usually ≤50km^2， a whole water catchments
- As a scale of a town or villages
- It is easy to deal with soil and water loss according to the hydrologic and erosion law in a basin
- It is suitable for management in a town or villages scale

The policy of preventing soil and water loss in key regions

- The key regions of preventing soil and water loss usually is the mountain and grassland where:
- The vegetation is good
- The soil erosion is not serious
- It is easy for soil erosion if vegetation destroyed

The policy of soil and water conservation in small watershed

- The investment of water conservation in small watershed is mainly from nation
- Especially in key regions of controlling soil and water
- soil and water conservation in small watershed is mainly in the charge of the management agency in county government
- As a part of government procurement for public services

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The policy of soil and water conservation in small watershed

- Middle reaches (hill slope)

The policy of soil and water conservation in small watershed

- soil and water conservation in small should combine the soil and water conservation technology of
- Engineering
- Forestry and grass
- Agricultural tillage

The policy of soil and water conservation in small watershed

- lower reaches (bottom of hills

- Artificial wetland
- River bank management
- river regulation

The policy of soil and water conservation in small watershed

- Upper reaches (top of hills)
- Reducing human activity
- Vegetation Restoration
- Forestation and planting grass

The policy of soil and water conservation in small watershed

- A stream from upper to low reaches
- gully head protection measures

The policy of soil and water conservation in small watershed

- Middle reaches (hill slope)
- Planting economic fruit forest (middle slope)
- Changing slope into terrace (gentle slope)
- Water and water conservation agriculture (flat slope)

The policy of soil and water conservation in small watershed

- A stream from upper to low reaches
- Check dam
- Forest belt against stream inflow flushing

The policy of soil and water conservation in small watershed

- A stream from upper to low reaches
- Dam and reservoir


The policy of soil and water conservation evaluation and monitoring of production and construction projects

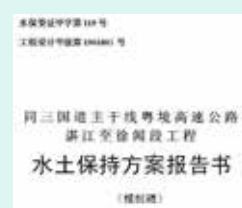
The policy of soil and water conservation in small watershed

- Participatory planning in soil and water conservation in small watershed
  - ✓ Participants: experts, local government , Villager
  - ✓ Participatory survey: local government and experts investigate from villagers to know what they want in the soil and water conservation in small watershed

- One of the environmental impact assessments:
  - Weather there are limiting factors from the view of soil and water conservation
  - The impacts of a certain production and construction projects on soil and water conservation
  - Weather the suitable measures of soil and water conservation will be adopted by the project

The policy of soil and water conservation in small watershed

- Participatory planning
  - ✓ Make plans : local government and experts make different plans according to what villagers want
  - ✓ Revise plans: plans explained to the people and revised according the feedback of local government and villagers
  - ✓ Vote: villagers vote for the final plan from Some options

- According the scale of project the evaluation management would be in the charge of
  - Ministry of Water Resources
  - Administrative agency in the provincial ,district and county level government

The policy of soil and water conservation in small watershed

- participatory planning


- Three Simultaneity system
  - The soil and water conservation measures and the main project are designed constructed gone into operation at the same times .

The policy of soil and water conservation monitoring

- Concept:
  - ✓ Changes of soil and water loss and its influence factors in a region;
  - ✓ Soil and water of production and construction project
- System:
  - Ministry of Water Resources (monitoring centre)
  - 7 river basin management agencies
  - 31 provincial management agencies
  - Monitoring station

小流域综合治理规划设计方法

Planning and designing method for comprehensive management of small watersheds

中国南方水土保持研究会

Soil and water conservation research association of southern China

2018.06.28

提　纲Outline

1. 小流域综合治理规划设计Planning and design of comprehensive management of small watershed
2. 中国小流域综合治理进展Progress in comprehensive management of small watersheds in China
3. 小流域综合治理措施Comprehensive control measures for small watersheds
4. 规划设计案例Planning and design case


小流域综合治理规划设计Planning and design of comprehensive management of small watershed

小流域综合治理Comprehensive management of small watersheds

在遵循自然规律和经济规律的前提下，以小流域为单元，山、水、田、林、路、村统一规划，拦、蓄、排、灌、节、废、污综合治理，实现小流域内生态效益、经济效益和社会效益协同发展。

Area: 5~30 km^2

Under the premise of following the laws of nature and economy, small watersheds are taken as units, and mountains, water, fields, forests, roads and villages are planned in a unified way, so as to prevent, store, discharge, irrigate, conserve, dispose of waste and sewage in a comprehensive way, thus realizing the coordinated development of ecological benefits, economic benefits and social benefits in small watersheds.

小流域综合治理规划设计Planning and design of comprehensive management of small watershed

小流域综合治理Comprehensive management of small watersheds

以小流域为单元，依据水土流失规律和社会经济发展要求，合理调整土地利用结构和农村产业结构，科学配置各项水土流失治理措施，形成完整的小流域综合防治体系的具体部署和实施安排。

Taking small watersheds as units, according to the law of water and soil loss and the requirements of social and economic development, the land use structure and rural industrial structure should be rationally adjusted, various water and soil loss control measures should be scientifically allocated, and the specific deployment and implementation arrangement of a complete comprehensive prevention and control system for small watersheds should be formed.

小流域综合治理规划设计Planning and design of comprehensive management of small watershed

小流域综合治理Comprehensive management of small watersheds

小流域综合治理规划是水土保持中最基本的微观规划单元，也是落实区域水土保持规划的基本单元，是各项治理措施对位配置的指南。

The comprehensive control plan for small watersheds is the most basic micro-planning unit in soil and water conservation, is also the basic unit for implementing regional soil and water conservation planning, and is a guide for the alignment and allocation of various control measures.


小流域综合治理规划设计Planning and design of comprehensive management of small watershed

规划指导思想及原则Guiding ideology and principles of planning

（1）遵循自然规律与经济规律。坚持因地制宜，因害设防，综合治理的基本原则。坚持生态效益与经济效益相结合，治理水土流失与发展当地经济结合。

（2）坚持社会、生态、经济协调发展的原则，按照可持续发展的要求，开展小流域水土流失综合治理。

(1) follow the laws of nature and economy. Adhere to the basic principles of adjusting measures to local conditions, defending against disasters, and comprehensive management. Adhere to the combination of ecological benefits and economic benefits, control of soil erosion and development of local economy.

(2) adhere to the principle of coordinated social, ecological and economic development and carry out comprehensive control of soil and water loss in small watersheds in accordance with the requirements of sustainable development.

小流域综合治理规划设计Planning and design of comprehensive management of small watershed

规划指导思想及原则Guiding ideology and principles of planning

（3）在规划治理的顺序和措施的配置上，必须坚持先上游后下游，先支毛沟后主干沟，先坡面后沟道的原则；工程措施、植物措施、农业耕作措施相结合，长效性措施与短效性措施相结合。山水田林园道路综合规划，水土光热资源合理利用。

(3) in the order of planning and control and the allocation of measures, the principle of first upstream and then downstream, first branching furrows and then trunk furrows, first sloping surfaces and then furrows must be adhered to; Engineering measures, plant measures and agricultural cultivation measures are combined, and long-term measures and short-term measures are combined. Comprehensive planning of forest garden road in mountain and water fields, rational use of water and soil photo-thermal resources.

小流域综合治理规划设计Planning and design of comprehensive management of small watershed

规划指导思想及原则Guiding ideology and principles of planning

（4）坚持尊重自然规律，将综合治理与自然恢复相结合，实行荒山荒坡封禁管护，水土流失严重的小流域重点治理。植被建设采取乔灌草相结合的方式。

(4) adhere to respect for the laws of nature, combine comprehensive control with natural restoration, implement the management and protection of barren hills and slopes, and focus on small watersheds with serious soil and water loss. Vegetation construction adopts the method of combining arbor, shrub and grass.

2 中国小流域治理研究进展Progress in comprehensive management of small watersheds in China

- 中国小流域综合治理起步于20世纪80年代初，经过20多年的水土流失治理实践，逐步探索出了一条以小流域为单元综合治理的经验，即以小流域为治理单元，对每条小流域进行规划设计、审查、施工、检查、验收。
- The comprehensive control of small watersheds in China started in the early 1980s. after more than 20 years of soil and water loss control practice, it has gradually explored a comprehensive control experience with small watersheds as a unit, that is, small watersheds as a control unit to carry out planning, design, review, construction, inspection and acceptance of each small watersheds.

2 中国小流域治理研究进展Progress in comprehensive management of small watersheds in China

长江上游地区小流域综合治理 Comprehensive management of small watersheds in upper reaches of Yangtze river

广州增城市派潭河流域综合治理 Comprehensive management of pylan river basin in Zengcheng city, Guangzhou

中国南方红壤区小流域综合治理 Comprehensive management of small watersheds in red soil region of southern China

黄河中游地区小流域综合治理 Comprehensive management of small watersheds in the middle reaches of the yellow river

3 小流域综合治理措施Comprehensive control measures for small watersheds

3 小流域综合治理措施Comprehensive control measures for small watersheds

工程措施 Engineering Measures

改变坡面水流路线，降低流速，水流、泥沙就地入渗沉积
Change the slope water flow route, reduce the flow velocity, and allow water flow and sediment to enter and deposit in situ.

3 小流域综合治理措施Comprehensive control measures for small watersheds

坡面水系工程 Slope drainage engineering

山边沟引水系统 Mountain side ditch diversion system

台地坎下沟引水 Diversion from xiagou of platform ridge

贮水池 Reservoir

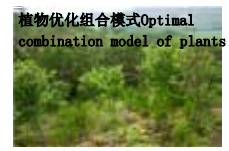
3 小流域综合治理措施Comprehensive control measures for small watersheds

林草措施 Forest and grass measures

农林复合模式Agroforestry model

植物篱笆技术 Plant fence technique

植物地被模式 Plant stem pattern



植物优化组合模式Optimal combination model of plants

3 小流域综合治理措施Comprehensive control measures for small watersheds

坡面水系工程 Slope drainage engineering

沉沙蓄水系统 Sediment storage system

灌溉区 Irrigated area

蓄水池 Cistern

3 小流域综合治理措施Comprehensive control measures for small watersheds

农业耕作措施 Agricultural farming practices

以改变微地形为主 To change the micro-topography

等高带作 Contour ribbon farming

等高垄作 Contour ridge farming

以增加植被覆盖为主 To increase the coverage of vegetation

秸 秆覆盖 Straw cover

以改良土壤为主 Mainly in improved soil

生物质炭添加 Biochar addition

3 小流域综合治理措施Comprehensive control measures for small watersheds

工程措施 Engineering Measures

梯田 Ladder Field

谷坊 check dam

鱼鳞坑 fishscale pits

水平竹节沟 Horizontal bamboo sulcus

3 小流域综合治理措施Comprehensive control measures for small watersheds

封禁措施 Banned measures

实行封禁治理，可以恢复自然植被的生长与演替；迅速控制水土流失，改善生态环境；更好地发展畜牧业。

The implementation of banned governance can restore the growth and succession of natural vegetation; quickly control soil erosion and improve the ecological environment; and better develop animal husbandry.

3 小流域综合治理措施Comprehensive control measures for small watersheds

林草措施 Forest and grass measures

在小流域中建立生态经济型防护林体系，一可发挥林术特有的生态屏障功能，二可为社会提供更多的林产品，提高经济效益。

The establishment of an eco-economic protection forest system in small watersheds can play the unique cow - state barrier function of forest technology, and can provide more forest products for the society and improve economic benefits.

3 小流域综合治理措施Comprehensive control measures for small watersheds

封禁治理措施和手段：Banned governance measures and measures:

- 用封山禁牧代替传统的散牧方式
- Replace traditional grazing methods with grazing prohibition
- 退耕还林还草
- Returning farmland to forests and grasslands
- 合理利用土地，调整产业结构
- Rationally use land and adjust industrial structure
- 制定合理的规划与设计，坚持以科技为导向
- Formulate reasonable planning and design，and adhere to science and technology

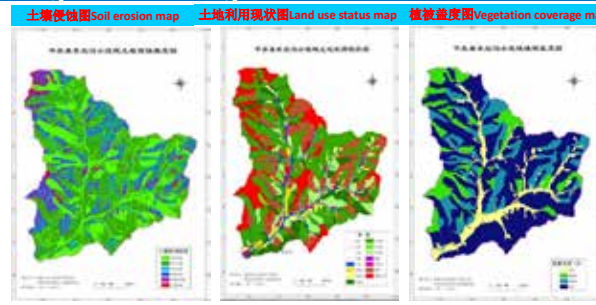
5 规划设计案例——生态输水型小流域 Planning and design case - ecological small watershed

东北沟小流域位于河北省平泉县西部，属燕山山脉中低区，流域面积19.3km²，海拔593-1179m，属于滦河水系上游。有一个行政村，有310户，1100口人。
Located in the western part of Pingquan County in Hebei Province, the Dongbeigou Small Watershed belongs to the middle and low-lying area of the Yanshan Mountains. It has an area of 19.3km2 and an elevation of 593-1179m, belonging to the upstream of the Luanhe River system. There is an administrative village with 310 households and 1,100 people.

在地貌、气候、土壤、植被等方面均具有广泛代表性，属于京津水源区的典型小流域，曾于1989年，被列为滦河重点治理工程项目区，经过初步治理。
It has been widely represented in landforms, climate, soil, vegetation, etc. It belongs to the typical small watershed of Beijing-Tianjin water source area. In 1989, it was listed as the key project area of Luanhe River and had been preliminary treated.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

土壤侵蚀图Soil erosion map　土地利用现状图Land use status map　植被盖度图Vegetation coverage map

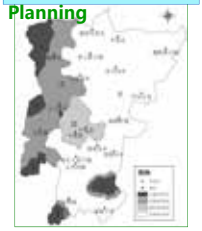


5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

流域定位研究Watershed positioning research

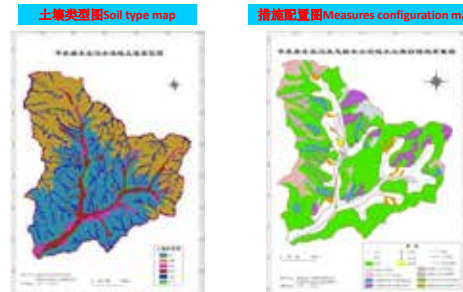
- 京津地区重要的生态屏障
- Important ecological barriers of Beijing and Tianjin
- 《全国生态功能区划》中被划为“极重要水源涵养区”。It is classified as "a very important water conservation area" in "National Ecological Function Zoning".
- 河北省主体功能区规划中，为水源涵养、水源地与生物多样性保护区，功能定位属于限制开发区。In the planning of the main function area in Hebei Province, it is the water source conservation area, water source area and biodiversity conservation area, and the functional orientation belong to the restricted development area.
- 依据“围粮寓田”理论，该区粮食安全定位：粮食生产能力自给，生态保护优先。According to the theory of "grain-stuffing in farmland ", the area's food security positioning as: grain production capacity is self-sufficient, and ecological protection is prioritized.

平泉县主体功能区规划 Pingquan County Main Function Area Planning



5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

土壤类型图Soil type map　措施配置图Measures configuration map



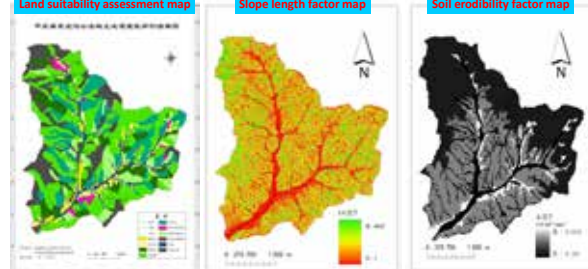
5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

粮食安全与资源保障能力研究结论
Research conclusions on food security and resource guarantee capabilities

- 调查显示：人均占有粮食459.2kg，（小康标准：人均占有粮食400 ～600 kg），人均占有粮食＞400kg概率是98%。说明东北沟小流域粮食生产能力可以自给。The survey shows that the per capita possession of grain is 459.2kg, (standard for well-off: 400-600kg per capita), and the probability of per capita possession of grain more than 400kg is 98%. It shows that the grain production of the Dongbeigou small watershed can be self-sufficient.
- 提出建立粮食安全基本农田约束线：粮食单产368.6kg/亩，保障人均占有粮食＞400kg，至少需要基本农田1194亩。
- It is proposed to establish a basic farmland constraint line of food security: grain yield is 368.6kg/mu (an unit of area), and guarantee per capita possession of grain> 400kg. It needs at least 1194 acres of basic farmland.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

土地适宜性评价图 Land suitability assessment map　坡度坡长因子图 Slope length factor map　土壤可蚀性因子图 Soil erodibility factor map



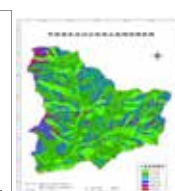
5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

- 根据调查表明，现有水平梯田693.2亩，坡式梯田1354.5亩，合计2047.7亩。说明梯田面积能满足农田约束下线，部分坡式梯田需改造或实施保护性工程。
- According to surveys, there are 2047 .7 mu(an unit of area) existing farmland, including 693.2 mu of horizontal terraced fields and 1354.5 mu slope terraced fields . It shows that the terrace fields area can meet the constraints of the farmland, and some slope terraces fields need to be transformed or implemented.
- 通过对土地适宜性评价研究表明：高度宜农地663.3亩，较宜农地1289.3亩，合计1952.6亩。说明东北沟土地无论从质上，还是数量上都能满足小流域基本生产生活需求。
- According to the evaluation of land suitability, there are 663.3 mu of highly suitable agricultural land and 1289.3 mu of appropriate agricultural land , a total of 1952.6 mu. It shows that the land of Dongbeigou can meet the basic production and living needs of the small watershed both qualitatively and quantitatively.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

土壤侵蚀现状分析Analysis of Soil Erosion Status

- 流域侵蚀模数为 2359.24 t / (km²•a)，属于轻度侵蚀；
- The erosion modulus of the basin is 2359.24 t / (km2 • a), which belongs to mild erosion.
- 中度侵蚀以上的区域面积占总面积的 26.8%，侵蚀量占总量的 82.7%；
- The area of moderate erosion accounted for above 26.8% of the total area, and the amount of erosion accounted for 82.7% of the total area.
- 侵蚀主要源于15°以上坡面，占侵蚀总量的92.1%；
- The erosion mainly comes from the slopes steeper than 15°, accounting for 92.1% of the total erosion;
- 坡耕地侵蚀模数最大，为 6112.9 t / (km²•a)，荒草地占总面积 33.2%，侵蚀量却达总量的74.9%。
- The sloping arable land has the highest erosion modulus of 6112.9 t / (km2 • a), and the wasteland occupies 33.2% of the total, but the erosion amount reaches 74.9% of the total.



5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

土地生态经济分区研究

Research on Land Ecological Economic Zoning

分区方法：依据生态经济目标定位和发展现代农业需求，在土地适宜性评价基础上，结合GIS技术，选择地形部位、坡度、植被盖度、区位条件等指标，划定生产生活区、生态输水区、生态生产复合区。

Zoning method: According to the positioning of ecological economic goals and the demand of modern agricultural developing , based on land suitability assessment, combined with GIS technology, select the terrain parts, slope, vegetation coverage, location conditions and other indicators, to delimit production and living areas, ecological water delivery district, ecological production complex area.

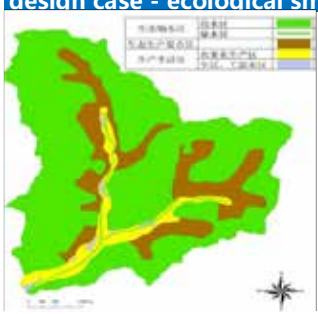
5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

水土流失治理关键技术 Key technologies for soil and water loss control

核心问题：重点解决各生态功能区的生态修复技术、水土流失治理技术及其效益，确立水源区水土流失治理与生态修复关键技术。

The core issues: We will focus on solving the ecological restoration technologies, soil erosion control technologies of each ecological function zone and its benefits , and establish key technologies for water and soil erosion control and ecological restoration in water sources area.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed



三大功能区 Three functional areas	亚区 Sub-region	面积（km²） Area (km2)	比例（%） proportion(%)
生态输水区 Ecological water supply area	产水区 Water production area	13.8	71.1
	行水区 Water running area	0.1	0.6
生态生产复合区 Ecological production complex area		4.0	20.9
生产生活区 Production and living area	农果业生产区 Agricultural and fruit production area	1.2	6.4
	生活、工副业区 Life and sideline work areas	0.2	1.0

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

关键技术：强度剧烈侵蚀坡面治理技术
技术原理：全部泥沙就地拦蓄，植被快速恢复
关键技术：（1）大于25°隔坡编篱拦沙植被建造技术。（2）小于25°水平沟生物篱、鱼鳞坑整地植被建造技术。（3）提高植被成活率技术。
Key technologies: aggressive erosion slope treatment technology
Technical principle: All sediments are stored on site and vegetation restored quickly
Key technologies: (1) vegetation construction techniques of fencing for sand blocking in slope steeper than 25°. (2) Horizontal bio-fence ditch and fish scale pit for vegetation construction technology in slope gentler than 25°. (3) Tech[illegible]ival rate of [illegible]

隔坡编篱拦沙植被建造技术 vegetation construction techniques of fencing for sand blocking

水平沟生物篱草地植被建造技术 horizontal bio-fence ditch for vegetation construction technology

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

生态输水区：主要位于中、低山地，地势高陡区域及沟道。该区人类活动干扰小，阳坡水土流失较为严重，常形成侵蚀劣地；部分支毛沟侵蚀强烈；道两岸村庄、耕地防护标准低。

Ecological water transfer area: mainly located in the middle and low hills, high and steep terrain areas and dicthes. The human activities in this area are less disturbed, and the soil erosion on the sunny slope is more serious, often forming erosion land; some branches of ditch are strongly eroded; the protection standards for the villages and farmland on the two sides of the ditches are low.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

水土流失治理关键技术 Key technologies for soil and water loss control

关键技术：中轻度侵蚀坡面治理技术
技术原理：以坡面来沙量为工程拦沙设计依据，实现拦沙排水。
关键技术：（1）小规格鱼鳞坑整地植被建造技术。（2）竹栅、砌石护埂排水技术。
Key Technologies: Treatment Technology of Medium and Light Erosion Slope
Technical principle: The amount of sand from the slope surface is the design basis for the sand interception of the project, and sand drainage is implemented.
Key technologies: (1) Small-scale fish scale pit for vegetation construction technology. (2) Drainage technology for bamboo rafts and stone masonry.

小鱼鳞坑Small fish scale pit

竹栅护埂Bamboo Rafts

砌石护埂stone masonry

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

生产生活区：主要位于近村缓坡、河流阶地，是农副业经济区和居民生活区。该区人为活动剧烈，主要问题是种养殖业、加工业废水废料和生活垃圾污水的排放多，化肥农药施用量大，点源、面源污染严重。

Production and living area: It is mainly located in the gentle slopes in the near villages and river terraces . It is an agricultural and sideline economic zone and a residential living zone. The man-made activities in this area are intense. The main problems are the discharge of wastewater from the wastewater and domestic waste of the farming, breeding and processing industry, and the emission of living waste is high. The amount of chemical fertilizers and pesticides is large, and the pollution from point sources and surf[illegible]

生态生产复合区：主要位于生态输水区和生产生活区之间过渡地带的缓坡山麓等地势低缓区域，主要问题是薄土层坡耕地较多，单产低、水土流失多发，土地利用方向依据未来经济社会生态发展需求呈弹性变化。

Ecological production complex area: mainly located in low-lying areas, such as gentle slopes and mountains of the transitional zone between the ecological water supply area and the production and living area. The main problems are that there are many sloping farmland with thin soil layers, and the yield is low, the soil erosion is frequent, and the land use direction is changed elastically based on the demand of future economic and social ecological development .

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

水土流失治理关键技术 Key technologies for soil and water loss control

关键技术：高输沙区沟道治理技术
技术原理：拦沙透水
关键技术：（1）木桩编篱谷坊（2）干砌石透水谷坊（3）浆砌石透水型谷坊
Key Technologies: Channel treatment technology in high sand transport dicth area
Technical principle: permeable sand blocking
Key technologies: (1) wood stakes and hedgerows (2) permeable loose

干砌石渡水谷坊 permeable loose [illegible]

木桩编篱谷坊wood stakes and [illegible]

浆砌石透水谷坊permeable grouted stone pitching

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

水土流失治理关键技术 Key technologies for soil and water loss control

关键技术：坡耕地治理技术
技术原理：蓄水保墒，保土排水
关键技术：（1）梯田修筑、抑蒸新技术，（2）薄土坡耕地田间拦挡排水技术
Key Technologies: Sloping Farmland Treatment Technology
Technical principle: water retention, soil conservation and drainage
Key technologies: (1) New technologies for terrace construction and steam suppression. (2) Technology of block and drainage in the field of thin soil slope


梯田筑软埂
soft ridge construction in erraced field


梯田抑侧蒸 inhibition of side steaming in terraced field


梯田抑侧蒸 inhibition of side steaming in terraced field

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

不同功能区水土流失治理模式
Water and soil loss control modes in different functional areas

生态生产复合区：模式构建原则，依据经济社会发展动态变化，建立弹性资源区，进行适度开发治理。
Ecological production complex area: the principle of pattern construction is that, running the establishment of flexible resource zones, and appropriate development and governance based on the dynamic changes in economic and social development.

重点实施薄土层坡耕地治理技术，果园及零散地块的土地整治技术。
Priority will be given to the implementation of technologies for the management of slope field with thin soil, remediation techniques


生态生产复合区
Ecological production complex area

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

不同功能区水土流失治理模式
Water and soil loss control modes in different functional areas

核心问题：解决不同治理技术的空间配置、技术集成的机理，建立不同下垫面水土资源与水土保持技术措施优化配置新模式。

Core issues: Solve the mechanism of of different governance technologies in spatial allocation and technology integration. And establish new models of optimized configuration in water and soil resources and conservation technical measures on different underlying surfaces.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

初步结论 Preliminary Conclusions

（1）生态输水型模式使得水源区改变了生态资本运营方式。

The ecological water supply model makes the water source area change the operation mode of ecological capital.

（2）新型生态资本运营使水源区得到185.7万元的生态收益，相应地，受水区享受了635.9万元生态收益，但其477.1万元成本却由水源区全部承担。

The new ecological capital operation enabled the water source area to receive an eco-benefits of 1.857 million yuan. Correspondingly, the water-receiving area enjoyed an eco-income of 6.359 million yuan, but its cost of 4.771 million yuan was fully borne

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

生态输水区：模式构建原则是总体弱化治理，局部强化治理，避免过度追求生态、经济效益，最大限度向下游多输水。
Ecological water supply area: The principle of pattern construction is weakening governance in whole, locally strengthening governance, avoiding excessive pursuit of ecological and economic benefits, and maximizing water supply to the downstream.

对轻度流失实施封禁；坡耕地退耕；中度流失实施弱化治理，强度流失实施强化治理，植被防护以低耗水植被代替高耗水植被，增加坡面产水，输水同时强化护村护地坝修筑。
Imprisonment for minor eroded land; slope farmland will be retired; moderate eroded land will be weakening implemented; strength eroded land will be strengthen governing; vegetation protection will use low water-consuming vegetation to replace high water-consuming vegetation to increase slope water production, and strengthen the construction of protection dam for village and earth with


生态输水区
Ecological water supply area

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

（3）水源区治理成本收益之间的差额应作为受水区对其进行生态补偿的标准。
The difference between the treatment costs and benefits of the water source area should be used as the standard for ecological compensation of the water receiving area.

（4）生态输水工程实施后，受水区每年应该给水源区补偿标准为291.4万元。
After the implementation of the ecological water transfer project, the compensation standard for the water source area should be 29.14 million yuan per year pay from the water receiving area.

5 规划设计案例——生态输水型小流域Planning and design case - ecological small watershed

不同功能区水土流失治理模式
Water and soil loss control modes in different functional areas

生产生活区：模式构建原则是强化农田流失治理和有限水资源高效利用，发展现代高效农业，重点控制点源和面源污染，保障人民基本生产生活，输好水。
Production and living areas: The principle of mode construction is to strengthen the management of eroded farmland and the efficient use of limited water resources, develop modern high-efficiency agriculture, focus on the control of point sources and surfacet source pollution, guarantee the basic production and life of people, and transport good water.
重点实施坡改梯、水资源高效利用、面源污染控制技术；农林废弃物无害化、污水减排与治理技术。
It will focus on the implementation of slope-changed terraced fields , efficient use of water resources, and surface source pollution control technologies; harmlessness of agricultural and


生产生活区
Production and living areas

Technologies and Measurements on Waste Water Treatment in Watershed

Southern Research Society of Soil & Water Conservation

28th June 2018

The basin has been recognised as a practical hydrological unit for water resources management.

Basins that cover more than one country – transboundary basins – present particular challenges for managers.

when policies are implemented at the basin scale, there is the opportunity to deliver 'whole basin' solutions and to resolve upstream-downstream (for a river) and region-to-region (for a lake or groundwater resource) controversies. The 'whole basin' approach allows the assessment of impact at a system level.

Contents

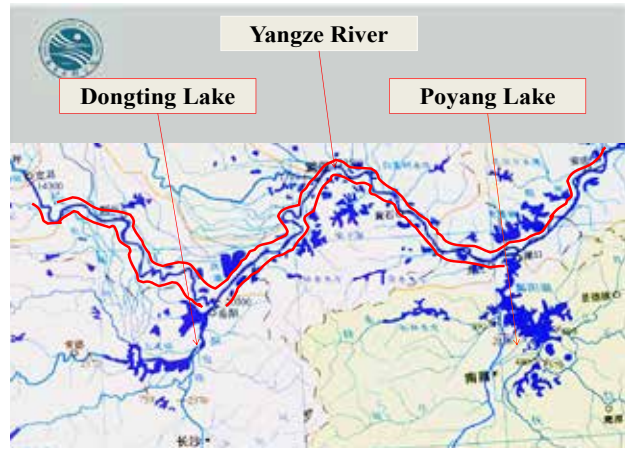
Poyang Lake

Located in North of Jiangxi Province, the Southern Bank of the Middle-low reach of Yangtze River.

Background

Hydrologically, watershed is an area from which the runoff flows to a common point on the drainage system.

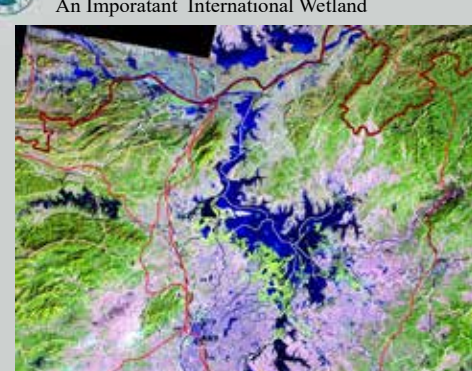
Watershed is not simply the hydrological unit but also socio-political-ecological entity which plays crucial role in determing food, social, and economical secruity and provides life support services to rural people.



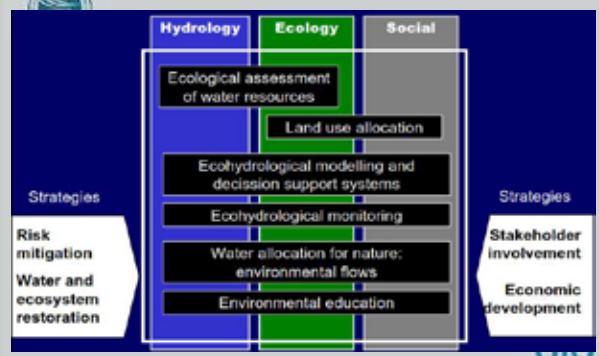
Water creates networks. Water is linked to other natural resources , the complexity of this network makes it difficult to implement adequate management measures.

The largest freshwater Lake in China

An Imporatant International Wetland

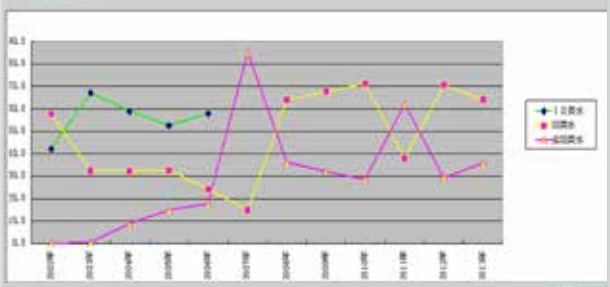


- Watershed area: 162225 km^2
- Poyang Region: 21970 km^2
- Lake area: 5181 km^2 (in 1998)
- Lake volume: 24.89 billion m^3



Integration of Instruments and Tools

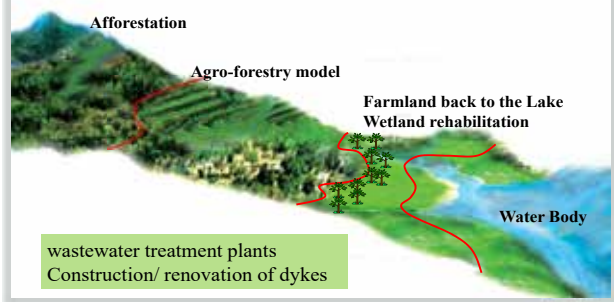
New Challenges



Water Quality in Poyang Lake from 2002 to 2013

Our Actions

Emission Decreases -Pollution Control- Waste Interception-Restoration



wastewater treatment plants
Construction/ renovation of dykes

- Economic growth, urbanization have a big impact on water resources.
- domestic, industrial waste increases.
- Advances in agriculture cause biological and chemical pollution

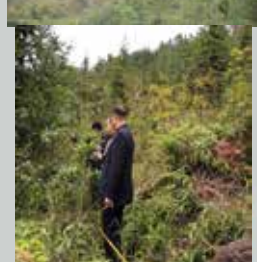
Afforestation

Considering the widely distributed pinus afforestation with simple structure and low function, and the vast developed navel orchard with heavy soil and N/P loss, experiments and pilot project were conducted during 2012-2015, with an approach to integrating a series of anti-soil erosion techniques and forest management technology to increase the water storage capacity.

Integrated Technologies and Measurements on Water Pollution

Which is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maxmize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems

Four native broadleaved tree species were planted for replacement after thinning in low function plantations. Five modification models in slash pine plantation and 3 other models were setup in masson pine plantation. The water storage increased 25.84% on average for all modification models 2 years later,



A series of soil and water loss controlling techniques (terrace slopecovered by grasses of Paspalum natatu , row inter-planting with Trifolium repens L., biochar application into soil, straw coverage on ground surface and water storage ditch) are integrated into 6 models for young orchard and 2 models for mature orchards.

The runoff, soil loss, and bulk density decreased 38.7%~86.4%, 29.2%~91.7% (3.92~12.31t/hm2) and 0.6%~15.2% on average, respectively, while the soil porosity increased 4.0%～22.4% in young native orchard.

For mature navel orange orchard, the runoff, soil loss, total N/P/K content decreased 67.9-80.1%, 51.5-54.7%,75.7-96.2% and 60-70% on average, respectively. The heavy mental loss(Ni、Cu、Cr、Zn、Pb and Hg) decreased 38.5% on average.

Constucted Wetland

CW have been widely used to treat diffuse pollution originating from intensive agricultural production patterns because of low cost, low energy consumption and good effect they promise in waste water. This biological waste water treatment systems are useful for reducing SS, N, P, BOD and COD in sewage. And they can be implemented in many different situations and built with materials available locally

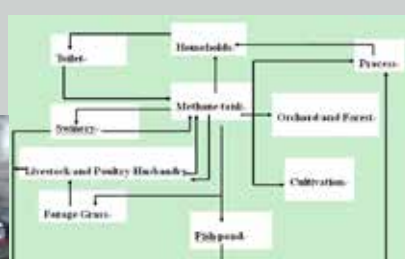
Ecological Agriculture

- **"Pig Raising-Biogas-Orchard(vegetable/fish/ others)" Project**

✓ Biogas capture and utilization in agricultural activities;

✓ Composting of organic waste (pig, poultry and cattle's manure) to reduce methane emission;

✓ Households combine latrines, barns and biogas ponds together



Our Goal

既要金山阴山，也要绿水清山

Keeping mountains green and water clean will secure people's livelihood with rich biodiversity along the entire river

Wetland rehabilitation

Riparian Zone(51.5 hm^2 totally) was divided into 3 sub-zone depends on hydrology feature, topography and land cover

1. Vegetation restoration on Beaches (20hm^2): Spontaneous recovery for degraded grassland
2. Aquatic Plant restoration zone (12hm^2)
3. Vegetational Type restoration zone(19.5hm^2): Artificial replant and landscape reconstruction for degraded grassland

Deep water area remained intact.

Vegetation Restoration and Reconstruction Techniques

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Restoration Ecology

- **Restoration Ecology**

It is a separate field of ecology and studies the mechanisms and techniques of restoring ecosystems that have been destroyed or degraded by human activity to a more natural state.

Restoration ecology has evolved as recently as the 1980s. The scientific field of **"restoration ecology"** was first identified and coined in the late 1980s by John Aber and William Jordan. The study of restoration ecology has only become a robust and independent scientific discipline over the last two decades (Young et al. 2005).

Vegetation Restoration

- **Vegetation Restoration**

It aims to restore the damaged forests and other natural ecosystems by protecting the existing vegetation, or planting tree-shrub-grass, thereby restoring its biodiversity and ecosystem functions.

Three key points:

1. To determine the benefits of ecology-society-economy through vegetation restoration;
2. To determine the community composition and structure;
3. To control community structure and function for restoring ecosystem function.

Vegetation Restoration

Natural Restoration:

Self recovery without human intervention and action

-long time periods, better site condition required

Natural Restoration with human intervention :

Improve soil nutrient conditions,

Select appropriate species or provenances

Restoration via Ecological Engineering :

Simulate ecosystem structure and functions

Ecological Principals for Vegetation Restoration

- Plant Ecological Adaptability
- Optimal Resource Utilization

Multi canopies（time-space diversity）

Difference in resource utilization

（deep-shallow roots、sun-shade plants…）

- Co-existence

Different species co-exist（trees-crops..）

Ecological Principals for Vegetation Restoration

- Density Effect
- Ecological Niche

Introduce appropriate species to fill in the niche so as to increase the ecosystem stability

- Ecological Succession

Progressive succession and species selection

- ……

Reconstruction Techniques

- Environmental Improvement Techniques

Leguminous plants、ground coverage、water saving、soil and water erosion controlling..

- Sloping Agricultural Land Techniques

ICIMOD-Southeast Asia, China

Annual- Perennial plants mixed

Agriculture- Graziery mixed

- Plantation Techniques

Conifer-Broadleaved plants mixed

Young plantation breeding

Plantation regeneration

Vegetation Restoration in Jiangxi, China

Mountain-River-Lake Project

Poyang Lake Watershed

97% area of Jiangxi Province

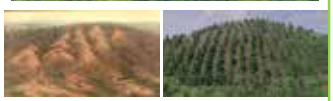
Frequent droughts and floods in 1980s

Red Desert- soil erosion

- **Initiated in 1983 by Jiangxi government and Poyang Lake Watershed was considered as a system**
- **Combining mountain-river-economy**
- **26 demonstration bases, 112 agriculture bases, 6 watersheds**

Mountain-River-Lake Project

Vegetation restoration in red hills- Longhui , Jiangxi



Plantation in harsh lands- Taihe, Jiangxi

- Small watershed restoration- vertical development
- Red soil hill development
- Forest coverage: 31.5% to 63.1%
- Ecological concepts and green rise

Ecosystem carbon-nitrogen-phosphorus

Modules	Slope position	Wild shrubs	Forest plantation	Significance
Soils	Upper	45.75±1.43b	38.11±3.23C	*P*<0.05
Soil layers	Middle	43.99±2.80b	44.48±5.91B	*P*>0.05
0-75 cm	Lower	52.90±4.37a	52.68±3.00A	*P*>0.05
	Average	47.55±2.21	45.09±3.28	*P*>0.05
ts	Upper	4.35±1.11b	56.19±5.01B	*P*<0.001
	Middle	7.08±4.08a	59.87±1.34B	*P*<0.001
	Lower	4.51±0.80b	82.62±5.47A	*P*<0.001
	Average	5.31±1.24	66.22±5.58	*P*<0.001
n level	Upper	50.10±0.33b	94.30±8.23C	*P*<0.001
	Middle	51.06±1.29b	104.34±4.58B	*P*<0.001
	Lower	57.40±5.16a	135.29±2.45A	*P*<0.001
	Average	52.85±2.40	111.31±8.20	*P*<0.001

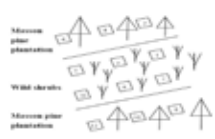
Wild shrubs<Masson pine; Upper<Middle<Lower (Chen et al., 2012)

Case study 1

Forest reconstruction in Taihe

Jiangxi Agricultural University

Experimental design



Wild shrubs Masson pine

Recovery process

Plantation design in 1990

Taihe barren land

After 5 yrs

Landscape changes since 1990

After 20 yrs

After 15 yrs

After 10 yrs

Case study 2

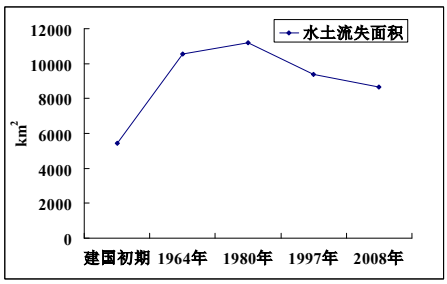
Soil and water erosion and vegetation restoration in Ganzhou, Jiangxi

Jiangxi Institute of Soil and Water Conservation

- Ganzhou City- ¼ of Jiangxi area;
- Serious soil and water erosion problem;
- Red desert

Soil and water erosion

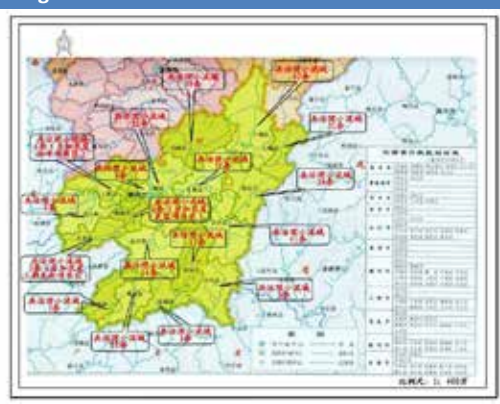
1950-1980 Ganzhou
Area of soil and water erosion



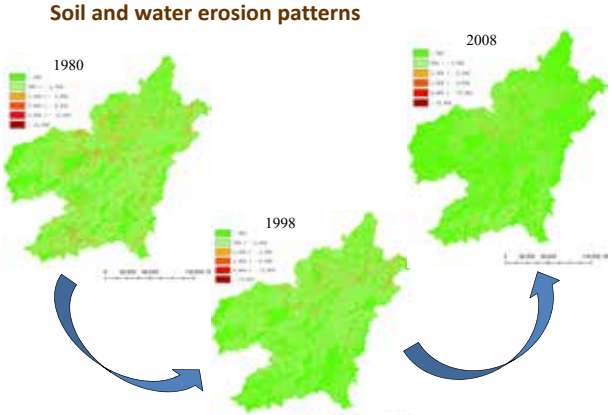
1950	5430km2
1964	10563km2
1980	11175km2
1997	9378km2
2008	8663km2

Watersheds:395
Reduction in area of soil and water erosion: 6291.27km^2

Investigation on soil and water conservation in Ganzhou



Soil and water erosion patterns



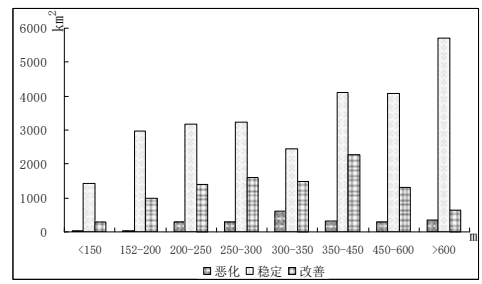
Temporal changes in soil and water erosion patterns

- 1980----2008 area was averagely reduced by 43.4%, particularly for middle and moderate magnitude (55.2%)

年份	<500 t·km^{-2}·a^{-1}	500-2500 t·km^{-2}·a^{-1}	2500-5000 t·km^{-2}·a^{-1}	5000-8000 t·km^{-2}·a^{-1}	8000-15000 t·km^{-2}·a^{-1}	>15000 t·km^{-2}·a^{-1}
	minimal/km^2	moderate /km^2	middle/km^2	intense/km^2	Very intense/km^2	severe/km^2
1980	27679	1130	8396	1501	392	281
1998	28818	845	6605	1658	932	521
2008	32762	911	3352	1468	538	348

Spatial changes in soil and water erosion patterns

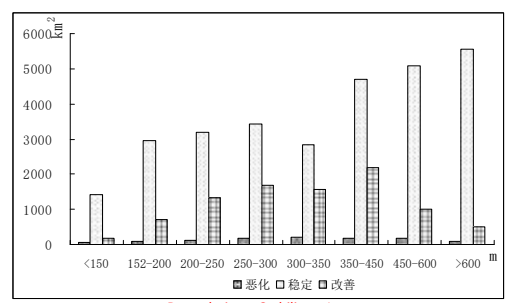
1980—1998 area-elevation



Degradation Stability Improvement

Spatial changes in soil and water erosion patterns

1998—2008 area-elevation



Degradation Stability Improvement

Vegetation Succession in this area

- Progressive succession in 30 yrs- multiple canopies
- 1016 woody species, 152 families, 531 genus

  dominant species in soil and water conservation

  Pinus massoniana Lamb.

  Schima superba Gardn. et Champ

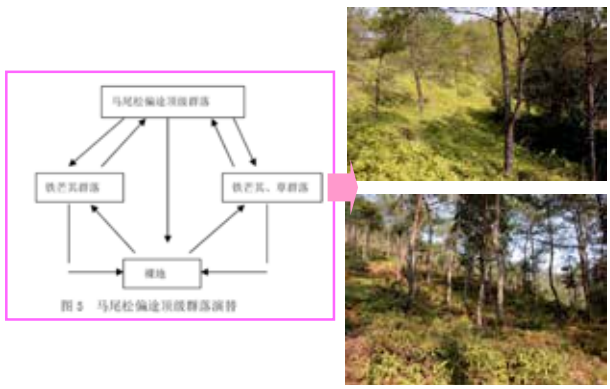
  Liquidambar formosana Hance.
- 369 herbaceous species

  Families: Compositae, Gramineae

Natural succession

Schima superba---- *Alniphyllum fortunei*

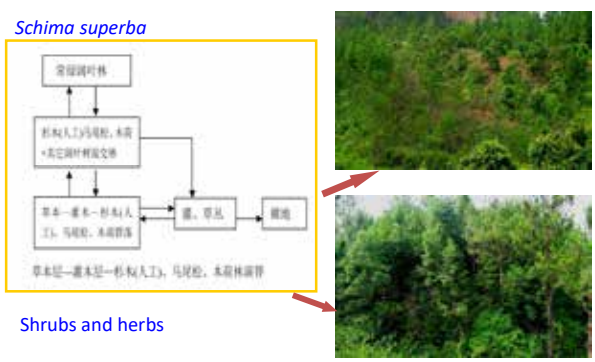
Pinus massoniana succession



Simulated succession

Pinus massoniana

Schima superba



Shrubs and herbs

Fruit Trees

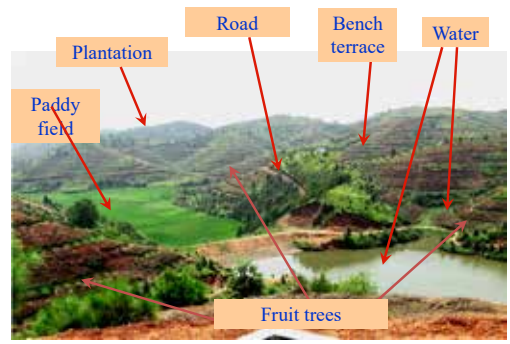
Changes in soil properties

Year	Erosion modulus (t/km²·a)	Erosion area (km²)	Soil bulk density (g/cm³)	Soil denuded thickness (cm)
1980	7255	11174.73	1.45	0.5003
1998	3402	9377.53	1.34	0.2539
2008	1010	6617	1.21	0.0835

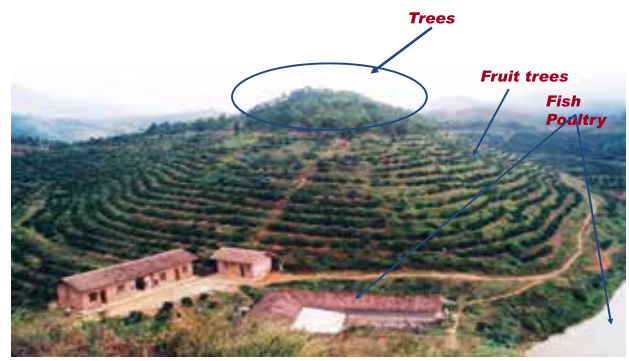
Soil denuded thickness was reduced by 0.42 cm and soil and water conservation can save soil produced in 200 yrs.

➢Examples

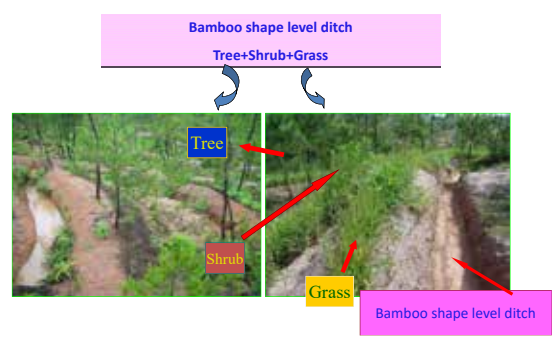
Small watershed comprehensive management



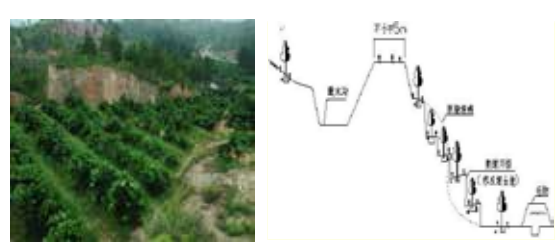
Vertical management



Slope land soil and water conservation



Slope collapse restoration



Improvement in vegetation structure

After

Before

Chapter 21

Project Profile of WCP II of Ningxia

This chapter presents the basic situation in Ningxia, the implementation of WCP II

Introduction

This chapter presents the basic situation in Ningxia, the implementation of WCP II and the main practice and experiences of project construction management.

The WCPII project in Ningxia has a loan of US$3 million. The project started its preliminary work in 2008 and was launched in 2012. It continued for five years till the end of 2016. The loan account was closed at the end of June 2017.

Ningxia is divided into three sections according to the topography: the first is the northern irrigation area. The terrain there is flat and the soil is fertile. The second is the middle arid zone, marked by drought and rain, wind and sand, poor land, poor living conditions. The third is the southern mountains. Hilly stretches and ravines stand in some areas, though damp and cold, the natural ecological environment is better. The existing arable land in the region is 16.5 million mu, with a per capita of 2.8 mu, ranking second in the country; 7.9 million Mu of irrigated land near the Yellow River is one of the 12 commodity grain production bases in the country; there are 36.65 million Mu of pasture land making it one of the ten largest pastoral areas in the country. Four billion cubic meters of Yellow River water can be used annually, accounting for 7% of the total amount of distribution. At the end of 2017, the total GDP of the entire region was 345.4 billion yuan.

The Ningxia project area involves 8 counties (cities, districts) and 2 state-owned farms. The feasibility investment for the project is 410.86 million Yuan, of which the World Bank loan is 30 million US dollars, and the domestic counterpart is 205.8 million Yuan. Three integrated measures including "engineering, agronomy, and management" were adopted to develop a water-saving irrigation area of 333,000 Mu and 37 water use associations.

In the Ningxia project area, a total of 2,266.517 km of channel cladding was completed, 528.27 km of drainage channels were repaired, 89.07 km of water pipelines were laid, and 1921 km of drip irrigation belts were laid. The development of water-saving irrigation area of 22,600 hectares, of which the irrigated area is 21,500 hectares, drip irrigation area is 0.09 million hectares. The complete water-saving irrigated area accounts for 103% of research area.

Implementation of WCP II

The Ningxia project area involves 8 counties (cities, districts) and 2 state-owned farms. The feasibility investment for the project is 410.86 million Yuan, of which the World Bank loan is 30 million US dollars, and the domestic counterpart is 205.8 million Yuan. Three integrated measures including "engineering, agronomy, and management" were adopted to develop a water-saving irrigated area of 333,000 Mu and 37 water use associations.

The WCPII project area in Ningxia has a loan of US$3 million. The project started its preliminary work in 2008 and was launched in 2012. It continued and was completed for five years and ended at the end of 2016. The loan account was closed at the end of June 2017.

In the Ningxia project area, a total of 2,266.517 km of channel cladding was completed, 528.27 km of drainage channels were repaired, 89.07 km of water pipelines were laid, and 1921 km of drip irrigation belts were laid. The development of water-saving irrigation area of 22,600 hectares, of which irrigation area of 21,500 hectares, drip irrigation area of 0.09 million hectares, completed water-saving irrigation area account for 103% of research area (see table below).


实施世行贷款节水灌溉项目情况
Implementation of WCP II in Ningxia
(一) 水利工程 Hydraulic engineering
表1 宁夏世行贷款节水灌溉项目水利工程与管理节水措施累计完成情况
Accumulated Completion of Water Saving Measures for Water Projects and Management Water Saving Irrigation Projects of WCP II in Ningxia

Agriculture measures

五年累计完成平衡配方施肥2.22万公顷，实施地膜覆盖4465公顷，引进和推广优良品种8681公顷，平田整地9589公顷，机深翻1.29万公顷，秸杆还田5256公顷，病虫害防治2673公顷，农田道路1107.6公里（表2）

A total of 22,200 hectares has been treated with balanced formula fertilization; 4465 hectares have been covered with plastic mulch; good varieties have been introduced and promoted in 8681 hectares; 9589 hectares of land at Pingtian; 12900 hectares now have deep drip irrigation; 5256 hectares of straw returned, 2673 hectares have been treated for pests and diseases, farmland roads of 1107.6 Km has been completed (Table 2 below)


实施世行贷款节水灌溉项目情况
Implementation of WCP II in Ningxia
(二) 农业措施 Agricultural measures
表2 宁夏世行贷款节水灌溉项目农业节水措施发展面积累计统计表
Agricultural water-saving measures cumulative area statistics of WCP II in Ningxia

Management and environmental protection measures

The first task is to establish and improve 37 farmers' water users associations and manage 330,000 Mu of irrigated area. The association organizes and conducts training programs every year, is equipped with basic office equipment and facilities, and implements irrigation projects and irrigation subjects and responsibilities. According to the research situation and monitoring and evaluation report, the management function of the association has performed well. The implementation of management measures has promoted water-saving irrigation, promoted the benign operation of water conservancy projects. Associations in the project area have played a leading role in promoting the healthy operation and development of the entire Yellow River Irrigation District.

The second is the organization of domestic training and exchange learning the programs participated in the training and learning activities related to procurement management, financial management, MIS system, water-saving irrigation technology and management, water use associations, etc. organized by the World Bank and Water Resources Department. The World Bank also, from time to time project management staff from 9 counties (cities, districts and bureaus) to Xinjiang, Hebei and other domestic water-saving irrigation advanced regions, for exchange learning. This improved their project management level and business capabilities and laid the foundation for the smooth implementation of the project.

Third, applied technology research and promotion: WCPII of Ningxia involves three special research sub-projects: (i) Xi'an University of Technology – Beijing Zhongguanlvyuan International Consulting Co., Ltd. won the bid for the joint venture "Ningxia Qingtongxia City based on ET. (ii) "The research and promotion of integrated water resources management planning and water rights pilots" was carried out by the Ningxia Academy of Water Resources as the subject of the research. (iii) Promotion of "Comprehensive treatment of saline-alkali land in Pingluo County of Ningxia", and "The Ningxia Yellow River Irrigation District based on ET". Small-scale irrigation project property rights reform pilot study" project. Each special project

team organized and conducted survey sampling, observation, data collection, modular testing, analysis, comparison and research as planned

Ningxia WCP II project construction management organization was sound, the preliminary work was solid. The construction management was standardized, the project quality was good, and the benefits were obvious. The beneficiary farmers in the project area fully supported and affirmed the implementation of the project, and the experts of the World Bank inspection team were extensive. Effusive in their praise. In particular, the project withdrawals and reimbursements were timely, accurate, and standardized, and have been recognized and praised by the World Bank and the Central Project Office.

Main practices and experiences

The World Bank project construction management has brought us many advanced construction management experiences: solid and multi-industry experts participated in the preliminary work of consultation, adopted comprehensive measures to promote the concept of water-saving irrigation, regular on-site inspection systems, tender procurement, construction management information systems, and construction. The entire process of the independent monitoring and evaluation system, payment methods for withdrawals and reimbursements, multi-sectoral and multi-industry cooperation and coordination mechanisms, etc. These management measures, reflect the rationalization of the Bank's loan-saving water-saving irrigation II project, and the scientific system management norms, to ensure the fundamental realization of the project objectives.

- Solid and orderly preparatory work

From 2006 to early 2012, the pre-project work has gone through specific project phases such as project proposal, feasibility study report, project implementation plan report (PIP report) and project implementation plan. The above reports were prepared by the corresponding qualified water conservancy and hydropower survey and design institutes. The project proposal and feasibility study report were submitted to the National Development and Reform Commission for review and approval after being reviewed and verified by the Autonomous Region and the Ministry of Water Resources. In addition, a number of special reports such as social assessment special reports, environmental impact assessment reports. Soil and water conservation programs have also been organized separately.

- Integrated water-saving concept of organic integration of the three major measures

Through the organic combination of engineering, agriculture, and management, and the overall advancement, it has overcome the previous situations of the respective administrative departments of water conservancy or agriculture, realized the importance of coordination of water, fertilizer, farming, and management, promoted water-saving irrigation, increased grain production, increase the income of farmers, through sustainable use of water resources.

- Established technical support services at all levels

In accordance with the requirements of the World Bank, a regional and county-level expert technical support service system was established before the start of the project, with the help of various types of experts in agriculture, water conservancy, water conservation, environment, and finance. It was responsible for guiding and serving the preparation, implementation, inspection, and acceptance of project implementation plans.

- Regular inspection and attention contributes to project construction effectiveness

The target framework will be incorporated into the legal text of the project agreement. A multi-industry, multi-disciplinary team of experts will be formed to conduct regular inspections twice a year, and through the mid-term adjustment of the project, assess and rectify the annual project plan and subproject construction content and objectives to ensure the smooth implementation of the project.

- Focus on the construction of WUA organizations and the construction of water-user capacity

First, through investigations and demonstrations, the project area has to establish and improve farmers' user associations so as to improve the democratic management and self-management capabilities of the project area.

The second is to improve the professional knowledge level and working ability of management personnel through training, inspections, etc., and improve the project construction management level to ensure the sustainable development of the project.

- Introducing third parties to conduct performance evaluation and monitoring evaluation

After the Ningxia project was launched, it recruited third parties through open procurement to monitor and evaluate the implementation of the project. Through the independent tracking and supervision of third parties it would be possible to evaluate the progress of the project, monitoring the World Bank loan payment, that local government supporting funds were in place, the use of project funds, project bidding, procurement of materials and equipment, civil engineering progress and quality, project benefits and other conditions. The data obtained and the report data of relevant documents are analyzed and arranged, and the actual implementation of the project is evaluated fairly and objectively. Compare the actual progress of the project with the planned progress and evaluate the degree of completion so as to control the progress, quality, investment, and benefits of the project.

- Reimbursement procedures are strictly regulated

宁夏世行贷款节水灌溉二期项目财务和资金管理严格规范，通过对所有参与项目建设管理人员培训后，在熟练、充分使用本项目创建的项目建设管理智能化信息系统（MIS）的基础上，在报账制度和财务管理方面创新了作法，探索了经验。

一是项目提款申请逐级审核提交到财政厅后由财政厅审核，并通过专用账户直接拨付承包商。该流程减少了支付步骤，提高了效率，杜绝了对项目专项资金的挤占、挪用。

二是对于支付给承包商的每一笔款项，财政厅会签署一份通知分发给项目各级单位，以便进行财务统计和债务管理。

三是自治区财政厅外债办严格执行外债管理制度，确保控制工程进度、记录报账和监控外债。

The finance and fund management of the Ningxia World Bank-financed water-saving irrigation phase II project is strictly regulated. After receiving training all participating project construction and management personnel are able to use, the project construction management intelligent information system (MIS), proficiently and fully. Innovating the practice in the reimbursement system and financial management, and exploring the experience.

- First, the project withdrawal application is submitted to the Department of Finance. After being audited step by step by the Department of Finance, the contractor is paid directly through a special account. This process has reduced the payment steps, increased the efficiency, and eliminated the expropriation and embezzlement of project-specific funds.
- The second is that for each payment made to the contractor, the Department of Finance will sign a notice and distribute it to all levels of the project for maintaining effective financial statistics and debt management.
- Third, the External Debt Office of the Autonomous Region's Department of Finance strictly implements the external debt management system to ensure the control of project progress, record reimbursement and monitoring of external debt.

In general, the WCP II Of Ningxia has clear objectives and tasks, complete management organization, advanced and rational planning and design concepts, and scientific and orderly management. Later we will carefully sort out and summarize the experience of the construction and management of the WCPII, and gradually promote the construction of the World Bank's new water-saving irrigation project concept and management experience.

Chapter 22

世行贷款节水灌溉项目
World Bank Water-Saving Irrigation Project
农民用水协会（WUA)交流材料
Farmers' Water Use Association (WUA) Exchange Material

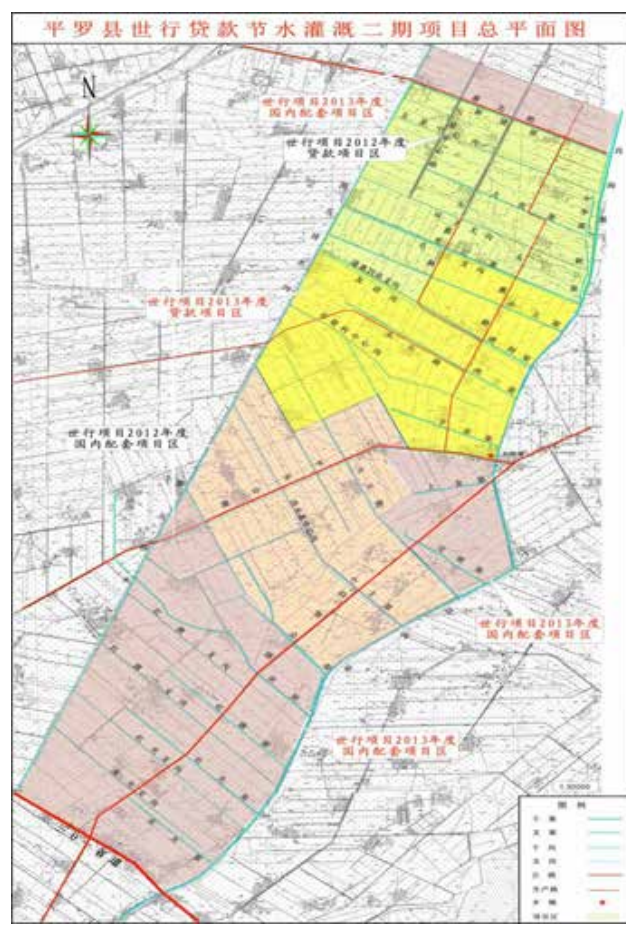
平罗县世行贷款节水灌溉二期项目领导小组办公室

Pingluo County World Bank loan saving irrigation two phase project leading group office

2018年6月

Pingluo County is located in the north of the Ningxia Hui Autonomous Region. It is the only established County in Shizuishan. The total land area of the county is 2059.79 square kilometers. It has jurisdiction over 7 towns, 6 townships, 143 administrative villages and 28 urban communities. Since ancient times, it is a land of fish and rice and rich land in the northwest. The Shahu scenic area, which includes water catchment areas, reed, bird, wetland and desert landscape, has become a famous national 5A tourist area located in Pingluo County. It has been rated as "the advanced county for attracting investment in the whole country" for three years. It has been awarded "one of the top 10 best investment and competitive city county in the country", and ranks in "the top 100 cities with the most investment potential in China" with a raning of eighty-sixth.

There are 8 farmers' water-user associations in the two phase of the world bank loan water-saving irrigation project in Pingluo County, which was established in 2005. It is the farmers' voluntary direct participation in irrigation water management, promoting the planning of water use, saving water and establishing a new irrigation management mechanism. It is the farmer's own water management organization to reduce the burden of the country and the countryside. Today, there are more than 80 members. These 8 associations are both commanders and fighters for irrigation. They are both the vanguard of water saving and the pacesetter of getting rich. The work of the peasant water association of the two phases of the World Bank loan for water saving irrigation project in Pingluo County is summarized as follows:



The two phases of World Bank loan for water saving irrigation project in Pingluo County is located in the east of Pingluo County. East by Changpang Canal, south to Hongqi village, west to fifth row of ditch, and north to Hubei road of Huang Qu Qiao Town, involving 8 administrative villages of canal mouth, head gate and yellow canal bridge in 3 towns. Planning and development of water-saving irrigation area of 2740 hectares, 26000 people benefited out of the entire population. Since 2008, we have drawn up the advanced water saving concepts and project management mode of the World Bank loan project to demonstrate the construction of water conservancy projects. By integrating the two major sectors of the World Bank loan project and domestic supporting projects, we will implement three water saving measures for water conservancy, agriculture and management. In the project area, the water conservancy projects which were aging and in disrepair, have been extensively renovated, and the comprehensive agricultural production capacity has been significantly improved. New forms of farmland, such as drought, irrigation, drainage, roads, and forests, have been formed. The new agricultural development trend is good in that most people are able to manage and develop water conservancy methods, remove water damage and benefit well. This is closely related to the efforts of the 8 farmers' Water Users Association, which is the main body of management measures in the project area.

- First, the staff members of the early work. Since the beginning of the project planning stage in 2008, the farmers' water user associations in the project area have been the farmers' own water management organization. Taking the project as an opportunity, it would be useful to seize the project construction to improve the rural water conservancy infrastructure, participating in the project construction with a feeling of ownership. Whether it is the project planning stage or the implementation stage, they are familiar with the geographical location of the project area, the water supply time, the laws, the crop planting seasons and the problems of irrigation in the project area, for many years. During the survey stage, the Association sent the people to follow the survey team and actively cooperate with them. During the survey channels and gullies are measured one by one, and the operation data of irrigation management in the project area are provided and rationalization proposals are put forward. In the designing the WUA, the present situation, operation mode and future development plan for the farmers' water user associations are provided for the designers to lay a good foundation for the project.
- Two. In the construction, the coordinator of the project implementation. 2012 to 2016 was the key period for the implementation of the World Bank water-saving irrigation project in our county. The construction period is also an irrigation period. In order to ensure that the project is completed on schedule, the peasant water association of the project area actively carries out propaganda to do a good job of farmers' ideological stability and prevent the occurrence of water robbing and water struggle and maintain the order of irrigation. On the basis of the original "one shovel" running water, to adjust the management unit of the trunk canal, adjust the irrigation management system and the irrigation time of the water supply, the way of the night irrigation in the night is adjusted to the night irrigation, and the irrigation of the crops has not been irrigated by the construction. In coordination with the construction units, according to the construction plan, a thorough irrigation plan is made during the construction period. According to the irrigation and water successively, the order of the lining channel is adjusted, and the irrigation and construction two are done as much as possible. On the other hand, as a representative of farmers, the association, on the basis of the views of the farmers, has actively contacted the office of the world bank project in accordance with the wishes of the farmers in accordance with the wishes of the farmers and provided the farmers' needs of chemical fertilizer, seeds, film varieties and participation in agricultural purchase.

Information regarding the planting area and crop species in the project area are provided to the

project office in time and accurately, and the detailed data are provided for the planned agricultural capital, which ensures the fair distribution of the agricultural capital. At the same time, in order to ensure the timely distribution of agricultural capital to the households, the Association launched the masses, and was widely linked to the migrant workers and the people who went back to the town to collect agricultural capital.

- Three, strong measures to do well in water-saving irrigation management. Water saving-irrigation and farmers' income increase are the main objectives of the World Bank project. As the main body of irrigation water, farmers' water users' Association and the beneficiaries of the project – farmers are both the beneficiaries and the executors. The peasant water user associations is the link between the leading groups of the two phase project of the World Bank water-saving irrigation project in Pingluo County and the farmer. The farmer now pays more attention to the development of the economic benefit of the project and the management of the project. After the completion of the transformation of office facilities of farmers' Water Association and purchase of computers and other office equipment, the Project Management Office actively carried out water-saving irrigation management. First, the staff composition and system construction of the Association have been perfected on the basis of the original association. Each association is equipped with 1 president, 1 vice president, 1 accountant, 1 toll collector and 3-5 water drier. According to the "one method of the five duty and three system", we have established the responsibilities of the president the vice president, the duties of the toll collector, the job assignment of the water personnel, the duties of the water drips, the system of financial management, the management system of the collection of water fee, the system of financial expenditure and the management of water, and so on. Proper methods provide strong policy support for the standardized and smooth operation of the association. Two, we should vigorously publicize the knowledge of water-saving irrigation, and distribute more than 2000 books about agricultural water-saving irrigation science knowledge and farmers' Water Users Association's knowledge popularization. In the project area, there were 12 training sessions for farmers and more than 700 training trips. Three, in order to improve the management level of the staff of the association. The association has actively contacted the technical personnel of water conservancy irrigation management center and water management unit in Pingluo County in stages and levels, and carried out irrigation management, water knowledge and water laws and regulations to guide the members of the association to master water technology. In order to improve the management level of water resources in rural areas. To provide strong support for the management of water, the association has established a team of association managers who understand and manage day-to-day operations. It is required to re measure the land and verify the area of the irrigation. In the past, due to irrationality of irrigated area and unreasonable and unfair water charges, water users faced many difficulties. In 2015, in the implementation of the project, the farmers' water-user associations used Pingluo County to carry out the land confirmation work, actively cooperated with the township, village and team cadres to re-check the irrigation area, solve the problem of the unequal allocation of water costs, the non payment of water taxes regulate and the flow of water, to ensure fair water and reasonable charges.

Through the implementation of various measures, the water quality of the project area has been greatly enhanced, and the water-saving consciousness of farmers has been generally improved. The management standard of the peasant water associations in the project area is more scientific and more reasonable in water distribution. The farmers' participation in water awareness is strong, and the water-saving effect is obvious. The water conservancy projects in the project area is 40 square per Mu after completion and operation of the project.

- Four, take the lead soldiers on the road. After the completion of the project construction, relying on the good irrigation and drainage conditions and irrigation management conditions in the project area, the farmers' water user associations actively contact, guide the large farmers, professional cooperatives and other companies to enter the project area to develop the characteristic industry, and vigorously adjust the industrial structure. Through the introduction of local Ningxia Xing Nong seed vegetable, Ningxia Lvchun seed vegetable, Pingluo County's flourishing plant and vegetable multiplication and other specialized cooperatives, and Guangdong and Inner Mongolia planting companies in the provinces of the region, more than 40 kinds of vegetable seed production of vegetable beans, amaranth, pumpkin, bitter gourd, gourgus and pigment Pepper have been developed, with an area of more than 2000 mu. The demonstration drive covered more than 200 households. Through the collective operation of the village, development of celery, dish vegetables, tomatoes, peppers and other open field vegetables more than 3000 mu, involving 400 households has been possible. Through the introduction of Shanghai seed industry west base, the development of corn seed production more than 2000 mu, covering more than 200 households. The efficiency of the project area was 150 Yuan per mu.

In short, the construction of water-saving irrigation projects through the World Wank has greatly stimulated farmers' enthusiasm and initiative in project construction and seed production. After the implementation of the project, the quality of the soil and vegetation has changed radically, the conditions of agricultural production have been obviously improved, the irrigation system of farmlands is straightened out, the effect of water saving has been obviously improved, the water level has been reduced, the problem of farmland salinization is effectively solved, and it has laid a solid foundation for the farmers to prosper.

Chapter 23

世行节水灌溉项目
World Bank Water Saving Irrigation Project
农资采购与发放交流材料
Exchange Materials of Agricultural Material Procurement and Distribution

Zhongwei Zhongning County,

Ningxia Hui Autonomous Region

2018年6月

Introduction

The project area of the World Bank water-saving project in Zhongning County involves Ning'an, Enhe and Mingsha. Through five years of implementation, the development of a water-saving irrigation area of 3,212 hectares has been developed an investment of 37,798,800 yuan, of which the Bank's loan funds are RMB 198.927 million. The agricultural water-saving measures paid by the World Bank loan were mainly balanced fertilization and fine seed procurement. The total investment was 1.868.9 million Yuan. Through four years of implementation, the people responded well.

Implementation procedures

在农业节水措施实施中，县世行办内部组织充分协作，分工明确、配合紧密，并充分调动农技人员的主观能动性，在乡村两级组织的配合下，精心组织、认真落实、顺利完成了采购和发放。农资的类型也完全符合所选地块的土壤性质和农户的种植习惯，符合世行环保生态可持续发展的理念，受益惠民范围尽可能扩大，有望起到典型示范作用。

In the implementation of agricultural water-saving measures, the internal organization of the county World Bank Office was fully involved, with clear division of labor and close cooperation of agricultural technicians. With the cooperation of rural and rural organizations, it was meticulously organized, implemented conscientiously, and successfully completed purchase and distribution; the type of agricultural resources also fully conforms to the soil properties of the selected plots and the farming habits of the local households. It conforms to the World Bank's philosophy of environmental protection and ecological sustainable development. The range of beneficiaries benefiting as much as possible is expected to play a typical demonstration role.

Pragmatic steps to implementation.

Like all World Bank Projects the 2012 project was implemented in 2013 as following these norms:

1、扎实做好前期调查工作

One: Do a good job in early investigation

2、按程序完成采购工作

Two: Complete procurement in accordance with procedures

3、细致做好农资发放

Three: Paying attention to the distribution of agricultural materials

Do a good job of proper and early investigation

In order to speed up the project procurement management, after the District World Bank Office approved the project implementation plan, the Office instructed the relevant personnel to seriously study the construction contents and requirements, and divided up the work. The

agricultural technology extension center under the county agricultural and pastoral bureau led the implementation with the assistance of other personnel. They relied on their own technical knowledge of agricultural technology and undertook the specific work of serving the rural grass-roots agricultural technical station.

In 2012, the construction scale of the project was 1200 hectares, and the investment of the project approval for agricultural water-saving measures was about 450000 Yuan. We carefully analyzed the rural economy, labor force, and labor situation in the project area, and considered that the average of more than 20 Mu per Mu was not attractive to the farmers. Farmers did not attach great importance or enthusiasm to the project, the appeal of the project and the actual effect is not strong, also can not play the role of the project undefined benefits to the people policy and demonstration drive. What about this passive problem? We have worked on this from the following aspects.

First of all, we have investigated the crop structure of the project area, and the farmers undefined Symposium in the project area, and the farmers undefined discussion in the project area, we have unified the understanding that the wheat yield is greatly influenced by the climate factors, it is difficult to achieve high and stable yield, and the efficiency is not high, the water consumption is high. In recent years, the planting area in the China Ning irrigation area is decreasing year by year; the rice crop is labor intensive is big and the area is reducing year by year.

Lycium barbarum needs the form of "company peasant household base" in order to build a large area, farmers undefined self-development is limited to some extent; only maize is widely accepted because of low labor requirement, easy operation and less water consumption, and its adaptability is the best. Therefore, we select three square spots for planting per hectare of maize to carry out unified sowing and management, and one square spot for 500 Mu of rice to unify varieties and carry out balanced fertilization.

Second, a meeting of village cadres and representatives of the masses was held to solicit opinions, agree on the planting structure, unify production management, and agree to the plan for the implementation of the plan. Finally, grassroots cadres were organized to measure, register and verify the four square points and heads of household. Project farmers understood the project plan, we promote water-saving irrigation for further benefits.

It is also clear that farmers should cooperate with the agricultural technology extension and not operate according to the requirements of the project (mainly under the overall control of broadcasting), and do not issue the World Bank project subsidies. The basic information register of demonstration points is then reported to the Project Office for safekeeping to find out the basis for the purchase of agricultural materials and the distribution plan.

Completion of procurement in accordance with procedures

According to the Purchasing Guide and Project Purchasing Plan, our office adopts an inquiry-based purchasing procedure to complete the purchasing work of the approved amount.

First of all, according to the planned planting area of soil, soil quality, and commercial conditions in the project area, the Agricultural Technology extension Center compiled the types and technical requirements of rice seeds and corn, and rice formula fertilizers. According to the situation of the approved estimate fund and the understanding of the agricultural material market, the total amount of all kinds of agricultural materials is listed preliminarily, and the approximate investment per Mu is grasped. Considering the change of the dollar exchange rate when the project is implemented, the investment amount is slightly reduced as compared to the approved amount.

After these materials, as per the list and technical requirements, were summarized by the project office, the tender documents were worked out jointly with the purchasing personnel. Then, according to the recommendation of the agricultural technicians and the agricultural law enforcement brigade, we sent inquiries to the three agricultural material

dealers respectively. Three suppliers actively participated in the bidding. Under the supervision of county finance, discipline supervision and audit departments, the bid evaluation experts of our joint agricultural department completed the bid evaluation work, selected the supplier and signed the supply contract.

Paying attention to the distribution of agricultural materials

First of all, the personnel from the project water conservancy,agriculturalandtechnicaldepartments to work out the amount of distribution. As funds are limited and the quantity of goods purchased is small, we use the form of subsidies to distribute funds. The four demonstration square spots have a total area of 3500 mu, and we purchased 1750 bags of compound fertilizer of 140 tons and 40 kg with 1 bag of fertilizer free of charge according to the area per mu.

Good seed issue: According to the contract, a total amount of Yuan for purchase of 28600 seeds, a small number, apportioned to 3500 Mu of land, each Mu of investment 8.17 Yuan, the register of farmers to record the specified seeds, cash subsidies paid.

Example: above, Wumou in the demonstration of 2 Mu of corn, 1.5 Mu of rice, to buy Zhengda 2 corn seed 3 kg 72 yuan (24 yuan per kilogram, he only need to pay 55.7 yuan to take away the 3 kg corn seed; He wants to buy 16 kg and 96 yuan (6 yuan per kilogram) of Ning-japonica rice. He can take 96 yuan of rice for 83.7 yuan.

Another step is the joint acceptance of goods, tabulation, filling in the card farmers task to the villagers groups, short roping goods task decomposition to the village committee, distribution of goods to each task decomposition villagers groups, task implementation to the village leader.

In order to reduce the amount of labor the supplier distributes the goods, we break down the task to the village groups to work together to complete it. After the goods are delivered to the supplier's warehouse, our office will check the quality and quantity of agricultural capital along with the staff of agricultural technology, quality supervision and finance departments, and fill up the goods inspection form.

Computer entry verification after registration, each village, set the number of goods statistics Adrian rodriguez Huber Fernando table to suppliers, distribution to the home take copies and blank copies of family cards sent to the village committee, farmers will be completed by the village committee on table card, affix one's seal, holding staff on-site audit tracking supervision again, again by village leader to send the card farmers to farmers. At the same time, we put up public notices in the beneficiary villages and groups, so that the masses can check whether the number issued is consistent with the card book.

Then the village committee organization vehicle centralized time unified goods away and distributed to the homes of the villagers, in spend

copies distributed, farmers are farmers CARDS, card table after the goods are consistent, farmers sign. When the group leader of the villagers distributed the goods, in order to prevent the accumulation of errors, the weighing method of "snake slough skin" was adopted, and the distribution was completed by signing one household after another.

In this process, the supplier is equal to the wholesalers, the total wholesale to the village, the village committee short roping, the redistribution of goods to the villagers groups, group leader is equal to the retailer, the agricultural materials with small said to the farmers. The task was decomposed to reduce the workload and timeliness of agricultural capital distribution, and at the same time to eliminate the traffic accidents of each household in the process of mining and transportation.

The project office staff shall take turns to supervise the issuance at all points according to the distribution time, and make good coordination and publicity work. Due to task decomposition, the distribution tasks of each group can be completed within 3 days at most. The benefits of our distribution are: layer upon layer supervision, quality and quantity guaranteed. For farmers, it is timely, not late working, cost saving and no risk.

Chapter 24

Agriculture and Water Conservancy in Hebei Province (Paper 4); Research and Popularization of Water-saving Irrigation and Forecast Technology Based on ET

Introduction

位于华北平原中部，陆地面积18.85万平方公里，海岸线长487公里，是全国唯一兼有海滨、平原、湖泊、丘陵、山地、高原的省份，享有“中国地形地貌缩影”之称。河北属于温带湿润半干旱大陆性季风气候，多年平均降水量536毫米。现辖11个设区市，2个省直管县（市），170个县（市、区），人口7470万。近年来，河北省坚持稳中求进工作总基调，牢固树立新发展理念，以供给侧结构性改革为主线，全面做好稳增长、促改革、调结构、惠民生、防风险各项工作，国民经济稳中有进、稳中向好，转型升级成效明显，人民生活持续改善。

Located in the central part of the North China Plain, Hebei province faces Bohai Sea on the east with the Taihang Mountains to its west, Yanshan Mountains to its north and the Yellow River to its south. It covers a total area of 188,500 sq km and its coastline is 487 km. Hebei, called the “epitome of China’s landforms”, is the sole province with seashore, plains, lakes, hills, mountains and plateaus. It has a temperate humid semi-arid continental monsoon climate with average annual precipitation of 536 mm. It exercises jurisdiction over 11 cities, 2 province-affiliated counties (cities) and 170 counties (cities, districts) and has a population of 74.7 million. In recent years, Hebei has been making progress while maintaining stability. Firmly established a new concept of development, focussing on supply-side structural reform and growing steadily, promoting reforms. The national economy enjoys a strong momentum of steady growth, the industrial transformation and upgrading has achieved remarkable success and people’s living standards have been improving constantly.

Hebei is a major agriculture resources province and the annual output of vegetables, meat, milk and eggs ranks at the top in China.

The whole province grain acreage amounts to 6.191 million hectares and the total grain output to 35.08 million tons;

The cotton acreage is 276 thousand hectares and the total cotton output is 301 thousand tons;

The oil plants acreage is 471 thousand hectares and the total oil plants output is 1.59 million tons;

The vegetables acreage is 1.233 million hectares and the total vegetables output is 82.598 million tons;

The total gardening fruits output is 15.71 million tons;

The total meat output is 4.637 million tons, the total eggs output is 3.769 million tons and the total milk output is 4.581 million tons;

The total aquatic products output is 1.275 million tons.

The agricultural mechanical total power of Heibei amounts to 75.89 million KW and the actual machine-ploughed acreage is 5.485 million hectares, accounting for the 63.5% of the total crop acreage; the machine-sowed acreage is 6.825 million hectares, accounting for 79.0%; the machine-harvested acreage is 5.534 million hectares, accounting for 64.1%. The entire mechanical production of wheat has been basically realized.

The total value of agricultural industrialization is approximately 693.48 billion Yuan. The strength of leading enterprises has been further enhanced. There are 640 enterprises with an annual sales revenue of over 1 billion Yuan, 75 enterprises with an annual sales revenue of over 1 billion Yuan and 5 enterprises with an annual sales revenue of over 10 billion Yuan, Agricultural products processing industry has become the third largest pillar of industrial of economic development in Heibei.

The ecological environment of agriculture has been effectively improved

25 national controlling points of agriculture non-point pollution have been established in Hebei. The pest controlled area of wheat and corn amounts to 22.669 million mu, and the area of soil testing and fertilizer recommendation to 94.55 million mu; the manure treatment facilities of 3492 livestock and poultry farms have been retrofitted. The activities of recycling waste mulching films have been demonstrated in 26 counties, the activities of vegetable safe production have been demonstrated in 9 counties, and the activities of rural cleaning projects have been demonstrated in 102 villages. The comprehensive utilization rate of straw is 95%, and the full-use of straw has been

The rural per capita disposable income amounts to 12,881 Yuan, the rural per capita consumption expenditure is 10,536 yuan and the Engel coefficient of rural households has dropped to 26.7%.

Water security capacity has been continuously enhanced

The severe shortage of water resources in Hebei province has become a bottleneck problem restricting the national economy and sustainable development. In the past five years, our province has been continuously increasing its investment in water conservancy, and has invested RMB 121.1 billion in water-funds, which is 5.5 times as much as in the last five years. The proportion of water conservancy investment in fixed assets investment in the province increased from 0.36% in 2012 to 0.96%. The aggregate investment and amplification of the water conservancy investment have created a new world record. A total of 1065 reservoirs with 100,000 m^3 have been built since 2017 in the province. There were 7,280 types of sluices with water discharge through sluice of more than 1 m^3/s, 4,425 pump stations with installed flow rate of more than 1 m^3/s and the embankment was 11778.67 kilometers. Apart from that, there were 263 irrigated areas with irrigation area more than 2000 mu, 3.2067 million electro-mechanical wells and 250 rural hydropower stations. All in all, the irrigation area has been up to 4804.66 thousand hectares and the water-saving irrigation area 3314.24 thousand hectares. The low-pressure pipeline area was 2,623.89 thousand hectares and the spray-micro-irrigation area was 351.52 thousand hectares.

Support capability of water resources has been improving constantly

The Middle Route Project of South-to-North Water Diversion took 12 years before it was officially opened and the auxiliary project with an involvement of nearly RMB 60 billion was completed. The major national project of water conservation and water supply for diverting water from the Yellow River to the Baiyang Lake in Hebei province was operated on schedule for water trials. The project not only can provide 22 counties and the farmland along the Heilonggang River valley with 2.72 million Mu an agricultural irrigation water, but also become an important “artery” for water delivery route to improve the ecological environment of the Xiong’an New Area and guarantee the water safety of the Baiyang Lake. The reservoir project of the Chengde Bimodal temple has been completed basically and reservoir project of the Ulahada in Zhangjiakou City has been in the phase of substantial preparations.

Achievements

The people have shared more benefits occured from the achievements of the reform and development of water conservancy.

- The accruing amounts of investment were RMB 9.52 billion, which solved the problem of drinking water safety of 19.33 million people. The tap water penetration and centralized water supply rate of the province have increased from 70% and 73%, in 2012 to 83.3% and 88.6% respectively. Large-scale water supply projects have benefited 36.34 million people. The administrative villages in about 18% of the province were covered by urban tap water pipeline network.

The economic and social water structure of the province has been significantly optimized

The "Three Red Lines" control index system for water resources management covering provinces, cities and counties has been established in China. At the same time, the action of controlling the consumption and intensity of water resources have been taken and water consumption standards for 31 industries (such as steel) which are stricter than national regulation have been established. Compared to the levels on 2012, the province's water consumption per RMB 10,000 of GDP and water consumption per RMB 10,000 of industrial added value were reduced from 78.5 m^3 and 20.7 m^3 to 54.6 m^3 and 13.9 m^3 respectively. The effective utilization coefficient of farmland irrigation water was raised from 0.650 to 0.672.

The quality of water ecology and water environment has been improved significantly

The comprehensive treatment of quality groundwater overdraft has been carried out for four years, with a total investment of RMB 31.8 billion. The scope of treatment covered 161 counties in 11 cities and all seven groundwater funnel areas. The governance model of scientific planning, right confirming and price determination, combination of management and control, energy-saving in the province, and energy introducing from outside the province and comprehensive application has been established. According to the third-party evaluation, the capacity of groundwater overdraft is 3.36 billion m^3, accounting for 56% of the province's groundwater overdraft volume. So the problem of the groundwater overdraft in Hebei for many years has been controlled preliminarily. The groundwater level of certain regions has recovered recently.

Dividends from water conservancy reform have been released continuously

The river extension system was implemented in an all-round way, and 15,350 river chiefs at all levels were designated. The management of rivers and lake in some areas has come into effect. The pilot

project of water resource tax reform was carried out and the standard of "five-high and five-low" tax was determined across the country. The reforms of agricultural water rights and water prices has been continuously pursued and 14 million farmers in 161 pilot counties in the groundwater overdraft region have completed the registration of agricultural water rights. In addition, they summarized and promoted the policies of "combination of water price lifting and water price compensation", total quantity control, quota management and the experience of terminal water price. The area of the irrigation water pricing reforms has gone up to 13 million mu, ranking first in China.

Chapter 25

Research and Popularization of Water-saving Irrigation and Forecast Technology Based on ET Hebei Province Water Conservancy Technology Test and Extension Center

Introduction

This project was formally established on July 23, 2015, requiring the completion of project tasks from July 2015 to December 2016—research algorithms, software development, training and promotion. Its technical foundation has three principles: ① result 1, ② result 2, ③ result 3.

The main content of this project: ① Water Rights distribution based on ET; ② irrigation forecast based on water right (root-layer water balance method, swap model method); ③ Popularization (training promotions, pilot County application).

1 Water right distribution based on ET (from results 3)

The basic principle of water right distribution is total quantity control and quota management.

1.1 Total control

Through various water-saving measures, gradually make the region's integrated ET reach the target ET. The level of integrated ET for the next year planning control is given. It is the baseline ET minus the next year's planned reduction on Target ET.

1.2 The quota management

The comprehensive irrigation quota equals the arable land ET in the next year plan control the integrated ET minus the effective precipitation for the next year. This irrigation quota can be used as the basis for the allocation of water rights (irrigation water right on the unit area).

2 Irrigation forecast based on water right

2.1 Water balance method of root layer (from results

According to the principle of water balance derive the process line of soil moisture change. It is used to calculate the moisture content *w* of in the future at some time. The lower limit of soil moisture *wd* is calculated by empirical equation. This empirical equation is based on the drought test data of the Irrigation Test Station network over the years. One of the important parameters—irrigation quotas (irrigation water rights).

Irrigation date and irrigation quota. When the forecast of *w* to the control of *wd*, the corresponding date is the date of irrigation, from the lower limit to the upper limit of water is the corresponding irrigation quota. Economic output is calculated by Jensen model. The forecast irrigation regime is optimized by dynamic programming method.

2.2 SWAP model method (from Wageningen University in Holland)

The SWAP model uses the finite difference method to solve 3 differential equations, and gives the distribution of water, salinity and temperature profiles of 2 m soil depths respectively.

The potential ET was calculated by Penman-monteith method, and the potential evaporation *Ep* and potential transpiration *Tp* were decomposed. For *Tp*, the actual crop transpiration can be obtained by multiplying the reduction coefficients of the soil water with too much, too little, freezing and too much salinity. The daily growth rate of dry matter was also given in the model, and it was allocated to root, stem, leaf and fruit organs.

Irrigation decision making method. Irrigation time, when the predicted soil relative effective water content to reach the critical value, is the date of irrigation. The irrigation quota has 3 options: from the lower limit to the field water holding rate, the given irrigation quota, or the upper and lower limit of irrigation quota.

3 Preparation for popularization and application

3.1 The quantification of qualitative indicators of meteorological forecasts for the next 15 days

①the weather state and the percentage of sunshine, ②the grade of the wind, and wind speed, ③the size of rainfall and snowfall, and the precipitation.

3.2 Estimation of meteorological elements over the next 15 days

According to 115 county meteorological stations in Hebei province, the meteorological data from the station to the 1980 more than 20 years, the latitude and longitude and elevation are independent variables, and the multivariate regression method is used.

3.3 The parameters of the model. Using the 2000-2015-year long series of meteorological data of 6 international exchange stations in Hebei Province and its surrounding areas, the parameters of the swap model were calculated for 6 villages and towns, 15 seasons winter wheat and 16 season summer maize, and the results were good.

4 Software design and information release

On the basis of the existing stand-alone software designed for the "root-layer water balance method", the main functions of "swap model" are encapsulated.

Information release, the use of "clear paper, the Internet, mobile phone messages, LED large screen" 4 ways to complete.

5 The popularization of forecasting method

5.1 Training promotion

10 project counties, 3 per county, a total of 30 technicians were trained. Overall assessment score of 86.02 points, evaluation of "satisfaction."

5.2 Pilot counties applied

The application effect of "root layer water balance method" in the pilot County monitoring area was compared with that in the last century in the 80s and 90 's. The results showed: that on the target ET of the pilot County was reduced 46.57 mm. And in the last century 80s, 90 's winter wheat saved the maximum irrigation quantity of 105 mm pilot counties to increase the output value of 1152.15 Yuan/hm^2. In the last century 80s, 90 's, the maximum value of winter wheat when the revenue was 480 Yuan/hm^2.

6 conclusion

"Root-Layer water balance method", simple and practical, easy to operate, it is applicable to winter wheat, summer corn, cotton planting areas in Hebei province, and "swap model", the main consideration is the impact of groundwater or deep soil water, not only for these 3 crops, but also for other crops.

Current progress

Training process, the county's technical staff suggested: directly from the "China Weather Network" Downloading meteorological data to the software database, can reduce the requirement of manual input. In the last year, we have completed the work of analyzing the weather data for the next 15 days from the "China Weather Network" page and incorporated it in the mobile database. These meteorological data can be calculated meticulously to the streets city, streets, townships and rural areas. In this way, the accuracy of irrigation forecasts is even higher. The development of intelligent technology in our country is very fast, the intelligent home system has started to market. I believe that one day, the Intelligent irrigation management system with the function of irrigation forecasting will be applied to the actual agricultural production in China. I am full of hope for the future!

Chapter 26

Introduction to Agriculture and Water Resources in Shanxi Province

Basic situation

Shanxi is located on the eastern bank of the Yellow River, The length from the north to the south is about 682 km, and from the east and west is 385 kilometers. The total land area of the province is 156700 km^2, accounting for 1.63% of the total area of China.

Climate and hydrology:

Climate

山西地处中纬度，属于暖温带、中温带大陆性气候。年平均气温在-4℃～14° C之间，无霜期80～205d，气温地区分布总趋向是自南向北、自平川向山地递减。无霜期南长北短，平川长山地短。全省年降水量在400～650毫米，但季节分布不均匀，夏季6月～8月降水高度集中且多暴雨，降水量约占全年的60%以上。

Shanxi is located in the middle latitudes, belonging to the continental climate zone. The annual mean temperature is between -4 and 14 degrees C, and the frost free period is 80 to 205 days. The annual precipitation in the province is 400~650 mm, but the seasonal distribution is uneven. In the summer from June to August, the amount of precipitation accounts for about 60% of the whole year.

山西整体气候特征：春季日温差大，风沙多而干旱；夏季短而炎热多雨；秋季短暂，气候温和晴朗；冬季长而寒冷干燥，雨雪稀少。

The climatic characteristics: the daily temperature difference is large in spring, high winds and the sand storm frequently happen, the summer is hot and rainy, the autumn is short, mild and clear, the winter is long, cold and dry, rain and snow are scarce.

Hydrology

山西共有大小河流1000余条，主要特点是河流较多，以季节性河流为主，水量变化的季节性差异大。山西河流源于东西高原山地，向西向南流的属黄河水系，向东流的属海河水系。

There are over 1000 rivers in Shanxi, which are mainly seasonal rivers, with seasonal variations in water volume. The rivers of Shanxi originate from the mountains of the east and west plateaus, flowing southwestward to the Yellow River system, and eastward to the Haihe River system.

境内黄河流域面积9.7万km2，占总省国土面积的62%，属于黄河水系的有汾河、沁河、涑水河等；

The area of the Yellow River basin is 97000 Km^2, accounting for 62% of the total land area of Shanxi. Fenhe River, Qinhe River and Sushuihe River belong to the Yellow River system.

境内海河流域面积5.9万km2，占总省国土面积的38%。属于海河水系的有桑干河、滹沱河、漳河等。

The area of the Haihe River basin is 59000 Km^2, accounting for 38% of the total land area of Shanxi. Sanggan River, Hutuo River and Zhanghe River belong to the Haihe River System.

Society and economy

山西省现辖太原、大同、阳泉、长治、晋城、朔州、晋中、运城、忻州、临汾和吕梁11个地市，119个县（市、区）。

Shanxi province has 11 cities which are Taiyuan, Datong, Yangquan, Changzhi, Jincheng, Shuozhou, Jinzhong, Yuncheng, Xinzhou, Linfen and Lvliang, and 119 counties (towns and districts).

2014年全省总人口3647.96万人，其中城镇人口1962.32万人，乡村人口1685.64万人。

In 2014, the total population was 36.479 million, of which 19.62 million were urban and 16.85 million were rural.

2014年全省生产总值12759.4亿元，人均生产总值3.50万元。

In 2014, the GDP of Shanxi was 1275.94 million Yuan, and per capita GDP was 35000 Yuan.

山西省农业生产主要分六大区域，分别为：

There are six main agricultural production areas in Shanxi Province:

（1）汾河平原区域：分布在汾河两岸，区域南部（运城、临汾市为主）主要生产高效粮食、水果等；区域北部（晋中、吕梁、太原为主）重点为高效设施农业；

Fenhe plain area: the southern part of the region (Yuncheng and Linfen city) mainly produce high efficiency grain and fruit, and the north of the region (Jinzhong, Lvliang and Taiyuan) focus on high efficiency facilities agriculture.

（2）雁门关区域：分布在桑干河、滹沱河河谷盆地，涉及大同、朔州、忻州，主要生产优质杂粮；

Yanmenguan area: distributed in the Sanggan River and the Hutuo River valley basin, involving Datong, Shuozhou and Xinzhou Cities, mainly produce high quality coarse cereals.

（3）上党盆地区域：分布在漳河、沁河河谷盆地，涉及长治、晋城、阳泉，主要成产优质杂粮和中药材；

Shangdang basin area: located in Zhanghe and Qinhe River valley basin, involving Changzhi, Jincheng and Yangquan cities, mainly produces high quality coarse cereals and Chinese medicinal materials.

Agricultural distribution in Shanxi

（4）吕梁山区域：分布在吕梁山低山丘陵地区，涉及吕梁、晋中、临汾，主要成产优质鲜干果（枣）和杂粮；

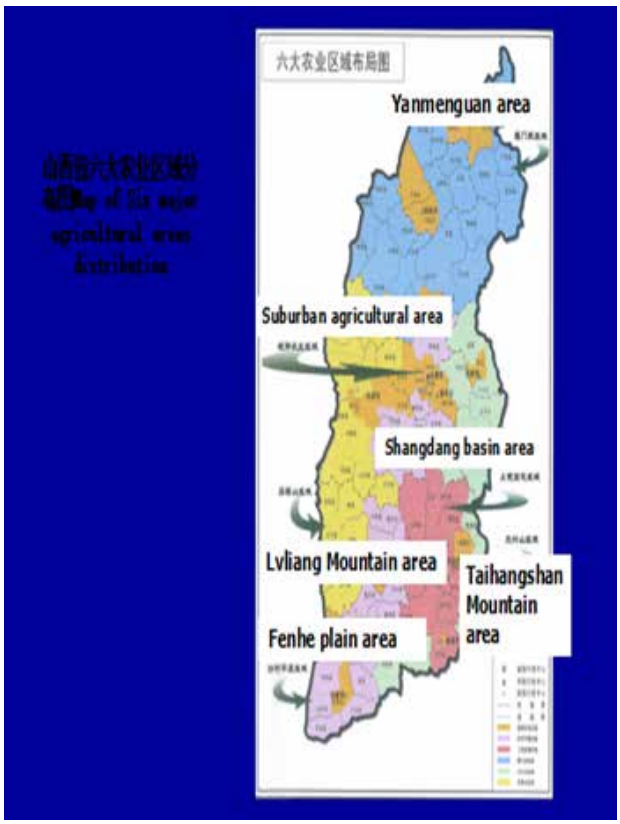
Lvliang mountain area: located in the hilly area of Lv Liang mountain, involves Lvliang, Jinzhong and Linfen cities, and mainly produces high quality fresh fruits, dried fruits (jujube) and coarse cereals.

（5）太行山区域：分布在太行山低山丘陵地区，主要成产杂粮和道地中药材；

Taihangshan mountain area: located in the hilly area of Taihangshan mountain, mainly produces coarse cereals and Chinese medicinal materials.

（6）城郊农业区域：分布在太原都市圈、晋北、南、东南城镇周边，主要为多功能农业和促进一二三产业融合发展的城郊农业。

Suburban agricultural area: distributed in the Taiyuan metropolitan area, the north, south and southeastern cities and towns, mainly follow multi-functional agriculture and the suburban agriculture that promotes the integration and development of the first, second and third industries.



Water resources status

（1）水资源总量Total water resources amount

全省多年平均水资源总量123.8亿m3，其中：地表水资源量86.8亿m3；地下水资源量84.0亿m3(重复量47.0亿m3)。

The average annual water resources is 12.38 billion m^3, including 8.68 billion m^3 surface water and 8.4 million m^3 of groundwater resources.

（2）水资源可利用量Available amount of water resources

全省水资源可利用量为83.80亿m3，其中：地表水可利用量51.90亿m3；地下水可利用量50.00亿m3；重复可利用量18.10亿m3；全省水资源可利用量中黄河流域50.0亿m3，占59.7%；海河流域为33.80亿m3，占40.3% 。

The available amount of water resources is 8.38 billion m^3, of which the surface water is 5.19 billion m^3, the groundwater is 5 billion m^3, and the reuse amount is 1.81 billion.

Development and utilization

自建国以来水资源开发利用大体经历了三个发展阶段：

The development and utilization of water resources have gone through three stages:

(1)上世纪50年代到60年代中期,以拦蓄引水为特征，兴建了一大批中小型水库及大中型灌区；

From the 50s to the mid 60s of the last century, a large number of small and medium-sized reservoirs and large and medium-sized irrigation districts were built with the characteristics of restraining water diversion.

(2)上世纪60年代中期到70年代末，以打井配套为主,大规模开发利用地下水资源；

From the middle of the 60s to the end of the 70s, the main purpose of well-drilling was to develop and utilize groundwater resources.

(3)上世纪80年代以来，以更新改造、节水挖潜、加强管理、调整分配为主，适应山西能源经济建设水资源需求。 特别是，2007年以来实施的“兴水战略” 、“大水网” 、水库除险加固和河道治理工程、提黄灌区建设和灌区节水改造工程等，在全省水资源配置、优化用水结构方面发挥了极大作用。

Since the 1980s, the focus has been on renovation, water saving, tapping the potential, strengthening management and adjusting allocations to meet the needs of water resources in Shanxi's energy and economic construction. In particular, "big water network", the reservoir removal and reinforcement and the river control project, the construction of the Yellow River irrigation area and the water-saving reforms projects have played a great role in the allocation of water resources and the optimization of the water structure in Shanxi.

Water supply situation

（1）按水类分According to water supply classification

全省水利工程总供水量73.39亿m3，其中:地表水31.84亿m3、占总量43.38%；地下水38.79亿m3、占总52.86%；再生水利用量2.76亿m3、占总量3.76%。

The total water supply of water conservancy projects in Shanxi is 7.339 billion m^3, of which the surface water is 3.184 billion m^3, accounting for 43.38% of the total water supply. The groundwater is 3.879 billion m^3, accounting for 52.86%, the amount of recycled water resources is 276 million m^3, and accounting for 3.76%.

According to the industry

全省各行业用水量：工业用水量15.50万m3 ；农业灌溉用水量39.93亿m3 ；城镇生活用水量6.21亿m3 ；农村生活用水量3.03亿m3 ；生态环境用水量3.32亿m3 ；林牧渔畜用水量2.81亿m3 ；其他用水量2.59亿m3 。

The water consumption of all industries : 155000 m^3 for industrial water use, 3.993 billion m^3 for agricultural irrigation, 621 million m^3 for urban living water, 303 million m^3 for rural living water, 332 million m^3 for ecological environment, 281 million m^3 for forest and animal husbandry and livestock, and 259 million m^3 for other water use.

The overall target

of agricultural water conservancy in Shanxi

根据《山西省“十三五”农业农村经济发展规划（2016-2030年》，到2020年全省农业相关发展目标如下：

According to the “13th Five-Year” agricultural and rural economic development plan of Shanxi province (2016-2030), the relevant agricultural development targets in 2020 are as follows:

（1）在严守6000万亩耕地红线的基础上，稳定粮食作物播种面积，粮食生产能力达到1350万吨以上；

As a result of strictly observing the red line of 60 million Mu of cultivated land, the grain production capacity has reached over 13.5 million tons.

（2）大水网基本建成，全省有效灌溉面积达到2567万亩，节水灌溉面积达到1637万亩；

The water network is basically built, so the effective irrigation area has reached 25.67 million mu, and the water saving irrigation area has reached 16.37 million Mu.

（3）地表水与地下水用水比例调整为2.5:1；

The ratio of surface water to groundwater is adjusted to 2.5:1.

（4）森林、草原综合植被覆盖率提高，5000万亩绿化林地得到有效保护；

The comprehensive vegetation coverage of forest and grassland has increased, and 50 million Mu of green woodland are effectively protected.

（5）农村居民人均可支配收入实现年均增幅高于国内生产总值和城镇居民收入增幅总体目标，达到13000元。

The average annual growth rate of per capita disposable income of rural residents is higher than that of GDP and urban residents' income, reaching RMB 13000 Yuan annually.

Chapter 27

Conclusion/Next Steps

Participants were exposed to many presentations and field /practical activities. Majority agreed that the success of proper catchment delineation; management as well as Integrated Water and Environment Management in Nigeria is achievable with joint efforts of relevant departments in the country (just like the Chinese experience) and the assistance of the World Bank.

Suggested approach and methodologies

a. Strategic studies

b. Integrated Management Planning and Strategic Action Plan

c. Use of new patterns of integrated water and environment management

d. Application of new paradigm of water consumption control (ET management) based water resources management

e. Application of new technology of remote-sensing ET monitoring

f. Application of newly developed tools of knowledge management system

Other solutions /support as practiced by the Chinese Government

a. Community mobilization to popularize the concept of "real water savings," from both a water-use efficiency and an overall resource perspective.

b. Development of mechanisms to ensure the financial sustainability of water resource management activities. Combination of "management fees" associated with water abstractions or discharges, special taxes on activities impacting water management.

c. Incentives: support and reward to those who use the water wisely while punishing those who do not do so.

d. Promote the use of conjunctive water use, artificial groundwater recharge, and treated waste-water irrigation.

e. Implementation of priority actions through sustainable financing, supervision, and monitoring of municipal, industrial, livestock, solid waste, and agricultural sources of pollution.

Expected Impact

a. Enhanced pragmatic cooperation on water-related affairs between water resources and environment protection departments

b. Catalyzed improvements in the regulatory system and related institutions for integrated water and environment management

c. Promotion and enhanced integrated water and environment management capacity

d. Effective implementation of the strictest water resources management regime in local areas

e. Accelerated improvements in grassroots-level water management service systems

There was that conviction and sense of purpose shared by all partcipants that the experiences and knowledge gained was a shining light in the dark. In conclusion, participants agreed that the SSKE has been a "great bridge constructed for many more cooperation. The SSKE coordinators, China (Ms Wang Yue) and Nigeria (Dr. Joy Agene) acknowledged the dedication of the participants from Day One despite the long travel (jet lag) and the tight schedules of the programme.

Other participants expressed great delight about the six procedures Chinese suggested for the development of green agriculture:

i. Construct the green consumption value system and advocate the concept of green agriculture ecological development concept

ii. Construct the agricultural production technology system characterized by the export of "green, high-quality and safe" agricultural products

iii. Build an efficient resource utilization technology system characterized by ecological cycles

iv. Construct a multifunctional ecological security system for agriculture

v. Build an assessment system for agricultural development based on green agriculture;

vi. Build a demonstration area for green agricultural development, foster brands and advantageous enterprises, and promote the development of industrialization

NEWMAP presented its far reaching achievements, all in line with the project development objective of reducing vulnerability of degraded targeted watersheds, via its best practices that has ensured implementation success beyond expectations and targeted projections:

i. Holistic watershed management approach and the use of state of the art engineering/ structural designs and flexible structures at targeted gully complexes and other erosion sites treated with at least 75% of planned rehabilitation measures for targeted sub-watersheds.

ii. Bio-remediation use of Vegetation (grassing) measures to complement civil works in treated gully areas, to regenerate the soil.

iii. Introduction of proper and well terminated drain-age systems at targeted gully complexes and other erosion sites with reduced severity level after treatment

iv. Adequate safeguard measures to strengthen disaster risk reduction and preparedness at state, local, and community levels.

v. Community ownership and participation towards greater adoption of sustainable land and water management practices by local people in the sub-watershed as well as extensive communications and outreach.

vi. 'Improved livelihoods of direct project beneficiaries in and around the project states and sites.

vii. Enhanced livelihoods in the sub-watershed, and, where necessary, implementation of local Resettlement Action Plans.

viii. Strong World Bank /FAO and FGN leadership

ix. Enhanced supervision missions and decentralization of decisions as structured in the implementation arrangements.

S/N	PDO Indicator	Actual	Target
1	Targeted gully complexes and other erosion sites treated with at least 75% of planned rehabilitation measures for targeted sub-watersheds (#)	18	30
2	Targeted gully complexes and other erosion sites with reduced severity level after treatment (#)	18	30
3	Vegetation cover in treated sub-watersheds (%)	85	100
4	Direct project beneficiaries (number), of which female (%)	7,313,858	681,000

Fadama in its presentation highlighted the project concept and traced the evolution and the various stages of growth to the current third stage of FADAMA III AF. The project has been able to improve the food value chain, especially using Cassava and Sorghum. Part of its numerous achievements includes; 195,503(crop), 163,991 (livestock), and 17,685 (fisheries) beneficiaries received extension services from ADPs. The major outcome of this component includes a 38.7% increase in the number of Fadama farmers that received extension services from ADPs. The project also supported farmers with new farming techniques as indicated below (see Presentation in the Annexure):

Indicator	Achievements
% Increase in new technology adopted in Fadama communities	350 out of 5,407(6.5%) Fadama Community Associations (FCAs) registered adopted new technology
	Livestock: 26 (7.4%)
	Agro forestry: 187 (53%) Crops: 137(39%)

Finally, the two projects stand to benefit immensely from the possible cooperation between China and Nigeria, in the following areas

i. The use of Sensors in monitoring livestocks could be explored with minimum costs since the services could come free under the SSKE.

ii. Developing water-saving irrigation systems is a smart move towards Smart Agriculture and protection of the watershed; technical expertise of the CAAS under the SSKE to be explored towards this gain.

iii. Nigeria also have great institutions like CAAS such as IITA etc, therfore it becomes imperative for government to support such institutions by bringing up and implementing the strictest possible farmland protection and water resource management systems, just like China.

iv. We should draw on the successful practices in China and allow compensation systems for farmland protection. At the same time, step up efforts to upgrade low and medium-yield farmland and increase high-yield farmland.

Immediate Action

i. At the instance of the SSKE the CAAS / CIDDC /IWHR officials agreed to honour calls for proposed special workshop on smart agriculture in Abuja, to disseminate information and knowledge on grassland management and sustainable production.

ii. Under the new cooperation, SSKE secretariat to explore further the area of High Resolution Image Data sharing with China.

For Dr. Agene, the Trust Fund will support important activities under Window 2 – Knowledge sharing and South-South Learning, between China, India and Nigeria, focusing on infrastructure development associated with major land and gully restoration, and agricultural development on restored landscapes. She cited the Chinese and Indian long history of successful Bank-supported sustainable land management programs, and summed up that the SSKE was designed to improve water management, agricultural productivity, rural livelihoods, and build resiliency to climate change.

The National Project Coordinator, NEWMAP, who also represented the Permanent Secretary Federal Ministry of Environment as leader of delegation, thanked the China Irrigation and Drainage Development Center/Ministry of Water Resources (CIDDC), China Institute of Water Resources and Hydropower Research; the Chinese Academy of Agricultural Sciences (CAAS); the World Bank Beijing Office and the great host Nanchang Institute of Technology(NIT) for the well-packed and well thought out study tour.

He recapped the various sessions, discussions and field visits and concluded that the programme was well packaged. He also presented three areas of further cooperation as occasioned from the study visit.

1) Data sharing and the use of Sensors in monitoring livestocks could be explored with minimum costs since the services could come free under the SSKE.

2) Developing water-saving irrigation systems is a smart move towards Smart Agriculture and protection of the watershed; technical expertise of the CAAS under the SSKE to be explored towards this gain.

3) NEWMAP to explore further cooperation with Soil & Water Conservation and Catchment management institute Dean county, Jiujiang city, Jiangxi province on water conservation, Watershed/Catchment Management solutions.

Annex 1

NEWMAP: Promoting Environmental Sustainability in Nigeria

NEWMAP presented its far reaching achievements, all in line with the project development objective of reducing vulnerability of degraded targeted watersheds, via its best practices highlighted below that have ensured implementation success beyond expectations and targeted projections:

i. Holistic watershed management approach and the use of state of the art engineering/ structural designs and flexible structures at targeted gully complexes and other erosion sites treated with at least 75% of planned rehabilitation measures for targeted sub-watersheds.

ii. Bio-remediation use of Vegetation (grassing) measures to complement civil works in treated gully areas to regenerate the soil.

iii. Introduction of proper and well terminated drain-age systems at targeted gully complexes and other erosion sites with reduced severity levels after treatment

iv. Adequate safeguard measures to strengthen disaster risk reduction and preparedness at state, local, and community levels.

v. Community ownership and participation towards greater adoption of sustainable land and water management practices by local people in the sub-watersheds as well as extensive communications and outreach.

vi. Improved livelihoods of direct project beneficiaries in and around the project states and sites.

vii. Enhanced livelihoods in the sub-watershed, and, where necessary, implementation of local Resettlement Action Plans.

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S/N	PDO Indicator	Actual	Target
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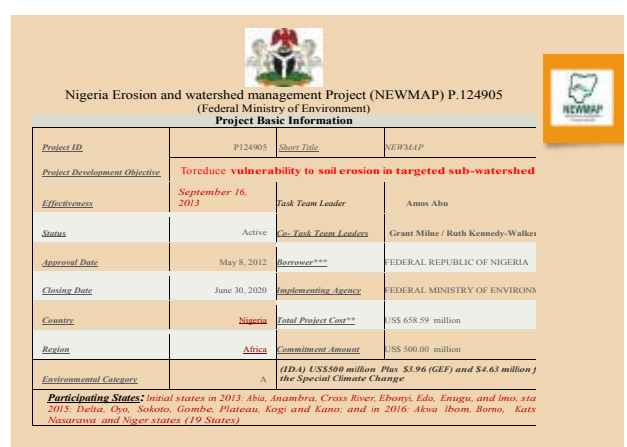
3	Vegetation cover in treated sub-watersheds (%)	85	100
4	Direct project beneficiaries (number), of which female (%)	7,313,858	681,000



Implementation Effectiveness

- The Project became effective in September, 2013. Intervention activities commenced initially with seven states (now referred to as first mover states) of Abia, Anambra, Cross River, Ebonyi, Edo, Enugu and Imo. Based on the progress recorded by the initial seven states, in September 2015 additional 7 states; Delta, Gombe, Kogi, Kano, Plateau, Oyo and Sokoto joined the project having met the necessary selection criteria. Presently, the third phase of states that recently joined the project includes; Akwa Ibom, Borno, Katisina, Nasarawa, and Niger, States; thus making a total number of 19 project states

- The first phase of the project targeted emergency rehabilitation in a limited number of major gullies in the initial seven States, with follow-on work to develop broader catchment management plans and community livelihoods. Over time, as lessons have been learned, a more integrated approach is now being introduced to additional sites in the first seven States as well as the new States in both the Southern and Northern regions of the country. This approach positions catchment management planning as the planning and implementing framework for soil and water conservation (including gully rehabilitation), livelihood development, safeguards management, and monitoring.

•Abia, Anambra, Cross-River, Ebonyi, Edo, Enugu and Imo.

Newmap intervention: Pictorial view
1. Auchi Gully intervention site /Edo state Nigeria

CENTRAL DRAIN: 2015 / 2017

*Central drain system constructed by NEWMAP after Land reclamation between **2015-17** The pictures by the left shows the situation before, while the pictures on the right shows the situation after NEWMAP's intervention*

PROJECT COMPONENTS

	Component 1	Component 2	Component 3	Component 4
Title	Erosion and Catchment Management Investments.	Erosion and Catchment Management Institutions and Information Services	Climate Change	Project Management
Sub-components	1A Gully Rapid Action and Slope Stabilisation 1B Integrated Catchment Management 1C Adaptive Livelihoods	2A Federal MDA effectiveness and services 2B State MDA effectiveness and services 2C Local Government capacity 2D Private sector capacity	3A Policy and Institutional Framework 3B Low Carbon Development	
Main activities	Stabilise severe gully erosion sites and conduct community-based catchment interventions	Strengthen the enabling environment for effective erosion and catchment management.	Strengthen government capacity to promote low carbon, climate resilient development.	Procure goods and specialist services to support project management, safeguards, M&E and oversight.
Main outcome	Priority erosion sites rehabilitated, and more secure livelihoods and catchment services established.	More capable, modernized and coordinated federal, state, and local institutions	Government better equipped to respond to climate change and low-carbon development options demonstrated	Established systems for project management, M&E and best-practices for future replication

Auchi Gully remediation:
Mix of Earthworks, Chutes and Bio-remediation with civil works

Use of earthworks and chutes during construction

Newmap Concept /Implementation Approach

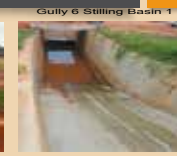
- ***Structured Implementation arrangements:*** *The bodies in charge of the project implementation are the Project Steering Committee, Technical Committee and the Project Management Units at both Federal and State level. The general principle is that the Federal Steering Committee is responsible for overall project coordination, alignment of project content and approach, and oversight of activities taking place across participating States through the Federal Project Management Unit (FPMU). The State Project Management Unit (SPMU) is responsible for the practical implementation of project activities within the specific frameworks.*
- ***Holistic watershed management approach*** *and the use of state of the art engineering/ structural designs and flexible structures at targeted gully complexes and other erosion sites treated with at least 75% of planned rehabilitation measures for targeted sub-watersheds.*
- *ii.* ***Bio-remediation*** *use of Vegetation (grassing) measures to complement civil works in treated gully areas to regenerate the soil.*
- *iii.* ***Well terminated drain- age systems*** *at targeted gully complexes and other erosion sites with reduced severity level after treatment*
- *iv.* ***Adequate safeguard measures*** *to strengthen disaster risk reduction and preparedness at state, local, and community levels.*
- *v* ***Community ownership*** *and participation towards greater adoption of sustainable land and water management practices by local people in the sub- watershed and extensive communications and outreach.*

Auchi Gully Remediation: Drains and Stilling Basin

Ekboadokai RHS side-drain

Gully 6 Drain

Gully 6 Stilling Basin 1



Gully 1 Stilling Basin 1

Gully 2 Stilling Basin 2

Newmap Concept /Implementation Approach Contd.

- ***Creation / formation of Site Committees*** *to ensure adequate community representation and Participation.*
- *Project encouraged communities to form* ***Community Interest groups (CIGs)*** *towards improved livelihoods of direct project beneficiaries in and around the project states and sites.*
- *vii. Implementation of local* ***Resettlement Action Plans(RAP)*** *to enhance livelihoods in the sub-watershed, and resettle affected persons where necessary*
- *viii.* ***Strong World Bank /FAO and FGN leadership/support***
- *ix.* ***Enhanced supervision missions & decentralization of decisions*** *as structured in the implementation arrangements*
- *x. Federal Project Management Unit (FPMU) support to participating states via the engagement of Specialized* ***Procurement and Engineering Supervision design Firms*** *to ensure quality control and best practices.*

AUCHI: ROADS AFTER GULLY FILLING & PROVISION of DRAINS and BLACKTOP 2015 - 2017

Gully 7

Inu Umoru road

Atakpa Gully reclamation in Cross River State Nigeria

NEWMAP Intervention in Ajali water works Enugu

BEFORE

NOW INTERVENTION IS GOING ON

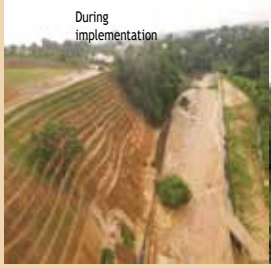
Use of Reno Mattresses to trap surface run-off and heal degraded areas as shown in Atakpa (left) and to support and protect side of drains as shown in picture 2 (right)

SUMMARY OF PROGRESS

- 21 first wave of sites nearing completion in the 7 initial states – 84% average physical progress.
- 48 new sites designs cleared for implementation across first 7 States. Civil works have commenced on 18 sites
- Total sum of N352,236,806 disbursed as sub-grants to 5,137 beneficiaries (2,327 male/ 2,810 female) under the livelihood enhancement activities
- 1,280 Project Affected Persons (PAPs) fully compensated with N891,030,101.69
- 35 officers received specialized training across line MDAs
- Installation of 19 Meteorological Stations, 15 Hydrological Stations and 6 Automated Flood Early Warning Systems across River Basins

Healing degraded areas via terracing, superb drainage and Bio-remediation a case of Ikot Awatim Cross River State

During implementation



The healing achieved

Alternative livelihood activities

Project Livelihood activities

Agro Processing CIG at Ugwuta

CIGs empowered in Asuke Ngwo Community

Welders Gubian makers CIG at Ugwuta

Rental Event management CIG at

New Heritage Gully erosion site Onitsha Anambra State: GULLY FILLING & PROVISION of DRAINS

Strengthening Institutions: support for Data capture and improving Data for Decision in Nigeria

PDO INDICATORS

S/N	PDO Indicator	Actual	Target
1	Targeted gully complexes and other erosion sites treated with at least 75% of planned rehabilitation measures for targeted sub-watersheds (#)	18	30
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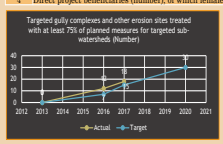
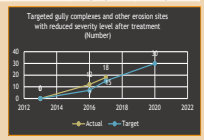
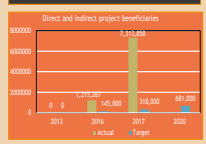






MOVING THE SSKE FORWARD:
SSKE Knowledge Fair Oct. 4-6 2017

Professor Demola Omojola, from the University of Lagos presenting a paper on **Geospatial Technology for Integrated Watershed and Erosion Management**. Seated from right, Mr. Salisu Dahiru NEWMAP National

SSKE /Watershed Management, Infrastructure and Agriculture between China, India and Nigeria.

- World Bank task teams secured financing from the China-World Bank Group Trust Fund of USD 433,000 to enhance South-South Learning and Knowledge sharing for Watershed Management, Infrastructure and Agriculture between China, India and Nigeria.
- Operational Focus on:

i. infrastructure development associated with major land and gully restoration,

ii. agricultural development and climate smart agriculture on restored lands, and

iii. applications of remote sensing, GIS, and Decision Support Systems (DSS) for more effective project management and M&E

- These activity would benefit the outcomes of NEWMAP, the Neeranchal National Watershed Project in India and FADAMA Project in Nigeria in terms of information and knowledge that would be shared among the participating countries of China, India and Nigeria.

Chief Host WB/SSKE/NEWMAP Knowledge fair Ibrahim Usman Jibril(Middle) TTL NEWMAP Dr. Amos Abu (seated right) and NEWMAP National Coordinator Mallam Salisu Dahiru (seated left) at one of the sessions

SSKE OBJECTIVES

Technology support , training, exchange learning and information dissemination between China, India and Nigeria in the following thematic areas:

a) Watershed Management and Gully Restoration;

b) Climate Smart Agriculture;

c) Managing Surface Run-off in Urban areas;

d) Application of Geo-Spatial Technologies for Erosion Control, Watershed Planning and Management

Dr Nagaraja Rao Harshadeep (Harsh/3rd From Left)WB Resource person/Conference Chairperson with Dr. Reddy and Mr Babu (from INDIA) flanked by Prof. Joseph Akinyede, (Nigeria Resource person) and Dr. Fidelis Anukwa and Barrister Ladi Jato -NEWMAP STATES Project coordinators of Cross river and Kogi state respectively

SSKE: The Journey So Far

Preparatory to effectiveness of SSKE, a Scoping mission was undertaken to China by the World Bank Country office Nigeria, NEWMAP-FPMU and FADAMA Project in April, 2017.During this Mission, a Technical Collaboration Agreement (TCA) was finalized and subsequently signed, to last for a period of 2years. An important outcome of the TCA includes:

a. international Geo-Spatial conference SSKE Knowledge Fair to commemorate the International Space Week from 4th -6th October, 2017, held in Abuja-Nigeria.

b. MoU between India and Nigeria developed and signed for Nigeria- Bhuvan project to be hosted by NARSDA.

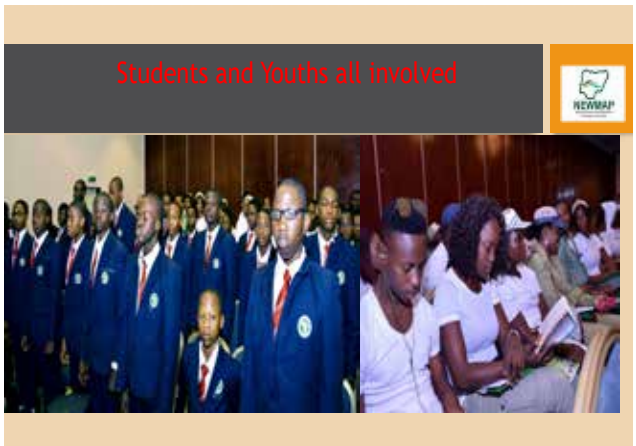
c. Also, considered is the knowledge transfer in the area of catchment management in the signed MoU. Nigeria is represented by NEWMAP while the Chinese Government is represented by the China Irrigation and Drainage Development Center (CIDDC) and China Green Water International Consulting Company (CGWIC).

Exposure Visit:

Currently ongoing, is the Study Tour/Training in china on "***Climate-Smart Agriculture and Integrated Watershed Management*** for 27 participants, 19th - 29th June, 2018.

MOVING THE SSKE FORWARD Contd.

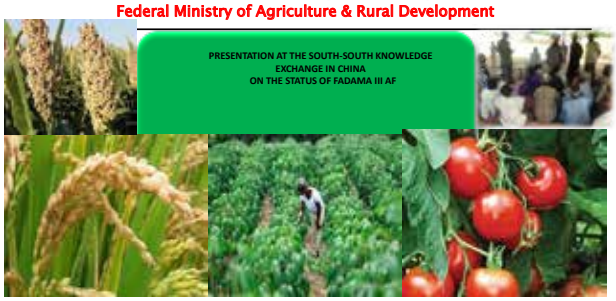
Group photograph of Coordinating Minister, Ibrahim Usman Jibril, Federal Ministry of Environment States Commissioners and Permanent Secretaries, project officers, participants and resource persons at the WB /NEWMAP SSKE Knowledge fair October 4-6 2017


Students and Youths all involved

FADAMA III AF

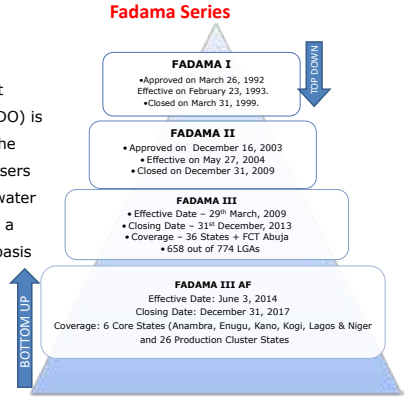
THIRD NATIONAL FADAMA DEVELOPMENT PROJECT-ADDITIONAL FINANCING (FADAMA III AF)

Federal Ministry of Agriculture & Rural Development



Fadama Series

The Project Development Objective (PDO) is to increase the incomes of users of land and water resources on a sustainable basis



FADAMA III ACHIEVEMENTS

COMPONENT I	
INDICATORS	
FUGs Registered	64,347
FCAs Registered	5,407
Participating LGAs	685
LDPs Prepared	4,726
LDPs Approved	4,561
LDPs Fully Implemented	3,438
FCAs Trained	4,462
FUGs Trained	48,791
LGA staff trained	2,713

COMPONENT II

RURAL INFRASTRUCTURE	ACHIEVEMENTS	
	KM	NOS
Feeder roads rehabilitated	563	165
Feeder road constructed	413	137
Drainage		49
Culvert		405
Small bridges		67
Lockup shop		709
Market stalls		1,493
Cooling shed constructed		125
Drying slab		11
Water Harvest		21
Borehole constructed		612
VIP Toilet		465
Cold room Housing		177
Storage facility		125
Poultry house		2,591
Concrete fishpond		1,416
Housing for processing machine		2,765
Piggery Houses		1,066
Livestock Housing		2,749
Stock Route		51
Watering points		61
Abattoir		13
Small earth dam		16
Open well		322
TOTAL	976	15,596

FADAMA III Achievement Cont'd

COMPONENT III

ENTERPRISE	FUGs That Procured Advisory Services
Crop	10,382
livestock	7,882
fisheries	4,864
Agro processing	2,781
Agro Forestry	604
marketing	1,221
Vulnerable	3,938
Total	31,672

	Improved Seedlings	Improved Seed	Inorganic Fertilizer	Agrochemicals	Organic Manure	TOTAL
FUG	4,760	9,324	9,137	7,442	3,602	34,265
Farmers	20,593	87,596	110,706	80,354	94,556	493,805

FADAMA IV ACHIEVEMENTS

- A total of 195,503 (crop), 163,991 (livestock), and 17,685 (fisheries) beneficiaries received extension services from ADPs. The major outcome of this component includes a 38.7 percent increase in the number of Fadama farmers that received extension services from ADPs.

Indicator	Achievements
% Increase in new technology adopted in Fadama communities	350 out of 5,407(6.5%) Fadama Community Associations (FCAs) registered adopted new technology
	Livestock - 26 (7.4%)
	Agro forestry-187 (53%)
	Crops -137(39%)

COMPONENT V

	Type of Assets	Number of Productive Asset Acquired
1	Crop production	
i	Animal traction	41,984
ii	Water Pump	20,395
iii	Tube well	2,651
iv	Wash bore	1,779
v	Chain saw	261
vi	Sprayers	14,842
2	Livestock Production	
i	Poultry production	53,348
ii	Piggery production	2,681
iii	Cattle production	5,165
iv	Sheep production	10,695
v	Goat production	11,296
vi	Grass cutter production	209
3	Fisheries	13,089
4	Agro-processing	

	Palm oil processing	1,598
i	Ground nut oil Processing	529
ii	Shea butter Processing	97
iii	Cassava Processing	3,743
iv	Yam Processing	40
v	Feed mill	86
vi	Rice Processing	904
vii	Other cereal Processing	1,918
viii	Tomato/Pepper Processing	2,432
ix	Fish Processing	374
x	Agro- forestry	
5	Snailry	914
i	Hunting Equipment	381
ii	Apiary	2,362
iii	Marketing	
6	Cold room	1,713
i	Rental	2,519
ii	Tricycle	108
iii	Vulnerable	47,643
7	Grand Total	245,766

Innovation and Creativity

Fadama III has initiated the following innovations in the project implementation at the state levels;

- **Fadama Village** : Clustering of subprojects into Fadama village. Encourages integration through byproduct utilization, enhances security, engenders healthy competition among groups, and ensures zero emission of solid and liquid wastes; and
- **ICT Centers**: Setting up of ICT center (Five desktop and a laptop computers) with full internet connectivity. At least 24 states ICT centers are still functional
- **Federated FCAs:** FUGs federate into FCAs at the Local Government and State levels to promote more access markets and financial institutions, service/input providers, etc.
- **Fibre Glass Tank for Aquaculture**: Use of fiber glass tanks for fish culture is advantageous because of the minimal space requirement, ease of maintenance, cost effectiveness and environmental friendliness.

Other Partnership and Collaboration

- The **Department of Cooperatives** trained Fadama groups on Cooperative Principles in five states.
- **USAID/MARKETS** trained our farmers and other staff on the Nigerian Agricultural Enterprise Curriculum.
- **British-American Tobacco Foundation** in Ogun, Ekiti and Kogi States has built cassava processing factories for some of our FCAs to add value to their production
- In Adamawa State, the **Raw Material Research Development Council** helped our FCAs involved in livestock production to equip a dairy plant in Yola.
- **Adamawa Agricultural Development and Investment Limited** (AADIL) is also helping the groups to develop improved pastures/fodder banks.
- **Life Rehab Foundation** provided a grant of N25M to 104 women groups in Niger State

FADAMA III AF VALUE CHAIN

Implementation procedure

- ✓ Preparation of Business Plan
- ✓ Funding of Business plan for production
- ✓ Funding of Public infrastructure e.g. Roads, Irrigation canals etc.
- ✓ Accessing Matching Grants
- ✓ Funding of support to the ADPs, Sponsored Research and On-farm Demonstration.
- ✓ Funding of NFCO, SFCO and Other Project Structures' Operational Activities.
- ✓ Funding of Collaborating Agencies Activities : FDAE, Seed Council, ARCN,
- ✓ Compliance Mechanism and sanctions

13

BASIS OF CATEGORIZATION OF STATES

Commodity	State	Strength
Rice	Lagos	Huge Market and Low Capacity Utilization of Existing Mills
	Niger	Largest Producer of Rice, Presence of Production Clusters and Small scale Processing Mills
	Enugu Anambra	Special Ecological Zone with Strong Processing Capacity e.g Omo Rice Mill
	Kano	Large Irrigable Land and Irrigation Facilities
Sorghum	Kano	High Production Potential and Large Market.
Horticulture	Kano	Kadawa, the Largest Producer of Tomato in Nigeria, and Existing Underutilized Capacity for Processing
Cassava	Kogi	Largest Producer of Cassava and Production Cluster

PRODUCTION CLUSTER STATES	**OSUN, ONDO, EKITI, PLATEAU, KADUNA, KEBBI, TARABA, EBONYI, SOKOTO, ADAMAWA, JIGAWA,BAUCHI,OGUN,OYO, KATSINA, FCT, BENUE, ZAMFARA, CROSS-RIVER, AKWA-IBOM, GOMBE, EDO, ABIA, RIVERS, IMO AND DELTA**

Achievements…….
COMPONENT I

- ➢ The first Micro-Finance Bank established by Fadama Farmers Community Association (FFCA) in Plateau State.
- ➢ Facilitators Fadama PIU Staff were trained on Nigerian Agricultural Enterprise Curriculum (NAEC).
- ➢ NAEC training stepped down to 500 Farmers in their State
- ➢ 2 Nos of Orientation workshops were held for key staff and facilitators respectively.

TRAINING PIX….

Stepping down of NAEC Training down to Farmers

Components

- ❖ Capacity Building, Communications and Information Support
- ❖ Small Scale Community Owned Infrastructure
- ❖ Advisory Services and Input Support
- ❖ Support to the ADPs, Research and On-farm Demonstrations
- ❖ Asset Acquisition for Individual FUGs/EIGs
- ❖ Project management, Monitoring and Evaluation.

11

COMPONENT I –Cont'd

- ➢ Business plan template was prepared through Consultancy
- ➢ 320 number facilitators were recruited to facilitate the preparation of business plan.
- ➢ 22,898 Nos business plans were developed;
  - 4,401 for cassava
  - 12,806 for rice,
  - 2,223 for tomato
  - 3,468 for sorghum
- ➢ Two Hundred and Three (203) off-takers have been linked with Production clusters across four value chains.
- ➢ Two Thousand Four Hundred and Forty-Eight (2,448) MoU's with Off-takers have been signed for all the four value chains.

Implementation Arrangement

- ❑ **At Federal Level - FMARD (NFTC) - NFCO**
- ❑ **At State Level SMANR (SFTC) - SFCO**
- ❑ **At Local Government Level - LGA (LFDC) - LFD**
- ❑ **At Community Level - Production Clusters - Production Groups**

COMPONENT I- Cont'd

- ❑ Several numbers of sensitization and mobilization of key stakeholders at intervention sites.
- ❑ 1,020 Nos of quarterly Fadama III AF newsletter have been produced.
- ❑ 89 programs aired in Kano, 208 jingles in Lagos and 10 community film shows in Niger.
- ❑ Six (6)Nos Mobile Media Vehicles procured and distributed to States.

FADAMA III AF COMMUNICATION & INFORMATION SYSTEM

Social media:

- Facebook – 959 friends
  59 private firms followers
- Twitter – 48 followers
- Queries- 36 queries responded to
- Website: www.fadamaaf.net
- Twitter: @FADAMAIII
- Email: fadamanfco@fadamaaf.net

Presentation of Input materials to farmers in Niger State

Inspection of Input materials to farmers in Niger State

COMPONENT II Cont'd

AEHE CENTRE (SIDE VIEW)

122 Boreholes (Tube wells) procured for Farmers in Badeghi, Niger State

AEHE CENTRE (FRONT VIEW)

COMPONENT IV **Support to the ADPs, Sponsored Research and On-farm Demonstrations**

- Training for Farmers Field School (FFS) Master Trainers has been done for the six core States, two master trainers per State.
- Farmers need assessment was conducted in the pilot States of Anambra, Enugu, Kano, Kogi, Lagos and Niger States.
- 4 Nos varietal comparism demonstration plot were established
- In Kano- three hectares each of 4 Nos rice varieties (Faro 44, 52, 60 and 61 - Anambra State - three hectares each of 4 Nos rice varieties comparism demonstration plots were established by NCRI
  4 hectares of the same varietal plots were established in Niger State.
- Nurseries for Tomato (Chibili, Kiarra and Thorgal) were established in 2 sites in Kano State.
- In Kogi State NRCRI Umudike has established 6 hectares of 4Nos Cassava varieties (TME 419, TMS 0505, TMS 01/1368) with emphasis on yellow cassava variety.

COMPONENT II

- Construction of irrigation infrastructure commenced in Anambra, Enugu, Lagos, Niger and Kano

- 222km of road have been contructed for 2 coats surface dressed feeder road intervention across the six core states

Nursery bed preparation at Kadawa in Kano state

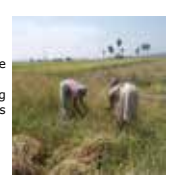
Transplanted rice showing row and spacing

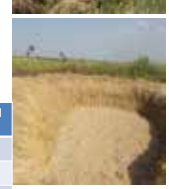
Irrigated field

Project Achievements (Rice Demonstration Plot in Anambra State)

COMPONENT III- ADVISORY SERVICES AND INPUT SUPPLY

- **Advisory Service**
- 1,022 Nos ASIC engaged to provide Advisory Service support to Production Groups (best Agronomy practice.
- 159 Smart Farmers that serves as a focal point of learning for the member were selected and trained.
- Groups were supported with 50% cost to prepare land using mechanical labour under Agricultural Equipment Hiring Centres (AEHS)
- **Input Support**
- 201,197 Farmers were supported with agricultural inputs;
  Tomato -24,491, Sorghum -36,684,
  Cassava -17,798 Rice -12,2233.
- 197,057.40 ha hectarage cultivated across the Value Chains;
  Tomato -17,356 ha, Sorghum -37,134ha,
  Cassava -19,135.4ha Rice -123,426 ha





	NPK/BAG	UREA/BAG	PLANTING MATERIAL	AGROCHEMICALS/LTR
RICE	8,952	5,234	93,190	19,472
CASSAVA	3,310	200	37,680	4,284
TOMATO	1,598	651	4,666	325
SORGHUM	19,383	9,707	6,757	4,524

COMPONENT V-Asset Acquisition for Individual FUGs/EIGs

5 Tractors, 1 Power Tiller and Mini-combined harvester procured in Niger State

COMPONENT VI-Project Management, Monitoring and Evaluation

- Baseline Study was undertaken to establish the benchmark that would allow for subsequent reviews and assessment of the project in the Core States.
- Midterm Review of the Project was conducted to establish that the Project was on course to achieving its Development Objectives at closing
- 9 Nos of WB/FGN Implementation Support Mission were undertaken since inception of the project till date to assess implementation progress of Fadama Ill AF.
- Fadama III AF documentation and coding of benefiting groups (PCs & PGs) and BPs into
- Panex has commenced in the six core States and Production Cluster States.
- Farmers database was developed to supplement Panex in the identified gaps. This records include; farmers registration (bio-data with picture) e.t.c.

ENVIRONMENT

- Environmental and Social Impact assessment are conducted in all project intervention areas.
- ESMPs are produced and costed in all the Business Plans across the States.
- The soil fertility testing and evaluation in the 4 core and the North-Eastern States was conducted.
- Pest Survey is conducted in all the Fadama III AF intervention States in the country.
- The Climate Smart Farmers are selected and trained at all clusters serving as lead farmers to the groups.

- The Environmental Specialist is a trained SoilDoc, using the SoilDoc Kit System to conduct on farm soil testing and produce results without going to lab.
- Grievance Redress Mechanism Register used at all group level to ensure all conflicts are recorded and resolved.
- Personal Protective Equipment were procured and Environmental Officers and farmers were trained adequately.
- Land titles were attached in all the Business Plans.
- 34 States have submitted their Environmental and Social Audit Report

Geographical Information System- GIS

- The GIS laboratory has been upgraded with **Software** 15 NOS ArcGIS 10.2.2 version with hardware 10 units of hand held Garmin GPS (model GPSMap62st).

The upgraded has aided various activities such as farm mapping, verification of farm lands, locatior and production of several maps.

Fadama III AF Other Support

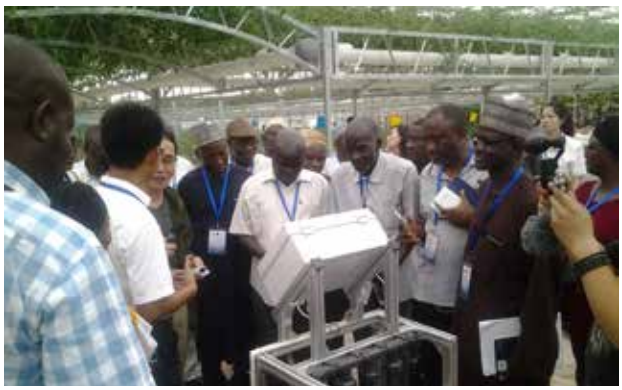
- The sum US $1.1 M was used to support livelihood activities of the affected victims in the project area comprising of Adamawa, Borno and Yobe States (The North East Initiative).
- A sum of N166,760,000 ($926,444.45) was used Support to Government Control of Influenza (Avian Influenza) in Nigeria.
- The World Bank approved the sum of US$1.5million of Fadama III AF credit to support the SCPZ project preparation. As at date only N43,756,745 ($243,093.03) has been disbursed.

❖ COLLABORATIONS

The project is maintaining synergetic collaboration with relevant agencies to eschew duplication of activities and effective usage of resources to achieve the project objectives. The major agencies include;

- **ARCN** –**Agricultural Research Council of Nigeria**
  - **IAR** – **Institute of Agricultural Research, Zaria** – **Sorghum**
  - **NCRI** – **National Cereals Research Institute** - **Rice**
  - **NIHORT** –**National Horticulture Research Institute** - **Tomato**
  - **NRCRI** – **National Root Crops Research Institute** - **Cassava**
- **NASC** - **National Agricultural Seeds Council** - **Seed multiplication**
- **NAFDAC** - **National Agency for Food Drugs Administration Control.** -**Quality Assurance Research**

Annex 3



National Coodinator NEWMAP extends some Publications to President Nanchang Institute of Water Management

NPC NEWMAP AND WORLD BANK Country Director China in Beijing

Yaohu school


INDIAN COFFEE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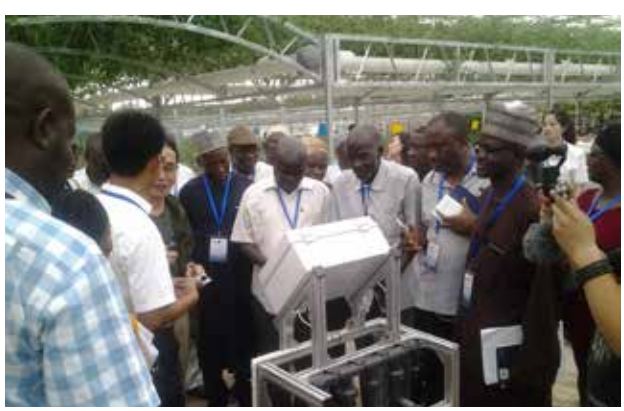
YORON
悦岸酒
! Warmly welcome de


WARMLY WELCOME DELEGATION TO SOUTH
-SOUTH COOPERATION
热烈欢迎南南合作
CHINA' S INTELLIGENCE AGRICULTURE FORUM BASED ON
INTEGRATED WATERSHED MANAGEMENT




Welcome Delegation of Nigeria to Gao' An Experimental Base of JIAAS


CLIMATE-SMART
SOIL & WATER
CONSERVATION
PLANT
CULTIVATION
Technologies
Methodologies


WARMLY WELCOME DELEGATION TO SOUTH
-SOUTH COOPERATION


-SOUTH COOPERATION


南南合作—中国基于流域综合
智慧农业高峰论坛
South-South Cooperation Forum on China' s Intelligenc
Agriculture Based
ntegrated Watershed Managemen