Smallholder Agriculture and Climate Change

Climate Smart Agriculture in China

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- Adaptation to Climate Change in Smallholder Agriculture in China
- Climate Smart Agriculture in China



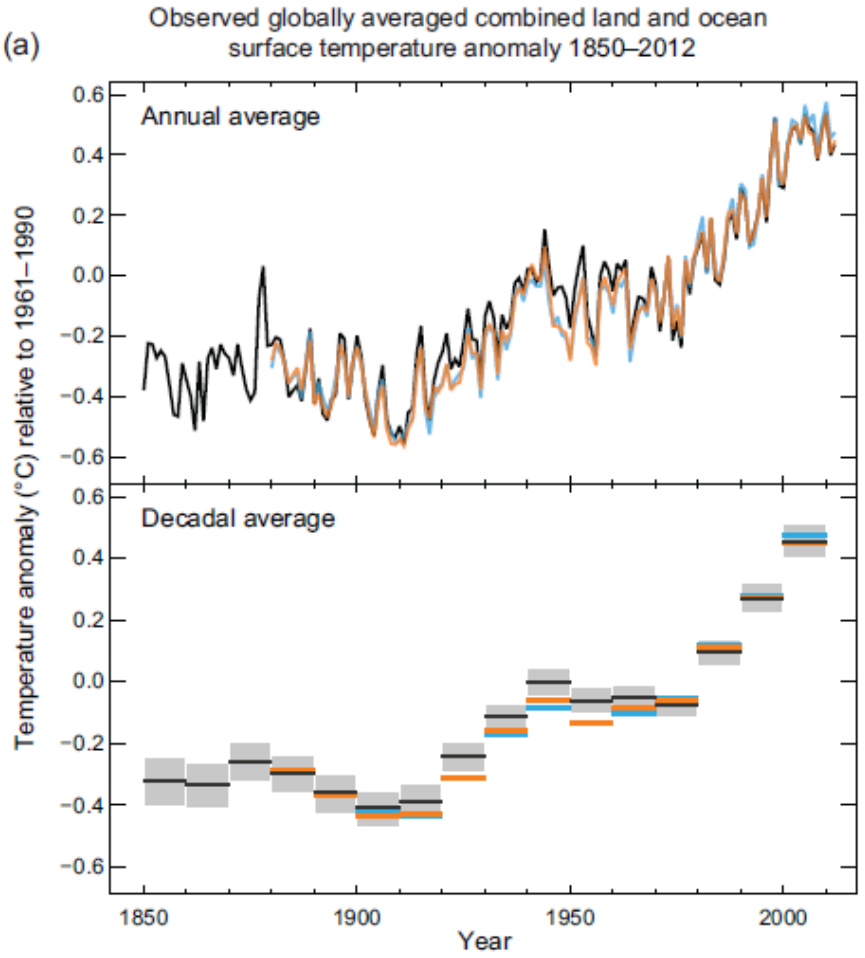
1. Interrelation between Climate Change and Agriculture

- Global Climate Change
- Climate Change Impacts on Agriculture
- GHGs emission in Agriculture Sector
- Climate Smart Agriculture



1.1 Global Climate Change

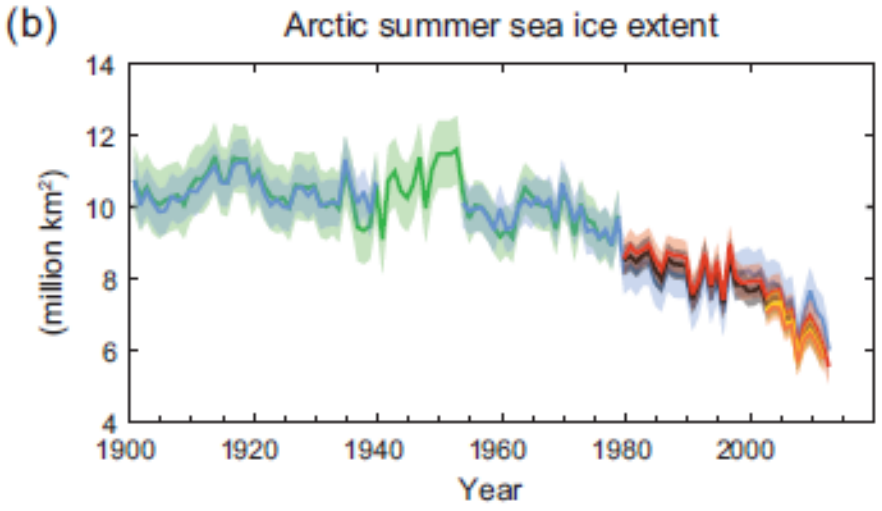
- According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), warming of the climate system is unequivocal.
- Since the 1950s, many of the observed changes are unprecedented over decades to millennia.

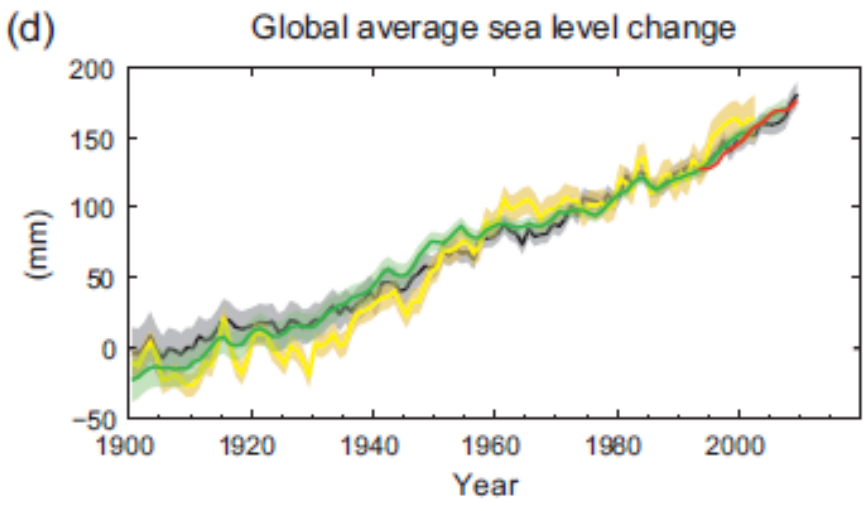


Climate Warming

(IPCC, 2013)

1.1 Global Climate Change



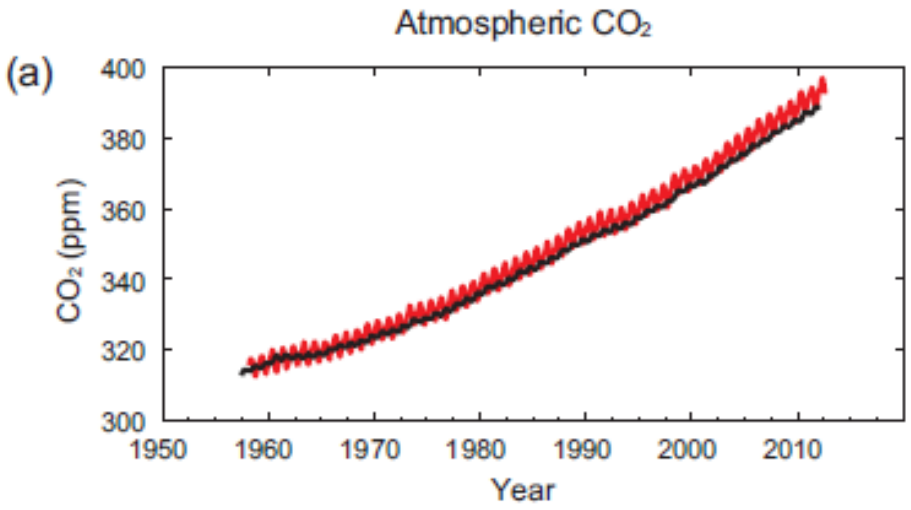


Ice Sheets & Snow Decreasing

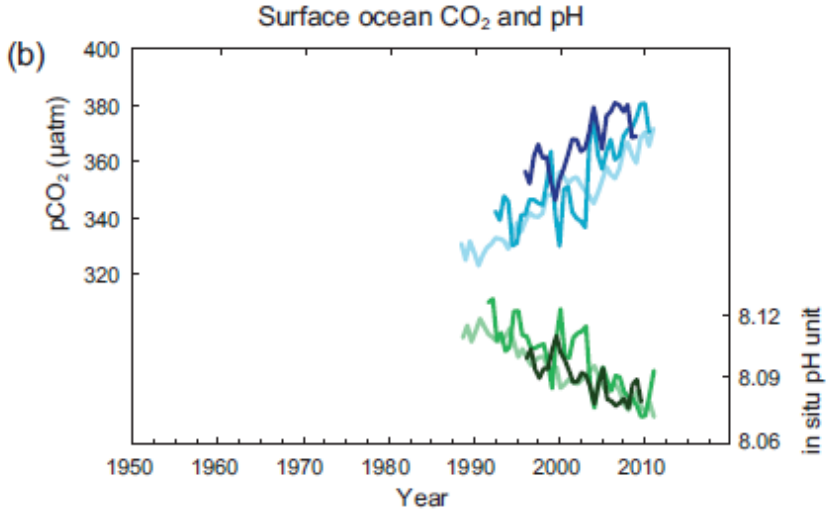
Sea Level Rising

(IPCC, 2013)

1.1 Global Climate Change



Increase in Atmospheric Concentrations of GHGs



Ocean Acidification

(IPCC, 2013)

1.1 Global Climate Change


Drought


Flood


Freeze injury


Typhoon

Increased Intensity & Frequency of Extreme Events

(IPCC, 2013)

1.2 Climate Change Impacts on Agriculture

- Climate change already affects the agriculture sectors in many parts of the world, and its impacts will be amplified in the years and decades ahead.
- A large body of evidence points to a prevalence of negative outcomes, with many agricultural systems becoming less productive and some plant and animal species disappearing.
- Those changes will have direct effects on agricultural production, which will have economic and social consequences and finally impacts on food security.

(FAO, 2016)

1.2 Climate Change Impacts on Agriculture

(1) Crops

- **Changes in Cropping Systems**

  Changes in radiation and heat resources result in changes of cropping systems, production and management mode, and industrial structure.

- **Changes in the occurrence of pests and diseases**

  Climate warming, especially warm winter, will benefit many insects (such as rice planthoppers and corn borers) safely survive the winter, and the scope is also expanding, which will increase the incidence and the extent of pests and diseases in the coming year.

- **Negative impacts on Yields**

  The effects of past climate trends on crop were observed with negative impacts being more common than positive ones. Evidence showed that, over the period 1980 to 2008 there was a 5.5 percent drop in wheat yields and a 3.8 percent drop in maize yields globally, compared to what they would have been had climate remained stable.

(FAO, 2016)

1.2 Climate Change Impacts on Agriculture

(2) Livestock

The most important impacts are on animal productivity, animal health and biodiversity, the quality and amount of feed supply, and the carrying capacity of pastures.

(3) Fisheries and aquaculture

Climate change, climate variability and extreme weather events compound threats to the sustainability of capture fisheries and aquaculture in marine and freshwater environments.

(4) Forestry

Climate change and climate variability threaten the provision of a range of crucial goods and environmental services from forests.

(FAO, 2016)

1.3 GHGs emission in Agriculture Sector

- By FAO estimates, emissions from agriculture, forest and other land use (AFOLU) stood at 10.6 gigatonnes (Gt) of carbon dioxide equivalent in the year 2014. The sector emits three types of anthropogenic greenhouse gases: CO_2, CH_4 and N_2O.

- Agriculture accounts for the largest share of emissions from AFOLU.

- Of the sources of specific GHG emissions from agriculture, the most significant contribution at the global level - amounting to 40% in CO_2 equivalent - comes from enteric fermentation in ruminants, which is a major source of CH_4 emissions. In terms of the magnitude of emissions, this is followed by manure left on pasture (16%), the use of synthetic fertilizers (12%) and rice cultivation (10%).

- Agriculture must contribute to mitigation if global temperature increase is to be kept below 2 °C.

(FAO, 2016)

Agriculture faces the double challenge of ensuring food security & reducing GHGs emissions!

1.4 Climate Smart Agriculture

More specifically for managing agriculture for food security under the changing realities of global warming, FAO has developed the "climate-smart agriculture" (CSA) approach, which it presented in 2010 at The Hague Conference on Agriculture, Food Security and Climate Change (FAO, 2010)

1.4 Climate Smart Agriculture

CSA is an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change (FAO, 2010). It emphasize three goals:

- sustainably increasing agricultural productivity and incomes
- adapting and building resilience to climate change
- reducing or removing greenhouse gases emissions

2. Adaptation to Climate Change in Smallholder Agriculture in China

- Smallholder Agriculture in China
- Key vulnerabilities to climate change risks in Smallholder Agriculture
- Approaches to strengthen the resilience of smallholder agriculture to climate change impacts



2.1 Smallholder Agriculture in China

- China is a country with densely population but less arable land.
- Smallholders are the basic units and important parts of agricultural production in China.

- According to the statistics of MoA, by the end of 2016, there are ~ **260 million** farmers operating scale of less than 50 acres , accounting for **97 %** of the total number of farmers and **82 %** of the total area of arable land, with an average area of 5 mu per household.
- According to preliminary estimates, during the past decade, the average annual growth rate of rural land transfer area in China is about 3%. In the next 30 years, considering the trend of land transfer and the attractive of new urbanization on rural labor force, the average annual growth rate of rural land transfer in China is expected to reach 3% -4%. Accordingly, by 2020, there will be 220 million smallholders with the scale of less than 50 acres, their operating arable land accounts for about 80% of the total area of cultivated land. **Therefore, the smallholders will continue to be the main body of agricultural production in China.**

（*People's Daily*, 2016）

2.2 Key vulnerabilities to climate change risks in Smallholder Agriculture

- For most developing countries, the impacts of climate change on crop and livestock productivity tend to be adverse and increasing.
- Increasing scarcity and degradation of natural resources heighten the sensitivity of smallholder agriculture to climate hazards, because degraded resources are less capable of maintaining productivity under climate stresses (FAO, 2012).
- outflow of rural labor resulting in family and agricultural burden increased for rural women and particularly sensitive to climate hazards.
- The limited capacity of smallholders to manage risks.
- In smallholder agriculture, adaptive capacity - or the ability to identify and implement effective actions in response to changing circumstances - is limited by barriers to the adoption of improved, climate-smart technologies and practices.

(FAO, 2016)

2.3 Approaches to strengthen the resilience of smallholder agriculture to climate change impacts

- Smallholder agricultural systems can adapt to climate change by adopting climate-smart practices, diversifying on-farm agricultural production and diversifying into off-farm income and employment.

- Sustainable management of natural resources will be key for adaptation to climate change and to ensure food security.

- Improvements in infrastructure, extension, climate information, mark access, credit and social insurance are needed to facilitate adaptation and diversification of smallholder livelihoods.

(FAO, 2016)

3. Climate Smart Agriculture in China

Climate Smart Staple Crop Production Project in China

- General Introduction of project
- Implementation Status of Project
- Project Impacts
- Prospects in the future

Climate Smart Agriculture

- **Achieve the goals of:**
  - ✓ Food security
  - ✓ Adaptation to climate change
  - ✓ GHGs emission reduction

CSA will help improve the utilization efficiency of resources and yield stability, enhance the capacity of risk resistance and carbon sequestration, reduce GHGs emission in agricultural production by policy innovation and management optimization.

Climate Smart Crop Production

- Explore approaches to improve the efficiency of crop production, enhance the adaptation ability to climate change and the capacity of carbon sequestration.
- Establish the crop production systems with high resource efficiency, high carbon sequestration, and low GHGs emission.

Approaches：

- ✓ Innovation of policy and management
- ✓ Optimization of crop production systems
- ✓ Integration of techniques

3.1 General Introduction of project

☐ Project basic information

- **Project name**：GEF Climate Smart Staple Crop Production Project
  (WB Pro No. 144531 / GEF Pro No. 5121)
- **Executing agency**：World Bank , Ministry of Agriculture of China
- **Project duration**：5 years（2015 to 2019）
- **Project sites**：Huaiyuan county, Anhui province , Ye county, Henan province
- **Key activities**：√ Technology demonstration and deployment
  √ Policy development
  √ Knowledge management
- **Finance**：Total : 30,100,000 $ (U.S. dollar)
  - GEF funds: 5,100,000 $
  - Local counterpart funds: 25,000,000 $

Project Sites

Huaiyuan County：

2 towns，12 villages

3333 ha, 4791 households

Rice-wheat cropping system

Yexian County：

2 towns，28 villages

3329 ha，10127 households

Wheat-corn cropping system

General Objectives

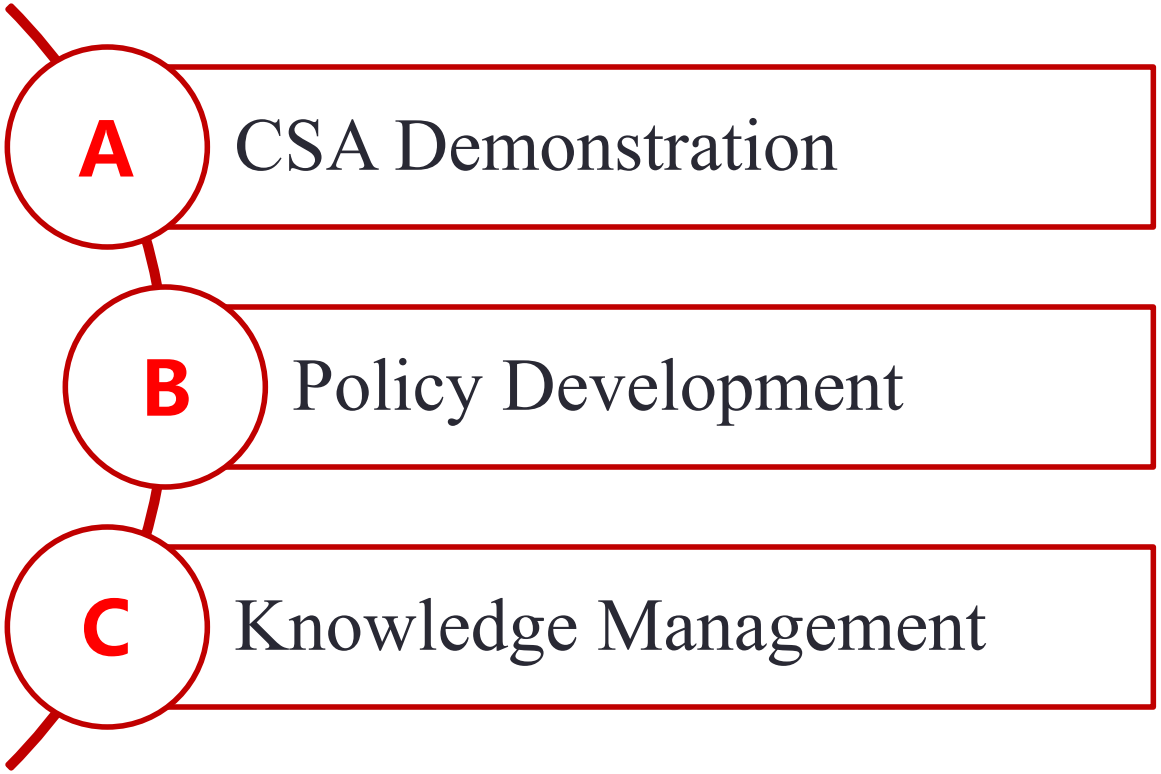
The project selects two major representative grain production areas in Henan and Anhui Provinces, under three major food grain production system of wheat, corn, rice. The project aims to carry out key techniques integration and demonstration, decrease nitrous oxide and other GHGs emission in crop production, innovate and apply supporting policies, promote and expand public knowledge, increase the use efficiency of agricultural inputs (e.g. fertilizer, pesticides, irrigation water and agriculture machine), decrease crop system carbon emission and increase soil carbon sequestration.

Main Targets

- To establish demonstration sites (covering 6700 hectares) of smart climate crop production.
- To reduce the amount of nitrogen fertilizer, pesticides applied per unit area, and irrigation & tillage energy consumption by 10%, 30% and 20%, respectively.
- To increase soil carbon sequestration through straw returning to field and conservation tillage technology, to increase soil organic content by 5-10%.
- To mitigate GHGs emission and increase soil carbon sequestration to a total amount of 65,000 tons CO_2-eq；



Project activities



➢ CSA Demonstration

GHGs emission reduction technique

•• Fertilizer reduction
•• Pesticide reduction and pest control
•• Water management

Technical training and services

- Expert Team
- Technical training and services
- Farmer Field schools (FFS)

Soil carbon sequestration technique

••Conservation agriculture production
••Agroforestry

M & E

- GHGs emission reduction
- social economic impacts
- Environmental Impacts
- Pest Control
- GIS

New production technique pilot

- New material application
- New models of GHG emissions reduction and soil carbon sequestration
- Conservative farming technique

Workshops

➢ Policy Development

- Development of China's CSA strategy and polices
- Formulation of Climate Smart Staple Crop Production guideline
- Development of meteorology and monitoring methodology for CSA

➢ Knowledge management

- Establishment of Information exchanges and management platform
- Documentation and dissemination of project outputs, experiences, best practices of the project
- Technical exchanges and discussions

3.2 Implementation Status of Project

(1) Demonstration and promotion of GHGs emission reduction and soil carbon sequestration techniques

- Crop residue retention techniques and conservation agriculture production techniques

  - By the end of 2016, the techniques were applied to a total area of over 30,000 mu.
  - Subsidies for the procurement of harvesting services that use crop residue retention techniques.
  - Procurement of rice harvester and corn harvester for householders.

Agroforestry development

- By the end of 2016, the area of agroforestry development through tree planting and tree management activities accumulated to 2500 mu.



- Agroforestry development greatly improved the natural environment and living condition, benefiting both crop systems and local residents.
- In 2016, the total amount of GHGs emission reduction and soil carbon sequestration reached **8534.87 tons CO_2-eq**.

Demonstration and promotion of fertilizer reduction techniques

- By the end of 2016, the techniques were applied to a total area of over 30,000 mu.
- Subsidies for the purchase of formula fertilizers and for the procurement of mechanized deep fertilization services.

- In 2015, the average yield of rice in Huaiyuan county project area was ~ 600 kg/mu, 18% higher than that in 2014.
- In 2016, the average yield of wheat in Huaiyan county project area was over 470 kg/ha, 8.6% higher than that in 2015. The average yield of rice was ~ 650 kg/mu, and both the yield and quality of rice were higher than those in non-project area.

☐ Demonstration and promotion of pesticides reduction techniques

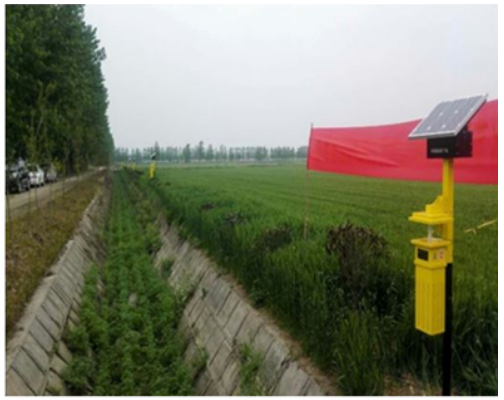
- Subsidies for the procurement of high efficiency pest management sprayers and the procurement of professional pest management services

  ✓ Huaiyuan county: Agricultural unmanned aerial vehicle (1 set)

  Tractor mounted boom sprayer (1 set)

  ✓ Yexian County: Hand - carried electrostatic sprayer (200 sets)

- Unified pest prevention and control of wheat



Demonstration of water saving practices

- **Rehabilitation of farm irrigation systems and related farm infrastructures**
  - ✓ Effectively improves the irrigation and drainage conditions for a total area of ~ 20,000 mu.
  - ✓ Contributed a lot to the virtuous circle of resources, and greatly improved the ability of resistance to natural disasters.

- **Yexian county:** provision of technical advisory services and acquisition and utilization of transformers (2 sets)

- **Huaiyuan county:** Subsidies to project farmers upon their satisfactory use of designated water saving practices (**Land leveling**).



✓ **By the end of 2016, the are of farmland leveled totaled to 5,000 mu.**

(2) New Production Technique Pilot

- Application on a pilot basis of **alternative fertilizers and related materials** to mitigate climate impacts.
- Piloting of **alternative crop rotation production systems** to determine their impact on productivity.
- Piloting of **conservation agriculture production techniques** in Huaiyuan and improving existing production techniques in Yexian.

Alternative crop rotation production systems

Wheat

Oilseed rape

Milk Vetch

Paddy-crayfish

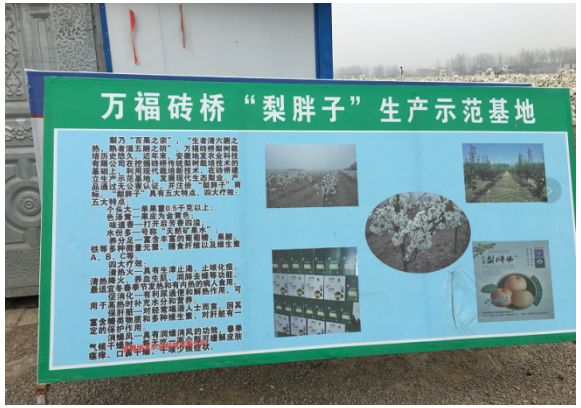
Corn

Peanut

Soybean

Paddy-Duck

Industrial restructuring



(3) Monitoring & Evaluation

Baseline scenario

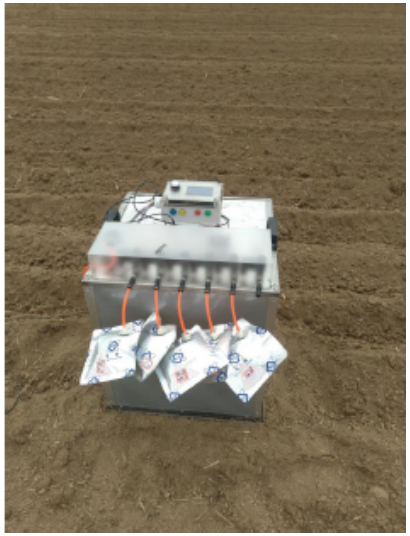
Project scenario

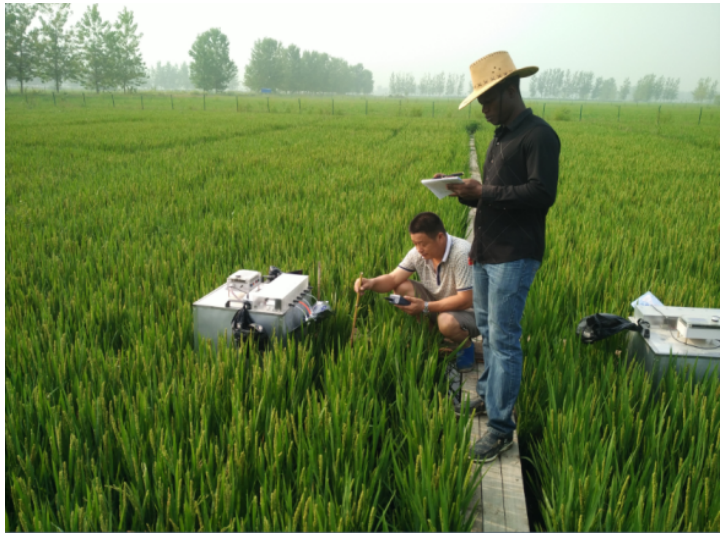
- GHG Monitoring – to assess the GHG mitigation
- Socioeconomic monitoring – to assess improvement in productivity and incomes
- Environmental monitoring – to assess resilience and environmental co-benefits

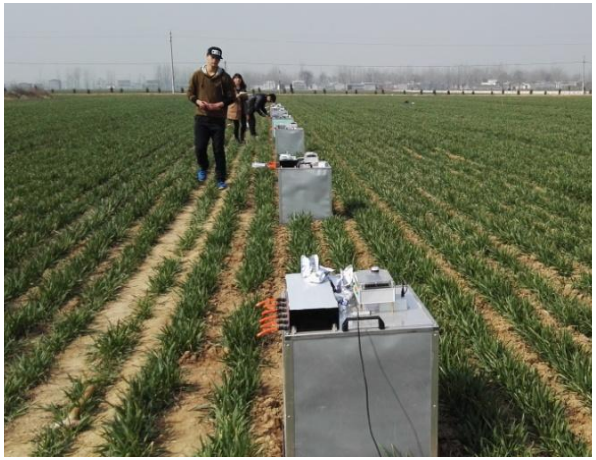
ΔR	=	BE	-	PE	-	LE
• Net anthropogenic GHG emissions & removals		• Baseline emissions & removals		• Project emissions & removals		• Leakage emissions (zero)

Farmer → Village → Extension staff/project unit → Database

Monitoring of GHGs emission



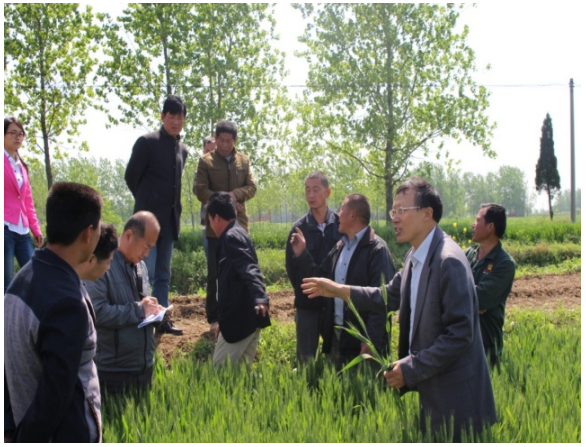




Social and environmental impact monitoring

(4) Technical training and service

- By the end of 2016, **12 FFS in Huaiyuan** and **18 FFS in Yexian** were established and operated properly in the project villages.
- **A national expert group** was teamed up to provide technical support during project implementation.
- **Two provincial expert groups** were teamed up to provide technical support to each project province on project related issues, and conduct technical training and services.



(5) International exchanges and cooperation

- Visit to USA and Canada on CSA (2016)
  - Share practices on CSA in China
  - Learn related techniques and policies on CSA
  - Explore potential cooperation with relevant agricultural management departments and research institutions

3.3 Project Impacts

Social Benefits

- **Farmers 'awareness of science and technology and environmental protection was improved**

The introduction of new technologies in the project area, education and training for farmers have updated farmers' concept of production and life, improve their awareness of science and technology and environmental protection, thus changed the traditional production and lifestyle.

- **The agricultural technical service system was improved in the project area**

The implementation of the project has promoted the construction of agricultural technical service system in the project area, involving agricultural mechanization services (fertilization, pest control, straw returning, etc.), to overcome a series of problems faced by small –scale farmer household businesses.

- **Capacity of agriculture departments was strengthened in the project area**

The implementation of the project has established an effective platform and mechanism for the agricultural management and technical departments in the project area to learn and accept advanced technologies and experiences. The implementation of the project is conducive to institutional strengthening and the improvement of personnel capacity.

3.3 Project Impacts

Economic Benefits

- **Increase in agricultural production efficiency and farmers' income**

  By using carbon sequestration technology, new machinery, production costs reduced while crop yields and farmers' income increased

- **Optimization of agricultural structure and improved comprehensive benefits**

  The implementation of the project has promoted the optimization of agricultural industrial structure and the enhancement of the comprehensive benefit of green agriculture industry chain, which is beneficial to the deep utilization of agricultural resources and the development of rural circular economy.

Environmental benefits

- **Agricultural non - point source pollution mitigated**

  Reduction of fertilizer, pesticide and straw returning has reduced the agricultural pollution sources for water used in the project area thus improve the quality of ecological environment in the project area .

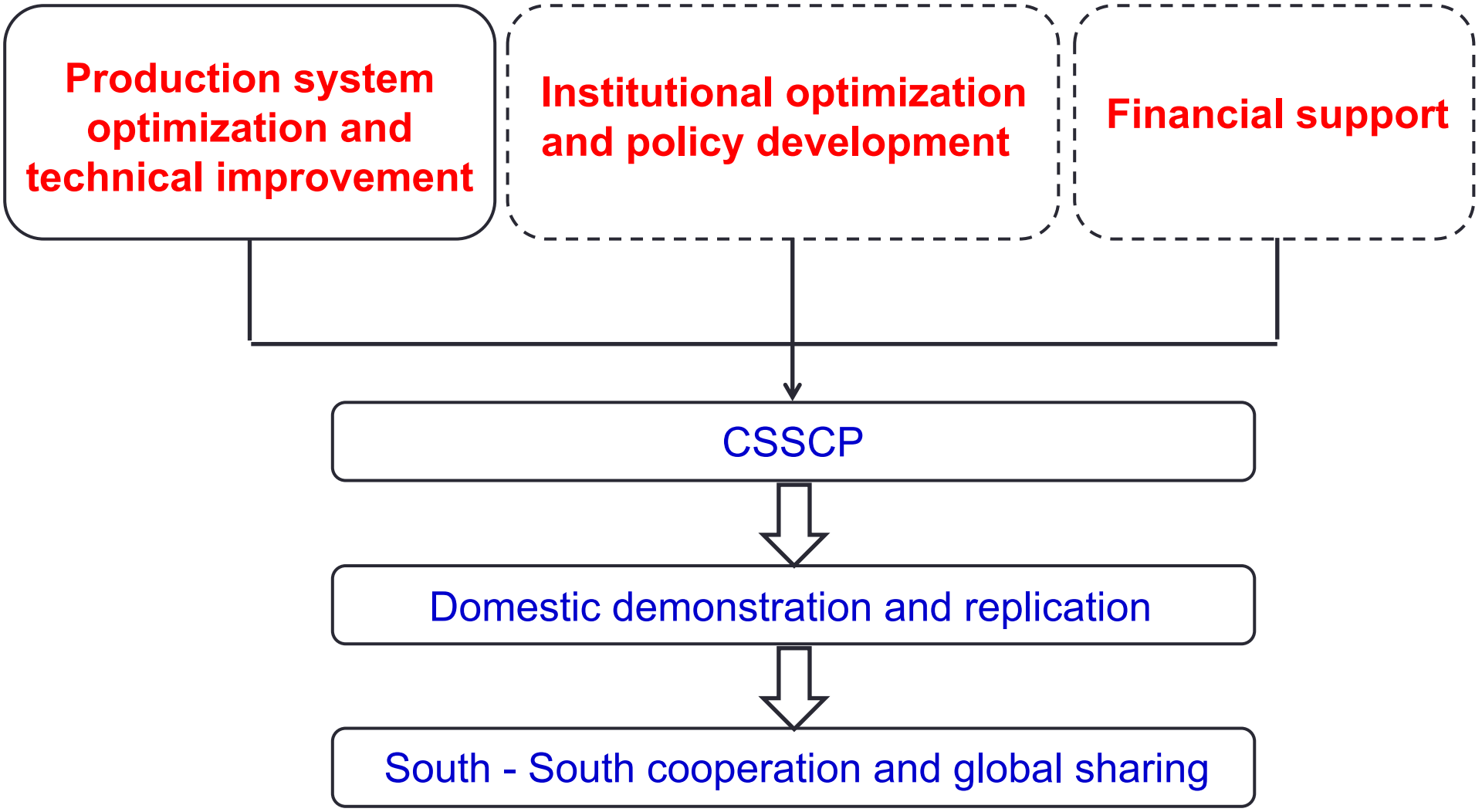
- **Carbon sequestration capacity increased and GHGs emission reduced**

3.4 Prospects in the future

- CSA is a good choice for Agricultural Sustainable Development to adapt to global climate change
- There is a need to realize the transformation of smallholder agriculture to CSA



3.4 Prospects in the future



Thank you!

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