Actions Taken by CAE for SDGs and Smart Agriculture Development Strategy

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- Actions Taken by CAE for SDGs
- Smart Agriculture Development Strategy

Actions Taken by CAE for SDGs

1. Conduct strategic consulting research and academic activities focusing on SDGs, and make policy recommendations

2. Organize CAE members, experts and employees to assist two impoverished counties in China's Yunnan Province in poverty eradication

3. Build two UNESCO Category II centers to provide knowledge data services and trainings for SDGs

Actions Taken by CAE for SDGs

1 Conduct consulting research and academic activities focusing on SDGs, and make policy recommendations

- Mechanical and Vehicle Engineering
- Information and Electronic Engineering
- Chemical, Metallurgical and Materials Engineering
- Energy and Mining Engineering
- Civil, Hydraulic and Architecture Engineering
- Environment & Light and Textile Industries Engineering
- Agriculture
- Medicine and Health
- Engineering Management

9 academic divisions of CAE

Actions Taken by CAE for SDGs

SDG4(Quality Education)

- Study on Characteristics of Demand and Training Trend of Engineering Science and Technology Personnel Based on Education for Sustainable Development
- Study on the Demand for Engineering Science and Technology Talents and Education System Reform in the New Era

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SDG5(Gender Equality)

- Women and Children's Health Development Promotion Summit Forum
- Workshop for Young Female Technologists in Developing Countries

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SDG6(Clean Water and Sanitation)

- High-end Forum on Sustainable Utilization of Water Resources and Drinking Water Safety Guarantee
- High-end Forum on Water Security and Sustainable Development

Actions Taken by CAE for SDGs

SDG7(Affordable and Clean Energy)

- Study on China's Energy Transformation and Development Strategy Powered by Offshore Wind Power
- Study on Hydrogen: Fundamentals and Strategies in China and France/Europe For Decarbonizing the Economy
- Study on Sino-French Nuclear Energy Development Strategy
- Comparative Study on Energy System Transformation between China and German

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SDG9(Industry, Innovation and Infrastructure)

- International Forum on Innovation and Emerging Industries Development
- Research on Develoment of Strategic Emerging Industries
- Research on Strategy of Sustainable Development of Manufacturing Industry

Actions Taken by CAE for SDGs

SDG11(Sustainable Cities and Communities)

- International High-end Forum on Water Pollution Control
- China-UK Smart City Seminar
- China-UK Urban Flood Prevention Seminar
- Study on Sustainable Development Strategy of China's Urban Construction
- Study on Safety Guarantee Strategy for the Major Structures of Transportation Infrastructure
- Strategy Research on Urban Underground Space Development and Planning

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SDG12(Responsible Consumption and Production) &13 (Climate Action)

- Research on Strategy and Path for China Achieving the Goal of Carbon Emissions peaking and Carbon Neutrality
- Research on China's Energy Production and Consumption Revolution

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Actions Taken by CAE for SDGs

SDG14(Life Below Water) & 15(Life On Land)

- **Research on Several Strategic Issues of Ecological Civilization Construction**
- **Research on Strengthening Marine Ecological Environmental Protection by Land and Sea Coordination**
- **Evaluation Report on China's Ecological Civilization Development Level**
- **Seminar on Green Development and Ecological Safety of Marine Industry**

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Many policy suggestions of CAE has promoted the issuance of relevant policies or the implementation of major engineering projects.

Actions Taken by CAE for SDGs

2 Organize CAE members, experts and employees to assist two impoverished counties in China's Yunnan Province in poverty eradication

Focusing on SDG1(No Poverty), SDG8(Decent Work and Economic Growth), and SDG10 (Reduced Inequalities), the CAE has made efforts to help Huize and Lancang, two impoverished counties in Yunnan Province, alleviate poverty and improve the living standard of local people.

The Academy has successfully explored a way to help poverty-stricken areas eliminate poverty through the way of developing industries and increasing incomes.

President Li on field trip to the two counties

President Li in meeting of Oats Help Poverty Alleviation

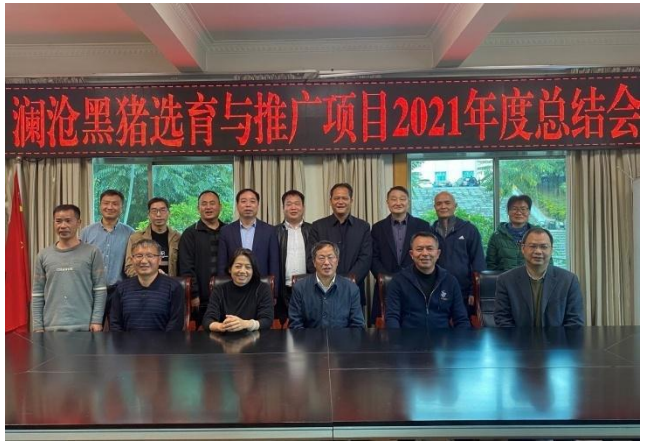
Actions Taken by CAE for SDGs

- Strengthen scientific and technological support and promote the development of local industries

We helped the two counties introduce high-tech enterprises and applicable technologies based on local resource conditions.

With the help of CAE members, the two counties succeeded in cultivating new high-quality and high-yield varieties of crops and Chinese herbal medicines. These have greatly increased the income level of the local people.

CAE member Tang Huajun, Zhu Youyong in the two counties



CAE member Yin Yulong in Lancang County

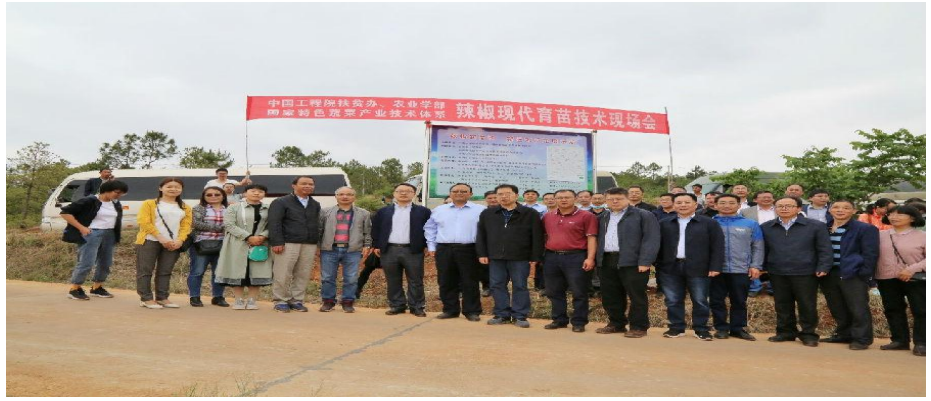
Actions Taken by CAE for SDGs

- Invite CAE members and experts to train local residents and improve their employability skills

Each year CAE will hold several skills training classes in the two counties. In 2021 alone, 1,259 local trainees completed the classes and many of them have become rural entrepreneurial leaders.

Secretary-general Chen gave report to local middle school students

CAE also coordinated various resources to promote the construction of Pu'er Vocational Education Center, to help more teenagers and local people receive good vocational education.



CAE Agriculture Academic Division guided chili seedling in the counties

Actions Taken by CAE for SDGs

- Organize "CAE Member Tour" to provide assistance for local economic and social development

We organized “CAE Member Tour " to Huize and Lancang for many times to provide assistance in talent training and industry development, in which more than 300 CAE members and experts were involved.

The CAE members actively carried out the assistance work in various fields including education and training, industry development, agriculture and healthcare .

Vice President Wang is helping local patient

CAE members and employees in the counties

Actions Taken by CAE for SDGs

3 Build two UNESCO Category II centers to provide knowledge data services and trainings for achievements of SDGs

United Nations Educational, Scientific and Cultural Organization
联合国教育、科学及文化组织

IKCEST
International Knowledge Centre for Engineering Sciences and Technology under the Auspices of UNESCO
国际工程科技知识中心
由教科文组织支持

International Knowledge Centre for Engineering Sciences and Technology under the Auspices of UNESCO
（IKCEST）

United Nations Educational, Scientific and Cultural Organization
联合国教育、科学及文化组织

ICEE
International Centre for Engineering Education under the auspices of UNESCO
国际工程教育中心
联合国教科文组织支持

International Centre for Engineering Education under the Auspices of UNESCO
（ICEE）

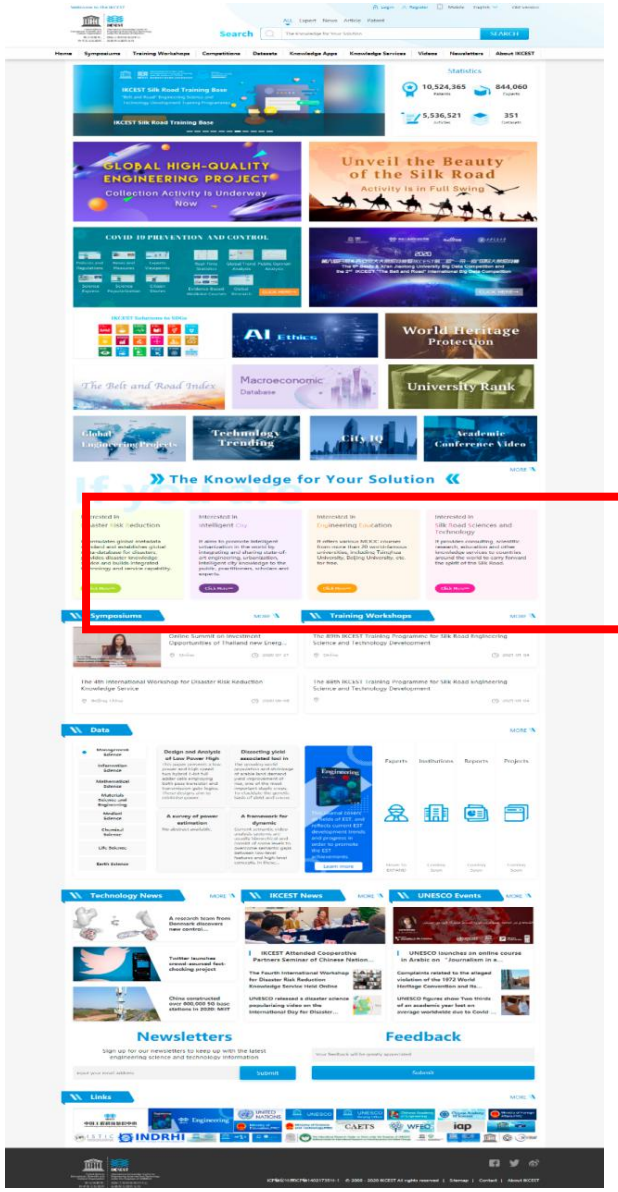
Actions Taken by CAE for SDGs

IKCEST

- Providing multi-domain knowledge data services

IKCEST Platform: www.ikcest.org

- Disaster Risk Reduction
- Intellengent City
- Silk Road Science and Technology
- Engineering Education



Actions Taken by CAE for SDGs

IKCEST has built several knowledge service platforms supporting multiple SDGs

IKCEST Platform: www.ikcest.org

Data Resources

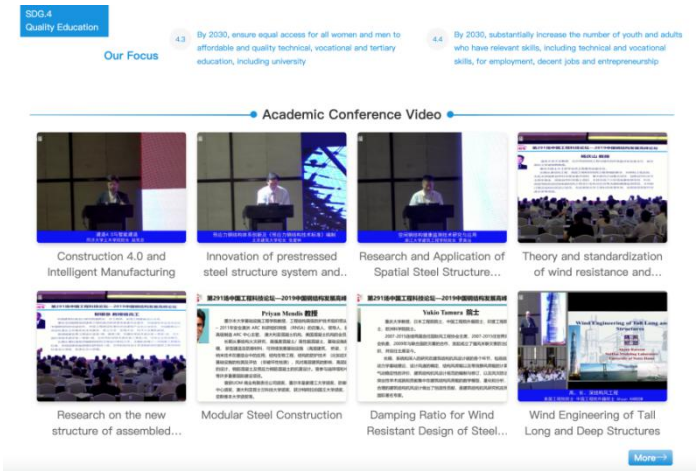
Annual Growth Rate of Data

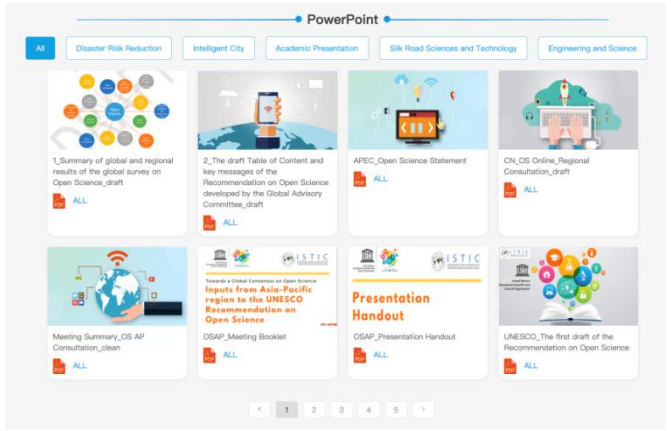
20 %

Total Amount of Data Resources

230 million pcs

News	Literature	Experts
50,000 pcs	11 million pcs	636 pcs
Institutions	**Projects**	**Patents**
81 pcs	44,299 pcs	over 40 million pcs





Actions Taken by CAE for SDGs

- Organizing online and offline training courses to provide training for engineers all around the world.

  - 2015-2021
  - Offering 110+ training workshops
  - 28 topics
  - 110 countries and regions
  - 15000+ trainees
  - female trainee percentage 40%

IKCEST

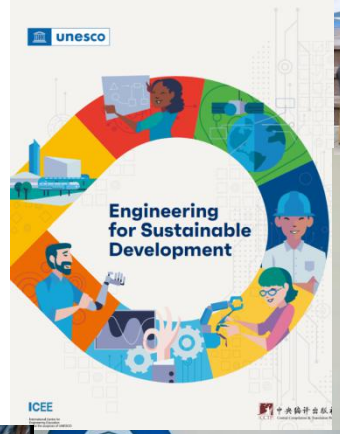
Actions Taken by CAE for SDGs

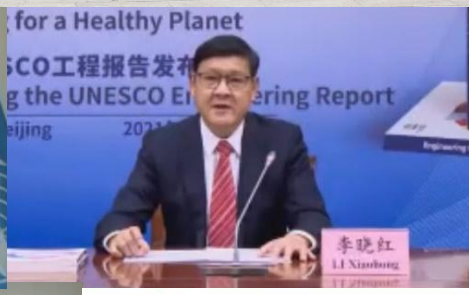
ICEE

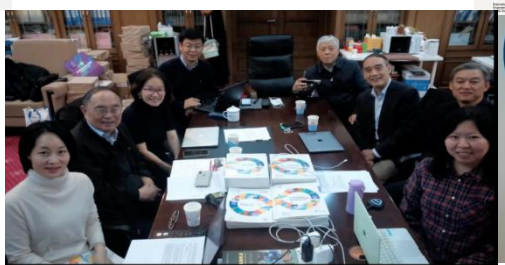
➢ Assisting UNESCO in publishing the report
“ Engineering for Sustainable Development ”

- “A flagship report of UNESCO”—— Report introduction
- “A standard setting-up milestone of UNESCO”——Report preface from Director-General Azoulay

- 4 years
- 3 languages main reports
- 6 UN languages executive summaries
- 4 advisory/steering committee meetings
- 40+ video conferences
- 45 authors from
- 35 organizations







United Nations Educational, Scientific and Cultural Organization

WORLD ENGINEERING DAY

Actions Taken by CAE for SDGs

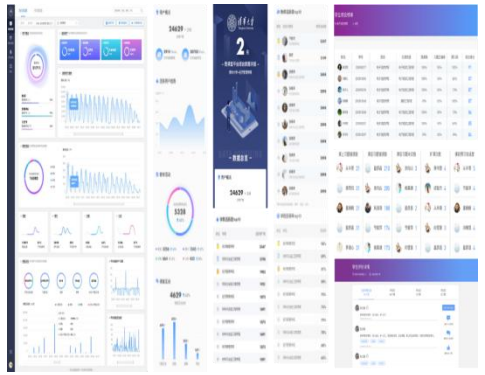
➢ICEE's partner "XuetangX"(International Version) becoming the official online education platform recommended by UNESCO

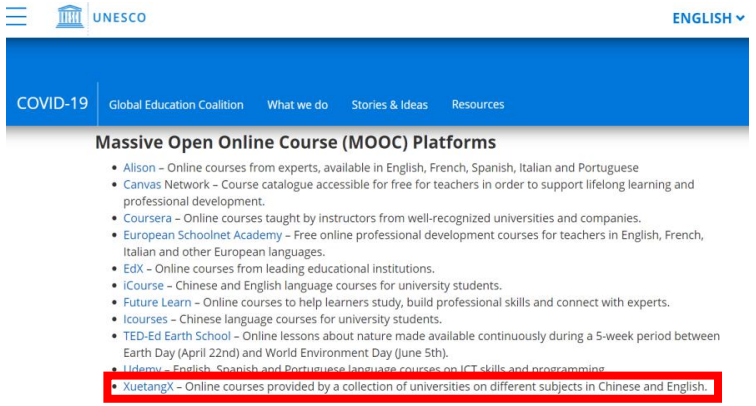
As of December 2020

- **83.71 million** registered learners
- **439 million** cumulative course attendance
- **4052** courses on the platform

on XuetangX international platform:

- **6** languages
- **434** courses
- **8.2 million** registered learners
- **46%** female learners





Actions Taken by CAE for SDGs

➢ ICEE organized global online education dialogues and webinars during the Covid-19 pandemic to support SDG4 "quality education"

26,000+ Livestream listeners

Co-organized Online Education Dialogue 2021
——2021: Rethinking Higher Education Capacity Building in the Post-pandemic Era.

Keynote
Prof. Dr. YANG Bin,
ICEE / Tsinghua University

5000+ Livestream listeners.

Co-organized Global MOOC and Online Education Conference 2021
– subforum 3. Educating Future Scientists & Engineers

Keynote 1
Prof. Dr. Michael E. Auer,
IAOE / IFEES

Keynote 2
Dr. Amal Kasry,
UNESCO

45,000+ Livestream listeners.

Smart Agriculture Development Strategy

A. China Agri Situation & Smart Agri Strategy

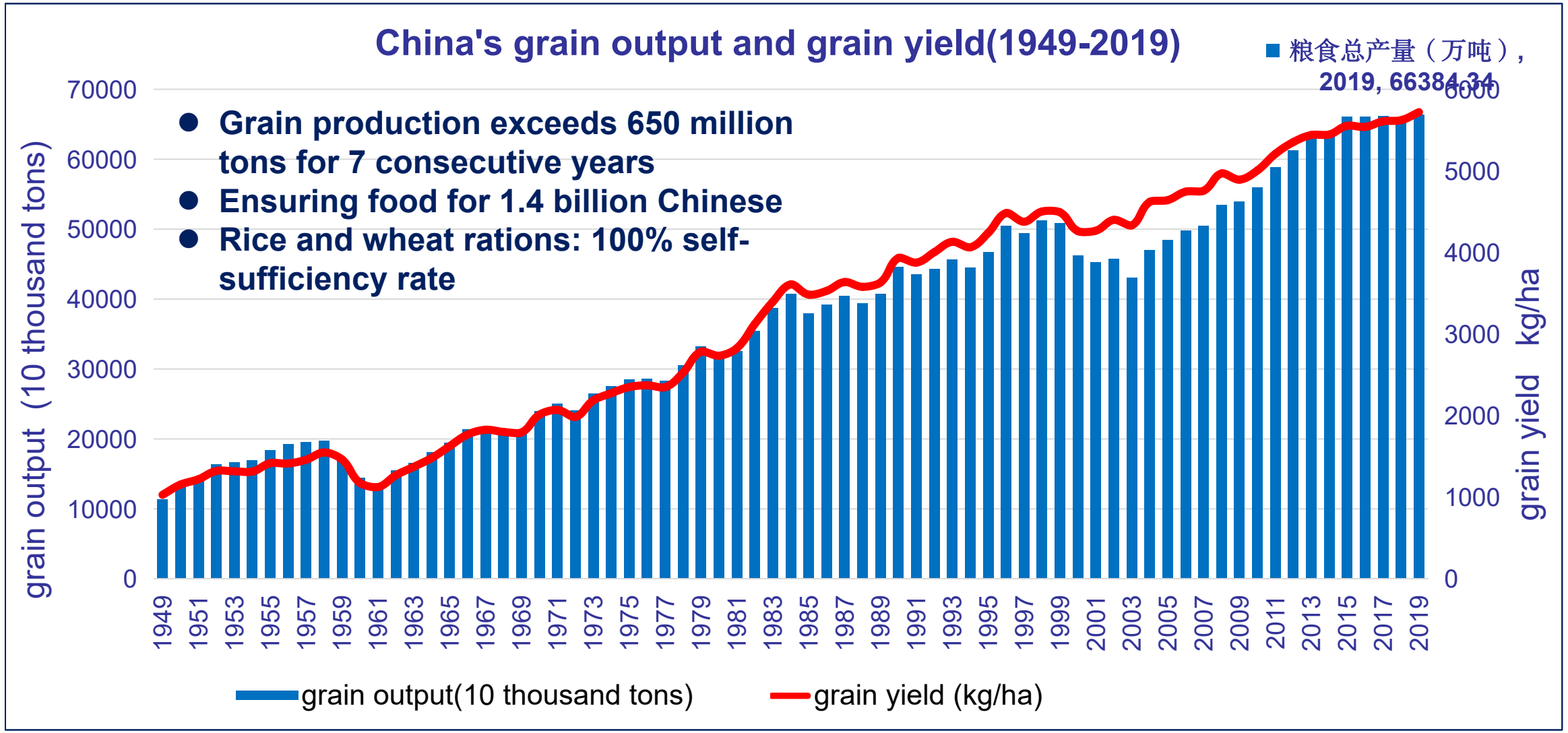
1. China Agri Situation
2. Smart Agri Development Strategy

B. Smart Agriculture Practice in China

C. Future and Prospects

By Dr. Chunjiang Zhao

1.1 Great achievements in China's grain production

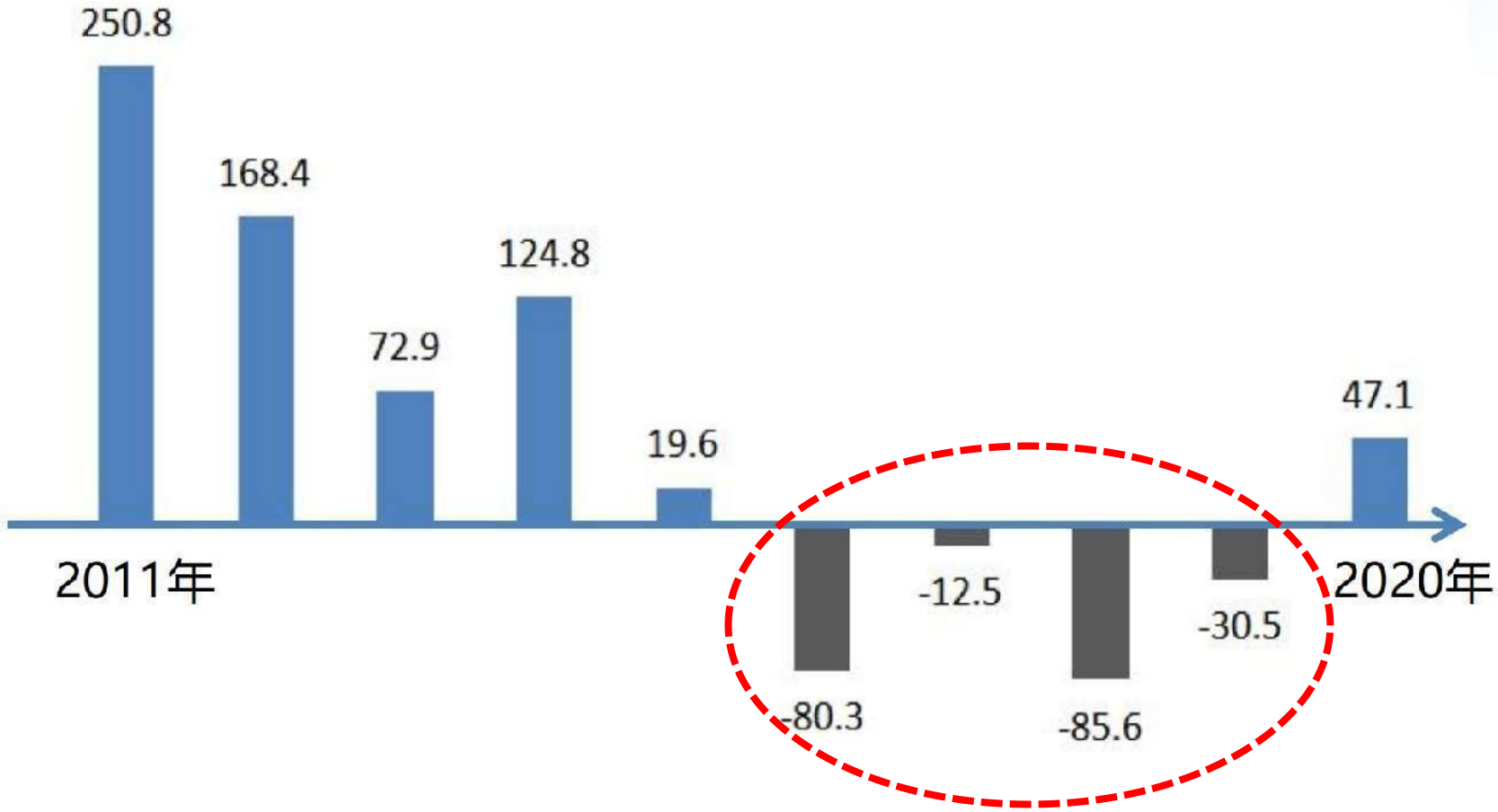


Data source: National Bureau of Statistics

1.2 Challenges facing China agriculture

- **Lower efficiency of resources**
  - N-Fertilizer use efficiency: **40.2%**
  - P-fertilizer use efficiency: **25.1%**
  - Pesticide Use Efficiency: **40.6%**
- **Small scale of farmers**
  - **210** Milion housholdings, **0.33**ha/per housholding
  - <**3.33**ha family accounted for **97%** with **82%** of farmland
  - Lower marginal benefit of investment
- **Urbanization result in reduction of rural labor**
  - 1991: rural labor **61%** of total
  - 2021: rural labor **25%** of total
- **Lower Agricultural machinization rate(2021)**
  - Crop production mechanization rate of :**71%**
  - Facility agricultural mechanization rate: **41%**
  - Animal husbandry Mechanization rate: **36%**
  - Aquaculture mechanization rate: **32%**

● lower economic income of famers



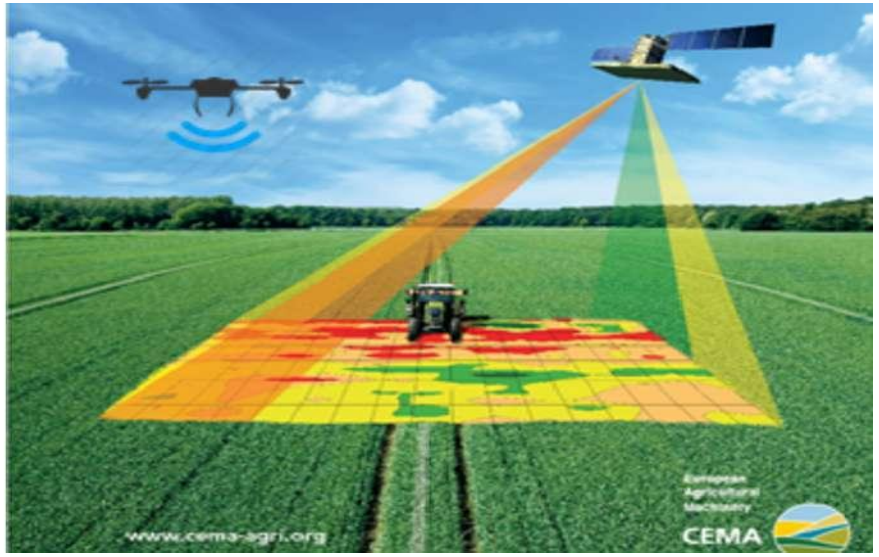
Net profit of China's three major grain crops (rice, wheat and corn, ￥/ mu ,2011-2020)

1.3 Smart Agriculture(SA) is one way for sustainablity

About Smart Agriculture

- Information perception
- Decision-making on big data
- Intelligent control & Precision input
- Personalized service

SA improving productivity & reducing negative impact inputs



- **climate change mitigation** (reduction of GHG emissions from agri practices and animal husbandry);
- **climate change adaptation** (to improve resilience of food production systems);
- **soil protection** (lower compaction, fertility restoration);
- **water protection** (quality & water resources);
- **reducing use of pesticides;**
- **protection of biodiversity** (maintenance and creation of landscape features);

2.1 China takes Smart Agriculture as the development direction of agriculture in the 14th Five-Year Plan

Smart Agriculture →

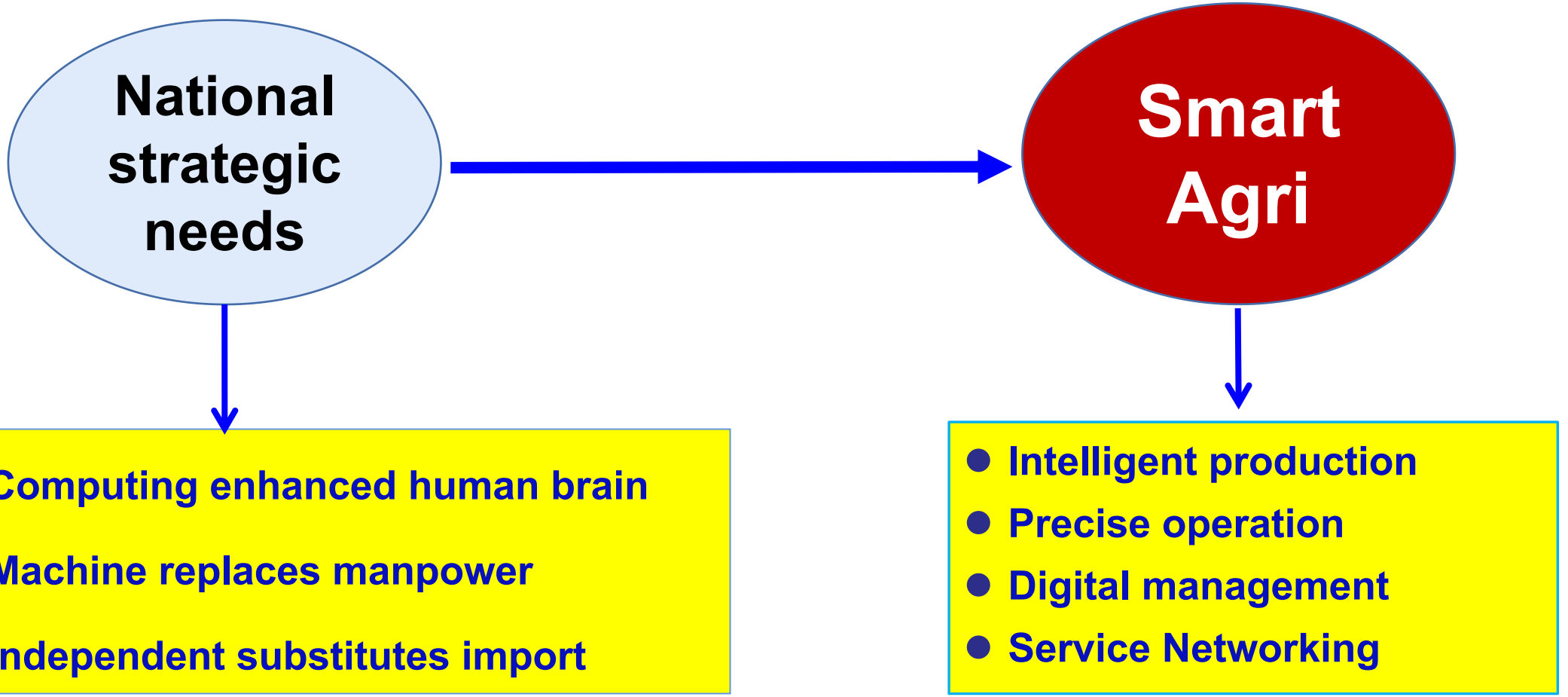
three transformations

- Traditional production method → high efficient green method
- Human and animal power → mainly machines
- Experience decision → big data intelligent decision

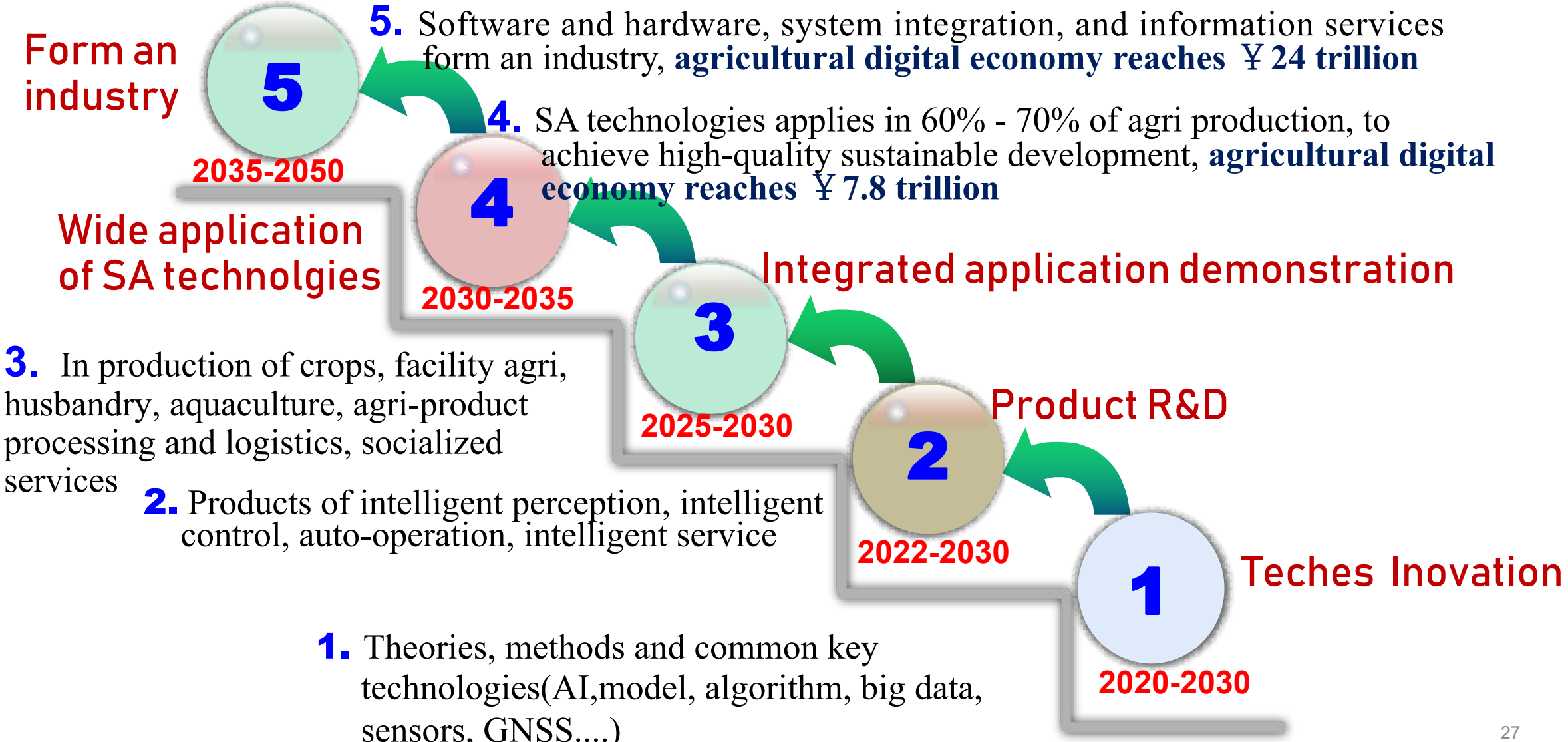
↓

Reform agri production mode, Promote high quality development

2.1 Strategic Objectives and Missions of SA



2.2 Road Map of SA in China(2020-2050)



2.3 China's Action to Promote Smart Agriculture

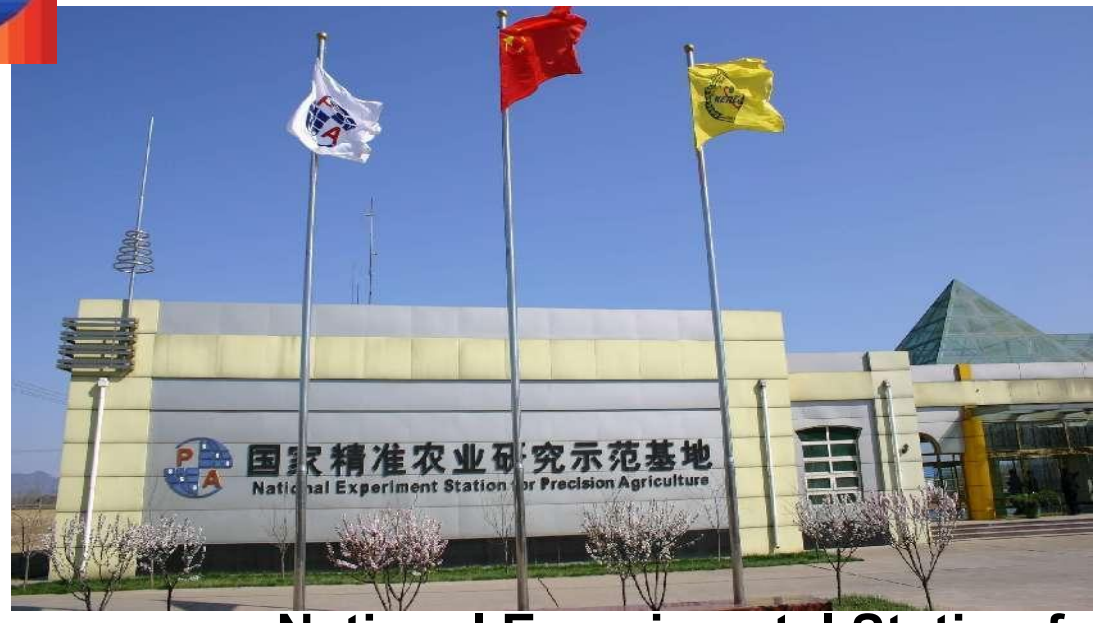
- **Evening Village Information Infrastructure:** 4G,5G,Iot,Big data storage and computing facilities;GNSS(BD)-CORS
- **Formulate standards and specifications**: data standards, sharing rules, product inspection and testing
- **Support Technological Innovation:** National Prgram of Agri. Science & Technology Innovation(Factory Agriculture and Intelligent Agricultural Machinery Project, ￥2 billion）
- **Application Scenario Driven:** Carry out application demonstration，explore application modes in different regions and production types
- **Talent team building**: building a multidisciplinary talent system，set up a smart agriculture major at the university，training farmers
- **Policy system guarantee:** policy subsidies to famers, produceres，farmers' professional cooperatives, application entities

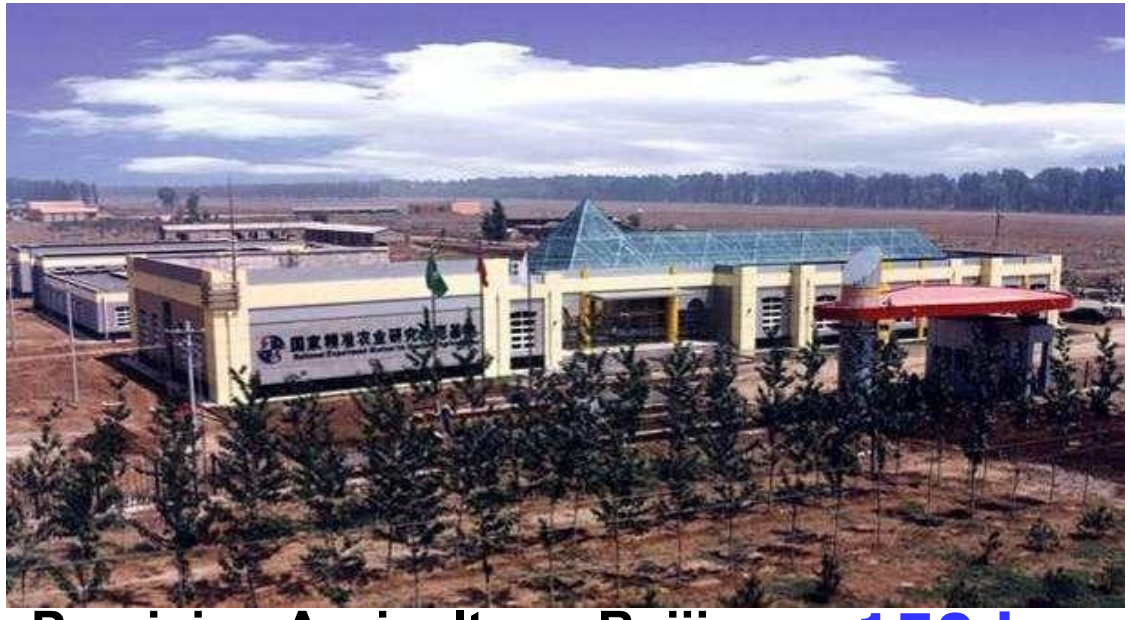
2.4 Application mode of SA technologies

Applicator	Technical application mode
Farmers Rural householders	Specialized information service mode: Establish extension and information service system for farmers, villages, towns and counties.
3.8million family farms 2.2mililion farmer cooperatives	Technology Packaged application mode: Choose combined application of technique suitable for a particular based on users' needs.
Large state farms Large agribusiness	Integrated Technology application mode: from information acquisition, decision-making, to precision operation, for large-scale farms and enterprises .

B. Smart Agriculture Practice in China

●China set up Smart Farming R&D& Demonstration Base

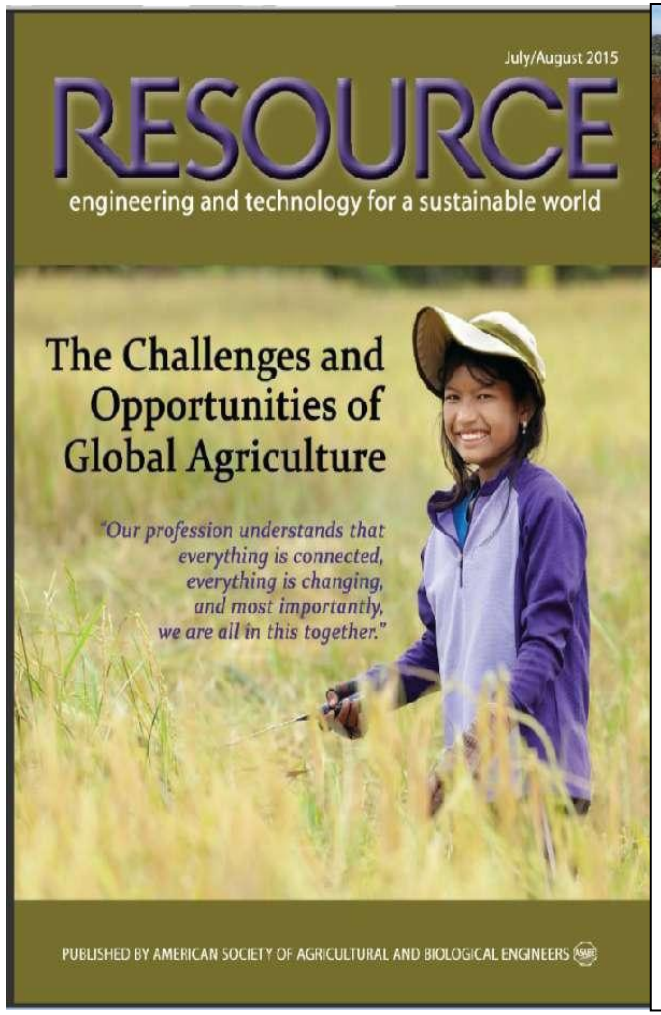


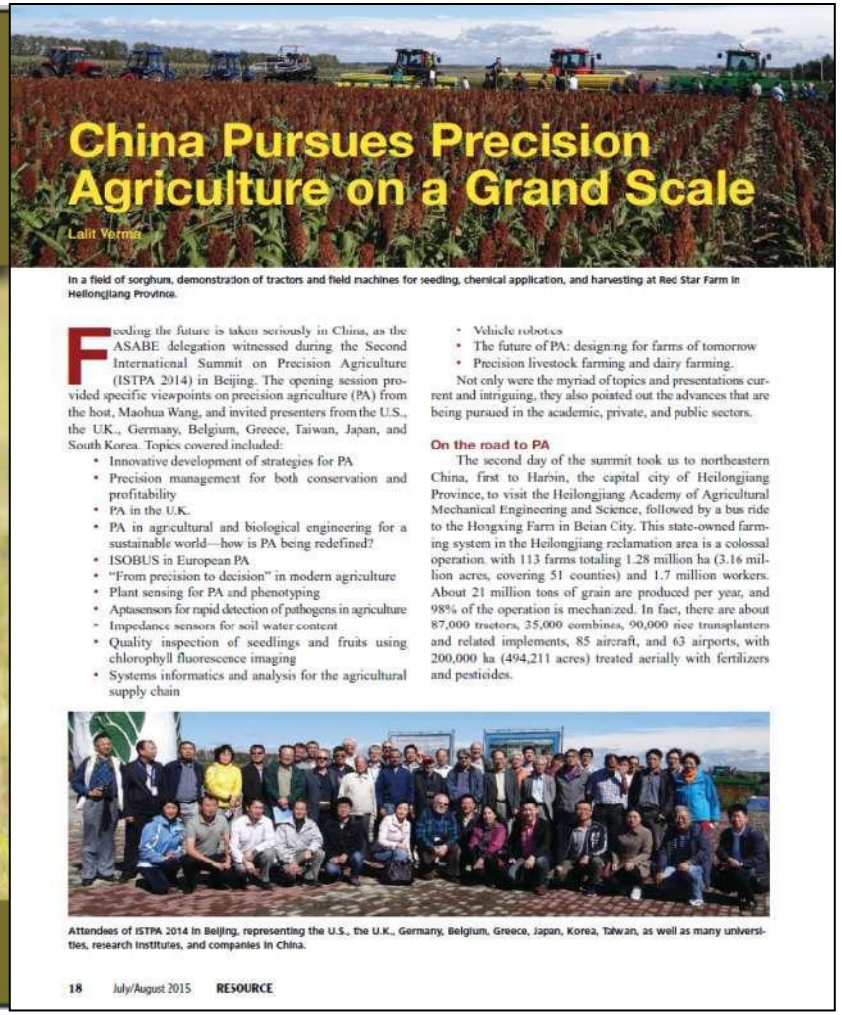


National Experimental Station for Precision Agriculture, Beijing **150 ha**

Batch Production line, Xiaotangshan Factory, NERCITA

Dr. Lalit Verma, the Former president of ASABE(American Society of Agricultural and Biological Engineers) visited NERCITA





China Pursues Precision Agriculture on a Grand Scale

Lalit Verma

In a field of sorghum, demonstration of tractors and field machines for seeding, chemical application, and harvesting at Red Star Farm in Heilongjiang Province.

Feeding the future is taken seriously in China, as the ASABE delegation witnessed during the Second International Summit on Precision Agriculture (ISTPA 2014) in Beijing. The opening session provided specific viewpoints on precision agriculture (PA) from the host, Maohua Wang, and invited presenters from the U.S., the U.K., Germany, Belgium, Greece, Taiwan, Japan, and South Korea. Topics covered included:

- Innovative development of strategies for PA
- Precision management for both conservation and profitability
- PA in the U.K.
- PA in agricultural and biological engineering for a sustainable world—how is PA being redefined?
- ISOBUS in European PA
- "From precision to decision" in modern agriculture
- Plant sensing for PA and phenotyping
- Aptasensors for rapid detection of pathogens in agriculture
- Impedance sensors for soil water content
- Quality inspection of seedlings and fruits using chlorophyll fluorescence imaging
- Systems informatics and analysis for the agricultural supply chain
- Vehicle robotics
- The future of PA: designing for farms of tomorrow
- Precision livestock farming and dairy farming.

Not only were the myriad of topics and presentations current and intriguing, they also pointed out the advances that are being pursued in the academic, private, and public sectors.

On the road to PA

The second day of the summit took us to northeastern China, first to Harbin, the capital city of Heilongjiang Province, to visit the Heilongjiang Academy of Agricultural Mechanical Engineering and Science, followed by a bus ride to the Hongxing Farm in Beian City. This state-owned farming system in the Heilongjiang reclamation area is a colossal operation with 113 farms totaling 1.28 million ha (3.16 million acres, covering 51 counties) and 1.7 million workers. About 21 million tons of grain are produced per year, and 98% of the operation is mechanized. In fact, there are about 87,000 tractors, 35,000 combines, 90,000 rice transplanters and related implements, 85 aircraft, and 63 airports, with 200,000 ha (494,211 acres) treated aerially with fertilizers and pesticides.

Attendees of ISTPA 2014 in Beijing, representing the U.S., the U.K., Germany, Belgium, Greece, Japan, Korea, Taiwan, as well as many universities, research institutes, and companies in China.

Verma (right) touring the China National Engineering Research Center for Information Technology in Agriculture (NERCITA)

The PA initiative in China began in 2000, when a Chinese delegation visited U.S. manufacturers, including John Deere and Case IH. China began importing U.S. machinery in 2001, and the concept of PA gained acceptance at the farm level just a couple of years later. Auto-guidance of tractors was the most accepted technology, as it increased efficiency by about 40% due to the higher precision. At the Hongxing Farm, all tractors larger than 200 hp now have auto-guidance.

In Heilongjiang Province, about 25% of the farmland is managed according to PA, which has resulted in greater yields and productivity. John Deere's GreenStar system, which depends on ground-level correction (GLC), is used. GLC has a 30 km radial coverage, and a network of GLC stations is being planned. This is just the beginning of the PA wave. Further improvements will include soil sampling and mapping, variable-rate application technology, and auto-guidance of all equipment. Yield monitors will help in identifying yield differences within and among fields, as one sample per hectare is insufficient for precision fertilizer applications. An increase in arable land will also contribute to yield increase, as the yield per unit of land has not increased yet.

A bottleneck appears to be the implementation of variable-rate technology in the field. Other elements that are still lacking include: field-scale comparisons of PA with the best practices of conventional farming, soil conservation and management practices, an organized schedule of projects to pursue from field experiments to commercial scale, life cycle analyses, agronomy-based inputs, as well as systems analyses, robotics, and optimization.

The Heilongjiang Province Agricultural Machinery Engineering Research Institute in Harbin is one of the entities providing technology for the China PA initiative. Others include the China National Research Center of Intelligent Equipment for Agriculture (NRCIEA), the China National Engineering Research Center for Information Technology in Agriculture (NERCITA), the National Research Center of Intelligent Equipment for Agriculture, the Chinese Academy of Agricultural Mechanization Sciences, and agricultural universities throughout China. China's investments in the PA initiative are impressive, and they are bearing fruit. At the same time, targeted technical conferences and R&D programs at universities and institutes are ongoing.

NERCITA was established in 2001 and now has approximately 300 researchers in its 100,000 ft² facility. NERCITA has also established a 167 ha field site for PA research and demonstrations near Beijing. It has developed large-scale intelligent agricultural implements, a GPS base station, a monitoring station for soil conditions, greenhouse control systems, and a platform for precision fertilization and pesticide application testing—as well as other technologies that are now widely used in China. NRCIEA was established in 2009 to conduct research and development in intelligent agricultural equipment and to establish a digital design and testing platform. Alone, these two entities—charged with providing research, design, development, and manufacturing support for intelligent mechanization—demonstrate the level of commitment to PA in China.

The First International Conference on Smart Agriculture Innovative Development (ICSAID 2014) followed ISTPA 2014 during the 18th World Congress of CIGR in Beijing. The CIGR Congress was an impressive showing by our Chinese hosts. The events also allowed ASABE leadership and academic administrators to interact with their counterparts and tour the facilities at China Agricultural University. These interactions richly contributed to ASABE's Global Engagement Initiative and reinforced the global importance of our profession.

Feeding the world in 2050 will greatly depend on the successful adaptation of PA technologies. However, systems that are successful on a large-scale in the developed world will need to be modified using appropriate technologies for application in developing regions that have more constrained resources. The PA initiative in China is a case in which abundant resources—natural, financial, and intellectual—are readily available. Other developing regions do not necessarily have such wealth and will need outside assistance to improve their productivity while sustaining their environment.

That's where we come in. Agricultural and biological engineering is essential for producing more food with the least inputs, and providing this food to the people who need it most. Feeding the future is the grand challenge, and ASABE and our profession have a central role in meeting this challenge.

ASABE Fellow and Past President Lalit Verma, Professor and Head, Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, USA, lverma@uark.edu.

3.1 Sensor for Smart Agri

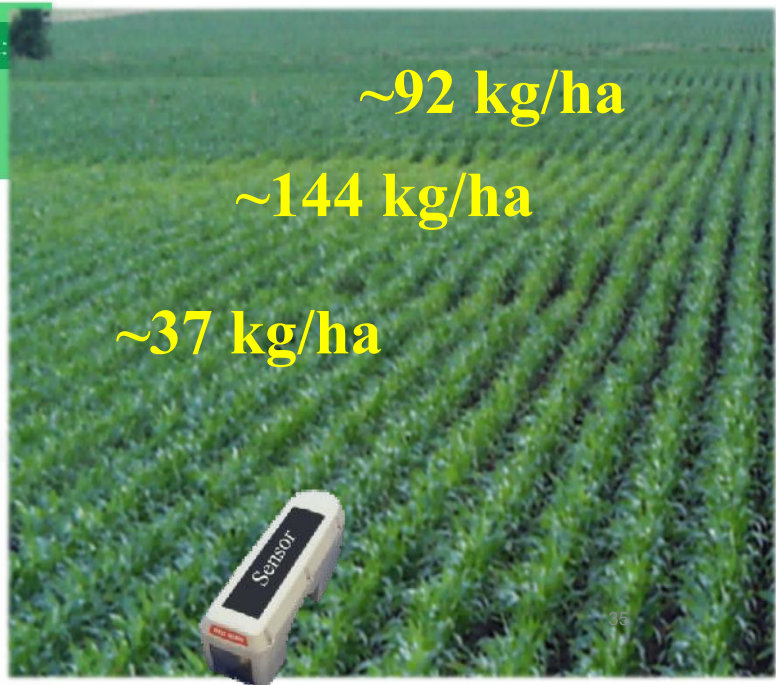
Soil nitrogen sensing using LIBS by NERCITA

Nitrogen sensor

prototype

- Soil total nitrogen(error≤ 6%)
- Soil available nitrogen(error≤ 8%)

● Crop Canopy Nitrogen Sensing



3.2 Beidou GNSS

Display

- Navigation Path Planning
- Human-computer interaction
- Navigation job status display

satellite receiving antenna

- Satellite positioning signal reception

satellite receiver

- High precision positioning
- Tractor heading and attitude determination

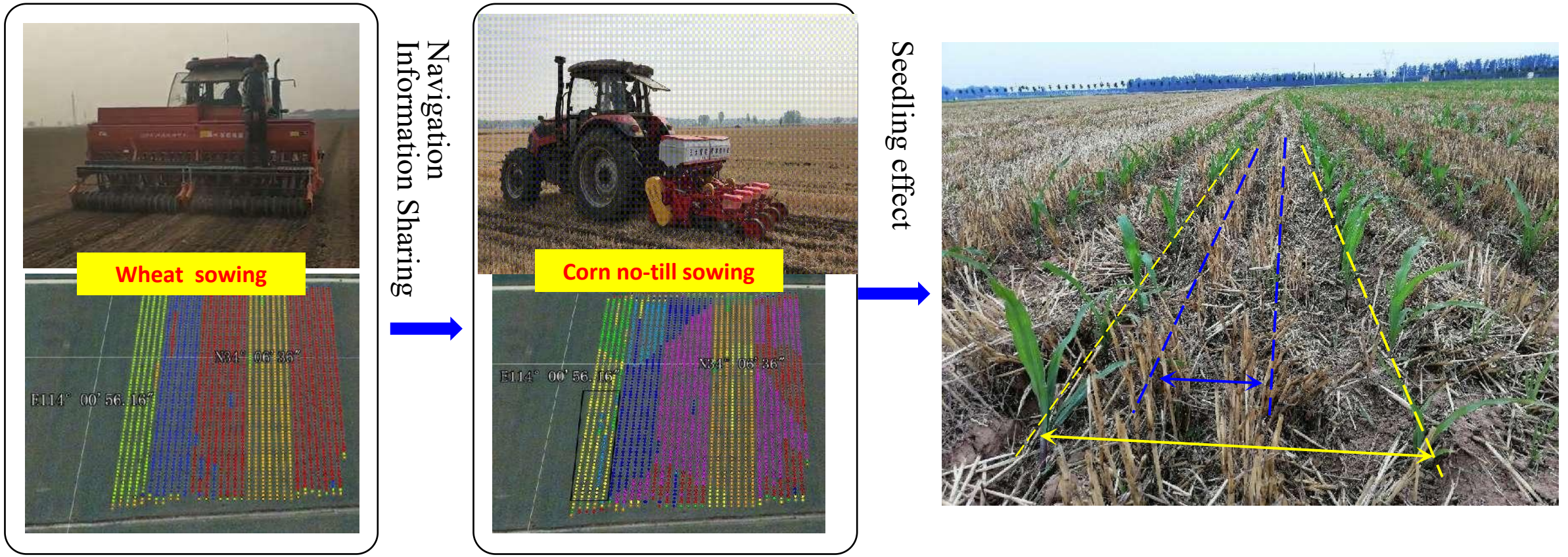
Electric steering wheel

- DC torque motor
- Realize automatic steering operation

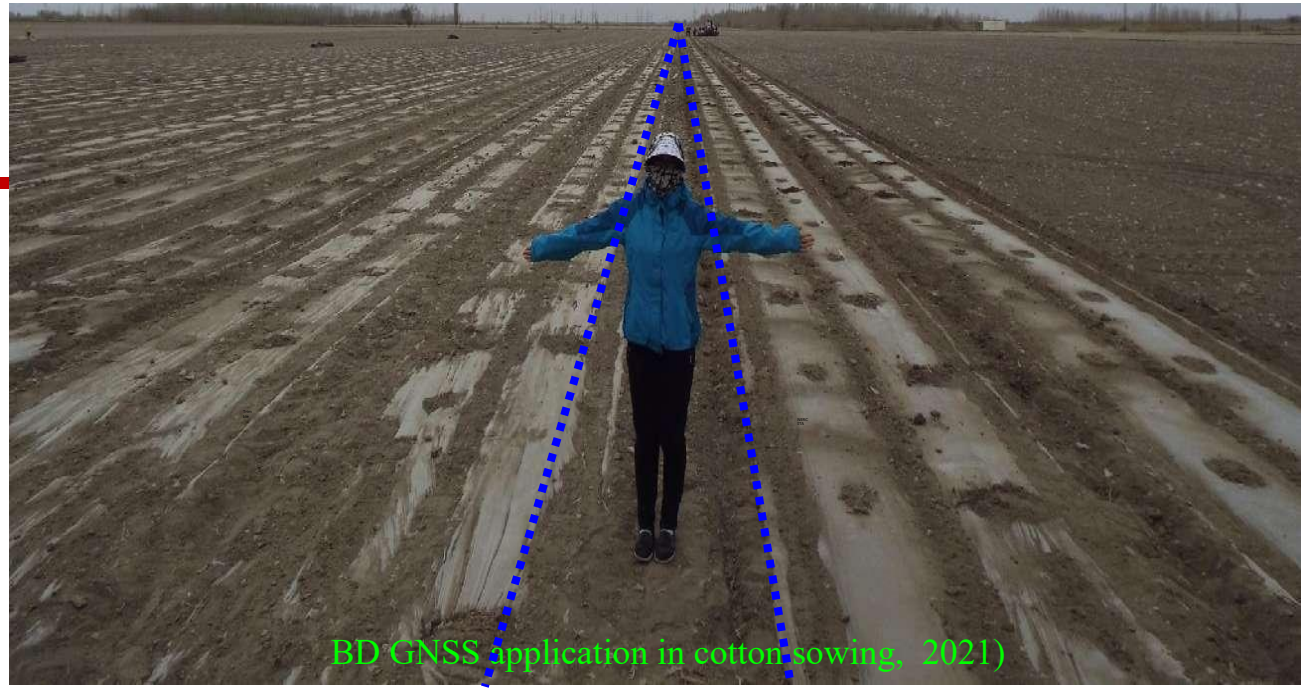
Angle sensor

- Real-time measurement of steering wheel angle

● BD-GNSS based corn sowing of wheat-corn cropping system



Ensure corn emerging

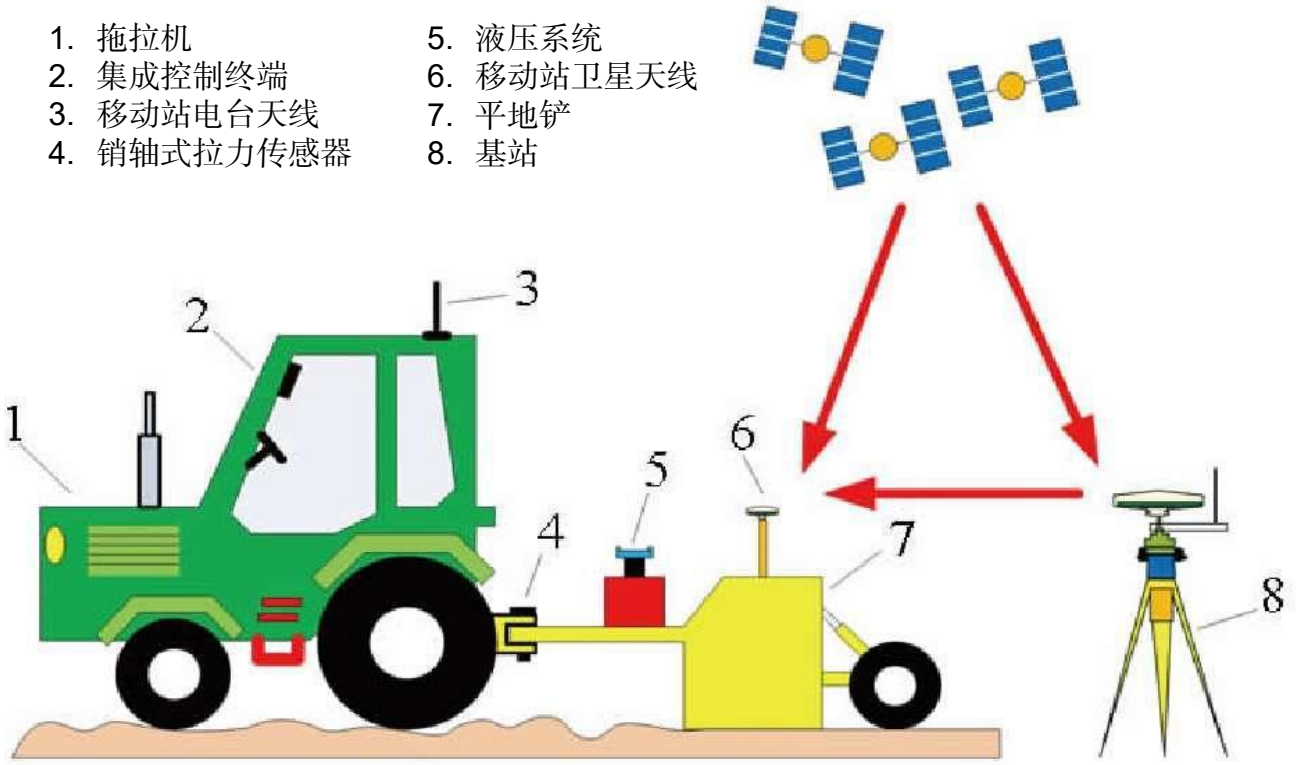


BD GNSS application in cotton sowing, 2021)

for more accumulated temperature, working at night by BD GNSS , 2021)

Land Leveling based on BD-GNSS

1. 拖拉机
2. 集成控制终端
3. 移动站电台天线
4. 销轴式拉力传感器
5. 液压系统
6. 移动站卫星天线
7. 平地铲
8. 基站




雷沃 M 1354

BD GNSS application in agri production

wheat

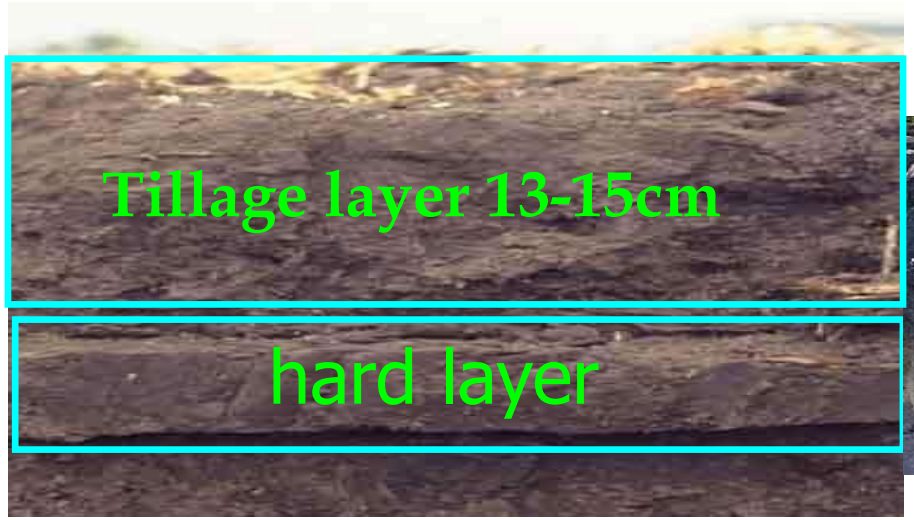
corn

cotton

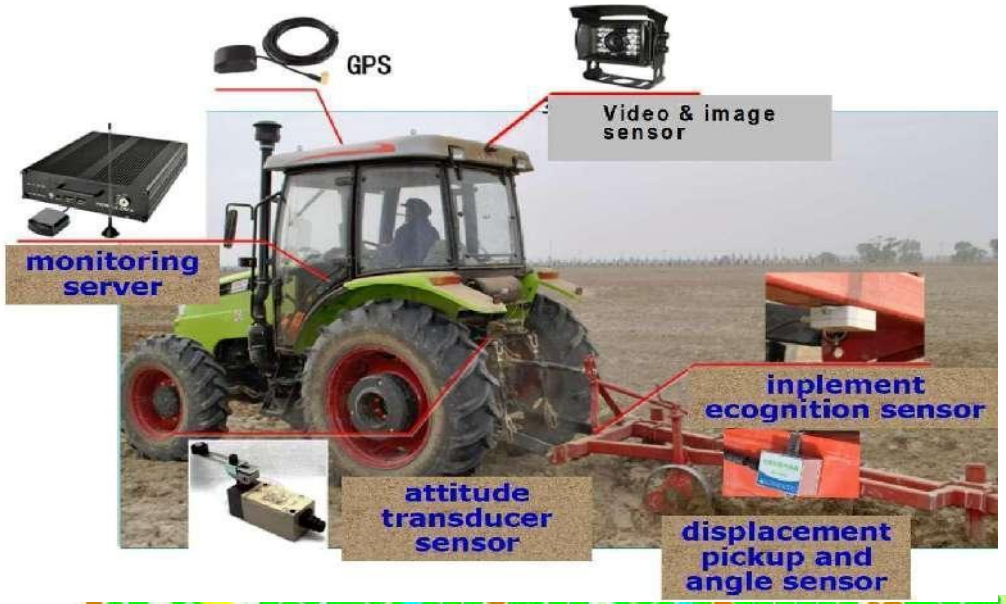
rice

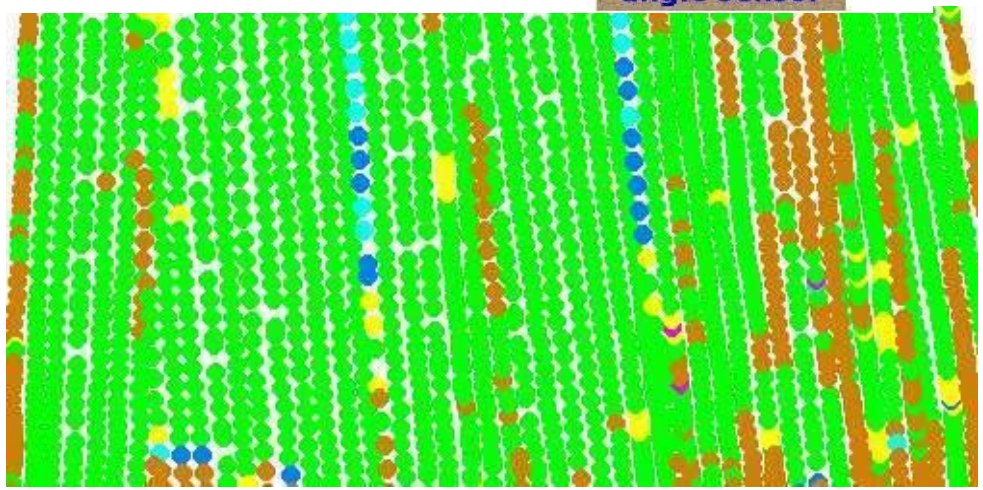
3.3 Farmland Subsoiling Mornitoring

- Hard soil layer at 15-20cm
- Breaking hard layer benefit crop growing
- by IOT of Ag-machiney to monitor
  - To install sensors in ag-machinery
  - By network (wireless & internet) to conect
  - To transfer real time data to Data center
  - To serve the machine owner, operator and provider



Tranditional VS Subsoiling Monitoring





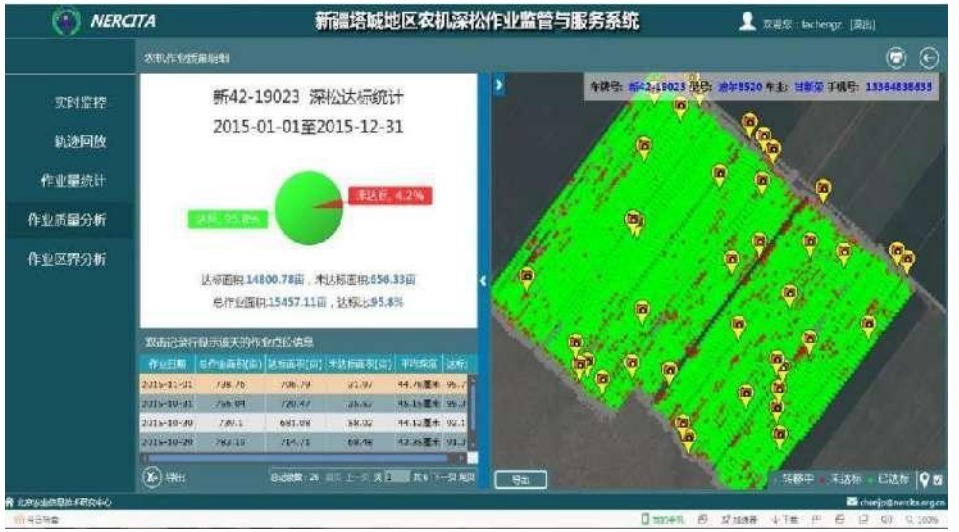
Mengcheng County, Anhui Province

Subsoiling Monitoring System

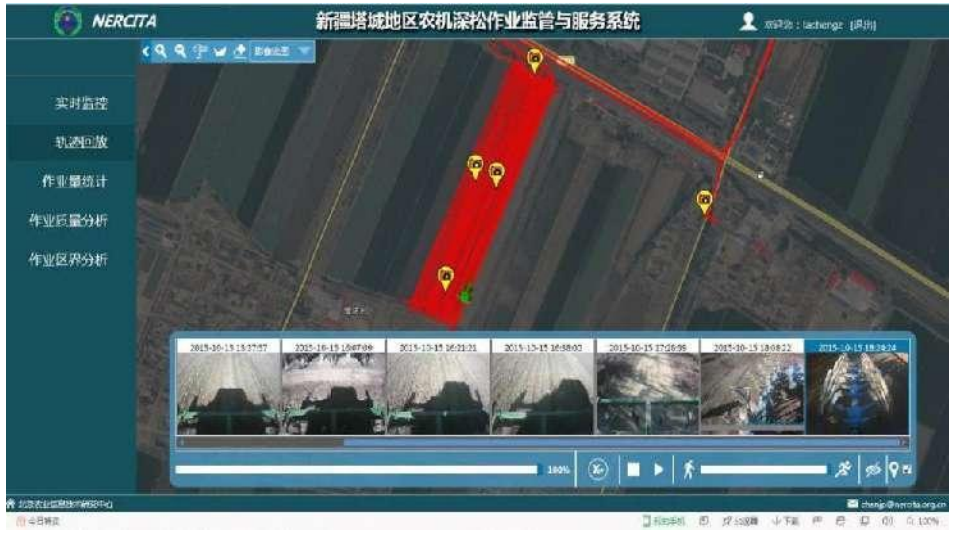
Using cloud computing technology

Provide five cloud services

Real-time monitoring for subsoiling



Analysis of operation quality



Tracing of your machine

Area of subsoiling operation

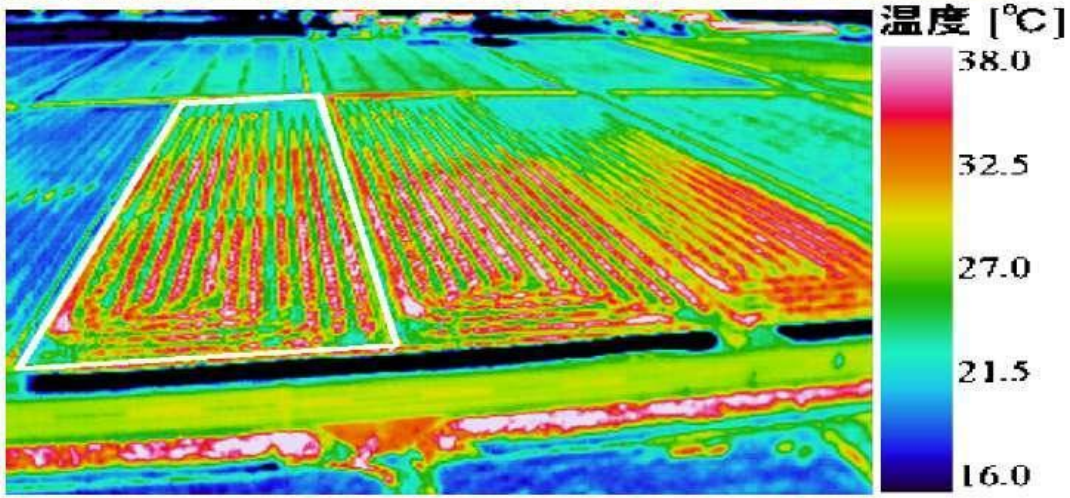
3.4 UAV &RS for Smart Agri

Hyper spectral imager self-developed

parameter	self-developed	SOC710GX
work form	line scan	line scan
band width	413-828	400-1000
spetrum resolution	2	4.2
band number	360	120
data bit	16-bit	12-bit

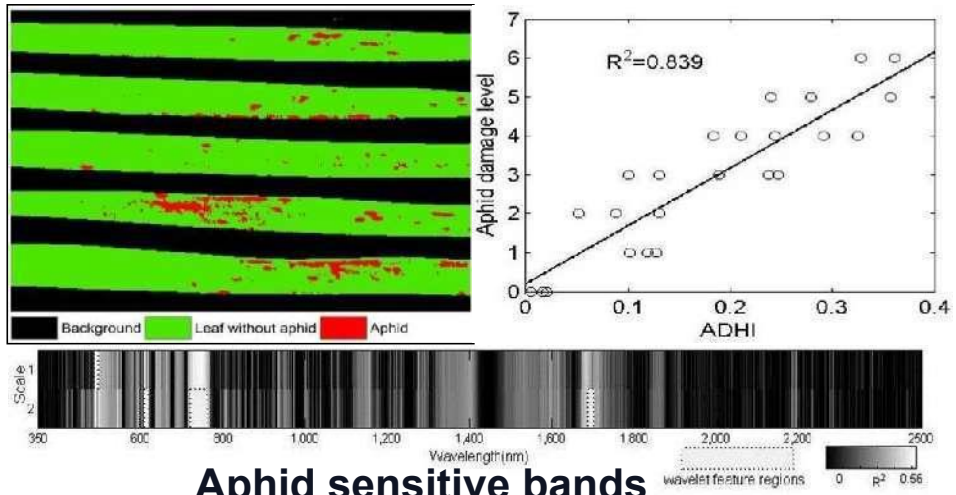
● UAV for crop monitoring

- Cultivar identification
- Growth monitoring
- Crop canopy temperature
- Crop BIOMASS
- Crop LAI
- Plant height



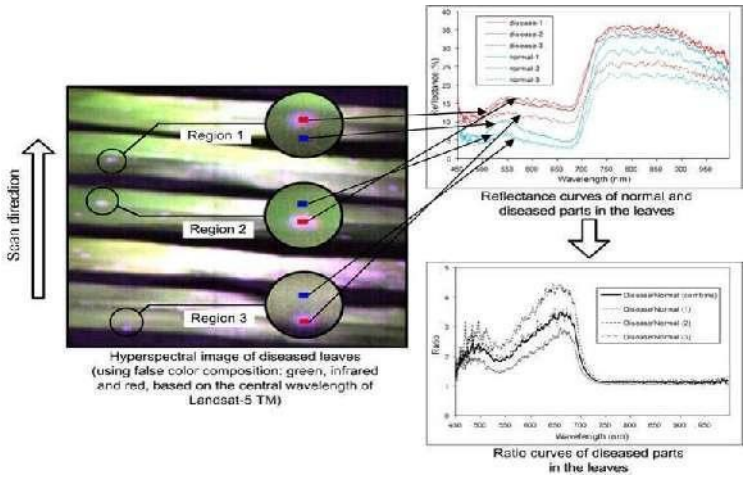
RS: Monitoring of crop diseases and pests

Constructing hyperspectral aphid index

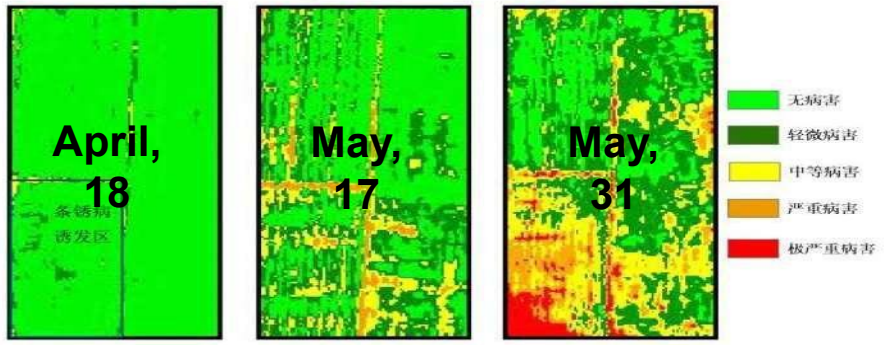


Aphid sensitive bands

Hyperspectral imaging analysis for powdery mildew detection

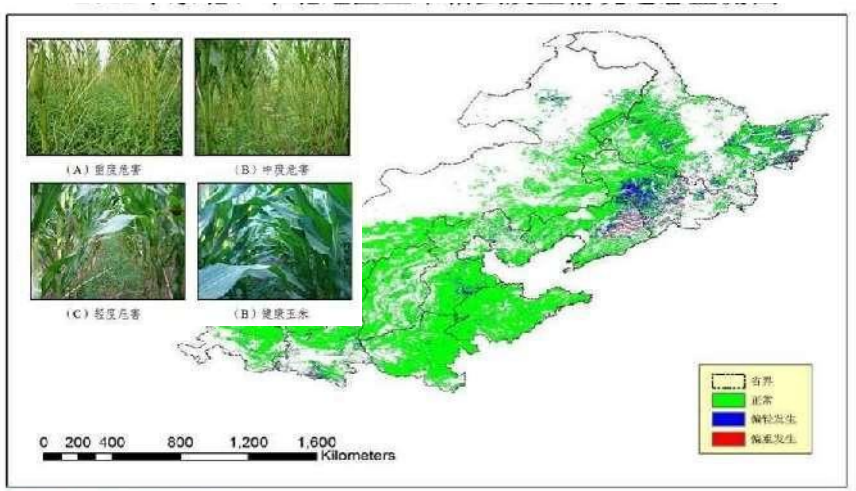


Yellow rust mapping by hyperspectral imagery

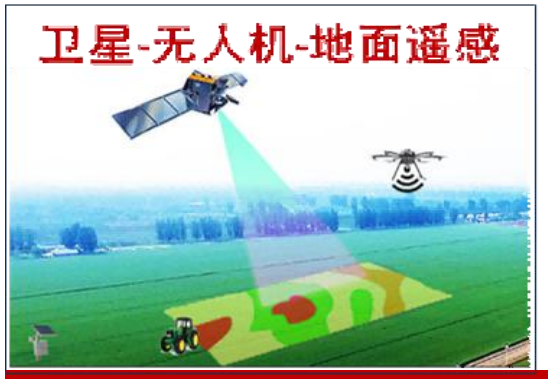


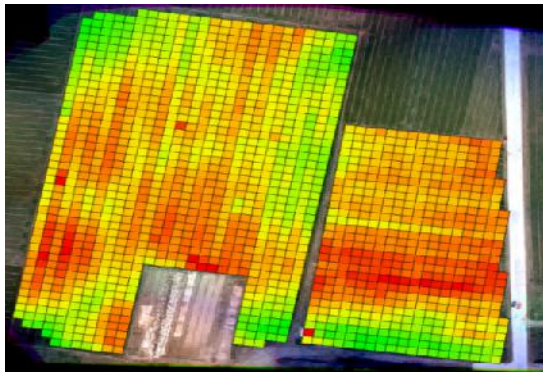
$$\text{病害光谱指数} = \frac{Red_{Disease} - Red_{Normal}}{Red_{Normal}} \times \frac{NIR_{Normal} - NIR_{Disease}}{NIR_{Normal}}$$

Monitoring of maize armyworm at regional scale

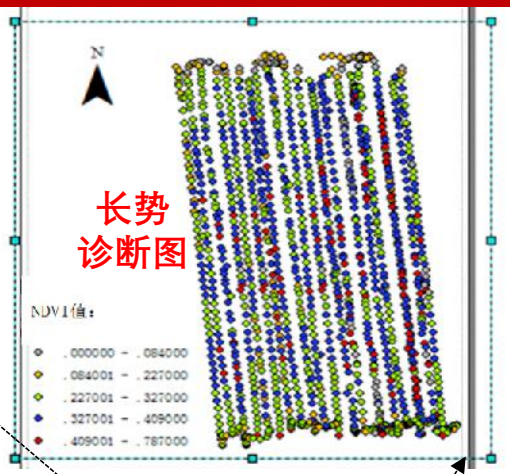


制图单位：北京农业信息技术研究中心　数据源：2012年7-8月MODIS影像　制图日期：2012年8月16日

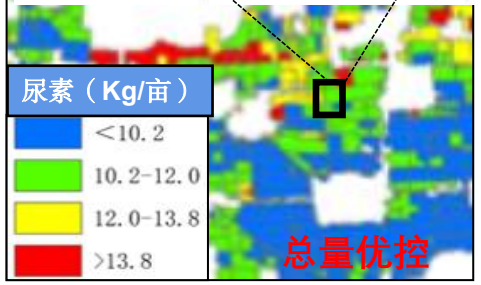




大底方 ✚ 小处方



$$\nabla_\theta J(\theta) = \nabla_\theta \left(\frac{1}{2} (X\theta - y)^T (X\theta - y) \right)$$



RS for Precision fertilization

Smart Farming, Field day, Hebei Province

3.5 Intelligent agricultural machinery

Combine harvester made by YTO Group Corporation

—General Secretary Xi Jinping，HLJ,2018

New energy powered unmanned tractor of YTO

Smart Farming Field Day, HongXing State Farm,HLJ province

3.6 Intelligent Information Service

Big data analysis mining

Knowledge
E-books,disease map and live video

Reporting service content

Service log

Exchange group

discuss Production problems

online reference

Q & A

Intelligent voice

Disease identification

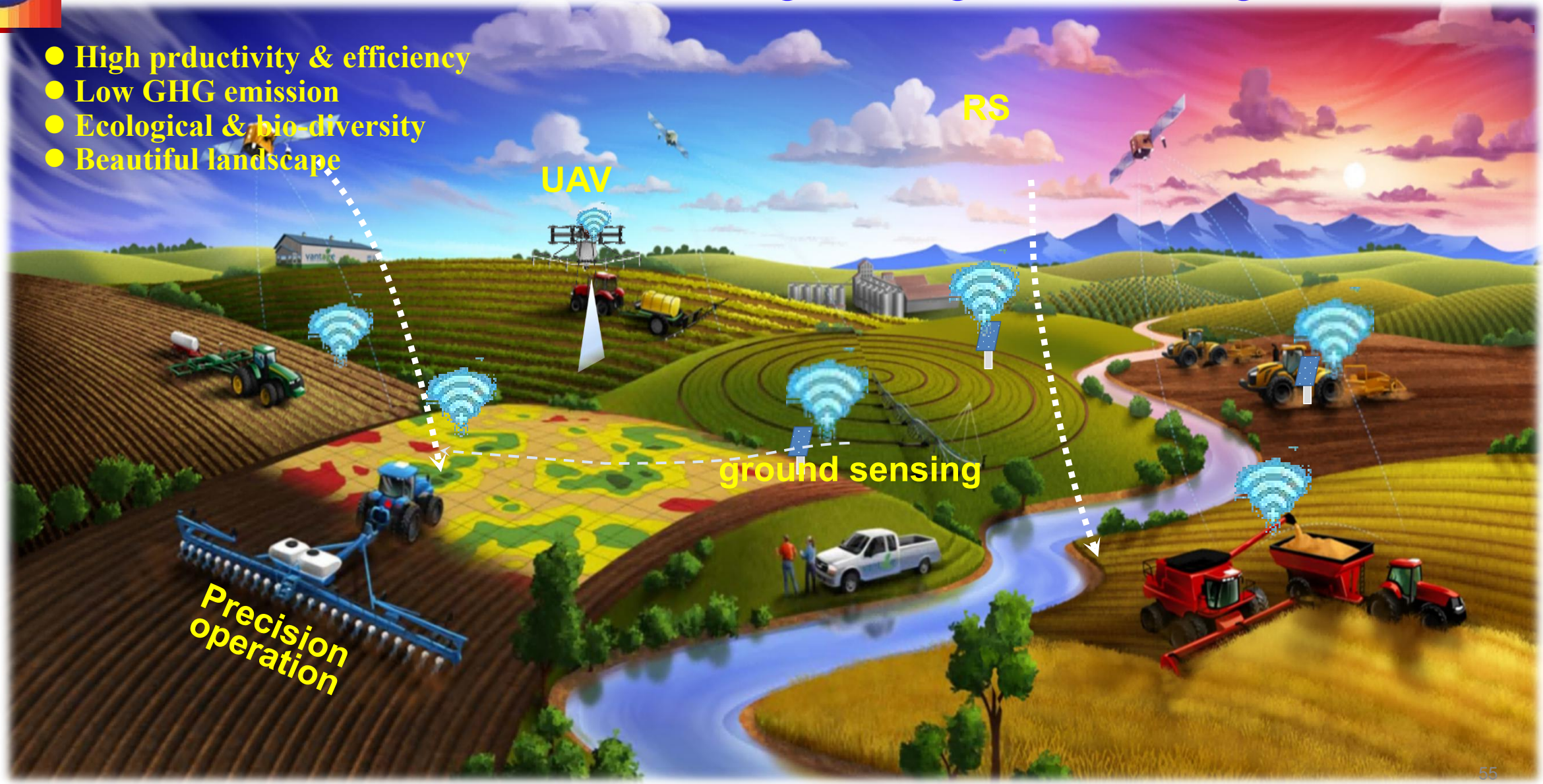
Answer questions anytime, anywhere

Self identifying crop diseases

Agricultural Technology Extension

C. Future and Prospects

Smart Farming & Digital Village



THANK YOU