



Potato R&D Models to meet future food security needs

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Outline

1 Potato Production in China

2 R&D Model: CARS-potato

3 CARS-potato's Contribution

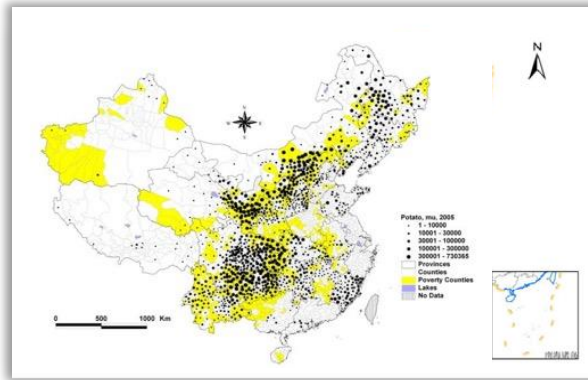


Potato's role in China

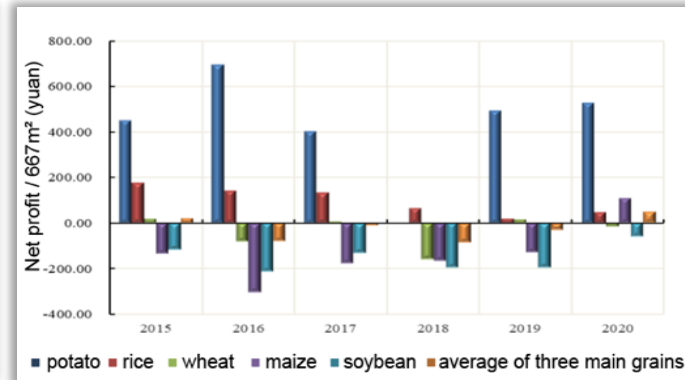
- Potato is considered as a main food, vegetable, feed and processing raw material crop in China.
- Potato industry also help alleviate poverty, improve food security, and increase income for farm households. Potato industry help 5.71 million people in poverty-stricken counties in 2023.



Potato foods in China



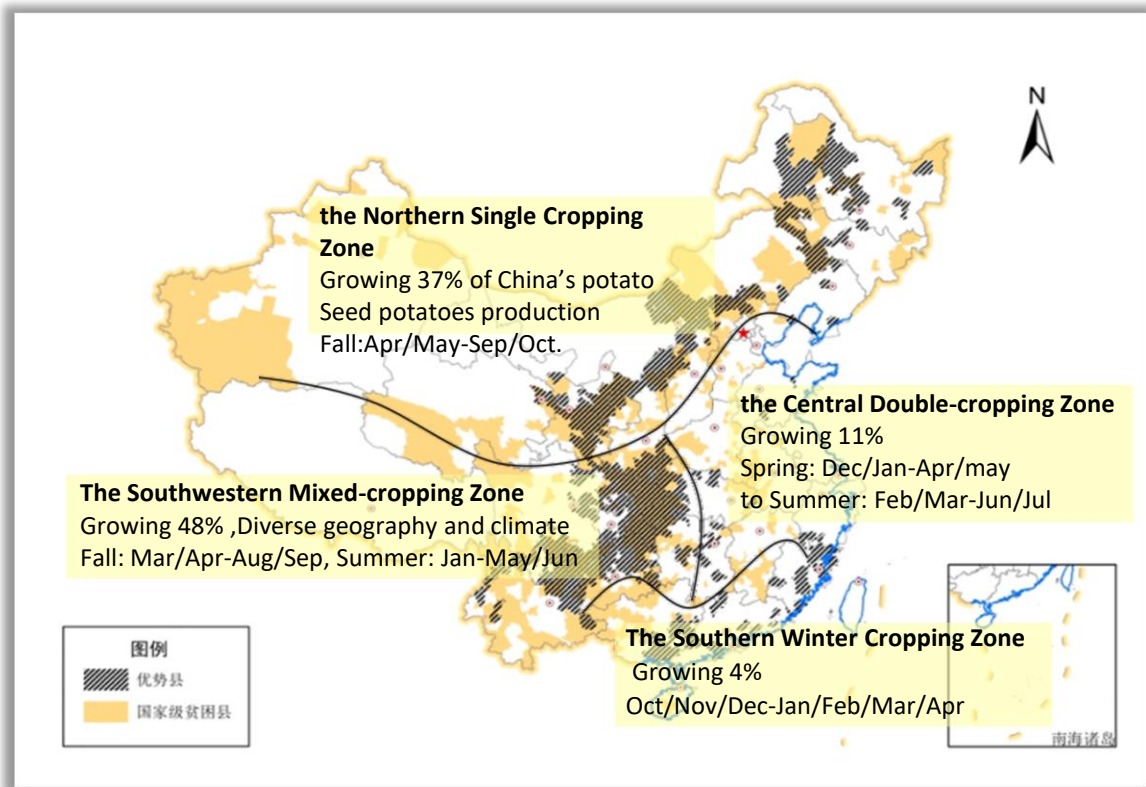
Distribution of potato growing and former poverty county



Net profit per MU from different major crops

Potato production in China

- Potatoes are widely distributed throughout the country in four agro-ecological zones
- The total acreage was 4.67 million hectare with a production of 96 million ton and a yield of 20.2 ton per hectare in 2022
- The area and total production accounted for 30% and 28% of the world respectively



Potato production in China

- 70% of potato area is in arid and semi-arid region where potatoes are grown in rain-fed fields. Plastic film mulching and water saving irrigation technologies are applied to keep soil moisture and collect limited rainwater for crop growing.
- Autumn is the main harvest season in the northern and south-western regions of China where single crop is planted. Potatoes are also interplanted with other crops in the south-western areas.



Potato production in China

- Summer potatoes are grown in plastic greenhouses, or covered by plastic film in the Central Plain, and harvested early summer to gain better profits from markets.
- Winter potatoes are produced in winter fallow paddy rice fields in Southern and lowland in South-western China.



Potato production in China

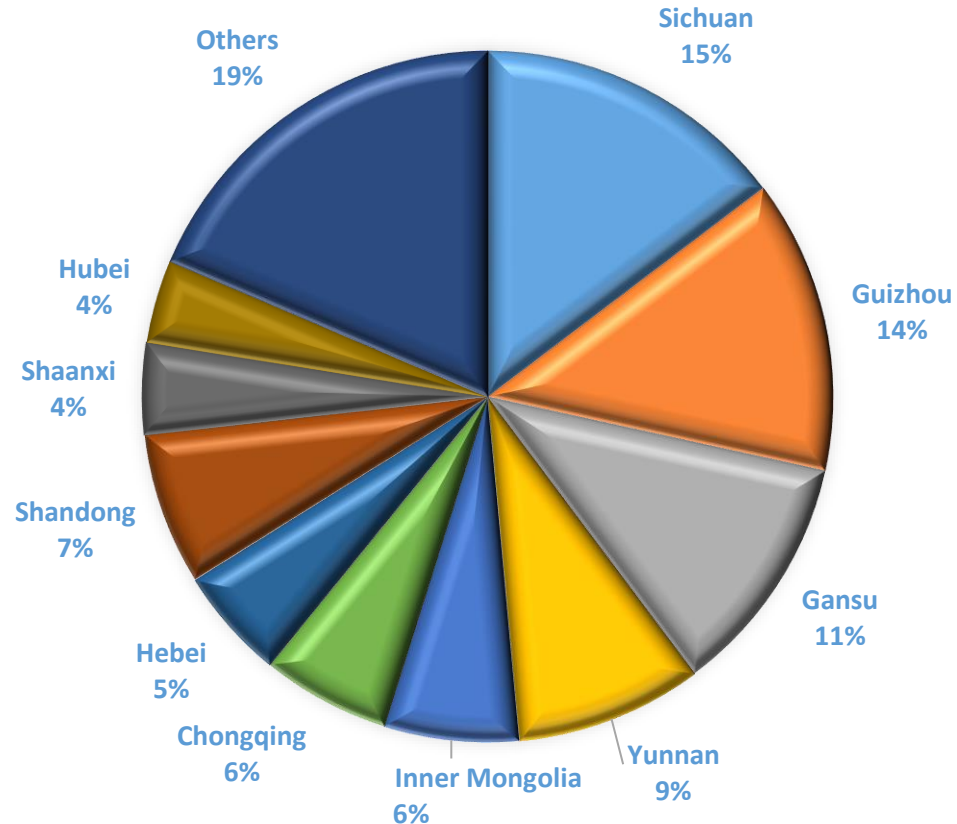
- Potatoes are grown mainly by small farmers. In recent years, however, mechanized farms are developing quickly in the north, e.g. in Inner Mongolia



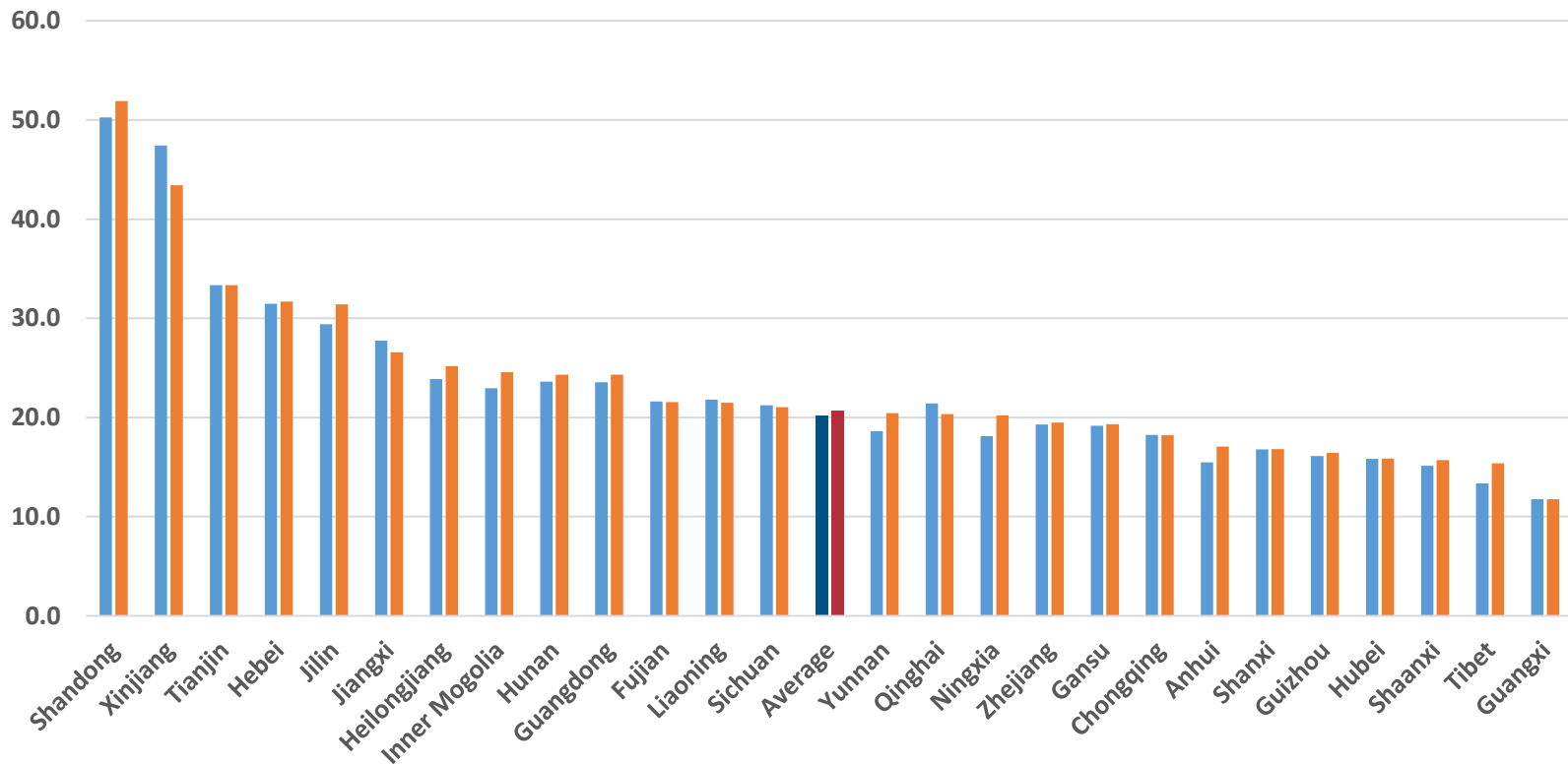
Main potato producers in China

PERCENTAGE OF TOTAL PRODUCTION

- Potatoes are mainly produced in the provinces of Sichuan, Guizhou, Gansu, Yunnan, Inner Mongolia, Shandong and Chongqing, etc.

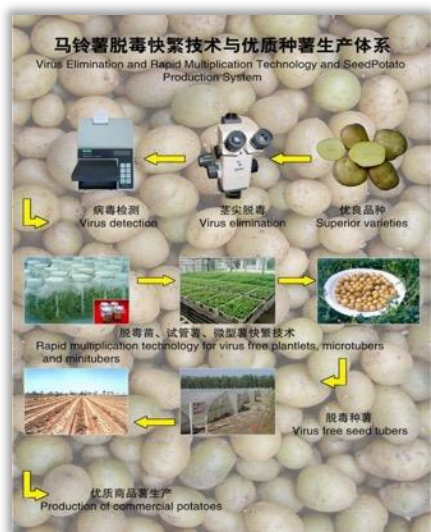


Yield various in provinces in 2021 and 2022



Seed potato production

- There is a formal virus-free seed potato production in China.
- There are about 300 private enterprises engaged in potato seed production.
- According to a survey, 3.5 billion virus-free minitubers produced in 2023.



Challenges of potato industry in China

- Lack of germplasm resources, varieties for processing, early varieties with good yield and tuber quality. Lack of quality supervision and certification for potato seed production.
- The growing season is generally severe with drought and water scarcity since most potatoes are grown on rain-fed plots in arid and semi-arid regions.
- Imprecise cultivation techniques with low efficiency of water and fertilizers, as well as with high level incidence of pests and diseases, and difficulty in mechanization of mountain slopes.
- Less than 15% of total production are processed, and with high cost of processing pollution treatments

GOC and GOP resources for potato R&D

- The Five-Year Key Research and Development Program
- Natural Science Foundation
- Potato R&D Center, China Agriculture Research System (CARS-Potato) since 2008.
- Key Labs for potato research
- Establishment of seed production bases, and seed potato quality testing centers etc.



Mission of China Agriculture Research System(CARS)

CARS has been founded by the MOF and organized by the MARA since 2008. It has 50 teams covering hundred of crops, livestock and aquatic products, and allocates scientists according to each product industry chain. The main tasks of CARS are:

- Gather high-quality resources around the priorities of each industry, cover all fields, conduct collaborative research, experimentation, integration and demonstration of key technologies to solve major technical problems across the entire industry chain
- Collect and analyze data and information of each industry, make R&D planning, carry out economic policy research, provide consultation for government decision-making, and information services to society
- Provide industry technology training and services for disaster reduction and emergency relief, rural revitalization, county economic development, enterprises, etc.

Operation and Management of the CARS

CARS Management Advisory Committee, Supervision and Evaluation Committee established by MARA, and Executive Expert Group(EEG) for each industry system



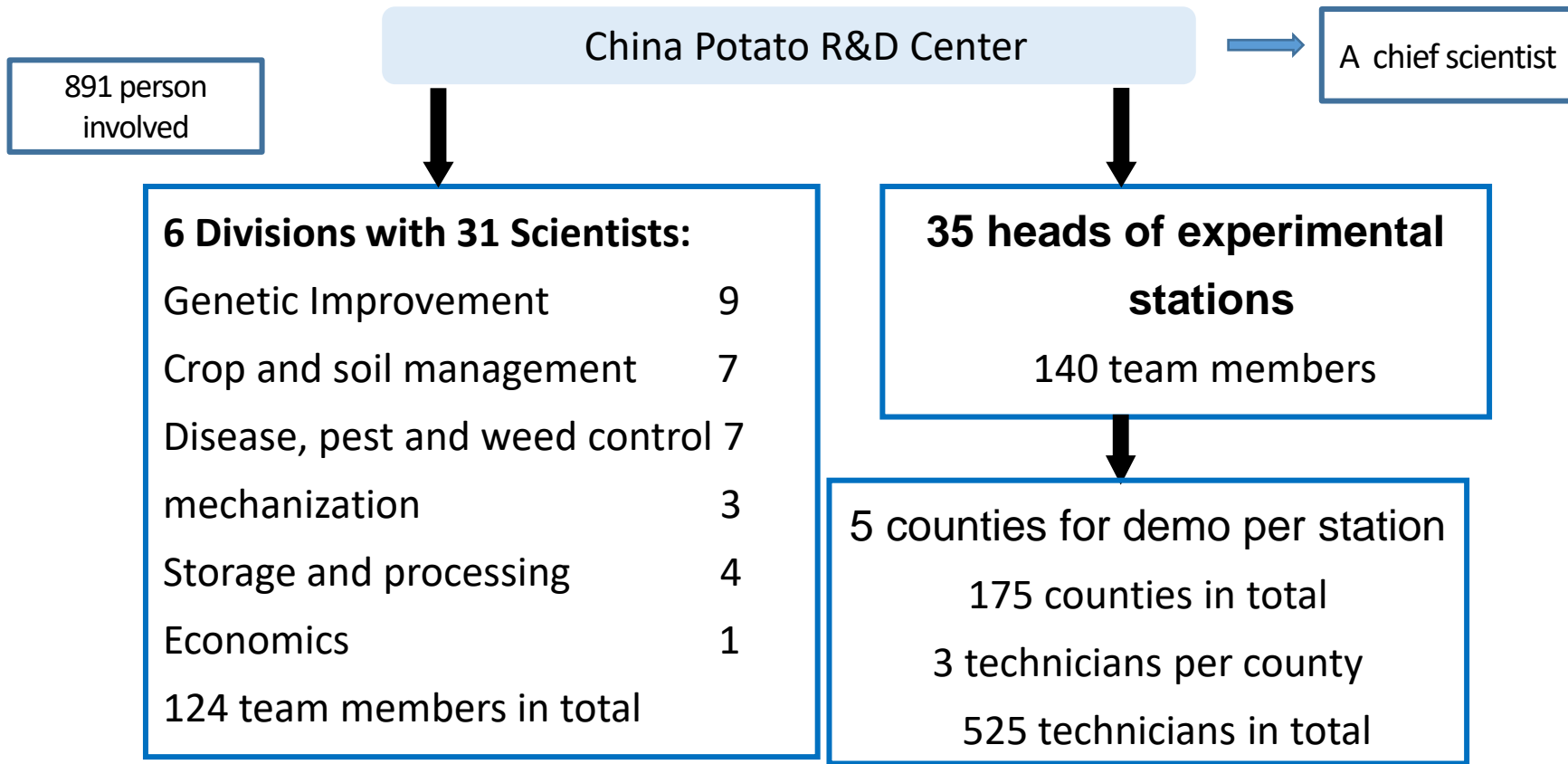
5 years per cycle,
Stable financial support,
Openness,
liquidity,
collaboration and competition

EEG proposes a 5-year and annual R&D plan for own industry, MARA will approve the plans only after being reviewed by the Management Advisory Committee.

The EEG decompose the plan to each scientist,
The chief scientist coordination to conduct joint R&D.

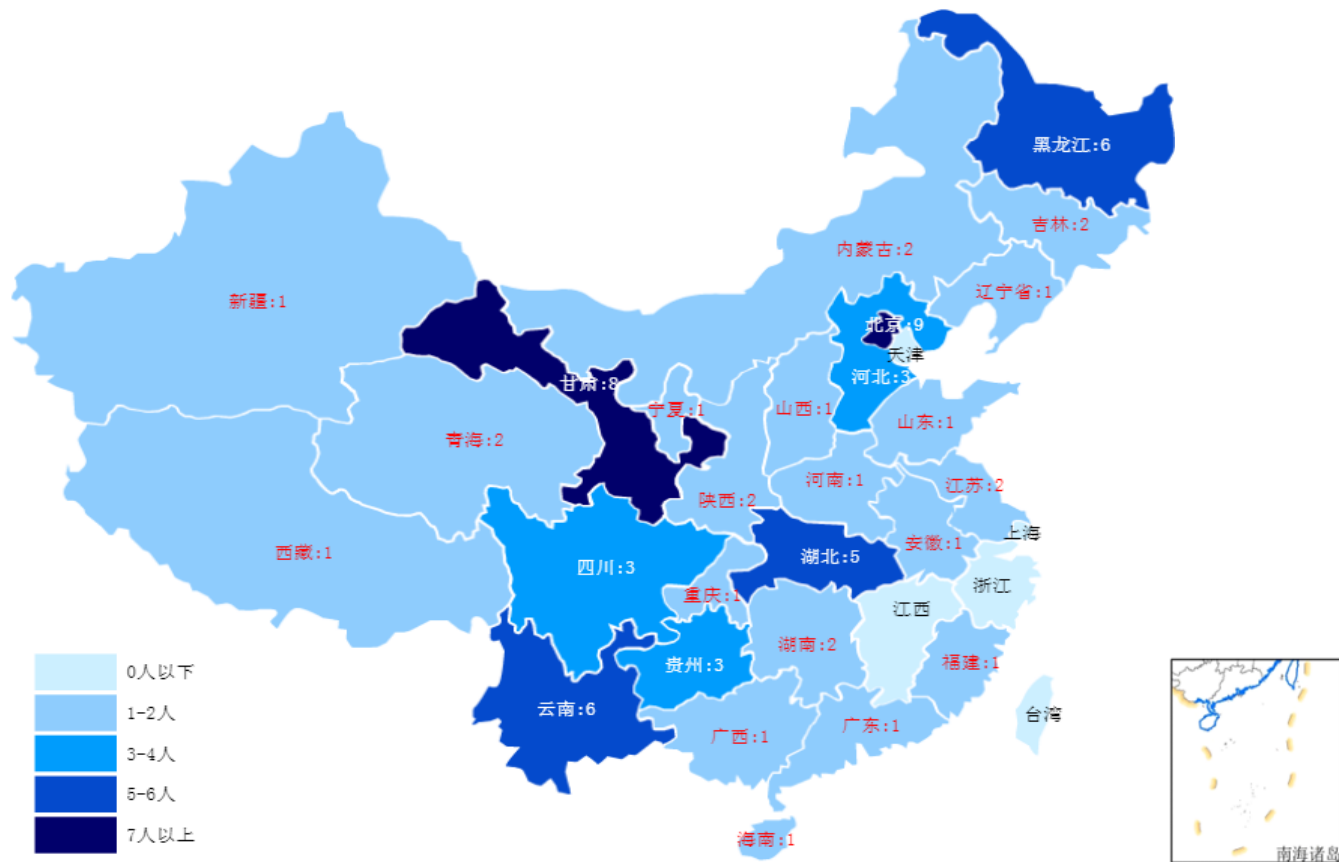
Th EEG is responsible for conducting annual and every 5 years evaluation within each industry system.

China Agriculture Research System-Potato(CARS-Potato)



Distribution map of the CARS-potato scientists

Every year, a 5 million USD budget mainly used for R&D experiment and demonstration, industrial assessment, technical training and service costs.



Research fields of the CARS-potato

- The CARS-potato focus on R&D of applied technologies for potato industry, including:
 - Germplasm innovation and variety development for tuber quality, resistance to biotic & abiotic stress, seed potato production technology
 - Precise management of crop and soil, especially water saving
 - Integrated control of pest, disease and weed
 - Field mechanization
 - Post harvest handling, processing and equipment
 - Tuber nutritional quality and food safety
 - Demonstration and delivery of new variety and technology to industry
 - Potato industry economics



R&D tasks of CARS-potato in different period since 2008

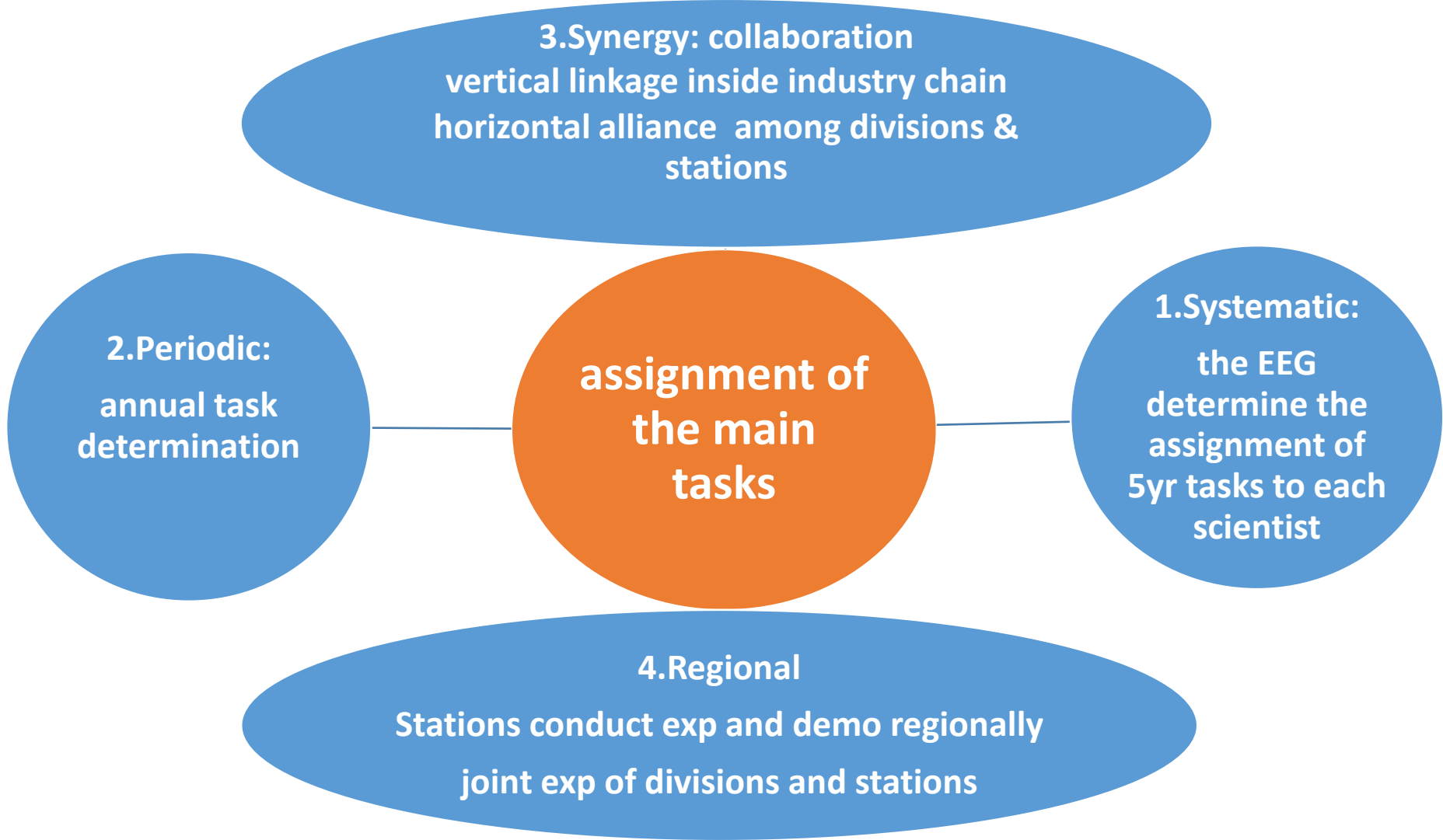
- During the '11th and 12th Five-Year Plan'(2008-2015), CARS-potato focused on yield improvement, disease early warning and control, processing waste treatment, and serve the technical needs of regional potato industry.
- In the '13th Five-Year Plan'(2016-2020), CARS-potato focused on technological issues for industry upgrading such as potato quality improvement, green production and efficiency increase, and helping poverty alleviation through science and technology



R&D tasks of CARS-potato in 14th Five-Year Plan(2021-2025)

- Solving the key technical issues to meet food security needs:
 - R&D and demonstration of key technology in genetic breeding and seed production
 - R&D and demonstration of dry farming green and intelligent cultivation technology
 - R&D of control technologies for late blight and soil borne diseases
- Serving the improvement of county economic and the empowerment of rural revitalization in main producing areas.
- Disaster and emergency technical guidance and training for production.
- Policy consulting and service
- Docking and serving the potato enterprises
- Construction of 28 industrial technology database





3.Synergy: collaboration
vertical linkage inside industry chain
horizontal alliance among divisions & stations

2.Periodic:
annual task determination

assignment of the main tasks

1.Systematic:
the EEG determine the assignment of 5yr tasks to each scientist

4.Regional
Stations conduct exp and demo regionally
joint exp of divisions and stations

An example of joint research in CARS-potato

Task 01A

1. Germplasm accurate evaluation and innovation

2. Efficient breeding technology and new variety development

3. Efficient seed potato production technology

4. Efficient new varieties supporting production technology

5. Integrate technology demonstration, application and radiation promotion

6. Application behavior of specificity and improved varieties

The Genetic Improvement Division, and the other Div. cooperate with the evaluation of resistance, storage and quality

The Crop and Soil M Division, and the other Div. provide varieties, pests control and mechanization

The stations conduct joint testing and demonstration, and the Div. provide new varieties and technologies

The Economics Division, and other experts assist in data collection.

R&D and demonstration of key technology in genetic breeding and seed production

CARS-potato's contribution to industry advancement

Overcome
technology
difficulties
and
support
industry
upgrading

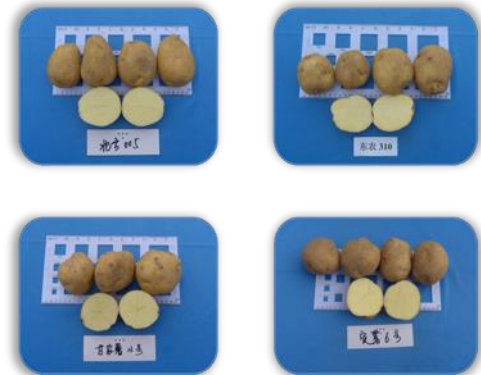
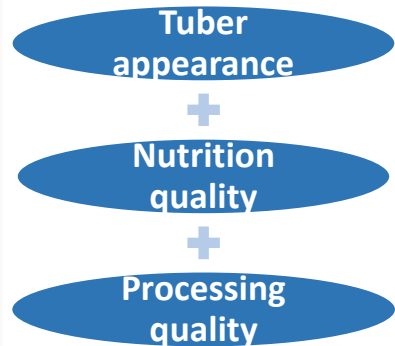
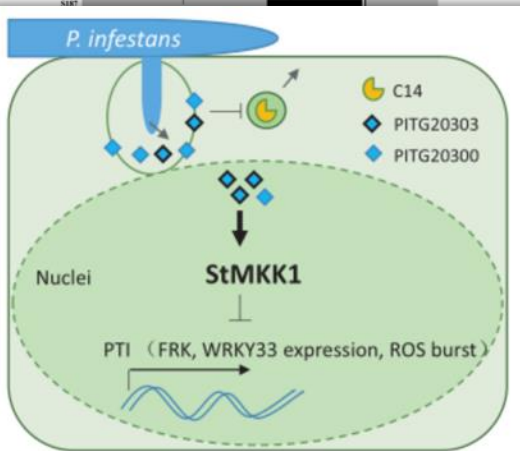
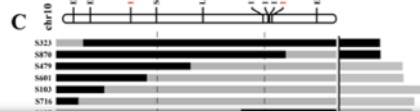
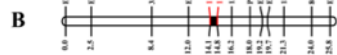
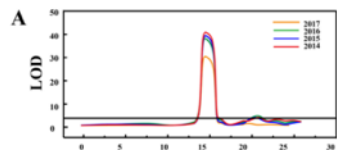
- Evaluated 2611 accessions of germplasm, and released 378 new varieties (accounts for 66% of total new potato varieties at the same stage in China)
- Developed 434 of new technologies, 182 sets of new equipment, products. Of these, 308 were adopted by enterprises and growers
- Formulated 368 new regulations and standards, obtained 689 approved patents
- Published 2669 academic papers and 38 works

CARS-potato's contribution to industry advancement

- Established 500 integrated technology demonstration bases across the country, promoted 4.31 million hectares of new varieties and technologies in total. This help rural revitalization, food security and farmers' income.
- held 1,447 training courses and on-site meetings. Trained 76 thousand technicians and 594 thousand potato growers.

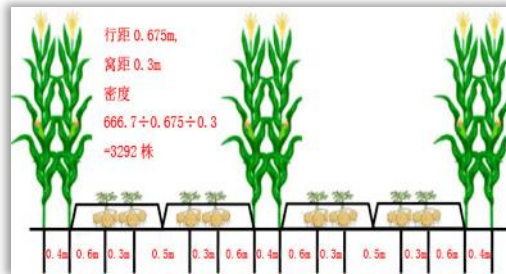


Improvement of quality and resistance of new variety



Enhancement of cultivation technology

- Yield and efficiency increase(13%) in dry farming by Integrated technology including intelligence, soil moisture preservation and water saving, rain harvesting and drip irrigation, disease control and mechanized operations
- Good benefits in early potatoes production by technology including green house or/under mulching, irrigation water saving, fertilizer and chemical reducing, intercropping and rotation with other crops, disease control, and small mechanical harvesting.





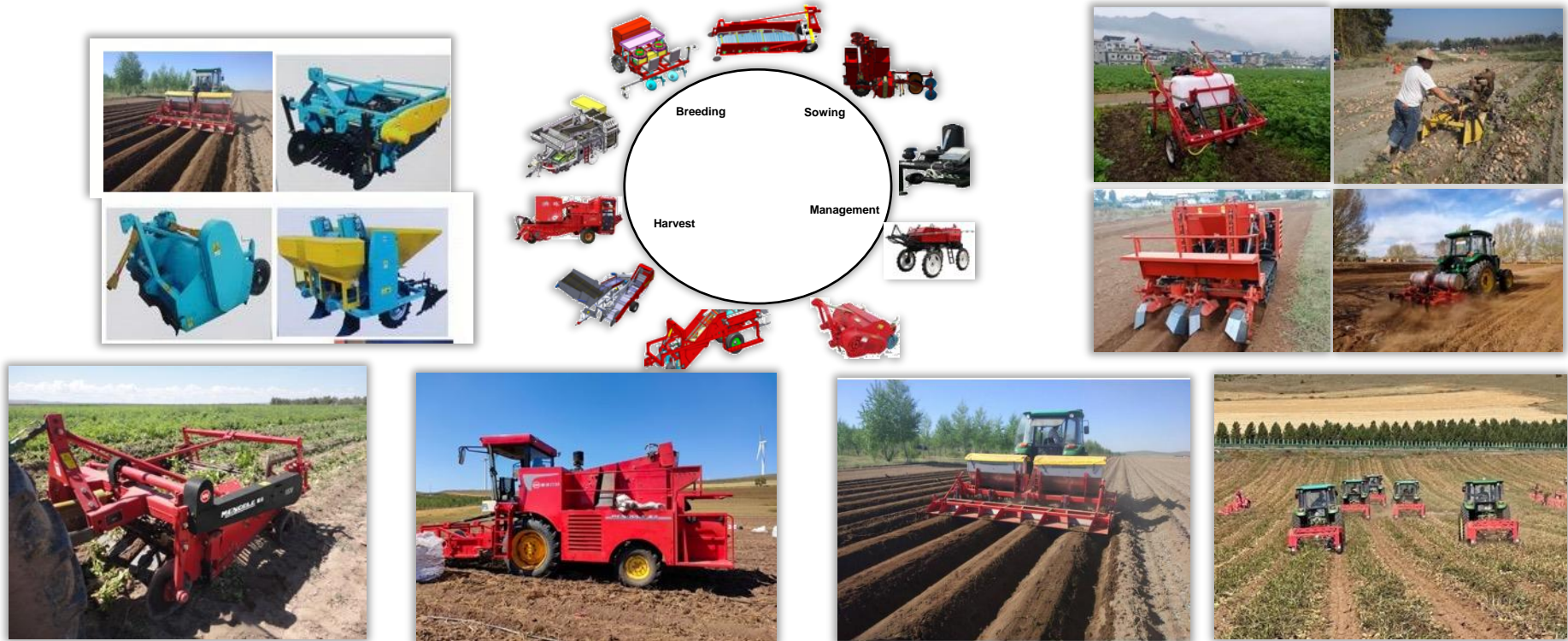
Yield raising 50.09%-86.75%, water use efficiency raising 6%



By different methods of mulching

Development of machinery

- Developed farming machineries for different scale growers with a trends of automation and intelligence



Progress of potato storage and processing system

- The potato fruit water treatment technology and recovery of nature protein from potato starch processing wastewater have been applied in 45 large and medium-sized potato starch enterprises.

China Agriculture Research System
现代农业产业技术体系

薯类淀粉加工分离汁水蛋白提取与废水处理成套技术

Potato Fruit Water Treatment Technology

薯类淀粉加工分离汁水蛋白提取与废水处理成套技术

薯类淀粉加工分离汁水蛋白提取

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扩张床吸附分离提取马铃薯活性蛋白技术

Recovery of Native Potato Protein by EBA Chromatography

马铃薯蛋白颗粒粉

Development new food processing products

Noodles



Steamed buns



Products of potato and rice



Regional Characteristics



Convenient ready-to-eat



Snack foods

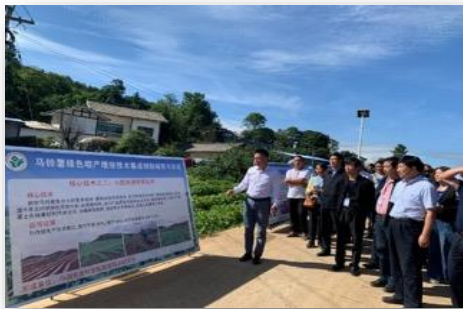


Establishment of demo. bases in main production area



Promotion of new varieties and technologies

- Demonstrate new varieties, technologies and agricultural equipment in different locations
- Conduct demonstration meetings



Weining, Guizhou



Zhaotong, Yunnan



Enshi, Hubei



Xiji, Ningxia



Heilongjiang

国家马铃薯产业技术体系 武川县域经济示范基地



国家马铃薯产业技术体系服务西吉县域经济成果展示基地



Demonstration of integrated technology: an example

- Technology: new variety + health seeds + remote sensing monitoring + integrated disease control+ drip irrigation with fertilizer + mechanization
- Results: the average yield of 48 ton/hm², which was 15% higher than that of ordinary drip irrigation. The nitrogen and potassium are reduced by 20.4% and 22.4% respectively.



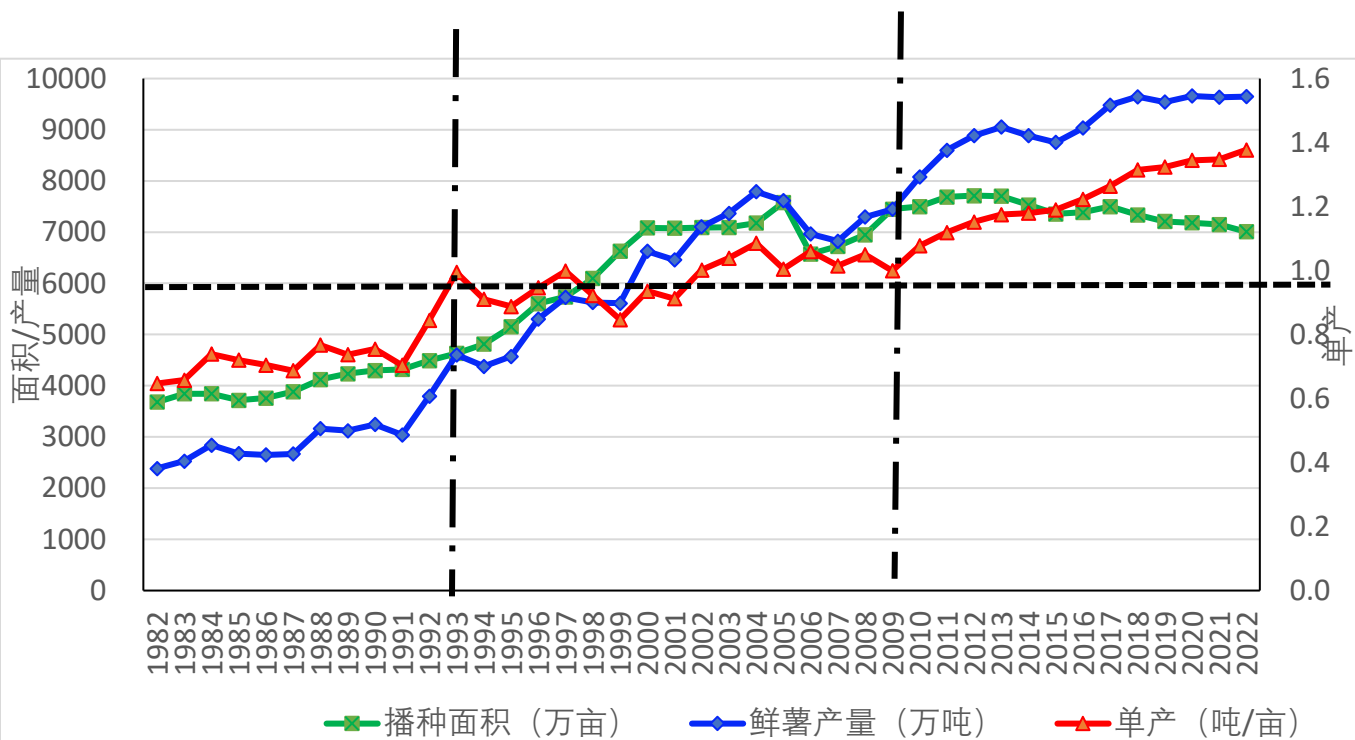
Technical service and consultation for potato industry

- Established a disaster emergency response working mechanism and formulated technical measures. provided 2205 times emergency technical services for potato production in more than 100 major producing counties
- Provided 41,578 times of technical consultation and docking service for 224 potato enterprises, and supported 67 commercial brands.
- Provided 1,512 research reports and policy suggestion to the MARA and local governments for decision-making, and 903 of them have been adopted.



Support the rapid development of China potato industry

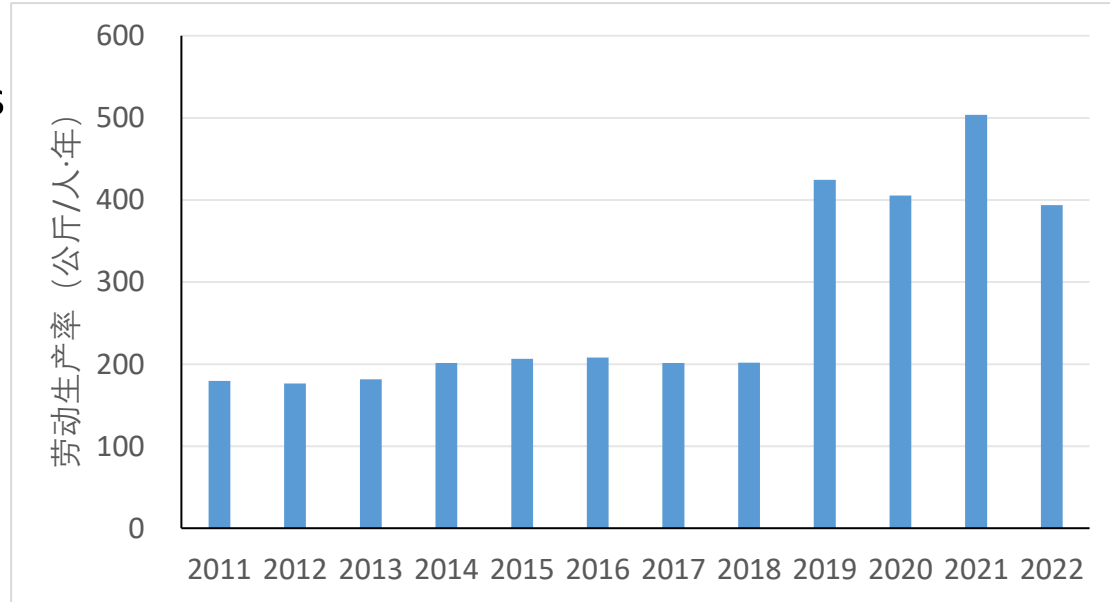
- Yield has continued to increase steadily, reaching 1.38 tons in 2022, an increase of 38% over 2009.



- The total production increased from 72.95 to 97.04 million tons from 2008 to 2022
- The processed products constantly enriched
- The annual supply capacity enhanced by improvement of storage facility technology.

Lead to a rapid increase in labor productivity

- The output of a single labor has stabilized at about 400 kg after 2019, an increase of 119% over 2011.
- In 2011, less than 180 kg of potatoes were produced per year per labor input



Note: The data comes from the "National Compilation of Statistical Data on the Cost and Benefit of Agricultural Products"

R&D green industry technology to meet future food security needs

- CARS-potato will continue to play a vital role in China potato industry development to meet food security needs in the future through
 - Improve germplasm, precision and intelligent breeding technology
 - Establish a new model of green environmentally friendly production of dryland potatoes, develop intelligent and precise crop management, reduce the use of chemical fertilizers and pesticides
 - Enhance innovation of facility technology and products in the field of storage and processing, and promote the processing and added value
 - Promote new variety and technology by service platforms
 - Strengthen the service and technical training

**Thank you !
Wish a nice
day!**

