

South - South Knowledge Sharing on Air Quality and Carbon Neutrality

Regional Knowledge Sharing Event: Agricultural Burning: Sectoral to Regional Impacts and Solutions

Measures to control agricultural burning in People's Republic of China (PRC) From Ban of Burning to Comprehensive Utilization

This is not an ADB material. The views expressed in this document are the views of the author/s and/or their organizations and do not necessarily reflect the views or policies of the Asian Development Bank, or its Board of Governors, or the governments they represent. ADB does not guarantee the accuracy and/or completeness of the material's contents, and accepts no responsibility for any direct or indirect consequence of their use or reliance, whether wholly or partially. Please feel free to contact the authors directly should you have queries.

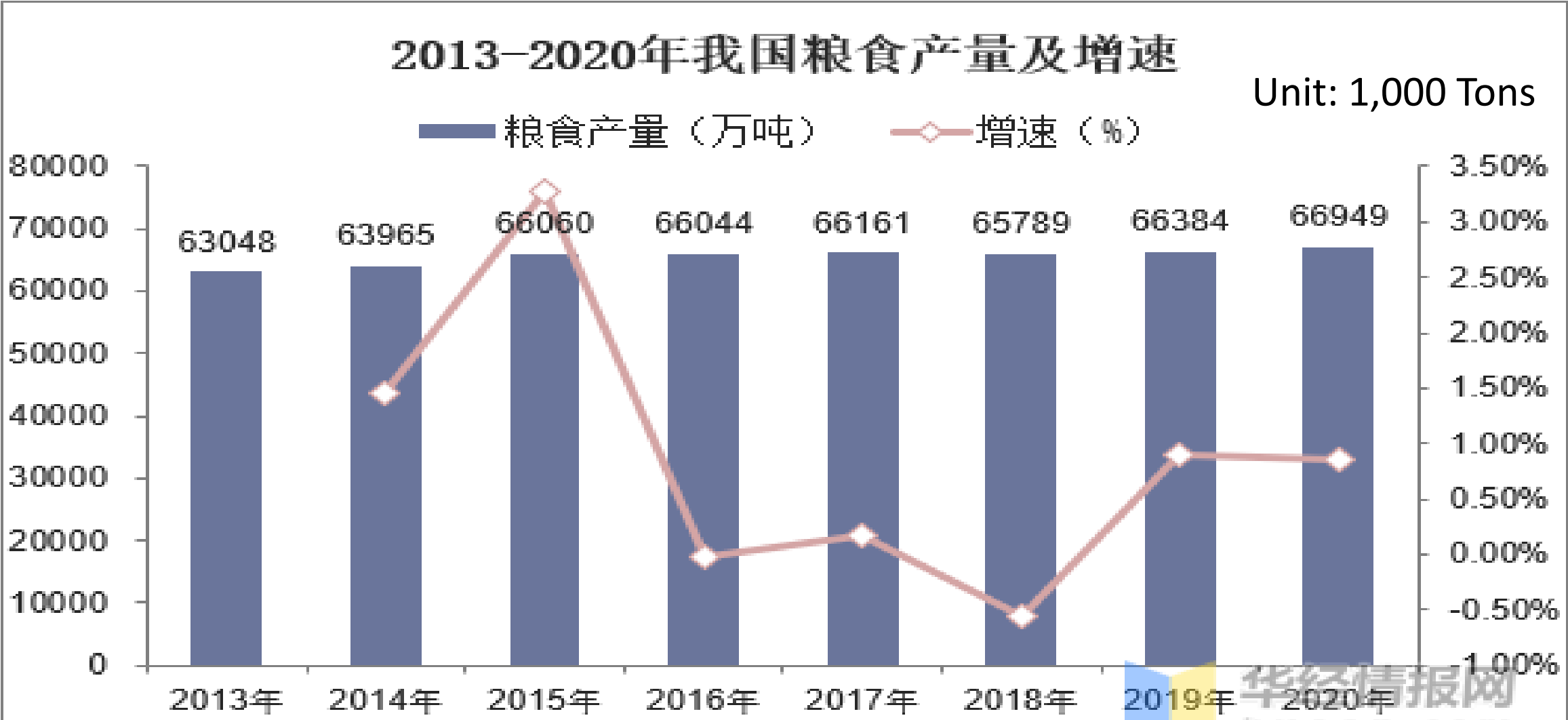
Wendao Cao, PhD

Senior Agriculture Economist,

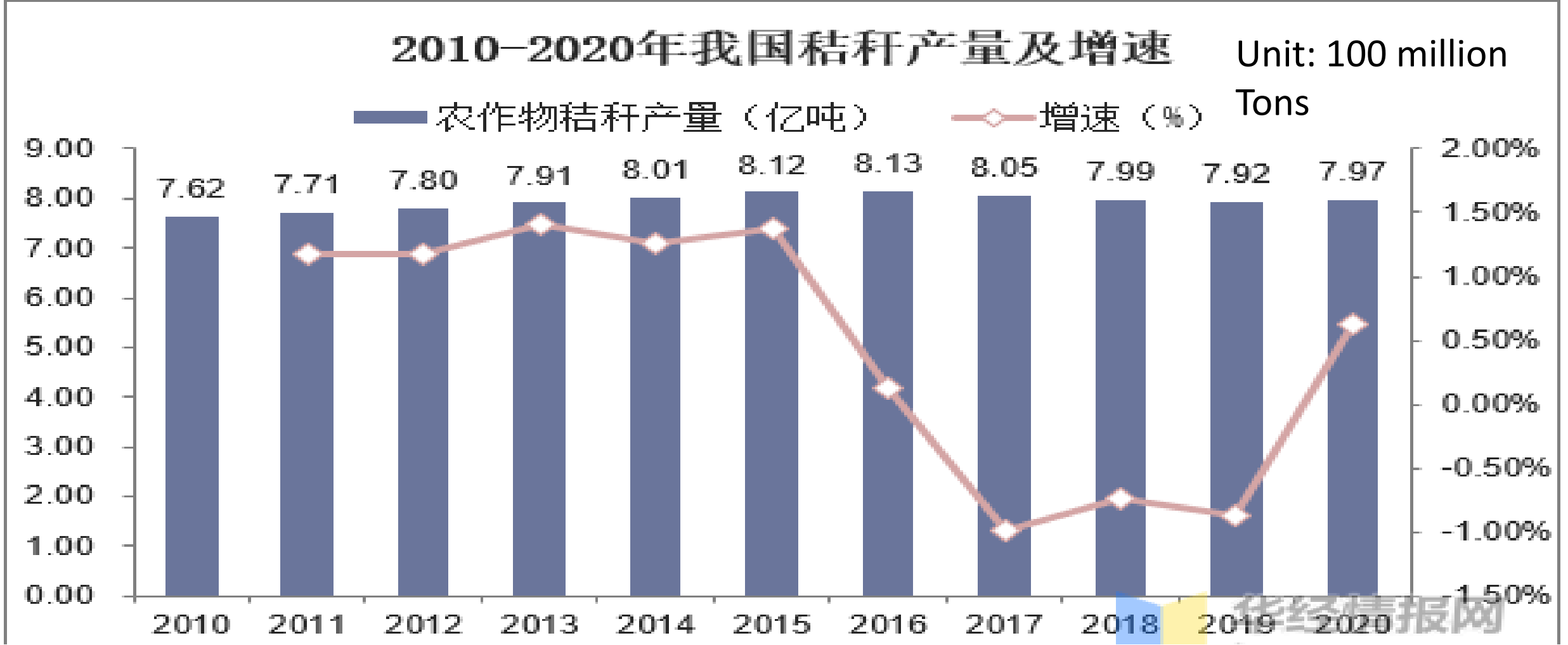
World Bank



PRC Grain (rice, wheat, corn) Production (2013-2020)



PRC Crop Straw Production (2010-2020)





- Crop straw residues in PRC, ranking the first in the world, account for 17.3% of the global production;
- In 1990-2000, straw burning is very popular in rural PRC.
- Straw burning releases a large amount of pollutants such as PM_{2.5}, SO₂, CO, NH₃, VOC, and NO_x.
- Straw burning contributes 5% of agriculture emission.
- Further, straw burning is one of the primary contributors to haze and smog formation during the harvest periods in PRC

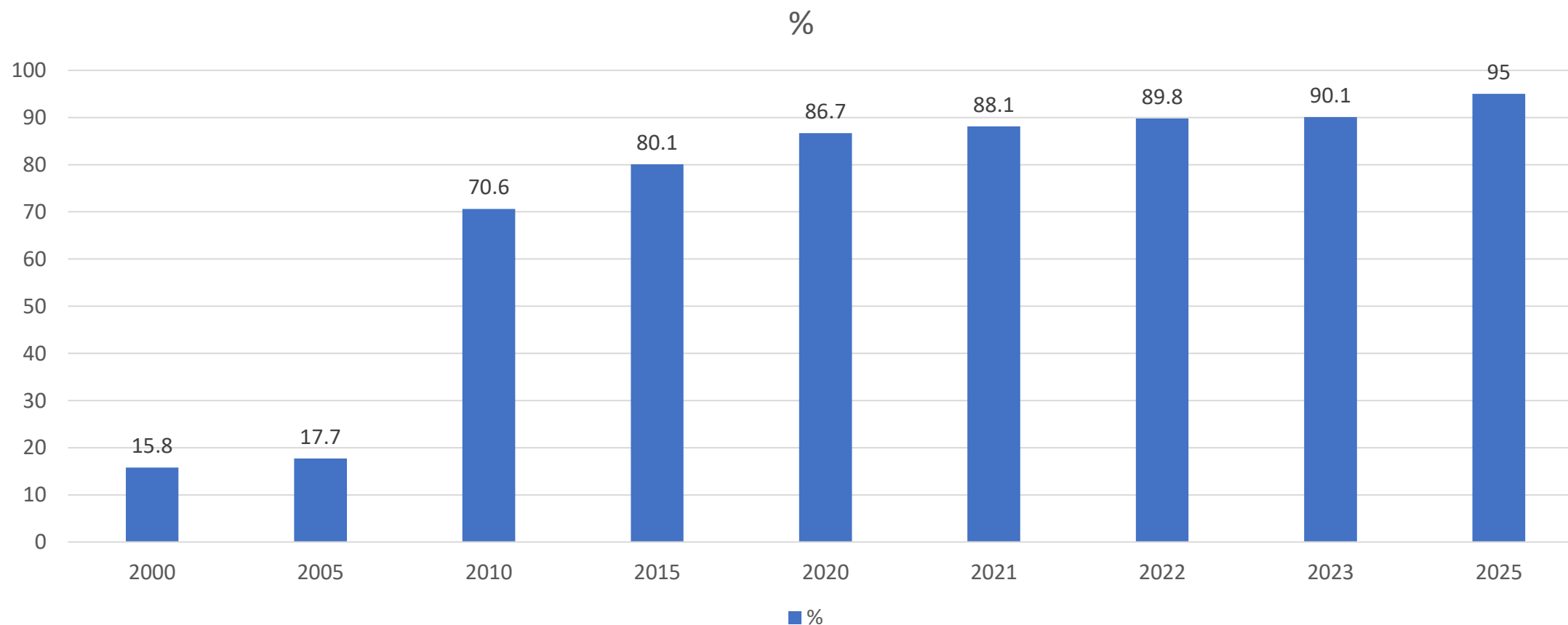
Key measures to better utilize crop straw residues in PRC

- The Party Central Committee and the State Council **attach great importance** to the comprehensive utilization of crop straw, propose phased task goals, and clarify the responsibility mechanism.
- **Promoting the more scientific, efficient, and valuable utilization of crop straw** has become an important task for agricultural green development, rural ecological revitalization, and energy conservation and emission reduction in agriculture and rural areas since 2010.
- **Improve laws and regulations and strengthen legal protection.** The revised Air Pollution Prevention and Control Law clearly requires people's governments at all levels and their agricultural departments to take measures to promote the comprehensive utilization of straw. At the same time, the revised "Solid Waste Pollution Prevention and Control Law" and "Air Pollution Prevention and Control Law" have also put forward more comprehensive requirements for supervising and prohibiting open burning.
- **Establish a service system** for straw collection, storage, transportation, and comprehensive utilization at county level.
- **Provide central government's budget transfer to pilot** comprehensive crop straw utilization as high as RMB 3 billion yuan annually

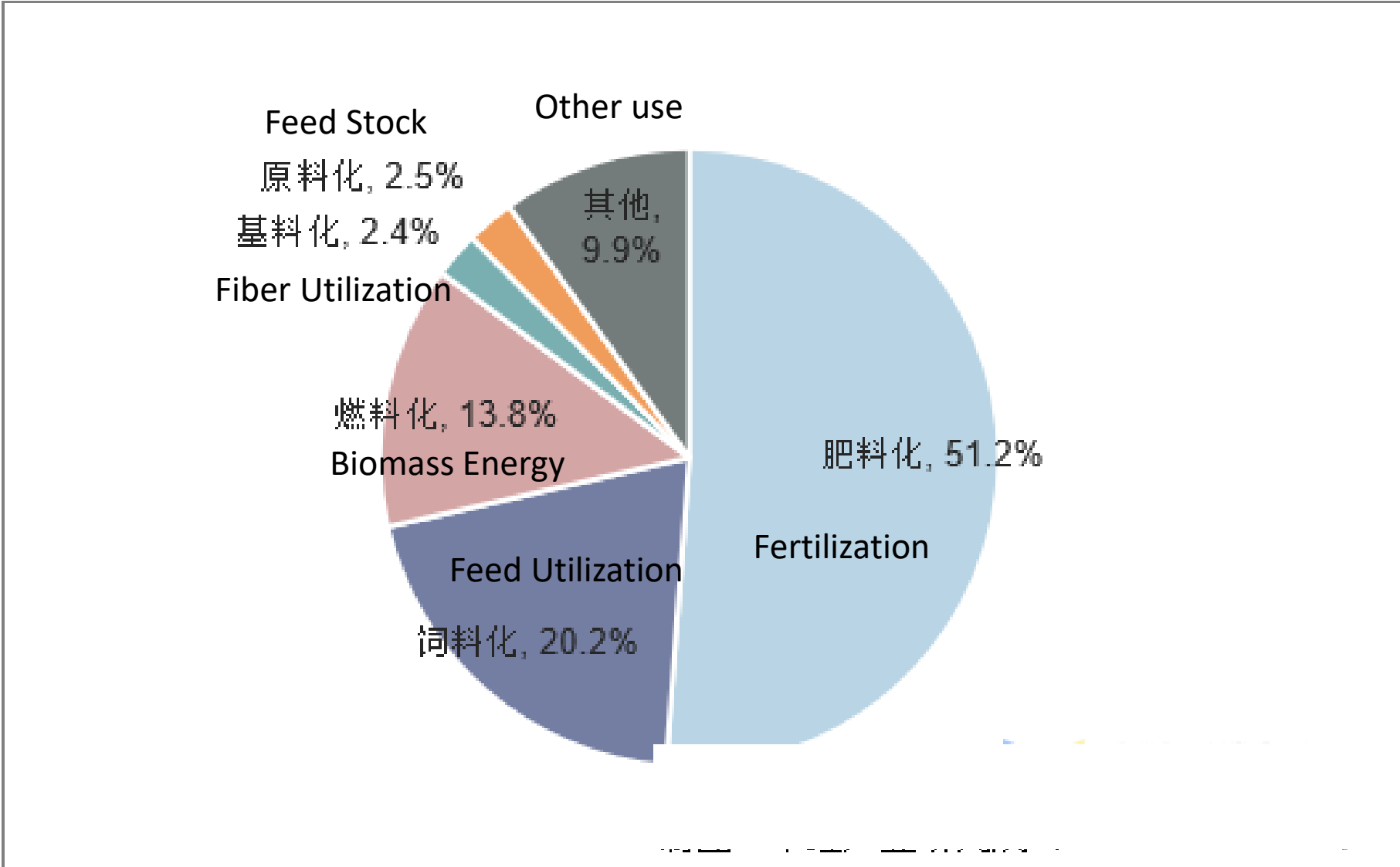
The World Bank's key projects/programs related to Crop Straw Utilization

- The Eco-farming Project (2009-2015) (US\$ 120 million) (small scale biogas)
- The Hebei Rural Renewable Energy Development Project (US\$71.5 million) (large scale biogas + manure management)
- The Hebei Air Pollution Prevention and Control Program (P4R) (US\$ 500 million)
- The Green Agriculture and Rural Revitalization Program (Guangxi and Guizhou) (US\$ 340 million)
- The Green Agriculture and Rural Revitalization Program (Hubei and Hunan) (US\$ 345 million)

PRC Crop Straw Residues Comprehensive Utilization Rate (%)



Crop straw comprehensive utilization rate reached 90% in 2022, with 662 million tons of crop straw utilized in PRC



Utilization of crop straw residues as fertilizer: returning crop straw residues to the farmland

- **Including** direct return of straw to the field, including mechanized direct return, covering return, rapid decomposition return, composting return, and processing of organic fertilizer.
- Returning crop straw residues to the farmland will significantly increase carbon sequestration above- and belowground and reduce GHG emissions by not burning the crop straw residues in the fields. It will also increase soil organic carbon (SOC); improve soil health (e.g., higher water retention, cation exchange, and nutrient absorption capacity); and promote a rural circular economy, such as better utilization of crop residues, which would, in turn, help reduce emissions intensity.

Utilization of crop straw residues as fertilizer: returning crop straw residues to the farmland



Straw crushing and returning to the field



Straw incorporating and returning to the field

Utilization of crop straw residues as fertilizer: returning crop straw residues to the farmland



Straw composting and returning to the field. In 2020, about 68 million ha of straw returning to farmland with a direct returning volume of 408 million tons.

Utilization of crop straw residues as source of biomass energy

- **Straw biogas (large and small scale)** . Straw biogas technology is an engineering process in which straw is fermented by microorganisms under anaerobic conditions to produce biogas. It can use various types of straw such as rice, wheat, corn, or straw mixed with fruit and vegetable waste, manure etc. for fermentation.



Utilization of crop straw residues as source of biomass energy

- **Straw gasification.** Straw gasification uses biomass technology to turn loose straw into clean and convenient fuel, turning waste into treasure, protecting the environment and meeting farmers' demand for high-quality energy. Straw gasification is not only a good way to utilize straw, but also a solution to renewable biomass resources and energy shortages in rural areas. Its social, economic, energy, and environmental comprehensive benefits are very significant.



Utilization of crop straw residues as source of biomass energy

- **Straw solidification molding technology** is the process of using lignin as a binder under certain conditions to compress loose and finely ground straw with a certain particle size into dense, regularly shaped rods, blocks, or granular fuels. The main process flow is to air or dry the raw materials, crush them with a crusher, and use compression molding machines such as roller extrusion, spiral extrusion, and piston stamping to compress and shape the straw. The products are then stored after ventilation and cooling.



Utilization of crop straw residues as source of biomass energy

- **Straw carbonization.** Straw carbonization is a black block fuel made from crop straw, sawdust, etc., without adding any adhesive, using biochemical technology, tempering, and high-temperature and high-pressure production. This biomass particle can be used as a general fuel, with low sulfur content and strong firepower, and is known as "green coal". Widely used in household heating stoves, heating boilers, industrial boilers, and straw power generation.



Utilization of crop straw residues as source of biomass energy

- **Straw power generation.**
Straw power generation refers to the direct combustion of straw or mixed combustion with coal through a boiler, generating high-temperature and high-pressure steam to drive a steam turbine to generate electricity.



Feed utilization

After the ammonization treatment of straw, the crude protein content increases by 4-5 percentage points, the digestibility of organic matter increases by 10-20 percentage points, and it contains various amino acids, thereby improving the nutritional value of straw, making full use of previously unusable nutrients, improving feed digestibility, improving palatability, saving grain, increasing fat, and disease resistance, and improving the economic benefits of animal husbandry. It can replace 30-40% of refined feed and also kill wild grass seeds to prevent mold. Therefore, feeding ammoniated straw to sheep, cows, etc. has a good effect.

Feed utilization

silage



ammonization



Base material utilization

Edible fungi belong to heterotrophic organisms and cannot synthesize nutrients themselves. Straw is rich in essential nutrients such as sugar, protein, amino acids, minerals, and vitamins for edible fungi. Using straw as raw material to produce edible fungi can not only improve the yield and quality of edible fungi, but also provide low-cost straw resources. Moreover, its culture medium can be used as high-quality organic fertilizer for returning to the field after use.



Utilization of crop straw residues as Feed Stock/Raw Materials: Emerging Method

- The mixture of straw fibers and resin after rolling treatment can be pressurized and molded in a metal mold to produce various low-density fiber sheets; By applying pressure and chemical treatment to its surface, it can be used to make decorative panels and once formed furniture, with characteristics such as high strength, corrosion resistance, fire resistance, flame retardancy, aesthetics, and low price.



Industrialization



Anhui Straw and Manure Comprehensive Utilization Industry Expo has been held for 6 consecutive years. More than 3000 products, technologies, models, and equipment exhibited at the Expos.

Conclusions

- Awareness Building and Mindset Change
- Political determination and Policy and Financing Support
- Technical innovation and service provision
- Industrialization and business-oriented development