

第二章 世界粮食安全

Understanding transformation

All people in the world can get any food that is not harmful to their health at any time according to their wishes.

Circular economy: an economy where the value of products, materials and resources are maintained for as long as possible with the aim of reducing waste and increasing a sustainable, low carbon, resource efficient and competitive economy.

第三章 气候变化与粮食安全

The role of climate change——Promotes agricultural civilization

The origin of crop——【wheat】 Fertile Crescent 【rice】 Hemudu Site
【corn】 Mexico/America

Emissions source of GHG——human activity、livestock

Greenhouse gas (GHG) emissions from human activity and livestock are a significant driver of climate change, trapping heat in the earth's atmosphere and triggering global warming.

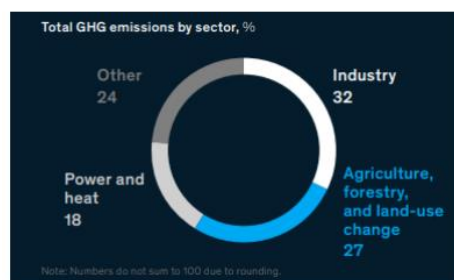
Causes and effects of climate change



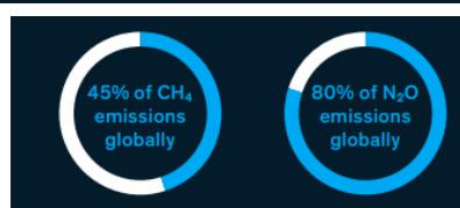
1. Relationship between Climate Change and Agriculture

Major contributors to agriculture emissions

Agriculture emissions contribute approximately 20 percent of global GHG emissions



Agriculture accounts for



Agriculture emissions contribute approximately **20 percent** of global GHG emissions

Nitrogen fertilizer、 Green revolution

Agriculture accounts for **80 percent of total nitrous oxide (N₂O) emissions**, mainly from the application of fertilizers both synthetic nitrogen and manure added to soils or left on pastures

Features of organic farming

- Protecting **soil quality** using organic material
- Indirect provision of crop nutrients using **soil microorganism**
- **Nitrogen fixation** in soils using legumes
- Weed and control based on methods like **crop rotation and natural predators**
- Rearing of **livestock**
- Care for the larger environment and conservation of natural habitats and wildlife



Climate-Smart Agriculture

Climate-smart agriculture (CSA) is an integrated approach to managing landscapes, cropland, livestock, forests and fisheries that addresses the interlinked challenges of food security and accelerating climate change.

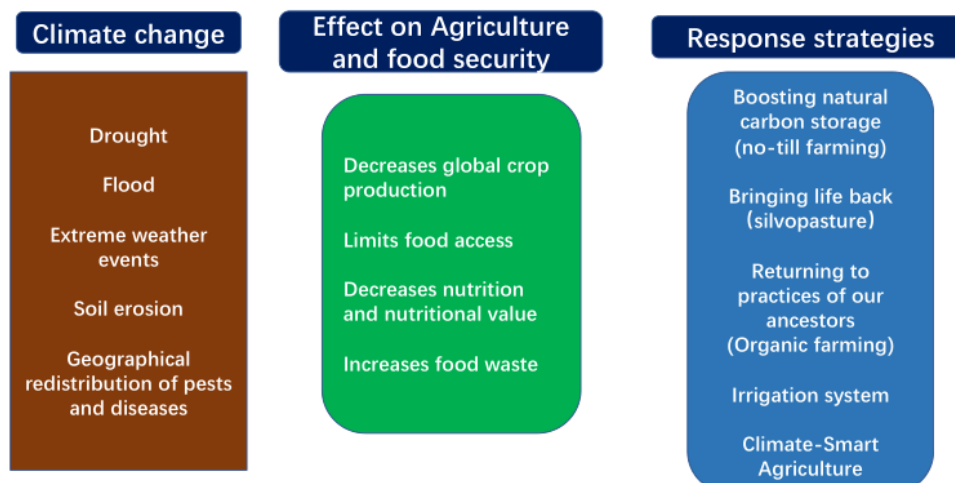
CSA aims to tackle three main objectives:

- ➔ Sustainably increasing agricultural productivity and incomes;
- ➔ Adapting and building resilience to climate change;
- ➔ Reducing and/or removing greenhouse gas emissions, where possible.

What is CSA?



Highlights for this Unit



第四章 农业技术进步

Background

The world cereal production has increased significantly since 1961.

The first technology revolution in agriculture made impressive strides: Between 1961 and 2018, cereal yields rose by 2.8 percent a year, or over 300 percent over the period.

What technologies promoted agriculture in the past decades?

Irrigation 灌溉

use of fertilizers and pesticides 肥料和杀虫剂的使用

the development of new and more productive crop

varieties (高效新品种的开发)

The status in the World

The world has to produce 70 percent more food by 2050, using less energy, fertilizer, and pesticide while lowering levels of Green house gas (GHGs) and coping with climate change. However, the efficiency gains are dropping and the challenges are greater.

The status In China

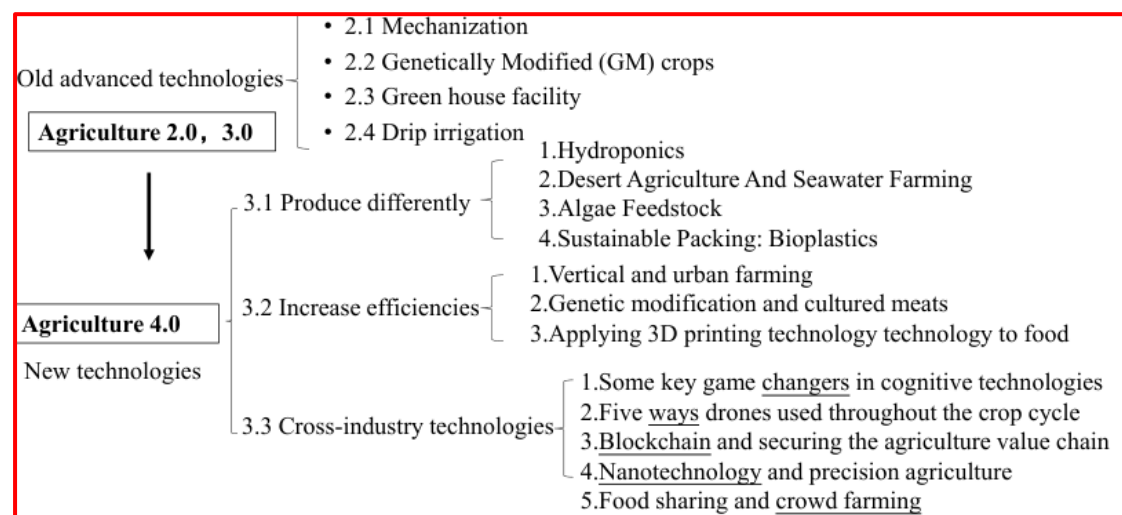
Amid a continuously increasing food demand, China has shifted from a net food exporter to a net importer over the past decade.

The status In China

● 农民收入	● 土地资源与利用
● 农村劳动力	● 水资源与利用
● 农业生产规模	● 农村基础设施建设
● 农业机械化水平	● 农业科技创新

Science and technology:

Old advanced technologies must be maximized, and new ones should be generated.



一、Old advanced technologies

1.Mechanization

As early as the 1940s, **the United States** had basically achieved agricultural mechanization.

Only 1.07 people per farm are engaged in production and operation in a farm (~2250mu in average).

China feeds nearly 20% of the global population with only 9% of the world's arable land. 中国用世界 9%的耕地养活了世界近 20%的人口。

China has about 30 times the agricultural workforce compared to the United States. (6.5 亿吨 vs 5 亿吨)

The mechanization rate of agriculture in China is 71%, while in the United States, it exceeds 95%.

In January 2022, the Ministry of Agriculture and Rural Affairs proposed that the mechanization rate of crop cultivation and harvesting in China will reach 75% by 2025.

What are the main factors that limit mechanization development in China?

The land: 南方丘陵 农田宜机化改造

The policy: 家庭联产承包责任制 2004 年土地流转政策

The innovation in mechanization: 与耕作模式配套的高效机械化

2. Genetically Modified (GM) crops

美国一直是全球转基因作物第一种植大国。2022 年美国累计种植转基因作物面积达 7480 万公顷以上，约占全球的 40%。2022 年，美国转基因玉米、大豆、棉花转基因普及率分别达 93%，95%和 95%。

美国转基因作物包括抗虫、抗除草剂的大豆、玉米和棉花等

1996-2022 年美国转基因玉米各种性状的普及率，单抗不断降低，双抗不断增多，2022 年达 81%。

我国目前批准商业化种植的转基因作物有（A．抗虫棉花 B．抗病毒番木瓜

以下哪些作物已获得我国转基因生物安全证书（A．抗虫耐除草剂玉米 B．耐除草剂大豆 C．转基因植酸酶玉米 D．抗虫水稻

3.Green house facility

The Netherlands

It has only 7,702 square kilometers of cultivated area, or 0.46% of American cultivated land.

It has less land per capita than China.

It is the world's second-largest exporter of agricultural products.

The Netherlands has **the largest scale** of greenhouse facility in the world.

温室存在的问题：

High energy usage 高能耗 Consumes much CO₂ 消耗大量 CO₂

亮点：

Larger scale 规模化 Precise control 精确控制（各类传感器 sensor）

Solar panels 能源供应问题 Reduced use of energy 能量损耗降低
 Reused of water 水循环利用 No CO2 escape 捕获 CO2 , 没有 CO2 逸出
 Increased vegetable growth 生长速度加快 Automatic 自动化

4 Drip irrigation

The Israel

The 67% of the land area is desert;

Only 20% of the land area is naturally arable, about 4,100 square kilometers;

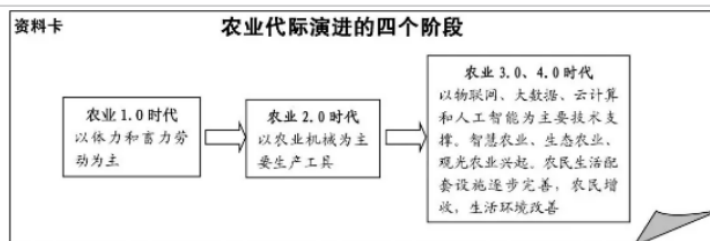
The climate is arid and semi-arid;

Israel's per capita water resources are 400 cubic meters (the world's per capita water resources are 8,800 cubic meters);

Farmworkers made up only 3.7% of the work force;

Israel is a major exporter of fresh produce and a world-leader in agricultural technologies.

AGRICULTURE 4.0



第一，农业1.0是指人力与畜力为主的传统农业时代。

第二，农业2.0时代是指隆隆作响的机械化农业时代。

第三，农业3.0时代是高速发展的自动化农业时代(信息化农业)。

第四，农业4.0时代是以无人化为特征的智能农业时代。

水肥一体化

Save water: water utilization has increased from 15% to 80%-95%

Save labor cost: irrigation of water, fertilizer and pesticide is controlled by computer

二、New technologies

Produce differently using new techniques

1. Hydroponics----for land shortage

Hydroponics, a subset of soilless culture, is the method of growing plants without soil, using mineral nutrient solutions in a water solvent.

水培法，无土栽培的一类，是在没有土壤的情况下，使用矿物营养液在水溶剂中种植植物的方法。Monolayer trough cultivation(单层槽培养)、Shallow liquid flow floating plate culture (浅流浮板培养)、Vertical ladder (垂直梯式培养)、Vertical zipper (垂直拉链式培养)、Vertical Tubular (垂直管状水培)

Benefits of hydroponics

Grow faster

Organic produce can be harvested through the year

Help higher yields

Allows crops to grow in areas that can not support crop in soil

Eliminates the need for massive pesticide use, good for environment
Water used in hydroponic system can be reused
Reduced fertilizer, pesticide and water by 90%
Require very less space

2.Desert Agriculture And Seawater Farming---for lack of water and land

The 71% of the world's surface is covered with water, in the form of oceans.

Of the remaining 29 percent, one-third consists of deserts of all types.

To tackle the food crisis, the world must turn the world's desert and sea into food production facilities.

A good example that integrates the hydroponics with desert and seawater farming:

Sundrop

Sundrop, a company based in Australia, has developed a hydroponics seawater technology that combines solar, desalination, and agriculture to grow vegetables in any region. This system is sustainable, doesn't rely on fossil fuels and doesn't require land.

Benefits of Sundrop

Better product
Better price (at a fixed price)
Better for people and planet
All year around
Usage of seawater
Usage of sustainable energy

3. Algae Feedstock-----for sustainable energy

- Algae causes discolored water, reduced light penetration, dissolved oxygen consumption during die-off, and toxin production.
- Algae explosion in Lake Erie is posing danger to fish, tourism and locals
- Algae farmed in aquaculture sites can become a substitute for feedstock and fishmeal. Plus, Algae is an effective and inexpensive substitute of biofuel.
- In addition to its Bio-fuel possibilities, algae has already been used in all kinds of ways you might not be aware of, food products, baby formula, or nutritional supplements. Algae contains the all-important nutrient Omega-3 fatty acids.

Benefits of Algae

It has a wide application
CO₂, waste water and heat are what algae needs
Sustainable and cheap energy

4.Sustainable Packing: Bioplastics---for health

- Bioplastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn, starch, straw, woodchips etc.
- A startup TIPA is developing an advanced flexible plastic packaging that fits seamlessly into current food manufacturing processes, offers consumers and brands the same durability and shelf life they have come to expect of ordinary plastics, but

that can return to nature after it has been used, much like an orange peel becomes part of the food waste stream.

三、New technologies

Three general trends: Produce differently 、 Increase efficiencies 、 Cross-industry technologies

3.2 Increase efficiencies in the food chain

Vertical and urban farming

- Vertical farming is the process of growing food in vertically stacked layers, producing food in challenging environments where suitable land is unavailable.
- Associated with urban farming, it uses soil, hydroponic, or aeroponic growing methods. The process uses 95% less water, less fertilizer and nutritional supplements, and no pesticides, while boosting productivity.

The world's largest 'vertical farm' -- AeroFarms

AeroFarms can grow produce year-round, allowing it to reach potential yields that are 390 times more productive, than a traditional farm of the same acreage.

Genetic modification and cultured meats

- To address the food needs of the future, genetic engineering is needed.
- Clustered, regularly interspaced, short palindromic repeat (CRISPR) technology is an important new approach to genome editing that allows greater selectivity and reduces the element of chance.

Clustered, regularly interspaced, short palindromic repeat (CRISPR)

成簇的，有规律间断的，短的回文序列

- CRISPR-Cas9 Can Be Adapted as a Gene Editing Tool
- Cas9 will cut whatever nucleic acid sequence the guide RNA tells it to cut.
- CRISPR is facilitating the generation of engineered animal food products.
- Culturing meat has a lot of potential to have an impact on the areas of food security, the environment, animal-borne food-related diseases, and animal welfare issues.
- MosaMeat, a Netherlands based company, believes lab-made meat—"meat without the butcher"—can provide the world's growing population high-quality protein while avoiding many of the environmental and animal-rights issues of conventional meat production.

Applying 3D printing technology to food

3D printing is a process whereby layers of material are formed to create objects—and in this case, familiar dishes.

Experts believe printers using hydrocolloids 凝胶 (substances that form gels with water) could be used to replace the base ingredients.

An example:

- Netherlands Organization for Applied Scientific Research has developed a printing method for microalgae (微藻), a natural source of protein, carbohydrates, pigments, and antioxidants, and is turning those ingredients into edible foods like carrots. The technology essentially turns “mush” into meals.
- The most exciting — and technically demanding— application for 3D food printers may be meat substitutes(肉类替代品). Some researchers have begun experimenting with algae as a replacement for animal protein, while others are trying to make meat from cow cells grown in a lab.

3.3 Incorporate cross-industry technologies and applications

- Some key game changers in cognitive technologies
- Five ways drones used throughout the crop cycle
- Blockchain and securing the agriculture value chain
- Nanotechnology and precision agriculture
- Food sharing and crowd farming

Some key game changers in cognitive technologies 传感技术:

Internet of Things (IoT)物联网

IoT technologies allow correlations of structured and unstructured data to provide insights into food production.

Automation of skills and workforce 技能与劳动力自动化

Operations will be done remotely (远程的), processes will be automated, risks will be identified, and issues solved.

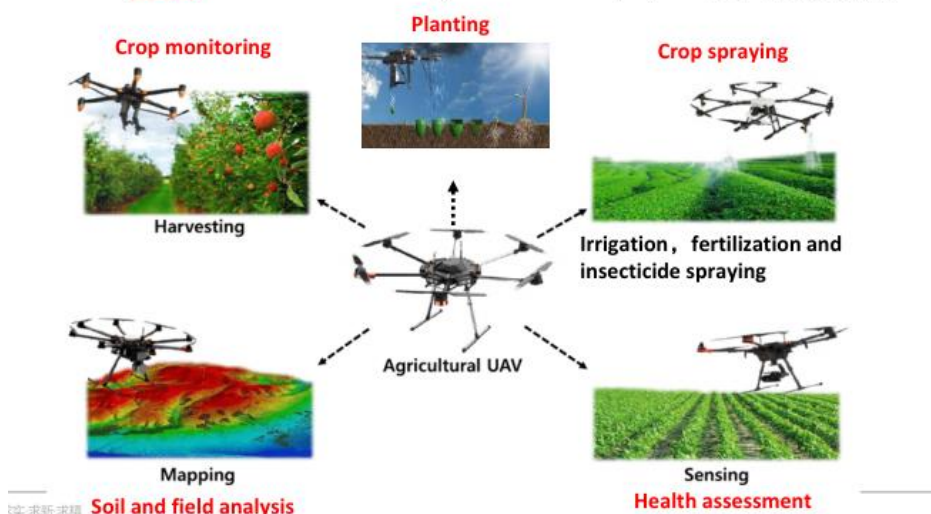
Data-driven farming 数据驱动农业

By analyzing and correlating information about weather, types of seeds, soil quality, probability of diseases, historical data, marketplace trends, and prices, farmers will make more informed decisions.

Chatbots 聊天机器人

Agriculture could also leverage AI-powered chatbots (virtual assistants) by assisting farmers with answers and recommendations on specific problems.

➤ Five ways drones used throughout the crop cycle 无人机的利用



Blockchain and securing the agriculture value chain

区块链与农业价值链安全

Blockchain can reduce inefficiencies and fraud and improve food safety, farmer pay, and transaction times. By improving traceability in supply chains, it can enable regulators to quickly identify the source of contaminated foods and determine the scope of affected products during contamination incidents.

Nanotechnology and precision agriculture

- The Green Revolution of the 20th century was driven by a blind use of pesticides and chemical fertilizers, resulting in a loss of soil biodiversity and a rise in resistance against pathogens and pests. The new revolution will be precision agriculture, driven by nanotechnology. This revolution will see nanoparticles delivered to plants and advanced biosensors for precision farming.

Nano encapsulated conventional fertilizers, pesticides, and herbicides will release of nutrients and agrochemicals in a slow and sustained manner, resulting in precise dosage to the plants.

Food sharing and crowd farming

- The sharing economy and crowd sourcing also have a place in preventing food waste.
- Olio, founded by social entrepreneurs, has built an app connecting people with their neighbors and local shops so that surplus food can be shared, rather than be discarded.
- Another social entrepreneurial project has developed the concept of Crowd farming (人群农业) .
- It has created a system in which the person has ownership over the trees and land that the farmer cultivates. In this way, the fruit of those trees goes to their owners, creating a direct link between production and consumption and avoiding overproduction and waste along the value chain.

第八章 农业产品的国际贸易

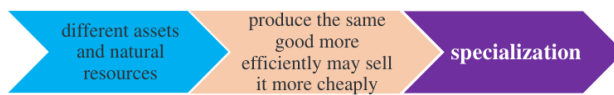
What is trade?

A basic economic concept involving the buying and selling of goods and services, with compensation paid by a buyer to a seller, or the exchange of goods or services between parties;

Where does trade take place?

Within an economy between producers and consumers (either within a country , or between trading nations);

International trade allows wealthy countries to use their resources—for example, labor, technology, or capital—more efficiently:



Why does trade (esp. international trade) occur?

Trade/International trade occurs because one country **enjoys a comparative advantage** in the production of a certain good or service, specifically if the opportunity cost of producing that good or service is lower for that country than any other country.

Note: In international trade, no country can have a comparative advantage in the production of all goods or services.

comparative advantage 课文后面有名词解释

Advantages of International Trade

Efficient use of Natural Resources: Since both the countries in the trade would be having some kind of natural resources, both of them can utilize it in the best possible manner.

Availability of all types of Goods: It enables the countries to possess all types of goods including those which they are not able to produce.

Specializations: It leads to the specialization of different goods in different countries.

Large Scale production: It enables countries to produce in large scale quantities.

Price Stability: It helps in equalizing the prices of the goods removing the wild fluctuation in the prices of the goods and or Services.

Increase of Technical know-how: It enables the Countries to exchange technology

between themselves which also adds to the countries technical bank and also to the GDP(Gross Domestic Product).

International Cooperation: It also helps in the co-operation of the International pressures on the Countries thus building relationships and understanding amongst leaders of the world.

Adverse effect on Home Consumption: International trade also has an adverse impact on the production of the Domestic Players since due to foreign competition, the upcoming industries in the market may collapse completely.

Disadvantages of International Trade

Adverse effect on Home Consumption: International trade also has an adverse impact on the production of the Domestic Players since due to foreign competition, the upcoming industries in the market may collapse completely.

Economic Dependence: The less developed countries in the World has to rely upon the Developed Economies in order to fulfill their Demand

Political Dependence: Sometimes International Trade is executed in order to fulfill a political agenda endangering the political dependency of the other Countries.

Import of Harmful Goods: It may also happen that any harmful goods are been imported which can cause chaos in the citizens of the importing country.

Storage of goods: Sometimes storage is a big problem among the importers since heavy imports can result in heavy pressures on the warehouse in order to store the goods in it.

World Wars: International Trade may also result in trade rivalries amongst the International players which may also result in World War.

Danger to International peace: It gives an opportunity to the Foreign players to come to another country and settle down thereby creating uncertainty and threat to Internal peace.

International trade is the exchange of goods and services between countries (at least two different countries).

- Trading globally gives consumers and countries the opportunity to be exposed to goods and services not available in their own countries, or more expensive domestically.
- The importance of international trade was recognized early on by political economists such as Adam Smith and David Ricardo.
- Still, some argue that international trade can actually be bad for smaller nations, putting

them at a greater disadvantage on the world stage.

Waves of Globalization (classical)

The 1st wave of globalization: during the second half of the nineteenth century
Combination of lower trade barrier and numerous technological innovations that strongly reduced transaction costs for movements not only of goods but also of people and capital.

- The 2nd wave of globalization: from 1945 (after Second World War, and is still continue)

Waves of Globalization (present)

Globalization 1.0 is pre-World War 1 globalization, which was launched by a historic drop in trade costs when steam and other forms of mechanical power made it economical to consume goods made faraway.

Globalization 2.0 is the post-World War II phase where trade in goods was combined with complementary domestic policies that helped share the pains and gains of globalization: establishment of institute-based, rule-based international governance

Globalization 3.0 hyperglobalization

The key is that globalization now meant factories crossing borders

Globalization 4.0 will happen when digitech allows arbitrage of international wage differences without the physical movement of workers.

好处 Globalization 4.0 brings us numerous benefits, including enhanced connectivity and communication, access to diverse cultures and ideas, expanded economic opportunities, improved innovation and technology sharing, and greater efficiency in resource allocation and problem-solving on a global scale.

The Belt and Road Initiative (BRI, B&R)

China's Belt and Road Initiative (BRI, B&R) (一带一路) is a strategy initiated by the People's Republic of China that seeks to connect Asia with Africa and Europe via land and maritime networks with the aim of improving regional integration, increasing trade and stimulating economic growth.

- The name was coined in 2013 by China's President Xi Jinping, who drew inspiration from the concept of the Silk Road established during the Han Dynasty 2,000 years ago – an ancient network of trade routes that connected China to the Mediterranean via Eurasia for centuries. The BRI has also been referred to in the past as 'One Belt One Road'.

The Belt and Road Initiative: redefining globalization

- A Chinese proposal: aiming to promote peaceful cooperation and common development around the world;

- Areas of Cooperation (Economy and Culture) under the B&R framework: public, transparent, and open, and brings positive energy to world peace and development;
- **Principle:** achieving shared growth through discussion and collaboration, and join hands to build a new system of global economic governance

对农业好处 The Belt and Road Initiative (BRI) boosts agriculture through resource complementarity, capacity cooperation, and market reciprocity, fostering productivity, technological advancements, and economic growth along the route.

Aims of BRI

- To create job opportunities for the related countries
- To introduce more talents and provide intellectual support for the BRI construction
- To promote the economic globalization and regional economic integration
- To help build a community with a shared future for mankind

Common destiny of all nations

Mankind's shared future

第九章 世界种子工业发展

1.转基因食物优点

Benefits of GM foods

There is a need to produce **inexpensive**, safe and **nutritious** foods to help feed the world's growing population. Genetic modification may provide:

- **Sturdy** 结实的、坚固的 plants able to **withstand** weather extremes
- Better quality food crops
- Higher **nutritional** yields in crops
- Inexpensive and nutritious food, like carrots with more **antioxidants** 抗氧化剂
- Foods with a greater **shelf life**, like tomatoes that taste better and last longer
- Food with **medicinal** /mə'disɪnəl/ 药用的 benefits, such as **edible** vaccines – for example, bananas with bacterial or rotavirus /ˈrəʊtəvaɪərəs/ 轮状病毒 **antigens** /ˈæntɪdʒən/ 抗原
- Crops resistant to disease and insects and produce that requires less chemical application, such as **pesticide** (杀虫剂) and **herbicide** (除草剂) resistant plants: for example, GM canola.



2.转基因食物可能的危害

Is GMO safe ?--Potential risks

- New allergens could be inadvertently created
- Antibiotic resistance may develop
- Cross-breeding
- Pesticide (杀虫剂) resistant insects
- Biodiversity
- Cross-contamination
- Pesticide use
- Health effects

Why seed production was shifted from small farmers to seed companies?

Seed production shifted to companies because they offer improved quality, consistency, access to advanced technology, and efficient marketing and distribution, which are often beyond the reach of small farmers.

1.How do you think about the rapidly growing global commercial seed market? Is this good or harm for farmers?

The rapidly growing global commercial seed market is a complex phenomenon that brings both opportunities and challenges for farmers. Here's a detailed analysis of its impacts:

Opportunities for Farmers

Access to High-Quality Seeds:

The commercial seed market provides farmers with access to a wider range of high-quality, genetically improved seeds.

These seeds often offer better disease resistance, higher yields, and improved adaptability to different climate and soil conditions.

Increased Productivity and Income:

By using commercial seeds, farmers can potentially increase their crop yields and productivity. Higher yields can lead to increased income for farmers, improving their livelihoods and economic stability.

Innovation and Technological Advancements:

The commercial seed market is driven by innovation and technological advancements in seed breeding and genetics.

These advancements can provide farmers with new tools and solutions to address agricultural challenges, such as climate change and pests.

Challenges for Farmers**Cost of Seeds:**

Commercial seeds can be more expensive than traditional seeds.

This can increase the production costs for farmers, potentially impacting their profitability.

Dependency on Seed Companies:

Farmers may become more dependent on seed companies for their seed supply.

This dependency can limit farmers' autonomy and negotiating power in the market.

Risk of Monoculture:

The widespread use of commercial seeds can lead to monoculture, where a large portion of the farmland is planted with the same crop variety.

Monoculture increases the risk of crop failures due to pests, diseases, or adverse weather conditions.

In conclusion, the growth of the global commercial seed market is a double-edged sword. It offers significant potential for improving agricultural productivity and income for farmers, but also poses challenges that need to be carefully managed and addressed.

2. How do you understand about the genetically modified seeds?

Genetically modified seeds, also known as transgenic seeds, refer to seeds whose genes have been altered using modern biotechnology. This process involves modifying the DNA that instructs the cells of an organism how to build proteins, thereby altering the traits of the organism.

+ 上面截图的优缺点

4. 国际著名种子公司:

拜耳 (Bayer CropScience)

科迪华 (Corteva Agriscience)

先正达 (Syngenta)

巴斯夫 (BASF)

利马格兰 (Limagrain)

5. As Chinese government pay more attention to the domestic seed industry, how do you understand the role of seed industry in our country?

The seed industry plays a crucial role in China's agriculture and food security. High-quality seeds are the foundation for achieving high yields and improving the quality of agricultural products. The development of the seed industry directly affects the stability and sustainability of agricultural production, as well as the competitiveness of agricultural products in the international market.

Furthermore, the seed industry is an important component of the agricultural innovation system. Through genetic improvement and breeding technology, the seed industry continuously pushes forward the upgrading of agricultural varieties, enhancing the resistance of crops to pests and diseases, and improving their adaptability to changing environmental conditions. This contributes to increasing agricultural productivity and ensuring food security.

In summary, the seed industry is a key factor in China's agricultural development and food security, and its role cannot be ignored.

6. After reading this text, what do you think about the future development of global seed industry? Please state your opinions.

抄文章 4、5 点加结论