



INTELLIGENT TECHNOLOGY & EQUIPMENT

GREENHOUSE PRODUCTION

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PROTECTED AGRICULTURE INSTITUTE

CHINESE ACADEMY OF AGRICULTURAL ENGINEERING PLANNING&DESIGN

REPORT OUTLINE



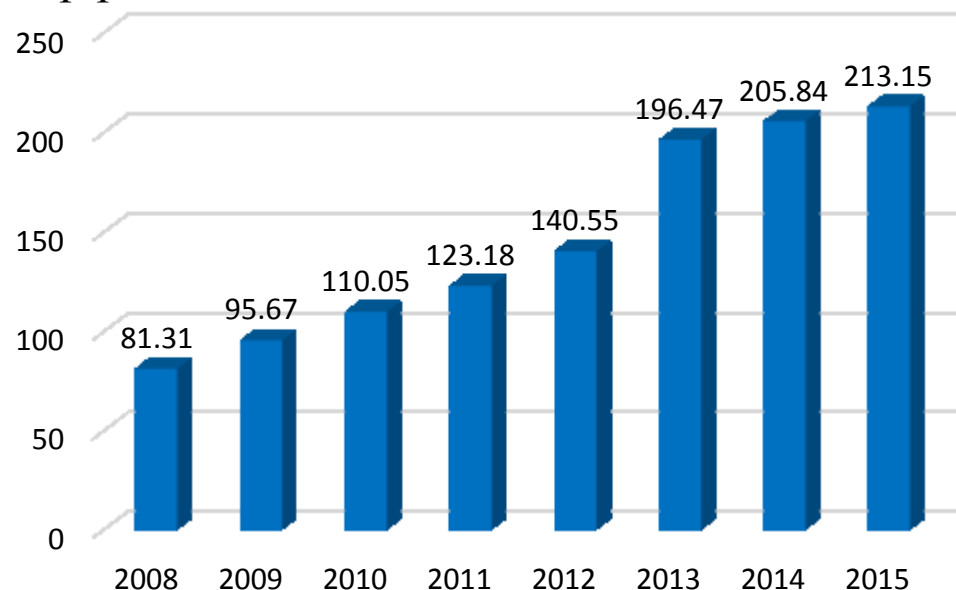
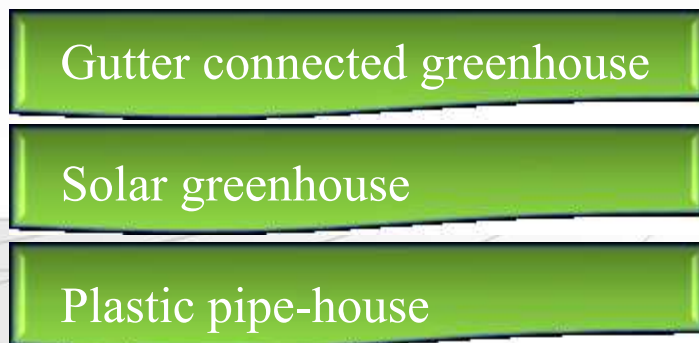
1. Developing Status for GH
2. Indoor Environment control
3. Clusters water-fertilizer supply

1. Developing Status for GH



By the end of 2016, the amount of greenhouse was 2082.8 thousand ha in China(not include small tunnels), which took **more than 80%** of the world.

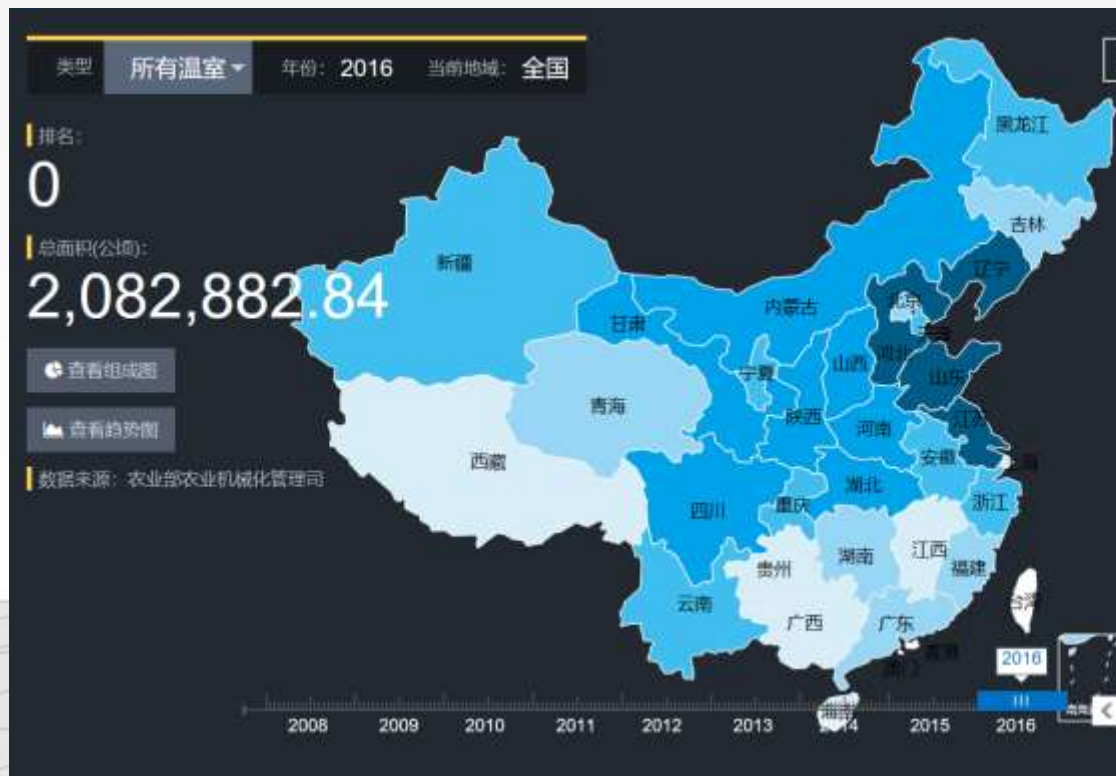
51.8 thousand ha for gutter connected greenhouses, 661.4 thousand ha for Solar greenhouses, 1.3697 million ha for plastic pipe-houses.



Unit: 10 thousand hectare

(Data source: National Statistical Yearbook of Agricultural Mechanization

1. Developing Scale



Top10	Province	Scale (ha)
0		
1	Jiangsu	338028
2	Shandong	296286
3	Liaoning	292016
4	Hebei	216382
5	Hubei	97878
6	Gansu	87600
7	Inner Mongolia	79050
8	Sichuan	76214
9	Henan	74644
10	Shanxi	68823

2. Cultivation Varieties

More than **88%** of the greenhouse is used for vegetable production



6.2% for flowers production, increasing fast



5% for fruit production, (including Berry)



For supply

In 2016, the output of vegetables from greenhouse is about **250 million tons**, accounting for **30.5% of the total vegetable output** of the country. For every people, with an average per capita share of 180 kg.



Great wall station
in the South Pole

For promoting income

The net output value of greenhouse horticulture is more than **570 billion yuan**. The income of every rural people increase more than 980 yuan by greenhouse horticulture

From Market



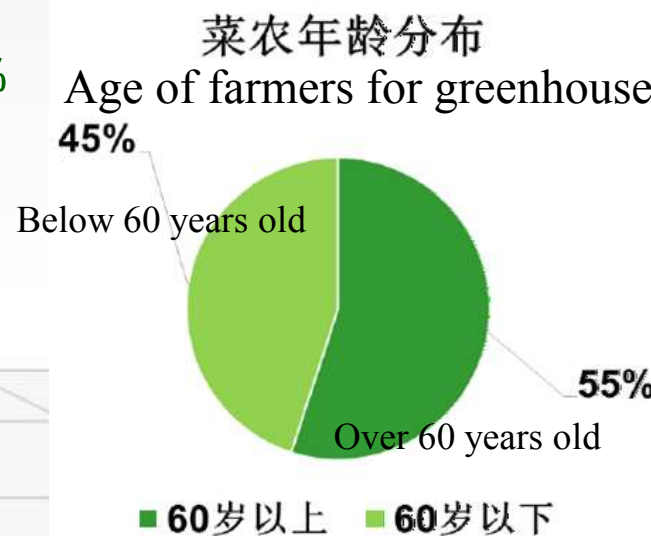
With the development of economy, demand for high quality and safety horti-products is increasingly strong.

Green Safe Fresh Delicious for products

From labor cost

Labor cost takes more and more shares of total cost for greenhouse productions , which restricts the scale development of industry.

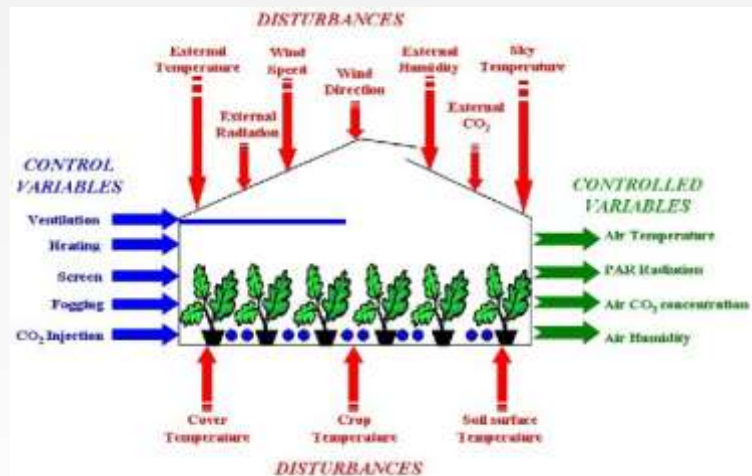
For grafting seedlings **22%~25%** For GH vegetable more **50%**



For saving labor and making precise production

the application of intelligent technology and equipment for GH necessary!

5. Developing status



Gutter connected greenhouse is easy to combine with intelligent tech&equip

— More equipment ventilation, cooling, heating、 artificial lighting

— More indoor space easy for automatic operation

— Stable process harvest time and production can be forecast



Automatic production of whole process for pot flower (Tianjin)

Anthura



基质破碎



基质填装



种苗移栽



移动喷灌+潮汐灌



智能检测、分级

Substrate mixture

Pot filling

Young plant transplant

Tidal irrigation

Classify

Automatic production of whole process for seedling (Inner Mongolia)



2ha greenhouse, investment 30 million yuan, 80 million seedling can be harvest



搅拌

Mixture



播种

Seeding



移栽

Transplant



补苗

fill the gaps

5. Developing status



Solar GH&Plastic pipe-house are main types of China. They also have demands for intelligent production.

- Few equipment;
- Few indoor space;
- Non-stable for production;



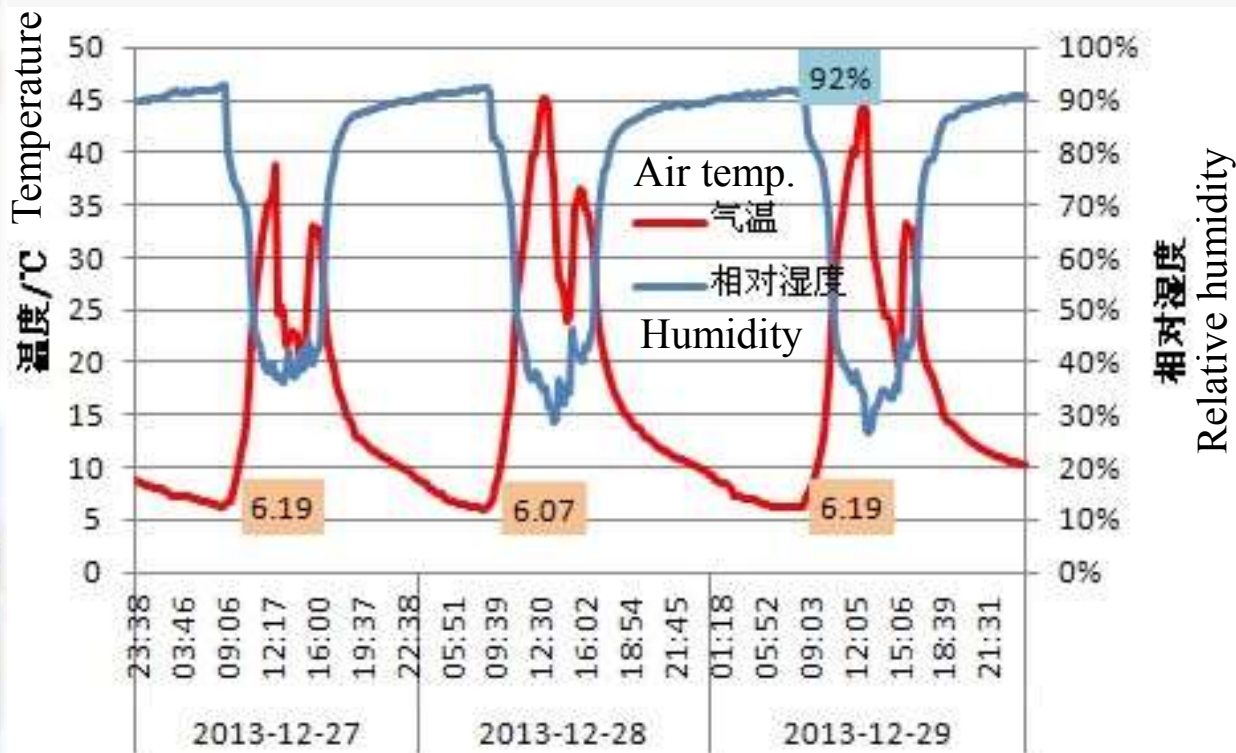
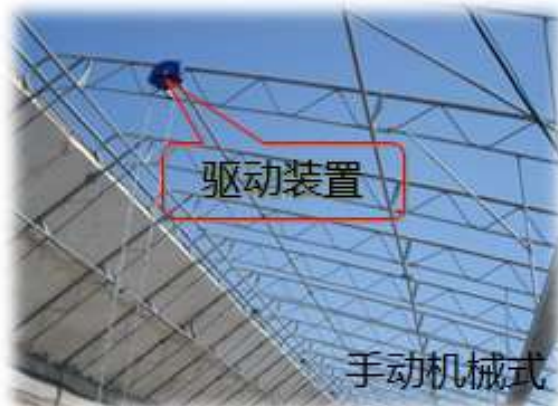
Production link Labor using

生产环节	劳动比重
耕整地	3%
定植	2%
灌溉施肥	23%
植株管理	30%
温室环境管理	19%
采收	15%
输送	6%
商品化处理	0%
秸秆废弃物处理	3%

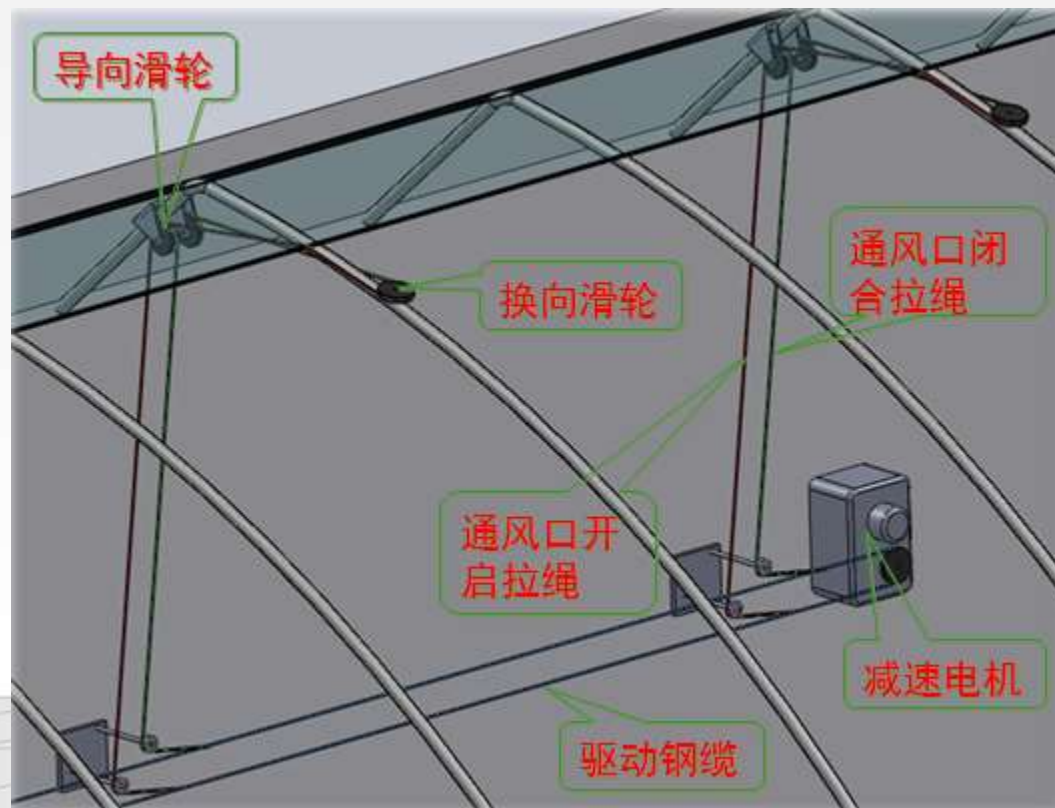
2. Indoor Environment control



Ventilation is the most frequently environmental control method for solar greenhouse. and it is also an important link affecting the quality and output of products.



The temperature and humidity of the greenhouse change abruptly when opening and closing the air outlet manually.



Gear motor ➡ **Drive steel cable** ➡ **Vent rope** ➡ **Vent open**

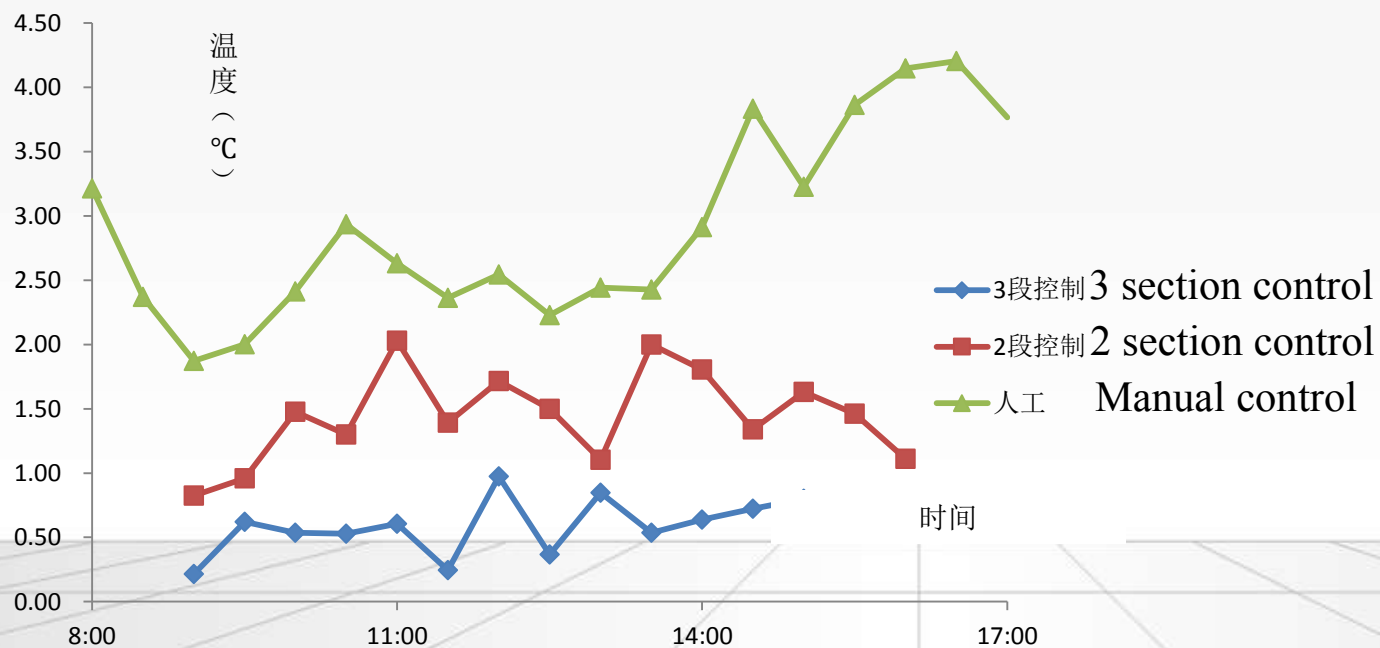
Automatically adjust ventilation according to indoor temperature changes



Separating the GH with several subsection for ventilation control. Each section detect temp and give signal for vent. Solve the temperature difference in greenhouse



Temp. deference from setting point with actual temp.

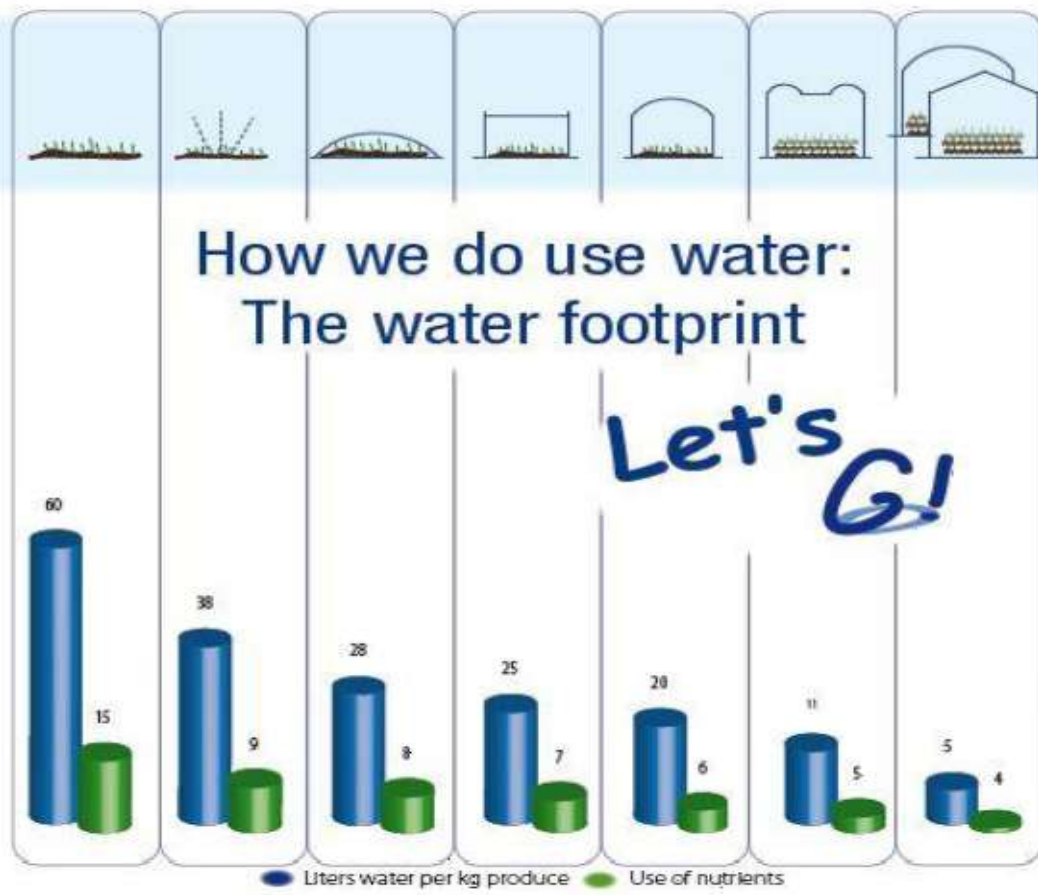


The 3 section control mode has the lowest temperature fluctuation.



3. Clusters water-fertilizer supply





- Reduction of water and fertilizer;
- Water and fertilizer cluster agement of greenhouses in the park ;

1. Design of fertilizer distribution pipeline

2. Equipped Water-fertilizer supply machine

3. Setting Cluster control

4. Establish Integrated irrigation-fertilization mode

4. Water-fertilizer supply machine

PID+PWM algorithm module (enhance control accuracy)

Channel ratio adjustment module (adjust fertilizer ratio)

Irrigation management module (automatic irrigation)

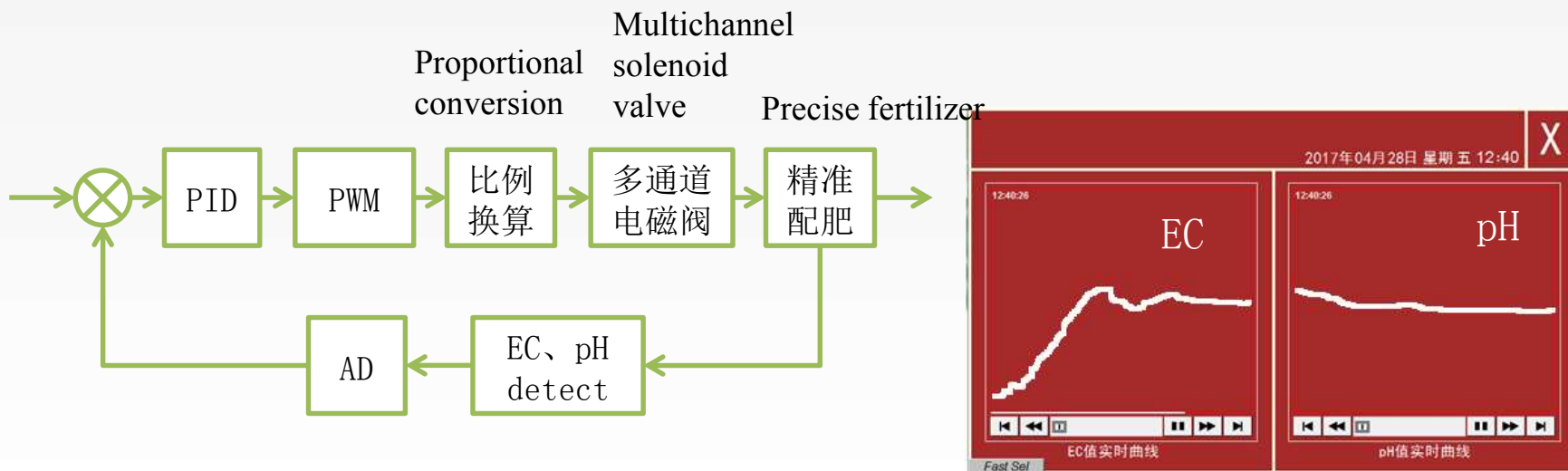
EC adjustment error is less than (+8%);

pH adjustment error is (+0.05);

response time is less than 120 s



4. Water-fertilizer supply machine



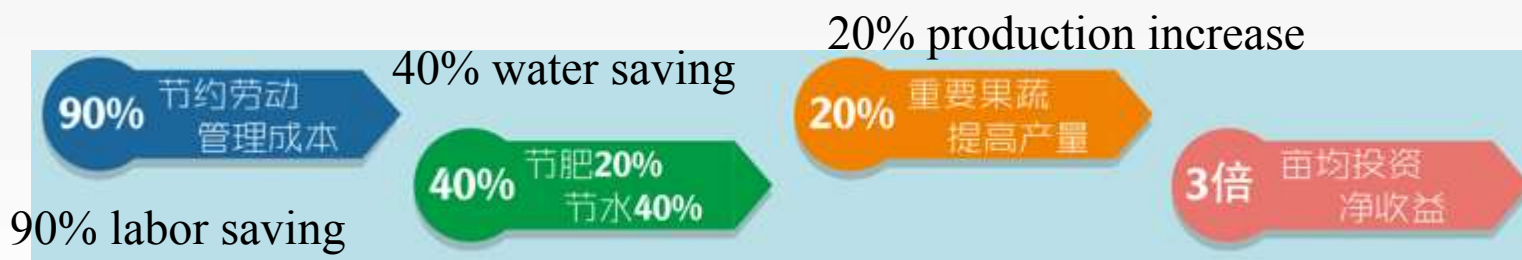
Based on the control of "**startup time + irrigation frequency + irrigation volume**", intelligent irrigation control is carried out.

- Wired: 2 line decoding, **2 lines to achieve communication, feedback and power supply**, reduce the use of lines and quantities.
- Wireless: **LoRa**, low energy consumption wide area wireless Internet of things communication technology to achieve remote automatic control.



Used in Beijing, Hebei, Shandong, Ningxia, Guangdong,

Used for soil cultivation, substrate cultivation, water cultivation



Leaf vegetable in Hebei

农业农村部规划设计研究院

Tomato in Shandong

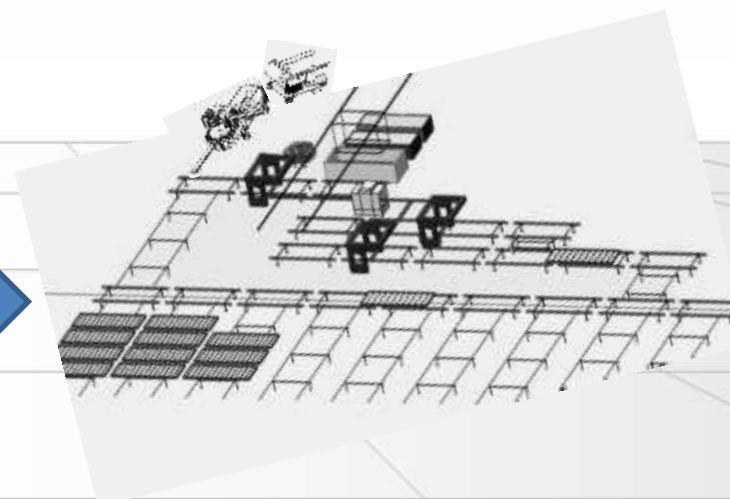
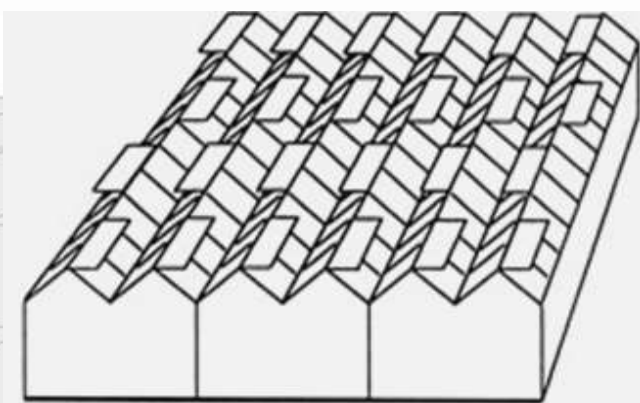
CHINESE ACADEMY OF AGRICULTURAL ENGINEERING P&D



Institute of Protected Agriculture

The earliest research and promotion of greenhouse horticulture in China

Establish National Greenhouse Horticulture research center



Thank You!



敬请帮助指正