Agricultural Lighting White Paper

I. Introduction

With the continued growth of the global population and the increasing prominence of food security issues, agricultural production methods are undergoing profound changes. Traditional farming methods relying on natural light can no longer meet the demands of modern agriculture for high yields, stability, and sustainability. LED agricultural lighting, with its high energy efficiency, adjustable spectrum, and intelligent control, is becoming one of the core technologies of smart agriculture.

According to data from Zhiyan Consulting, in 2023, the output value of China's LED plant lighting industry reached 21.755 billion yuan, a year-on-year increase of approximately 18.6%; the market size was approximately 4.338 billion yuan, a year-on-year increase of 21.9%. It is projected that by 2030, the global plant lighting market will exceed 15 billion US dollars, maintaining a compound annual growth rate in double digits.

II. Industry Background and Market Trends

2.1 Global Market

The global LED plant lighting market exceeded 3 billion US dollars in 2023, mainly used in greenhouse supplemental lighting, vertical farms, and plant factories.

Demand is strong in North America and Europe, especially in developed countries with advanced facility agriculture such as the Netherlands and Japan.

The global market is projected to grow at a CAGR of approximately 12-15% from 2024 to 2030.

2.2 China Market

The Chinese LED plant lighting market reached RMB 4.338 billion in 2023 and is projected to exceed RMB 10 billion by 2030.

Main application scenarios: vegetable greenhouses, flower cultivation, fruit tree supplemental lighting, plant factories.

Policy support: The Ministry of Agriculture and Rural Affairs promotes smart agriculture, and local governments subsidize the upgrading of lighting in facility agriculture.

III. Solution Framework

3.1 Plant Lighting Solutions

Red and Blue Light Plant Lamps: Wavelengths concentrated at 450-470nm (blue light) and 630-660nm (red light), promoting photosynthesis.

Full-Spectrum Plant Lamps: Simulate natural light, improving the quality of fruits and vegetables.

Application Data: Experiments show that red and blue LED lamps can increase tomato yield by 20-30% and lettuce yield by 25%.

3.2 Livestock Lighting Solutions

Brooding Lamps: Provide stable illumination, improving poultry survival rates.

House Lighting: Improve animal welfare and reduce stress.

Case Study: After adopting LED house lighting, a large-scale farm saw a 15% decrease in chicken mortality and an 8% increase in feed conversion rate.

3.3 Aquaculture Lighting Solutions

Aquaculture Lamps: Promote fish growth and increase yield.

Underwater LED Lamps: Improve the aquatic environment and enhance fish activity.

Case Study: At a southern aquaculture base, the use of underwater LED lamps increased tilapia production by 12% and feed utilization by 10%.

3.4 Cold Chain Lighting Solutions

Cold Storage Lamps, Corrosion-Resistant Lamps, Moisture-Proof Lamps: Ensure food storage safety.

Case Study: After adopting LED cold storage lamps, a cold chain storage center saw a 40% reduction in lighting energy consumption and a 5% reduction in food spoilage.

IV. Key Products and Technical Parameters

Product Category	Spectral range	power	Lighting effects	Service life	Application scenarios
Red and blue light plant lights	450–470nm / 630–660nm	50–200W	120–180 lm/W	≥50,000 hours	Greenhouses, plant factories
Full-spectrum plant lights	380–780nm	100–300W	130–200 lm/W	≥50,000 hours	Fruit and vegetable cultivation, flower cultivation
Livestock shed lighting	4000–5000K	30–100W	100–150 lm/W	≥40,000 hours	Livestock farms
Underwater LED lights	450–550nm	20–80W	100–130 lm/W	≥30,000 hours	Aquaculture bases
Cold storage lights	5000–6500K	50–150W	110–160 lm/W	≥50,000 hours	Cold chain storage

V. Core Technological Advantages

Customized Spectrum: Provides customized spectral solutions for different crops.

Blue light promotes leaf growth, red light promotes flowering and fruiting.

Full spectrum enhances fruit and vegetable quality.

Intelligent Control: Supports APP, voice, and sensor linkage.

Remotely adjusts light intensity and duration.

Integrates with temperature and humidity control systems.

Energy Efficiency: LED light sources are 50-70% more energy-efficient than traditional high-pressure sodium lamps.

Lifespan up to 50,000 hours.

System Integration: Integrates with security, environmental monitoring, and irrigation systems.

Comfort and Safety: Flicker-free, low blue light ensures plant and animal health.

VI. Application Cases

Greenhouse: A vegetable base deployed full-spectrum plant lights, resulting in a 30% increase in yield and significant quality improvement.

Livestock Farm: Using brooder lights increased poultry survival rate by 12%.

Aquaculture Base: Underwater LED lights promote fish growth, increasing yield by 15%.

Cold Chain Warehousing: Corrosion-resistant cold storage lights ensure food safety and reduce energy consumption by 40%.

VII. Future Outlook

Smart Agriculture and IoT Integration: Automatic light optimization through sensors and AI algorithms.

AI-Driven Spectral Optimization: Dynamically adjusting the spectrum based on crop growth data.

Carbon Neutrality Goals: LED agricultural lighting will become an important tool for energy conservation and emission reduction.

Market Forecast: By 2030, the Chinese LED agricultural lighting market is expected to exceed 10 billion yuan, and the global market size will exceed 15 billion US dollars.

VIII. Conclusion

Agricultural lighting solutions are not only tools for increasing yields but also core supports for smart agriculture and sustainable development. Zhengfa Technology will continue to drive LED technology innovation, provide customized lighting solutions, and help customers achieve energy conservation, efficiency improvement, and green development