

Market Potential Prediction and Policy Path of Hydroponic Vegetables in Green Agriculture Strategy

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Abstract

With the growth of global population, the intensification of resource constraints and the increasing attention of consumers to food safety and health, green agriculture has become an important direction of modern agricultural development. Hydroponics vegetables, as an important part of green agriculture, show great market potential with its advantages of water saving, land saving, environmental friendliness, short growth cycle and good quality. This paper aims to analyze the market potential of hydroponics vegetables in green agriculture strategy, and explore the policy path to promote its development. Through literature review and data statistics, this paper reveals the development status, growth trend, driving factors and challenges of hydroponic vegetable market, and puts forward corresponding policy suggestions, in order to provide reference for government decision-making and enterprise development.

Keywords

Green Agriculture, Hydroponic Vegetables, Market Potential, Policy Path, Sustainable Development.

1. Background

China is a country with a large population, and the per capita cultivated land area is relatively small. With the continuous increase of population, the per capita cultivated land will be further reduced in the future [1]. The limitation of land resources puts forward higher requirements for agricultural production efficiency. The challenges of environmental crises such as soil degradation and climate change to agricultural production have increased the uncertainty and risk of agricultural production and food security. Therefore, the transformation of agricultural production technology has become an urgent problem to be solved. At the same time, in the post epidemic era, the concept of healthy diet is deeply rooted in the hearts of the people and has become an important part of the modern lifestyle [2]. With the continuous improvement of consumers' health awareness, the wave of green consumption has risen, leading to profound changes in the consumer market. In the past, people tended to pay more attention to the taste and taste of food, less attention to nutritional value and health, and the popularity of the concept of healthy diet has made more and more people pay attention to nutritional balance. The characteristics of hydroponics vegetables, which are pollution-free and environmentally friendly, are bound to attract a wave of healthy consumers.

As the top-level design of industry development, national policies also provide clear guidance and support for the transformation and upgrading of agriculture and food industry. In recent years, the state has issued a series of policies and measures to promote agricultural modernization, including increasing investment in agricultural science and technology research and development, optimizing the agricultural industrial structure, and promoting the green development of agriculture. These policies not only provide financial support and policy

guarantee for the R&D and innovation of agricultural technology, but also encourage agricultural enterprises to increase investment in science and technology and improve product quality and competitiveness [3]. At the same time, technology iteration and upgrading has become an important force to promote the development of agriculture and food industry. With the rapid development of information technology, the Internet of things, big data, artificial intelligence and other advanced technologies have been widely used in the field of agriculture. The application of these technologies not only improves the accuracy and efficiency of agricultural production, but also promotes the intelligent and transparent supply chain of agricultural products.

Therefore, as a sustainable agricultural model, green agriculture emphasizes the efficient use of resources, environmental protection and ecological balance. Hydroponic vegetables as a typical representative of green agriculture, through soilless cultivation, use nutrient solution to provide water and nutrients for plant growth, effectively avoid soil pollution, waste of water resources and other problems, and have broad market prospects.

2. Literature Review

The production technology is constantly upgraded, and the research on Hydroponics technology is from production optimization to sustainable exploration. Despommier proposed the concept of "vertical farm" and demonstrated the significant advantages of soilless cultivation in yield per unit area and water saving efficiency, which has become the theoretical cornerstone of urban agriculture [4]. Barbosa et al. established a life cycle assessment model and pointed out that the carbon footprint of hydroponics vegetables was 30% -50% lower than that of open-air cultivation, but energy consumption concentration may offset some environmental benefits [5]. The above research shows that agricultural production technology has been constantly improving, from optimizing production technology to sustainable development, which has greatly promoted agricultural production.

The production and consumption of hydroponic vegetables in the world are good, supported by national policies, and China's agricultural policies have been issued, but the implementation needs to be strengthened. Through the "farm to fork" strategy, the EU will include vertical agriculture in the support scope of the green transition fund, and the 2025 plan will cover 10% of the urban vegetable supply [6]; The Singapore government subsidized hydroponics farms through the "30 ×30 express" program, raising their lettuce self-sufficiency rate from 8% to 14% . China's "14th five year plan for national agricultural green development" clearly puts forward the "development of intelligent plant factories", but the implementation of the policy still faces problems such as lack of standards and fragmentation of subsidies. The above research shows that the State supports the development of green agriculture, but how to transform and upgrade agriculture into the ranks of green development is still an urgent problem to be solved.

3. Technical Characteristics and Advantages of Hydroponic Vegetables

3.1. Definition and Classification of Hydroponic Vegetables

Hydroponic vegetables are vegetables that grow in the nutrient solution layer and only provide water, nutrients and oxygen through the nutrient solution, which are different from the traditional soil cultivation [7]. According to different cultivation methods, hydroponics vegetables can be divided into nutrient liquid membrane technology (NFT), deep flow technology, floating plate hydroponics technology, etc [8].

3.2. Technical Characteristics of Hydroponic Vegetables

Soilless cultivation: hydroponic vegetables do not need soil, and their roots grow directly in nutrient solution, avoiding soil pollution and soil borne diseases.

Nutrient solution supply: nutrient solution is a solution containing a variety of nutrient elements prepared according to the needs of plant growth, which provides continuous and stable nutrient supply for plants through the circulating supply system.

Environment controllable: hydroponic vegetables are usually cultivated in controlled environments such as greenhouses or indoor farms, which can accurately control environmental factors such as light, temperature and humidity, and provide the best growth conditions for plants.

3.3. Advantages of Hydroponic Vegetables

Water and fertilizer saving: the nutrient solution of hydroponic vegetables can be recycled, greatly reducing the waste of water resources. At the same time, because the nutrients in nutrient solution can be accurately controlled, the loss and waste of nutrients in traditional soil cultivation are avoided, and the fertilizer utilization rate is improved.

Short growth cycle: compared with traditional soil cultivated vegetables, the growth cycle of hydroponic vegetables is significantly shorter, which can enter the market faster and meet the demand of consumers for fresh vegetables.

Good quality: hydroponic vegetables can fully absorb the nutrients in the nutrient solution during the growth process, and because the growth environment is controlled, the occurrence of diseases and pests is reduced, so its quality is better than that of traditional soil cultivated vegetables.

Environmentally friendly: hydroponic vegetables do not rely on soil, reducing the occupation and destruction of land resources. At the same time, due to the reduction of the use of pesticides and fertilizers, the pollution to the environment is relatively small.

4. Development Status of Hydroponic Vegetable Market

4.1. Overview of Global Hydroponic Vegetable Market

In recent years, the global hydroponic vegetable market has shown a rapid growth trend. According to statistics, the scale of the global hydroponic vegetable market has reached about 77.9 billion yuan in 2023, and is expected to reach 148.2 billion yuan by 2030, with a compound annual growth rate maintained at a high level. The main driving forces of the global hydroponic vegetable market include the increase in consumer demand for healthy food, the acceleration of urbanization, the shortage of water resources and the government's support for green agriculture.

4.2. Current Situation of Hydroponic Vegetable Market in China

(1) Market size and growth trend

In China, hydroponics vegetable industry also showed strong growth momentum. According to statistics, the output of hydroponic vegetables in China has reached 11million tons in 2022, and the market scale has reached 43.5 billion yuan, with an average annual growth rate of more than 30% in recent years. It is expected that the market scale of hydroponic vegetables in China will continue to expand by 2025, and the compound annual growth rate is expected to maintain a high level.

(2) Market distribution and consumer groups

China's hydroponic vegetable market has covered many provinces across the country, forming a relatively complete market system from planting, processing, sales to export. In terms of

consumer groups, with the improvement of consumers' awareness of food safety and healthy diet, hydroponic vegetables are gradually favored by consumers in first and second tier cities and some regions with rapid economic development. At the same time, with the development of cold chain logistics, the market coverage of hydroponic vegetables has gradually extended to second and third tier cities and even wider regions.

(3) Key players and competitive landscape

The main participants in China's hydroponic vegetable market include agricultural leading enterprises, professional hydroponic vegetable production enterprises, cross-border agricultural science and technology enterprises and some traditional soil vegetable producers. Agricultural leading enterprises and professional hydroponic vegetable production enterprises occupy an important position in the market by virtue of their scale advantages, technical advantages and brand influence. Agricultural science and technology enterprises entering across the border, such as Internet enterprises and real estate enterprises, also actively participate in the hydroponic vegetable market and rapidly expand market share through the marketing mode of online and offline combination.

5. Market Potential Prediction of Hydroponic Vegetables

5.1. Market Size Forecast

Based on the current market development trend and future growth potential, it is expected that the market scale of hydroponic vegetables in China will continue to maintain a rapid growth trend. By 2030, the market scale of hydroponic vegetables in China is expected to exceed 100 billion yuan and become an important growth point in the field of green agriculture. This prediction is mainly based on the following considerations:

Consumer demand growth: with consumers' growing concern about healthy diet and environmentally friendly lifestyle, hydroponic vegetables will be favored by more consumers because of their soilless cultivation, pollution-free, high quality and other characteristics. It is expected that the consumption demand of hydroponic vegetables will continue to grow in the next few years.

Technical progress and cost reduction: with the deepening application of intelligent and automatic technology in hydroponic vegetable production, the production efficiency will be further improved and the production cost will be gradually reduced. This will help to expand the market scale of hydroponic vegetables and improve their market competitiveness.

Policy support and guidance: the government has continuously increased its support for green agriculture and issued a series of policies and measures to encourage the development of hydroponic vegetable industry. These policies will provide strong guarantee and impetus for the development of hydroponic vegetable market.

5.2. Growth Trend Analysis

Product diversification trend: with the increasing demand of consumers for the diversity of vegetable varieties, the hydroponic vegetable industry will continue to develop new varieties, enrich product categories and meet market demand. In addition to the common leafy vegetables, more fruit vegetables and rhizome vegetables will be gradually introduced.

Intelligent and branding trends: with the continuous development of Internet of things, big data, artificial intelligence and other technologies, the production of hydroponic vegetables will be more intelligent and accurate. At the same time, brand building will also become an important means to enhance the competitiveness of hydroponic vegetable industry. By strengthening brand building and improving product quality and service level, enterprises will win the trust and support of more consumers.

Internationalization trend: with the in-depth development of Global trade liberalization and regional economic integration, the internationalization of hydroponic vegetable industry will accelerate. Chinese hydroponic vegetable enterprises will actively expand the international market, strengthen the integration and mutual recognition with the international market, and enhance their international competitiveness.

5.3. Consumer Group Forecast

In the future, the consumer groups of hydroponic vegetables will be more extensive and diversified. In addition to the existing urban middle and high-end consumers, it will also gradually expand to ordinary urban residents, rural residents and consumers in the international market. As consumers' awareness of healthy diet and environmentally friendly lifestyle continues to improve, hydroponics vegetables will become the preferred vegetable variety for more consumers.

6. Policy Path to Promote the Development of Hydroponic Vegetable Market

6.1. Policy Support and Guidance

Formulate a special development plan: the government should issue a special plan for the development of hydroponic vegetable industry, clarify the development goals, key tasks and policy measures, and provide macro guidance for industrial development. Provide financial subsidies and tax incentives: provide financial subsidies and tax incentives to enterprises and farmers engaged in hydroponic vegetable production to reduce production costs and improve production enthusiasm. Support technology R&D and Innovation: set up a special fund to support the R&D and innovation of hydroponic vegetable technology and promote industrial technology progress and upgrading.

6.2. Environment Friendly and Sustainable Development

Promote environmentally friendly production technology: encourage enterprises to adopt environmentally friendly production methods, such as the use of clean energy, energy conservation and emission reduction measures, to reduce energy consumption and emissions in the production process. Strengthen water resources management: hydroponic vegetable production requires a large amount of water resources. The government should strengthen the management and protection of water resources to ensure the sustainable use of water resources. Promote green certification and identification: establish a green certification and identification system for hydroponic vegetables to improve consumers' trust and recognition of products.

6.3. Social Governance and Public Participation

Strengthen industry supervision and standardization construction: the government should strengthen the supervision of hydroponic vegetable industry, formulate industry standards and specifications, and ensure product quality and safety. Promote public participation and popular science education: through popular science education, publicity and promotion, improve the public's awareness and acceptance of hydroponic vegetables, and promote the growth of market demand. Support the development of cooperatives and family farms: encourage cooperatives and family farms to participate in hydroponic vegetable production, give full play to their advantages in the local market and meet market demands at different levels.

6.4. International Cooperation and Exchange

Strengthen international exchanges and cooperation: the government should encourage enterprises to strengthen cooperation and exchanges with international advanced enterprises,

introduce advanced technology and management experience, and improve their own development level. Promoting international trade and cooperation: by participating in international exhibitions and establishing overseas sales networks, China's high-quality hydroponic vegetable products will be introduced to the global market to improve international competitiveness.

7. Conclusion and Prospect

7.1. Conclusion

Through literature review and data statistics, this study analyzed the market potential and policy path of hydroponics vegetables in green agriculture strategy. The results showed that hydroponics vegetables showed great market potential because of its advantages of water saving, land saving, environmental friendliness, short growth cycle and good quality. It is estimated that by 2030, the market scale of hydroponic vegetables in China is expected to exceed 100 billion yuan. However, the development of hydroponic vegetable market is also facing challenges such as high technology input cost, consumer awareness needs to be improved, and fierce market competition. Therefore, the government should increase support, improve the standardization and regulatory system, promote technological innovation and R&D, strengthen market promotion and brand building, and expand international markets and cooperation to promote the healthy development of hydroponic vegetable market.

7.2. Prospects

Future research can further explore the details of hydroponic vegetable technology, such as the formula optimization of nutrient solution and the precise control of cultivation management, in order to improve the production efficiency and quality of hydroponic vegetables. At the same time, in addition to hydroponics vegetables, the research can also be extended to other green agriculture fields, such as organic agriculture and ecological agriculture, to explore the market potential and policy path of different green agriculture models. With the continuous development of globalization, future research can strengthen international cooperation and exchange, learn from foreign advanced green agricultural technology and management experience, and promote the international development of China's green agricultural industry.

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