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Challenges to Food Development in Global Perspectives

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Despite having only 7% of the world's arable land, China manages to feed roughly 22% of the world's population. Large-scale environmental pollution throughout the country as a result of agriculture casts a shadow on this remarkable achievement. China proposed the Green Food Strategy in the 1990s and established a specialized management agency, the China Green Food Development Center, complete with a monitoring network for policy and standard creation, brand authorization, and product inspection to guarantee nutrition security and environmental sustainability. In 2019, 15,984 green food companies offered 36,345 unique products, all of which adhered to these 140 environmental and operational standards. 8.2% of China's total farmland area and 9.7% of the country's annual agricultural GDP were devoted to growing green food, respectively. In this work, we provide a comprehensive overview of the current state of green food regulation, standards, and authorization in China, as well as its environmental benefits, challenges, and potential strategies for optimization and scaling in the future. The rapid growth of China's green food industry may point to a replicable, win-win strategy for protecting the environment, boosting agro-economic growth, and enhancing human nutrition and health in other developing countries and regions.

Keywords; Food Security, Food Quality, Sustainable Development

Introduction

The need to increase annual grain production by about 580 million metric tonnes (MT) by 2030, or 2% per year, to meet the grain demands of the rapidly growing population is a leading challenge of the 21st century [1]. China's total annual grain production has increased from 280 to 617 million tons (120%) and the average grain yield has increased from 2949 to 6081 kg ha1 (106%) over the last four decades (1980-2018) [2]. This is although 22% of the world's population depends on only 7% of cultivated land [1]. High levels of resource inputs are crucial to such successes in grain production. Increases from 9.34 to 20.65 million tonnes of chemical nitrogen (N) fertilizers applied have led to a decrease in overall N use efficiency to 0.25 from 0.42 in developed countries [3]. Soil acidification, increased greenhouse gas emissions, nitrogen deposition, and eutrophication of surface water are the results of releasing an excess of synthetic N into the environment [4]. Heavy metals such as Cd and Mn are made much more bioavailable by soil acidification in southern China [5], and some composts and phosphate fertilizers contain unintentionally high concentrations of heavy metals. Heavy metals, especially cadmium (Cd), nickel (Ni), and arsenic (As), have contaminated nearly 20% of China's farmland [6], and the resulting food contamination is a growing agricultural and social problem [7]. Another obstacle to enhancing food quality is the excessive use of pesticides, the intensity of which has increased from 5.83 kg/ha in 1990 to 13.07 kg/ha in 2018—a growth rate of 4.28% per year, on average [3]. Therefore, in 2015, in order to maintain agriculture development in China, the public policy "zero growth of chemical fertilizer and pesticide use by 2020" was initiated.

In 1990, China's Ministry of Agriculture (MOA) coined the term "green food," which encompasses a wide variety of raw materials and finished products derived from plants, animals, fungi, and other microorganisms, as well as various spices and seasonings [8]. The China Green Food Development Center has established standard operational protocols for the entire industry chain, from farm to fork, to ensure quality control and efficient resource utilization throughout the entire process of producing, processing, packaging, storing, and transporting green foods (CGFDC). By imposing stringent regulations and conducting regular inspections, "green food" dramatically reduces resource inputs like chemical fertilizers, pesticides, and related additives; spreads new technologies; enhances environmental and food quality; and boosts farmers' incomes [9][10]. The domestic and international markets for green food, as well as the number of products and companies producing them, have expanded at an exponential rate over the past three decades. In this article, we provide a comprehensive overview of the green food industry's significance, challenges, and regulatory framework [11].

What's the Deal with China's Green Food? A Look at Its Development, Standardization, and Categorization to maintain the standard and safety of China's food supply, the country formally adopted organic food in 1989, green food in 1990, and safe food (pollution-free food) in 2001. Constraints on the variety and quantity of chemical inputs across all three tiers stand out as a defining feature of this type of categorization. Only organic fertilizers can be used in organic farming, and the use of biological pathogen control is strongly encouraged. However, only a select few consumers can afford organic food due to its high quality and price [12][13]. The green food category is more popular among Chinese farmers and better satisfies consumers' demands for quality and safety because it uses half as many chemical fertilizers, pesticides, and additives as conventional farming does and bans or restricts the use of nearly 72% of China's commercially available pesticides [14][15]. After the majority of food producers and farmers had already adopted the certification system's safety standard, it was discontinued in 2018. The China Green Building and Development Council oversees a network of 96 regional and national monitoring organizations that ensure compliance with national policies and standards (CGFDC). Green food, in contrast to "safe" food, places more of an emphasis on environmental control by laying out detailed requirements for on-site research, monitoring, and evaluation. All raw materials used in production pass stringent environmental quality tests, including those for soil, water, and air, and are guaranteed to be free of any heavy metals and other contaminants at or below the strictest national standards[16]. According to China's national food safety standard, general agricultural producers have access to 527 different types of pesticides. However, the green food guide only recommends using 131 of these pesticides. A HACCP-like "from farm to fork" control principle is used in the green food industry.

Once approved, applicants can start producing and selling their products bearing the CGFDC's "Green food" logo. The validity of the authorization is immediate and extends for three years, after which it must be renewed. The businesses that use the "green" logo on their food products undergo an annual inspection by the monitoring team to ensure that their processes and goods are up to par.

Recently, there has been a push to get smaller farms off of the conventional agriculture track and into the green food business, which has led to an increase in the number of businesses but no discernible growth in farmland. Instead of expanding into new regions, newly certified businesses are more interested in food processing for higher added value, which has a greater impact on modernizing the industry. Briefly put, the yearly home

The agricultural sector contributed roughly 9.7 percent to GDP in 2019, with total sales of CNY 465.7 billion (National Bureau of Statistics of China). The green food market appears to be thriving outside of China, with exports jumping from US$0.04 million in 2001 to US$4.13 billion in 2019. Numerous farmers have been drawn to the sustainable food industry as it has steadily grown, and industrial standardization has been fostered as a result.

Products of agriculture and forestry in their raw and refined forms Food and drink items Domesticated animals and birds Aquatic crops and other goods. Green food is comprised of 23,986 different items, the vast majority coming from agriculture and forestry (73.5 million tonnes). Sixty-six percent of the total amount of green food can be broken down into the categories of vegetables, fruits, and rice. Meat (1.4%), pig (1%), lamb (0.8%), and chicken (0.5%) products make up the third grouping (5.5%). Products derived from the oceans and seas make up the 4. There is a significant barrier to entry for producers of livestock, poultry, and aquatic products because green food does not allow for direct GM feed or additives [17].

Ecological Patterns

Green food outlets were most numerous along the mainland's eastern coast and in Heilongjiang at year's end but could be found in every province by 2020. Only five provinces in China are home to more than 40% of all green food businesses, with the majority located in Shandong. It is difficult to do business in Tibet, so most companies do not even try. in addition to merchandise (42). The western part of China has better environmental conditions than the rest of the country, giving it an edge in the race to become self-sufficient in environmentally friendly food production for the sake of rural and economic development.

China's novel and sophisticated approach to ensuring long-term food quality is green food. Green food is one approach to sustainable agriculture, environmental protection, and human health that is being adopted globally. Particularly prevalent in the United States, Western Europe, and North America are organic farming and integrated farm management practices. For instance, LEAF (Linking Environment And Farming) in the United Kingdom is working hard to provide a food and farming system that is more sustainable and resilient [18] [19]. The Positive Effects of Organic and Sustainable Foods on Agriculture and the Environment Significant environmental, economic, and social effects have resulted from the rapid growth of green food on the mainland over the past three decades [20] [21]. This article examines the effects on crop production and environmental protection of a 50% reduction in chemical nitrogen fertilizers and a 50% increase in organic fertilizers (N fertilization guide for green food) (Table S2).

Crop Production

Numerous studies have shown that only about half of applied nitrogen (N) fertilizers are taken up by crops, with the rest ending up in the soil, water, or air where it can cause severe environmental damage. Crop yield was found to increase by 12.7% when animal manure was used in place of 50-75% of chemical N fertilizers, according to a recent meta-analysis. [22]. This method of growing green cucumbers eliminates the risk of contamination from the environment, making it a better option for human consumption than cucumbers grown by local farmers [23][24].

Environmental Assessment

Organic fertilization decreases water pollution while increasing soil organic matter, microbial activity, and the capacity to hold water and nutrients [25] [26]. One more distant challenge is changing the public's conception of "green food" as a separate category [27]. Such a product structure is inadequate to meet consumers' dietary preferences and requirements. The western part of China has a lot of untapped potentials because of its abundance of natural resources and because it seems like a good place to grow organic food, but it lags far behind the eastern part of the country in terms of development. For instance, Xinjiang and Ningxia are two of China's most important regions for growing grapes, used in both fresh consumption and winemaking [28]. Green food has the potential to improve local economic development, employment opportunities, and farmer incomes if production is scaled up in the right way, using sequential processing and optimized logistical organization [29].

Technical Growth

Upgrading industries, decreasing food waste, and increasing productivity are all aided by technological advancements. New methods are needed all along the food production and distribution chain to manage nutrients, crops and animals, diseases, processing, refrigeration, and waste [30]. In addition to boosting export competitiveness, innovations in technology ensure food quality, foster the growth of industry leaders, and enable more effective advertising and marketing campaigns. Sixty percent or more of green food producers today are very small operations with few resources for R&D and technological advancement. One reason green food production technology is not more widely used by local farmers is a lack of training programs for farmers and an inadequate understanding of the technology's fundamental importance [31].

There is still a significant lack of competitiveness and low levels of trade in the green food industry as a whole [32]. Despite China's green food industry's impressive growth, not nearly enough of it is meeting the country's and the global demand for healthy, non-toxic produce. In 2017, people spent more than USD 69.8 billion on organic food consumption [36]. This indicates that the market for organic food is large and growing around the world. Yet, in 2017, China's exports of green food were worth only about USD 2.5 billion. Green food is not under some international standards and permits the use of chemical compositions in production. Barriers to the export of environmentally friendly foods include a lack of product variety and an absence of processed goods [33]. Higher prices increased consumer awareness and skepticism about green food products.

Green food, also known as organically produced food, is in high demand, and this has been a major factor in the growth of related businesses. Few people buy green food because they are skeptical of the claims made by manufacturers and they are unaware of the standards by which green food is currently judged [34].

Supporting the growth of the sustainable food sector is not always an easy task for policymakers [35]. The green food industry has received significantly less funding for R&D, which has led to a severe lack of information in this field. Improved regulations to enhance the structural efficiency of the industry help green food grow. [36]. Insects and aquatic organisms, both of which have a low environmental impact, should be considered for their potential as "green food." It's possible that insects could one day be a reliable replacement for meat in human and animal diets. Higher feed conversion rates and improved growth efficiencies distinguish them from traditional livestock[37] [38]. Insect-based diets have additional benefits, including lowering pesticide use and increasing biodiversity in habitats. Similarly, seafood like jellyfish has the potential to be developed as a protein-rich alternative with fewer carbohydrates and fats and fewer negative effects on the environment [39]. In a nutshell, the key to successful regional green food development is the establishment of an industry with distinctive products and a well-defined organizational framework, as well as the application of a superior resource base. Green food development allows for innovative supply chain management that has positive environmental effects and boosts earnings for farmers and businesses. Having a distinct brand identity is essential in the green food industry

Green crop production may be eligible for additional ecological subsidies to lower chemical fertilizer use and raise carbon sequestration. By providing substantial tax deductions, the government could stimulate the growth of the livestock, poultry, and aquatic industries, as well as the processing and distribution of food and organic fertilizers [40][41].

The possible global effects of China's green food industry have been projected using scenario analysis. A common example is the "Green Food Fertilizer Application Guideline," which proposes halving the use of chemical N fertilizers to increase China's share of "green

food" from 10% to 20%, and the resulting reduction in N fertilizer use and emissions that could result from such widespread adoption [42]. For this analysis, it was assumed that the loss of nutrient nitrogen in fruit is similar to that in vegetables.

[40]. The production of eco-friendly foods is a practical strategy for lowering N-based fertilizer use and consequently reducing environmental damage. Despite its history of excessive N fertilizer use, China has made sustainable agriculture a top priority. [43] [44]. However, China's agricultural sector still has a way to go before it can adequately address the twin challenges of increasing agricultural output while reducing its environmental footprint [45]. With its reduced reliance on chemical inputs, green food production is a method that can be used indefinitely without causing harm to the environment. Sustainable development in China can be achieved through measures such as the widespread adoption of green food farming practices and the replacement of intensive conventional agriculture.

By enhancing the soil's physical, chemical, and biological properties, greener farming methods can boost soil health and lessen the environmental pollution that plagues all living things. For the soil's biological processes, which are the soil's backbone, to flourish, carbon-rich amendments must be introduced. In sum, the widespread adoption of environmentally friendly farming practices has the potential to increase the availability of healthy food, enhance soil fertility and quality, and ultimately raise people's standard of living sustainably.

Conclusions

When compared to traditional yield-centered production systems, green food's historical focus on the environment and food quality dates back to the early 1990s, when arable land was carefully selected, chemical inputs were drastically reduced, and postharvest regulations were gradually established. Since people are becoming more conscious of environmental and health concerns, and since healthy diets have become a popular new consumption trend, the social and economic environment is much more conducive to green food. The implementation of green food standards is also supported by the increasing enforcement of environmental protection policies. More conventional farmers are prepared to use half as much chemical nitrogen fertilizer and 131 types of pesticides, out of 527 on the market, to satisfy environmental regulations and boost food quality. Green food is a model for agricultural development that has the potential to lessen the burden on the environment and increase farmers' incomes.

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