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SOME MODERN AND SUSTAINABLE AGRICULTURAL MODELS IN THE WORLD AND LESSONS FOR VIETNAM

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ABSTRACT

This article analyzes several modern and sustainable agricultural models worldwide and draws lessons for Vietnam in developing green agriculture. In the context of climate change, resource scarcity and increasing food security demands, global agriculture has achieved significant production gains while facing environmental pressures. Leading countries such as the Netherlands, Israel and New Zealand have successfully implemented various sustainable agricultural models, ranging from the application of high technology, efficient water resource management and circular agriculture to environmentally friendly livestock farming. The study indicates that to develop sustainable agriculture, Vietnam needs to enhance the application of science and technology, expand organic production, build agricultural value chains linked with enterprises and proactively adapt to climate change. This article provides a reference framework for policy orientation and practical development of sustainable agriculture in Vietnam.

Keyword: Sustainable agriculture; Modern agriculture; Climate change; High-tech agriculture; Circular agriculture; Netherlands; Israel; New Zealand; Vietnam

1. INTRODUCTION

In the context of globalization and complex climate change, developing modern and sustainable agriculture has become an inevitable trend and a top priority. Agriculture plays a crucial role in the economy and serves as a pillar of food security for every nation (Nguyen Thi Quynh Trang & Dao Thi Huong, 2025). It not only provides food for human consumption but is also closely linked to food security, environmental protection, biodiversity conservation and sustainable livelihoods for billions of farmers worldwide (FAO, 2024). The projected global population of nearly 10 billion by 2050 (World Bank Blogs, 2019) poses immense pressure on agriculture to increase production while minimizing negative impacts on the environment and natural resources.

In Vietnam, Prime Ministerial Decision No. 150/QD-TTg approving the Strategy for Sustainable Agricultural and Rural Development for 2021–2030, with a vision to 2050, emphasizes the goal of developing ecological agriculture, modern rural areas and cultured farmers. It also underscores the need to innovate growth models to enhance added value, economic efficiency, environmental protection and climate change adaptation (Prime Minister, 2022). This decision serves as both a guideline and a critical driving force for Vietnam's agriculture to integrate deeply and achieve sustainable development in the future.

Over the past decades, several pioneering countries have made significant strides in applying science and technology to agricultural production, creating modern, intelligent and environmentally friendly farming models. The Netherlands stands out with its circular agriculture model, where by-products from livestock and crop production are recycled into energy, fertilizers, or animal feed, forming a closed-loop, efficient and sustainable agricultural ecosystem (OECD, 2023). Israel is recognized as a "hub" of high-tech agriculture, particularly with drip irrigation technology that saves water. The country leads the world in water recycling, with up to 70% of water being reused, offering efficient production solutions even under scarce water resources (Tran Minh Nguyet et al., 2024). Meanwhile, New Zealand has strongly developed agriculture integrated with sustainable natural resource management, especially in dairy farming and crop cultivation under strict biosecurity standards, combined with digital technology to monitor the environment and product quality

(Khanh Huyen, 2024). These models have enabled the three countries to achieve superior agricultural productivity and quality while significantly reducing environmental impact, conserving resources and increasing economic value, serving as important references for other countries on the path to sustainable agriculture.

For Vietnam, agriculture remains a cornerstone of the economy, contributing significantly to export turnover and ensuring national food security (Le Minh Hoan, 2025). However, Vietnam's agricultural sector still faces major challenges, such as small-scale production, low labor productivity, environmental pollution from excessive fertilizers and pesticides and increasingly evident impacts of climate change (Tran Duc Vien, 2023). Therefore, studying, learning from and applying experiences from modern and sustainable agricultural models worldwide is essential to identify suitable approaches that align with Vietnam's natural and socio-economic conditions. Based on this need, this article focuses on analyzing exemplary modern and sustainable agricultural models globally and draws valuable lessons for reforming, restructuring and developing Vietnam's agriculture toward efficiency, environmental friendliness and climate adaptability.

2. SOME MODERN AND SUSTAINABLE AGRICULTURAL MODELS IN THE WORLD

In the context of climate change and the depletion of natural resources, many countries have developed sustainable agricultural models that combine advanced technology and smart management to optimize production efficiency, minimize negative environmental impacts and increase economic value. Below are some pioneering countries with successful sustainable agriculture models.

2.1. The Dutch Agricultural Model

The Netherlands is known as one of the leading countries in applying technology to agriculture. Although it accounts for only about 0.008% of the world's agricultural land, the Netherlands is the second-largest exporter of agricultural products globally, just after the United States. Despite agricultural land covering only 19% of its territory, the Netherlands achieved agricultural export values exceeding €122 billion in 2022 (Dinh Le Tuyet Trinh, 2025). This success does not rely on fertile land or abundant natural resources but stems from building an advanced, closed-loop and sustainable agricultural model, characterized by the principle of "nothing goes to waste", the foundation of circular agriculture.

In the Netherlands, all by-products from crop cultivation and livestock are processed for reuse, turning what would be considered waste into valuable resources. For example, cow manure is processed to produce biogas, providing energy for production and supplying electricity to the national grid; treated wastewater is used to irrigate grass, forming a complete circular system. On-site grown grass becomes feed for cows, reducing costs and protecting the environment. Thanks to this model, dairy farms in the Netherlands reduce methane emissions by up to 40 percent, increase the opportunity to recycle soil nutrients by 25 percent and save an average of €12,000 in production costs annually.

Technology plays a key role in the success of Dutch agriculture. Farms use IoT sensors to monitor resources such as water, energy and nutrients, combined with artificial intelligence (AI) to optimize irrigation, fertilization and energy adjustments according to demand. High-tech greenhouses maximize sunlight, recycle water and use renewable energy, consuming only 4 liters of water to produce 1 kg of vegetables, compared to 15 to 20 liters using traditional methods.

The Netherlands not only focuses on production but also emphasizes a circular supply chain, where agricultural by-products are recycled into animal feed or organic fertilizers, reducing losses in transportation and storage by up to 15 percent. This ecosystem encourages businesses to invest in research, development and the long-term maintenance of sustainable models. The Dutch government plays a central role in connecting farmers, enterprises and scientific organizations. Favorable tax policies, financial support and regular training help disseminate the effectiveness of circular agriculture and promote collaboration among stakeholders. The reuse of agricultural by-products enables the Netherlands to save over €6 billion annually in raw material costs and reduce supply chain losses by 15 percent. Livestock waste is converted into energy and organic fertilizer, cutting emissions by 40 percent and creating direct economic benefits for farmers (OECD, 2023).

Overall, the experience of developing sustainable agriculture in the Netherlands lies in combining circular principles, advanced technology, efficient supply chain management and government support. This is a model that other agricultural countries, including Vietnam, can learn from to optimize resources, increase economic value and protect the environment.

2.2. The Israeli Agricultural Model

Israel is a country with a population of approximately 8.5 million people, but more than 70 percent of its territory lies in desert areas with harsh climatic conditions, limited and poor-quality arable land (Tran Minh Nguyet et al., 2024). However, the country is recognized as a global agricultural model thanks to its ability to apply scientific and technical knowledge, innovation and effective management. In a short period, Israel has transformed from a state of food shortage to self-sufficiency while efficiently exporting agricultural products, with agricultural production value over the past five years consistently exceeding USD 3.5 billion per year, of which exports account for more than 20 percent.

Harsh natural conditions and rapidly increasing population pressure have prompted the Israeli government to invest heavily in research centers and technology development for agricultural production (Nguyen Thi Quynh Trang & Dao Thi Huong, 2025). As a result, Israel has become a leader in the application of high technology in agriculture, achieving notable successes such as water-saving drip irrigation, soil desalination, greenhouse vegetable cultivation and aquaculture in desert areas. Israel also recycles up to 70 percent of water used in agriculture, leading the world in water management (Truong Huyen, 2019).

Biotechnology, automation and information technology are widely applied, enhancing productivity and product quality, reducing costs and environmental impacts and ensuring strict management of standards, measurements and agricultural product quality. Besides technology, agricultural production organization models also play an important role. Two common forms are Kibbutz – collective agricultural villages based on principles of shared ownership, equality, combining production, consumption and training; and Moshav – rural private enterprises with multiple farms that both produce and transfer technology while providing agricultural solutions. Although Kibbutzim account for about 2.5 percent of Israel's population, they contribute nearly 40 percent of the national agricultural output, generating a total agri-industrial value of up to USD 8 billion.

Another key factor in Israel's success is the innovative spirit of its people, where any individual, whether a farmer or a scientist, is supported to realize improvement ideas (Vishwajeet Kumar, 2020). The country also ranks among the highest globally in agricultural research investment and emphasizes the development of education and technology training.

From Israel's experience, Vietnam can learn to develop high-tech agriculture, improve productivity and product quality, enhance international competitiveness and ensure food security in the context of population growth and limited resources. Applying advanced technology, developing effective organizational models and fostering an innovative spirit are valuable lessons for Vietnam to build a modern, sustainable and highly competitive agricultural sector.

2.3. The New Zealand Agricultural Model

New Zealand is a world leader in sustainable livestock farming, with more than 40 percent of its land used for agriculture and animal husbandry. The country has established a strict environmental management system to protect soil and water while enhancing the quality of export products (Nguyen Chi Hieu, 2024).

One of New Zealand's sustainable agricultural models is sustainable livestock farming, which applies strict environmental protection standards, including managing livestock emissions and recycling animal waste into organic fertilizer. This not only helps reduce environmental impacts but also increases productivity and product quality. New Zealand develops natural grazing models without the widespread use of antibiotics for animals. They use GPS sensors, drones and AI to manage herds on large pastures. For dairy animals such as cows and sheep, smart wearable devices are used to monitor health and milk production.

In addition, New Zealand has implemented land and water conservation programs to ensure that livestock farms do not cause water pollution or land degradation. The country has also developed

a strong agricultural training system. Institutions such as Lincoln University and Massey University specialize in training high-quality farmers and agricultural engineers and offer many practical agriculture programs linked to field conditions in each region. The agricultural advisory network in New Zealand is well developed, supporting farmers in each region with data on weather, soil and market trends.

A key factor in the success of New Zealand's dairy industry is strict regulations on biosecurity and product quality. The government completely bans the use of animal growth hormones and genetically modified products, ensuring that milk is natural and safe for consumers. At the same time, major dairy factories such as GMP Dairy and BODCO apply strict production standards combined with modern technology, from formula milk production to supply chain management, maintaining stable quality and the ability to export to many international markets. Additionally, the application of advanced technologies such as BioLactolTM in colostrum processing, combined with scientific research, has helped New Zealand produce highly nutritious dairy products that meet global market demand (Khanh Huyen, 2024).

This experience shows that the combination of favorable natural conditions, sustainable management and the application of high technology is the decisive factor in enabling the dairy and livestock sector to achieve high economic efficiency and long-term sustainability.

3. CURRENT STATUS OF AGRICULTURAL DEVELOPMENT IN VIETNAM

Over the past 50 years, Vietnam's agricultural sector has achieved remarkable growth, transitioning from a state of food shortage to becoming one of the countries ensuring domestic food security and contributing to global food security, with rice exports ranking among the highest in the world. From a monoculture rice-based agriculture in 1975, Vietnam has gradually developed a diversified and comprehensive agricultural system, including food crops, perennial industrial crops, livestock, aquaculture and fruit trees. In 1975, the country's total rice production reached only 5.49 million tons, with an average yield of 2.11 tons per hectare, while per capita food production was only 243.3 kg. Meat production of all types was approximately 450 thousand tons, mainly from low-yield local livestock breeds. During this period, Vietnam had to import hundreds of thousands of tons of food to meet domestic demand. Thanks to reform policies and agricultural development, by 2024, total grain production reached 48 million tons, including 43.5 million tons of rice and more than 4.4 million tons of maize, nearly nine times higher than in 1975. The livestock sector also grew strongly, with total meat production reaching 8.1 million tons, nearly 20 times higher than in 1975 (Le Minh Hoan, 2025).

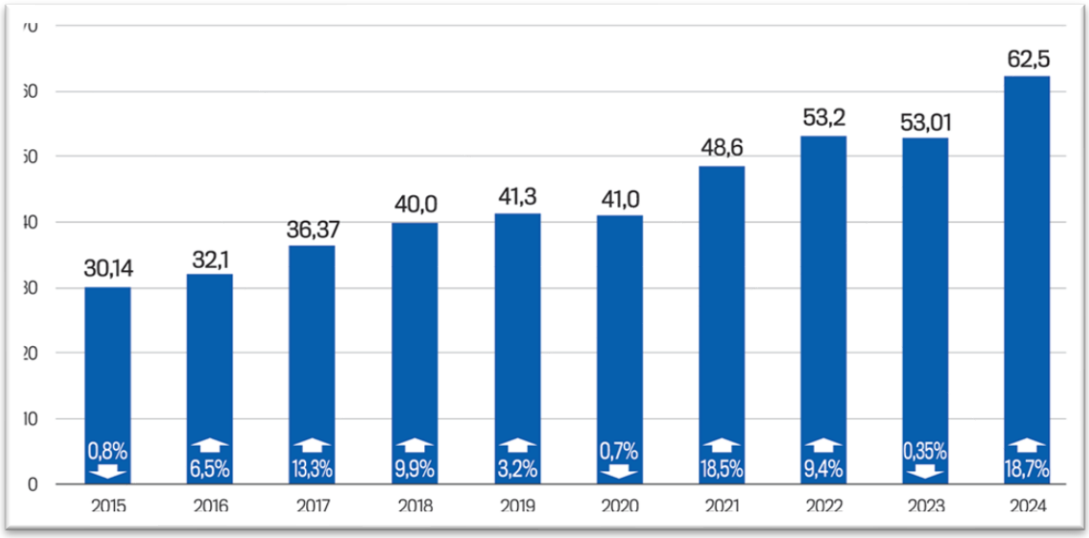

Figure 1. Vietnam's Agricultural, Forestry and Aquatic Product Exports in 2015 – 2024 (billion USD)

(Source: Chau Nguyen & Nhat Quang, 2025)

Even during the 2015 – 2024 period, exports of agricultural, forestry and aquatic products showed an increasing trend, rising from 30.14 billion USD in 2015 to 62.5 billion USD in 2024. Currently, Vietnamese agriculture is not only a pillar of the national economy but also a foundation for social stability and the livelihoods of the majority of rural residents. The sector is developing in the direction of green, organic, circular agriculture, integrating multiple values, applying science and technology, aiming for high added value, sustainable efficiency and close linkage with processing industries, post-harvest preservation and domestic and international markets. However, alongside these impressive results, Vietnamese agriculture still faces many challenges, including limited resources, environmental degradation, climate change, market fluctuations and global consumption trends. Therefore, continuing innovation and developing ecological, large-scale, high-value and sustainable agriculture is an urgent requirement to maintain Vietnam's position on the global agricultural map, aiming toward the vision for 2045.

4. SOME LESSONS LEARNED FOR VIETNAM IN DEVELOPING SUSTAINABLE AGRICULTURE

In the context of Vietnam promoting the transformation from traditional agriculture to modern and sustainable agriculture, referring to international experiences is necessary to guide appropriate development. Successful models in the Netherlands, Israel and New Zealand show that modern agriculture does not rely solely on fertile land or abundant natural resources, but more importantly on a harmonious combination of technology, smart management, efficient production organization and supportive government policies. The following are some practical lessons that Vietnam can apply.

First, applying high technology and smart management in agricultural production.

Modern agricultural models around the world show that technology is a key factor to optimize productivity, product quality and minimize negative environmental impacts. Vietnam can implement solutions such as IoT sensors, drones and artificial intelligence (AI) to manage crops, livestock, irrigation and fertilization, thereby improving resource use efficiency. Building high-tech greenhouses, water-saving irrigation systems and using renewable energy will also help reduce production costs, protect the environment and create clean agricultural products that meet international food safety standards. In addition, biotechnology and modern processing can be applied to increase the added value of agricultural products while developing organic and environmentally friendly products.

Second, developing efficient production organization models and linking value chains.

Experience from Israel shows that the Kibbutz and Moshav models combine production, consumption, training and technology transfer, creating an environment for cooperation and innovation. Vietnam can learn by establishing new-style cooperatives and organizing production by region and value chain, from production to processing and distribution, based on local advantages. Connecting businesses, farmers and research centers will help improve productivity, product quality and increase the competitiveness of Vietnamese agricultural products in domestic and international markets.

Third, sustainable resource management and environmental protection.

Experience from New Zealand emphasizes strict management of land, water and climate resources, combined with applying sustainable farming and production standards. Vietnam can implement circular agriculture models, use organic fertilizers, recycle agricultural by-products and limit the use of antibiotics and growth hormones in livestock. This not only minimizes environmental impacts but also improves product quality, ensures food safety and adapts to climate change.

Fourth, supportive policies, training and human resource development.

Successful countries have strong government policies, including tax incentives, financial support, training and connecting stakeholders. Vietnam needs to build comprehensive policies to encourage farmers and businesses to invest in high technology and sustainable production. At the same time, developing networks for training engineers, technical staff and farmers and providing agricultural advisory services to enhance management and technology operation capacity will help improve production efficiency and competitiveness in Vietnamese agriculture.

Fifth, increasing added value and competitiveness of agricultural products.

International models that combine technology, effective management and circular value chains help increase productivity, reduce costs and enhance product value. Vietnam needs to develop deeply processed products, local specialty products and build reputable agricultural brands that ensure traceability, food safety and international quality standards. This will provide a foundation for Vietnamese agriculture not only to meet domestic demand but also to strengthen its position in global export markets.

Overall, referring to and applying international experiences in modern and sustainable agriculture will help Vietnam orient agricultural development toward ecological, large-scale, efficient and environmentally friendly models. Applying high technology, smart management, organizing production along value chains, protecting natural resources, combined with supportive policies, training and human resource development will be key factors to enhance productivity, quality and added value of Vietnamese agricultural products. This also forms the basis for Vietnam to continue affirming its position in export markets, ensuring national food security and promoting sustainable rural economic development. With a vision toward 2045, Vietnam's agriculture will aim for a modern ecological model, large-scale production, closely linked to processing industries and domestic and international markets, while meeting international standards for food safety and sustainable development.

5. CONCLUSION

In recent years, Vietnamese agriculture has made remarkable progress, transforming from a country facing food shortages into a leading global agricultural exporter, making an important contribution to global food security. These achievements stem from policies of innovation, the application of science and technology, efficient production organization, and the diversification of sectors from rice and perennial crops to livestock and aquaculture. At the same time, Vietnam is moving toward green, organic, and circular agriculture, increasing added value, protecting the environment, and adapting to climate change. Referring to international experiences from leading countries such as the Netherlands, Israel, and New Zealand shows that modern and sustainable agriculture requires an integrated combination of high technology, smart management, resource protection, and efficient production organization. The Netherlands stands out with circular agriculture, Israel leads in water-saving irrigation and rigorous land management, while New Zealand exemplifies sustainable livestock farming and product quality control. These lessons provide an important foundation for Vietnam to develop modern agriculture, enhance productivity and product quality, link with domestic and international markets, and at the same time protect the environment and ensure long-term sustainability. Based on the current situation and international models, it can be affirmed that the future direction of Vietnamese agriculture must be built on the foundation of science and technology, value chain management, ecological agriculture, and human resource development, aiming to establish a modern, sustainable, and highly competitive agricultural sector on the global market, while contributing to improved living standards and environmental protection.

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