

Solutions Developing High-Tech Agriculture in Tra Vinh

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ABSTRACT

Developing high-tech agriculture and promoting scientific and technological innovation are among the key solutions to enhance production efficiency, increase farmers' income, and move toward a sustainable agricultural sector. In order to accomplish this objective, Tra Vinh has initiated efforts to foster agricultural growth with a focus on achieving high quality standards, so ensuring the integrity of local agricultural produce. This article provides a comprehensive analysis of the achievements and constraints encountered in the use of high technology on key crop varieties within the province in recent years, consequently presenting potential remedies. This initiative is deemed appropriate for fostering sustainable agricultural growth in Tra Vinh during the medium and long term.

Từ khóa: Agriculture development, high-tech agriculture, current situation, solution, Tra Vinh

I. INTRODUCTION

Currently, there is a growing demand for high-quality agricultural products, but the potential to increase agricultural land area is limited due to the adverse effects of climate change on agricultural development (Bonny, 2017). Modern technologies including greenhouse technology, drip irrigation, fertiliser irrigation, biotechnology, genetic manipulation, and IoT with remote monitoring systems are currently used in agricultural production. Among them, remote technology integrated with the Internet and wireless communications such as Internet of Things (IoT) is a promising technology that offers novel ways to modernise the agriculture economy. Understanding the importance of high-tech agriculture for economic development, The 13th National Congress of Delegates reiterated its commitment to restructuring agriculture and promoting rural economies by creating contemporary ecological rural areas with educated farmers. The main emphasis is on developing extensive

concentrated commodity agriculture with the use of modern technologies as detailed in “The Strategy for Sustainable Agriculture and Rural Development”.

It might be argued that there is a significant and unavoidable shift in the socio-economic context. Today, there is consensus on the importance of sustainable agriculture, but there are differing views on the optimal approach, particularly between high-tech agriculture and agronomy. High-tech agriculture must include agronomic factors to prevent ecological and societal harm. Agronomy requires a variety of advanced technology tools, along with local and farmer expertise. To advance high-tech agriculture, it is essential to integrate agronomic principles with contemporary research and technology tailored to specific regions (Zhao et al., 2010). The advancement of high-quality agriculture in several provinces in our country has demonstrated significant effectiveness by increasing agricultural productivity and the production of high-quality agricultural goods. This has met both domestic demand and export requirements, reduced the impact of natural factors, and contributed to environmental conservation. For instance, agricultural productivity in Lam Dong province improved by 35-40% and costs reduced by 35% due to the implementation of high technology, particularly IoT technology (Lê Bá Tâm, 2021). Yet, in certain areas, high-tech agricultural progress is limited in scope and lacks concurrent investment, resulting in low efficiency. High-tech agricultural advancements are primarily found in agricultural businesses and farms, with minimal involvement from individual farming households. Similarly, Binh Phuoc, a province in the Mekong Delta, has significant potential for high-tech agriculture, however, agricultural production in the province has not fully utilised its assets. High-tech agricultural zones have been established but have not experienced substantial development... Thus, by examining the existing state of high-tech agricultural advancement in Binh Phuoc province, that suggests strategies to

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foster high-tech agriculture in the region, aiming to enhance sustainable agricultural growth nationwide.

II. CURRENT SITUATION OF HIGH-TECH AGRICULTURE DEVELOPMENT IN TRA VINH PROVINCE

2.1. General introduction of Tra Vinh agriculture

Tra Vinh province is situated on the southeastern coast of the Mekong Delta, covering a total area of 239,077 hectares. This area comprises 185,160 hectares of agricultural land, which represents 77.45% of the province's natural area and approximately 5.5% of the agricultural land in the region (Vãn Minh, 2021). The province is situated between the Tien River and the Hau River, with 65km of shoreline. It has a complex network of rivers and canals, flat and productive soil, and a cool climate that is less prone to floods and storms. Optimal conditions have facilitated the growth of diverse agricultural production, including rice, crops, industrial crops, fruit trees, and aquaculture in sweet and brackish water.

Salinity has played a key role in advancing the agricultural economy and achieving notable success across various sectors. The Tra Vinh Provincial Planning for the period 2021-2030, with a vision to 2050, was approved by the Deputy Prime Minister under Decision No.1142/QĐ-TTg. It emphasises the importance of developing the agricultural sector in the province towards modernity, sustainability, circularity, concentrated commodity production, large scale along the value chain,

efficiency, and high competitiveness through the application of science and technology and climate change adaptation (Prime Minister, 2023).

Indeed, agriculture in Tra Vinh province has had significant expansion in recent years, resulting in the production of many commodity products. Around the last three decades, the yearly crop production area has declined by around 33 thousand hectares. The perennial crop production area expanded by 11.2 thousand hectares over this period. The production land area for the agriculture industry has been altered to reduce in order to expand perennial crop output. Traditional crops like rice, maize and peanuts still occupy a significant area, with rice experiencing the largest decrease but not yet meeting the target outlined in the Production Structure Transformation Plan for agriculture, forestry, salt production and aquaculture in Tra Vinh province. The perennial tree area has expanded, with coconut exhibiting the highest growth rate. This adjustment signifies a shift in land allocation for agricultural output towards increased efficiency. In 2010, the production of coconut trees was over 164 thousand tonnes, which rose to about 309 thousand tonnes in 2020, showing an increase of more than 1.88 times while the production area only increased by 1.62 times (Statistical Department of Tra Vinh Province, 2020). This indicates enhanced productivity of this crop. This transition aligns with addressing and adjusting to climate change as well as the demands of both domestic and international agriculture markets. Moreover, these products serve as raw materials for processing businesses and valuable export items.

Table 1: Production area and quantity of main crops in Tra Vinh province in period of 2000-2020

Unit: Area: ha, Quantity: quintal

Production	2000		2010		2020	
	Area	Quantity	Area	Quantity	Area	Quantity
Annual crops						
Rice	23,704	39.73	232,636	49.69	205,114	45.82
Corn	2,610	29.34	5,220	51.74	3,718	55.37
Peanut	1,530	20.77	4,397	43.89	3,580	50.8
Perennial crops						
Coconut	-	-	14,552	164,013	23,698	308,746.7
Citrus	-	-	3,054	42,000	3,188	67,504.98

Source: Võ Thế Trường, 2023

However, agriculture production scale in Tra Vinh province is small, high-tech agriculture is not widespread, and there are limited connections in the production, processing, and consumption of agricultural products. Therefore, analysing the

current high-tech agricultural development in Tra Vinh province to suggest solutions for agricultural development using advanced technology to enhance agricultural production efficiency is important for promoting the provincial economy sustainably.

2.2. Current situation of high-tech agriculture in Tra Vinh province

Tra Vinh province has just started using scientific advancements in agricultural production, with a focus on agriculture 4.0, to enhance product quality. The objective is to address both domestic and international market demands by ensuring production, food safety, and environmental protection. The practises of high-tech agriculture include:

Production model of rice cultivation

The enhancement of production capacity, supply, and consumption of goods is facilitated by the implementation of efficient production and economic models. In Tra Vinh, farmers in significant rice cultivation areas, including Tap Ngai commune (Tieu Can district), Chau Dien commune (Cau Ke district), Nhi Truong commune, Truong Tho commune (Cau Ngang district), Cang Long, Cau Ke, Tieu Can, Tra Cu, and Cau Ngang, have employed various rice varieties such as Dai Thom 8, OM 5451, ST24, and ST25. These cultivars are of superior quality and appropriate. The crop exhibits strong adaptability to various weather and soil conditions, hence offering price and output benefits for export markets. The present rice cultivation approach employs cluster seeding devices as a means to decrease the quantity of seeds put in rows by 50%. Rice plants are cultivated using intelligent fertilisers in conjunction with integrated pest management (IPM) techniques, the application of drones (unmanned aerial vehicles – UAVs) for spraying pesticides and fertilizers, combined with insect monitoring systems in rice fields and fruit orchards, enables automatic measurement of wind speed and temperature through sensors. These systems can manage and monitor insect population density captured in traps, with the capability to analyze up to 20 insect species. Data are automatically updated and transmitted to management agencies and specialized authorities for monitoring. This supports farmers in proactively controlling pests and diseases, minimizing environmental pollution from plant protection chemical applications, and safeguarding public health. Resulting in significant cost reductions and labour savings, while also achieving a 25% increase in production (Phúc Sơn, 2023).

Moreover, numerous enterprises have presently formed partnerships with cooperatives and farmer households in order to engage in organic rice production. For example, in the Winter - Spring crop

of 2021 - 2022, the Phat Tai Agricultural Cooperative (Thanh My commune, Chau Thanh district) has collaborated with Au Lac Joint Stock Company (Hanoi) to conduct a pilot study on the application of microbial organic fertiliser in the cultivation of 20 hectares of rice. The primary objective of this initiative was to assess the efficacy of this fertiliser in achieving notable efficiency improvements, including a reduction in the cost of chemical fertilisers by approximately 20% (Nguyễn Tâm & Huyền Diễm, 2022). In the interim, the productivity and output of rice have remained consistent with historical levels of production. Throughout the summer-autumn crop, the cooperative is actively promoting the utilisation of a blend of microbial organic fertilisers among farmers and members. Despite its novelty, farmers are progressively acclimating to and embracing this form of agriculture. Approximately 30 hectares are anticipated to be utilised for the application of mixed microbial organic fertiliser. Furthermore, the firm intends to provide organic fertiliser to producers on a credit basis, with the intention of recouping the cost at the conclusion of the season. The selling price will align with the price that the factory had previously delivered to level I agencies. In a broad sense, the utilisation of nitrogen Organic farming confers numerous advantages to both farmers and businesses through the enhancement of soil quality, reduction of production expenses, improvement of rice grain quality, and facilitation of enterprises' export needs.

Production model of coconut

The cultivation of coconut palms in Tra Vinh province has experienced substantial growth, including over 26,000 hectares of land. Among these, a significant portion of over 5,000 hectares has been cultivated through the utilisation of organic coconut growing techniques. In addition to its emphasis on the cultivation of superior coconut output, Tra Vinh presently holds the second position in terms of coconut cultivation area within the Mekong Delta, trailing only Ben Tre. Consequently, in order to fully exploit the capabilities and advantages of coconut, the People's Committee of Tra Vinh province has officially sanctioned the "Strategy for enhancing the coconut value chain of Tra Vinh province for the period 2022-2025" (Hà Dũng, 2022). The objective of the strategy is to achieve a coconut productivity of around 16 tonnes per hectare by 2025. There is a minimum of 8,000 hectares of organic coconut cultivation, with 6,000 hectares having obtained

worldwide organic certification. Furthermore, a minimum of 10 enterprises collaborate with coconut growers to establish designated areas for the cultivation of raw materials, catering to the processing and consumption of high-value-added product chains in the market. Out of these, about two companies increased their areas of raw material production and enlarged their markets for product consumption.

Presently, coconut farmers in Tra Vinh have used numerous novel technical methodologies in their production practices with the aim of enhancing the productivity, quality, and value of coconut trees in a manner that is environmentally friendly. Additionally, this foundation is advantageous in meeting the criteria for cultivating regions to engage in the exportation of fresh coconuts, particularly in the Chinese market. Thanh Tri Coconut Growing Cooperative (Huyen Hoi commune, Cang Long district) has successfully established an efficient and centralised production model on a 112 hectare area, with the involvement of 246 farmer households. There exist two widely recognised varieties of coconut, namely the green Siamese coconut and the strawberry coconut, which collectively yield approximately 6,000 tonnes of coconut annually. The cooperative's production process is rigorously implemented with the assistance of the Tra Vinh Department of Agriculture and Rural Development. To guarantee optimal circumstances for the crops, a spacing of 6m between coconut trees and 8m between rows of trees has been maintained. The cooperative employs a method of excavating holes and utilising organic fertiliser derived from cow and poultry manure, in conjunction with composting facilitated by *Trichoderma* fungus. Chemical fertilisers are employed during the first growth phase of new trees, however, after one year, the cooperative will transition to utilising organic fertilisers (Hò Thảo, 2023).

Production model of orange

The enhancement of citrus production productivity in Tra Vinh province is a matter of significant importance, given its status as an important crop in the province. This objective is pursued through the implementation of scientific and technological advancements in Tra Vinh province, with the help of the Mountainous Rural Programme. The Tra Vinh Agricultural Extension Centre is responsible for implementing the dissemination of technological advancements and establishing a framework for the cultivation and breeding of superior seedless oranges.

Up to now, the project has successfully acquired and executed technical procedures pertaining to breeding, growing, pest management, harvesting, and preservation. Additionally, it has provided training to 200 farmers on various approaches. To far, the cultivation of seedless oranges has been implemented across an area of 20 hectares in the districts of Chau Thanh and Cau Ke (E-commerce Trading Floor of Tra Vinh province, 2022). This initiative has demonstrated notable efficacy, garnering support from both the government and the local populace. Seedless oranges have a value that is 30 to 40% higher than ordinary oranges. This is the pioneering seedless orange production model in the province, which aims to generate wealth, generate employment opportunities, and introduce innovative goods. It seeks to address the issue of excessive use of chemical fertilisers, pesticides, and high planting density in traditional farming methods.

2.3. General discussion of high-tech agriculture in Tra Vinh province

Tra Vinh's production and quality of agricultural goods have improved as a result of promoting high-quality agriculture, which has successfully met both domestic consumption and international export demands. The data indicates a rise in the value of the agricultural sector and production crops, despite a large decline in the sector's share of the economic structure in recent times (Table 2).

Table 2: GRDP and proportion of economic sectors in Tra Vinh province in the period of 2010-2020

Unit: GRDP: billion VND, Proportion: %

Sector		2010	2015	2020
Sector area 1 (Agriculture, forestry, fisheries)	GRDP	9,080	16,278	19,417
	Proportion	59.94	45.92	30.72
	GRDP	2,221	5,241	21,935

Sector area 2 (Industry, construction)	Proportion	14.66	14.79	34.71
Sector area 3 (Service)	GRDP	3,848	13,926	21,846
	Proportion	25.40	39.29	34.57

Source: Statistical Department of Tra Vinh Province, 2020

The expansion of cultivated land has been observed to result in a steady reduction in the number of annual trees, while simultaneously increasing the proportion of fruit trees and permanent trees. According to Vo The Truong (2023), while statistical data indicates a decline in the proportion of food crops from 40.5% in 2016 to 37.67% in 2020, the annual industrial crop group has experienced a decrease from 9.9% to 8.17%, however, the groups of fruit trees and perennial industrial trees have all shown an increase of 1-2 percentage points.

Tra Vinh Agriculture is actively engaged in the implementation of production on a medium to large scale. This involves the establishment of production linkage models that align with contemporary farming practices, with the aim of enhancing productivity and improving the quality of products. Vietnam's agricultural production efficiency has substantially improved due to the implementation of advanced technology in the production process. This is evidenced by the achievements demonstrated in the illustrative instances presented in the preceding section. The development of high-tech agriculture has made a substantial contribution to enhancing the efficiency of local land utilisation, fostering sustainable economic growth in the region by implementing novel production techniques, and effectively mitigating risks in agricultural production through the establishment of strong connections with businesses, cooperatives, and farmers.

Nevertheless, the development of high-tech agriculture in Tra Vinh still exhibits several deficiencies and constraints, which are outlined below:

Firstly, due to the substantial financial resources required for high-tech agriculture models and the volatile and high-risk nature of the market, these models have received little investment in recent years, rendering the production of high-tech agricultural products unattainable. Engage in competition to secure a significant share of the overall value of the agricultural goods within the province. Limited money and land finances pose challenges for enterprises, cooperatives, and rural households seeking to expand their production area and scale. The imposition of restrictions on

investment capital has resulted in a range of associated challenges, including: a sluggish growth rate in the agricultural sector; a sluggish pace of crop and livestock restructuring; a scarcity of businesses engaging in high-tech agricultural investments; a limited number of high-tech agricultural models being constructed in the province, characterised by slow pace, small-scale operations, scattered production, and lack of sustainability.

Secondly, while certain technologies have been used in certain crops, their implementation is limited in scale and lacks synchronisation and integration within the production process. Consequently, the complete efficacy of these technologies has not been fully realised in the context of agricultural productivity. Moreover, the level of technological implementation in production remained at a modest level. The utilisation of machinery and equipment in agricultural production in Vietnam remained antiquated and lacked uniformity. The utilisation of advanced technology in various domains, including electrification, chemistry, and computerization, remained limited and lacked coordination, so falling short in addressing the requirements of agricultural modernization.

Thirdly, the implementation of novel methodologies in multi-member cooperatives and agricultural households continues to encounter numerous challenges. Due to the lack of the availability of agricultural high-quality human resources, certain cooperative members have faced challenges associated with the acquisition and utilisation of novel technologies. Moreover, because of the lack of receiving comprehensive and professional training, they also tend to fail to establish a cohesive production process in order to effectively engage in brand promotion, market development, and expansion, resulting in disparities in the quality of agricultural goods. The aforementioned constraints pose a significant obstacle in achieving the goal of transforming Tra Vinh as a best 'agricultural power' in Vietnam.

Forthly, Tra Vinh province, despite its several geographical advantages in agricultural growth, is confronted with numerous challenges stemming from the impact of unpredictable weather patterns in recent times. The research of Hoàng Thị

Thảo et al. (2022) indicates that Tra Vinh is susceptible to several climatic threats, including drought, saltwater intrusion, high tides, and coastal erosion. The average duration of drought is 4 months, with the largest period lasting 7 months per year and the shortest being 3 months per year. Salinity intrusion is most pronounced in the months of April and May annually. Due to that, the growth rate of the agricultural sector might exhibit volatility, as it is subject to various factors like weather conditions, climate patterns. The sustainability of agricultural development remains inadequate, as it has not fully harnessed the potential and benefits of the local area.

Fifthly, the scope of strategic planning, planning, and development in the agricultural sector in Vietnam in general and in Tra Vinh in specific remains constrained. Certain forecasting plans exhibit a lack of alignment with actual production levels. Additionally, there are numerous issues pertaining to the management and organisation of plan implementation, resulting in a lack of synchronisation between production and planning. In fact, although the forms of production organisation in agriculture and rural areas have undergone gradual reform, however, there is still a scarcity of models that effectively connect production and consumption of products along the value chain. Furthermore, the existing linkages between production and consumption are not close and are not sustainable. Additionally, there is a lack of integration between production, processing, consumption, and export.

III. COCLUSIONS AND SOLUTIONS

It can be said that the advancement of high-tech agriculture is an inexorable trajectory in the establishment of sustainable agricultural practices, aimed at mitigating the consequences of climate change. The agricultural sector in Tra Vinh province is progressing towards modernization, with a growing utilisation of advanced technologies in the cultivation of important native commodities. There is a growing interest in reforming the form of production organisation to strengthen joint ventures and associations, as well as promoting the application of scientific and technological advances. This involves associating production development with brand building, consuming products in a chain, and ensuring stable value. Nevertheless, the analysis provides evidence that the present state of technology implementation in agriculture in Tra Vinh is still confronted with certain constraints and deficiencies. Hence, in order to facilitate the advancement of high-

tech agriculture, the article puts up several proposed solutions for the local governance as outlined below:

Firstly, in accordance with the function of orientation and space allocation for agricultural growth in the province, it is imperative to design and implement plans and policies for agricultural development in general, with a specific focus on high-tech agriculture. Specifically, prioritise the development of high-tech commodity agricultural products with the aim of transforming them into the primary products of the province. In order to foster the growth of advantageous agricultural input enterprises and facilitate the development of agricultural product processing industries that utilise advanced technology, it is imperative to adopt innovative thinking in the planning of the province's agricultural sector. This approach aims to address the input requirements of farmers while also catering to the preferences of the market for agricultural products.

Secondly, further improve the utilisation of cutting-edge science and technology in manufacturing. Applying biotechnology in seed production to effectively produce the successful cultivation and selection of varieties that exhibit favourable yield and superior quality, particularly in the context of climate change. Moreover, the utilisation of scientific and technological advancements in the manufacturing of secure agricultural commodities in accordance with GlobalGAP and Organic criteria to cater to market demands, fostering the establishment of a strong product and product branding, and implementing product and product brand registration to augment the market value of products.

Thirdly, consider to further establish the development of infrastructure and provision of high-tech agricultural services. Specifically, allocating resources towards the construction and enhancement of infrastructure and amenities to guarantee the excellence of high-tech agricultural zones and regions, with the aim of enticing high-tech enterprises to establish their presence in the area. The province should give priority to the promotion, establishment, and implementation of major experimental zones, centres, and camps in the field of high technology. These initiatives aim to facilitate research, application, and technology transfer within the region.

Forthly, focus on enhancing the recruitment and development of skilled personnel for enterprises, manufacturing facilities, and commercial institutions

that contribute to the advancement of advanced agricultural practices. The function of training institutions in the province, particularly Tra Vinh University and the Department of Science and Technology, is crucial in serving as intermediaries between domestic and international institutes and schools, in order to facilitate human resource training. Optimise training sessions to enhance farmers' knowledge, abilities, and farming expertise in agricultural production, with a specific focus on high-tech agriculture. In order to attract highly skilled human resources for the sustained growth of high-tech agriculture in Tra Vinh province, a remuneration system has been implemented for officials in the high-tech field.

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