

Research Article

Development of High - Tech Agriculture in Do Luong District: Current Situation and Suggested Solutions

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Abstract

In the context of global digital transformation and the increasing need for sustainable agriculture, high-tech agriculture (HTA) has become a strategic direction for many developing countries, including Vietnam. Do Luong district in Nghe An province possesses favorable natural conditions and a large labor force, yet its agricultural sector has struggled to modernize due to land fragmentation, capital limitations, and weak technological integration. This study aims to assess the current status of HTA development in Do Luong, identify major obstacles, and propose feasible solutions. Utilizing a mixed-methods approach, combining secondary data from 2015–2024 with stakeholder analysis and SWOT methodology, which the research evaluates both crop and livestock production practices. Although several HTA initiatives have been introduced, such as greenhouse vegetable cultivation, automatic irrigation, and VietGAP certified supply chains, their adoption remains modest and uneven. The study is grounded in the Agricultural Innovation Systems framework and the technology acceptance model to provide both theoretical and comparative perspectives. Findings highlight multiple challenges, including lack of skilled human resources, limited institutional support, and unstable market conditions. In response, the paper suggests integrated solutions focusing on land consolidation, digital transformation, human resource training, and policy reform. The research offers a roadmap to support sustainable and inclusive agricultural modernization aligned with Vietnam's Industry 4.0 agenda.

Keywords

High-tech Agriculture, Do Luong, Development, Industry 4.0

1. The Problem

The application of high technology in agricultural production is an idea of sustainable agricultural development that helps solve challenges in agricultural development with superior features of technology, such as greenhouse technology, automation technology, sensor technology, etc. Thereby contribute to reducing costs, boosting productivity, lowering expenses, enhancing product quality, and protecting the environment, and minimizes the dependence of the agricultural production process on natural factors such as weather and

climate. Therefore, the development of high - tech agriculture is becoming a mainstream trend, the key to the success of countries with developed agriculture and also an inevitable trend for Vietnam's agricultural industry in the integration period under the strong impact of the industrial revolution 4.0 [3]. In recent years, high-tech agriculture has been promoted in many regions across the country, yielding initial positive outcomes [9].

Fully aware of the context and importance of high-tech

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agricultural development, Nghe An province has clearly stated the view: "Developing modern agriculture on the basis of applying scientific and technological advances and advanced production methods to improve productivity, quality, efficiency, competitiveness. Agricultural development is associated with the transformation of labor structure in agriculture, the process of urbanization and the construction of a new civilized countryside, increasing land use efficiency and increasing agricultural labor productivity, improving farmers' income and life"¹. According to the orientation of agricultural development zoning under the planning of Nghe An province, Do Luong district is determined to have advantages in the production of high-quality rice, organic agricultural products and urban food supplies and concentrates on raising large livestock, cultivating medicinal herbs, and developing farm and garden economies, etc. The People's Committee of Do Luong district has also determined the goal of "Building and developing agricultural areas with high - tech application, associated with the restructuring of the agricultural sector in the district in order to build a comprehensively developed agricultural sector in the direction of producing goods in the chain associated with the consumption market... Promote the production development in the direction of applying biotechnology, high technology, production according to VietGap standards, organic agriculture, biology..."².

Do Luong district belongs to the delta region, located in the west of Nghe An province, has semi-mountainous terrain characteristics, is a place of convergence and spread of the transportation system, favorable for the expansion of regional trade and cultural exchanges with localities inside and outside Nghe An province between our country and Laos. The total natural area within the administrative boundary is 35,009.25 hectares. The district has 32 communes and 1 township, of which 32/32 communes meet the new rural standards, 05 communes meet the advanced new rural standards (Yen Son, Hoa Son, Tan Son, Trang Son, Dong Son). The population as of December 31, 2021 is 220,864 people (ranked 7th out of 21 districts, cities and towns of Nghe An province), of which 95.41% of the population lives in rural areas. The labor force is quite abundant, as of December 31, 2021, the district has 147,602 employees, of which 53,719 people are workers in agriculture, accounting for 45.7%¹⁴². Although the district possesses favorable conditions, it has not been effectively exploited, the development of high-tech agriculture is spontaneous, highly dependent on nature, low content of "gray matter" and has not attracted additional resources. The agricultural sector is gradually losing its competitive position, increasingly lagging behind major districts of the province such as Quynh Luu, Yen Thanh, Dien Chau... Therefore, it is necessary and urgent to study and assess the current situation of high-tech agricultural development to establish a strategic vision and implement effective support policies.

Theoretical Framework

To strengthen the conceptual foundation of the study, two relevant theoretical models are adopted: the Technology Ac-

ceptance Model (TAM) by Davis (1989) and the Agricultural Innovation Systems (AIS) framework proposed by the World Bank (2012) [11]. TAM explains the adoption of high-tech agricultural practices based on perceived usefulness and ease of use—factors that are particularly relevant in smallholder settings like Do Luong, where awareness, digital skills, and capital constraints are common. Meanwhile, the AIS framework highlights the importance of multi-actor collaboration—linking farmers, cooperatives, research institutions, private firms, and government bodies—in fostering innovation within enabling policy environments. This framework helps interpret the fragmented and uneven progress of HTA development in Do Luong and suggests that stronger institutional coordination is needed. These frameworks together offer both a behavioral and systemic lens for analyzing the challenges and potential of high-tech agriculture in the district.

2. Methodology

This study adopts a mixed-methods approach to evaluate the current status and development potential of high-tech agriculture in Do Luong district, Nghe An province. The methodology consists of two main components: data collection and data analysis.

2.1. Data Collection

Secondary data were compiled from official reports, statistical yearbooks, planning documents, and policy papers issued by the Do Luong District People's Committee and the Nghe An Provincial Statistics Office from 2015 to 2024. These include indicators on land use, crop and livestock production, investment in infrastructure, and high-tech application levels. To enrich the dataset and provide practical insights, informal consultations were held with local officials, cooperative leaders, and farm owners.

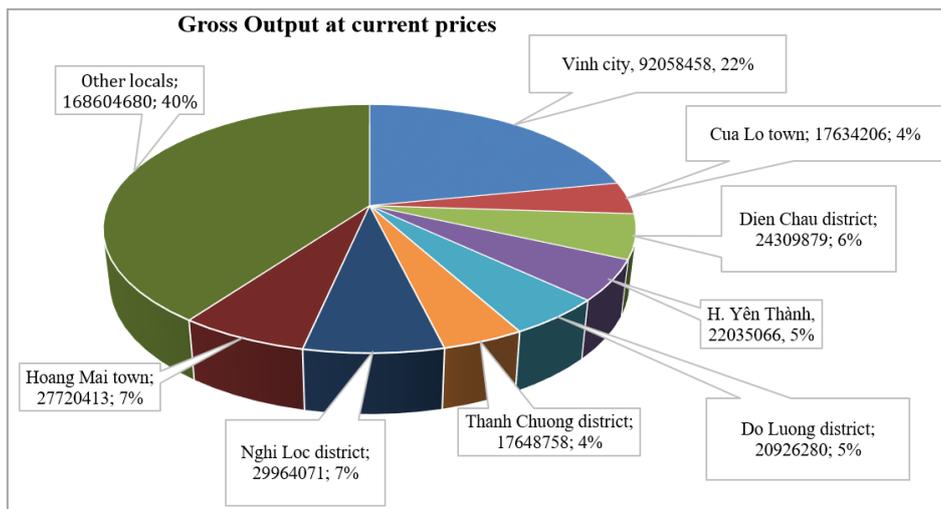
2.2. Data Analysis

Collected data were processed using descriptive statistical methods to identify trends in agricultural production and high-tech adoption. A SWOT analysis was applied to assess internal and external factors influencing HTA development. Comparative analysis was also employed to benchmark Do Luong against other leading districts in Nghe An, such as Nghi Loc, Hoang Mai, Yen Thanh, Thanh Chuong... This methodological framework ensures a comprehensive understanding of the district's agricultural transformation and supports the formulation of context-specific policy recommendations aligned with Industry 4.0 objectives.

3. The Current Situation of High – Tech Agricultural Development of Do Luong District

Do Luong district is one of the key areas for economic development of Nghe An province, for many years it has always been in the top 5 localities contributing the most to the total production value of the province. With the aim of transforming Do Luong into a new economic and cultural hub,

acting as a driving force for the Western region’s growth, Nghe An province has structured Do Luong district into three spatial development zones in the direction of connecting with the overall development of the whole province. In particular, the development of high – tech agriculture in subdivision 1 (Northwest region) is associated with the cultivation of fruit trees, industrial trees, medicinal herbs and cattle breeding; Zone 2 (Central Region) associated with rice and crop cultivation; Zone 3 (Southeast region) focuses on the development of high-tech forestry, rice and crop cultivation³.



Source: Statistics Department of Nghe An province

Figure 1. Total production value of localities in Nghe An province, 2022.

Determining that production development is the central goal of the new rural construction program, thereby improving the material and spiritual well-being of its residents, Do Luong district has focused on directing and synchronously implementing solutions to promote production development, restructure the agricultural economy, etc reorganize produc-

tion in the direction of restructuring the agricultural sector and linking production along the value chain. While agricultural production has developed relatively steadily, the growth rate remains slow, and significant breakthroughs have yet to be achieved.

Table 1. Top 5 localities with the largest rice growing area in Nghe An province in the period 2015-2024.

Unit: ha

Local	Year									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dien Chau	18,443	18,247	18,446	18139	17,437.47	17,394.42	16,738	16,200	15,800	15,500
Yen Thanh	25,291	24,582	25,472	25,271	24,802.58	24,311.33	24,185	23,900	23,700	23,500
Do Luong	14,986	14,999	15,412	15,658	16,269.15	16,446.57	16,752	17,000	17,200	17,300
Thanh Chuong	14,058	14,273	14,376	14,227	13,690	13,781	14,038	14,050	14,100	14,150
Nghi Loc	13,857	14,773	15,261	14,913	15,084.2	14,742.81	14,627	14,500	14,400	14,300

Source: Statistics Department of Nghe An province

Agricultural production linkages along the value chain were initially formed. Of the total rice cultivation area of 16,799.21 hectares (average yield: 58.04 quintals/ha, output: 97,499 tons), there are 1,695.1 hectares of production area along the value chain, connecting from production to consumption with 10,424.86 tons of rice consumed (accounting for more than 10%). The district has established a 3-party model between the Agricultural Service Center, the Rice Seed Production Company and agricultural cooperatives, typically: The model associated with the Central Agricultural Joint Stock Company, QP5 commercial rice production (area of 89.82 hectares, output of 603 tons), ST25 rice variety (area of 10 hectares, output of 51.6 tons); Affiliated with Vinh Hoa Science and Technology Co., Ltd., producing AC5 high-quality rice (area of 41.6 hectares, output of 261 tons); Affiliated with TW1 Seed Joint Stock Company to produce commercial rice VRN10, VNR20 (area of 37.46 hectares, output of 205.6 tons); Affiliated with International Technology Development and Application Investment Co., Ltd., producing commercial rice of Ha Phat 3 rice variety (area of 16.79 hectares, output of 105.78 tons).

Similar to rice cultivation, in the total vegetable area of the district of 1,581.21 hectares (average yield of 93.46 quintals/ha, output of 14,778.34 tons/ha), there are 107.8 hectares of production along the value chain, with an output of 1,692.46 tons (accounting for 11.45%). A number of linkage models from production to consumption have been established such as: Linkage model between Tru Phuc Green Cooperative and Dang Gia Production and Trading Co., Ltd.; with an output of 10 tons/year, products are certified to meet Viet Gap standards and the Certificate of production facilities to ensure food safety; The association model between Trung Son Safe Agricultural Products Cooperative and Vincommerce General Trade Service Joint Stock Company, with an average output of 3-4 quintals of vegetables and fruits of all kinds/orders; The high-tech vegetable production model associated with the association of product consumption in Think Son commune with the Bibi green chain of stores and clean food, with a scale of 1.6 hectares.

In addition, there are a number of other association models such as: Medicinal plant cultivation model associated with essential oil extracts and processing, association with Do

Luong Pharmaceutical Essential Oil Processing Clean Food Cooperative, area of 20 hectares; API Green Hemp planting model in association with An Phuoc Hemp Company (providing seeds); Sweet corn planting model in association with Dong Giao Export Food Joint Stock Company (seed supply, technical guidance, product consumption); The model of growing red flesh dragon fruit according to Japanese technology in association with Dang Gia Production & Trading Co., Ltd. (product consumption).

Along with the formation of concentrated raw material areas, many farm owners, businesses, cooperatives, and farmer households have used high technology and techniques in agriculture but are mainly focusing on production. Typically, models of application of fully automatic and semi-automatic irrigation systems such as: The model of producing Ha Black grapes in a greenhouse, scale of 4,000m² in Think Son commune; The model of vegetable production in net houses has a scale of 3,000m² in Think Son commune, 2,000m² in Trung Son commune, and 2,000m² in Lac Son commune... Some models are highly effective, bringing stable income to people such as: high-tech agricultural production model in 10 greenhouses, planting on substrates, applying fully automatic drip irrigation technology, area of 40,900m², average profit of more than 600 million VND/ha/year; The ST25 rice production model in Dang Son, Lac Son, Van Son, Nam Son communes has an average yield of 52-58 quintals/ha in the spring crop, 46-56 quintals/ha in the summer-autumn crop, profit after deducting costs is over 39 million VND/ha; Integrated model of afforestation, fruit tree planting combined with livestock farming on forest land in communes: Giang Son Dong, Giang Son Tay, Hong Son, Nam Son, etc.

Livestock farming continues to be maintained in diverse forms, shifting from small-scale livestock farming in residential areas to livestock farming in the direction of concentrated industry, semi-industry, farms and livestock. Some farms and concentrated livestock households have applied a few technologies such as: Irrigation system, cooling by motors, ventilation fans, barn treatment preparations. Some models with household scale apply biological bedding in pig breeding, chicken farming and several aquaculture models in the direction of VietGAP.

Table 2. Summarizing the output of main livestock in Do Luong district, in the period 2015-2024.

Type of Pet	Units of Calculation	Year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Buffalo	heads	17,528	16,954	15,898	14,894	13,216	12,370	12,781	12,643	12,411.2	12,178
Cow	Thousand head	28,345	28,282	26,540	26,323	25,721	22,181	23,324	23,611	23,824.6	24,039
Pig	Thousand head	108,066	98,245	88,021	93,996	62,697	62,180	61,058	61,923	63,472.8	64,095

Type of Pet	Units of Calculation	Year									
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Chickens, ducks, muscovy ducks, geese	Thousand heads	1,336	1,362	1,430	1,452	1,594	1,793	1,830	1,853	1,878	1,899

Source: Author compiled from data of the Statistics Department of Nghe An province

In the district, there are 310 farms and family farms, of which 16 farms meet standards with an area of 57.55 hectares. Many models of association and consumption of products have been formed, prominent such as the pig breeding model (5,400 heads/year) in Boi Son commune and Trang Son commune; Broiler breeding model (36,000 heads/year) linked between Do Luong Chicken Breeding Cooperative Group and Sunshine and Wind high – tech Agricultural Development Application Co., Ltd.; Broiler breeding model (12,000 heads/year) in Giang Son Dong commune of Cao Khanh Poultry Breed Co., Ltd.; The model of raising beef cattle from waste dairy calves (1,000 heads/year) in Bai Son commune...

In addition, the district promotes planting, intensive farming, afforestation in combination with planting medicinal plants and animal husbandry, encouraging forest economic development along the value chain to improve economic efficiency. Converting from raw acacia forests, harvesting young timber to planting and trading, exploiting large timber forests... associated with sustainable forest management and the implementation of forest certification (FSC). Deploy and replicate models of planting trees for wood such as *doi*, paving, and black flute. Building a raw material afforestation area in Dai Son commune (618 hectares, North Central high – tech Forestry Zone Project of Thien Minh Duc Group Joint Stock Company); *doi* timber planting project combined with ecotourism in Van Son commune (50 hectares).

The positive results in agricultural development in general and high – tech agriculture in particular mainly come from the mobilization and effective exploitation of available potentials. In addition, the district has focused on leading, directing and doing a good job in site clearance and promulgating many mechanisms to attract businesses to invest in the area to maintain the pace of growth, improve rural infrastructure, especially renovate and upgrade agricultural and food markets, etc a system of linked channels for the consumption of agricultural products. The district has formed the South Do Luong Town industrial cluster, Lac Son and Thuong Son industrial clusters, has 2 industrial garment factories (Minh Anh, Kido) and Bai Son Cement Factory. In the period of 2015 - 2021, the district has attracted 1,796 projects with a total capital of VND 23,688 billion, of which capital from organizations, individuals and enterprises are 12,009 billion VND (116 projects). The district has 442 small and medium-sized enterprises operating mainly in fields such as mineral exploita-

tion, cement production, corrugated iron production, steel profiles, plastics, water tanks, building materials, wood processing, civil construction, mechanical engineering, etc., creating jobs for 12,737 employees with an average income of 5 -7 million VND/person/month. The district currently has 7 craft villages, production and business activities are quite stable, creating many jobs and increasing income for rural people. Cooperatives and craft villages have developed and standardized nearly 20 local specialty products to build OCOP products. By the end of 2022, the district has 2 products with 4 stars, 24 products with 3 stars. The development of enterprises, industrial clusters, craft villages, and cooperatives has contributed to improving people's living standards, thereby promoting the expansion of the market for high – tech agricultural products. Practice has shown that the development of high – tech application production is the right direction, which has been creating a new impetus for Vietnam's agricultural industry in general and in Do Luong district in particular.

4. Assessment of Advantages and Disadvantages in the Development of High – Tech Agriculture in Do Luong District

Advantageous:

Do Luong district generally has a fairly flat terrain, a relatively large area, agricultural land area is 24,959.6 hectares (accounting for 70.56%), of which: agricultural production land is 15,573.55 hectares; Forestry land with forests is 8,775.52 hectares; Aquaculture land 555.42 hectares; Other agricultural land is 55.11 hectares.

The district is a land of biodiversity, which can be divided into the following sub-regions: Delta, Lam Riverside, Northwest semi-mountainous region and Southeast semi-mountainous region. In which:

- 1) The delta area (key rice area) includes Do Luong town and 13 communes: Trang Son, Dong Son, Yen Son, Van Son, Thinh Son, Hoa Son, Lac Son, Xuan Son, Minh Son, Tan Son, Quang Son, Thai Son, Thuong Son. It has an area of 11,324 hectares. The characteristics of this area are relatively flat terrain, at an altitude of 9m to 11m above sea level. There are many divided hilly areas around, with a fairly complete agricultural system, so it

is convenient for agricultural production, which is a key rice area of Nghe An province.

- 2) The area along the Lam River includes 7 communes: Nam Son, Bac Son, Dang Son, Luu Son, Da Son, Trung Son and Thuan Son. There is an area of 4,483 hectares of fertile land, which is convenient for industrial crop cultivation and development of mulberry farming villages.
- 3) The semi - mountainous region of the Northwest includes 7 communes: Ngoc Son, Lam Son, Bo Son, Giang Son Dong, Giang Son Tay, Hong Son and Bai Son. With an area of 10,419.9 hectares, the characteristics of this area are alternating 2 forms of hilly terrain and valleys. The hilly terrain runs in the northeast direction (from Giang Son Tay commune to Ngoc Son) and the valley topography (in the form of a basin valley with streams flowing through it including Giang Son Dong, Hong Son and Bai Son communes; the sloping valley form includes Bo Son and Lam Son communes).
- 4) The semi - mountainous area of the Southeast includes 5 communes, namely Hien Son, Nhan Son, My Son, Tru Son and Dai Son with an area of 9,027 hectares. This terrain area is characterized by hills running in the northwest-southeast direction alternating 2 types of hilly terrain and sloping valleys, the terrain is quite complicated, valleys and rocky mountains [13].

Do Luong people have a rich history, culture, love for their homeland and a very high sense of village. Therefore, the population often lives in concentration, gathered in clusters. This feature creates favorable conditions for the accumulation and concentration of land for the development of specialized farming and agricultural production areas on a large scale. In addition, people are not fully dedicated to agricultural production but also expand to many other sub-occupations, so land acquisition often takes place faster and more conveniently than in other localities.

The district gathers many important traffic routes: National Highway 7A, 7B, 46, 15A, Road 7C (N5) and provincial roads 533, 534, connecting many localities inside and outside the province, so it is very convenient for circulation and exchange of goods. This is an important basis to build Do Luong into a transshipment center, expand the market for agricultural products in the area and supply to other localities.

The irrigation system of the whole district is relatively convenient due to the presence of Ba Ra dam to block water to the Dao River, there are 112 large and small dams; the system of canals and ditches is basically concreted, convenient for agricultural development. In 2022, the area of agricultural production land that is actively irrigated is 20,512.26 hectares/21,441.95 hectares, reaching 95%; The area of agricultural and non-agricultural land that is actively consumed is 29,575.13 hectares/30,472.65 hectares, reaching 97%.⁴

Difficult:

Regarding land:

The large - scale shortage of land for investment in the application of science and technology in concentrated produc-

tion areas is currently a major barrier due to the small amount of land for agricultural production, the agglomeration of land and the concentration of land is still slow due to the lack of effective aggregation strategies and policies in the district. The planning for the construction of large - scale specialized commodity production areas faces many difficulties. The production land fund has been assigned to the small majority of households with a fragmented and small way of thinking and doing business, so applying high technology to production is very difficult and expensive. With the reason that production is not profitable and the state does not have support policies, many farmers are willing to abandon land for 2/3 of the year, but when businesses and cooperatives want to lease back farmers' land to invest in production, the cost of sublease is very high because there is no mechanism for people to trust to hand over land to leased enterprises; Farmers have the mentality of keeping the land because they consider the land as the final means of production.

In addition, the district has also focused on supporting small and medium-sized enterprises and farmer households with conditions to apply high technology. However, the whole district currently has only 273 farmer households accumulating land of 2 hectares or more for agricultural, forestry and fishery production with an area of 1,125.89 hectares and 2 enterprises investing in agricultural, forestry and fishery production. Meanwhile, by the end of 2021, Nghe An province has over 26,555 hectares of high-tech agricultural production, 25 enterprises and 29 cooperatives applying high technology in agricultural production. It can be seen that this result is not commensurate with the stature and potential of the district [12].

Regarding capital sources:

Because the support policies are not strong enough, especially the loan support with preferential interest rates, farmers are still struggling with the problem of converting from traditional agriculture to high-quality, clean agriculture because the high - tech agricultural production model requires the organization of production to be carried out on a relatively large scale and investment commensurate in terms of infrastructure and production technology. The investment cost for a high - tech farm is usually 4 - 5 times higher than building a farm according to the traditional model. Therefore, the investment in high - tech agricultural production for enterprises with strong financial foundations, is also a risky challenge because investment in land, greenhouses, technology, etc. It is not guaranteed to succeed immediately if there is a lack of personnel, experience and a strong enough distribution system. Do Luong has a large source of remittances as well as idle money, but there is no reasonable investment attraction policy to exploit this resource for economic development in general and high - tech agriculture in particular in the district.

Regarding the application of science, technology, and human resources

Despite initial efforts, research capacity, technology transfer mechanisms, and the quality of human resources in

Do Luong remain limited, posing significant barriers to the development of high-tech agriculture. Effective adoption of high-tech agricultural practices requires a workforce with sufficient scientific and technical knowledge. However, interviews with local cooperative leaders and extension officers reveal a widespread shortage of skilled labor, especially in digital agriculture, automation, and biosafety management.

Many rural workers still rely on traditional farming methods and lack the training to operate modern technologies such as sensor-based irrigation systems or greenhouse automation. Young laborers who are more receptive to technology often migrate to urban centers or work abroad, leaving behind an aging agricultural workforce. These demographic shifts have resulted in a gap between the technological demands of modern agriculture and the actual capabilities of available labor. For example, a farm owner in Yen Son commune shared that although he received training on digital monitoring systems, he had to abandon the system due to lack of staff capable of maintaining and interpreting the data effectively.

Moreover, high-tech processes like VietGAP certification, IPM/ICM integration, and biotechnology-based production are rarely implemented in a synchronized or scalable way, partly due to the difficulty of collective coordination and inconsistent policy support.

Market challenges and Climate exposure

Do Luong's agricultural producers also face unstable

markets for high-tech products. Interviews with vegetable cooperatives in Thinh Son and Lac Son communes indicated that although they met VietGAP standards, inconsistent purchasing volumes and frequent price drops discouraged continued investment. Many high-tech products, despite having higher production costs, do not command sufficiently higher prices in the market to offset initial and operational investments. This is especially problematic for small-scale farmers who operate on thin profit margins and lack access to guaranteed off-take contracts or retail networks. Without branding, certification marketing, or e-commerce integration, products remain undifferentiated and vulnerable to price volatility.

In addition, the district is frequently affected by climate risks, including storms and floods that damage infrastructure and disrupt supply chains. These uncertainties further reduce the willingness of farmers and cooperatives to invest in costly technologies without institutional guarantees or insurance mechanisms.

The combined impact of skill gaps, unstable markets, and climate risks highlights a key trade-off: while high-tech agriculture promises long-term gains in productivity and quality, the short-term costs, learning curves, and external uncertainties present real disincentives for adoption. Addressing these challenges requires not only infrastructure investment but also targeted training, market development, and risk-sharing mechanisms.

5. A Few Suggestions

5.1. SWOT Analysis of High-Tech Agriculture Development in Do Luong District

Table 3. SWOT Analysis of High-Tech Agriculture Development in Do Luong District.

Strengths	Weaknesses
- Favorable natural conditions and diverse agro-ecological zones	- Fragmented and small-scale land use
- Abundant rural labor force	- Limited access to capital and credit
- Strategic geographical location for trade and logistics	- Lack of skilled human resources and weak technology transfer
- Existing value chain linkage models (e.g., rice, vegetables)	- Inconsistent application of advanced farming practices and standards
Opportunities	Threats
- Government policies supporting digital and sustainable agriculture	- Market instability and low consumer trust in local HTA products
- Rising demand for safe, certified agricultural products	- High initial investment costs and slow return on investment
- Potential for enterprise – cooperative – farmer partnerships	- Climate risks: storms, floods, droughts
- Integration with e-commerce and smart farming trends	- Brain drain: outmigration of young, tech-savvy labor

Source: Author compiled

5.2. A Few Suggestions to Develop High - Tech Agricultural Development in Do Luong

From the current situation of high – tech agricultural development in Do Luong district, the authors realize that to promote stronger development in the coming time, it is necessary to focus on the following groups of solutions:

Group of solutions to promote land accumulation and concentration:

- 1) Do Luong district needs to strengthen propaganda and raise people's awareness of the necessity of land accumulation and concentration to form concentrated agricultural production areas and high – tech agricultural zones. In addition, it is necessary to clearly explain specifically the rights, obligations and responsibilities of households, cooperatives, enterprises, etc. for each form of land accumulation and concentration. From there, creating a consensus in the process of accumulating and concentrating land for the development of high – tech agriculture.
- 2) It is necessary to ensure that the accumulation and concentration of land takes place transparently and democratically, according to the market mechanism, ensuring both the interests of the people and the interests of enterprises. The results of practical research show that amending controlling regulations (such as land deadlines, time, etc.) is often not as important as building "trust" for people and businesses through clear regulations on people's rights when using, land transfer, especially in rural relations. In resolving conflicts and disputes related to land, it is necessary to ensure the participation of all relevant subjects and the supervision and management of community organizations [8, 10].
- 3) To associate the process of land accumulation and concentration with the process of economic restructuring and reassignment of laborers in rural areas. Along with that, encourage the development of cooperative models, have a mechanism to attract economic sectors to participate in investment in the development of high-tech agriculture, pay attention to policies for leading enterprises, sectors and key products, create conditions for leading, and promote the development of high – tech agriculture.

Group of solutions to promote chain linkage:

In order to organize and manage the development of high – tech agriculture in chains, in which enterprises play the core and central role of the chain, creating breakthroughs in changing the agricultural production model, the district should promote the replication of two models:

Linking businesses and people to build large fields, applying high – tech in crop production and cultivation according to the production chain and agricultural product value chain (Nuclear farm model). There are mechanisms and policies to encourage cooperatives to transform their operating models from mainly providing input and output support ser-

vices in people's production to a model that both participates in organizing and managing production processes and quality and acts as an intermediary point between enterprises and people to build large fields for high – tech application according to high – tech agricultural product chain. [2, 4]

Model of linking enterprises and farms and farms applying high – tech in animal husbandry (Centralized model). Synchronous high – tech application from breeding, barn, feed, breeding process and disease management, waste treatment technology, hygiene and ecological environment assurance. [5]

Strengthen the linkage in product production and consumption, form chains of agricultural products applying high – tech to ensure stability and sustainability in the development of high – tech agriculture in the district. In order for the association and cooperation between land users to concentrate large-scale agricultural land for production to achieve economic efficiency, it is necessary to encourage the connection of contracts between farmers and enterprises and cooperatives, in which the contract clearly states the rights and responsibilities of the two parties in a harmonious manner and the regulations on handling violations.

The intermediary role of state agencies in connecting links needs to be further strengthened. The district needs to actively promote joint ventures and associations between farmers and businesses, cooperatives, shops, supermarkets, boarding schools, collective kitchens, etc. in the area in order to well implement the provision of input services for the production and output of agricultural and food products. Agricultural development in general and high – tech agriculture in particular must be sustainable, inclusive and multi - valued. Therefore, it is necessary to effectively use and promote traditional values, production and farming practices, agricultural activities and typical ecological environment, associated with digital transformation; Strengthen the connection and integrated value between industries through promoting agricultural development associated with e-commerce services, eco-tourism, community tourism, etc.

Some other solutions:

- 1) To review land use planning, ensuring that the planning must be stable and long-term oriented to meet the requirements of the process of restructuring the agricultural sector, in which priority is given to the development of high – tech agriculture. In addition, it is necessary to publicize the land use planning that has been approved by the competent state agency to create conditions for land users and business owners to invest in the field of agriculture that is easy to learn, access and rest assured to invest in the development of high – tech agriculture [1, 7].
- 2) To intensify research, transfer and application of science and technology to production, processing, business, and replicate good production and business practices. In particular, using high-yield and high-quality plant varieties; synchronous application of mechanization (from land cultivation, planting, care, harvesting, preservation

and consumption); applying advanced processes IPM, ICM, quality management processes according to VietGAP standards...

- 3) To step up brand development, promotion and promotion of local high – tech agricultural products through exhibitions, fairs, and centers for introduction of agricultural products inside and outside the district. Support and encourage cooperatives and businesses to build websites to promote products, receive feedback from consumers, and link to the district's website,... Develop reports and clips introducing production techniques and high – tech agricultural products to be broadcast regularly on the district's radio and television channels to introduce to consumers; design and print smart electronic stamps to easily trace the origin of products and provide information about the establishments where products are circulating on the market.
- 4) To concentrate on training human resources and improving the quality of the contingent of scientific and technological cadres. Review the contingent of agricultural technical staff of communes and agricultural cooperatives in the district, advise on making plans for training, research and study of production models, application of science and technology in agricultural production. To expand links and cooperation with institutes and universities in research, training and transfer of science and technology; strengthen training and fostering agricultural economic thinking, market thinking, e-commerce, new farming skills, values and skills in agricultural and rural tourism for local people.

Based on the current status of high - tech agricultural development in Do Luong district, the following groups of solutions are recommended to foster stronger progress in the future.

6. Conclusion

High-tech agriculture is a trend of development integration, an effective technological solution that creates new breakthroughs in agricultural production, creating a basis for rapid transformation of agriculture in the direction of industrialization and modernization [6]. In order to promote the development of high-tech agriculture, the Party and the State have paid attention to directing and promulgating many specific mechanisms and policies to attract investment and support businesses, organizations and farmers. In particular, attracting investment in high-tech agriculture enjoys many incentives such as: for enterprises to borrow without collateral up to 70% - 80% of the value of high-tech agricultural projects in the form of flexible loans; loans with interest rates lower than market interest rates from 0.5% to 1.5%; incentives on land rent, reduction of administrative procedures, etc. The Government also devotes a lot of resources to research, technology transfer, improving productivity and quality of agricultural products; implement the policy of allocating land and

long-term forests to users, creating conditions for the accumulation and concentration of agricultural land according to market principles to form modern agriculture. Efforts to find and expand markets for agricultural products by participating in many free trade agreements, gradually bringing Vietnamese agricultural products into markets with large purchasing power and high requirements for quality such as Japan, Europe, the US, Australia, etc. However, for science and technology to really promote the development of the agricultural sector, in the coming time, more attention is needed from ministries, sectors and localities to improve policies and put policies into practice effectively. For district-level governments, it is necessary to uphold the proactive and drastic role in formulating plantings and plans for the development of high-tech agriculture, renovating production organizations to form appropriate forms of production organization (hi-tech agricultural zones, hi-tech agricultural zones, enterprises, projects, production and business plans applying high technology), supporting and creating the best conditions for people to access and enjoy high-tech agricultural development policies.

Over the past time, Do Luong district has focused on applying science and technology to agricultural production and initially achieved success. However, besides the achieved results, the development of high-tech agriculture in the district still has limitations and exists. Therefore, in order for high-tech agriculture to be replicated in a sustainable way, in addition to the above suggestions, the district needs to promote the potentials, advantages and basic foundations of agricultural production in the direction of circular economy, build linkage chains, in which clearly delineate the role of each element to implement specialization, systematization, associated with the application of scientific advances, to digitize the entire process from production, processing to consumption in order to improve added value for agricultural production.

Abbreviations

HTA	High-Tech Agriculture
US	United State

Conflicts of Interest

The authors declare no conflicts of interest.

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