Application of High Technology in Farming Activities of the Co Ho People in Lac Duong District, Lam Dong Province

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Abstract

In the past, the Co Ho people in Lac Duong district, Lam Dong province, relied on traditional farming practices rooted in their experience, local weather, and natural resources. However, they have gradually adapted to transitioning from these conventional methods to high-tech agricultural practices. Based on survey data from 364 Co Ho households and field research, the study analyzed the current state of high-tech adoption in farming and the factors influencing this transition. The findings revealed that households had adopted advanced techniques such as drip irrigation, smart fertilization, and new crop varieties, optimizing production efficiency, increasing yields, and meeting market demands. Among the factors influencing high-tech adoption, technical aspects had the most decisive impact, followed by economic, cultural-social, and natural conditions. This highlights that the shift towards high-tech agriculture depended on access to technology and community awareness, support policies, and real production conditions, which collectively shape the sustainable development of modern farming practices in rural areas like Lac Duong.

Keywords: *Co Ho people, farming, High-tech agriculture, Lam Dong province.*

Introduction

In the context of globalization and the Fourth Industrial Revolution, applying high technology in agriculture is becoming an inevitable trend. This aims to enhance productivity, improve product quality, minimize negative environmental impacts, and improve the economic livelihoods of the population. In Vietnam, particularly in agricultural potential areas like the Central Highlands, applying high technology in agricultural production has brought significant benefits (Nguyen, 2020; Vu et al., 2022; Vu, 2023). Lac Duong district, Lam Dong province, is one of the localities with strengths in agricultural production. The Co Ho community here plays a vital role in cultivation activities. However, most Co Ho households still maintain traditional farming methods and face numerous challenges, such as climate change, soil degradation, pests, and unstable product markets. The application of high technology in the cultivation activities of Co Ho households is considered a potential solution to address these difficulties, thereby promoting sustainable development and improving the socio-economic life of the community (World Bank, 2019)

Despite numerous support policies from local authorities and related organizations to promote the application of high technology in agriculture, the level of access and practical application by Co Ho households remains limited. Factors such as high investment costs, lack of knowledge and skills to access technology, and traditional farming habits have hindered this transformation

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process. Furthermore, the lack of information about the effectiveness of high-tech application models in cultivation is a significant barrier for local people (FAO, 2020; Nguyen et al., 2020; Sakata, 2023; Vinh et al., 2021). This study analyzes the current high-technology applications in cultivating Co Ho households in Lac Duong district, Lam Dong province, and the influencing factors. Based on this, we propose several solutions to enhance the access and application of high technology in agricultural production, contributing to increasing income and stabilizing the livelihoods of Co Ho households.

Literature Review

The application of advanced technologies in agriculture has become a crucial trend in enhancing productivity, product quality, and environmental protection. High-tech agriculture (HTA) integrates advanced technologies such as biotechnology, automation, and intelligent monitoring systems to optimize production processes. In Vietnam, the application of high-tech agriculture in crop production has yielded positive results, such as automated irrigation technologies that help save water and increase crop yields (Ministry of Science and Technology, 2021; Nguyen & Nguyen, 2021b). However, domestic studies have also indicated that the transfer of technology in rural areas and among ethnic minority communities faces many challenges due to the lack of infrastructure, limited knowledge of new technologies, and financial constraints. Several studies showed that although high technology had great potential, the level of access and application in ethnic minority communities remained limited, and the Co Ho people in the Lac Duong district were among them (Hoang et al., 2023; Nguyen & Nguyen, 2021a). Additionally, a study by Nguyen Van Quyet and Nguyen Quy Thanh (2023) showed that applying high-tech agriculture in the Central Highlands, especially within ethnic minority communities, could enhance production efficiency, but it also required support in terms of technical training and infrastructure to achieve sustainable success. These challenges need to be thoroughly studied to propose suitable solutions.

International studies have also highlighted the significant potential of high-tech agriculture. Countries like the Netherlands and Israel have successfully applied technologies such as automated irrigation systems and intelligent monitoring, which help increase productivity and reduce resource use (Gulati et al., 2021; H. Farhangi et al., 2020; İpek, 2022). Several studies indicated that although these technologies were widely implemented in developed countries, their application in developing countries faced significant challenges related to costs and farmer training (Becerra-Encinales et al., 2024; Bethi & Deshmukh, 2023; Saidu et al., 2017). Furthermore, a recent study by Yang et al. (2025) on high-tech adoption in agriculture emphasized that policy frameworks and incentives are key factors in fostering innovation adoption, particularly in rural and developing areas, highlighting the need for comprehensive governmental and institutional support to boost technology integration. From domestic and international studies, it is evident that developing high-tech agricultural models is crucial, particularly in ethnic minority regions, such as Lac Duong, where there is substantial potential but a lack of technology and training support.

Methodology

Combination of Qualitative and Quantitative Research: The authors employed grounded theory and survey methods to objectively and scientifically approach the research issue. They conducted direct and indirect observations of agricultural activities among the Cơ Ho people in Lac Duong, Lam Dong (Glaser et al., 1968). The study integrated interdisciplinary research from various fields, including linguistics, folklore, geography, sociology, agriculture, and

demographics.

Theoretical Research and Sampling Method: The authors synthesized and analyzed data from books, journals, and scientific articles. They utilized both purposive (judgmental) sampling and convenience sampling methods. The subjects were households of the Cơ Ho ethnic group in Lam Dong. The sample size was determined based on the distribution table by Krejcie and Morgan (1970)

Survey Method: The research was conducted through sociological investigation methods, including field surveys and direct interviews with 364 households, among which 337 had adopted high technology. The survey questions encompassed economic, technical, natural conditions, socio-cultural, and educational factors. In addition, interviews were conducted with key individuals within the community to gain deeper insights (Pham & Nguyen, 2011).

Data Analysis: Quantitative data were processed using SPSS software, employing Cronbach's Alpha to test reliability (Cronbach & Lee J., 1951), exploratory factor analysis (EFA), and multiple linear regression to evaluate the impact of each factor (Dormann et al., 2013; Nguyen & Nguyen, 2009). Qualitative analysis was also conducted to assess the effect of high technology on the livelihood and income of the people, clarifying the benefits and challenges in the transition to new production models.

Results and Discussion

Traditional Agricultural Practices of the Co Ho People

The Coho people belong to the Mon-Khmer language group in Vietnam, including local subgroups such as Coho Srê, Coho Nộp, Coho Chil, Coho Lạch, Coho T'ring, and Coho Cờ dòn. According to the 2019 Population and Housing Census, there are 200,800 Coho people in Vietnam, with 175,531 residing in Lam Dong province (General Statistics Office of Vietnam [GSOV], 1979). The traditional agricultural practices of the Coho people primarily relied on slash-and-burn cultivation and wet rice farming, with a heavy dependence on land and forest resources. Since 1986, thanks to the Doi Moi policy, the economy of the Coho people shifted from subsistence farming to commercial agriculture, particularly coffee cultivation, which contributed to improving their economic livelihoods. Agriculture had been the main economic activity of the Coho people, based mainly on subsistence farming and reliance on natural resources, particularly land and forests (Le & Mai, 2017). This article discusses the two traditional farming methods of the Coho Chil and Coho Lạch subgroups, as they are the two largest and most concentrated groups in the Lac Duong district, each with different agricultural practices.

The Chil group residing in high mountainous forest areas primarily engaged in swidden agriculture and cultivated short-term crops such as rice, corn, pumpkins, sweet potatoes, cassava, vegetables, and beans. Since the 1990s, due to the economic value of coffee, cashews, and flowers, they transformed their crop structure and improved cultivation techniques, which enhanced their income (General Statistics Office of Vietnam [GSOV], 2020). The Lach group, residing in gently sloping hill areas, practiced wet rice and swidden cultivation. Their wet rice farming techniques were improved by adopting scientific and technological advancements, increasing productivity and living standards (General Statistics Office of Vietnam [GSOV], 2020). Over time, the Co Ho people in Lac Duong gradually replaced traditional rice varieties with new ones, adopted modern techniques, used fertilizers and pesticides, and conducted two crop cycles yearly. This helped to increase productivity and income, and many households

shifted to cultivating high-value crops such as coffee, mushrooms, vegetables, flowers, tubers, and fruits, helping them escape poverty and achieve prosperity.

Current Status of High-Tech Applications in Agricultural Activities of the Co Ho People in Lac Duong District

High-tech applications in agricultural activities aimed to increase productivity, reduce manual labor, and enhance product quality. For the Co Ho people, this transition marked a significant change in their production methods and the organization of their socio-economic life. Survey results from Figure 1 showed the rate of high-tech usage in the agricultural activities of the Co Ho people in the Lac Duong district, categorized by the duration of their involvement in farming. The results indicated that the rate of high-tech usage in farming households increased over time. Specifically, the high-tech usage rate was 87% for the group with less than 5 years of involvement, 91.4% for the group with 5 to 10 years, 96.7% for the group with 11 to 20 years, and 95.5% for the group with more than 20 years of involvement. This reflected the increasing trend in high-tech applications in agricultural production over time, possibly due to development, improvement, and increased awareness of the benefits of technology in the production process. Households with long-term involvement in farming might have become accustomed to applying modern technologies to optimize production and increase crop yields.
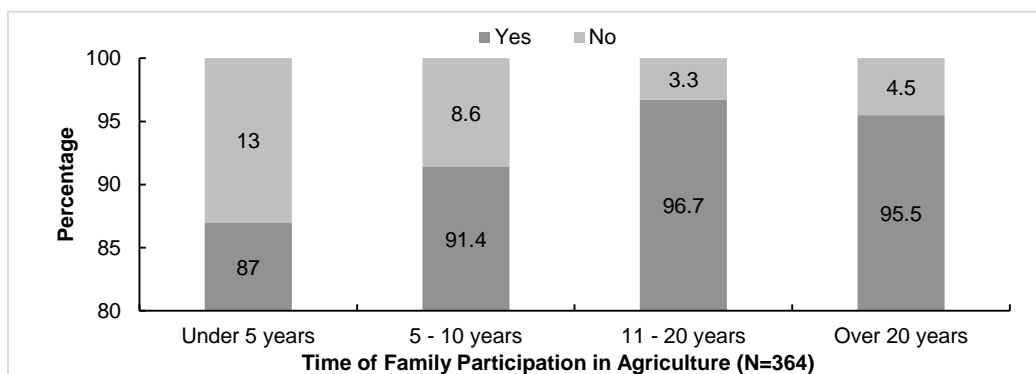

Figure 1 The rate of high-tech usage in agricultural activities by the duration of household involvement in farming

The analysis results from the Pearson Chi-Square test and Linear-by-Linear Association indicated a complex relationship between the duration of agricultural participation and the use of advanced technology among the Coho households in Lac Duong District. The Pearson Chi-Square test did not provide sufficient evidence to confirm a clear connection between the duration of agricultural participation and the use of advanced technology (χ^2=5.628; df=3; p=0.131). In contrast, the Linear-by-Linear Association analysis revealed a statistically significant linear relationship between the agricultural participation duration and the advanced technology usage rate (df=1; p=0.033). This means that the longer the involvement in agriculture, the higher the rate of advanced technology usage, and this relationship was statistically significant. Although the Pearson Chi-Square test did not establish a strong relationship between the two variables, the linear analysis showed a positive and statistically significant trend between agricultural participation and the use of advanced technology.

The analysis results from the Pearson Chi-Square test and Linear-by-Linear Association showed that the relationship between the duration of involvement in farming and the use of high

technology in the households of the Co Ho people in the Lac Duong district was quite complex. The Pearson Chi-Square test did not identify a clear relationship ($\chi2$=5.628; df=3; p=0.131), while the Linear-by-Linear Association analysis revealed a statistically significant linear relationship (df=1; p=0.033). Specifically, the longer the participation in farming, the higher the rate of high-tech usage. Although the Pearson Chi-Square test did not prove a strong relationship, the linear analysis indicated a statistically significant positive trend. Several previous studies can explain this result. According to a survey by Do Kim Chung (2021), using high technology in agriculture increases productivity, helps reduce production costs, and improves product quality. This could motivate households in the Co Ho community to adopt and use high technology as they gain more experience applying new techniques. Another study also pointed out that farmers recognized the benefits of high technology for production efficiency in the early or late stages of agricultural production. This explains why high-tech use in farming has become widespread despite no apparent difference in usage levels based on the duration of participation (Le & Le, 2014)

However, the study also indicated that, although high technology has been widely applied, a small proportion of households still did not use this technology, especially in the groups with less than 5 years and between 5 to 10 years of involvement. These households may face difficulties in accessing high technology due to factors such as initial investment costs, lack of knowledge about the technology, or lack of support from organizations and relevant authorities.
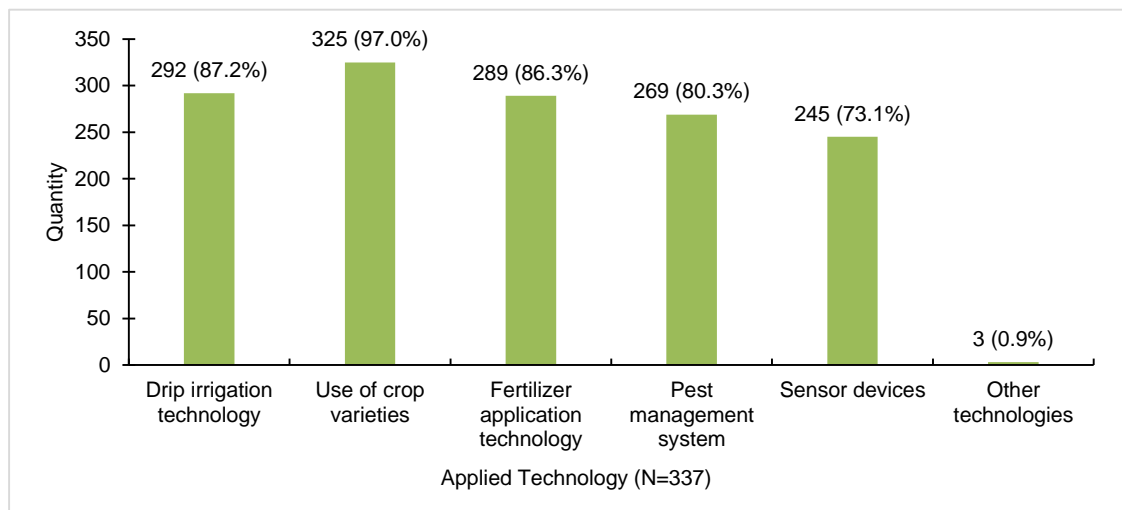
Figure 2. Types of high-tech applications used by Co Ho households in agricultural activities

Data from Figure 2 showed the prevalence of modern methods in the agricultural practices of the Co Ho people. The use of new crop varieties accounted for the highest rate at 97.0%, reflecting their interest in improving seed quality to enhance productivity and adapt to environmental conditions. The second most prevalent was drip irrigation technology (87.2%), followed by innovative fertilization technology (86.3%), indicating a trend towards prioritizing methods that optimize water and fertilizer resources, reduce waste, and improve efficiency. However, the utilization rates for sensor devices and automated pest management systems were lower (73.1% and 80.3%, respectively), possibly due to high initial investment costs or technical operation requirements.

Data from Figure 3 indicated that economic factors and labor efficiency were the main reasons Co Ho households adopted high-tech agriculture methods.
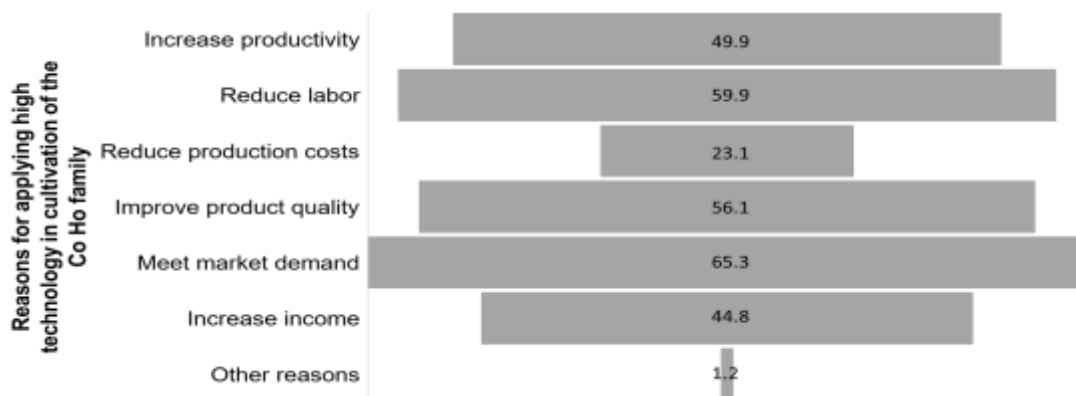
Figure 3 Factors driving Co Ho households to adopt high-tech agricultural practices

The primary reason for applying high-tech methods in farming was to meet market demands (65.3%), reflecting the pressure on the quality and quantity of agricultural products. Technology helped reduce manual labor (59.9%) and improved product quality (56.1%). However, only 23.1% of households found that technology reduced production costs, indicating that initial investments could be a barrier. Mr. Pang Ting Sin (a Co Ho resident in Lat commune, Lac Duong district) asserted: "*Farming is much easier now, much less laborious than before, with machinery support; the quality of the product output is no longer a difficult problem thanks to the application of high technology in farming.*" Co Ho households in Lac Duong district, Lam Dong province, actively adopted high-tech agricultural models to meet market demands and improve their income, with coffee, vegetables, and flowers having the highest adoption rates (50.6% and 44.1%, respectively). Other crops like rice and corn had very low rates (5.3%), reflecting a shift in agricultural structure from traditional production to higher economic value models. The results from field surveys in Table 1 also recorded this trend, with many households adopting high-tech agrarian models such as mushroom, flower, strawberry, chili, and vegetable cultivation in greenhouses using misting and drip irrigation technology. Overall, adopting high-tech agricultural practices increased income and helped Co Ho households adapt to climate change, optimize resource use, and enhance sustainability in production.

**Table 1** High-tech crops adopted by the Co Ho people.

Model	Number of Households	Area (m²)	Upfront costs (million VND/1,000m²)	Income (millionVND/1,000m²)	
				Monthly Income	**Annual Income**
Mushroom cultivation	25	2,000	70 (for 50m²)	10-12	120-144
Carnation, cut rose, gerbera, chrysanthemum cultivation	-	1,000	180-400	-	80-245
Strawberry cultivation in a greenhouse	30	1,000	220	15	180
Strawberry cultivation	5	1,000	-	45	540

on substrate					
Palermo pepper cultivation	10	1,000	-	-	180
Bell pepper cultivation	12	1,000	-	-	120
Clean vegetable cultivation	41	1,000	-	-	20-25 (for every 25 days)
Artichoke cultivation	10	-	-	-	-

Factors influencing the adoption of high-tech agricultural practices by Co Ho households

Adopting high-tech agricultural practices was crucial in improving productivity, product quality, and household income. However, not all households were ready to embrace new technologies in production. This study aimed to identify the factors influencing Co Ho households' decision to adopt high-tech agricultural practices in Lac Duong district, Lam Dong province.

The factors influencing the adoption of high-tech agricultural practices by Co Ho households in the Lac Duong district were hypothesized to consist of seven components (Figure 4).
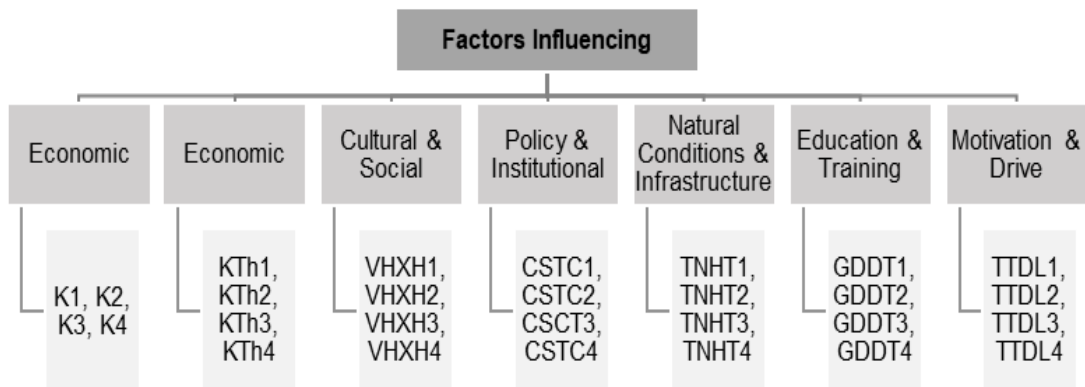
Figure 4 Factors influencing the adoption of high-tech agricultural practices by Co Ho households in the Lac Duong district

The results of factor and regression analysis showed that the factors influencing the adoption of high-tech agricultural practices by Co Ho households in the Lac Duong district correlated with economic, technical, cultural-social, natural conditions, and infrastructure factors. To determine the impact of these factors, the study employed Cronbach's Alpha analysis, Exploratory Factor Analysis (EFA), and multiple linear regression.

The Cronbach's Alpha analysis results indicated that 24 observed variables achieved high reliability after excluding unsuitable variables, with a KMO coefficient of 0.661 and Bartlett's test significance value of 0.000, confirming the suitability of the data for factor analysis. After performing factor analysis, the observed variables were grouped into five components: Education and Training, Economy, Natural Conditions and Infrastructure, Cultural-Social, and Technical factors (Table 2).

Table 2 Rotated Factor Matrix

Factor	Observed Variable
Education and Training	GDĐT1, GDĐT2, GDĐT3, GDĐT4
Economy	KT1, KT2, KT3
Natural Conditions and Infrastructure	TNHT1, TNHT2, TNHT3
Cultural and Social	VHXH1, VHXH2, VHXH3
Technical	KTh1, KTh2, KTh3

The factor and regression analysis results indicated that the factors influencing adopting high-tech agricultural practices by Co Ho households in the Lac Duong district showed a complex interaction between economic, technical, cultural-social, natural conditions, and infrastructure factors. The factor analysis (Table 2) identified five main factors impacting the decision to adopt high-tech agricultural practices. These groups included education and training, the economy, natural conditions and infrastructure, and cultural, social, and technical factors. These findings presented a comprehensive view of the factors affecting the decision to adopt high-tech farming, extending beyond financial considerations to encompass the willingness to access and apply new techniques, living environment conditions, and cultural-social factors within the community (Loi, 2022).

The regression model was constructed to analyze the relationship between independent factors and the decision to adopt high-tech agricultural practices. The regression analysis results showed that economic, technical, natural conditions and infrastructure, as well as cultural-social factors, all significantly impacted this decision. The regression model had an R^2 value of 0.133, meaning that these factors could explain 13.3% of the variation in adopting high-tech agricultural practices (Table 3).

Table 3 R Values of the regression model

Model	R	R^2	Adjusted R^2	SE	Durbin-Watson
1	0,364[a]	0,133	0,120	1,174	1.353

Specifically, the regression coefficients demonstrated that the Technical factor had the most substantial influence and was the most significant factor in deciding the adoption of high-tech practices. In contrast, the Economic and Natural Conditions factors had adverse effects (Table 4).

Table 4 Results of the multiple regression analysis.

Independent Variable	Unstandardized Coefficient (B)	Standardized Coefficient (Beta)	t	Sig.
Technical	-0,733	-0,232	-4,222	0,000
Natural Conditions and Infrastructure	-0,540	-0,122	-2,215	0,027
Cultural-Social	0,825	0,181	3,385	0,001
Economy	-0,159	-0,066	-1,243	0,215

The regression analysis (Table 3 and Table 4) showed that the Technical factor strongly influenced the decision to adopt high-tech practices. This could be explained by the importance of accessing and utilizing advanced technologies in agricultural production, particularly ensuring the maintenance and repair of high-tech equipment (Loi, 2022). When households could

effectively maintain and operate these devices, they were more motivated to adopt technology in production. As the regression results indicated, the regression coefficient for the Technical factor was 0.935, demonstrating its significant impact on the decision to adopt high-tech practices (Table 4).

In contrast, the Economic and Natural Conditions and Infrastructure factors negatively affected high-tech adoption. This could be attributed to the costs of investing in high-tech practices and the stability of the product market, as well as environmental factors such as land and water resources, which directly affected households' decisions to transition production models. Any challenges in accessing these factors could diminish the motivation to adopt high-tech practices. Specifically, the regression coefficients for the Economic and Natural Conditions and Infrastructure factors were -0.733 and -0.540, respectively, indicating an inverse relationship with the decision to adopt high-tech practices (Table 4).

Additionally, the observed variables in each factor group all had high average scores, particularly those under the Technical, Cultural-Social, and Natural Conditions factors. This reflected the importance of these factors in influencing the decision of Co Ho households to transition their production models (Table 5).

Table 5 Average scores of variables impacting the decision to adopt high-tech practices.

Factor	Average scores
Economy	3.82
Technica	4.0
Cultural-Social	4.0
Natural Conditions	4.0

Table 5 showed that the Technical, Cultural-Social, and Natural Conditions factors all had high average scores, indicating their significance in household decision-making. Factors such as adequate technical training, community support, and access to natural resources were crucial in adopting high-tech practices. These factors must be prioritized when developing support policies and promoting high-tech agricultural production models in rural areas. The high average scores of these factors highlighted their strong influence on household decisions.

However, it should also be noted that despite the widespread adoption of high-tech practices, a small proportion of households had not yet accessed this technology, particularly those with fewer years of farming experience. Factors such as initial investment costs and a lack of technological knowledge might have been significant barriers for these households (Ngo et al., 2024). Thus, providing information, training support, and improving infrastructure were essential in fostering the development of high-tech agriculture within the Co Ho community. These factors were also reflected in the results of Table 5, where elements like training and technical support had the highest scores. This underscored that access to technology and comprehensive technical support were prerequisites for households to invest in high-tech practices confidently.

In summary, the results indicated that economic, technical, cultural-social, and natural condition factors significantly impacted the decision to adopt high-tech agricultural practices. These factors require coordinated consideration and support to promote the adoption of advanced technologies in agricultural production in rural areas such as the Lac Duong district. Authorities and communities should focus on improving these conditions to facilitate farmers' access to and utilization of advanced technologies, thereby enhancing production efficiency and quality of life.

Conclusions and Recommendations

Adopting high-tech agricultural practices in farming by the Co Ho people in Lac Duong district, Lam Dong province, had significant impacts, contributing to increased productivity, optimized resource utilization, and improved household income. The research revealed that most Co Ho households adopted high-tech production models such as drip irrigation, new crop varieties, and smart fertilization, which helped reduce labor efforts, enhance product quality, and better meet market demands. However, the level of technology adoption was still influenced by several factors, with the Technical factor having the most substantial impact, followed by Economic, Cultural-Social, and Natural Condition factors. This indicated that the development of high-tech agriculture depended not only on access to technology but also on community awareness, supportive policies, and actual production conditions.

To promote the sustainable development of high-tech agriculture within the Co Ho community, strategic and comprehensive solutions needed to be implemented as follows:

First, local authorities needed to expand training programs and technical guidance to improve households' understanding and operational skills regarding new technologies.

Second, reasonable financial support policies were necessary to reduce the burden of initial investments, enabling more households to access advanced technologies.

Third, infrastructure development, especially irrigation systems, transportation, and post-harvest storage, was crucial in enhancing production efficiency.

Finally, collaboration among research organizations, businesses, and local people was essential to establish suitable high-tech agricultural models, contributing to the sustainable socio-economic development of the Co Ho community in Lac Duong.

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