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Case Report

# Production Development of Chestnut Tree: A Case study in Vietnam

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## Abstract

The Chestnut tree was a perennial tree that brought a well-known trademark and high economic value to producing households in Chi Vien commune, Trung Khanh district, Cao Bang province. However, households had not taken full advantage of all available benefits while the potential for chestnut production and consumption was high. This study aims to analyze the situation of the development of chestnut production in Chi Vien commune and propose solutions to promote the development of chestnut trees in the commune. The primary data was collected by interviewing 60 farm households on three scales of chestnut production in Chi Vien commune and five traders including collectors, wholesalers, and retailers. Results show that in recent years, the area and output of Chestnut trees in the commune increased significantly. Chestnut products are directly consumed in two forms, mainly indirectly (76.2%). The efficiency in chestnut production was very high. The large-scale households got the highest mixed-income, followed by medium-scale households, and the lowest was in small-scale households. However, being mixed with Chinese Chestnuts reduced the quality and reputation of Chestnuts in Chi Vien Commune in particular and Trung Khanh in general. Therefore, the proposed solutions include support policies for farmers growing Chestnut trees, capital solutions, solutions for agricultural extension, application of new science and technology, the building of a chain of links, and the development of product consumption markets. Through the above synchronous solutions, Chi Vien is towards the goal of sustainable development of chestnut production in the commune shortly.

## Introduction

Chestnuts are grown in Trung Khanh district, Cao Bang province has long been considered the best in Vietnam [1]. This species has a life span of 70 to 80 years, and fruiting time lasts from 40 to 50 years [2]. Seeds have large fruit, rich in nutrients, fragrant and fleshy [3]. Chestnuts being perennial agricultural products are consumed domestically and exported to foreign countries, especially to the Chinese market. They can be a productive and profitable orchard crop [4]. Besides, Trung Khanh Chestnuts have been granted geographical indication certificates by the Intellectual Property Office of Viet Nam, which is the basis for a strong development of sayings in quantity, becoming a sustainable commodity of the locality [5].

Chi Vien commune is a commune in Trung Khanh district, Cao Bang province, the area of growing Chestnuts has increased over the years. Chi Vien has favorable soil and climate, in addition, large rivers and streams are flowing through, providing enough water for irrigation, and creating good conditions for plants to grow [6]. While the potential for chestnut production and consumption was high, households had not taken full advantage of all available benefits. Chestnut consumption was still fragmented, small, and scattered. Besides, the market for chestnuts was being competed with cheap Chinese chestnuts. The preliminary processing and preservation technique has not been paid attention to, so chestnut use time was generally short. Therefore, Trung Khanh has had many solutions to expand the chestnut tree area, including the development of concentrated production areas to bring the chestnut brand reach out to the province [7].

The study aims to

- Assess the current situation of the development of Chestnut tree production in Chi Vien commune, Trung Khanh district, Cao Bang province
- Analyze the factors affecting the development of Chestnut production in the commune
- Propose solutions to strengthen the development of Chestnut production in the future.

## Methodology

### Methods of selecting research points

Chi Vien, being a large chestnut area in Trung Khanh district, Cao Bang Province, Vietnam has stable quality and high productivity. To carry out this research, the research was conducted in three villages: Pac Mac, Ban Khy, and Na Mu. These are typical locations in terms of chestnut quality, chestnut land area, and chestnut production efficiency.

### Methods of data collection

Secondary data was collected from local departments, the annual statistical reports, and other documents related to the statistical source over the three years from 2018 to 2020.

Primary data was based on interviewing 60 households' information, including investment, production costs, consumption, income, and farmers' expectations. The content of farm-household interviews was based on a prepared questionnaire. It revolved around scale issues, production costs, price, labor, difficulties in the production process technological application, etc. The criterion for sample selection depended on the chestnut growing area. Firstly, a large-scale group (more than 2 hectares) consisted of 21 households. Secondly, the medium-scale group (between 1 and 2 hectares) consisted of 27 households. Lastly, a small-scale group (less than 1 hectare) consisted of 12 households. In addition, the research also interviewed five traders (collectors, wholesalers, and retailers) to collect consumption data on chestnuts.



## Methods of data analysis and processing

To analyze the data, several traditional methods were used.

- Method of descriptive statistics:** included absolute index, relative number, average number, and households' characteristic classification were used. Then this helped to assess the current production and consumption situation in the locality and participating markets.
- Comparative statistical method:** applied to compare productivity, output, number of households growing chestnut, agricultural extension, and the relationship between product production and consumption over time...On that basis, comments, and assessments on chestnut production development in Chi Vien commune.
- The SWOT analysis method was used in the research.** The comprehensive and general method of assessing chestnut production and consumption includes strengths (strong), weaknesses (weak), opportunities (opportunity), and threats (threats). This method determined the internal and external factors affecting Chestnut's production activities in the research area.

## Results and Discussion

### Current development of Chestnut production in Chi Vien commune, Trung Khanh district, Cao Bang province

#### General situation of production development of Chestnut tree in Chi Vien commune

The Chestnut trees are suitable for the hydrological climate and flat low terrain in Chi Vien commune, Trung Khanh district, Cao Bang province. Since the 1930s, chestnut trees have been present on the road of Chi Vien village. However, at that time, people still valued rice and other food crops such as corn, beans, potatoes, etc. Until 1998, the chestnut tree began to be planted by some farmers. They produced the pedigree tree, a delicious variety of Chestnut trees, which was grown in many communes. Up to the present time, in the whole district of Trung Khanh, the area of the tree was about 300 ha, of which over 60% of the area is harvested.

The Chestnut here has been well-known with Trung Khanh Chestnuts' trademark and geographical indication since 2011, bringing advantages in trade and tourism for the locality. The geographical area included communes: Dinh Minh, Chi Vien, Kham Thanh, and Phong Chau in Trung Khanh district. Different from chestnuts in other localities, in Trung Khanh the seeds are large, 5-6 times more than forest chestnuts. The bark is dark brown, the undercoat is light white, the skin is thin, and the kernel is yellow, when eaten, it has a delicious and greasy taste.

In recent years, the crop structure of the Chi Vien commune has had a significant change, and the Chestnut trees must be mentioned. Chestnut trees have an important position in the economic development of Chi Vien commune in particular and Trung Khanh district in general. Chestnut trees contribute to helping people stabilize their lives and get rich, significantly contributing to the conversion of plant varieties, and improving the production value of the crop industry in the commune. In the period 2018 - 2020, the total area of Chestnut trees in the commune increased by 32.2%/year, from 30 ha in 2018 to 52.5 ha in 2020. The area of Chestnuts for harvest increased by 28.3%/year, from 26.1 ha in 2018 to 43 ha in 2020.

In Chi Vien commune, Chestnut is a variety that has been developing for a long time in the commune. This tree variety is typical of the region. Chestnuts are high-yielding, easy to care for, and the quality of their delicious seeds is popular with consumers. Chestnut products are harvested mainly from September to November. The process of consuming Chestnuts is straightforward; often, farmers will reduce a small portion to eat and bring the rest to the market. Chestnut products are directly consumed in two forms: direct consumption and indirect consumption. Direct consumption is when people bring products to the market to sell to consumers without intermediaries. Indirect consumption is when people sell products through intermediaries, and these agents sell products to consumers. In this form of consumption, there are main actors such as collectors, wholesalers, and retailers.

### Production development of Chestnut tree production in surveyed households

To conduct this research, 60 chestnut-growing households with different production scales in Chi Vien commune were selected for the survey. Of these, there were 12 small-scale households, 27 medium-sized households, and 21 large-scale households.

From table 1, we can see that the average area of Chestnut trees in households was 1,6 ha/household. This included both the newly planted area and the harvested Chestnut area; this area consisted of both garden and hill land. The harvested area of the household was 1.3 ha/household. The average yield of Chestnuts in households by size was 1.5 tons/ha. The average output by the size of Chestnut growers was 2 tons/household, however, the gap in the output of large-scale farmers compared to small and medium-sized households was very high (4 tons/household versus 1.4 tons per household and 0.3 tons/household).

Table 1: Area, productivity, and output of Chestnuts of households

Indicators	Unit	Small scale	Medium scale	Large scale	Generality
Number of surveyed households	Households	12	27	21	60
1. Total area of Chestnut tree	Ha/ Households	0.3	1.1	3.0	1.6
2. Area of the harvested Chestnut tree	Ha/ Households	0.2	0.9	2.5	1.3
3. Average yield	Tons/ha	1.3	1.5	1.6	1.5
4. Average output	Tons/ Households	0.3	1.4	4	2

Source: Author's field survey in 2021.

The period of basic construction to produce fruit trees in general and Chestnut trees, in particular, is a crucial stage in the cycle, which partly determines the quality and quantity of products. Therefore, how to take care of the tree to grow healthy and the investment cost for this period is minimal, but the quality is still guaranteed. Investment in the basic construction period includes the price of new varieties, the cost of taking care of the unproductive stage (from 1-3 years old), and the investment cost of necessary production materials. In fact, after three years of planting the new Chestnut tree for harvest, the cost of taking care of the Chestnut Garden during this time is included in the basic construction stage.

Table 2 shows the investment cost (in nominal value) in the basic construction period. According to the survey, the total cost for three years of the basic construction period of planting Chestnut trees was 29171.7 thousand VND/ha, of which the small-scale households invested the lowest cost (25483.3 thousand VND/ha), and the large-scale households invested the highest cost (32704.8 thousand VND/ha). Table 2 showed that the cost of tillage was essential, next was the cost of pesticides. According to the development strategy of chestnut cultivation since the 2010s in Trung Khanh district, and recently in the period 2015-2020, most of the chestnut growing households were supported with seedlings. The chestnut tree variety was put into production, using 70% of seedlings propagated by the grafting method, and 30% of seedlings were propagated by seeds. During the tillage stage, spraying the right amount of pesticides was very important in cleaning the soil to help plants grow better. The pesticides used in this period were mainly insecticides and herbicides. In which pesticides helped to clean up pests in the ground: bugs, worms, hair clippers... Herbicides help to kill weeds, and seed grass, clear the surface of the planted soil, and remove places residences of pests and diseases. Fertilizer was essential for Chestnuts - normally fertilized twice per year. For small producers, this source of fertilizer could be self-sufficient, but for large producers, this source of fertilizer the often bought for 40,000 - 50,000 VND/bag. Experience in Chestnut production in households shows that it was best to

apply buffalo manure during the growing period because it helped the tree grow and recover quickly. Finally, the labor cost, at this time, the labor cost paid in cash was not high, mainly family labor. For households that focused on making land, labor costs were higher than other households. On average, the labor cost was 5226.7 thousand VND, with the rental price ranging about 200 thousand per day. Thus, in the basic construction phase, the most costs incurred in the first year, in the following years of the basic construction phase, were mainly fertilizer costs. The total value of the orchard during the basic construction period is the basis for calculating the cost of allocating orchards for years, with the business cycle of Chestnut trees being about 50 years (Table 2).

**Table 2:** Investment cost in the basic construction period\* (Unit:1000 VND/ha).

Indicators	Small scale	Medium scale	Large scale	Whole sample
I. Cost of materials				
1.1 Soil preparation	12125	13888.9	13381	13358.3
1.2 Plant protection pesticides	233.3	203.7	209.5	211.7
1.3 Fertilizer	7958.3	8963	13571.4	10375
II. Labor costs	5166.7	5007.4	5542.9	5226.7
III. Total production costs	25483.3	28063	32704.8	29171.7

Note: \*The costs were calculated in nominal value  
Source: Author's field survey in 2021

Through the survey data in table 3, we can see that the investment cost of Chestnut production in the production and business period of the scale groups was significantly different. Types of costs included fertilizer, plant protection products, other material costs, labor costs, and garden value depreciation expenses. Because the chestnut tree belongs to the perennial tree with a business cycle of about 50 years and was considered a fixed asset of the production and business process of the chestnut tree, this expense had been amortized evenly over the years.

Large-scale households had the highest total investment cost with 11074.6 thousand VND/ha in the production and business period, next by the medium-scale household with 9079.1 thousand VND/ha, and the small-scale households with 8479.7 thousand VND/ha. It can be seen that large-scale households had to hire a lot of labor, especially for the fertilizing, pruning, rooting, harvesting, and classifying of chestnuts. In addition, large-scale households had much more year-old trees, and they needed to invest more and vice versa. The higher the age of the Chestnut tree, the more households tended to increase production investment costs gradually. Because the older the tree, the lower the yield, the smaller the seed, and the lower the quality of the origin, it was necessary to have fertilizer, pesticide, and soil improvement regime better than the early stage of production and business to obtain higher yields and ensure the longevity of the tree. To improve production and business efficiency, households invested in Chestnut production costs, applied their available experience in production, and absorbed scientific and technical advances to reduce costs and maximize profit.

**Table 3:** Investment cost of Chestnut tree production in the production and business period of surveyed households (average for 1 ha) (Unit:1000 VND/ha).

Indicators	Small scale	Medium scale	Large scale	Whole sample
I. Intermediary cost (IC)	1095	1036.3	1134.8	1082.5
1.1 Fertilizer	516.7	496.3	547.6	518.3
1.2 Plant protection products	320	282.6	295.2	294.5
1.3 Other material cost	258.3	257.4	291.9	269.7
II. Labor cost	6875	7481.5	9285.7	7991.7
III. Depreciation	509.7	561.3	654.1	583.4
Total cost	8479.7	9079.1	11074.6	9657.6

Note: \*The costs were calculated in nominal value  
Source: Author's field survey in 2021.

Consumption of products is a critical stage in the production process. The fruit tree market, in general, depends on people's living standards and usage habits. The demand for the product depends on the consumer demand is very large. It also depends on factors such as preferences, season... Therefore, Chestnut production needs to pay attention to the above factors to produce products that meet consumers' tastes. Better quality, early-ripening, late-ripening, etc.... to facilitate consumption and sell the product at a reasonable price.

As shown in table 4, the consumption of Chestnuts by households is mainly in two forms: direct form and indirect form. The direct form was a channel system where producers bring manufactured products to consumers. In this channel, the advantage was that producers could sell at a higher price than in other channels. However, the limitation was that the number of products sold would be less than in other consumption channels. All sizes of households consumed products in both forms, but mainly indirectly (76.2%), of which 51.7% quantity of Chestnut was sold to wholesalers up to 63.8%, sell to retailers 13.8%, and direct channels only 6.9%. Similarly, in medium-scale and large-scale households, the percentage selling to wholesalers was 51.7% and 47.7%, respectively. The percentage of selling to wholesalers accounted for a high percentage because wholesalers often paid higher prices than collectors and bought more in volume than retailers. However, this form often occurred when the Chestnuts were ripe in the primary season, so producers were often forced to price, and the amount of money collected was not high.

The chestnut harvest season is from September to November every year. Chestnuts in Chi Vien were bought at the price of 80,000 - 150,000 VND/kg depending on size and time, many buyers came to the garden to buy or contacted to send to Cao Bang city, to other provinces and cities. The average yield of Chestnuts was 130-160 kg/ha. Results from table 5 indicate that on average, 1 hectare of chestnuts for production value (GO) was about 173.8 million VND. After deducting expenses, the average mixed-income (MI) was about 164.1 million VND/ha. Mixed income was highest among large-scale households (173.7 million VND/ha), followed by medium-sized households (168.7 million VND/household), and the lowest was in small-scale households (137.1 million VND/household).

The efficiency in chestnut production was very high. On average, three groups of chestnut-growing households had an MI/IC of 151.6 times, showing that: if they spend 1 dong in intermediate costs, chestnut producers would get 151.6 dongs in mixed-income. In addition, the family labor of chestnut-growing households was also very high, reaching an average of 1029 thousand VND/labor. The group of large-scale households achieved the highest economic efficiency because this group of households invested a lot in production. The family labor of large-scale households got 1105.5 thousand VND/labor, 75.2 thousand VND/labor higher than that of medium-sized households, and 283.2 thousand VND/labor higher than that of small-sized households (Table 5).

**Table 4:** Consumption volume of Chestnuts in households.

Scale	Total weight (tons)	Direct channel		Indirect channel					
				Collector		Wholesaler		Retailer	
		Q (tons)	S (%)	Q (tons)	S (%)	Q (tons)	S (%)	Q (tons)	S (%)
Small scale	5.8	0.4	6.9	0.9	15.5	3.7	63.8	0.8	13.8
Medium scale	14.5	3.7	25.5	1.4	9.7	7.5	51.7	1.9	13.1
Large scale	17.6	5.3	30.1	2.5	14.2	8.4	47.7	1.4	8
Total	37.9	9.3	24.8	4.8	12.7	19.5	51.7	4.2	10.8

Source: Author's field survey in 2021

**Table 5:** Results and economic efficiency of Chestnut production of households in 2020

Indicators	Unit	Small scale	Medium scale	Large scale	Whole average
<b>I. Results</b>					
1.1 Production value (GO)	1000 VND	145600	177750	184800	173787.5
1.2 Intermediate costs (IC)	1000 VND	1095	1036.3	1134.8	1082.5
1.3 Value added (VA)	1000 VND	144505	176713.7	183665.2	172705
1.4 Mixed income (MI)	1000 VND	137120.3	168670.9	173725.4	164129.9
1.5 Family labor (L)	Labor	166.8	163.7	157.1	159.5
<b>II. Efficiency</b>					
2.1 GO/IC	Times	133	171.5	162.9	160.5
2.2 VA/IC	Times	132	170.5	161.9	159.5
2.3 MI/IC	Times	125.2	162.8	153.1	151.6
2.4 GO/L	1000 VND/labor	873.2	1085.8	1176	1089.6
2.5 VA/L	1000 VND/labor	866.6	1079.5	1168.8	1082.8
2.6 MI/L	1000 VND/labor	822.3	1030.3	1105.5	1029

Source: Author's field survey in 2021.

## Factors affecting the development of Chestnut tree production

### Natural conditions

In general, Chi Vien commune's topography, soil, and ecological environment were homogeneous. The commune had specific natural conditions, distributed on hillsides with an altitude of about 450 - 600m, surrounded by limestone mountains, creating an excellent year-round climate suitable for chestnut development, bringing much higher economic efficiency than Chestnut trees in other regions.

However, besides those advantages of natural conditions, it also had certain obstacles in terms of weather conditions that have affected the growth and development of Chestnut cultivation. Hot, humid, and rainy, so pests and diseases also increased, so plants were susceptible to infections, so it was necessary to pay attention to the growth and development of plants; During the flowering period, the weather changed, so there were frequent hailstorms that make productivity and production worse.

### Policies of Chestnut Production Development

During the chestnut season in 2020, while many places were still struggling to prevent and control the COVID-19 epidemic, Cao Bang province has launched a Smart Agriculture Project and Trung Khanh chestnut development plan for the period of 2021 - 2025, with a vision to 2030. Including a plan to shape a chestnut-growing area in Trung Khanh district with a scale of up to 1,000 hectares with many specific measures to improve the lives of indigenous peoples such as linking the program to build new countryside and developing tourism community, nature conservation, and environmental protection.

In addition, in order to create the necessary basis for branding and diversifying products extracted from chestnuts, confectionery, wine, etc., Cao Bang has established a regulation on the use of collective marks "Trung Khanh chestnuts", product quality management regulations for Trung Khanh chestnuts. The advertising company has embarked on the design and production of trial signs of the logo and trademark of Trung Khanh chestnuts. People also expected that after the chestnut tree product was starred under the OCOP program, the brand and value of Trung Khanh chestnuts would be enhanced, bringing higher incomes to local people.

### Production resources

#### Chestnut varieties

The Chestnut seeds of the growing households were mainly self-nurturing in the garden or registered with the Agriculture Department of Trung Khanh district to obtain sources. In recent years, thanks to the attention of local authorities to support varieties and guide the selection of plant varieties, households have learned to choose and learn about the quality and origin of the types.

Through the survey, it can be seen that the growers used 100% of nursery seeds. Out of 60 surveyed households, 18 households produced nursery seeds by themselves (30%), and 42 households registered to obtain Chestnut tree varieties at the Agriculture Department of Trung Khanh district (70%). This shows that the quality of locally grown Chestnuts was secure (with clear origin and provenance).

#### Infrastructure system

In general, Chi Vien commune had an infrastructure system that ensured the level of use of households in chestnut production and business. The newly invested and upgraded infrastructure system has partly met the demand for production demand for the people in the commune. According to the survey data, the infrastructure system for production and business reached 86% of people's needs. However, the rest of the 14% of the infrastructure system has not yet met the production and business needs of households in the commune. That was one of the problems that needed attention and resolution.

#### Capital resource

Capital is an essential factor in production and business; it will determine the way and level of household investment. In Chi Vien commune, the relationship between the Bank and the Commune People's Committee was increasingly closed, creating favorable conditions for departments, unions, and people to borrow production capital. The procedures were becoming more straightforward and more accessible for people to access loans. However, the amount of capital that people could borrow was still too small to meet the production and farming development needs of Chestnut growers.

#### Labor resource

There were some advantages that the number of households participating in the training program accounted for 70%, proving that they wanted to improve productivity and gain more experience. The number of people participating in the training was higher than in previous years, proving farmers' awareness of the programs about the benefits and effectiveness of planting with the proper techniques.

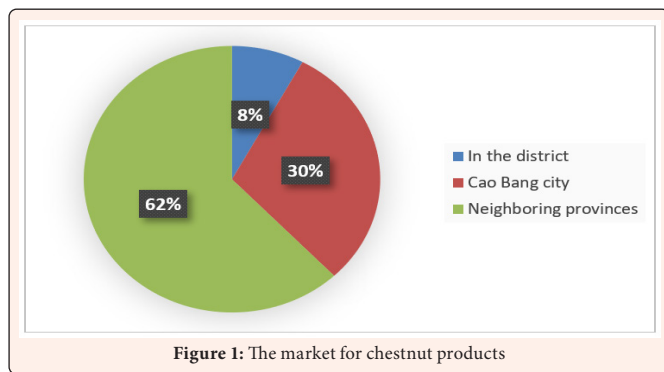
However, few households only went to be presented in the training because they enjoyed some support. Besides, some farmers mainly participated in production with their own experience, without training, so the level of labor was low, and the ability to apply new science and technology was still limited.

#### Consumption market

In the development of Chestnut production, the most crucial factor was the market factor. Trung Khanh in general and Chi Vien commune in particular was known as a place with favorable, rich, and diverse natural conditions, so this place was associated with famous scenic spots such as Ban Gioc waterfall, Nguom Ngao cave, etc... So, this was an advantage to developing and expanding the market for Chestnut products.

Figure 1 indicates that the market for household consumption of Chestnuts was mainly in neighboring provinces, reaching 62.1%, followed by the Cao Bang city area accounting for 30%, and the rest was in the district at 9.67%. In general, the market in neighboring provinces would be a potential market that needs to be developed. Because the products produced had regional characteristics that other areas did not have, this could create consumption markets in regional markets and Cao Bang City.

However, Chestnuts already had a brand name, but specific solutions were needed to protect and promote the brand. No organization had stood out to represent the purchase to consume and protect the brand, so being mixed with Chinese Chestnuts at low prices reduced the quality and reputation of Chestnuts in Chi Vien Commune in particular and Trung Khanh in general. In terms of appearance, Cao Bang chestnuts were not big and beautiful, but fragrant, friable, and sweeter than Chinese chestnuts. Trung Khanh chestnuts were not enough to supply the market, while Chinese chestnuts had a low price of only 50,000 - 70,000 VND/kg. In addition, products made from chestnuts were few and undiversified. Currently, the district has only 1 chestnut wine production facility, but the operation is also inefficient.



Source: Author's field survey in 2021

**SWOT analysis**

Applying SWOT analysis to clarify the situation of Chestnut production development in the commune, it can be seen in table 6.

**Table 6:** SWOT matrix in the development of Chestnut production in Chi Vien commune.

	Strengths (S)	Weakness (W)
	- Land	- Farmers with low professional knowledge
	- Climate	- Facilities were still limited
	- Experienced labor	- Lack of production capital
Chance (O)	Combination S-O	Combination W-O
- The consumer market was expanding	- Increase investment in area expansion	- Open training class
- Exclusive branded Chestnut products were protected	- Apply new science and technology to production	- Mobilize loans with reasonable interest rates
- There were more and more new scientific and technical advances	- Protect the recognized brand	- Have policies to attract young workers into the production force
Challenge (T)	Combination S-T	Combination W-T
- Climate changed	- Add new varieties with better resistance	- Plan areas for specialized cultivation of Chestnuts tree
- Prices of fertilizers and materials were not stable	- Take advantage of the area of reasonable tree distribution	- Build a solid irrigation system

Source: Author's field survey in 2021

**Solutions to promote the development of Chestnut production in Chi Vien commune, Trung Khanh district, Cao Bang province**  
**Support policies for farmers growing Chestnut trees**

Local authorities need to have specific policies to encourage people to develop Chestnut trees to bring higher incomes to households and, at the same time contribute to the socio-economic development of the commune:

- a) Involving local departments and agencies to contribute ideas on the direction of Chestnut tree development in the long run to ensure sustainability.
- b) Promote the work of plantations and land exchange with appropriate policies so that people have conditions to expand the scale of Chestnut production. It is easy to apply science and technology and invest in intensive farming to increase the productivity and quality of Chestnut orchards.
- c) Help farmers learn about market information for Chestnut products and input markets so that farmers can quickly adapt to production conditions in the market mechanism.
- d) In the period 2021 - 2025, Trung Khanh district plans to develop a new planting area of 900 ha, renovating and replacing 100 ha of the existing chestnut area; seedlings are put into production, using 70% of seedlings propagated by grafting method, 30% of seedlings are propagated by seeds; chestnut tree area of communes in the concentrated production area averages 25 ha/year/commune.

**Capital solutions**

- a) Simultaneously with the policy of building and expanding the people's credit fund, it is necessary to conduct credit services, the new Bank with preferential rates for farmers to borrow to expand the investment scale in Chestnut trees. Take advantage of credit channels for production and business development, programs, and projects to develop commodity production to create jobs in the locality.
- b) Encourage and expand organizations to contribute capital to help each other develop production and business. Focus on investing in the development of the local Chestnut Planting Association so that the households participating in the club can actively and effectively live and help new farmers grow Chestnuts who have not had experience in Chestnut production.
- c) Solutions for agricultural extension, application of new science and technology.
- d) Strengthen agricultural extension work, and actively build and replicate highly effective farm and hill garden economic models. Organize cooperative groups by product area as a place and apply scientific and technical advances to farmers. At the same time, promotes propaganda and encourages people to accumulate land to change plots on a large scale.
- e) Increase the number of technical training sessions on fruit tree production, specifically Chestnut trees, in a year to equip farmers with technical uniformity, creating homogenous production areas in terms of product quality criteria. Training content should be complete, concise, clear, and illustrated with facts. Training classes need to be timed correctly for people to attend. The duration of the training sessions needs to be shortened, speaking concisely and meaningfully due to the limited ability of people to sit in one place.
- f) Along with developing existing local Chestnut varieties, it is necessary to test types from other places for higher yield and better seed quality... At the same time, it needed to coordinate with institutes, universities, and centers to select and breed chestnut varieties with high yield and good adaptability to local conditions.

**Building a chain of links and developing product consumption markets**

- a) In order to raise awareness and change production thinking, the province, district, and commune focus on supporting farmers in planting techniques, taking care of well-developed trees, and improving the production and quality of chestnuts; have a roadmap to support each key commune to build a production and business cooperative, diversify



products from chestnuts such as wine, confectionery... At the same time, establish regulations on the use of collective marks “Trung Khanh chestnut”.

- b) Building a chain of links, and sales channels at wholesale markets, trade centers, supermarkets, scenic spots, and historical sites inside and outside the province; organize the listing of products to participate in agricultural product exchanges in the province and some big cities; brand promotion associated with tourism, online sales, product introduction on social networks to attract domestic and foreign customers. Strengthen forms of joint ventures and associations, and create an open investment environment to invite businesses and investors to develop the production, processing, preservation, and consumption of chestnut tree products.
- c) The People’s Committee of Trung Khanh district needs to assume the prime responsibility for and coordinate with functional sectors in, designing and exploiting agro-tourism models based on expanding production areas in parallel with conserving the natural landscape, and environmental sanitation. schools, and at the same time introduce and promote Trung Khanh chestnut products associated with tourism, develop a service network to attract visitors; and take steps to build brands, geographical indications, and product traceability for Trung Khanh chestnuts.

## Conclusion

The average area of chestnut cultivation in the household was 1.6 ha/household, of which the harvested area of the household was 1.3 ha/household. The average yield of chestnut was 1.5 tons/ha. The results and economic efficiency of chestnut production were quite high. The large-scale households got the highest mixed-income (173.7 million VND/ha), followed by medium-scale households (168.7 million VND/household), and the lowest was in small-scale households (137.1 million VND/household). The mixed-income of family labor of three scale groups was 1105.5 thousand VND/labor at large-scale households, 1030.3 thousand VND/labor at medium-scale households, and 822.3 thousand VND/labor at small-scale households.

Chestnut production depended on factors such as natural conditions; policies of chestnut production development; production resources; and the consumption market. Chi Vien had favorable natural conditions for the development of chestnut production. However, households had not taken advantage of all available benefits, the land for chestnut production was still fragmented, people still relied on experience to take care of chestnuts, and the application of science and technology was still limited. The market for chestnuts was being competed with cheap Chinese chestnuts, lower quality, but bigger and better designs had reduced the quality and reputation of Trung Khanh Chestnuts.

In order to develop the chestnut tree in the future, it was necessary to implement many synchronous solutions. It will solve the problem of the output market well and have suitable and flexible policies for people to have a stable selling price, and promote and protect the branding of chestnut trees in the commune. Chi Vien towards the goal of sustainable development of chestnut production in the commune in the near future.

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