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# Analysis of factors affecting the join linkage of organic tea production farmers in Thai Nguyen Province, Vietnam

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**Abstract**
This study was conducted to analyze the factors influencing farmers' decisions to participate in linkages with enterprises in organic tea production in, Thai Nguyen province, Vietnam. Using the Analytic Hierarchy Process (AHP) method, the research identified key factors affecting farmers' participation decisions, including: (1) Compliance with production processes; (2) Access to inputs; (3) Production capital; (4) Cultivated land area; (5) Output market for products; (6) Purchase price of products; and (7) Farmers' trust in enterprises. The study recommends that, in order for farmers to be willing to engage in linkages, enterprises must ensure a stable consumption market, guarantee benefits for producers, and build farmers' trust in the enterprises.

**Keywords:** Organic tea production, farmers' participation, enterprise linkages, Thai Nguyen province, Vietnam, Analytic Hierarchy Process (AHP), decision-making factors

## Introduction

Production linkages in general, and agricultural production linkages in particular, are voluntary yet mutually beneficial economic activities, bound by prior agreements—often in the form of contracts—between production entities. They represent a form of coordination between production, processing, and the consumption of agricultural products, closely associated with organizational structures in the agro-forestry sector, and subject to institutional frameworks designed to achieve the objectives of cooperative engagement. Agricultural production linkages play an essential role in ensuring shared benefits among stakeholders in agro-forestry production, fostering voluntariness and accountability among participants, and enhancing overall production efficiency [1].

Numerous scientific studies and practical applications have demonstrated that production linkages improve operational efficiency, facilitate market access, and enhance both the quantity and quality of agricultural products, thereby increasing their overall value [2, 3]. Stakeholders in production and consumption exert a positive influence on the sustainable development of specific value chains as well as the agricultural sector at large. These positive impacts can be seen in: (i) strengthening household farmers' managerial capacity in controlling product quality and production costs, thereby utilizing resources more effectively; (ii) enhancing the competitiveness of enterprises and the entire industry; and (iii) establishing stable raw-material zones, generating high-quality export products with secure markets [4, 5]. Nonetheless, such linkages are not equally suitable for all agricultural commodities; they tend to be more effective for highly specialized or novel products [6].

In Vietnam, production linkages between farmers and enterprises have been implemented for decades. Since 2002, Decision No. 80/2002/QĐ-TTg of the Prime Minister has provided policies to encourage agricultural product consumption through contractual arrangements, thereby promoting vertical linkages between enterprises and farmers. Contract-based cooperation has since expanded and become increasingly common in agricultural production, gradually fostering stable and cohesive relationships between farmers and enterprises [7]. However, after nearly two decades, the outcomes remain below expectations. Linkage models still face notable limitations: small-scale and fragmented production, weak and loosely defined benefit-sharing mechanisms, inadequate and inconsistent support policies, and frequent contract violations [8, 9].

Thai Nguyen province currently has more than 22,000 hectares of tea, of which approximately 200 hectares are cultivated under organic standards in key tea-growing regions. In response to the rising demand for safe products, the province has gradually shifted toward organic, chemical-free tea production. Its development strategy sets a goal that by 2030, all concentrated tea areas will adopt GAP and organic standards. To achieve this target, multiple measures must be implemented simultaneously, among which production linkages are considered indispensable, as they enhance both product value and quality. Linking production and processing activities in tea can eliminate—or at least substantially reduce—intermediary costs, ensuring processing enterprises a stable supply of raw materials with reliable quantity and quality at reasonable costs, thus lowering production expenses, improving product quality, and strengthening competitiveness in both domestic and international markets [10].

Despite enterprises' urgent demand for stable raw-material areas and farmers' difficulties in product marketing, the connection between the two remains weak. Farmers are not yet genuinely prepared to participate in such linkages, creating a pressing challenge across many localities in the province. Against this backdrop, the present study aims to analyze the factors influencing farmers' decisions to engage in contractual linkages with enterprises in organic tea production in Phu Luong district, Thai Nguyen province. The findings are expected to provide a scientific basis for

proposing context-specific solutions and policies that strengthen and promote farmer–enterprise linkages in organic tea production and consumption, thereby advancing toward clean and sustainable agriculture.

## Research Methodology

### 1. Data Collection Methods

**Secondary data:** Secondary data, which provide essential information for analyzing the factors influencing farmers' participation in production linkages with enterprises, were collected from documents and reports of relevant departments, agencies, and organizations related to tea production.

**Primary data:** The study conducted interviews with all 79 households engaged in organic tea production in Tuc Tranh commune. In addition, three focus group discussions were organized, involving 16 key informants and seven local officials who provided supplementary information.

### 2. Analytical Methods

The study employed **descriptive statistical methods** to determine farmers' objectives in participating in linkages as well as to identify the factors affecting their participation.

To further analyze the influencing factors, the study utilized the Analytic Hierarchy Process (AHP). This method, proposed by Thomas L. Saaty, an Iraqi-born mathematician, in 1980, is a multi-criteria decision-making approach. AHP is a quantitative technique used to rank alternative options and select the one that best satisfies predetermined criteria. It allows decision-makers to identify the optimal option by conducting pairwise comparisons and applying a specific computational mechanism (Saaty, T. L., 2008) [11]. Today, AHP has been refined and widely applied across various fields, including agriculture and forestry, economics, education, and politics.

The implementation of the AHP method in this study followed these steps:

**Step 1:** Identify the factors influencing farmers' participation in production linkages.

**Step 2:** Rank and compare the identified factors affecting farmers' participation.

**Pairwise comparison:** Conduct pairwise comparisons to determine the relative importance among influencing factors.

**Establish a comparison matrix:** Each factor (e.g., F1 in the left-hand column) is compared with the corresponding factors (F1 … Fn) listed in the top row of the matrix. The guiding question for comparison is: "How much more beneficial, satisfactory, contributive, or significant is Factor 1 compared to Factor 2, Factor 3, …?"

**Table 1:** Pairwise Comparison Matrix

| YT | YT1 | YT2 | YT3 | YT4 | … | YTn |
|---|---|---|---|---|---|---|
| YT1 | YT11 | YT21 | YT31 | YT41 | … | YTn1 |
| YT2 | YT12 | YT22 | YT32 | YT42 | … | YTn2 |
| … | … | … | … | … | … | … |
| Ytn | YT1n | YT2n | Yt3n | Yt4n | … | Ytnn |

(**Source:** Saaty, T. L, 2008) [11]

Saaty introduced a scale of relative importance (Table 2) to assess the significance of factors in the comparison matrix.

**Table 2:** Saaty's Scale of Relative Importance for Pairwise Comparison

| Scale | Definition | Explanation |
|---|---|---|
| 1 | Equal importance | Two factors are considered equally important. |
| 3 | Moderate importance | Experience and judgment slightly favor one factor over the other |
| 5 | Strong importance | Experience and judgment strongly favor one factor over the other |
| 7 | Very strong importance | One factor is strongly preferred over the other, and this is clearly evident in practice |
| 9 | Extreme importance | One factor is absolutely more important than the other, representing the highest level of dominance. |
| 2, 4, 6, 8 | Intermediate values | Used to express compromise between the above judgments. |

(**Source:** Saaty.T. L, 2008) [11]

The comparison matrix is constructed based on the weights assigned to each factor. In this study, the normalization method was applied to calculate the weights; the larger the weight, the greater the level of influence, and vice versa.

**Step 2:** Data aggregation: Pairwise comparison results were synthesized to obtain a single value of priority, from which the overall priority index was determined. Saaty's proposed solution for deriving weights from pairwise comparisons is the least squares method. This method employs a minimum-error function to reflect the true preferences of the decision-maker.

**Step 3:** Consistency ratio (CR): A certain degree of inconsistency is acceptable within a defined threshold. If the consistency ratio (CR) is less than or equal to 10%, the judgments are considered reasonably consistent; otherwise, they are not.

The formula for calculating the consistency ratio is as follows:

**CR=CI:RI**

Where:

- **CI** is the Consistency Index, calculated using the following formula:

CI=λmax−nn−1CI = \frac{\lambda_{\text{max}} - n} {n - 1}CI=n−1λmax−n

In which:

- nnn represents the number of criteria (factors),
- λmax\lambda_{\text{max}}}λmax denotes the maximum eigenvalue of the comparison matrix.

$$\lambda max = \frac{1}{n}\left[\frac{\sum_{n=1}^{n} W1n}{W11} + \frac{\sum_{n=1}^{n} W2n}{W22} + \frac{\sum_{n=1}^{n} W3n}{W33} + \ldots\ldots + \frac{\sum_{n=1}^{n} Wnn}{Wnn}\right]$$

- RI is the Random Index. The relationship between the RI value and the number of factors (nnn) was proposed by Saaty, as shown below:

**Table 3:** Random Index (RI) Values

| N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0,52 | 0,89 | 1,11 | 1,25 | 1,35 | 1,4 | 1,45 | 1,49 | 1,52 | 1,54 | 1,56 | 1,58 | 1,59 |

(**Source:** Saaty. T.L, 2008) [11]

## 3. Information Processing Methods

Information collected from household interviews was synthesized and processed using Microsoft Excel.

Data obtained from interviews with key informants and local officials, as well as insights from group discussions, were aggregated, analyzed, cross-checked, and simplified according to specific themes and research objectives.

The Analytic Hierarchy Process (AHP) framework was applied to determine the relative importance of each factor through weight values. On this basis, the study identified the degree of influence of each factor on farmers' participation in production linkages.

## Results and Discussion

### 1. Farmers' Objectives in Participating in Linkages

The objectives of farmers in the vertical linkage between farmers and enterprises for organic tea production were discussed and agreed upon by the surveyed households. The results are presented in table 4.

**Table 4:** Farmers' Objectives in Participating in Linkages with Enterprises

| Criteria | Level of Importance (%) | | |
|---|---|---|---|
| | Less Important | Important | Very Important |
| 1. Product consumption | 0,0 | 5,1 | 94,9 |
| 2. Support with fertilizers and plant protection chemicals | 6,3 | 27,8 | 65,9 |
| 3. Technical support | 4,4 | 41,2 | 54,4 |
| 4. Improving product quality | 3,1 | 53,2 | 43,7 |
| 5. Reducing production risks | 5,1 | 52,2 | 42,6 |
| 6. Access to credit sources | 9,0 | 49,8 | 41,2 |
| 7. Enhancing product competitiveness | 10,8 | 48,4 | 40,8 |

(**Source:** Group discussion results, 2024)

The results in Table 4 indicate that the objective most highly valued by farmers when engaging in linkages with enterprises in organic tea production is product consumption. This implies that households expect to reduce the burden of searching for markets, thereby allowing them to concentrate on production, processing, and improving product quality. In addition, farmers also anticipate receiving technical support from enterprises as well as access to quality agricultural inputs such as fertilizers and plant protection chemicals.

Furthermore, linkages between farmers and enterprises enable producers to increase income per unit of cultivated area, reduce production costs, and improve their managerial skills and capabilities. Through such partnerships, farmers expect opportunities to expand networks, enhance the competitiveness of their products, and at the same time, minimize production risks.

### 2. Analysis of Factors Influencing Farmers' Participation in Linkages with Enterprises

#### 1.1 Identification of Influencing Factors

Farmers' participation in production linkages is influenced by a variety of factors [13]. This study identified the key factors affecting farmers engaged in organic tea production, with the results presented in Table 5.

**Table 5:** Factors Influencing Farmers' Participation in Linkages

| No. | Group of Influencing Factors | Specific Factors |
|---|---|---|
| 1 | Related to production (YTSX) | (YT1) Production process |
| | | (YT2) Access to production inputs |
| | | (YT3) Production resources |
| | | (YT4) Cultivated tea land area |
| 2 | Related to consumption (YTTT) | (YT5) Product consumption market |
| | | (YT6) Product purchase price |
| | | YT7) Enterprise reputation |

**Source:** Research results, 2024

The results in Table 5 show that the factors influencing farmers' participation in linkages are categorized into two groups:

1. Production-related factors include four aspects: production process (YT1), access to production inputs (YT2), production resources (YT3), and cultivated land area (YT4).
2. Consumption-related factors comprise three aspects: product consumption market (YT5), purchase price of products (YT6), and enterprise reputation (YT7).

**(YT1) Production process:** The organic tea production process is highly stringent, covering all stages from crop management, fertilization, harvesting to processing (roasting and drying). It prohibits the use of chemicals such as chemical fertilizers, pesticides, and herbicides. Organic tea growers must rely solely on natural inputs (e.g., composted manure) and use ecological practices for pest and weed control (e.g., manual insect removal, hand weeding, mowing). Farmers, however, are accustomed to conventional methods and often express concerns about the difficulties and persistence required to comply with the strict organic standards when participating in linkages.

**(YT2) Production inputs:** Organic farming requires the use of organic fertilizers and biological pesticides. Yet, the supply of such inputs that meet the standards for organic tea production remains limited, making both accessibility and quality control difficult.

**(YT3) Production resources:** Farmers often maintain the perception of "labor as profit." In reality, household labor resources are highly constrained, with an average of only one to two workers per family. Organic farming, however, demands two to four times more labor compared to conventional methods. Hiring additional workers is challenging due to labor scarcity and high wages, leading producers to worry about increased production costs from hired labor.

**(YT4) Cultivated tea land area:** Tea production land is often fragmented and small-scale, causing farmers to be concerned about meeting the requirements for organic farming.

**(YT5) Product consumption market:** The availability of stable markets remains the foremost concern for farmers, as

it determines the effectiveness of agricultural production. Farmers are particularly apprehensive about the certainty and stability of product markets when engaging in linkages with enterprises.

**(YT6) Purchase price of products:** Organic farming requires higher investment than conventional methods, resulting in higher production costs. Consequently, reasonable purchase prices are critical to ensuring producers' profitability, making price an important factor positively influencing farmers' decisions to participate in linkages.

**(YT7) Enterprise reputation:** Agricultural production is heavily dependent on external factors and is highly vulnerable to risks. Therefore, the reputation and willingness of enterprises to share risks exert significant psychological influence on farmers and play a decisive role in their willingness to engage in linkages.

### 1.2 Determining the Relative Importance of Factors Affecting Farmers' Decisions to Participate in Production Linkages

Farmers' participation in production linkages is influenced by multiple factors, each exerting a different degree of impact on their decision to engage with enterprises. By applying the nine-point scale of the Analytic Hierarchy Process (AHP), this study conducted pairwise comparisons of influencing factors through consultations with 13 key farmers who possess substantial experience and deep knowledge of issues related to production linkages. The results are presented in Table 6.

**Table 6:** Pairwise Comparison Matrix of the Relative Importance of Factors Influencing Production Linkages

| Factors | YT1 | YT2 | YT3 | YT4 | YT5 | YT6 | YT7 |
|---|---|---|---|---|---|---|---|
| YT1 – Production process | 1/1 | 5/3 | 7/5 | 5/3 | 5/7 | 5/7 | 7/3 |
| YT2 – Production inputs | 3/5 | 1/1 | 1/1 | 7/5 | 4/7 | 3/5 | 7/5 |
| YT3 – Production resources | 5/7 | 1/1 | 1/1 | 7/2 | 3/7 | 3/7 | 5/3 |
| YT4 – Cultivated tea land area | 3/7 | 3/7 | 3/5 | 1/1 | 1/7 | 1/5 | 1/3 |
| YT5 – Product consumption market | 7/5 | 7/5 | 7/3 | 7/3 | 1/1 | 3/1 | 7/3 |
| YT6 – Purchase price of products | 7/5 | 5/3 | 3/7 | 5/1 | 1/3 | 1/1 | 7/1 |
| YT7 – Enterprise reputation | 3/7 | 3/5 | 5/7 | 3/1 | 3/7 | 1/7 | 1/1 |
| Total score | 5,97 | 8,23 | 7,16 | 22,50 | 3,62 | 6,09 | 16,07 |

(**Source:** Research results, 2024)

The degree of influence of the factors on farmers' participation in production linkages is reflected through their weight values, with larger weights corresponding to stronger influence. Based on the results of the pairwise comparison matrix in Table 6, and by applying the AHP method, the study normalized the data and determined the weights of the factors affecting farmers' participation in linkages. The results are presented in

**Table 7:** Normalized Matrix and Weights of Factors Influencing Production Linkages

| Factors | YT1 | YT2 | YT3 | YT4 | YT5 | YT6 | YT7 | Weight |
|---|---|---|---|---|---|---|---|---|
| YT1 – Production process | 0.17 | 0.20 | 0.20 | 0.07 | 0.20 | 0.12 | 0.15 | 0.16 |
| YT2 – Production inputs | 0.10 | 0.12 | 0.14 | 0.10 | 0.16 | 0.10 | 0.09 | 0.12 |
| YT3 – Production resources | 0.07 | 0.09 | 0.08 | 0.13 | 0.12 | 0.02 | 0.06 | 0.08 |
| YT4 – Cultivated tea land area | 0.07 | 0.05 | 0.06 | 0.04 | 0.04 | 0.03 | 0.02 | 0.05 |
| YT5 – Product consumption market | 0.23 | 0.21 | 0.33 | 0.31 | 0.28 | 0.49 | 0.15 | 0.29 |
| YT6 – Purchase price of products | 0.23 | 0.20 | 0.06 | 0.22 | 0.09 | 0.16 | 0.44 | 0.20 |
| YT7 – Enterprise reputation | 0.12 | 0.12 | 0.14 | 0.11 | 0.12 | 0.07 | 0.10 | 0.11 |
| n= 7; CI = 2,52; RI = 1,32; CR = 0,05 | | | | | | | | |

**Source:** Research results, 2024

The results presented in Table 7 show that the product consumption market and the purchase price of products are the two most influential factors, with weights of 0.29 and 0.20, respectively. These factors exert the strongest impact on farmers' decisions to participate in production linkages. This finding is consistent with previous studies [12] and reflects the reality of agricultural production in Vietnam. Most farmers concentrate their efforts and resources on production, only to face significant concerns about marketing their products. The consumption of agricultural products remains a persistent challenge, with recurring scenarios of oversupply leading to falling prices—an ongoing source of anxiety for farmers. Moreover, agricultural products are largely sold in small quantities through informal traders, with limited contractual arrangements ensuring stable and fair prices. Farmers still have little influence over both the market access and the pricing of their products. The challenge is particularly pronounced for organic produce, which is often difficult to distinguish from conventional products, resulting in additional barriers in both market access and securing appropriate output prices.

By contrast, the cultivated tea land area is the least influential factor, with a weight of 0.05. Although most tea farms are small in scale, scattered across multiple locations, and thereby present difficulties for mechanization, fertilization, and pest control, the study results suggest that land size exerts relatively little influence on farmers' decisions to participate in linkages with enterprises.

## Conclusion

A variety of factors influence farmers' decisions to participate in organic tea production linkages with enterprises. These include: the production process, access to production inputs, production resources, cultivated tea land area, consumption markets, purchase prices, and the reputation of enterprises. Among these, the output market emerges as the most critical factor, followed by the purchase price of products, both of which directly determine the benefits farmers receive from participating in linkages.

To strengthen and sustain farmer–enterprise linkages in organic tea production, enterprises must ensure stable markets for product consumption while safeguarding the rights and benefits of farmers. In addition, enterprises

should implement policies to provide technical support in organic cultivation and facilitate farmers' access to quality production inputs, thereby enabling farmers to adhere to strict organic farming practices.

The study further recommends that, in addition to clearly defining the responsibilities of all parties, both farmers and enterprises must actively share risks and honor contractual commitments. At the same time, support from the government, scientists, and local authorities is essential in providing guidance, technical consultation, and brand development for organic tea products. Through the coordinated implementation of these solutions, farmers will be more motivated to participate in linkages, gradually overcoming the current shortcomings in organic tea production linkages, and thereby contributing to the sustainable and effective development of the tea sector in the locality.

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