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Planning for the Development of Coffee Farming in the Context of Regional Development in Tapanuli Utara Regency

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study aims to design a development plan for coffee farming in North Tapanuli Regency. The research methodology involves Location Quotient (LQ) analysis to identify the main bases of coffee farming, SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis with an A'WOT matrix for weighting determination, and coffee production trend analysis using a linear trend model to forecast production for the period 2023-2033. The findings reveal that several districts in North Tapanuli Regency, including Parmonangan, Sipoholon, Tarutung, Siatas Barita, Pangaribuan, Sipahutar, Siborongborong, Pagaran, and Muara, are identified as the main bases for coffee farming.

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Determining factors involve land, capital, market, human resources, and technology. Development strategies include institutional optimization, the formation of joint cooperatives, and enhanced coordination among relevant authorities. Production forecasts indicate positive growth until 2033. Recommendations involve institutional optimization, cooperative formation, increased coordination, land protection, and efforts to enhance human resources. With the implementation of these strategies, it is anticipated that coffee farming will positively contribute to the economic growth and well-being of the local community in North Tapanuli Regency.

Keywords: Planning; tapanuli utara regency; location quotient; trend; SWOT.

1. INTRODUCTION

Regional development planning plays a crucial role in efforts to enhance the local economy. The goal of this planning is to optimize existing resources in the region, with the hope of achieving improved economic conditions. However, the emergence of assumptions also raises questions about the validity of the development theories or concepts on which it is based [1]. According to Susanto, planning is an effort to select and connect facts, as well as to make and use assumptions about the future by describing and formulating the necessary activities to achieve desired outcomes [2].

Development theories encompass various social science approaches that address issues of underdevelopment. These theories include growth theory, rural development theory, agro-first theory, basic needs theory, and others. Throughout its evolution, development theory has become increasingly complex and interdisciplinary [3-5]. Therefore, there is no standardized and final definition of development; instead, there are proposals regarding what should be implied by development in specific contexts [6].

According to Tarigan [7], comparative advantage in a commodity for a region is a relative advantage compared to other commodities in the region. The form being compared, not the form of real added value, is the essence of superiority in this context. Commodities that have a relative advantage, even in comparison, are more advantageous for development compared to other commodities produced in both regions/areas.

The agricultural sector is considered to play a crucial role in providing employment, meeting food needs, and contributing to the country's foreign exchange through exports. Additionally, the agricultural sector significantly serves as a supplier of raw materials for the industrial sector. Agriculture can be divided into four main pillars: farmers, structural officials, functional officials, and stakeholders [8].

In 2022, in North Tapanuli Regency, the agricultural sector contributed 43.91% to the formation of the Gross Regional Domestic Product (GRDP). This sector is divided into several sub-sectors, including food crops, plantations, livestock, fisheries, and forestry. Out of a total population of 272,587 people or 61,256 households (KK) in North Tapanuli Regency, 54,316 households or 88.67% are engaged in the agricultural sector. The plantation sub-sector is one of the sources of income for the community, with coconut, coffee, cloves, chocolate, and tobacco as the top five leading commodities with high market value

North Tapanuli Regency, situated at an elevation of 150-1,700 meters above sea level, harnesses its extensive potential for agriculture and agribusiness. With a tropical climate and an average temperature of around 28°C, this regency is home to the majority of the Toba Batak ethnic group, predominantly adhering to the Christian faith. Comprising 15 districts, with Tarutung as its capital, North Tapanuli Regency includes the most extensive district, Garoga, covering an area of 567.58 km² with a population density of only 29 people per km².

Recent data indicates that the population of North Tapanuli Regency has reached approximately 318,424 individuals, comprising 159,102 males and 159,322 females, with a population density of around 85 people per km² [9].

This region is also recognized as a central hub for coffee cultivation in North Sumatra Province, contributing significantly as an essential export

commodity for the country's foreign exchange. Several districts in North Tapanuli, such as Siborong-borong, Sipahutar, Garoga, Sigotom, Pangaribuan, Silindung, Martimbang, Pahae, Pagarsinondi, and Tarutung, are major coffee producers.

In 2022, the coffee production in North Tapanuli Regency reached 11,823 tons from 17,240.12 hectares of Arabica coffee land and 567.82 tons from 1,299 hectares of Robusta coffee land. North Tapanuli coffee, besides holding significant potential for further development, also received the highest accolades in a nationwide coffee exhibition in 2014.

Given its evident strengths, the development of this region should consider the pivotal role of agricultural commodities, such as coffee, in development planning. Previous research relevant to the topic, "Planning the Development of Coffee Farming for Regional Development in North Tapanuli Regency," includes findings from Bangun (2020) in his study titled "Analysis of Commodity Regionalization and the Contribution of Arabica Coffee to Regional Development in North Tapanuli Regency." Bangun concluded that Arabica coffee plays a significant role in the economy and regional development of North Tapanuli Regency.

Another study incorporating Location Quotient analysis is the research conducted by Cynthia, P., and Ibrahim, T.J. (2018), who used this method to examine the chili commodity in Kediri Regency. This analytical method has also been applied to analyze leading economic sectors in various regions, such as districts and cities in Bali, West Aceh Regency, and North Aceh Regency. Additionally, economic structure and base sector analysis have been employed to drive the economy of Bontang City during the period 2008-2012.

Considering the findings from these studies, there is a compelling need for further research on the planning of coffee farming development in the context of regional development in North Tapanuli Regency. This research proposes applying the Location Quotient (LQ) method with the hope of providing in-depth insights into the role of the plantation sector, specifically coffee, in the local economy. The study also aims to evaluate the extent to which this sector can be considered a leading and strategic sector in its regional context. Therefore, this research is expected to make a meaningful contribution to the development and planning of North Tapanuli Regency.

2. METHODS

This research utilizes both primary and secondary data obtained through interviews and questionnaire completion by relevant stakeholders. Secondary data is sourced from relevant government agencies, encompassing the production values of coffee commodities in each district of North Tapanuli Regency from 2012 to 2022. The research site selection was purposive, involving direct observations in North Tapanuli Regency, North Sumatra Province.

2.1 Analisis Location Quotient

The analysis is conducted using the Location Quotient (LQ) method, applying the formula referenced from the Bendavid-Val formula as explained [10]. The analytical steps involve the collection of primary and secondary data, careful selection of the research location, and the application of the LQ formula to evaluate the economic role of the coffee plantation sector at the district level.

$$LQ = \frac{\frac{VR_1}{VR}}{\frac{V_1}{V}}$$

LQ: Location Quotient value
VR1: Area of coffee plantations in the District (ha)
VR: Total area of plantations in the District (ha)
V1: Area of coffee plantations in North Tapanuli Regency (ha)
V: Total area of plantations in North Tapanuli Regency (ha)

2.2 Trend Analysis

The least squares method is a statistical technique used for trend analysis, and it involves fitting a line (or curve) to a set of data points in such a way that the sum of the squares of the vertical distances (residuals) of the points from the line is minimized. The general equation for a least squares regression line is:

$$Y = a + b\,(X)$$

Explanation:

Y = The predicted or observed value (dependent variable)
a,b = Constanta Value
X = Time

The least squares method helps find the best-fitting line through the data points, minimizing the sum of the squared differences between the observed and predicted values.

2.3 SWOT Analysis

The A'WOT method integrates SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis with the Analytical Hierarchy Process (AHP), offering a sophisticated approach to strategic analysis.

3. RESULTS AND DISCUSSION

3.1 Location Quotient (LQ)

The Location Quotient (LQ) analysis is employed to ascertain whether coffee farming is a base or non-base sector in each district of North Tapanuli Regency. Data on land area, production, and crop productivity for the year 2023 are obtained from the Central Statistics Agency (Badan Pusat Statistik) of North Tapanuli Regency.

This table provides an overview of the concentration of economic density in the coffee plantation sector compared to the total economic density of plantation sectors in North Tapanuli Regency, based on the results of the LQ analysis for land density in various commodities across districts in 2022.

Based on the LQ values, the district of Siborongborong has the highest value for the coffee commodity at 1.81. This means that the economic density concentration for coffee farming in the Siborongborong district is 1.81 times higher compared to the overall economic density in the plantation sector of North Tapanuli Regency. The comparative advantages of each district in North Tapanuli Regency, based on the LQ values for plantation land density in 2022, are presented in Table 3.

From the LQ calculations for the 15 districts in North Tapanuli Regency, it is evident that 9 districts serve as basis areas for Arabica coffee. Siborongborong district stands out as the primary basis for coffee, having the highest LQ value at 1.81. This indicates that for every 1 unit of coffee plantation land allocated to meet the needs of Siborongborong district, an additional 1.81 units are allocated to fulfill the coffee commodity demand in other regions.

3.2 Trend Analysis Coffee Production In North Tapanuli Regency

In order to predict coffee production in North Tapanuli Regency for the next ten years (2023-2033), a trend analysis was conducted using the coffee production data series from 2018 to 2022. Employing a linear trend model, the coffee production is forecasted for the specified period.

Table 1. Land area, production, and crop productivity of plantation crops in north tapanuli regency, 2023

Crop	Land Area (ha)	Production (ton)	Productivity (kg/ha)
Rubber	9,975	5,561.78	651.75
Arabica Coffee	16,893.83	15,712.12	1,158.31
Robusta Coffee	1,088.50	567.80	521.65
Coconut	346.08	269.72	1,034.68
Cocoa	3,190.50	1,776.67	665.11
Cinnamon	192.80	1,120.91	5,813.85
Candlenut	298	223.47	749.90
Areca Nut	296.90	178.44	601.01
Tobacco	378.74	457.01	1,206.65

Source: Central Statistics Agency of North Tapanuli Regency, 2023

Table 2. Location Quotient (LQ) values for plantation land density in north tapanuli regency, 2022

District	Coffee	Rubber	Coconut	Cacao	Tobacco
Parmonangan	1,37	0,55	0,42	0,69	-
Adiankoting	0,13	2,65	0,98	1,19	-
Sipoholon	1,68	0,17	1,18	0,05	-
Tarutung	1,67	0,14	2,01	0,09	-
Siatas Barita	1,78	0,01	0,83	0,02	-
Pahae Julu	0,02	2,16	0,70	3,17	-
Pahae Jae	0,01	2,68	3,38	1,49	-
Purbatua	0,03	0,64	3,44	7,07	-
Simangumban	0,24	0,69	1,33	6,07	-
Pangaribuan	1,73	0,04	0,10	0,26	-
Garoga	0,47	2,17	0,57	0,81	-
Sipahutar	1,80	-	0,32	-	-
Siborongborong	1,81	-	-	-	-
Pagaran	1,26	-	-	-	9,69
Muara	1,61	-	6,90	0,22	-

Source: Data processed 2023

Table 3. Comparative advantages of each district in north tapanuli regency based on lq values for plantation land density, 2022

District	Plantation Commodities
Parmonangan	Coffee
Adiankoting	Rubber and Cocoa
Sipoholon	Coffee and Coconut
Tarutung	Coffee and Coconut
Siatas Barita	Coffee
Pahae Julu	Rubber and Cocoa
Pahae Jae	Rubber, Coconut, and Cocoa
Purbatua	Coconut and Cocoa
Simangumban	Coconut and Cocoa
Pangaribuan	Coffee
Garoga	Rubber
Sipahutar	Coffee
Siborongborong	Coffee
Pagaran	Coffee and Tobacco
Muara	Coffee and Coconut

Source: Data Processed, 2023

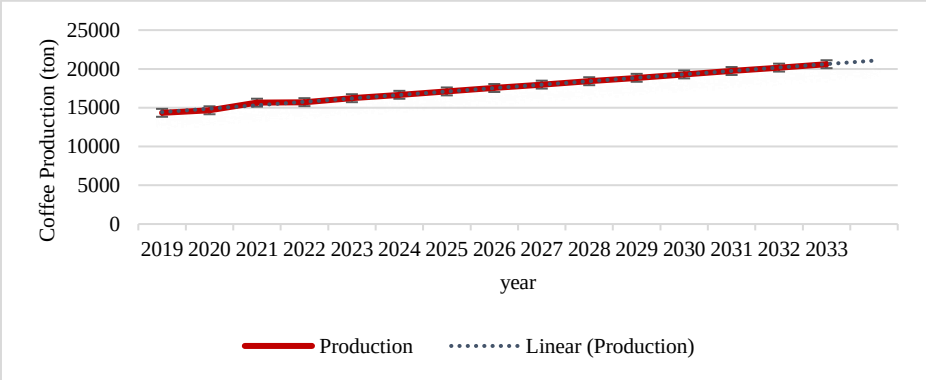

Fig. 1. Trend analysis coffee production in north tapanuli regency
Source: Data Processed BPS North Tapanuli 2018-2022

Based on the forecasting results, coffee production in North Tapanuli Regency exhibits a competitive advantage with a positive growth trend. The highest production is predicted to occur in 2033, reaching a quantity of 18,410.84 tons. This optimistic projection is attributed to advancements in cultivation practices, optimal utilization of production factors, and supportive government policies promoting coffee farming.

As per Thamrin, the expansion of cultivation areas, production rates, and the number of farmers engaged in coffee farming continues to rise. However, several technical challenges persist, including conventional farm management practices, suboptimal use of inputs, fluctuations in global market prices, and the need to meet international company and market standards. These challenges highlight the complexity of the coffee farming landscape, underscoring the importance of addressing technical barriers while leveraging the industry's growth opportunities.

3.3 Other Influencing Factors

3.3.1 Factors influencing coffee farming: perspective of the regional development planning agency of north tapanuli regency

According to the perception of the Regional Development Planning Agency (Badan Perencanaan Pembangunan Daerah or Bappeda) of North Tapanuli Regency, the most influential factors in the sequential development of coffee farming are land (0.41), capital (0.19), human resources (0.16), market (0.14), and technology (0.10).

The above-average weighting (0.2) assigned to land and capital indicates that these factors are dominant and highly crucial in the development of coffee farming in North Tapanuli Regency. The high rate of land conversion in this region makes land a critically important requirement, and the availability of capital becomes crucial once land is secured.

3.3.2 Stakeholders' perception of coffee farming

According to the analysis based on the perception of the Department of Agriculture and Plantation of North Tapanuli Regency, the most influential factors in the sequential development of coffee farming are land (0.465), human resources (0.156), capital (0.156), market (0.123), and technology (0.10).

Among the primary factors influencing the development of coffee farming, land is perceived as the dominant and highly important factor by the Department of Agriculture and Plantation. Thus, stakeholders view land as the key element in the development of coffee farming in North Tapanuli Regency.

3.3.3 Perception of agricultural extension officers in north tapanuli regency

According to the perception of Agricultural Extension Officers in North Tapanuli Regency, the most influential factors in the sequential development of coffee farming in the region are market (0.494), capital (0.251), technology (0.141), human resources (0.072), and land (0.042). The weighting above the average (0.2) is

Table 4. Trend analysis coffee production in north tapanuli regency

Year	Forecast	Trend (ton)
2023	14175,870	14.175,87
2024	14336,740	14.336,74
2025	14663,940	14.663,94
2026	15644,500	15.644,50
2027	15712,120	15.712,12
2028	16220,712	16.220,71
2029	16658,738	16.658,74
2030	17096,764	17.096,76
2031	17534,790	17.534,79
2032	17972,816	17.972,82
2033	18410,842	18.410,84

Source: Data Processed, 2023

given to market and capital. This means, based on the perception of Agricultural Extension Officers in North Tapanuli Regency, market and capital are dominant factors that significantly influence the efforts to develop coffee farming in the region.

The market is considered crucial for the development of coffee farming in North Tapanuli Regency, not only due to the proximity to coffee export companies but also because the demand for coffee in this area is relatively high. Capital is also a determining factor in the development of coffee farming as this commodity requires a substantial amount of capital for the provision of both seedlings and the necessary infrastructure.

3.3.4 Perception of coffee farmers in north tapanuli regency

The perception of all respondents engaged in coffee farming represents the opinions of various participants, processed by finding the geometric mean to create a collective perception with new weighted values for each factor. According to the perception of all respondents, the most influential factors in the development of coffee farming in North Tapanuli Regency, in sequential order, are land (0.277), capital (0.262), market (0.241), human resources (0.156), and technology (0.064).

The availability and suitability of land for coffee farming are the most crucial aspects in the development of coffee farming in North Tapanuli Regency. The decreasing availability of land poses a threat to the existence of coffee plantations. The second highly influential factor is capital. Government financial assistance is instrumental for the sustainability of the coffee commodity. However, effective management is essential to ensure that these funds reach other farmers in need. Personal capital availability is also important to reduce dependency on the government or loans from banks. The third priority factor is the market. Assurance of coffee product absorption by the market, price stability, and an efficient marketing chain are key factors for farmers to obtain reasonable profits.

3.4 SWOT Analysis

The A'WOT method applied in the research is used to determine the weighting in SWOT analysis. Several strengths, weaknesses, opportunities, and threats factors can be observed in Table 5.

The SWOT matrix employs the ST (Strengths-Threats) strategy as the primary strategy. This strategy is formulated by leveraging all strengths to mitigate threats as much as possible for the development of coffee farming in North Tapanuli Regency.

The support from institutions overseeing agriculture in North Tapanuli Regency and the potential marketing locations serve as strengths and assets in formulating a growth strategy. On the threat side, minimizing factors such as pest and disease attacks, extreme weather changes like El-Nino, and land conversion is crucial.

3.4.1 Internal strategic factors analysis summary

Internal Strategic Factor Analysis (IFAS) is employed to analyze internal strategic factors, and the preparation of the IFAS matrix serves the purpose of understanding the level of importance and influence in determining the development planning of coffee farming in Tapanuli Utara Regency. The significance of each factor is determined based on the processed questionnaire data using Microsoft Excel.

The influence level of each factor is identified by assigning a rating from 1 to 4, where a rating of 4 indicates a very strong influence, 3 indicates a moderately strong influence, 2 signifies a somewhat weak influence, and 1 denotes a very weak influence.

The following is the Internal Strategic Factors Analysis Summary (IFAS) table that examines the importance weights of each strength and weakness factor, along with rating values indicating their influence levels. The multiplication results of the weights and ratings for each factor will constitute the cumulative scores of internal factors to be used in the internal-external matrix analysis.

From Table 6 of the IFAS matrix, it is evident that the total score of the multiplication of weights and ratings for all strengths and weaknesses factors is 2.989. This value originates from the strength factor score, which is 1.981, and the weakness factor score with a value of 1.008. In the weight column, the weights of each factor are known,

which are the results of processing questionnaire data using the Analytical Hierarchy Process (AHP) method.

The weights obtained for each factor are multiplied by 0.5 to ensure that the total weights of strength and weakness factors have a value of 1 (Rangkuti 2009). In the rating column, it can be observed that most strength factors have a rating of 3 (moderately strong), except for the market location potential, which has a rating of 4 (very strong). For weakness factors, there are 2 factors with a rating of 3 (moderately strong): coffee price fluctuations and limited capital. In contrast, the conditions of natural resources and the expensive price of coffee facilities and infrastructure have a moderately weak rating (2).

3.4.2 External strategic factors analysis

The analysis of external strategic factors, also known as External Strategic Factors Analysis Summary (EFAS), is conducted by formulating the EFAS matrix. The purpose of creating the EFAS matrix is to determine the level of importance and influence of external factors, both opportunities and threats, in the development planning of coffee farming in North Tapanuli Regency. The significance of each factor is determined based on the processing of questionnaire data using Microsoft Excel. The influence of each factor is measured by assigning a rating from 1 to 4, where a rating of 4 indicates a very strong influence, 3 indicates a moderately strong influence, 2 indicates a somewhat weak influence, and 1 indicates a very weak influence.

Table 7 represents the External Strategic Factors Analysis Summary (EFAS) table that considers the weight of importance for each opportunity and threat factor, along with a rating that reflects its level of influence. The cumulative score resulting from the multiplication of weights and ratings for each factor will serve as the evaluation point for external factors, which will be used in the analysis of the internal-external matrix.

Table 5. Factors of strengths, weaknesses, opportunities, and threats

	Internal Factor		External Factor
1	**Strengths**	**3**	**Opportunities**
	- Potential marketing locations		- High demand for coffee
	- Adequate human resources		- Favorable coffee prices
	- Institutional role		- Proximity to input producers
	- Local institutional support		- Efficient marketing channels
2	**Weaknesses**	**4**	**Threats**
	- Coffee price fluctuations		- Unclear land ownership status
	- Natural resource conditions		- Land conversion
	- Limited capital		- Pest and disease attacks
	- Expensive coffee infrastructure		- Influence of weather changes

Table 6. IFAS matrix analysis results

Strategic Internal Factors		Weight	Rating	Score
Strength				
1	Market Location Potential	0,172	4	0,687
2	Adequate Human Resources	0,145	3	0,435
3	Institutional Role	0,118	3	0,355
4	Local Institutional Support	0,168	3	0,504
Weaknesses				
1	Coffee Price Fluctuation	0,073	3	0,218
2	Natural Resource Conditions	0,080	2	0,160
3	Limited Capital	0,141	3	0,424
4	Expensive Coffee Facilities	0,103	2	0,206
Total		1		2,989

Table 7. EFAS matrix analysis results

Strategic External Factors		Bobot	Rating	Skor
Opportunities				
1	High Coffee Demand	0,165	3	0,496
2	Favorable Coffee Prices	0,123	2	0,246
3	Proximity to input producers	0,092	2	0,183
4	Good Marketing Distribution channels	0,144	3	0,433
Threats				
1	Unclear land ownership status	0,120	3	0,359
2	Land Conversion	0,113	3	0,338
3	Pest and Disease Attacks	0,137	3	0,412
4	Influence of weather changes	0,106	3	0,317
Total		1		2,785

Internal Factors / External Factors	STRENGTH (S)	WEAKNESS (W)
	1. Potential marketing locations 2. Adequate human resources 3. Institutional role 4. Local institutional support	1. Coffee price fluctuations 2. Natural resource conditions 3. Limited capital 4. Expensive coffee infrastructure
OPPORTUNITIES (O) 1. High demand for coffee 2. Favorable coffee prices 3. Proximity to input producers 4. Efficient marketing distribution channels	SO Strategy	WO Strategy
THREATHS (T) 1. Unclear land ownership status 2. Land conversion 3. Pest and disease outbreaks 4. Impact of climate change	ST Strategy	WT Strategy

Fig. 2. Matrix analysis SWOT

From Table 6 of the EFAS matrix, it is known that the total score of the multiplication of weights and ratings for all opportunity and threat factors is 2.785. This value comes from the opportunity factor score, which is 1.359, and the threat factor score with a value of 1.426. In the weight column, the weights of each factor are known, which are the results of processing questionnaire data using the Analytical Hierarchy Process (AHP) method.

The weights obtained for each factor are multiplied by 0.5 to ensure that the total weights of opportunity and threat factors have a value of 1 (Rangkuti 2009). In the rating column, it can be observed that there are 2 factors with a rating of 3 (moderately strong): high coffee demand and good marketing distribution channels, and 2 factors with a rating of 2 (moderately weak): favorable coffee prices and proximity to input producers.

4. CONCLUSION

Based on the research on the development planning of coffee farming in North Tapanuli Regency, it can be concluded that the districts of Parmonangan, Sipoholon, Tarutung, Siatas Barita, Pangaribuan, Sipahutar, Siborongborong, Pagaran, and Muara are the main bases for coffee farming. The most influential factors in the development of coffee farming are land, capital, market, human resources, and technology. Therefore, the development planning of coffee farming in North Tapanuli Regency should be focused on these key districts. Recommended strategies include optimizing institutional development, forming joint farming group cooperatives for product marketing, and enhancing coordination among relevant agencies to protect coffee land from conversion and explore the bio-physical and spatial potential of the region. Thus, the development of coffee farming in North Tapanuli Regency can be implemented optimally, balancing the pressure from imported products, and providing a positive contribution to economic growth and the well-being of the local community.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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