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Research Article

Analysis of Rainfall on the Production of Sidimpuan Snake Fruit (Salacca sumatrana Becc.) in South Tapanuli Regency

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Abstract

Rainfall is one of the climatic elements that directly influences agricultural production; moreover, it often becomes a limiting factor in crop productivity. This study aims to analyze the effect of rainfall on the production of Sidimpuan snake fruit (Salacca sumatrana Becc.) in East Angkola and West Angkola Districts, South Tapanuli Regency. This research employed a survey method. The research data consisted of secondary data, including rainfall data and Sidimpuan snake fruit production data from 2014 to 2023 in East Angkola and West Angkola Districts, South Tapanuli Regency. Data were collected using purposive sampling techniques. The data were analyzed using regression and correlation analyses, presented in the form of tables and graphs, and described descriptively. The results show that rainfall in East Angkola District, South Tapanuli Regency, has a negative effect on the production of Sidimpuan snake fruit, with a regression coefficient of r = 0.4, indicating a weak relationship between rainfall and Sidimpuan snake fruit production. The contribution of rainfall is 19%, while 89% of Sidimpuan snake fruit production in East Angkola District, South Tapanuli Regency, is influenced by other factors not examined in this study. Meanwhile, the regression analysis for rainfall in West Angkola District, South Tapanuli Regency, shows a positive effect on Sidimpuan snake fruit production, with a regression coefficient of r = 0.5, indicating a moderate relationship between rainfall and Sidimpuan snake fruit production. The contribution of rainfall is 21%, while 79% of Sidimpuan snake fruit production in West Angkola (Sipirok) District, South Tapanuli Regency, is influenced by other factors not examined in this study.

Keywords: Rainfall, Sidimpuan Snake Fruit, Regression Analysis.

INTRODUCTION

North Sumatra Province is one of the provinces in Indonesia that is rich in natural resources and has considerable regional potential, particularly in the agricultural sector. One of the well-known agricultural products from North Sumatra is Sidimpuan snake fruit (Salacca sumatrana Becc.), which originates from South Tapanuli Regency. Sidimpuan snake fruit is one of the leading local commodities of South Tapanuli Regency, with an annual production of approximately 21,524 tons (BPS Kabupaten Tapanuli Selatan, 2023).

Sidimpuan snake fruit is distributed across all districts in South Tapanuli Regency, with the main production centers located in West Angkola and East Angkola Districts. The cultivation of Sidimpuan snake fruit began around 1930. In addition to its distinctive taste, Sidimpuan snake fruit has a unique and pleasant aroma as well as specific characteristics in terms of color, namely red known as salak narara (red Sidimpuan snake fruit), white known as salak nabontar (white Sidimpuan snake fruit), and salak sibakua. Since 1999, Sidimpuan snake fruit has been officially registered as a nationally superior fruit originating from North Sumatra through a decree of the Minister of Agriculture.

Based on data on the production capacity of Sidimpuan snake fruit, the crop should be able to achieve yields of approximately 30 tons per hectare (BPS Kabupaten Tapanuli Selatan, 2011). However, based on interviews with Sidimpuan snake fruit farmers, in recent years up to the present, the production obtained has continuously declined. Even the maximum yield achieved is only around 10 tons per hectare per year, and this level is very difficult and rarely attained by Sidimpuan snake fruit farmers. According to farmers, the decline in production has worsened each year. During minor harvest seasons, fruits that should still be harvestable are often not harvested at all because there are no fruits available for harvest.

Many factors contribute to the decline in snake fruit production in general, one of which is environmental factors. As stated by (Kartasapoetra, 1986), climatic and weather elements influence soil conditions as well as plant growth and development. For example, rainfall, temperature variations, and humidity affect the dissolution of organic and inorganic materials in the soil and can accelerate or slow down the loss of water from the soil and plants.

One climatic element that has a very significant and observable influence on plant growth and productivity, both directly and indirectly, is rainfall, as stated by (Prawoto & Erwiyono, 2008). Rainfall levels that are either below or above a certain range can have negative impacts on plant growth.

Rainfall is a climatic element that greatly affects crop cultivation activities, including the cultivation of Sidimpuan snake fruit, because it is generally planted on rainfed land and is commonly located near river flows. This condition is also one of the causes of low fruit set during the dry season, resulting in harvest frequencies of only one or two times per year, instead of the four harvests that should occur annually (Rai et al., 2014).

This study aims to examine and analyze the question: "How does rainfall affect the production of Sidimpuan snake fruit (Salacca sumatrana Becc.) in South Tapanuli Regency?" It is expected that the results of this analysis will contribute to increasing snake fruit production, considering that Sidimpuan snake fruit is capable of bearing fruit throughout the year without distinct fruiting and non-fruiting seasons.

This research is expected to serve as a source of information for practitioners and stakeholders concerned with the analysis of environmental factors affecting the production of Sidimpuan snake fruit in South Tapanuli Regency.

METHOD

Time and Location

This study was conducted from July to August 2024 in South Tapanuli Regency, specifically in Sitinjak Village (West Angkola District) and Huta Ginjang (East Angkola District).

Instruments and Materials

The instruments used included an altimeter, measuring tape, weighing scale, stationery, and a camera. The main materials were 10-year rainfall data, 10-year Sidimpuan snake fruit production data, topographic maps, and relevant books and scientific journals.

Research Method

This research employed a survey method using both primary and secondary data. Primary data included site elevation and morphological characteristics of Sidimpuan snake fruit plants. Secondary data consisted of 10-year rainfall data obtained from BMKG and 10-year production data from BPS. Data were analyzed using regression and correlation analyses and described descriptively.

Sampling Technique

Samples were selected using proportional random sampling, with respondents representing 10% of the population in Sitinjak Village and Huta Ginjang.

Observation Parameters

Observed parameters included fruit morphology (taste, shape, skin color, spine color, flesh color), seed morphology (shape and color), and fruit weight, analyzed descriptively.

Data Analysis

Regression and correlation analyses were used to examine the relationship between rainfall (independent variable) and Sidimpuan snake fruit productivity (dependent variable). Simple linear regression and correlation coefficients (r) and determination coefficients (R^2) were applied to assess the strength and contribution of rainfall to production.

RESULT AND DISCUSSION

The results of this research are presented in the table below:

Table 1. Rainfall Data in East Angkola and West Angkola Districts, South Tapanuli Regency.

No.	Years	Rainfall/District/mm/year	
		East Angola	West Angola
1.	2014	2.045	2.298
2.	2015	2.657	2.364
3.	2016	1.922	2.584
4.	2017	2.247	2.361

5.	2018	1.723	2.574
6.	2019	2.437	2.430
7.	2020	2.154	3.160
8.	2021	2.661	2.275
9.	2022	1.960	309
10.	2023	2.449	594

Secondary Data Source: Class I Deli Serdang Climatology Station

Table 2. Salak Production Data in East Angkola and West Angkola Districts, South Tapanuli Regency.

No.	Years	Salak Production/ District/ Ton/ Year	
		East Angola	**West Angola**
1.	2014	119,80	260,78
2.	2015	12.069	52.102,88
3.	2016	97.50	250.230,60
4.	2017	13.65	496.593,25
5.	2018	677,59	408.435,05
6.	2019	35,80	145.168,90
7.	2020	3,20	192.501,40
8.	2021	35,80	145.168,90
9.	2022	254,20	69.624,10
10.	2023	20,10	269,76

Secondary Data Source: Central Statistics Agency of South Tapanuli Regency

Table 3. Measurement of Height Parameters

No	District Name	Tool	Altitude (m abovesea level)
1	East Angkola District (Hutaginjang)	Altimeter	755
2	West Angkola District (Sitinjak)	Altimeter	650

Source: Primary Data

Table 4. Morphology of the Salak Sidimpuan Plant (Balacca Sumatrana Becc)

No.	Observation Parameters	Location	
		East Angkola District (Hutaginjang)	**West Angkola District (Sitinjak)**
1.	Fruit morphology consists of:		
	Fruit Flavor		

	Fruit Shape	Oval	Round
	Fruit Skin Color	Brown	Blackish brown
	Fruit Thorn Color	Brown	Blackish
	Fruit Flesh Color	Yellowish White	Reddish white
2.	Seed Morphology:		
	Seed Color	Chocolate	Blackish
	Seed Shape	Oval	Round
3.	Fruit Weight (gr)	50 gr/piece	70 gr/piece

Source: Primary Data

Discussion

Regression and Correlation Analysis of Rainfall on Snake Fruit (Salacca Sumatrana Becc) Production in East Angkola District.

Table 5. Rainfall on Snake Fruit (Salacca Sumatrana Becc) Production in East Angkola District.

No.	Years	Rainfall (mm/year)	Snake Fruit Production (Tons/Ha)
1	2014	2.045	119,80
2	2015	2.657	12.069
3	2016	1.922	97.50
4	2017	2.247	13.65
5	2018	1.723	677,59
6	2019	2.437	35,80
7	2020	2.154	3,20
8	2021	2.661	35,80
9	2022	1.960	254,20
10	2023	2.449	20,10

Source: Secondary Data

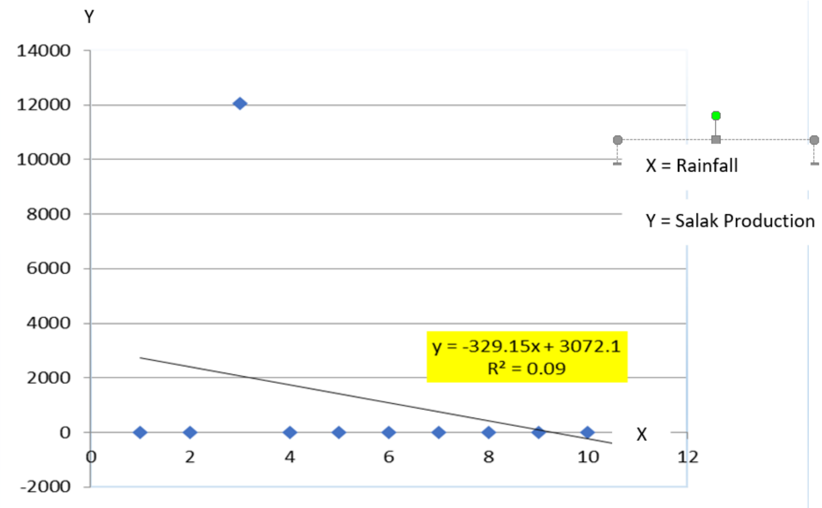


Figure 1. Regression Analysis Curve of Rainfall (mm/year) and Salak Production (tons/year) Against Salak Production in East Angkola District

Based on the correlation analysis between rainfall and snake fruit production in East Angkola District, the correlation coefficient (r = 0.4) indicates a weak relationship. The coefficient of determination (R^2) is 19%, which shows that rainfall accounts for 19% of the variation in snake fruit production in East Angkola District, South Tapanuli Regency, while the remaining 81% is influenced by other factors not examined in this study. Based on the coefficient of determination value, the effect of rainfall can be categorized as moderate.

Furthermore, the regression equation shows a positive intercept (a) and a negative regression coefficient (b). This indicates a negative correlation between rainfall and Sidimpuan snake fruit production in East Angkola District. In other words, an increase in rainfall leads to a decrease in snake fruit production in this district, and conversely, a decrease in rainfall results in an increase in snake fruit production. This relationship can be observed in the following graph.

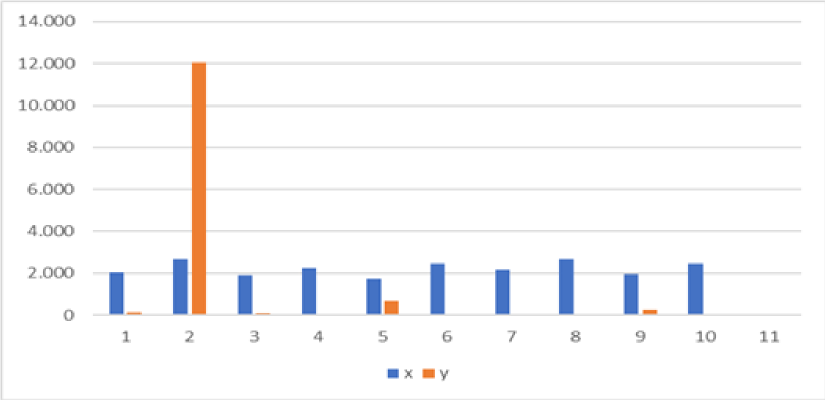


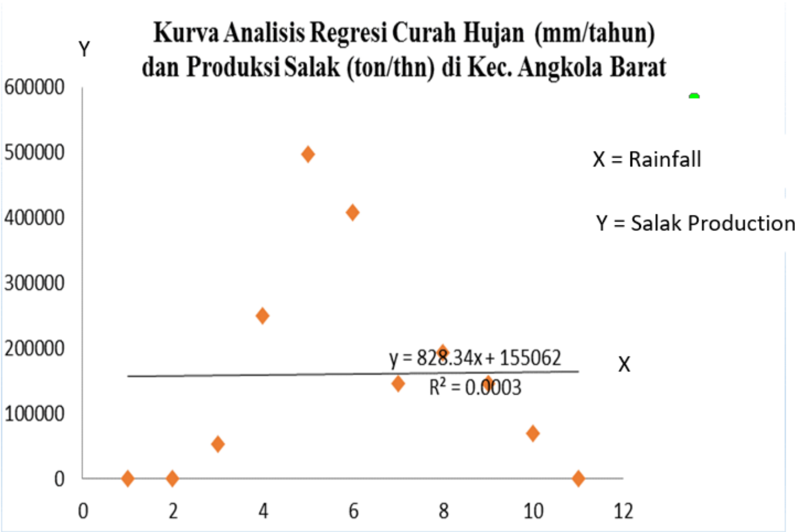
Figure 2. Relationship between Rainfall and Salak Production in East Angkola District.

The graph illustrates that the x-variable represents rainfall, while the y-variable represents snake fruit production. The bar chart clearly shows that when the value of the x-variable increases, the value of the y-variable decreases, and conversely, when the value of the x-variable decreases, the value of the y-variable increases.

Table 6. Rainfall on Snake Fruit (Salacca Sumatrana Becc) Production in West Angkola District.

No.	Years	Rainfall (mm/year)	Snake Fruit Production (Tons/Ha)
1	2014	2.298	260,78
2	2015	2.364	52.102,88
3	2016	2.584	250.230,60
4	2017	2.361	496.593,25
5	2018	2.574	408.435,05
6	2019	2.430	145.168,90
7	2020	3.160	192.501,40
8	2021	2.275	145.168,90
9	2022	309	69.624,10
10	2023	594	269,76

Source: Secondary Data



Based on the correlation analysis between rainfall and snake fruit production in West Angkola District, the correlation coefficient (r = 0.5) indicates a moderate relationship. The coefficient of determination (R^2) is 21%, showing that rainfall contributes 21% to the variation in snake fruit production in South Tapanuli Regency, while the remaining 79% is influenced by other factors not examined in this study. Based on the coefficient of determination value, the effect of rainfall is categorized as weak.

Furthermore, the regression equation shows that both the intercept (a) and the regression coefficient (b) are positive. This indicates a positive correlation between rainfall and Sidimpuan snake fruit production in West Angkola District. In other words, an increase in rainfall leads to an increase in Sidimpuan snake fruit production in this district, whereas a decrease in rainfall results in a decline in production. This relationship can be observed in the following graph.

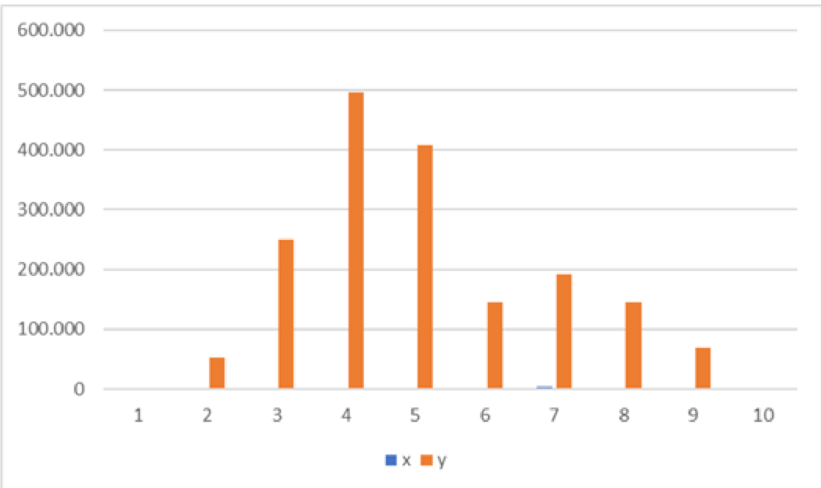


Figure 3. Relationship between Rainfall and Salak Production in West Angkola District.

The graph illustrates that the x-variable represents rainfall, while the y-variable represents snake fruit production. The bar chart clearly shows that when the value of the x-variable increases, the value of the y-variable also increases, and conversely, when the value of the x-variable decreases, the value of the y-variable decreases.

According to (Anarsis, 1996), snake fruit grows well in areas with high rainfall or regions that experience rainfall throughout the year, with annual rainfall exceeding 2,000 mm but not more than 4,000 mm. Snake fruit plants require sufficient water but cannot tolerate prolonged waterlogging. In highland areas, snake fruit grows optimally in regions with annual rainfall above 2,000 mm and below 4,000 mm (Anarsis, 1996).

Rainfall affects water availability, which is essential for various plant physiological processes. Water is required for photosynthesis, the conversion of nutrients into food, and works in conjunction with sunlight. It also functions as a temperature regulator, as water can absorb and distribute heat. In addition, water serves as a transport medium for nutrients from the soil into the plant. Therefore, water deficiency can cause plants to wilt, experience stunted growth, and in severe cases, die.

Sidimpuan snake fruit is generally cultivated at elevations of 300–700 meters above sea level with flat to hilly topography. The preferred climatic condition is climate type B according to the Schmidt and Ferguson classification, with annual rainfall ranging from 2,100 to 2,600 mm. Excessive rainfall can reduce fruit production due to increased flower rot and drop. Conversely, insufficient rainfall results in low relative water content in leaves, leading to very high flower abortion rates—up to 88.96%—thereby disrupting flower development into fruit and causing failure in fruit formation.

Based on the findings of Sumatera (2013), snake fruit plants grown below 570 m above sea level and above 570 m above sea level produce lower fruit quality, including reduced flesh thickness, total soluble solids (TSS), TSS/total acid ratio, and number of fruits per bunch. An elevation of 570 m above sea level represents an ideal environmental condition for fruit growth and development, resulting in better fruit quality, although statistically it is not significantly different from snake fruit grown at 460 m above sea level, except for the TSS/total acid ratio.

Observations of the fruit morphology of Sidimpuan snake fruit from East Angkola and West Angkola Districts reveal noticeable differences. Snake fruit produced in West Angkola exhibits better fruit quality than that from East Angkola. This is reflected in fruit color, size, and taste, in accordance with standardization guidelines adopting the Indonesian National Standard for snake fruit (SNI 01-30167-1992). These standards are based on fruit characteristics, including varietal uniformity, maturity level, fruit size, and cleanliness. Fruit size is classified as small (<32 g per fruit), medium (33–60 g per fruit), and large (>61 g per fruit) (Hilda, 2013).

CONCLUSION

Based on the findings of this study, it can be concluded that rainfall plays a role in influencing the production of Sidimpuan snake fruit (Salacca sumatrana Becc.) in both East Angkola and West Angkola Districts, South Tapanuli Regency. The results of the regression and correlation analyses show that in East Angkola District, the relationship between rainfall and Sidimpuan snake fruit production is weak, as indicated by a regression coefficient of 0.4. The coefficient of determination reveals that rainfall contributes 19% to the variation in production, while the remaining 81% is influenced by other factors that were not examined in this study.

In contrast, the analysis conducted in West Angkola District indicates a moderate relationship between rainfall and Sidimpuan snake fruit production, with a regression coefficient of 0.5. The coefficient of determination shows that rainfall accounts for 21% of the variation in production, whereas 79% is affected by other unobserved factors. These findings suggest that although rainfall influences Sidimpuan snake fruit production, its contribution is relatively limited, and other environmental or agronomic factors play a more dominant role.

Based on these conclusions, future research is recommended to incorporate additional factors beyond rainfall that may affect agricultural productivity, in order to obtain a more comprehensive understanding of optimal growth conditions for various crops. Moreover, further studies focusing on Sidimpuan snake fruit production should consider other growth-related factors, such as varietal characteristics, soil conditions, cultivation practices, and other environmental variables, to support efforts to improve yield and fruit quality.

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