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THE ROLE OF CALDERA GEOPARK IN TOURISM DEVELOPMENT OF LAKE TOBA SUPER PRIORITY DESTINATIONS, INDONESIA

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Abstract: This study aimed to analyze the role of the Toba Caldera Geopark as a mediating variable in the development of the Lake Toba area using the SEM-PLS data analysis technique. The research method using SEM-PLS analysis consists of sub-models, namely measurement and structural models or external and internal models. The convergent validity of the PLS with reflective indicators is assessed based on the loading factors of the indicators. The results demonstrate that the Toba Caldera Geopark can accelerate the role of tourism variables such as attractions, amenities, and ancillaries in enhancing the development of the Lake Toba area. However, development has not increased the influence of tourism accessibility in the Lake Toba area. The integrated management of Caldera Geopark with tourism development is recommended as an effective approach to expedite the development of Lake Toba area. Tourist destinations were reported to significantly influence the development of the Lake Toba area, and the Caldera Toba Geopark mediated efforts to develop the tourism sector. Factors related to tourist destinations, such as attractions, amenities, and ancillaries, played a significant role in the development of the Lake Toba area. Accessibility did not have a significant influence on the development of the area, either directly or indirectly, through the Geopark. Development was required, including improving attractions, amenities, and ancillaries, using the Caldera Toba Geopark as an approach for management, utilization, and development. Collaboration between the government, private sector, and local and international communities creates sustainable tourism development programmes. Meanwhile, attention to environmental sustainability, local culture, and community participation was important for managing the UNESCO Global Geopark.

Keywords: Caldera Geopark, development, Lake Toba Area, tourism sector

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INTRODUCTION

The tourism sector is strategically positioned in various development policies, specifically in Indonesia, which has tourism assets (Sugiarti and Fikri, 2021). Over the last five years, tourism has experienced significant growth, in line with the designation of the tourism sector as a priority development sector (Widiastuti and Silfiana, 2021). Indonesia has enormous tourism potential, supported by its geographical conditions and cultural heritage (Riady, 2021). Furthermore, one of the tourist attraction areas is Lake Toba, located in North Sumatra Province.

Lake Toba is a volcanic-tectonic lake formed by subsidence processes that created Pulau Samosir in the central part, surrounded by water (Solada et al., 2020). However, the aesthetic beauty of the panorama and potential natural resources in the area are threatened by sustainability owing to unbalanced economic, social, and environmental development pressures. This is attributed to population growth, urbanization, high industrial and agricultural activities, and fish farming around the lake, which poses the greatest threat to the environment (Remus et al., 2023). These influences include a reduction in the diversity of lake biota, a decline in water quality, and sedimentation-causing shallowing, all of which affect environmental functions.

The Lake Toba area has been designated a National Strategic Area, focusing on the tourism sector (Buaton and Purwadio, 2015). Since July 2020, the area has also been designated as a member of the Global Geopark Network (GGN) (Muzambiq, 2023; Manurung and Sinabariba, 2021), which was established in 1998 by UNESCO (Fujii and Ito, 2020; Zouros, 2004). The commitment required as a geopark member includes conserving the geological park heritage and promoting sustainable research in the Lake Toba area. Furthermore, 91 geoparks from 27 countries were members of the GGN in 2012. A serious commitment is required from the central government, provinces, districts, and the entire

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community to maintain the lake as a GNN member. Sustainability after restoration undoubtedly has a double positive impact on a number of physical, chemical, and biological aspects, and specifically socio-economic aspects. Toba Caldera Geopark has numerous natural tourist destinations, including those around the outer ring road (Purwoko et al., 2022).

An area with diverse potential resources can be used and managed by a community based on the potential and characteristics of the area (Endah, 2020). The current trend in the use of natural exotica focuses on conservation rather than exploration. Geopark development is carried out based on the Regulation of the Minister of National Development Planning/Head of the National Development Planning Agency Number 15 of 2021 concerning the National Action Plan for the Development of Indonesian Geoparks in 2021–2025. Geopark development is conducted through three pillars: conservation, education, and sustainable community economic development in the tourism sector (Hutabarat and Pratiwi, 2022).

The Lake Toba Geopark has four pillars: pro-poverty, pro-growth, pro-employment opportunities, and pro-environment. From a pro-poverty perspective, geopark development should contribute to achieving millennium objectives by empowering the local economy to reduce poverty and benefit communities. Pro-growth demonstrates that the utilization of Geopark space should be oriented toward socio-economic growth throughout the Lake Toba area. This is crucial because the needs and interests related to the socioeconomic development of communities are met through Geopark-based spatial planning. Pro-employment opportunities include planning the utilization of geopark space to generate new opportunities for economic activities. Geopark development creates job opportunities for the tourism industry and management.

Pro-environment is related to development in maintaining the integration of geological diversity and biodiversity for educational, conservation, and local economic growth purposes, by focusing on environmentally conscious principles. Conceptually, the development of a geopark cannot be separated from the needs of the government and community to advance the surrounding areas. Natural components that have the ability to develop the tourism sector, must sustainably act as drivers of economic growth in the surrounding area. Therefore, the development of the Toba Caldera area should be examined because of the direct proportionality between the Global Geopark and Lake Toba.

MATERIALS AND METHODS

1. Data Collection

This study was conducted in the Toba Caldera Geopark Area, North Sumatra Province. The area spans seven regencies: Samosir, North Tapanuli, Toba Samosir, Humbang Hasundutan, Simalungun, Dairi, and Lake Toba Tourism Area. According to the level of explanation, the research type is quantitative/associative/correlational, as the data analysis uses inferential statistics to determine the degree of relationship and form of influence between the independent and dependent variables. Qualitative and quantitative data were obtained from primary and secondary sources.

Probability sampling provides an equal chance for each element of the population to be selected as a sample member (Purwoko et al., 2023). Based on the Slovin formula, the sample size is calculated as follows:

$$n = \frac{N}{1 + Nd^2}$$

Therefore, the sample size is 204 individuals.

2. Variables, Sub-Variables, and Indicators

The tourism destination variable is measured using attractions, accessibility, amenities, and ancillaries. The area development variable is mediated by the Caldera Geopark, with the sub-variables conservation, education, and community empowerment.

3. Data Analysis

Structural Equation Models (SEMs). According to Hasan et al. (2020), SEM-PLS analysis consists of sub-models, namely the measurement and structural, or outer and inner, models. The steps of SEM-PLS analysis are as follows: Measurement Model Test (Outer Model). Hair et al. (2014) asserted that an outer or measurement model was used to assess validity and reliability. Therefore, this model ensures that the measurements are valid, and the tests conducted include the following:

Validity Test

A validity test is performed to determine the instrument's ability to measure the variables in 2 (two) ways:

Convergent Validity: The convergent validity in PLS with reflective indicators is assessed based on the loading factor of the indicators (Hair et al., 2020). The rule of thumb used for convergent validity is outer loading > 0.7, communality > 0.5, and average variance extracted (AVE) > 0.5.

Discriminant Validity: The discriminant validity is assessed based on the cross-loading of each variable. Another method used to assess discriminant validity is to compare the square root of AVE for each construct with the correlations between others (Kaartina et al., 2015). The model has sufficient discriminant validity when the square root of AVE for each construct is greater than the correlation.

Table 1. Validity Test Parameters in the PLS Measurement Model

Validity Test	Parameter	Rules of Thumb
Convergent	Outer loading	Greater than 0.7
	Average variance extracted (AVE)	Greater than 0.5
Discriminant	Square root of AVE and Correlation of latent variables	Square root of AVE > Correlation of latent variables
	Cross loading	Greater than 0.7 within

Reliability Test: Following Al-Emran et al. (2019), a reliability test is conducted to measure the internal consistency of the measurement tool. Reliability indicates the accuracy, consistency, and precision of the measurement tool. There are two types of reliability: Cronbach's Alpha: Cronbach's alpha is a statistical technique used to measure internal consistency in the reliability test of instruments or psychometric data (Sharma, 2016). This variable measures the lower limit of the construct's reliability and the expected value is > 0.6.

Composite Reliability: Composite reliability measures the true reliability value of a variable (Hair et al., 2014). However, the variable is considered better at estimating the internal consistency of a construct and should be > 0.6.

Inner Model Test (Structural Model)

According to Sankowska (2013), a structural model test is conducted to predict the causal relationships between variables or test hypotheses. The test is performed to ensure the robustness and accuracy of the constructed structural model. The inner model in PLS can be evaluated through the coefficient of determination (R^2), Stone-Geisser test (Q2), and Goodness of Fit (GoF).

R-square Test (R^2): Zhang (2017) reported that R^2 is used to measure the level of variation in the change in independent variables concerning the dependent variable. A higher R^2 value indicates a better predictive model in the proposed study. However, this is not absolute in terms of measuring accuracy because the basis of theoretical relationships is the most important parameter for explaining causality. The value can detect the direct influence of specific exogenous variables on endogenous variables, which is preferably ≥0.10.

Q^2 (Stone-Geisser Test): Q^2 (Uji Stone-Geisser) in PLS is used for predictive relevance in constructive mode (Taghizadeh et al., 2016). The parameter measures the consistency between the observation values produced by the model and the estimates.

Goodness of Fit (GoF): The total R^2 value can be manually used to calculate the GoF because PLS does not provide a specific menu (Dirsehan and Cankat, 2021). This value is classified as follows:

Small: GoF = 0,1; Medium : GoF = 0,25; Large: GoF = 0,38

Hypothesis Test: Dijkstra and Henseler (2015) explained that path coefficients or inner model values show a significance level in hypothesis testing. The path coefficient or inner model score, represented by the t-statistics value, should be above 1.96 and 1.64 for two-tailed and one-tailed hypotheses at a confidence level of 95%, where alpha is 5%, and power is 80%. The p-value should be < 0.05 (5%), and the significance of hypothesis confirmation can be determined by comparing the t-table and t-statistic. This hypothesis is accepted when the t-statistic value is higher than the t-table.

RESULTS AND DISCUSSION

1. SEM-PLS Test Results

Measurement Model Design (Outer Model = Model Feasibility Test): The design of the measurement model aims to test its feasibility by analyzing the relationship between each indicator and the latent variable measured through validity and reliability.

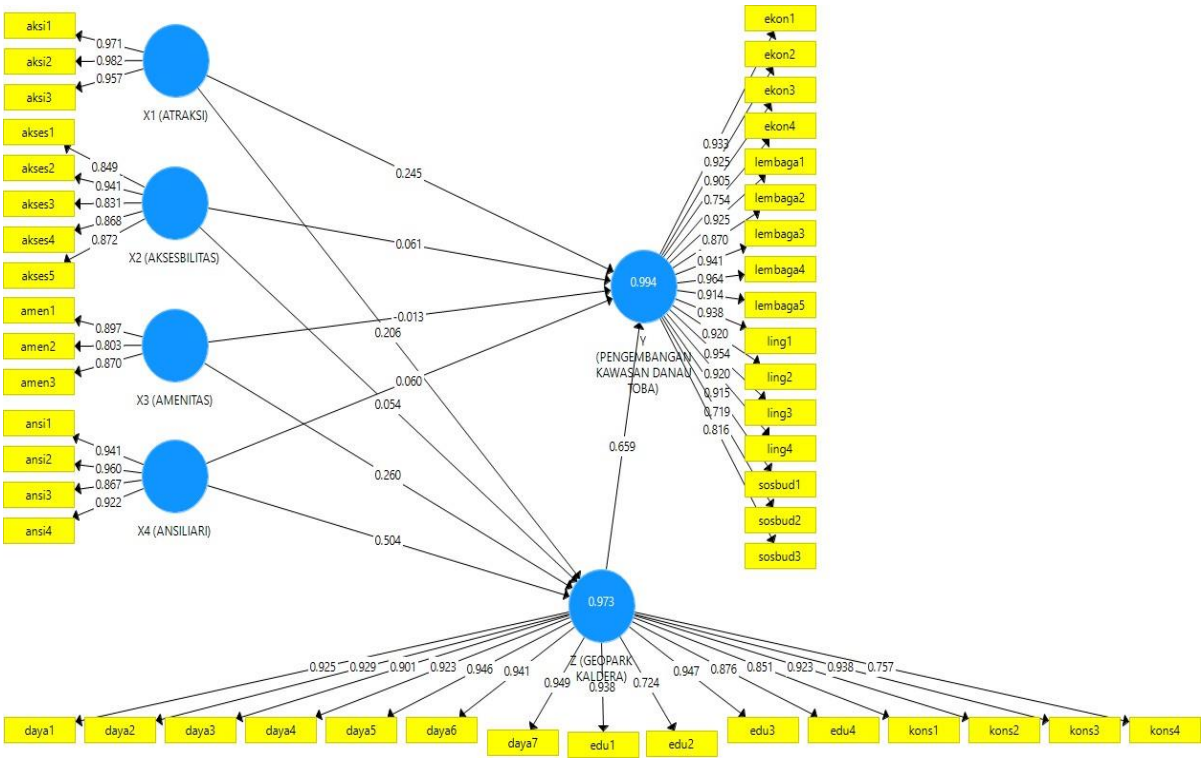

Figure 1. Structural Equation Model (SEM)

Convergent Validity Test: The convergent validity test aims to analyze the loading factor values between the latent variables and indicators (Sujati et al., 2020). A loading factor value greater than 0.7 is considered valid. The results show that the indicators have a validity of r-count greater than the outer loading value (0.7). Therefore, all constructs of the research variable indicators (X, Y, and Z) are valid. Discriminant Validity Test: The discriminant validity test aims to

determine adequate discrimination of the constructs or latent variables by comparing the loading factor values (Rönkkö and Cho, 2022). A variable is considered valid when the loading factor value is greater than 0.7 (Nasution et al., 2020). The results based on cross-loading demonstrate that the correlation values between the latent variables are greater than the cross-loading value (0.7). Therefore, discriminant validity between variables is adequate.

Discriminant Validity Based on Average Variance Extracted (AVE): The results of the discriminant validity test based on the AVE cross-loading values show that the six latent variables have AVE-count of 0.941, 0.762, 0.735, 0.852, 0.805, and 0.811. The latent variables have an AVE count greater than the AVE-table value (0.5), indicating that the six latent variables have adequate discriminant validity (AVE; Voorhees et al., 2016). Reliability Test: The reliability test is conducted to measure the internal consistency, accuracy, and precision of the measurement tool based on composite reliability (>0.6) and is supported by Cronbach's alpha values (> 0.6) (Putra et al., 2021). The latent variables have Cronbach's alpha values of 0.968, 0.922, 0.821, 0.942, 0.983, and 0.983, which are greater than 0.6. Additionally, the six latent variables have composite reliability values of 0.979, 0.941, 0.893, 0.958, 0.985, and 0.985, respectively, which are greater than 0.6. In conclusion, the variables have high reliability and the model is considered appropriate.

Structural Model Design: Parameter Estimation and Model Evaluation

1. Path Coefficients: SEM-PLS uses path coefficients to determine the strength and significance of the hypothesized relationships between latent constructs. These path coefficients can also be standardized as beta coefficients (Oliver et al., 2010). Bootstrapping techniques are typically used in PLS-SEM to analyze t-values for path coefficients and assess the significance of the hypothesized connections (Efron, 2007). The standardized range of values is between -1 and +1 and the estimated standard path coefficients approaching +1 show a strong positive linear relationship for negative values (Yung and Bentler, 1994). The results indicate the path coefficient values of the structural model as follows:

Table 2. Path Coefficients of the Structural Model

Relationships between Variables	Path Coefficients	Estimated Coefficients
Destination (X) - Geopark Caldera (Z)	□1	0.973
Destination (X) - Development of Lake Toba Area (Y)	□2	0.595
Geopark (Z) - Development of Lake Toba Area (Y)	□3	0.404

2. Outer Weight Values: According to the outer weight values for all latent variables, all latent variables have t-statistic values > 1.96 (Devi et al., 2015). Therefore, it can be concluded that Variable X (X_1, X_2, X_3, and X_4) significantly influences Variable Z (Geopark Caldera), while Variable X (X_1, X_2, X_3, and X_4) influences Variable Y (development of Lake Toba area).

Path Equations; a. Equation for the Influence of X on Z; $Z = 0.973X + e$

b. Equation for the Influence of X on Y; $Y = 0.595X + e$

c. Equation for the Influence of Z on Y; $Y = 0.404Z + e$

Structural Model Test: A test of the inner structural model is conducted to predict causal relationships between variables, or a hypothesis test based on R^2 values, Q2, and GoF.

1. Results of R^2 Test (Endogenous Variables): The analysis of variance (R^2) or determination test measures the extent of the independent variables on the dependent variables (Hair et al., 2020). The influence scale ranges from 0 to 1, with a value of 1 indicating a highly accurate level of prediction. The R^2 value is the coefficient of determination for endogenous constructs, with the values categorized as 0.67 (strong), 0.33 (moderate), and 0.19 (weak) (Suhan and Achar, 2016). The test results for the causal relationship between the latent (tourism development) and endogenous variables Y (development of Lake Toba area), as well as Z (Geopark Caldera) are as follows:

Table 3. Results of the Determination Test (R^2)

Variable Endogen	R^2	Standard (0.67)	Conclusion
Endogenous Variables	0.994	0.67	Strong
Development of Lake Toba Area (Y)	0.973	0.67	Strong

Table 3 shows that the R^2 values for Y and Z are 0.994 and 0.973, hence the endogenous variables have strong determination. A total of 99.4% of the development of the Lake Toba area variable can be explained by independent attraction (X1), accessibility (X2), amenity (X3), and ancillary (X4), while 97.3% of Geopark Caldera (Z) can be explained by the independent attraction (X1), accessibility (X2), amenity (X3), and ancillary (X4) variables. In contrast, other unexamined factors explain the remaining portion.

2. Results of Q^2 Testing (Stone-Geisser Test) (For Endogenous Variables): Q^2 in PLS is used to test the predictive relevance in a constructive model (Othman et al., 2021). This variable measures how well the observed values generated by the model match its parameter estimates in the following categories (Chin, 2010). $Q^2 = 0.02$ – small category; $Q^2 = 0.15$ – moderate category; $Q^2 = 0.35$ – large category. In this research, the Q^2 test obtained the following results:

Table 4. Results of the Q^2 Test

Endogenous Variables	SSO	SSE	$Q^{2\,(1\text{-SSE/SSO})}$	Standard	Conclusion
X (Destination)	816.000	816.000			
Y (Development)	816.000	55.727	0.932	0.35	Large
Z (Geopark Caldera)	612.000	74.946	0.878	0.35	Large

Table 4 shows the values of Q^2 (Y1) = 0.932 and Q2(Z) = 0.878, both of which are greater than 0.35. Therefore, the endogenous variables (Y and Z) in this study have Q^2 values classified as large (>0.35).

3. Goodness of Fit (GoF) – Total R^2 Values (For Endogenous Variables)

The GoF is a single measure used to validate the combined performance of the outer and inner models (Vinzi et al., 2010). The total R^2 values can be used to calculate the GoF of the model manually because PLS does not provide a specific menu.

a. GoF = 0,1 small category; b. GoF = 0,25 moderate category; c. GoF ≥ 0.38 large category

The calculation results of GoF value in this research are as follows:

Table 5. Results of the GoF Test

Regression	R^2	Squared R^2
Area Development (Y)	0.994	0.994
Geopark Caldera (Z)	0.973	0.973
Total		1.967

Based on the total R^2 of 1.967, the GoF values used to validate the performance of the combined outer and inner models are considered large.

Hypothesis Test Results

Direct Influence of Independent Variable X on Dependent Variable Y. According to the t-statistic > 1.96 and p-value < 0.05, the independent variable significantly influences the dependent variable. Partial Influence of X_1, X_2, X_3, and X_4, on Y

The partial influence of X (X_1, X_2, X_3, and X_4) on Y (development of Lake Toba area) shows the following results:

Table 6. Partial Direct Influence of X on Y

Parameter	t-statistic	t-table	p-value	Conclusion
X_1 Attractions -> (Y)	6.761	1.96	0.000	Significant
X_2 Accessibility-> (Y)	1.352	1.96	0.177	Not significant
X_3 Amenities -> (Y)	3.625	1.96	0.000	Significant
X_4 Ancillary -> (Y)	6.607	1.96	0.000	Significant

Table 6 shows that out of the four independent variables, X2 (accessibility) (T2 = 1.352), which is smaller than the t-table value (1.96) does not have a significant influence on Y (development of Lake Toba area).

In the relationship between X_1 (attraction) and Y (development of Lake Toba area), X_1 has a t-statistic value of 6.761 and a p-value of 0.000. Since the t-statistic value (6.761) is greater than the t-table (1.96) and p (0.000) is less than 0.05, Hypothesis 1 is accepted. This is consistent with Nikjoo and Ketabi (2015), who found that attraction plays a crucial role in attracting tourists' interest in visiting a destination. As a primary tourist destination, Lake Toba area relies on unique natural attractions, cultural diversity, and tourist attractions offered (Astuti, 2021). Beauty of nature, cultural heritage, recreational activities, and quality tourism services are closely related to destination development. According to Jaya (2019), a captivating and memorable tourism experience for tourists in the Lake Toba area positively influences the local economy by increasing the number of tourists. This experience provides incentives for environmental preservation, infrastructure improvement, and better services for local communities. In this context, the significant relationship between attraction (X_1) and the development of the Lake Toba area (Y) is based on visual appeal and the generated social, economic, and environmental influences.

In the relationship between X_2 (accessibility) and Y (development of Lake Toba area), X_2 has a t-statistic value of 1.352 and a p-value of 0.177. Since the t-statistic value (1.352) is less than the t-table (1.96) and p (0.177) is greater than 0.05, Hypothesis 1 is rejected. Although accessibility is important for determining the comfort of tourists at the destination, the variable does not directly influence destination development. This differs from Pandža Bajs (2015) who explained that ease of accessibility is one of the offerings in tourist destinations. The Lake Toba area faces challenges in optimizing tourism potential owing to other internal and external factors that play a role in converting accessibility into substantial destination development. This is supported by Cholik (2017), who found that infrastructure factors, local transportation, access to the destination, and a lack of integration in tourism promotion hinder the conversion of accessibility into significant destination development. Although accessibility plays a crucial role in providing pathways to the destination, its influence on the development of the Lake Toba area (Y) is less prominent because of the complexity of its interactions with other dominating factors in the destination development process.

In the relationship between X_3 (amenities) and Y (development of Lake Toba area), variable X_3 has a t-statistic of 3.625, with a p-value of 0.000. Since the t-statistic value (3.625) is greater than the t-table (1.96) and p (0.000) is less than 0.05, Hypothesis 1 is accepted. Lee (2016) stated that amenities such as accommodation facilities, restaurants, local transportation, and other public services form the foundation for sustainable destination development. The presence of adequate amenities enhances tourist comfort and satisfaction, and supports a strong tourism infrastructure. This could increase the destination's attractiveness, tourist visitation rates, and local economic growth through the tourism sector. Furthermore, diverse and high-quality amenities can create a positive cycle in which tourists spend more time and resources at the destination (Reitsamer and Brunner-Sperdin, 2017). This could significantly influence the development of Lake Toba area. Therefore, the strong correlation between (X_3) and (Y) shows that enhancement, diversification, and quality of amenities are key factors in strengthening comprehensive tourism destination development.

In the relationship between X4 (ancillary) and Y (development of Lake Toba area), X4 has a t-statistic value of 6.607 with a p-value of 0.000. Considering that the t-statistic (6.607) is greater than the t-table value (1.96) and p (0.000) is less than 0.05, Hypothesis 1 is accepted. Ancillary includes various supporting factors, such as government policies, private investments, development programmes, cross-sectoral cooperation, and community initiatives supporting the growth and empowerment of the Lake Toba area. These factors enhance the attractiveness of the destination and contribute to infrastructure development, environmental preservation, job creation, and local economic development (Ebrahim and Ganguli, 2019). The presence of a conducive regulatory framework, targeted investments, and close collaboration among the government, private sector, and communities are key drivers in enhancing the potential of the destination. Therefore, the significant relationship between X4 and Y shows that supporting factors play a crucial role in creating an ecosystem that supports the sustainable and competitive growth of the tourism destination. Simultaneous Influence of Variable X on Y

The simultaneous influence of X (tourist destination) on Y (area development) is presented in Table 7.

Table 7. Simultaneous Influence of Variable X on Y

Parameter	t-statistic	t-table	p-value	Conclusion
X on Y	295.659	1.96	0.000	Significant

The t-statistic value (295.659) > t-table (1.96) shows that the independent variable X (tourist destination) has a significant influence on the dependent variable Y (development of Lake Toba area). In the context of the development of Lake Toba area, the significant relationship between X (tourist destination) and Y (development of Lake Toba area) reflects the close integration between tourist destinations and the growth of the area. Brouder et al. (2016) explained that tourist destinations are not only focal points for tourists, but also catalysts for economic, social, and environmental transformation. As a major tourist destination, the Lake Toba area influences global perceptions of its tourism potential. Natural uniqueness, rich cultural heritage, and various tourist attractions serve as the foundation that influences tourist arrivals, infrastructure development, and the empowerment of local communities.

However, development includes various stakeholders and related sectors in an effort to strengthen the local economic base, preserve the environment, and enhance the quality of life of surrounding communities. Therefore, the significant relationship between Tourist Destination (X) and the development of Lake Toba area (Y) demonstrates the role of the destination as a primary driver in shaping the identity of an area, economic growth, and sustainable development.

However, it is important to remember that the successful development of the Lake Toba area depends not only on the physical presence of tourist destinations but also on the strategic integration of tourism promotion, sustainable destination management, and active inclusion from the government, private sector, and local community. This is evident in ecotourism in Tangkahan, where various stakeholders experience benefits through effective management, as reported by Purwoko et al. (2022). This requires cross-sector cooperation in designing holistic policies, proper resource allocation, and joint efforts to raise awareness of the importance of environmental conservation, empowerment of local communities, and sustainability in destination management. Although the relationship between tourist destination (X) and the development of Lake Toba area (Y) demonstrates a significant influence, the sustainability and success of destination development depend on well-planned strategies, close collaboration, and a commitment to maintaining a balance between tourism growth and sustainability.

Direct Influence of Variable X on Z ; Partial Influence of X_1, X_2, X_3, and X_4 on Y

The partial influence of independent variables (X_1, X_2, X_3, and X_4) on Z are shown in Table 8.

Table 8. Partial Influence of X on Z

Parameter	t-statistic	t-table	p-value	Conclusion
X_1 Attraction -> Z (Geopark Caldera)	2.552	1.96	0.011	Significant
X_2 Accessibility -> Z (Geopark Caldera)	0.535	1.96	0.593	Not significant
X_3 Amenity -> Z (Geopark Caldera)	5.204	1.96	0.000	Significant
X_4 Ancillary -> Z (Geopark Caldera)	6.540	1.96	0.000	Significant

Of the four independent variables, X_2 (accessibility) (t-statistic X2 = 0.535), which is smaller than the t-table value (1.96), does not have a significant influence on the dependent variable Z (Geopark Caldera). Regarding the relationship between X_1 (attraction) and Z (Geopark Caldera), X_1 has a t-statistic value of 2.552, with a p-value of 0.011. Considering that the t-statistic value (2.552) is greater than the t-table value (1.96), and p (0.011) is less than 0.05, the hypothesis is accepted. In the context of the relationship between X_1 (attraction) and Z (Geopark Caldera), the significant influence of attraction on the Geopark Caldera formation is closely related to its value and uniqueness. Attractions, including natural beauty, cultural heritage, and diverse tourist activities around Lake Toba, provide a strong foundation for supporting the development of Geopark Caldera. The geological and geomorphological attractions of the area, such as the presence of a rare super caldera and other unique geological features, play crucial roles. Croes and Kubickova (2013) explained that strong tourist attractions provide a platform for gaining global attention, attracting investment interest, and receiving support from various stakeholders. This is in line with Purwoko et al. (2021) who found that the quality of attractions influences their appeal to tourists. Therefore, the significant relationship between X_1 (attraction) and Z (Geopark Caldera) confirms that the existence of attractions, as the foundation of tourist attractions, is a key element in the formation and recognition of the area.

On the relationship between X_2 (accessibility) and Z (Geopark Caldera), X_2 has a t-statistic value of 0.535 with a p-value of 0.593. Given that the t-statistic value (0.535) is smaller than the t-table (1.96) and p (0.535) is greater than 0.05.

Hypothesis 1 is rejected. Although accessibility is important in influencing the growth and recognition of a tourist destination, other factors such as geological uniqueness, ecosystem diversity, potential for scientific research, and local community wisdom are the primary determinants in assessing the Geopark. The focus is on the rare geological values and ecological richness that attract tourist attention. In this context, the lack of a significant relationship between accessibility and the development of the Geopark Caldera may be due to a lack of understanding of its enormous potential. Although accessibility is considered important in the evaluation of the Geopark, other specific and unique factors become strong determinants in assessing its influence on development and recognition.

In the relationship between X_3 (amenities) and Z (Geopark Caldera), X_3 has a t-statistic value of 5.204 and a p-value of 0.000. Considering that the t-statistic (5.204) is greater than the t-table value (1.96) and p (0.000) is less than 0.05, the hypothesis is accepted. The importance of amenities in supporting Geopark Caldera can be seen from a comprehensive perspective of tourist experience and destination sustainability. According to Brochado and Pereira (2017), complete tourism amenities, from comfortable accommodation to supporting facilities such as transportation and public services, can enhance tourists' comfort and accessibility. Although Geopark Caldera focuses on geological uniqueness as its primary asset, good amenities can be a determining factor in expanding the destination's appeal, extending length of stay, and creating opportunities for memorable experiences. Adequate amenities can also support local economic growth, improve the quality of life in the surrounding community, and indirectly contribute to environmental preservation efforts through regulations and investment. In this framework, the significant relationship between X_3 (amenities) and Z (Geopark Caldera) affirms that the presence of good tourism amenities has a strong influence on the development of the Geopark.

In the relationship between X_4 (ancillary) and Z (Geopark Caldera), X_4 has a t-statistic value of 6.540, with a p-value of 0.000. Since the t-statistic (6.540) is greater than the t-table value (1.96) and p (0.000) is less than 0.05, Hypothesis 1 is accepted. In the context of the relationship between X_4 (ancillary) and Z (Geopark Caldera), significance is based on the crucial role of supporting factors or accelerators in shaping and developing Geopark Caldera as a sustainable destination. Shier and Handy (2016) explained that supporting factors, such as government policies targeting private investments, cross-sector collaborations, and local community initiatives, influenced Geopark's recognition and development. Active inclusion and support from various stakeholders provide a strong foundation for Geopark management and promote economic growth, environmental preservation, and empowerment of the local community. The success of a sustainable destination depends on geological richness as well as a strong framework of cooperation and support from supporting factors. Therefore, the significant relationship between X_4 (ancillary) and Z (Geopark Caldera) demonstrates that a strong integration of supporting factors is the key to maintaining sustainability, recognition, and development as a sustainable and competitive destination. Simultaneous Influence of Variable X on Z.

The simultaneous influence of X (tourist destination) on Z (Geopark Caldera) is presented in Table 9.

Table 9. Results of the Simultaneous Test of the Influence of Variable X on Z

Parameter	t-statistic	t-table	p-value	Conclusion
X on Z	213.045	1.96	0.000	Significant

The t-statistic value (213.045) is greater than the t-table of 1.96, indicating that the independent variable X (tourist destination) has a significant influence on the dependent variable Z (Geopark Caldera). The path diagram represents the simultaneous direct influence of variable X (tourist destination) on Z (Geopark Caldera). In the context of the relationship between X (tourist destination) and Z (Geopark Caldera), significance is reflected in the primary role of tourist destinations in shaping and supporting the development of Geopark Caldera as a unique and attractive destination.

According to Nainggolan et al. (2021), Lake Toba is a magnet for tourists worldwide, and its recognition provides a strong foundation for promoting and developing Geopark Caldera. The presence of an established destination has positive influences, such as increased global awareness of the geological potential of the area, investment in research, and attention to environmental preservation. By leveraging the existing beauty of the destination, Geopark Caldera gains wider recognition, maintains its existence, and promotes sustainable growth.

Therefore, the significant relationship between X (tourist destination) and Z (Geopark Caldera) indicates that the existence of tourist destinations is a key factor in maintaining the relevance, global recognition, and sustainable development of Geopark Caldera. Direct Influence of Variable Z on Y. Partial Influence of Z1, Z_2, and Z_3 on Y. The partial influence of independent variables (Z_1, Z_2, and Z_3) on Y are shown in the following table:

Table 10. Results of the Hypothesis Test on the Direct Influence of X on Z

Parameter	t-statistic	t-table	p-value	Conclusion
Z_1 Conservation -> Y	2.488	1.96	0.013	Significant
Z_2 Education -> Y	4.273	1.96	0.000	Significant
Z_3 Community Empowerment -> Y	6.951	1.96	0.000	Significant

Table 10 shows that Z (Geopark Caldera) has a significant partial influence on variable Y (development of Lake Toba area). This is indicated by the t-statistic values: X_1 = 2.488 (>1.96), X_2 = 4.273 (> 1.96), and X_3 = 6.951 (> 1.96).

In the relationship between Z_1 (conservation) and Y (development of Lake Toba area), Z_1 has a t-statistic value of 2.488, with a p-value of 0.013. Given that the t-statistic value (2.488) is greater than the t-table (1.96) and p (0.013) is less

than 0.05, Hypothesis 1 is accepted. Concerning the relationship between Z1 (Geopark conservation) and Y (development of Lake Toba area), the importance of geological conservation as a core element plays a crucial role in the development and sustainability strategy of Lake Toba area. Conservation efforts focused on geological richness, unique ecosystems, and cultural heritage are the foundation for environmental preservation and key drivers of area development. Geopark Caldera creates a strong basis for sustainable development in the surroundings through a planned approach to preserve the authenticity and sustainability of geological features. According to Xu and Wu (2022), geological conservation promotes awareness of the importance of environmental preservation, triggers innovation in ecotourism approaches, and provides opportunities to support local economic growth in line with sustainability principles.

Therefore, the significant relationship between Z1 (Geopark conservation) and Y (development of Lake Toba area) confirms that geological conservation efforts form the main foundation for preserving the identity and uniqueness of the area and serve as a primary driver for building the area as a sustainable and globally competitive tourist destination.

In the relationship between Z2 (education) and Y (development of the Lake Toba area), Z2 has a t-statistic value of 4.273, with a p-value of 0.000. Considering that the t-statistic value (4.273) is greater than the t-table value (1.96) and p (0.000) is less than 0.05, the hypothesis is accepted. In the context of the relationship between Z2 and Y, the importance of education as a core element of Geopark Caldera reflects its central role in influencing the development and sustainable growth of the Lake Toba area. Through sustainable and structured education programmes, Geopark Caldera preserves geological authenticity and creates a platform to enhance public awareness of the importance of conservation, sustainability, geological values, and ecosystem diversity (Gordon et al., 2021). Therefore, a well-integrated education establishes a close relationship between humans and the environment, enabling local communities and tourists to become agents of change and promote sustainable practices. In this context, the significant relationship between Z2 and Y indicates that education and public awareness play key roles in designing and maintaining sustainable growth in the Lake Toba area.

In the relationship between Z3 (community empowerment) and Y (development of Lake Toba area), Z3 has a t-statistic value of 6.951 and a p-value of 0.000. Given that the t-statistic (6.951) is greater than the t-table (1.96) and p (0.000) is less than 0.05, H1 is accepted. In the context of the relationship between Z3 and Y, the importance of community empowerment as a key aspect is reflected in its integral role in influencing the growth and sustainable development of Lake Toba area. Through targeted empowerment programmes, Geopark Caldera promotes the active inclusion of the local community in management, environmental preservation, and sustainable economic development. Opportunities, knowledge, skills, and community empowerment enable individuals to become essential partners by facilitating opportunities. Therefore, the significant relationship between Z3 and Y indicates that community empowerment supports economic and social growth and serves as a foundation to ensure sustainability and broader integration into the development of the Lake Toba area.

Simultaneous Influence of Z Variables on Y: The simultaneous influence of the endogenous variable Z (Geopark Caldera) on the endogenous variable (tourism development) is shown in Table 11.

Table 11. Results of the Hypothesis Test on the Direct Influence of Z on Y

Parameter	t-statistic	t-table	p-value	Conclusion
Z Geopark Caldera -> Y (Area Development)	433.964	1.96	0.000	Significant

Table 11 shows that the calculated t-value for the influence of Z-Y = 433.964 (>1.96) with a p-value = 0.000 (<0.05). Therefore, Z (Geopark Caldera) significantly influences the dependent variable Y (development of Lake Toba area). The significant relationship between Z (Geopark Caldera) and Y (development of Lake Toba area) is reflected in the important role of Geopark Caldera in the strategy of the development and preservation of the area. Geopark Caldera is an attractive tourist destination and a center for research, education, and environmental preservation. The recognition as a significant site positively influences the number of tourist visits and international attention to Lake Toba area. According to Ginting et al. (2021), the recognition has significant social and economic influence by promoting local economic growth, expanding educational and knowledge opportunities, and integrating sustainability principles into area development. The significant relationship between Z (Geopark Caldera) and Y (development of Lake Toba area) demonstrates that the role of Geopark as a center for education, research, and preservation strengthens the identity of Lake Toba area as a prominent destination as well supports sustainable growth.

Indirect Influence of Independent Variables on the Dependent Variable through Variable Z (Geopark Caldera)

Partial Indirect Influence of Independent Variables on the Dependent Variable through Z (Geopark Caldera)

The hypothesis test is conducted based on the t-statistic and p-value, with the criterion that when the t-statistic > 1.96 and the p-value < 0.05, the independent variable significantly influences the dependent variable. The hypothesis test regarding the indirect influence of X (tourism destination X1, X2, X3, and X4) on Y (development of Lake Toba area) through Z (Geopark Caldera) is shown in Table 12.

Table 12. Results of the Hypothesis Test on the Indirect Influence of X Z Y

Parameter	t-statistic	t-table	p-value	Conclusion
X1 Attraction -> Z -> Y	2.618	1.96	0.009	Significant
X2 Accessibility -> Z -> Y	0.533	1.96	0.594	Not Significant
X3 Amenities -> Z -> Y	4.982	1.96	0.000	Significant
X4 Ancillary -> Z -> Y	6.461	1.96	0.000	Significant

Of the four independent variables X, X2-Z-Y (T = 0.533 <1.96) does not have a significant partial influence on Y (area development). Regarding the relationship between X1 through Z and Y, X1 has a t-statistic value of 2.618 and a p-value of 0.009. Considering that the t-statistic value (2.618) is greater than the t-table (1.96) and the p-value (0.009) is lower than 0.05, this hypothesis is accepted. Therefore, attraction significantly and positively mediates the influence of Geopark Caldera on tourism development. The tangible and positive relationship between attraction and the mediation of Geopark Caldera's influence on tourism development is reflected in its primary role as the main magnet for tourist interest. Geopark Caldera, with its geological richness and natural uniqueness, has become a central attraction that captures tourists' attention. Strong attractions in the Geopark area, including the beauty of nature, geological uniqueness, and diverse tourism activities, have increased tourist visits. This variable is the main bridge to introducing Geopark Caldera as a unique destination, creating a deep impression and expanding the attractiveness of the area. Kachniewska (2015) stated that strong attractions increase the number of tourists and stimulate the growth of infrastructure, economic investment, and awareness of the importance of environmental conservation. Attractions play a significant role in the influence of Geopark Caldera on tourism development, enhancing its role as a key asset in attracting attention, maintaining interest, and stimulating sustainable growth in the tourism sector of the Lake Toba area.

In the relationship between X2 through Z and Y, X2 has a t-statistic of 0.533 and a p-value of 0.594. Considering that the t-statistic value is smaller than the t-table and the p-value (0.594) is higher than 0.05, Hypothesis 1 is rejected. Therefore, accessibility cannot mediate the influence of Geopark Caldera on tourism development. Although this variable is an important factor in determining the number of tourist arrivals, the primary focus tends to be on the rare geological values and ecological richness that influence the global perception of the area. In some cases, the lack of optimal accessibility may not be stated because the primary focus is on preserving the authenticity of nature and geological education. Unique geological factors and ecosystem diversity may be the dominant factors influencing the development of the Geopark. In contrast, accessibility is less likely to influence the development of the tourism area.

In the relationship between X3 through Z and Y, X3 has a t-statistic value of 4.982 and a p-value of 0.000. Considering that the t-statistic value is greater than the t-table value and the p-value (0.000) is lower than 0.05, Hypothesis 1 is accepted. Therefore, amenities significantly and positively mediate the influence of Geopark Caldera on tourism development. The significant and positive relationship between amenities and the mediation of Geopark Caldera's influence on tourism development is reflected in enhancing the attraction and comfort of tourists. Anuar et al. (2013) explained that comfortable accommodation, good transportation facilities, adequate services, and other supporting infrastructure create a tourist-friendly environment. Meanwhile, comprehensive facilities and good services extend the duration of tourist stays, enhance the tourist experience, and create a positive impression. Adequate amenities also provide opportunities to support local economic growth, stimulate tourism investments, and expand local community job opportunities. Therefore, the significant role of Geopark Caldera in tourism development demonstrates that improving facilities and services meets tourists' needs and strengthens the sustainable growth of the area.

In the relationship between X4 (ancillaries) through Z and Y, X4 has a t-statistic value of 6.461 and a p-value of 0.000. Considering that the t-statistic value (6.461) is greater than the t-table of 1.96, and p (0.000) is lower than 0.05, this hypothesis is accepted. Therefore, ancillaries significantly and positively mediate the influence of the Geopark Caldera on tourism development. The significant and positive relationship between ancillaries and the mediation influence on tourism development is reflected in the crucial role played by supporting infrastructure, policies, and cross-sector initiatives. According to Enciso-Santocildes et al. (2020) (Anuar et al., 2013), ancillaries such as targeted private investment, cross-sector cooperation, supportive government policies, and the active participation of the local community are the key drivers of expanding attractiveness. Directed investments improve tourism facilities and open doors for innovation in the area's management, promotion, and sustainable development. Cross-sector cooperation creates holistic programmes that integrate environmental sustainability, education, and economic growth. Meanwhile, the participation of the local community creates continuity in conservation efforts, resource management, and the well-being of the surroundings. In this context, ancillary plays a crucial role as a mediator of the influence of Geopark Caldera on tourism development, ensuring cross-sector integration and sustainability.

Simultaneous Indirect Influence of X on Y through Z

The simultaneous indirect influence of Z on Y through Z is shown in Table 13.

Table 13. Results of the Hypothesis Test on the Simultaneous Indirect Influence of X on Z and Y

Parameter	t-statistic	t-table	p-value	Conclusion
X -> Z	211.962	1.96	0.000	Significant
Z -> Y	428.218	1.96	0.000	Significant
X-Z-Y	155.605	1.96	0.000	Significant

The simultaneous indirect influence of X on Z and Y results in a t-statistic of 155.605 > 1.96, with a significance (sig-p) of 0.000 < 0.05. Therefore, X (tourist destination) has a significant influence on Y (area development) through Z (Geopark Caldera). The phenomenon in which X (tourist destination) simultaneously has a significant influence on Y (area development) through Z (Geopark Caldera) reflects the complex dynamics of the relationships between the three variables. Therefore, prominent tourist destinations, such as Lake Toba, with natural attractions, geological richness, and various tourist activities, are magnets for tourists and investment interests. As an entity encapsulating geological uniqueness and ecosystem diversity in the area, Geopark Caldera plays a crucial role in enhancing the destination and

raising awareness of natural wealth. The Geopark as a center for education, preservation, and activities, promotes the growth of tourism infrastructure, economic investment, and sustainability awareness. A strong foundation is provided for holistic area development by integrating the aspects of tourism, preservation, and sustainable development.

Therefore, X (tourist destination) simultaneously influences Y (area development) through the crucial role of Z (Geopark Caldera) as the main driving force in the dynamics of area growth and development. This is reinforced by F. Xu and Fox (2014) in China and the UK, where tourism development is related to sustainability.

To develop Geopark Caldera as a sustainable tourist destination, an essential step is to conduct in-depth research on the relationship between X (tourist destination), Z (Geopark Caldera), and Y (area development). Further quantitative and qualitative research can help understand the dynamics of these variables. Cross-sector collaboration, including the government, tourism industry, local communities, and educational institutions, is crucial for achieving this objective. With strong partnerships, tourism infrastructure is improved and sustainable management can be implemented, providing a solid foundation for growth. Additionally, educating the community on the values of environmental conservation, history, and cultural richness is the key to strengthening their identity and sustainability awareness. Educational programmes that include an understanding of the importance of preserving nature can mobilize active community participation. Therefore, education becomes a crucial factor in connecting tourists and local communities to the values upheld by Geopark Caldera.

CONCLUSION

In conclusion, tourist destinations were reported to significantly influence the development of the Lake Toba area and the Caldera Toba Geopark mediated efforts to develop the tourism sector. Factors related to tourist destinations, such as attractions, amenities, and ancillaries, played a significant role in the development of the Lake Toba area. Accessibility did not have a significant influence on the development of the area, either directly or indirectly, through the Geopark. Development was required, including improving attractions, amenities, and ancillaries by using Caldera Toba Geopark for management, utilization, and development.

Collaboration among the government, private sector, and local and international communities creates sustainable tourism development programs. Meanwhile, attention to environmental sustainability, local culture, and community participation was important for managing the UNESCO Global Geopark.

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