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Visualization of Tourism Site Visit Levels in Karo Regency Using Tableau

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Abstract

Indonesia is one of the places with numerous tourist destinations and have unique attractions. One such province is North Sumatra, precisely in Karo Regency. However, to maximize the potential of tourism and achieve sustainable growth, a good understanding of tourist visitation rates to these attractions is essential. Timely, detailed, and integrated information on the number of tourist visits is crucial for formulating tourism policies, developing infrastructure, and effective resource management. The research objective is to develop a BI dashboard using Tableau software that can deliver information related to tourist visitation data in Karo Regency from 2010 to 2016 in an interactive and easily understandable manner. The study employed a secondary data analysis method by processing data collected from the Karo Regency government. The research process comprised data collection, data cleaning, Tableau implementation, and result analysis. Based on the conducted research, it can be concluded that during the period from 2010 to 2016, the tourist destinations with the highest number of visits were Lag Sibayak and Lau Debuk-Debuk, attracting a total of 1,099,738 tourists. On the other hand, Lag Sinabung, Danau Lau Kawar, and Gunung Sinabung were the tourist destinations with the lowest number of visits, with a total of only 52,282 tourists.

Keywords: Business Intelligence, Dashboard, Tourism, Tableau

1. Introduction

Tourism development has become a primary focus for local governments. They aim to boost regional economies, create job opportunities, and promote tourism potential. Indonesia, as a country with numerous tourist destinations, boasts unique attractions in each of its provinces [1]. One such province is North Sumatra, specifically Karo Regency. Karo Regency is home to several tourist spots, including Sipiso-piso Waterfall, Gundaling, and Taman Mejuah-juah, attracting visitors from far and wide [2].

To fully harness the tourism potential and ensure sustainable growth in the industry, it is of utmost importance to possess a comprehensive understanding of the visitation rates to various attractions. This can be achieved through timely, detailed, and integrated information and data analysis using business intelligence tools. Such data plays a crucial role in formulating well-informed tourism policies, developing robust infrastructure, and efficiently managing resources. By utilizing business intelligence, tourism authorities and stakeholders can gain valuable insights into visitor trends, peak seasons, and popular attractions, enabling them to make informed decisions about allocating resources and investments strategically. This data-driven approach also empowers them to identify areas with untapped potential, helping in the creation of new attractions and experiences that align with visitors' interests and preferences. Timely, detailed, and integrated information on tourist visits plays a crucial role in formulating tourism policies, developing infrastructure, and managing resources effectively [3]. The concrete outcomes are expected from the utilization of this dashboard are able to assist the government of Karo Regency in predicting various decisions regarding its tourism potential. The government can predict when the high season is, when and where there is a need for the revitalization of tourist attractions, and where there is a need to conduct promotions for tourist attractions.

In the present era of digitization, technology can aid in collecting, analyzing, and visualizing data to obtain valuable insights [4]. Business Intelligence (BI) emerges as a popular technology in this context [5]. BI systems and applications process various organizational data, whether operational, transactional, or other forms, into meaningful knowledge [6]–[9]. By utilizing BI technology, local governments, tourism authorities, and stakeholders can access and analyze tourist visitation

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data more quickly and easily [10]. They can observe visitor trends over time, identify busy and lean seasons, and obtain valuable information on visitor numbers.

Tableau stands out as a popular BI software that can be leveraged for this research [11]. Tableau's remarkable capacity to present data in a visual and interactive manner empowers users to grasp and analyze information with unparalleled efficiency [12]. Through seamless integration of diverse tourism data sources such as databases, tourist surveys, and geographic information into Tableau's platform, a comprehensive analysis of visitor patterns in Karo Regency, located in the North Sumatra Province, becomes achievable. The process of assimilating data and generating visually appealing representations enables stakeholders and decision-makers in the tourism industry to gain valuable insights and make informed choices. By utilizing Tableau's user-friendly interface and data visualization capabilities, complex datasets are transformed into intuitive charts, graphs, and maps, facilitating a deeper understanding of tourism trends, patterns, and potential areas for improvement in Karo Regency's tourism sector [13]–[15]. The implementation of Dashboard with Tableau will provide benefits for the government by making better decisions and formulating more effective policies based on the display of various data and graphs presented neatly on Tableau. The displayed visitation data facilitates decision-makers in deciding various promotions, suitable infrastructure improvements, and the creation of activities most appropriate for each tourist attraction.

The purpose of this study is to develop a Business Intelligence dashboard using Tableau software, presenting interactive and easily comprehensible information regarding tourist visitation to attractions in Karo Regency from 2010 to 2016. The insights gained from this dashboard can aid local governments and tourism authorities in making better decisions and formulating policies for the development of tourism in Karo Regency. The data used in this research is the tourist visitation data to tourist attractions in Karo regency within 1 year, for each tourist attraction and divided into adult and children visits. The data was obtained from the Karo regency government website. This data will be integrated into Tableau in the form of a CSV file.

2. Research Methods

This study employs a secondary data analysis method, involving the processing of data previously collected by another party, specifically the Karo Regency government. The focus lies on developing a dashboard with business intelligence, following the development process outlined by Moss & Atre through their Business Intelligence Roadmap [16]. The subsequent paragraphs will present the framework of this research. The business intelligence roadmap displayed in Figure 1.

2.1. Data Collection & Data Cleaning

The data source utilized in this research originates from tourist visitation records in Karo Regency, available on the official website through the link http://pariwisata.karokab.go.id/. From the various .xls formatted datasets accessible on that webpage, the researchers selectively focused on data from the years 2010 to 2016 for their study. Each Excel file encompasses columns representing the months, tourist attractions, and a compilation of tourist sites found in Karo Regency (Gundaling; Sipiso-Piso; Lag Sibayak and Lau Debuk-Debuk; Lag Sinabung, Danau Lau Kawar, and Gunung Sinabung; and Taman Mejuah-Juah). These are further divided into two columns, presenting the number of adult and child visitors, along with a final column presenting the total monthly visitation count for each year.

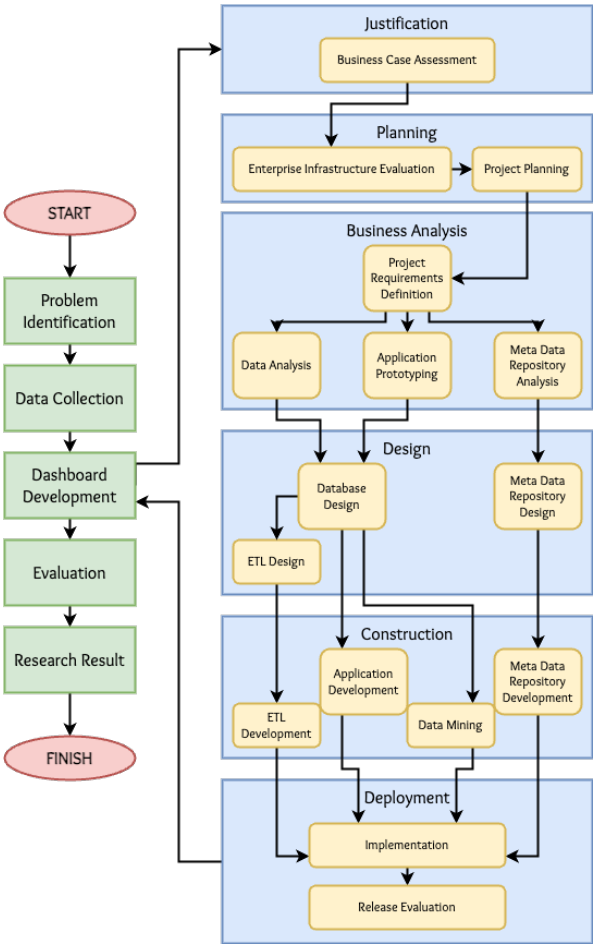

Figure 1. Business Intelligence Roadmap

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DATA KUNJUNGAN WISATAWAN KE OBYEK WISATA KABUPATEN KARO 2010

BULAN	GUNDALING		SIPISO-PISO		LAG. SIBAYAK, LAU DEBUK-DEBUK		LAG SINABUNG, DANAU LAU KAWAR, GUNUNG SINABUNG		TAMAN MEJUAH-JUAH		JUMLAH
	DEWASA	ANAK-ANAK	DEWASA	ANAK-ANAK	DEWASA	ANAK-ANAK	DEWASA	ANAK-ANAK	DEWASA	ANAK-ANAK	
JANUARI	9.900	3.650	12.000	2.500	9.410	1.125	1.129	0	670	0	**40.384**
PEBRUARI	9.000	3.000	6.900	1.150	5.400	700	1.337	0	467	0	**27.954**
MARET	10.500	2.750	9.350	1.175	8.650	1.325	1.325	0	400	0	**35.475**
APRIL	8.200	1.200	8.800	1.100	9.940	890	1.337	0	447	0	**31.914**
MEI	14.500	7.250	11.000	3.500	12.660	2.800	1.323	0	467	0	**53.500**
JUNI	12.000	7.500	7.000	3.500	8.800	2.100	1.006	0	515	0	**42.421**
JULI	5.500	1.750	6.500	1.250	4.950	1.075	670	0	300	0	**21.995**
AGUSTUS	9.900	8.650	10.600	4.600	10.116	3.025	1.536	0	334	0	**48.761**
SEPTEMBER	6.000	4.000	8.200	4.500	3.578	900	0	0	467	0	**27.645**
OKTOBER	5.900	2.150	3.500	1.450	3.473	975	0	0	334	0	**17.782**
NOPEMBER	7.000	3.500	3.400	1.900	7.000	1.800	0	0	400	0	**25.000**
DESEMBER	11.300	5.050	4.700	2.950	8.120	2.075	672	0	200	0	**35.067**
Total	**109.700**	**50.450**	**91.950**	**29.575**	**92.097**	**18.790**	**10.335**	**0**	**5.001**	**0**	
JUMLAH											**407.898**
Total Kunjungan Wisatawan yang berkunjung ke Kabupaten Karo = 30% x 407.898 = 530.267 orang											**530.267**

Figure 2. Raw Data in Excel

The raw data obtained is disorganized and separated for each year's visitation data. As a result, the researchers have created a new Excel file containing a combination of tourist visitation data for Karo Regency from 2010 to 2016, while excluding some irrelevant data for this study. This Excel file comprises five columns, namely year, month, tourist attractions, adult visits, and child visits. This Excel file will serve as the data source to be visualized using Tableau software.

	Tahun	Bulan	Objek Wisata	Kunjungan Dewasa	Kunjungan Anak
2	2010	January	Gundaling	9900	3650
3	2010	January	Sipiso-piso	12000	2500
4	2010	January	Lag Sibayak Lau Debuk-Debuk	9410	1125
5	2010	January	Lag Sinabung Danau Lau Kawar Gunung Sinabung	1129	0
6	2010	January	Taman Menjuah-Juah	670	0
7	2010	February	Gundaling	9000	3000
416	2016	November	Taman Menjuah-Juah	533	245
417	2016	December	Gundaling	7259	2205
418	2016	December	Sipiso-piso	4888	1137
419	2016	December	Lag Sibayak Lau Debuk-Debuk	12422	5946
420	2016	December	Lag Sinabung Danau Lau Kawar Gunung Sinabung	0	0
421	2016	December	Taman Menjuah-Juah	818	382

Figure 3. Data Cleaning Result

2.2. Dashboard Development

Tableau is a software used for creating data visualizations in the form of interactive dashboards, facilitating easy and interactive data analysis [17]. This software enables users to import, merge, and analyze data from various sources effortlessly. The specific version used in this research is Tableau Desktop Public Version 2023.1.0, accessible for free or as open source.

The process of creating a dashboard using Tableau involves six main development phases: justification, planning, business analysis, design, construction, and deployment. In the justification phase, a business case assessment is conducted to analyze the current situation and problems faced. The planning phase includes enterprise infrastructure evaluation and project planning, which involves planning for hardware, software, operating systems, database management systems, networks, and other supporting components. It also includes defining metadata standards, data-naming conventions, logical data models, testing methods, change-control processes, data management, and other supporting components.

During the business analysis phase, several steps are performed. Firstly, project requirements are defined to understand the scope and limitations of the BI project and the technology used. Secondly, data analysis is conducted to ensure data quality, cleanliness, and the development of logical data models. Thirdly, metadata repository analysis is performed to meet metadata requirements through interface analysis. Lastly, Application Prototyping gives an overview of the dashboard's appearance by selecting prototype tools and creating prototypes.

Moving on to the design phase, it comprises several steps. Firstly, Database Design reviews data access requirements, plans the business intelligence database, creates the database, and prepares query monitoring and tuning plans. Secondly, the Extract/Transform/Load (ETL) process is executed to validate data, perform source-to-target mapping, plan ETL process flow, program ETL, and prepare the ETL staging area. Lastly, the Metadata Repository Design follows up on the previous analysis by testing the metadata repository, planning metadata applications, and migration processes.

The construction phase involves three steps. Firstly, Extract/Transform/Load Development builds the ETL according to the designed plan, integrates processes, and conducts testing. Secondly, Application Development finalizes project requirements, plans application programs, creates and tests applications. Lastly, Metadata Repository Development establishes the metadata repository database, migrates metadata, and develops metadata repository applications.

The development phase represents the final stage of building the business intelligence dashboard. It includes Implementation and Release Evaluation. Implementation involves testing all application components, developing the database and BI applications. Release Evaluation gathers feedback from the development team and learning media to ensure the developed dashboard meets the requirements.

The visualized data presented through the dashboard is then analyzed to gather information and provide recommendations to stakeholders for managing tourist attractions in Karo Regency, Sumatera Utara.

3. Results and Discussions

The research results in the creation of a visual data dashboard for tourist attraction visits in Karo Regency, North Sumatra.

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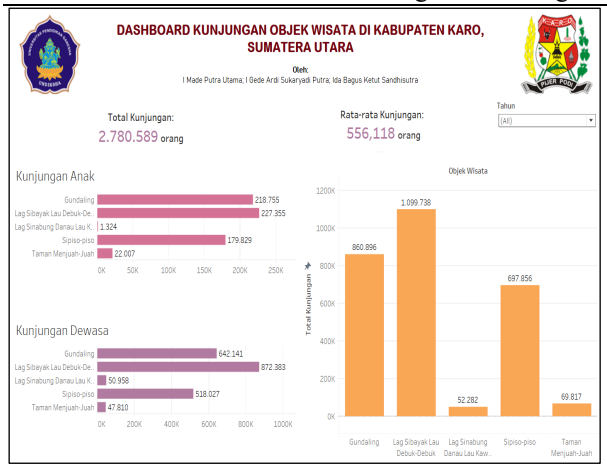

Figure 4. Dashboard of Tourist Attraction Visits in Karo District, North Sumatra

This dashboard comprises five worksheets, namely Total Visits worksheet, Average Visits worksheet, Children Visits worksheet, Adult Visits worksheet, and Total Visits per Tourist Attraction worksheet. Within the dashboard, there is also a Year filter that allows users to visualize data based on their selected year. The visualizations utilized in this dashboard include horizontal and vertical bar charts, as well as text. Bar charts were chosen as they effectively represent specific categories, in this case, the tourist attractions in Karo Regency. A summary of the information obtained from this dashboard is presented in Table 1.

Table 1. Dashboard Data Summary

Year	Total Visits	Average Visits	Highest Visits	Lowest Visits
2010	407.898	81.580	Gundaling	Taman Mejuah-juah
2011	411.745	82.349	Gundaling	Taman Mejuah-juah
2012	439.068	87.814	Lag Sibayak & Lau Debuk-Debuk	Taman Mejuah-juah
2013	388.349	77.670	Lag Sibayak & Lau Debuk-Debuk	Taman Mejuah-juah
2014	326.621	65.324	Lag Sibayak & Lau Debuk-Debuk	Lag Sinabung, Danau Lau Kawar, & Gunung Sinabung
2015	371.164	74.233	Lag Sibayak & Lau Debuk-Debuk	Lag Sinabung, Danau Lau Kawar, & Gunung Sinabung
2016	435.744	87.149	Lag Sibayak & Lau Debuk-Debuk	Lag Sinabung, Danau Lau Kawar, & Gunung Sinabung
Total	2.780.589	556.118	Lag Sibayak & Lau Debuk-Debuk	Lag Sinabung, Danau Lau Kawar, & Gunung Sinabung

Below are the steps involved in building worksheets and a dashboard using Tableau.

3.1. Input Data

In this phase, you start by selecting the "Connect to Data" feature and importing the Excel file that will serve as the data source. Next, you need to align the data types provided by Tableau with the raw data. For example, you may need to change the data type of the "Year" column from Number (as provided by Tableau) to String because the values in the "Year" column won't undergo mathematical operations.

3.2. Child Visits Visualization

To build the Child Visits Visualization, you drag the "Tourist Attractions" table into the Rows shelf and the "Child Visits" table into the Columns shelf. To display the detailed count of visits for each tourist attraction, you can select "Label" in the Marks menu and check the "Show mark labels" option. For customizing the bar chart colors, choose "Color" in the Marks menu and select the desired colors. To add a filter for the Year, drag and drop the "Year" table and place it in the Filters shelf. Then, select the "Show Filter" option to display the filter on the worksheet. The final appearance of the Child Visits Visualization can be seen in Figure 5.

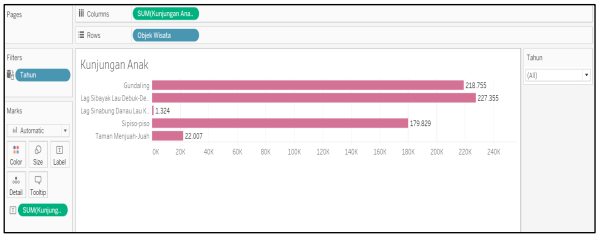

Figure 5. Child Visit Visualization

3.3. Adult Visits Visualization

The Adult Visits Visualization has the same layout as the Child Visits Visualization. Hence, you can duplicate the Child Visits Visualization and rename the duplicated worksheet accordingly. Afterward, replace the "Child Visits" table in the Columns shelf with the "Adult Visits" table. Change the bar chart colors using the "Color" option in the Marks menu. The final appearance of the Adult Visits Visualization can be seen in Figure 6.

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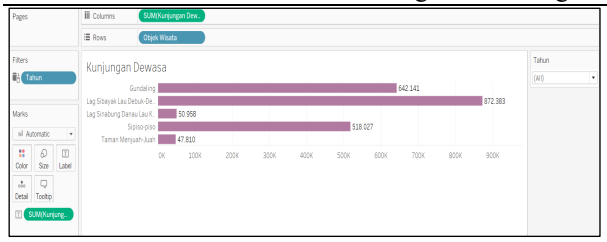

Figure 6. Adults Visit Visualization

3.4. Total Visits per Tourist Attraction Visualization

The Total Visits per Tourist Attraction Visualization is built by creating a Calculated Field to sum up the total Child Visits and Adult Visits. You can do this by selecting the "Analysis" menu, then choosing "Create Calculated Field." Provide a title and the calculation formula in the new tab that appears, which is SUM([Child Visits]) + SUM([Adult Visits]). Next, drag the "Total Visits" table into the Rows shelf and the "Tourist Attractions" table into the Columns shelf. To display the detailed count of visits for each tourist attraction, you can select "Label" in the Marks menu and check the "Show mark labels" option. The final appearance of the Total Visits per Tourist Attraction Visualization can be seen in Figure 7.

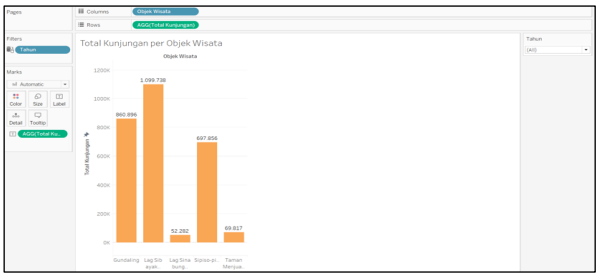

Figure 7. Total Visits per Tourist Attraction Visualization

3.4. Total Visits Visualization

For the Total Visits Visualization, you simply drag and drop the "Total Visits" table into the worksheet and edit the text display by selecting "Text" in the Marks menu. To adjust text alignment, you can choose "Text" in the Marks menu, which opens a new tab allowing you to set horizontal and vertical alignment, as well as direction and text wrapping. This worksheet uses the Middle Center alignment. The final appearance of the Total Visits Visualization can be seen in Figure 8.

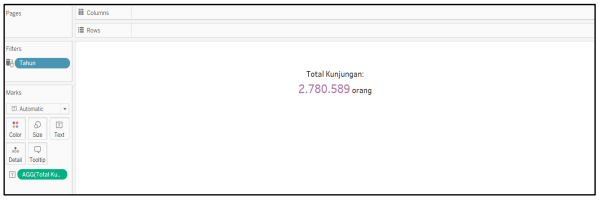

Figure 8. Total Visit Visualization

3.5. Average Visits Visualization

To build the Average Visits Visualization, you create a new Calculated Field to calculate the average visits of tourists to attractions in Karo Regency. This is done by selecting "Create Calculated Field" in the Analysis menu and providing the title and calculation formula [Total Visits] / 5. This formula calculates the average visits for each tourist attraction by dividing the total number of visits by the number of attractions (5 in this case). Next, duplicate the Total Visits Visualization and edit "Total Visits" to "Average Visits," replacing the Total Visits calculation with the Average Visits calculation. The final appearance of the Average Visits Visualization can be seen in Figure 9.

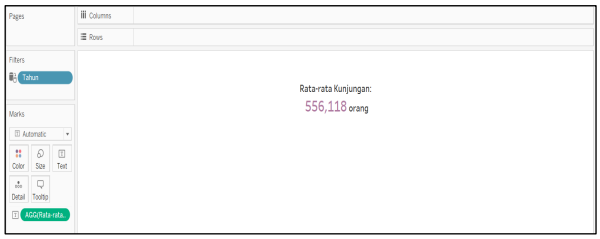

Figure 9. Average Visit Visualization

3.6. Building the Dashboard

The Tableau dashboard is constructed using horizontal and vertical containers to arrange its layout. Figure 10 illustrates the structure of the containers used in this research. To build the dashboard, you start by selecting "New Dashboard" and setting the dashboard's size. Then, you drag and drop a horizontal container for the title and logo and another horizontal container for the Total Visits, Average Visits, and Year Filter worksheets. Additionally, drag and drop a final horizontal container and place a vertical container within it as a container for the Child Visits and Adult Visits worksheets. Put the Total Visits per Tourist Attraction worksheet to the right of the vertical container. Adjust the width and height of each container and worksheet to organize the dashboard's appearance. Ensure the filter works across all worksheets by choosing the "Apply to Worksheets" option and selecting "All Using This Data Source."

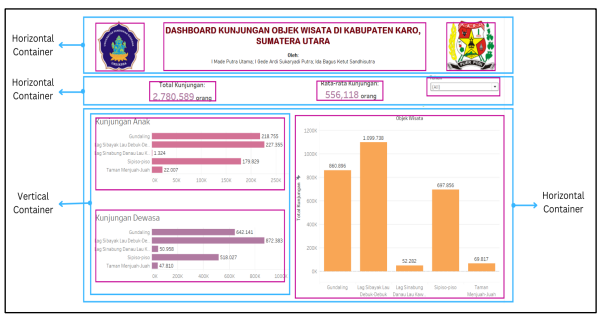

Figure 10. Container in Dashboard

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4. Conclusion

Based on the data analysis and visualization conducted, the conclusion drawn is that the tourist attractions with the highest number of visits from 2010 to 2016 are Lag Sibayak and Lau Debuk-Debuk, with a total of 1,099,738 visitors. This number represents nearly 40% of the total tourist visits in Karo Regency. These tourist attractions experienced a significant increase in visits and held the top position in Karo Regency from 2012 to 2016. On the other hand, the tourist attractions with the lowest number of visits are Lag Sinabung, Danau Lau Kawar, and Gunung Sinabung, with a combined total of only 52,282 visitors over the 7-year period, equivalent to 1.9% of the total tourist visits in Karo Regency.

Based on the findings, some recommendations can be made. Firstly, it is essential to maintain and enhance the visits to Lag Sibayak and Lau Debuk-Debuk tourist attractions. As they contribute significantly to the overall tourist visits in Kabupaten Karo, the government should focus on developing and improving facilities at these sites. Enhancing the quality of infrastructure, accessibility, promotion, and efficient management can help boost tourist visits and strengthen Kabupaten Karo's position as a preferred tourist destination. Secondly, efforts should be made to increase visits to Lag Sinabung, Danau Lau Kawar, and Gunung Sinabung tourist attractions, which have relatively low numbers of visitors. The government needs to identify factors that might affect visits to these attractions, such as poor accessibility or inadequate promotion. By improving infrastructure and implementing effective promotional campaigns, the number of tourists visiting these sites can be increased. Lastly, for further research, it would be beneficial to create data visualizations for the period from 2017 to 2022 to track the development of tourist visits to attractions in Kabupaten Karo. This information would provide valuable insights into the trends and changes in tourism patterns over time and guide future strategies for the region's tourism development.

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