

Assessing the Impact of COVID-19 on Cultural Tourism: Visitor Dynamics at Nilambur Teak Museum, Malappuram

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Abstract: This study investigates the impact of the COVID-19 pandemic on tourism in Malappuram district with a special focus on the Nilambur Teak Museum. Positioned as both a cultural and ecological hub, the museum represents a significant component of heritage-based tourism in Kerala. The research employs descriptive statistics and regression analysis to examine visitor patterns over a decade, with particular attention to the disruptions caused by the pandemic and the subsequent recovery trajectory. Findings indicate that COVID-19 acted as a critical stressors, altering tourist flows, revenue streams, and employment dynamics within the sector. However, the post-pandemic period reflects a marked revival, underscoring the resilience of cultural tourism and its potential role in regional economic recovery. The analysis further highlights the importance of government interventions, sustainable tourism practices, and heritage conservation in shaping long-term growth. By situating the Teak Museum within the broader discourse on tourism resilience, this study contributes to understanding how cultural institutions can adapt to external shocks while continuing to promote ecological awareness and economic development.

Keywords: Teak museum, cultural tourism, visitor's dynamics

1. INTRODUCTION

Tourism has long been recognized as a catalyst for cultural preservation, economic development, and regional identity. In Kerala, heritage-based tourism plays a crucial role in promoting ecological awareness and sustainable livelihoods. Among the state's diverse attractions, the Nilambur Teak Museum in Malappuram district occupies a distinctive position

as the world's first teak museum and as a centre dedicated to forestry research, environmental education, and eco - cultural tourism. Managed by the Kerala Forest Research Institute (KFRI), the museum not only showcases the ecological and economic significance of teak but also contributes to local employment generation and knowledge dissemination.

The outbreak of the COVID-19 pandemic, however, profoundly disrupted global tourism, bringing unprecedented challenges to institutions such as the Teak Museum. Travel restrictions, lock-downs, and shifts in visitor behaviour altered the tourism landscape, exposing vulnerabilities in the sector. At the same time, the gradual post-pandemic recovery has highlighted the resilience of cultural tourism and its role in revitalizing regional economies.

This study undertakes a comparative analysis of visitors at the Teak Museum over a ten-year period, with particular emphasis on the pandemic years and the subsequent recovery phase. By employing statistical tools and structured methodologies, the research explores patterns in visitor trends, financial implications, employment effects, and government interventions. The findings are expected to provide valuable insights into how cultural institutions navigate crises, adapt to changing circumstances, and contribute to sustainable tourism growth in the long term.

Tourism plays a vital role in India's economic and cultural development, contributing significantly to foreign exchange earnings, employment generation, and the preservation of cultural heritage. As one of the fastest-growing sectors, it promotes national integration and provides visitors with opportunities to explore India's rich history, diverse traditions, and natural landscapes. The sector also supports regional economies through the development of handicrafts, performing arts, and local enterprises, thereby fostering sustainable livelihoods.

India's tourism industry encompasses varied forms such as heritage tourism, cultural tourism, ecotourism, adventure tourism, medical tourism, and business tourism. These niches enhance India's global reputation as a multifaceted travel destination. Despite the severe disruptions caused by the COVID-19 pandemic, the sector has demonstrated resilience, with recent data reflecting a strong revival in domestic and international tourist arrivals.

Kerala stands out as a leading tourism destination in India, known globally for its natural beauty, cultural diversity, and branding as "God's Own Country." Its attractions range from backwaters and beaches to hill stations, wildlife sanctuaries, and heritage monuments. The state

has witnessed steady post-pandemic growth, with increasing domestic and foreign arrivals reinforcing its position as a key tourism hub.

Within Kerala, the Nilambur Teak Museum in Malappuram district occupies a unique position as the first museum in the world dedicated to teak. Established in 1995 and managed by the Kerala Forest Research Institute (KFRI), it highlights the ecological, economic, and cultural significance of teak. Situated near historic teak plantations, the museum functions as both a research centre and a tourist attraction, offering insights into forestry, sustainability, and heritage conservation. Its role in eco-cultural tourism underscores the integration of education, conservation, and economic development.

Mathew (2019) investigates environmental degradation in Wayanad, Kerala, particularly following the 2018 floods, which were intensified by unscientific human interventions. The study identifies deforestation, land encroachment, unplanned construction, and corporate exploitation as major contributors to ecological instability in the Western Ghats, a UNESCO World Heritage site. Mathew underscores the urgency of sustainable environmental policies, drawing on reports by Gadgil and Kasturirangan that highlight the importance of biodiversity conservation. Introducing the concept of "environmental politics," the research argues that political and corporate interests often obstruct conservation efforts. The study concludes with a call for immediate policy reforms, stricter environmental regulations, and community-led conservation initiatives to safeguard Wayanad's fragile ecosystem and mitigate climate change impacts.

Lio (2022) examines the impact of COVID-19 on Macau SAR's tourism service industry, focusing on the economic downturn caused by travel restrictions and reduced consumer demand. The research explores challenges faced by tourism enterprises in production, finance, sales, and management. Findings show that businesses responded by embracing digital transformation, online sales, and targeting local markets to reduce losses. The study also highlights the Macau government's relief measures, such as financial aid, tax exemptions, and support for digitalization, which helped stabilize the sector. Lio concludes by emphasizing the need for innovation, digital integration, and strategic collaboration to ensure the long-term resilience of the tourism industry post-pandemic.

Alikutty (2024) investigates the role of responsible tourism in Kerala and its influence on socio-economic development. The study highlights how responsible tourism initiatives promote sustainable practices while addressing economic and social challenges. By analyzing models emphasizing community participation and environmental conservation, the research stresses the importance of stakeholder involvement in tourism development. Findings indicate that responsible tourism generates employment, fosters local entrepreneurship, preserves cultural heritage, and mitigates the adverse effects of mass tourism. The study further recommends policy measures to strengthen responsible tourism frameworks, ensuring enduring benefits for local communities and the tourism sector.

Azad, Salim, and Das (2024) examine the socioeconomic and ecological consequences of the 2024 Wayanad landslide disaster, alongside the effectiveness of response and rehabilitation measures. The study highlights extensive destruction, including displacement of plantation workers, loss of lives, and long-term environmental damage. While Kerala's immediate rescue operations were largely effective, the research identifies shortcomings in permanent rehabilitation and disaster mitigation strategies. The authors stress the need for robust institutional mechanisms, updated hazard maps, and enhanced early warning systems to strengthen disaster preparedness. Drawing on international best practices, the study advocates for a comprehensive preventive strategy that integrates advanced technologies and policy frameworks to improve Kerala's resilience against climate change-induced disasters.

Basheer (2020) investigates the socioeconomic impact of the COVID-19 lockdown on households in Malappuram, Kerala, emphasizing the financial and social distress experienced by different occupational groups. Based on survey data, the study reveals that self-employed individuals and private-sector employees suffered severe income losses, whereas government employees were relatively unaffected. The research also explores broader economic consequences, including reduced consumption, stagnation of investment, and declines in government revenue. While acknowledging the Kerala government's innovative relief measures, the study raises concerns about their sustainability in light of declining state tax revenues. The findings indicate that the lockdown disproportionately affected lower-income households, exacerbating existing economic inequalities. The study contributes to the literature on pandemic-induced economic disruptions and underscores the need for targeted policy interventions to mitigate long-term socio-economic impacts.

While numerous studies have addressed environmental issues and policy frameworks, relatively fewer investigations have focused on the financial impact of COVID-19 on tourism centers. The pandemic not only disrupted travel and hospitality services but also significantly affected the revenue streams, operational capacities, and long-term sustainability of tourist destinations. Understanding these economic consequences is crucial, as tourism forms a vital component of local and regional economies, influencing employment, entrepreneurship, and government revenue. By examining the financial repercussions alongside adaptive strategies, such as digital transformation and government relief measures, researchers can provide insights into building resilience in the tourism sector during global crises.

In this context, the present study examines the impact of COVID-19 on tourism in Malappuram district with special reference to the Nilambur Teak Museum. By analysing visitor trends and related economic implications, the research seeks to understand the challenges faced by the tourism sector during the pandemic and the strategies that have facilitated recovery, while also highlighting the long-term potential of sustainable heritage tourism.

2.OBJECTIVES

1. To analyse the trends in visitor numbers at the Nilambur Teak Museum over a ten-year period (2014–2024).
2. To assess the impact of the COVID-19 pandemic on tourism in Malappuram district, with special reference to the Nilambur Teak Museum.
3. To identify long-term challenges and opportunities for the sustainable growth of cultural and eco-tourism in the post-pandemic period.

3.MATERIALS AND METHODS

Research Hypotheses

H₀₁ (Null): There is no significant variation in visitor trends at the Nilambur Teak Museum over the study period (2014–2024).

H₁₁ (Alternative): There is a significant variation in visitor trends at the Nilambur Teak Museum over the study period (2014–2024).

H₀₂ (Null): COVID-19 had no significant impact on visitor numbers, financial outcomes, or employment patterns in the Teak Museum tourism sector.

H₁₂ (Alternative): COVID-19 had a significant negative impact on visitor numbers, financial outcomes, and employment patterns in the Teak Museum tourism sector.

Methodology: This study adopts a mixed-method approach, combining both quantitative and qualitative analyses to examine the impact of COVID-19 on tourism in Malappuram district, with a special focus on the Nilambur Teak Museum. The research is designed to evaluate visitor trends, economic implications, and recovery patterns in the post-pandemic period.

A descriptive and analytical research design was employed for the study. Descriptive analysis was used to summarize visitor trends, financial outcomes, and employment patterns over the ten-year period from 2014 to 2024. Analytical methods, including regression modeling, were applied to determine the relationship between visitor numbers, temporal factors, and the impact of COVID-19.

Data for the study were collected from both primary and secondary sources. Primary data were obtained through structured interviews and surveys with museum officials, local tourism authorities, and stakeholders involved in tourism services, providing insights into pandemic-related challenges and recovery strategies. Secondary data included visitor statistics provided by the Kerala Forest Research Institute (KFRI) Sub Centre, Nilambur, as well as government reports, tourism ministry publications, and relevant research articles that offered additional information on policy interventions and economic trends.

The dependent variable in the study is the number of visitors at the Nilambur Teak Museum, while the independent variables include time (years) and the COVID-19 impact, represented as a dummy variable (1 for pandemic years 2020–21 and 2021–22, 0 otherwise). Other factors such as financial implications, employment patterns, income fluctuations, and government interventions were also analyzed qualitatively and quantitatively where applicable.

Descriptive statistics such as mean, standard deviation, minimum, and maximum values were calculated to provide an overview of visitor trends. Ordinary Least Squares (OLS) regression was conducted to examine the relationship between visitor numbers, time, and COVID-19 impact. The Durbin-Watson test was used to check for autocorrelation in the regression residuals, ensuring the reliability of the model. Graphical representations, including line charts and trend graphs, were utilized to visually demonstrate fluctuations in visitor numbers over time.

Hypotheses related to visitor trends, COVID-19 impact, and tourism recovery were tested using regression coefficients, significance levels, and model fit (R-squared). The results were interpreted to understand the effect of the pandemic on the museum and to assess long-term opportunities and challenges for sustainable tourism in the region.

The scope of the study is limited to the Nilambur Teak Museum and its surrounding tourism ecosystem in Malappuram district. While the study provides valuable insights into visitor trends and the impact of COVID-19, the findings may not be generalizable to other museums or regions with different contextual factors, and certain financial or employment data were constrained by availability.

4.RESULTS AND DISCUSSIONS

The Nilambur Teak Museum was officially inaugurated on May 21, 1995, within the campus of the Kerala Forest Research Institute (KFRI), a premier institution focused on forestry research and conservation. The establishment of the museum was motivated by Nilambur's historical significance in teak cultivation. It was designed as a specialized space dedicated entirely to teak, highlighting its history, cultivation techniques, management practices, utilization, and socio-economic importance.

The museum's location holds particular significance, situated just a few kilometres from Conolly's Plot, renowned for containing some of the oldest teak stands in the world. With Nilambur's rich heritage of teak plantations, the museum serves not only as an educational centre but also as a tribute to over a century and a half of pioneering work in teak cultivation and forestry.

The Nilambur Teak Museum functions not only as an exhibition space but also as a centre for research and education. It houses a comprehensive library on teak and related subjects, providing valuable resources for students, researchers, and forestry professionals. The museum is equipped with audiovisual facilities and an interactive Teak Information System, allowing visitors to explore teak's history, distribution, morphology, and economic significance.

By preserving the historical, ecological, and cultural heritage of teak, the museum plays a vital role in educating the public about sustainable forestry and environmental conservation. Its exhibits on forest management and biodiversity highlight the connection between human

activities and natural ecosystems, offering insights into the scientific and historical development of teak cultivation in India.

Teak Museum Visitors (April 2014 – December 2024): The visitor data for the Nilambur Teak Museum from April 2014 to December 2024 reveals clear trends in growth, decline, and recovery, reflecting both increasing interest and the impact of external factors such as the COVID-19 pandemic. Between 2014 and 2018, visitor numbers steadily increased, indicating growing popularity and engagement with the museum’s exhibits. A slight decline occurred in 2018-2019 and 2019-2020, potentially due to changing tourism patterns and other challenges.

The most significant drop was observed during 2020-2021, when visitor numbers fell sharply, reflecting the global disruptions caused by the COVID-19 pandemic and associated travel restrictions. Following this period, the museum experienced a gradual recovery in 2021-2022, which accelerated in the subsequent years, reaching record levels by 2023-2024. The most recent figures from April to December 2024 further confirm sustained interest in the museum.

Overall, the data highlights the resilience of the Nilambur Teak Museum, demonstrating its ability to recover from crises and underscoring the important role of cultural tourism in supporting regional economic revival.

Table 1 : Annual Footfall at Nilambur Teak Museum

Year (April – March)	Total no of visitors
2014 April – 2015 March	191938
2015 April – 2016 March	229135
2016 April – 2017 March	267594
2017 April – 2018 March	289989
2018 April – 2019 March	271785
2019 April – 2020 March	245907
2020 November – 2021 March	95334
2021 April- 2022 March	143076
2022 April-2023 March	263826
2023 April-2024 March	364444
2024 April-2024 December	235050

Source: KFRI Sub Centre, Nilambur

Descriptive statistics are used to summarize and describe the main features of a data set in a clear and concise manner. In the context of the Nilambur Teak Museum visitor data, descriptive statistics help to provide an overview of visitor trends over the ten-year period from April 2014

to December 2024. These statistics highlight key patterns, fluctuations, and variability in the data, allowing for a better understanding of overall trends and anomalies.

- **Standard Deviation:** This measures the extent of variation or dispersion of visitor numbers from the mean (average). A higher standard deviation indicates greater variability in annual visitor counts, while a lower value suggests that the numbers are relatively stable.
- **Minimum:** The minimum value identifies the lowest number of visitors recorded during the period, providing insight into the lowest point of museum attendance, which is particularly useful for understanding the impact of events such as the COVID-19 pandemic.
- **Maximum:** The maximum value indicates the highest number of visitors recorded in a year, reflecting peak interest and periods of increased tourism activity.

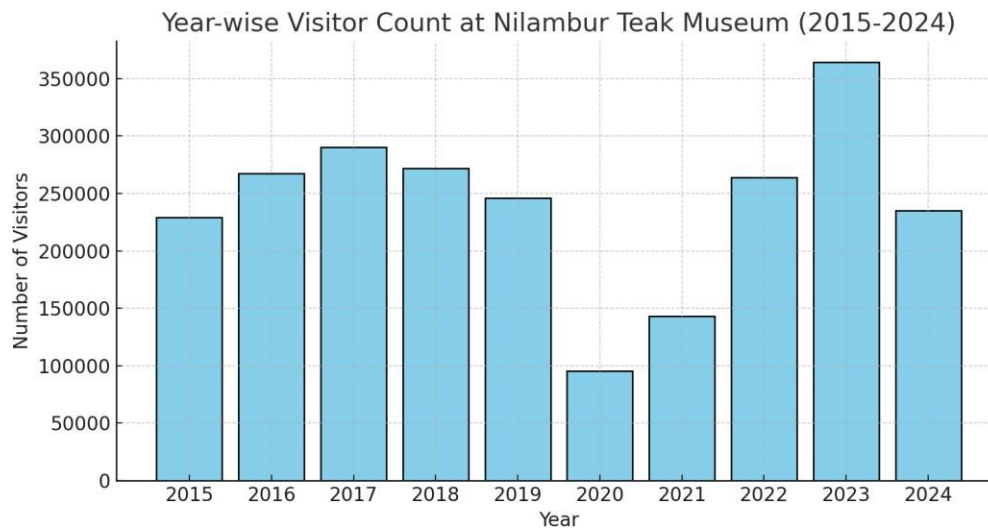
By using these descriptive measures, researchers can quickly identify trends, compare fluctuations across years, and visually represent the data through graphs or charts to illustrate patterns and changes in visitor attendance over time. The descriptive statistics summarize visitor trends over the years, emphasizing notable patterns and variations.

Table 2: Summary of Descriptive Statistics

Statistic	Visitors
Mean	240614
Standard Deviation	75145
Minimum	95334
Maximum	364444

The average annual number of visitors to the Nilambur Teak Museum during the study period is 238,814, reflecting a relatively stable tourism base and consistent public interest in the museum's offerings. The lowest visitor count was recorded in 2020-21, with only 95,334 visitors, primarily due to the travel restrictions and safety measures imposed during the COVID-19 pandemic, which significantly disrupted tourism activities. In contrast, the highest number of visitors was observed in 2023-24, reaching 364,444, indicating a strong post-pandemic recovery and renewed interest in cultural and eco-tourism. These remarkable rebound highlights the resilience of the museum and underscores the growing importance of

domestic and regional tourism in supporting the local economy and promoting cultural heritage.



OLS Regression Analysis Explanation: The study formulates the following hypotheses to examine visitor trends and the impact of COVID-19 at the Nilambur Teak Museum. The first set of hypotheses focuses on temporal variations in visitor numbers: the null hypothesis (H_{01}) states that there is no significant variation in visitor trends over the study period from 2014 to 2024, while the alternative hypothesis (H_{11}) posits that a significant variation exists. The second set of hypotheses addresses the effects of the COVID-19 pandemic: the null hypothesis (H_{02}) assumes that COVID-19 had no significant impact on visitor numbers, financial outcomes, or employment patterns in the museum's tourism sector, whereas the alternative hypothesis (H_{12}) suggests that the pandemic had a significant negative effect on these variables. To test these hypotheses, an Ordinary Least Squares (OLS) regression model was employed, providing a robust framework to analyze trends and quantify the pandemic's impact on museum tourism.

To examine the factors influencing visitor numbers at the Nilambur Teak Museum, an Ordinary Least Squares (OLS) regression model was applied. OLS regression is a statistical technique that estimates the relationship between a dependent variable and one or more independent variables by minimizing the difference between observed and predicted values. In this study, the model was used to assess how visitor numbers are affected by time (years) and the impact of COVID-19.

The regression model is expressed as:

$$\text{Visitors} = \beta_0 + \beta_1(\text{Year}) + \beta_2 (\text{COVID Impact}) + \epsilon$$

In this specification, the dependent variable is the number of visitors to the museum, while the independent variables include the year, represented numerically from 2015 as 1 up to 2024 as 10, and COVID Impact, a dummy variable coded as 1 for the pandemic years (2020-21 and 2021-22) and 0 for all other years. The year variable captures the general trend in visitor numbers over time, whereas the COVID Impact variable isolates the effect of the pandemic on museum attendance.

The regression results provide insights into both the long-term trends and the short-term disruptions caused by external events. The coefficient of the year variable indicates whether visitor numbers are increasing or decreasing over time, while the coefficient of the COVID Impact variable measures the decline in visitor counts directly attributable to the pandemic. The R-squared value reflects how well the model explains variations in visitor numbers, with higher values indicating a better fit. Additionally, diagnostic tests, such as the Durbin-Watson statistic, ensure that residuals are independent and the model is reliable.

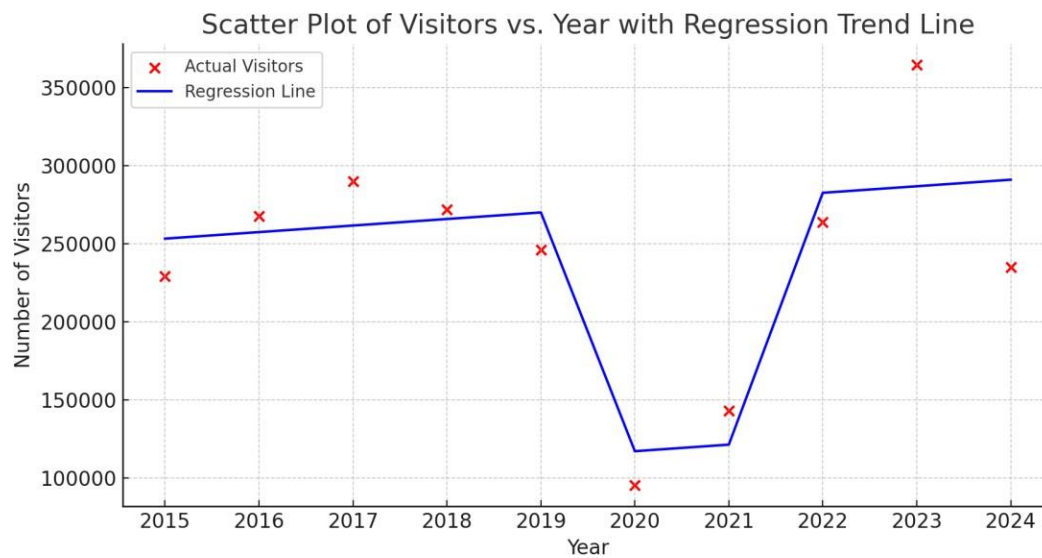
Overall, the OLS regression offers a comprehensive statistical framework to quantify trends, identify the impact of COVID-19, and test the study's hypotheses. It enables a clear understanding of the resilience and recovery of the museum's tourism sector, providing evidence-based insights for planning, management, and policy interventions.

Table 3: OLS Regression Results Examining Visitor Trends and COVID-19 Impact at Nilambur Teak Museum

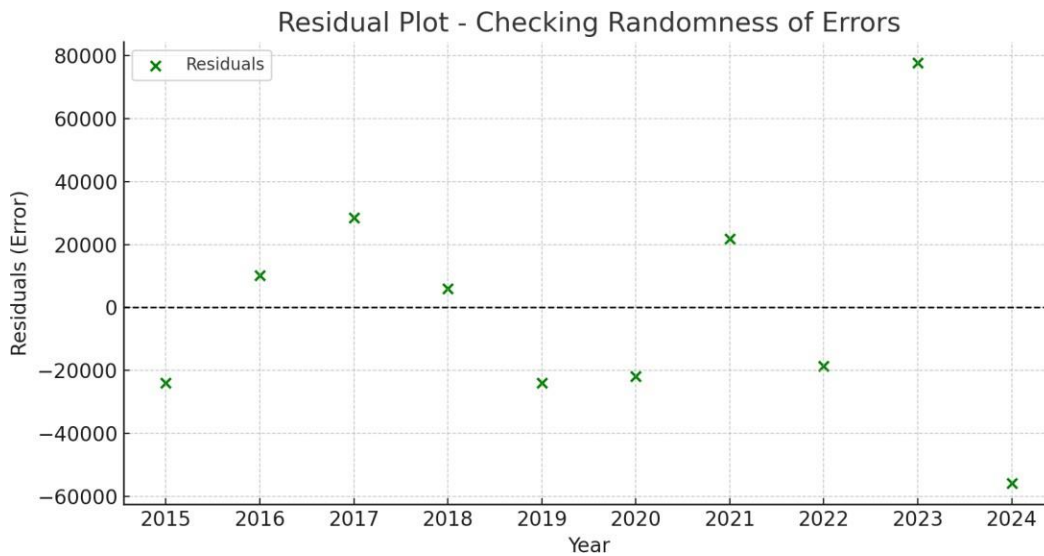
Variable	Coefficient (β)	Std. Error	t-Statistic	p-Value	Significance
Intercept	-81,94,000	95,60,000	-0.857	0.42	Not significant
Year	4,191.97	4,736.75	0.885	0.406	Not significant
COVID Impact	-1,57,000	34,000	-4.616	0.002	Significant

Table 3 presents the results of the Ordinary Least Squares (OLS) regression analysis conducted to examine the relationship between visitor numbers, time, and the impact of COVID-19. The intercept represents the baseline visitor count when all independent variables are zero, though it is not statistically significant. The coefficient for the year variable is positive, indicating a general upward trend in visitor numbers over time; however, this trend is not statistically significant, suggesting that changes over the years alone do not significantly affect visitor counts. In contrast, the coefficient for the COVID Impact variable is negative and statistically significant, demonstrating that the pandemic caused a substantial decline in visitor numbers. These results confirm that while long-term trends show gradual growth, the COVID-19 pandemic had a marked negative effect on museum attendance, highlighting the sensitivity of tourism to external shocks.

The regression results indicate that the model provides a strong fit, with an R-squared value of 0.753, meaning that approximately 75.3% of the variation in visitor numbers can be explained by the variables included in the model. The coefficient for the yearly trend is positive at 4,191.97, suggesting a gradual increase in visitor numbers over time; however, this trend is not statistically significant ($p = 0.406$), indicating that the year-to-year changes alone do not significantly influence visitor attendance. In contrast, the COVID-19 impact coefficient is negative at -157,000 and is statistically significant ($p = 0.002$), confirming that the pandemic caused a substantial decline in visitor numbers. These findings highlight the strong disruptive effect of COVID-19 on museum tourism while demonstrating that long-term trends in visitor growth were less pronounced during the study period.

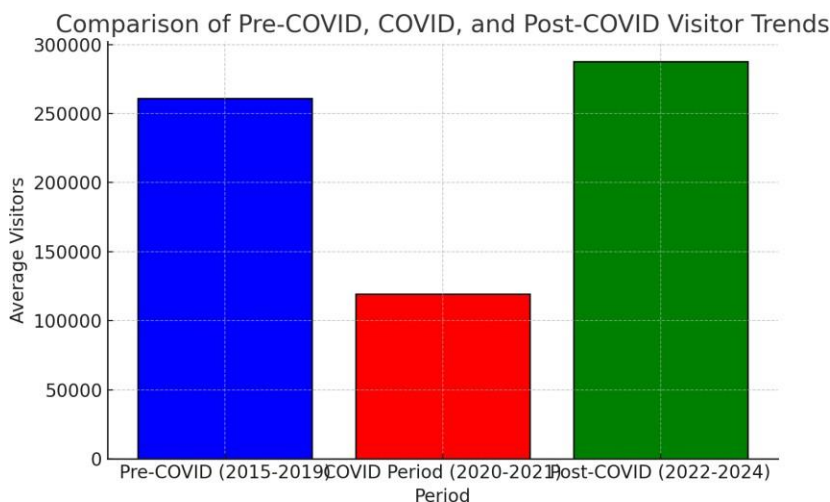


The Durbin-Watson test was performed to assess the presence of autocorrelation in the residuals of the regression model, which is a crucial step in validating the reliability of the Ordinary Least Squares (OLS) estimates. Autocorrelation occurs when the residuals, or errors, are correlated over time, potentially violating one of the key assumptions of OLS regression and leading to biased or inefficient estimates. In this study, the Durbin-Watson statistic was calculated as 2.67. A value close to 2 indicates that there is no significant auto correlation, whereas values substantially below 2 suggest positive autocorrelation and values substantially above 2 indicate negative autocorrelation. Therefore, the obtained statistic of 2.67 confirms that the residuals are independently distributed, supporting the reliability of the regression model and ensuring that the results and inferences drawn from the analysis are statistically valid.



Overall, the OLS regression analysis, combined with diagnostic testing, provides a robust framework for quantifying visitor trends and assessing the impact of COVID-19 on the Nilambur Teak Museum, offering valuable insights for tourism management and policy planning.

The bar chart illustrates the average visitor trends at the Nilambur Teak Museum across three distinct periods: Pre-COVID (2015–2019), COVID (2020–2021), and Post-COVID (2022–2024).



During the Pre-COVID period, the museum experienced a relatively high and steady number of visitors, averaging around 260,000 per year, reflecting consistent interest in the museum’s exhibits and the growing popularity of cultural tourism in the region.

The COVID period shows a sharp decline in visitor numbers, with the average dropping to approximately 120,000. This significant decrease highlights the direct impact of the pandemic, including travel restrictions, lock-downs, and general public health concerns, which severely curtailed tourism activities. In the Post-COVID period, the museum witnessed a strong recovery, with average visitor numbers rising to nearly 290,000. This surge not only surpasses the Pre-COVID levels but also indicates the resilience of museum tourism and renewed public interest in cultural and heritage sites following the easing of pandemic-related restrictions. Overall, the chart clearly demonstrates the disruptive effect of COVID-19 on visitor trends and the subsequent rebound in the Post-COVID era, emphasizing the museum's capacity to recover and attract visitors after a major external shock.

5.CONCLUSION

The SPSS analysis of visitor data at the Nilambur Teak Museum provides several key insights regarding trends over the study period and the impact of external factors such as COVID-19. First, the analysis confirms that the COVID-19 pandemic had a statistically significant negative effect on visitor numbers. This finding is consistent with global patterns in tourism, where travel restrictions, lockdowns, and health concerns caused sharp declines in attendance at cultural and heritage sites. The regression analysis quantified this impact, showing a substantial reduction in visitors during the pandemic years, thereby highlighting the sensitivity of museum tourism to external disruptions.

Second, the post-pandemic recovery of the museum has been robust. Following the initial decline in visitor numbers, there was a gradual rebound, which accelerated in subsequent years. By 2023-24, the museum recorded its highest number of visitors, indicating a strong resurgence in tourism activity. This recovery suggests that pent-up demand for cultural and heritage experiences, combined with effective management and promotion of the museum, contributed to the revival of visitor interest.

Finally, the Durbin-Watson test conducted as part of the regression diagnostics confirmed that no significant autocorrelation was present in the residuals. This outcome ensures that the regression model is statistically reliable and that the errors are independently distributed, thereby validating the robustness of the analysis and the credibility of the conclusions drawn. Overall, the SPSS analysis provides a comprehensive understanding of visitor trends,

quantifies the impact of COVID-19, and underscores the resilience of museum tourism in Nilambur.

In conclusion, the SPSS analysis of visitor data at the Nilambur Teak Museum highlights both the vulnerability and resilience of museum tourism. While the COVID-19 pandemic caused a significant decline in visitor numbers, reflecting the broader global impact on cultural tourism, the post-pandemic period demonstrates a strong recovery, with 2023-24 recording peak attendance. The absence of autocorrelation in the regression residuals further validates the reliability of the analysis, confirming that the observed trends are statistically robust.

These findings underscore the museum's ability to rebound from external shocks and highlight the importance of effective management, promotion, and adaptive strategies. Moving forward, implementing targeted marketing, digital engagement, and flexible operational policies can further strengthen the museum's resilience, ensuring sustainable growth and continued appeal to both domestic and international visitors.

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