

THE IMPACT OF THE MUSEUM KARST GEOPARK GUNUNG SEWU ON THE LOCAL COMMUNITY ECONOMY IN WONOGIRI REGENCY: A POST-COVID-19 CASE STUDY

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Abstract

The evaluation of the development of the Gunung Sewu Karst Geopark Museum in Wonogiri Regency post-COVID-19 is crucial due to its potential impact on economic recovery and community welfare. This paper aims to identify the impact of the Gunung Sewu Karst Geopark Museum on the economy of the community in Wonogiri Regency after COVID-19. This study uses Descriptive Analysis, Correlation Analysis, and Separate Linear Regression, with variables including Gross Regional Domestic Product (GRDP) per capita (G), Number of Tourists (T), Income of the Karst Museum Area (I), Labor Force Participation Rate (LFPR), Unemployment Rate (U), Number of Poor People (P), Number of Hotel Rooms Available in Wonogiri Regency (H), and Inflation (INF). The analysis reveals a positive and significant relationship between the number of tourists and an increase in GRDP per capita, while museum income shows a negative relationship with GRDP per capita. The number of hotel rooms also positively contributes to the regional economy, whereas unemployment is negatively correlated with GRDP per capita. Although the increase in LFPR, the decrease in the number of poor people, and inflation contribute to GRDP per capita, their effects are not significant. In conclusion, tourism and attractions such as the Gunung Sewu Karst Geopark Museum have significant potential to be key drivers of the local economy and the revival of the tourism sector. However, targeted strategies and policies are needed to improve quality and attract more tourists, thereby increasing local income.

Keywords: Museum Karst Geopark, Community Economy, GRDP per Capita, Post-COVID-19, Gunung Sewu Geopark

A. INTRODUCTION

The Gunung Sewu Karst area was designated by UNESCO as the Gunung Sewu UNESCO Global Geopark in 2015 due to its remarkable potential for development, featuring a unique karst landscape, natural beauty, and rich cultural diversity of the local communities (Amelia, 2016). The Gunung Sewu Karst region is located on the southern plate of central Java, Indonesia, spanning across three provinces: East Java, Central Java, and the Special Region of Yogyakarta (Widyastuti et al., 2024). The karst morphology of Gunung Sewu is shaped by carbonate rock formations, consisting of hundreds of small, cone-shaped hills with rounded summits (Mulyanto & Surono, 2009). This karst area is composed of the Middle Miocene Wonosari Formation, which overlays Tertiary volcanic rocks from an ancient, now inactive volcano. The Wonosari Formation consists of layered limestone, massive limestone, and reef limestone (Haryono et al., 2023).

Karst is a unique landscape shaped by the interaction between acidic water and easily soluble rocks, such as limestone and dolomite, over time creating a diverse yet fragile environment both

above and below ground (Ford & Williams, 2007). The unique natural landscape of karst holds the potential to become a world heritage site, raising geological heritage awareness and improving quality of life in karst areas. A prime example is Dong Van Karst Plateau UNESCO Global Geopark, which has successfully boosted the local economy through nature tourism (Tuan et al., 2024).

The Wonogiri Karst Museum is truly unique; it not only showcases the karst landscape but also offers insights into the prehistoric history of ancient humans (Irawan & Kurniawan, 2020). The tourism appeal at the research site includes artificial attractions like the museum and natural attractions such as the surrounding karst landscape. Indoor activities take place within the museum, while outdoor activities involve visits to cave geosites (Kunardi et al., 2020). The Karst Museum features unique characteristics of the karst landscape and insights into ancient human life, making it a resource for education, research, and recreation related to the development of karst in Indonesia. It also serves as a socio-economic catalyst by providing benefits to the surrounding community.

The COVID-19 crisis in Indonesia has had a significant impact on the economy, particularly affecting the trade flow of food products, which are essential for everyone (Ibrahim et al., 2024). This crisis also led to substantial income loss and job displacement, especially among men, younger people, individuals with lower educational attainment, and self-employed or part-time workers in non-agricultural sectors (Putra et al., 2023). The COVID-19 crisis has resulted in an unprecedented decline in tourist arrivals across the country. This could be devastating for the country as it reduces growth and increases poverty significantly (Pham & Nugroho, 2022). Collaboration in governance and the facilitation of interests among local governments, stakeholder groups, and private sector investors have been ongoing since the crisis to enhance the quality of the tourism economy and the creative industry (Kusumaningrum et al., 2024).

Wonogiri Regency faced the effects of COVID-19, including a decrease in the quality and quantity of trade, a shortage of fresh food supplies, and shorter working hours (Indrawan et al., 2022). The tourism sector had minimal impact on economic growth in Wonogiri Regency in the years prior to the COVID-19 crisis (Nugraheni & Setyowati, 2024). This situation presents both a challenge and an opportunity to implement significant changes aimed at enhancing the quality of tourism, thereby improving the economy.

Tourism plays a vital role in advancing social and economic development in various rural areas (Marinello et al., 2023; Moayerian et al., 2022). Establishing economic, cultural, and social sustainability for local businesses is considered essential, necessitating strategies that prioritize value growth. Planning plays a crucial role in ensuring the sustainable growth of tourism destinations (Moliterni et al., 2024). In this regard, evaluating the economic benefits derived from the presence of the Karst Museum is essential to achieve optimal and sustainable outcomes.

Identifying karst is essential to safeguard natural karst ecosystems for sustainable development in karst regions, enhancing the biophysical quality of karst areas and improving the socioeconomic conditions within these zones (Chen et al., 2024). Museum Karst Geopark Gunung Sewu is Indonesia's only karst museum, showcasing unique natural beauty and landscapes. It attracts tourists interested in learning about human history, karst topography, and enjoying the stunning scenery. This paper aims to identify the impact of the Gunung Sewu Karst Geopark Museum on the economy of the community in Wonogiri Regency after COVID-19. To maximize its potential, effective policies are necessary to promote sustainable tourism development in the area, thereby enhancing local community welfare and protecting the environment.

B. RESEARCH METHOD

This research was conducted at the Indonesian Karst Museum located in Wonogiri Regency. The study location can be seen in Figure 1.

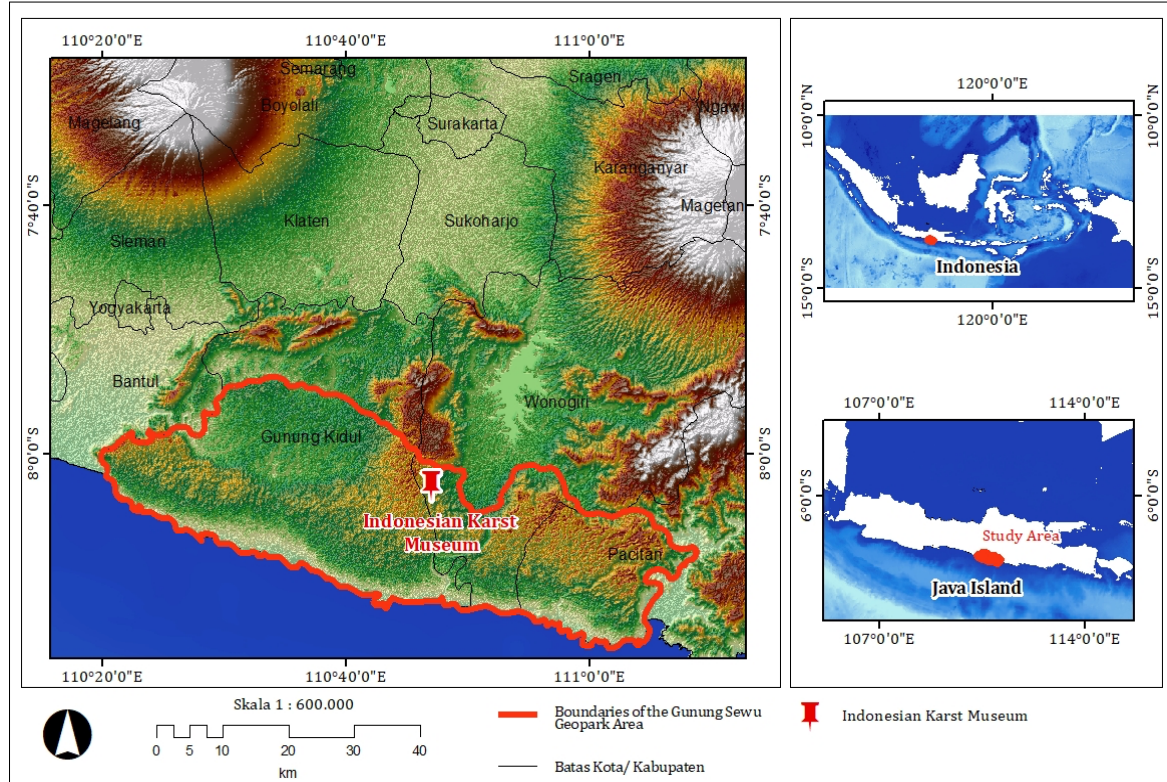


Figure 1. Study Location: Indonesian Karst Museum located in the Gunung Sewu Geopark Area
Source: SRTM 30m DEM analysis, Gunung Sewu Geopark Area Boundary updated from research Soedwiwahjono & Pamardhi-Utomo (2020), Study location points from GPS points

The data used is time series data from the years before COVID (2015-2019) to post-COVID-19 (2020-2023). The variables include Gross Regional Domestic Product (GRDP), the number of tourists (T), income from the Karst Museum area (I), labor force participation rate (LFPR), unemployment rate (U), the number of people living in poverty (P), the number of available hotel rooms in Wonogiri Regency (H), and Inflation (INF). The data source comes from BPS publications for the years 2015-2023.

The research employs methods such as Descriptive Analysis, Correlation Analysis and Separate Linear Regression. Based on the analysis results, conclusions are drawn to provide policy recommendations. Descriptive Analysis is conducted to describe and summarize the characteristics of the data, providing an initial understanding of the trends, patterns, and distributions of each variable used in the study.

The correlation analysis uses Pearson to test the relationships and strengths of association between variables, allowing for the identification of significant connections. The data used for Pearson correlation analysis is the 2015-2023 time series. The Pearson correlation formula is as follows:

$$r_{xy} = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Where:

- r_{xy} : the Pearson correlation coefficient between variables x and y.
 n : the number of paired observations for x and y.
 $\sum xy$: the sum of the product of paired scores for x and y.
 $\sum x$ and $\sum y$: the sums of the scores for each variable.
 $\sum x^2$ and $\sum y^2$: the sums of the squared scores for each variable.

Separate Linear Regression is applied to evaluate the influence of each independent variable on the dependent variable individually, allowing for more precise insights into how factors like tourism, income from the museum, and other variables impact GRDP per capita. The data used for Separate Linear Regression is the 2020-2023 time series to be more specific to the time after COVID-19. Separate Linear Regression employs a three-model regression approach with the following formulas:

$$\text{Model 1} : \log G = \beta_0 + \beta_1 \log T + \beta_2 \log I + \epsilon \quad (1)$$

$$\text{Model 2} : \log G = \beta_0 + \beta_1 \log T + \beta_2 \log H + \epsilon \quad (2)$$

$$\text{Model 3} : \log G = \beta_0 + \beta_1 \log U + \beta_2 \log LFPR + \epsilon \quad (3)$$

- Description :
 β_0 : Intercept, the expected value of the dependent variable when all independent variables are zero.
 $\log I$: Logarithm of income generated from the Karst Museum area.
 $\log LFPR$: Logarithm of the labor force participation rate.
 $\log G$: Logarithm of Gross Regional Domestic Product (GRDP) per capita.
 $\log T$: Logarithm of the number of tourists.
 $\log H$: Logarithm of the number of available hotel rooms.
 $\log U$: Logarithm of the number of Unemployment.
 ϵ : Error term, representing the variation in the dependent variable that cannot be explained by the independent variables in the model.

C. FINDINGS AND DISCUSSION

Table 1. Variable Description

Variable	Mean	Std. Dev.	Min	Max
log_G	1,696	0,257	16,700	17,375
log_T	10,006	1,178	7,600	11,054
log_I	18,448	1,077	16,153	19,471
log_U	9,825	0,402	9,472	10,701
log_P	11,655	0,073	11,541	11,735
log_H	6,290	0,227	5,872	6,471
log_LFPR	13,360	0,221	13,132	13,671
log_INF	1,180	0,408	0,445	1,854

Source: Statistical analysis processed from BPS Wonogiri Regency Publication data 2015-2023

The average value for log_G, or GDP per capita (1,696), indicates moderate variation with a standard deviation of 0,257, suggesting economic stability in Wonogiri from 2015 to 2023.

Meanwhile, the number of tourists experienced significant fluctuations, with an average log_T of 10,0062 and a standard deviation of 1,1775, influenced by the COVID-19 pandemic. Income from the Karst Museum also showed considerable variation, with an average log_I of 18,4484 and a standard deviation of 1,0773, affected by the number of tourists and other factors.

Unemployment remained relatively stable with an average log_U of 9,8249 and a standard deviation of 0,4019. The poverty rate was very stable, with an average log_P of 11,6549 and a small standard deviation (0,0733). Meanwhile, the number of hotel rooms showed fluctuations influenced by tourism demand, with an average log_H of 6,2899 and a standard deviation of 0,2265. Labor force participation and inflation rates showed varying degrees of stability and fluctuation, with averages of 13,36 and 1,18, and standard deviations reflecting stability and volatility influenced by local and global economic factors.

Table 2. Correlation Matrix

	log_G	log_T	log_I	log_U	log_P	log_H	log_LF
log_G	1						
log_T	-0,3795	1					
	0,3137						
log_I	-0,3043	0,9658	1				
	0,4259	0					
log_U	0,2651	-0,7799	-0,7746	1			
	0,4905	0,0132	0,0142				
log_P	-0,0464	0,0301	-0,1111	0,0684	1		
	0,9055	0,9387	0,7759	0,8613			
log_H	0,7039	-0,5582	-0,3493	0,3727	-0,4658	1	
	0,0343	0,1183	0,3568	0,3232	0,2064		
log_LFPR	0,8146	-0,6611	-0,5806	0,7373	-0,0379	0,7159	1
	0,0075	0,0525	0,1011	0,0234	0,9228	0,0301	
log_INF	-0,203	0,8908	0,8084	-0,5706	0,2074	-0,5668	-0,43
	0,6004	0,0013	0,0084	0,1086	0,5924	0,1116	0,23

Source: Statistical analysis processed from BPS Wonogiri Regency Publication data 2015-2023

GRDP per capita has a weak negative relationship with the number of tourists and museum income, suggesting that an increase in tourist numbers or museum income slightly decreases GRDP per capita, although this relationship is not statistically significant. In contrast, the number of tourists has a very strong correlation with museum income, reflecting the high dependency of museum income on visitor numbers. The unemployment rate shows a significant negative relationship with both the number of tourists and museum income, meaning that when unemployment increases, the tourism sector and museum tend to experience a decline.

Poverty has a weak and insignificant correlation with other economic indicators such as tourism, museum incomes, unemployment, or hotel room availability. The number of hotel rooms has a moderate positive correlation with GRDP per capita, indicating that an increase in hotel rooms may boost GRDP per capita, likely influenced by higher tourism demand. Furthermore, the labor force participation rate has a significant positive correlation with GRDP per capita, indicating that greater labor force participation leads to higher local economic performance. Inflation shows a negative correlation with both GRDP per capita and the number of hotel rooms, suggesting that higher inflation can reduce economic performance and the tourism sector.

Table 3. Regression Analysis of Logarithmic Variables: Coefficients and Statistical Significance Model

Model 1 : $\log(G) = 49,552 + 3,873 \log(T) - 3,826 \log(I) + \epsilon$						
log_G	Coefficient	Std. Err.	t	P > t	[95% Conf. Interval]	
log_T	3,873	0,143	27,13	0,023**	2,059	5,687
log_I	-3,826	0,145	-26,45	0,024**	-5,664	-1,988
_cons	49,552	1,26	39,31	0,016**	33,536	65,568
Model 2 : $\log(G) = -1,82 + 0,043 \log(T) + 5,425 \log(H) + \epsilon$						
log_G	Coefficient	Std. err.	t	P>t	[95% conf. interval]	
log_T	0,043	0,03	-1,46	0,383	-0,335	0,421
log_H	5,425	0,908	-5,97	0,10*	-6,115	1,696
_cons	-1,82	5773113	-3,15	0,196	-915,566	5,515
Model 3 : $\log(G) = 18,125 - 0,654 \log(U) + 0,418 \log(LFPR) + \epsilon$						
log_G	Coefficient	Std. err.	t	P>t	[95% conf. interval]	
log_U	-0,654	0,076	-8,61	0,074 ⁺	-1,618	0,311
log_LFPR	0,418	0,487	0,86	0,548	-5,77	6,607
_cons	18,125	7,016,122	2,58	0,235	-71,024	107,273

Source: Statistical analysis processed from BPS Wonogiri Regency Publication data 2020-2023

The regression results for Model 1 reveal that the number of tourists has a positive and significant coefficient ($p = 0,023$), indicating a significant impact on GRDP per capita. This suggests that increased income from the tourism sector boosts the local economy. Conversely, income from the Karst Museum shows a significant negative coefficient ($p = 0,024$), implying that income generated by the museum negatively affects GRDP per capita. Additionally, the constant term is significant ($p = 0,016$), reflecting a substantial baseline contribution to GRDP per capita.

In Model 2, the regression results show that the number of hotel rooms has a positive and significant coefficient at the 0,10 level, indicating that an increase in the number of hotel rooms has the potential to enhance the local economy, although the effect is not particularly strong. In Model 3, the results reveal that the unemployment rate has a significant negative impact on GRDP per capita, with a p-value of 0,074, slightly above the 0,05 significance threshold. This suggests that rising unemployment adversely affects the local economy. Conversely, the labor force participation rate shows no significant effect on GRDP per capita ($p = 0,548$), indicating that changes in labor force participation are not associated with economic shifts in this model.

These findings align with other research, such as a 2020 study in Sri Lanka, where a 78% decline in tourist numbers led to a 1,8% reduction in real GDP (Wickramasinghe & Naranpanawa, 2023). The availability of hotels plays a crucial role in boosting the economy through the tourism sector. Furthermore, improving quality to support sustainability can significantly enhance the tourism industry on a larger scale (Guerra & Gonçalves, 2024). The COVID-19 pandemic crisis led to an increase in unemployment and a decrease in GRDP per capita. However, while the tourism sector has the potential to reduce unemployment and boost labor force participation, its impact remains insignificant due to the sector's limited capacity to absorb labor (Al-Thaqeb et al., 2022).

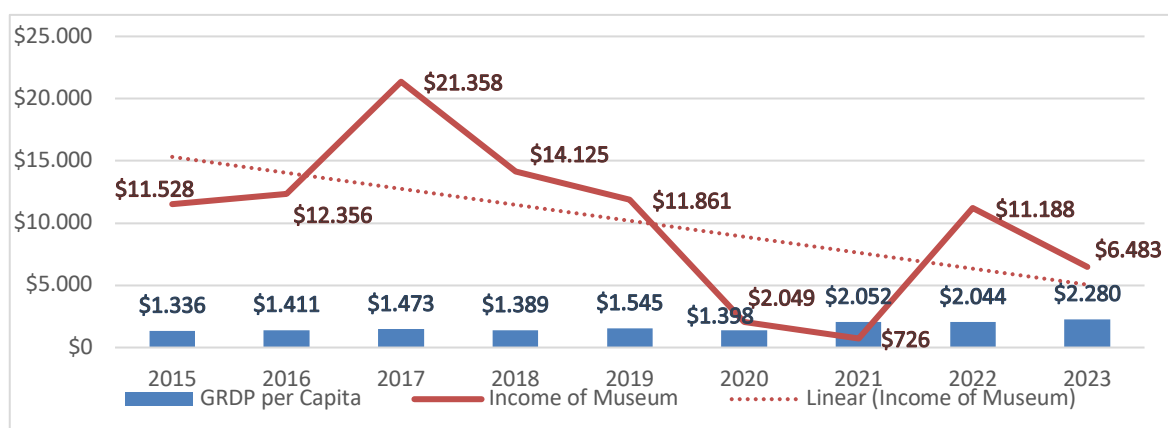


Figure 2. Indonesian Karst Museum Income and GRDP per capita (in USD)

Source: BPS Wonogiri Regency Publication data 2015-2023

From 2015 to 2019, GRDP per capita showed gradual increases, reflecting stable economic growth. However, in 2020, when the COVID-19 pandemic began to impact, GRDP per capita fell to \$1,398, indicating an economic contraction due to lockdowns and restrictions on economic activities. Although there was a slight recovery in 2021 and 2022, GRDP per capita increased to \$2,280 in 2023, showing post-pandemic recovery and likely an increase in economic activities, including tourism and Geopark development. Income from the Karst Museum Geopark Gunung Sewu dropped drastically in 2020 to \$2,049, a significant decline compared to previous years. This can be understood due to the pandemic, which led to the closure of tourist sites and travel restrictions that severely impacted the tourism sector, including museums. In the years prior (2015-2019), museum income had been steadily increasing, showing the important role of the Karst Museum in the local economy before the pandemic.

Although museum income did not return to pre-pandemic levels in the first few years after COVID-19, there was a recovery in 2021 and 2022, with museum income reaching \$726 in 2021 and \$11,188 in 2022. This suggests that despite a significant drop, the sector began recovering as social restrictions eased and tourism interest increased following mass vaccination and the reopening of tourist destinations. In 2023, museum income was recorded at \$6,483, which, although lower than in 2017 and 2018, shows recovery from the direct impact of the COVID-19 pandemic. Tourism income in Wonogiri Regency also dropped sharply in 2020 to \$63,273, far lower than in 2019, which reached \$360,117. This reflects a drastic decline in the number of tourists visiting the region due to travel restrictions and tourism activity limitations. In 2021, tourism income was very low, at \$16,727, even lower than in 2020, but in 2022 and 2023, this sector began to recover, reaching \$139,738 and \$146,458, respectively. Although the income has not yet returned to pre-pandemic levels, this indicates that the tourism sector is gradually recovering and contributing to local economic recovery.

The COVID-19 pandemic caused a spike in unemployment in 2020, with the number reaching 13,174, possibly reflecting job reductions in the tourism sector and other industries directly impacted by social restrictions. However, from 2021 to 2023, the unemployment rate began to decrease gradually, showing economic recovery with the addition of jobs, though still below pre-pandemic levels. Overall, the unemployment rate reflects the economic impact and structural changes in the community, including in the tourism sector, which was affected by COVID-19. This aligns with research by Al-Thaqeb et al. (2022), which found that during the COVID-19 crisis, political uncertainty and regulations led to higher unemployment rates.

Before the pandemic (2015-2019), both museum and tourism income experienced stable growth. The Karst Museum Geopark and tourism in Wonogiri Regency contributed to the local economy's improvement, reflected in the rising GRDP per capita. After the pandemic (2020-2023), there was a significant decline in museum and tourism income. This sharp drop was caused by travel restrictions, temporary closure of tourist destinations, and a reduction in tourism activities. However, from 2021 onward, there was a recovery, although it had not yet reached pre-pandemic levels. This recovery can be attributed to the reopening of tourist destinations, mass vaccination, and increased interest in local tourism after the pandemic. By 2023, while income had not returned to pre-pandemic highs, positive signs of recovery were evident.

The Karst Museum Geopark Gunung Sewu plays an important role in the local economy, but the COVID-19 pandemic had a significant impact on the income of this sector. The tourism sector, which heavily depends on tourist visits, was also severely affected by the pandemic. After the pandemic, there was significant recovery, though both museum and tourism incomes have not fully recovered. Economic recovery can be seen in the increase in GRDP per capita in 2023, reflecting improvement in the local economy. The museum and the tourism sector linked to the Gunung Sewu Geopark may have contributed to this recovery, though challenges remain in reaching higher income levels than before.

Generally, the tourism sector has been affected by COVID-19, including income loss, job losses, and a reduction in funds for development (Anele, 2021; Dube, 2021; Wu, 2021). However, recovery strategies can be implemented to improve the quality of the tourism sector, which is also relevant to the post-COVID-19 condition of the Karst Museum. These strategies will have direct and indirect implications for the GRDP of Wonogiri Regency. These strategies include providing economic stimulus packages from the government, utilizing indigenous community groups, and promoting conservation-linked land use. The government's role in managing financial aid, stimulus packages, and unemployment benefits post-COVID-19 will have a significant positive impact on the tourism economy and the related multi-sectoral areas (Hartmann et al., 2024; Hynes et al., 2021).

The Karst Museum of Indonesia within the Gunung Sewu Geopark offers numerous unique advantages that can advance the tourism sector and the regional economy of Wonogiri Regency. The Karst Museum plays a key role in the inventory of valuable artifacts related to karst, serving as a recreational site, research center, educational facility, and a means of preserving and protecting natural and cultural heritage (Kunardi et al., 2020). From a geological perspective, the Gunung Sewu Geopark area, particularly the Karst Museum site, possesses invaluable uniqueness. A long historical journey can be told based on the origins of the karst materials and caves that are open for visitation. This beauty and uniqueness can be packaged and promoted to enhance the added value to the local community's economy.

D. CONCLUSION

The Karst Museum of Indonesia, located within the Gunung Sewu Geopark, has significant potential to boost the economy of Wonogiri Regency. In the years prior to the pandemic (2015-2019), regional income was relatively high, but it experienced a significant decline due to COVID-19 (2020-2023). Government involvement is needed to further focus on the tourism sector, particularly the Karst Museum of Indonesia, in terms of services and promotion to increase the number of visitors. Additionally, collaboration with both domestic and foreign investors is essential to develop related facilities that could attract more tourists. It is hoped that by continually

increasing both domestic and international tourist numbers, unemployment will decrease, labor force participation will rise, and GRDP per capita in Wonogiri Regency will improve.

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