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Article

Measuring the resilience of rural tourism in Indonesia using the Adjusted Mazziotta-Pareto index

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Abstract: Rural tourism plays a crucial role in rural development in Indonesia by providing employment opportunities, livelihood, infrastructure, cultural preservation, and environmental preservation. However, it is prone to external shocks such as natural disasters, public health events, and volatility in the national and global economy. This study measures the resilience of rural tourism to external shocks caused by the COVID-19 pandemic in 24 rural tourism destinations in Indonesia covering four years from 2019 to 2022. A synthetic composite index of the Adjusted Mazziotta-Pareto index (AMPI) is used to measure rural tourism resilience followed by clustering analysis to determine the typology of the resilience. The AMPI measure is also compared with the conventional Mazziotta-Pareto index (MPI) method. The resilience index is composed of capacity and performance components related to resilience. The results show that in the first year of COVID-19, most tourism villages in Indonesia were severely affected by the pandemic, yet they were able to recover afterward, as indicated by positive differences in the AMPI index before and after COVID-19. Thus, rural tourism villages in Indonesia have a strong capacity and performance to recover from pandemic shock. Lessons learned from this analysis can be applied to policies related to rural tourism resilience in developing countries.

Keywords: rural tourism; resilience measurement; Adjusted Mazziotta-Pareto index; clustering; rural tourism policies

1. Introduction

Tourism faced a critical situation for survival during the COVID-19 pandemic outbreak from 2019 to 2022 (Vărzaru et al., 2021; Chan and Chen, 2022), and it has been one of the last sectors to recover from the pandemic (Organization for Economic Co-Operation and Development (OECD), 2020). As a result, tourism vulnerability became a prominent issue, and it represents a major threat to the sustainability of tourism throughout the world (Gössling et al., 2020). Vulnerability illustrates the extent to which a system reacts adversely during the occurrence of a dangerous event (Proag, 2014). Tourism vulnerability is related to tourism properties, where the structure and function of the tourism system are easily damaged due to its inability to adapt quickly to various tensions and disturbances originating from within and outside the system (Qin and Chen, 2022).

One type of tourism that is increasing in various countries is rural tourism. Using natural resources, culture, and the way of life of rural residents as tourist attractions (Dimitrovski et al., 2012), rural tourism is considered capable of overcoming various problems in rural areas, such as limited job opportunities and high poverty (Markey et al., 2008; Lv et al., 2021). It is also considered to provide new kinetic energy in

revitalizing rural areas (Neumeier and Pollermann, 2014). As one of the main sources of income and employment for local communities and residents of tourist villages, rural tourism has been negatively affected by the pandemic (Jamini and Dehghani, 2022), and it has been thrown into an economic crisis (Panzer-Krause, 2022; Jamshidi et al., 2022). However, in contrast to some researchers, Ibanescu et al. (2022) stated that rural tourism has proven to be a very resilient sector in facing unexpected shocks.

COVID-19 has changed the nature of development challenges basically (Kharas, 2021) and exacerbated imbalances in institutional and funding constraints on development strategies, particularly related to health risks (Ahmad, 2021). Considering the impact of the COVID-19 outbreak, which has been generally difficult for rural tourism, Hu et al. (2021) stated that special attention is needed to increase the resilience of the rural tourism system. Resilience is a paramount variable to help rural tourism recover from the consequences of the pandemic and other external shocks (Pocinho et al., 2022), and it is a crucial component of rural tourism sustainability (Yu et al., 2023). The essence of tourism resilience is developing creative ways to adapt, plan, and prepare for risk (Basurto-Cedeño and Pennington-Gray, 2018).

The concept of resilience has been developed in various fields, but an integrated method has not been developed, and there is no generally accepted tourism resilience model (Yu et al., 2023). Considering tourism's complex and multidimensional characteristics, an appropriate approach is needed to determine tourism resilience. One way is to use a composite index (Mazziotta and Pareto, 2017a), which can be used to measure concepts that cannot be captured by one indicator alone (Scaccabarozzi et al., 2022). The method provides a tool for stakeholders to gain a comprehensive and integrated understanding of tourism destination resilience and provides powerful information that policymakers can use to analyze current policies, negotiate conditions, prepare future plans (Gallego and Font, 2019), and make assessments in terms of resource allocation (Panda et al., 2016).

Indonesia is a country rich in natural resources, culture, and diverse values of rural life. Accordingly, rural tourism is growing steadily in the country. Many new rural tourist destinations have emerged in various regions and have provided new jobs for rural residents outside their main jobs, which are generally agricultural jobs. As the role of the agricultural sector is decreasing in the rural economic structure, the existence of rural tourism gives villagers and villages hope and a way to improve their economy.

In Indonesia, rural tourism is institutionalized in the form of tourism villages (Ariyani et al., 2022), which are the integration of accommodation, attractions, facilities, and infrastructure supporting tourism with the procedures and traditions of village community life (Nuryanti, 1993). However, from mid-2019 to the end of 2021, rural tourism experienced a drastic decline as a result of the COVID-19 pandemic (Sasongko et al., 2022). Tourist numbers dropped, several tourist villages closed, managers' income decreased, traders around tourist destinations lost their livelihoods, and rising unemployment occurred in tourist villages (Damanik et al., 2022). This research is directed to determine the resilience of rural tourism in Indonesia during the pandemic. The results of the research will provide a breakthrough in explaining how tourist villages in Indonesia performed before and after the COVID-19 pandemic.

There is a lack of studies examining the resilience of rural tourism in Indonesia,

specifically those that incorporate temporal variations using a composite index. It is important to understand the impact of shocks on rural tourism comprehensively by using a simple measurement. This understanding will enable improvements to be made and provide policymakers and stakeholders with better insights into how temporal variations affect the capacity and performance of tourism village industries in terms of recovery. The tourism village resilience index can be used as a basis for developing policies to build a resilient rural tourism system, which is expected to support the rural economy.

2. Literature review

The literature on resilience lacks a specific theoretical framework that can be applied in compiling a composite index for rural tourism, especially in the case of Indonesia. Therefore, in this research, we use basic concepts regarding resilience and develop a synthetic measurement of resilience based on variables that are proxied from the parameters of the capacity and performance aspects of tourist villages. This synthetic measurement approach has been used to measure the competitiveness index of cities in Italy (Scaccabarozzi et al., 2022).

2.1. Defining resilience

Resilience is defined differently by many experts (Holling, 1973; Folke et al., 2010; Proag, 2014; etc.). However, in essence, it is a dynamic measure of a system's capacity to adapt to challenges threatening the function and development of the system in the future (Heslinga et al., 2020). The Organization for Economic Co-Operation and Development (OECD) states that resilience is related to events resulting in risks and shocks to a system, where risks are the possibility of negative events and their negative consequences while shocks occur when risks become a reality (OECD, 2014).

Theoretically, the concept of resilience was first developed by Holling (1973) in 1973 to model fluctuations in ecological systems from the process of human relations with the environment. Holling (1973) stated that resilience is a process of persistence and a measure of a system's ability to absorb changes in state variables and driving variables. The concept of resilience has two broad forms: (1) hard resilience, describing the immediate strength of a system, structure, or institution when under stress, and (2) soft resilience, indicating the system's ability to absorb and recover from the impact of disruptive events without change that is fundamental in function or structure (Proag, 2014).

The resilience of a system indicates its ability to reduce the magnitude and duration of deviations from the targeted system performance level (Proag, 2014). Each system has a different capacity to achieve and improve the system (Bayrak, 2022). This capacity includes (1) absorption capacity, which is the system's ability to absorb disturbing events; (2) adaptive capacity, which is the system's ability to adapt to events; and (3) restorative capacity, which is the system's ability to recover from disturbing events (Fiksel, 2003). Early and timely intervention and other control measures can help to mitigate or even prevent the negative effects of shocks on the system (Walker et al., 2004; Folke et al., 2010).

Since the 21st century, resilience has become increasingly widely accepted as a

framework for understanding world systems and has been explored in various anthropogenic contexts, including tourism (Cochrane, 2010). The concept of resilience was first used in tourism in the 1990s (O'Hare and Barrett, 1994). Although, for more than a decade, resilience in tourism only discussed topics related to environmental or financial shocks, still now has covered more complex and holistic aspects by integrating broader topics, including recovery after socioeconomic shocks, community resilience, and the impact of the tourism industry on the resilience capacity of a region (Ibanescu et al., 2022).

The concept of resilience in tourism has spread across many perspectives (McCartney et al., 2021), including business and organizational vulnerability (Annarelli and Nonino, 2016); impact and disruption to hotel operations (Brown et al., 2018); environmental and ecological sustainability of formal and informal tourism businesses (Biggs et al., 2012); tourism resilience to climate change (Dogru et al., 2019); community resilience and the importance of involving and connecting local community knowledge to build destination resilience (Kwok et al., 2016); resilience and recovery from COVID-19 (McCartney et al., 2021); as well as household resilience and subjective well-being in tourism livelihoods (Munanura et al., 2021). The main factors for building resilience in the tourism industry are government response, technological innovation, local ownership, and consumer and employee trust (Sharma et al., 2021). Even though information technology is not yet used by all tourism business managers, it is believed that the development of digital information technology will be able to increase competitiveness in the future (Halim, 2022). Resilience studies in the tourism sector also extend to rural areas, especially regarding the vulnerability and ability of rural tourism systems to adapt during the COVID-19 pandemic (Yu et al., 2023). These applications include tourism projects in rural land development (Shi et al., 2022); community resilience in rural tourism (Lew et al., 2016); the impact of COVID-19 on rural resilience (Yu et al., 2023); and rural tourism in Japan during the new normal (Ohe, 2022).

Various ways to strengthen the resilience of tourist villages to encounter external shocks such as the COVID-19 pandemic have been implemented in many countries, which can be used as lessons learned. In India, three approaches have been taken by rural tourism to face and survive the COVID-19 crisis: (1) a good team to support the business, (2) increased digital engagement, and (3) diversification of their customer base (Aithal et al., 2023). In Italy, the resilience of tourist villages is formed through the participation of local tourism managers who are strengthened by flexibility, inclusiveness, integration, and the ability to achieve the goals of economic sustainability and development prospects through new, creative, and innovative ways (Ivona et al., 2021). Meanwhile, in Iran, four variables are the main components of the resilience of rural tourism: (1) the local government budget, (2) environmental knowledge, (3) community welfare, and (4) a social support system (Jamini and Dehghani, 2022).

In New Zealand, the following factors are considered to enable the creation of greater resilience and a sustainable future: providing sufficient marketing funding for tourism recovery, strengthening tourism place identity, product development, emphasizing good connectivity between residents and communities through strengthening rural networks, and building social capital within and between regions

(Fountain et al., 2020). A study conducted in one of the tourist villages in Malang Regency, East Java, Indonesia, suggests several actions that can be taken to respond to the COVID-19 pandemic: implementing health protocols, providing cash or non-cash assistance to families affected by the pandemic, strengthening the agricultural sector and human resources skilled in the field of tourism services, and practicing innovation in outdoor tourism products based on local uniqueness (Sari et al., 2022). In Malaysia, to revive tourism, several things have been done: tourism operators must not rely too much on tourists from abroad but on domestic tourists to become their main clients, business actors must diversify into market sectors and commercial businesses such as agricultural businesses, and the government has offered financial support to tourism operators to increase domestic travel (Abdullah et al., 2023).

2.2. Measurement rural tourism resilience

Measuring rural tourism's resilience is crucial to optimizing its capacity and performance and demonstrating the system's ability to deal with shocks (Ibanescu et al., 2020). However, considering that tourism is a complex system including many interdependent variables and activities characterized by non-linear relationships, measuring tourism resilience, especially rural tourism, is challenging (Baggio, 2008). In addition, there is no single definition of rural tourism (Tang, 2022). Further, the constant changes occurring in spatial patterns, service facilities, product types, development modes, and functional benefits of rural tourism systems (Lv et al., 2021) strengthen the complexity of this task.

Tourism represents a complex system, so its performance cannot be measured with one descriptive indicator but must be multi-aspected or comprised of a combination of various dimensions (Mazziotta and Pareto, 2013). The dimensions used to measure tourism performance can be considered proxies for the phenomenon (Proag, 2014). Considering this concept, building a composite indicator is the right approach to measure the tourism resilience index (Scaccabarozzi et al., 2022).

Developing a composite index is a valid technique for measuring multidimensional phenomena, because it allows researchers to consider various dimensions of a phenomenon and combine them into one or more individual indicators (Mazziotta and Pareto, 2013). The combination of two or more individual indicators into a composite index is determined by the creator of the composite indicator (Freudenberg, 2003; OECD, 2008). Composite index is formed when each indicator is compiled into one index based on the underlying model. It is an ideal approach to measure multidimensional concepts that cannot be captured by a single index (OECD, 2008).

The process of creating composite indicators is carried out in several phases as follows (Freudenberg, 2003; Mazziotta and Pareto, 2017b):

- Developing a theoretical framework for the composite.
- Identifying and developing relevant variables.
- Standardizing variables to allow comparisons
- Weighting variables and groups of variables.
- Conducting sensitivity tests on the robustness of aggregated variables.

3. Method

There are numerous methods to measure resilience both at the sectoral level and regional level. For example, there is the quantitative approach using risk assessment such as resilience efficiency and the qualitative approach using the risk method (Proag, 2014). In terms of tourism industries, the World Bank (2020) has developed a tourism resilience framework that includes risk, planning, preparation, and responses to shocks. Similarly, Cox (2016) developed the tourism resilience index based on qualitative data. In terms of quantitative analysis measurement, tourism is commonly measured using regression analysis (Duro et al., 2022). In other cases, tourism resilience can be measured using shift-share analysis (Benítez-Aurioles, 2020).

One method of measuring resilience is the Mazziotta-Pareto index (MPI) and the Adjusted Mazziotta-Pareto index (AMPI), which are the most powerful methods of the two partial compensation methods (Scaccabarozzi et al., 2022). The MPI is a formative composite index to summarize a series of indicators that are considered irreplaceable. That is, all components must be balanced (de Muro et al., 2011). It is based on a non-linear function starting from the arithmetic mean and introducing a penalty for units with unbalanced indicator values. The index is designed to meet the following characteristics: (1) normalization of indicators with special criteria that remove units of measurement and effects of variability; (2) independent synthesis of "ideal units," since the set of "optimal values" is arbitrary, non-univocal, and can vary over time; (3) ease of calculation; and (4) ease of interpretation (Mazziotta and Pareto, 2016).

In this study, tourism resilience at the village level is measured using a synthetic indicator known as the Adjusted Mazziotta-Pareto index (AMPI) developed by Mazziotta and Pareto (2016). The AMPI is a variant of the Mazziotta-Pareto index (MPI) developed by Mazziotta and Pareto (2013). It is a non-compensatory composite index that allows comparability of the data across units and over time.

Compared with other composite methods, the AMPI has several advantages. These include, among other things, that the AMPI is more robust, it allows space-time comparison among the units being analyzed, and it is less sensitive when one or two indicators are excluded (Mazziotta and Pareto, 2017a; Lazar and Litan, 2022). In addition, the AMPI has a so-called "penalty effect," whereby if a unit in the analysis has a low value in one indicator and a high value in another, then that unit will receive penalty without compensation.

The AMPI method started with normalizing data or indicators using the following formula:

$$r_{ij} = \frac{\left(x_{ij} - \mathrm{Min}x_j\right)}{\left(\mathrm{Max}x_j - \mathrm{Min}x_j\right)} \times 60 + 70 \quad (1)$$

where x_{ij} is the matrix of n rows containing unit analysis and m columns containing indicators, and max_{xj} and min_{xj} are the "goalspots" for indicator j. In this context, the goalposts are the minimum and maximum values for indicator j across all tourist villages at all periods considered. Such a normalization is a refinement of the MPI method to appreciate absolute changes over time (Mazziotta and Pareto, 2014). The range of normalization is varied between 70 and 130.If we denote M_{ri} and S_{ri} as the mean and standard deviation of the normalized value of unit i, respectively, the generalized

form of AMPI is given by the following equation:

$$AMPI^{+/-} = M_{r_i} \pm S_{r_i} cv_i \quad (2)$$

where $cv_i = S_{r_i}/M_{r_i}$ represents the coefficient of variation of the unit *i*. The sign ± indicates whether the phenomenon to be measured is maximized (the higher the better) or minimized (the lower the better).

As stated earlier, the AMPI needs a "goalspot" to facilitate the interpretation of the results. A reference point of 100, which is the average of indicators in a given year, is used. An AMPI value higher or lower than this reference point indicates whether the unit being analyzed is progressing or regressing. In this case, it indicates whether the units are more resilient or vice versa. The procedure to set the goalspot is the following:

$$Refx_j \pm \Delta \quad (3)$$

where $\Delta = \frac{(Supx_j - Infx_j)}{2}$, where $Supx_j$ and $Infx_j$ represent the maximum and the minimum of indicator *j* across all periods and the reference value of indicator *j* (Mazziotta and Pareto, 2017a).

In addition to the AMPI method, this study also uses the traditional Mazziotta-Pareto index (MPI) to compare the resilience level of tourist villages without using a "goalspot" year, such as that used in the AMPI method. Therefore, the MPI measures the level of resilience independent of time (year). For this study, the MPI score is calculated for every year from 2019 to 2022.

As in the AMPI method, the calculation of MPI also involves normalization of the data through the z-score method. The formula for normalizing the matrix is:

$$z_{ij} = 100 \pm \frac{x_{ij} - M_{x_j}}{S_{x_j}} \times 10 \quad (4)$$

where x_{ij} = the original matrix value; Mx_j = the average value of the indicator (individual column); and Sx_j = the standard deviation of the indicator (individual column).

Once the normalized values have been calculated, the next step of the MPI method is to find aggregation of the index using the following formula:

$$MPI^{+/-} = M_{z_i} \pm S_{z_i} cv_i \quad (5)$$

where M_{z_i} = the mean value of the standardized values (horizontally); S_{z_i}= standard deviation of the standardized values (horizontally); and cv_i = coefficient of variation of the standardized values. The plus or minus signs in the formula are due to the polarity of the indicators concerning one of the phenomena under study.

The measurement of resilience using the AMPI method begins with selecting indicators of rural tourism resilience. In this study, indicators of the resilience of rural tourism are composed of the two main components of resilience: capacity components and performance components. Capacity relates to resources that are part of the rural tourism system, whereas performance relates to the results of the work of a tourist village during and after the disturbance occurred. The reasons for selecting capacity and performance as measures of resilience are based on several points. First, as stated by Vaughan and Frankenberger (2018), resilience consists of a combination of three distinct elements: (1) resilience capacity, (2) shock and stress, and (3) well-being outcomes. Therefore, capacity dimension is an important element when measuring

resilience at various levels. Second, Proag (2014) argued that a system of resilience will depend on the inherent property of the system, and one of these properties is the capacity dimension. In addition, Proag (2014) stated that a system could be categorized as a resilience system if it is able to reduce both the magnitude and duration of the deviation from its targeted performance levels. Hence, the performance component could be used as a measure of the resilience of the system.

There are many ways to measure resilience capacity using various indicators. Vaughan and Frankerberger (2018) stated that deriving capacity indicators could be developed from three types of their functions: (1) to prevent or reduce a shock or stress, (2) to prepare for an anticipated shock or stress, and (3) to act when shocks and stresses occur. For example, the number of people who have been trained in various activities, or capacity building, could be used as a proxy of function number three, while the number of people employed in a system such as tourism could be used as a proxy for function number one and two. Reducing the number of people employed, for example, could be seen as a strategy to reduce shocks and stress. Similarly, deriving resilience performance could be proxied from indicators that are considered to have the capability to reduce the magnitude and duration of the shocks, so as to return to the targeted performance. Income derived from activities, such as tourism, for example, could be used as a proxy for a performance measure since is often used as a targeted indicator. Similarly, the cost of running a system could also be used as a proxy for resilience performance since it indicates the efficiency of the system to return to the targeted performance (Rose, 2007).

As for this study, indicators that relate to the capacity and performance of rural tourism resilience are based on the indicators mentioned in the previous paragraph, and are listed in **Table 1**.

Table 1. Resilience indicators of rural tourism.

Capacity dimension	**Performance dimension**
Capacity building: number of trainings conducted in a year (times)	Tourist: number of tourists during the year (person)
Employees: number of employees in a year (people)	Income: total income for a year (IDR)
Village development index: a framework to maintain villages' potential and ability to achieve sustainable development and prosper village life (per district)	Cost: total cost for a year (IDR)

The implementation of the resilience measurement was carried out by analyzing 24 tourist villages scattered in Java, Bali, and West Nusa Tenggara. The choice of the 24 tourist villages was based on the following reasoning:

- Availability of data.
- Presumably impacted by the COVID-19 shock.
- Considered to have an economic and social impact on the rural economy.
- Represent tourist destinations in Java and outside Java.

In order to capture the resilience of the villages from the COVID-19 shock, the data were collected from 2019 (pre-COVID) to 2022 (during and after COVID). Data on the indicators for all 24 tourist villages are listed in **Tables 2–5**.

Table 2. Original indicators 2019.

Tourism village	Capacity building	Employees	Village development index	Tourists	Income	Cost
Pentingsari	7	42	0.784	21,263	22,353,430	1,609,445
Karangrejo	10	11	0.702	7694	1,891,371	862,902
Wanurejo	4	9	0.702	1200	655,586	398,852
Bleberan	1	101	0.744	64,943	350,973	951,042
Tinalah	2	39	0.709	11,157	427,421	169,812
Gunung Gajah	1	6	0.682	20,655	56,700	67,500
Pulau Cemara	2	17	0.611	37,563	197,537	104,705
Mandiraja	1	15	0.660	12,000	40,000	55,000
Wana Wisata	1	7	0.649	93,231	753,428	963,610
Tlogoweru	10	6	0.599	500	12,000	15,000
Wonosari	0	17	0.610	47,395	664,956	103,309
Tlogowero	1	11	0.746	27,740	82,125	217,800
Bilebante	5	150	0.689	22,638	1,079,000	679,140
Tambaksari	4	16	0.666	6291	85,740	72,400
Pampang	0	30	0.689	60	4428	228
Bendolawang	2	26	0.657	418	2150	3500
Malangjiwan	0	19	0.661	20,608	1,610,249	615,133
Beji	5	25	0.752	6,500	32,000	112,000
Tetebatu	5	178	0.681	3638	960,000	480,000
Sade	6	11	0.671	94,132	390,000	256,000
Bonjeruk	7	27	0.674	2300	1,548,800	80,500
Hanjeli	2	25	0.657	1400	65,000	85,000
Tepus	0	15	0.749	106	210,000	20,000
Cibuntu	1	10	0.709	28,964	354,295	201,879

Table 3. Original indicators 2020.

Tourism village	Capacity building	Employees	Village development index	Tourists	Income	Cost
Pentingsari	0	0	0.799	0	0	0
Karangrejo	0	11	0.720	5930	757,500	812,053
Wanurejo	0	11	0.720	7000	486,200	355,858
Bleberan	2	96	0.756	35,939	724,360	434,616
Tinalah	11	31	0.745	2503	43,589	34,871
Gunung Gajah	0	9	0.706	31,671	98,190	95,703
Pulau Cemara	0	30	0.632	39,288	106,517	141,498
Mandiraja	0	20	0.665	15,000	75,000	60,000
Wana Wisata	2	7	0.662	19,004	175,600	155,314
Tlogoweru	1	6	0.607	50	2000	1500
Wonosari	1	17	0.623	36,045	440,582	102,408

Table 3. (*Continued*).

Tourism village	Capacity building	Employees	Village development index	Tourists	Income	Cost
Tlogowero	0	5	0.771	11,315	101,835	99,000
Bilebante	6	50	0.707	975	53,625	26,812
Tambaksari	2	16	0.738	6459	76,120	66,000
Pampang	4	30	0.717	1765	5295	420
Bendolawang	0	17	0.660	65	650	800
Malangjiwan	0	19	0.701	132,832	1,062,658	985,251
Beji	2	25	0.793	3800	76,000	68,000
Tetebatu	5	156	0.681	3337	656,685	320,000
Sade	4	20	0.686	41,150	100,000	70,000
Bonjeruk	4	29	0.714	1200	70,250	55,000
Hanjeli	1	15	0.647	950	70,000	50,000
Tepus	0	15	0.749	106	25,000	20,000
Cibuntu	0	10	0.730	0	0	0

Table 4. Original indicators 2021.

Tourism village	Capacity building	Employees	Village development index	Tourists	Income	Cost
Pentingsari	4	45	0.812	1100	82,500	61,874
Karangrejo	11	12	0.724	6192	1,048,052	927,398
Wanurejo	0	12	0.724	6000	424,414	300,004
Bleberan	0	96	0.767	16,293	306,199	183,719
Tinalah	13	44	0.759	3395	67,850	54,280
Gunung Gajah	0	5	0.709	19,505	61,798	61,107
Pulau Cemara	1	34	0.636	40,030	120,005	117,113
Mandiraja	0	10	0.665	10,000	50,000	45,000
Wana Wisata	2	8	0.669	46,813	561,860	335,82
Tlogoweru	2	6	0.638	100	4000	6000
Wonosari	1	17	0.627	48,153	488,063	83,321
Tlogowero	2	4	0.772	9125	82,125	79,200
Bilebante	7	70	0.709	2700	202,500	101,250
Tambaksari	0	16	0.740	4202	51,100	62,000
Pampang	4	30	0.719	323	969	324,000
Bendolawang	1	17	0.729	128	1500	1280
Malangjiwan	0	21	0.724	107,060	856,528	684,963
Beji	0	12	0.793	760	15,000	14,860
Tetebatu	4	197	0.692	4115	884,575	416,000
Sade	6	20	0.695	71,323	113,000	79,000
Bonjeruk	6	41	0.714	14,000	588,400	220,000
Hanjeli	1	15	0.655	500	40,000	33,000
Tepus	5	15	0.795	155	38,800	30,000
Cibuntu	1	10	0.754	17,181	146,905	112,500

Table 5. Original indicators 2022.

Tourism village	Capacity building	Employees	Village development index	Tourists	Income	Cost
Pentingsari	6	45	0.821	10,219	719,572	546,874
Karangrejo	15	18	0.749	12,006	2,8911	2,197,875
Wanurejo	0	9	0.749	20,000	655	333,008
Bleberan	0	84	0.796	18,524	350,973	210,583
Tinalah	15	44	0.802	9009	427,421	406,049
Gunung Gajah	1	5	0.715	15,760	56,700	65,540
Pulau Cemara	2	30	0.658	29,091	197,537	107,910
Mandiraja	0	10	0.724	8000	40,000	40,000
Wana Wisata	2	9	0.690	73,482	753,428	365,426
Tlogoweru	6	6	0.659	300	12,000	9000
Wonosari	1	17	0.652	68,119	664,956	103,906
Tlogowero	1	4	0.772	9125	82,125	79,200
Bilebante	5	100	0.796	13,000	1,079,000	431,600
Tambaksari	3	22	0.744	7824	85,740	81,000
Pampang	5	30	0.760	1476	4428	396
Bendolawang	1	17	0.758	215	2150	2000
Malangjiwan	1	20	0.735	145,955	1,610,249	1,175,856
Beji	0	12	0.820	1600	32,000	28,000
Tetebatu	2	176	0.770	6257	960,000	448,000
Sade	5	20	0.722	110,540	390,000	273,000
Bonjeruk	9	62	0.758	32,000	1,548,800	816,600
Hanjeli	1	18	0.672	800	65,00	47,000
Tepus	4	24	0.817	909	210,000	168,000
Cibuntu	1	10	0.790	13,137	354,295	201,879

4. Results and discussion

Before the COVID-19 pandemic, rural tourism in Indonesia showed promising growth. The growth is indicated by many new tourist destinations emerging and tourist villages as rural tourism operators increasing and growing in various regions. The number of tourist villages in Indonesia before the COVID pandemic was 1831 (Ariyani and Fauzi, 2023). However, in March 2020, when the government officially declared that Indonesia was affected by the pandemic and imposed large-scale social restrictions policies, tourist destinations in Indonesia faced a drastic decline in visitors and income (Sasongko et al., 2022). Nevertheless, some tourist villages were able to recover from the shock, as can be seen from the results of this study.

4.1. Resilience based on the AMPI method

Table 6 shows that one year after the pandemic, all 24 tourist village suffered from decline in their performance, as indicated by decreases in their AMPI scores (**Figure 1**). The delta (Δ) score from 2019–2020 shows changes in the resilience index

of the villages in 2019–2020. This period was the most critical period for the tourism village. All of the 24 villages studied experienced a decrease in their resilience index (negative delta AMPI). The impact affected the villages differently, however. Some experienced a slight reduction in their resilience score while others were affected greatly.

Table 6. Comparison of tourism village resilience index prior to and during the COVID-19 pandemic.

Tourist village	AMPI					
	2019	2020	Δ1	2020	2021	Δ2
Pentingsari	107,543	92,728	−14.815	92,728	99,363	6.635
Karangrejo	103,401	94,608	−8.793	94,608	108,836	14.228
Wanurejo	99,358	96,037	−3.321	96,037	99,233	3.196
Bleberan	103,293	102,091	−1.202	102,091	101,050	1.041
Tinalah	98,628	92,423	−6.205	92,423	101,606	9.183
Gunung Gajah	96,659	95,469	−1.19	95,469	96,610	1.368
Pulau Cemara	97,094	95,242	−1.852	95,242	98,471	3.229
Mandiraja	96,557	95,666	−0.891	95,666	95,744	0.078
Wana Wisata	99,879	97,276	−2.603	97,276	102,027	4.751
Tlogoweru	99,090	94,181	−4.909	94,181	95,247	1.066
Wonosari	96,174	95,931	−0.243	95,931	99,775	3.844
Tlogowero	98,003	95,103	−2.9	95,103	97,693	2.59
Bilebante	104,705	94,876	−9.829	94,876	100,928	6.052
Tambaksari	98,129	96,477	−1.652	96,477	96,436	−0.041
Pampang	96,381	94,768	−1.613	94,768	97,326	2.558
Bendolawang	97,041	94,443	−2.598	94,443	95,986	1.543
Malangjiwan	101,882	97,627	−4.255	97,627	107,394	9.767
Beji	99,838	96,154	−3.684	96,154	96,206	0.052
Tetebatu	104,052	98,319	−5.733	98,319	107,203	8.884
Sade	100,603	96,692	−3.911	96,692	101,590	4.898
Bonjeruk	99,790	95,858	−3.932	95,858	102,940	7.082
Hanjeli	97,321	96,095	−1.226	96,095	95,607	0.488
Tepus	96,584	94,218	−2.366	94,218	98,353	4.135
Cibuntu	97,597	93,544	−4.053	93,544	98,162	4.618

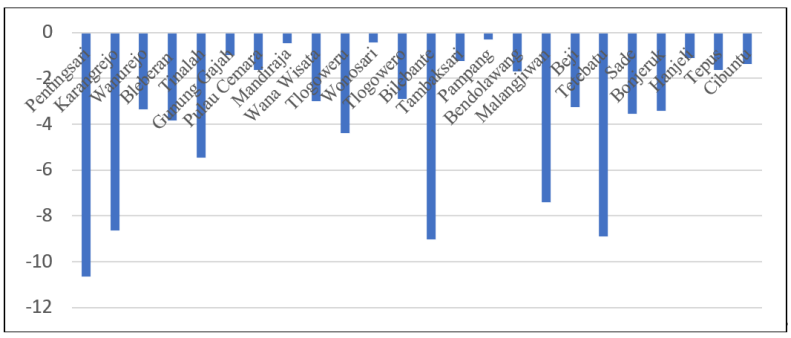

Figure 1. Delta AMPI 2019–2020.

During the period 2019–2020, the Pentingsari tourism village experienced the most significant decrease in their resilience index compared to that of other villages. The government's travel ban policy resulted in a significant reduction in the number of tourist arrivals in the village. Therefore, the Pentingsari tourist village, which offers rural and agricultural cultural attractions, closed its services rather than bearing costs disproportionate to its income. However, several other tourist villages remained open even though the number of visitors and their income decreased sharply. They kept active to maintain their tourism village status by engaging in other activities such as training their staff or maintaining their facilities.

Compared with the period 2019–2021, the period 2020–2021 shows significant differences in the tourism resilience index (**Figures 2** and **3**). During the period of 2020–2021 (one year after the COVID-19 pandemic), almost all villages, except the Tambaksari village, show a remarkable recovery evidenced by positive changes in their AMPI scores (delta AMPI positive). This indicates that during this period, the tourism villages adapted to the shocks caused by COVID-19. The resilience index generally increased because the tourist villages implemented health protocols (i.e., the Cleanliness Healthy Safety Environment or CHSE protocol) and conducted training related to services during the new normal period.

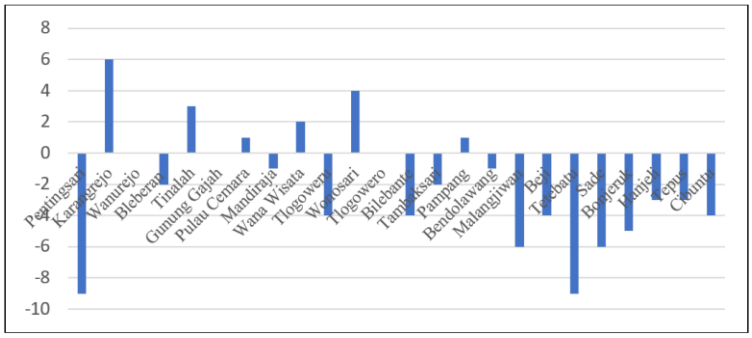

Figure 2. Delta AMPI 2019–2021.

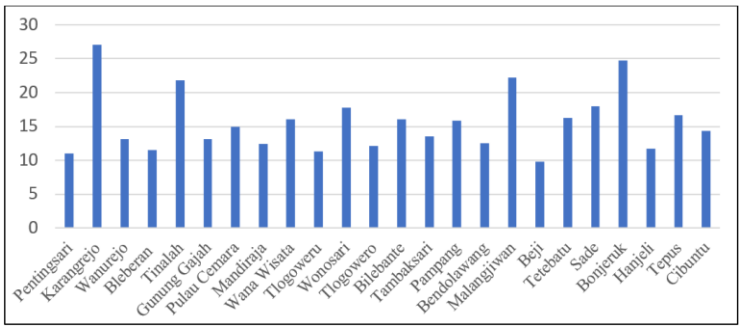

Figure 3. Delta AMPI 2019–2022.

Several villages also transformed their tourist destination by utilizing digital technology to create virtual travel packages. Digital tourism was developed to target visitors who were not able to visit the villages in person or were still afraid of catching COVID-19. It included using common digital platforms such as Instagram to promote tourism spots (making the tourist destinations "Instragammable"), developing an app that accommodates for reservations of homestay and local restaurants, increasing access to WIFI for tourists staying in the villages, and providing cashless payment

options for tourists. In addition, the recovery of tourism villages was supported by the Indonesian government policy that gradually reopened tourism activities. As a result of this policy, the number of visitors gradually increased. The development of digital technologies, in general, encouraged destination management organizations and stakeholders to optimize their competitiveness and improve the visitor experience (El Archi et al., 2023).

As can be seen in **Table 6**, during 2020–2021 (Δ2), the most significant increase in the resilience index occurred in Karangrejo village. Karangrejo village is a community-based tourism village that offers rural and agricultural cultural attractions. With full support from the community, especially in providing lodging facilities and implementing the CHSE protocol, this village succeeded in increasing the number of visitors, which was followed by increases in other resilience indicators.

Table 7 presents a comparison of AMPI resilience scores before, during, and after COVID-19 (i.e., from period 2019 to 2022 using 2022 as a "goalspot"). As can be seen from the table, the overall AMPI scores increased significantly toward 2022, which indicates that there was a strong trend of recovery from the shock. The most significant increase in AMPI scores occurred in 2021–2022 when all villages experienced an increase in the index, reaching double digits (**Figures 4–6**). This increase illustrates that tourist villages have adapted to the COVID-19 shock and can be considered as having fully recovered. One of the villages that showed the strong resilience, as indicated by the highest positive value of delta, is Karangrejo.

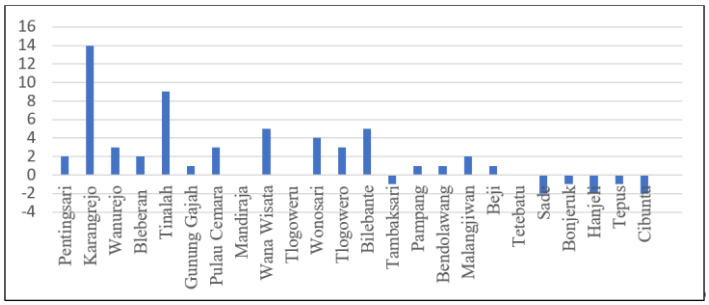

Figure 4. Delta AMPI 2020–2021.

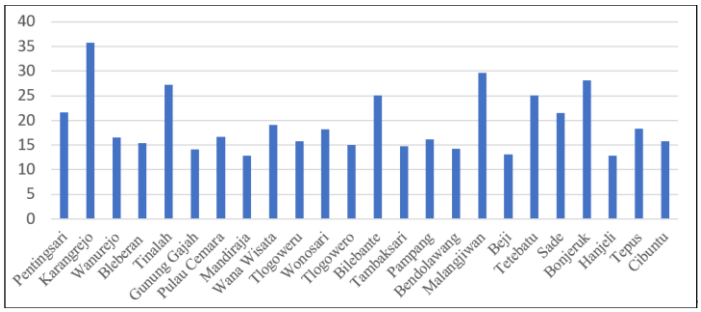

Figure 5. Delta AMPI 2020–2022.

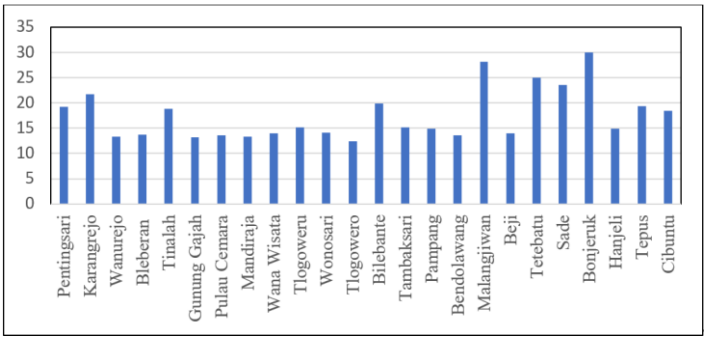

Figure 6. Delta AMPI 2021–2022.

Table 7. Comparison of tourism village resilience index after the COVID-19 pandemic.

Tourism village	AMPI								
	2019	2022	Δ1	2020	2022	Δ2	2021	2022	Δ3
Pentingsari	107,543	118,566	11.023	92,728	118,566	25.838	99,363	118,566	19.203
Karangrejo	103,401	130,491	27.09	94,608	130,491	35.883	108,836	130,491	21.655
Wanurejo	99,358	112,524	1.166	96,037	112,52	16.487	99,233	112,524	13.291
Bleberan	103,293	114,805	11.512	102,091	114,805	12.714	101,050	114,805	13.755
Tinalah	98,628	120,395	21.767	92,423	120,395	27.972	101,606	120,395	18.789
Gunung Gajah	96,659	109,813	13.154	95,469	109,813	14.344	96,610	109,813	13.203
Pulau Cemara	97,094	112,095	15.001	95,242	112,095	16.853	98,471	112,095	13.624
Mandiraja	96,557	109,006	12.449	95,666	109,006	13.34	95,744	109,006	13.262
Wana Wisata	99,879	115,969	16.09	97,276	115,969	18.693	102,027	115,969	13.942
Tlogoweru	99,090	110,458	11.368	94,181	110,458	16.277	95,247	110,458	15.211
Wonosari	96,174	113,914	17.74	95,931	113,914	17.983	99,775	113,914	14.139
Tlogowero	98,003	110,091	12.455	95,103	110,091	14.988	97,693	110,091	12.398
Bilebante	104,705	120,750	16.045	94,876	120,750	25.874	100,928	120,750	19.822
Tambaksari	98,129	111,619	13.49	96,477	111,619	15.142	96,436	111,619	15.183
Pampang	96,381	112,194	15.813	94,768	112,194	17.426	97,326	112,194	14.868
Bendolawang	97,041	109,545	12.504	94,443	109,545	15.102	95,986	109,545	13.559
Malangjiwan	101,882	124,144	22.262	97,627	124,144	26.517	107,394	124,144	16.75
Beji	99,838	109,628	9.79	96,154	109,628	13.474	96,206	109,628	13.422
Tetebatu	104,052	120,301	16.249	98,319	120,301	21.982	107,203	120,301	13.098
Sade	100,603	118,571	17.968	96,692	118,571	21.879	101,590	118,571	16.981
Bonjeruk	99,790	124,534	24.744	95,858	124,534	28.676	102,940	124,534	21.594
Hanjeli	97,321	109,075	11.754	96,095	109,075	12.98	95,607	109,075	13.468
Tepus	96,584	113,240	16.656	94,218	113,240	19.022	98,353	113,240	14.887
Cibuntu	97,597	111,961	14.364	93,544	111,961	18.417	98,162	111,961	13.799

One of the reasons for the success of Karangrejo village is its ability to build partnerships with several parties, especially state-owned enterprises, by forming a Village Economic Center (known locally as “Balkondes”). In addition, the Tourism Awareness Group (“Pokdarwis”) played a pivotal role in strengthening resilience to the COVID-19 shock. The collaboration of the two institutions was influential in developing creativity that encouraged visitor arrival. Karangrejo also shows a high level of community involvement in providing homestays and other supporting

facilities that have adapted to health protocols, which have become a source of increasing the performance of this tourist village, both in terms of the number of visitors and income. All of this is evidence of the successful implementation of community-based tourism, which has successfully dealt with the external shock of the COVID-19 pandemic. The success of the Karangrejo tourist village earned it an award from the Indonesian government as a sustainable tourism village.

4.2. Resilience based on the MPI method

Table 8 shows the resilience index calculated using the traditional MPI method. As explained earlier, compared with AMPI, the MPI assesses the resilience of unit analysis (tourist villages) for each year without using the goalspot or the year 2022 as the target. As can be seen in **Table 8**, the tourist village with the highest MPI score is Pentingsari, and the one with the lowest MPI score is Wonosari. The high resilience index of Pentingsari is attributed to the total income of this village, which is relatively higher compared to other tourist villages. In 2019,Pentingsari was a favorite tourist destination using environmentally-friendly themed tourism, which was in great demand before COVID-19. However, in 2020, the village closed its operations as a result of the decline in the number of visitors due to the increasingly rapid spread of the COVID-19 virus and the government's imposition of restrictions on activities outside the home, as explained in the previous section.

Table 8. Resilience index 2019–2022 using the MPI method.

Tourism village	MPI							
	2019	Rank	2020	Rank	2021	Rank	2022	Rank
Pentingsari	116	1	96	19	101	10	99	3
Karangrejo	104	5	104	4	110	1	97	4
Wanurejo	99	10	100	7	99	12	94	8
Bleberan	106	2	111	2	103	5	94	9
Tinalah	99	12	103	5	102	6	96	5
Gunung Gajah	96	18	98	15	95	20	92	16
Pulau Cemara	94	23	97	17	96	17	89	21
Mandiraja	95	22	95	20	93	22	92	15
Wana Wisata	99	9	97	16	101	8	92	18
Tlogoweru	95	19	92	24	92	24	87	24
Wonosari	93	24	98	14	97	15	88	23
Tlogowero	98	13	98	13	98	14	92	19
Bilebante	106	3	100	6	101	9	100	2
Tambaksari	97	15	98	11	96	19	94	7
Pampang	95	20	98	12	97	16	93	14
Bendolawang	95	21	93	23	95	21	92	17
Malangjiwan	102	6	112	1	109	2	95	6
Beji	101	7	100	9	96	18	89	22
Tetebatu	105	4	108	3	108	3	93	13
Sade	100	8	100	8	101	7	93	11

Table 8. (*Continued*).

Tourism village	MPI							
	2019	Rank	2020	Rank	2021	Rank	2022	Rank
Bonjeruk	99	11	99	10	103	4	103	1
Hanjeli	96	17	94	22	93	23	89	20
Tepus	97	16	96	18	99	11	93	12
Cibuntu	97	14	95	21	98	13	93	10

Table 8 also reveals that the impact of COVID-19 was felt differently across the villages, as indicated by variations in the ranking of MPI from 2019 to 2022. Variations and changes in the ranking of the MPI scores were attributed to variations in how the villages responded to the COVID-19 policy, such as limited mobility and the strict protocol of traveling. Hence, the level of resilience of each tourist village is influenced by its ability to adapt, innovate, and collaborate with partners, which impacts its public confidence to carry out tourism activities during a pandemic.

While Pentingsari performed well in 2019, once the pandemic struck, the village was greatly affected, as shown by the drastic decline in its MPI score from number 1 in 2019 to number 19 in 2020. In 2020, the tourist village that had the highest MPI score is Malangjiwan village. The main tourist attraction of Malangjiwan village is healthy water therapy that comes from natural springs with high pH and oxygen levels (reaching PH 7.5). The village is located within view of the exotic rice fields on Mount Merapi. Nearly 90% of its visitors are not merely looking for pure water tourism, but they are looking for a place to relax to enhance their health. The product's suitability to the needs and desires of the people during the pandemic, who were very focused on health, made this destination extremely attractive. The high resilience index of Malangjiwan village during the study period is caused by the resulting high number of visitors and large amount of income.

In 2021, Karangrejo village had the highest resilience index. This village is managed by the Village Economic Center (Balkondes) and the Tourism Awareness Group (Pokdarwis), which actively offered tour packages about life in the village and around it that were of great interest to tourists during the pandemic. Government policies allowed the reopening of tourism attractions once they implemented the CHSE protocol. In maintaining cleanliness and the environment, this village became a clean pilot village, which in its implementation, involved the entire village community. Karangrejo also has meeting room facilities and culinary spots, and it offers hotels and homestay facilities for tourists from out of town.

In 2022, Bonjeruk village was ranked first in the resilience index. It is an example of the success of the efficiency aspect of financing in determining the resilience of a tourism village in addition to income. This tourist village has developed cultural and historical tourism products, its rural nature, and special culinary impressions to show visitors how to live peacefully in the countryside. It has beautiful natural nuances and a noble culture that make visitors feel comfortable and relaxed after the hustle and bustle of life in their area of origin. After the tourism ban was lifted by the government and the pandemic gradually subsided, Bonjeruk village became a favorite choice for tourists from both within and outside the city. Thus, the number of visitors in this

village increased by up to 300%, and it is able to operate with an efficient number of employees and costs.

5. Typology of tourist villages based on resilience index categories

The results from the AMPI analysis can be used further to classify tourist villages based on three characteristics. These are (1) tourism villages that have a high resilience index (≥100) but experienced a decline during the COVID-19 pandemic period (Cluster 1-C1), (2) a tourist village that has a high and stable resilience index during the COVID-19 pandemic (Cluster 2-C2), and (3) a tourism village that has a low level of resilience and is immensely affected by the COVID-19 pandemic (Cluster 3-C3). The classification was carried out using the data mining-based Orange Software, which is still limited in the case of tourism in Indonesia (Ariyani et al., 2022). The reason for classifying rural tourism based on typology analysis is to provide policy makers with an easier distinction on resilience characteristics based on AMPI score. Typology was formed by grouping tourist villages based on common feature of the resilience index. This type of typology analysis is known as descriptive typology (Collier et al., 2012).

Typology analysis has been used in resilience analysis such as that by Keating et al. (2020) to understand specific policy intervention based on characteristics of the units being analyzed.

Figure 7 presents the clustering of the 24 villages based on resilience category. There are 9 villages in Cluster 1, 1 village in Cluster 2, and 14 villages in Cluster 3. The villages in Cluster 1 are well-established tourist villages that have a large number of human resources with sufficient and relatively high motivation and creativity. They carry out sufficient capacity-building development and are located in districts/sub-districts that have a developing village index in the category of independent and advanced villages. These tourist villages have made various efforts to deal with the COVID-19 pandemic, especially in adapting and adopting digital technology to offer virtual travel packages as a means of promotion and product development. Training on improving service excellence has become one of the most popular capacity-building effort. All of these efforts have succeeded in building public confidence regarding traveling to rural areas, as evidenced by the increasing number of visitors.

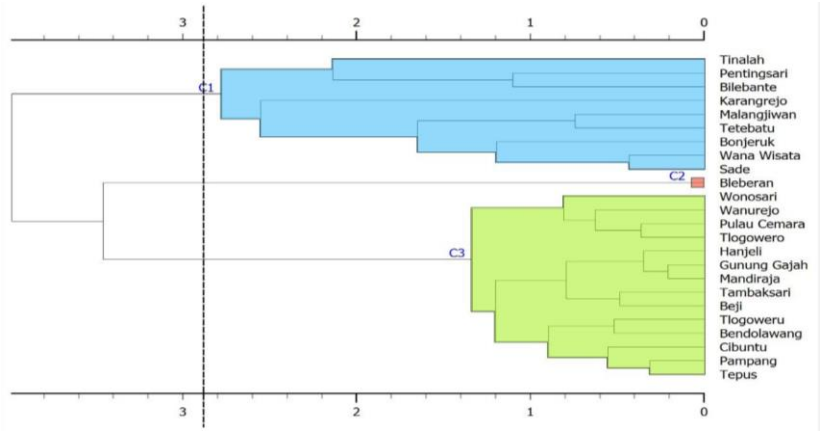

Figure 7. Tourism village typology based on resilience category.

The distribution of the 24 tourist villages between before, during, and after the COVID-19 pandemic is shown in **Figures 8–13**.

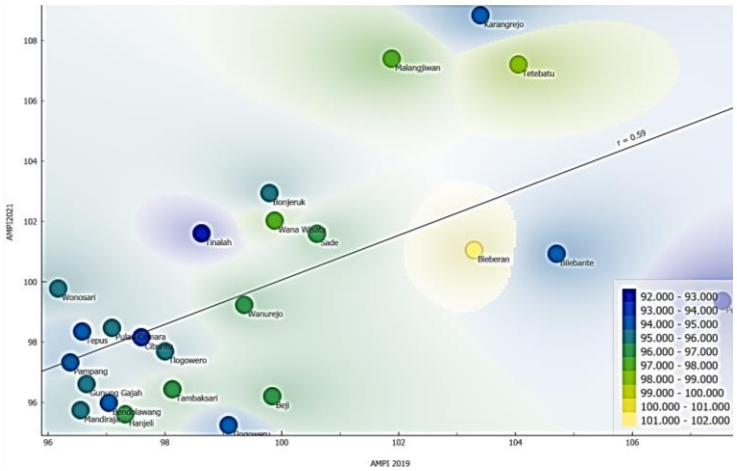

Figure 8. Scatter plot of tourism villages 2019–2021.

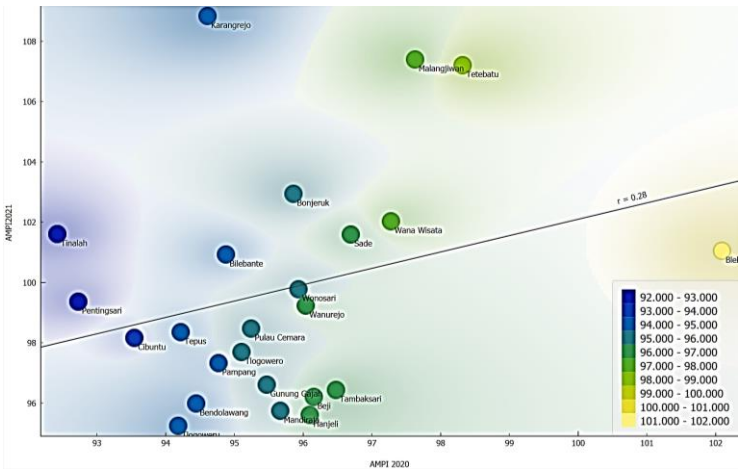

Figure 9. Scatter plot of tourism villages 2020–2021.

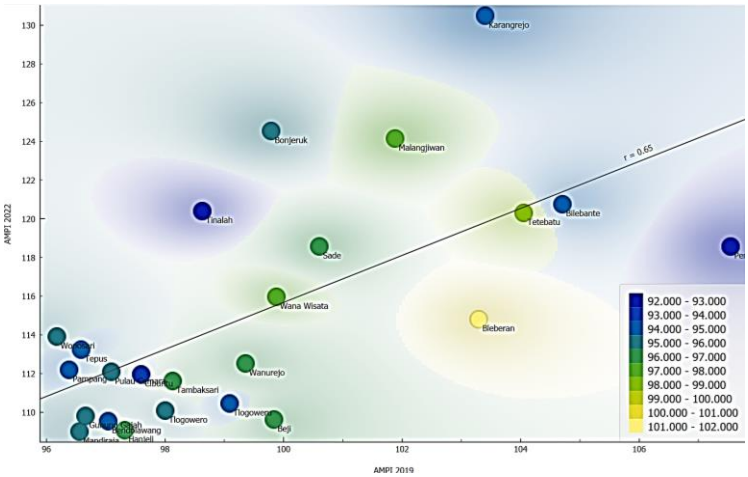

Figure 10. Scatter plot of tourism villages 2019–2022.

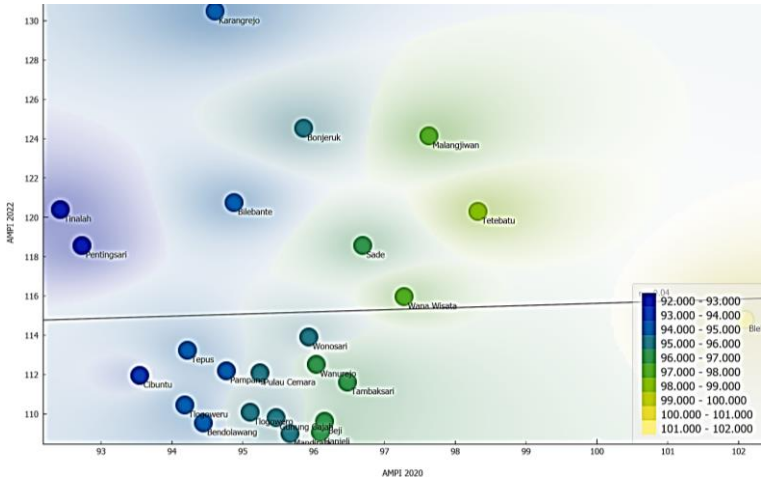

Figure 11. Scatter plot of tourism villages 2020–2022.

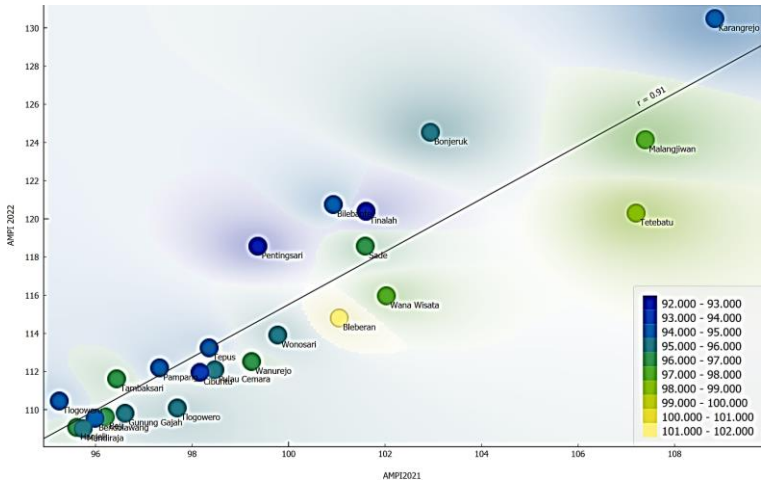

Figure 12. Scatter plot of tourism villages 2021–2022.

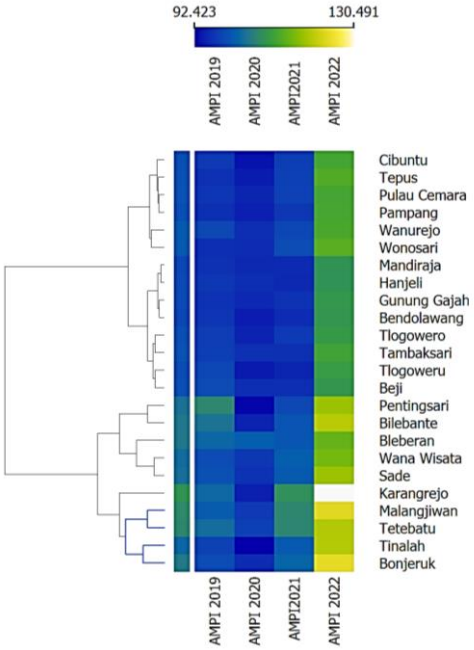

Figure 13. Heat map resilience distribution of tourism villages.

6. Conclusion

Measuring resilience, especially in the context of rural tourism in Indonesia, is a complex process, as no universal method can be implemented in different tourism settings. Yet, knowing how resilient rural tourism is allows us to develop better policy measures to protect it or help it recover from the shocks. A synthetic composite index is a tool of resilience measurement that can be easily understood by policy makers since it can be compared across regions and time. For this reason, this research used a simple composite index to measure the resilience of rural tourism in the developing country of Indonesia.

The main objective of this study was to assess the resilience level of rural tourism in 24 villages in Indonesia. It was guided by a research question on how resilient rural tourism in Indonesia is by comparing the level of resilience using a composite index before, during, and after the external shock of the COVID-19 pandemic. Using simple composite index, the results show that almost all rural tourisms villages were hard hit in the first year of the pandemic. However, unlike other tourism destinations, villages that offer rural tourism were able to recover from the shock within a relatively short period of time. Various creative ideas as a form of adaptation to a new normal were created by tourist village managers. Several villages succeeded in developing virtual travel packages by utilizing digital technology. It is recorded that more than 64 locations in Indonesia can be visited virtually. The villages also succeeded in training staff and implementing additional infrastructure in the context of health protocols, including cleanliness, health, safety, and environmental sustainability (CHSE). This illustrates the resilience of the rural tourist village in the face of the COVID-19 shock.

In all business sectors, resilience is the key to future business success. However, measuring how resilient a business entity is can be rather tricky. This study makes significant contributions to the understanding and measurement of resilience in several ways. It enhances existing methods used in resilience studies and introduces a novel approach by presenting a measurement of resilience using a composite index that incorporates temporal variations. This approach differs from the majority of tourism resilience studies, and it provides valuable insights and expands the current knowledge in this field. The approach used in this study can be used as a lesson learned for policy makers in managing rural tourism in Indonesia. The synthetic indicator of resilience derived from this study can be used to evaluate the resilience of tourism at the village level and to design better policy measures to strengthen this resilience. Despite its strength, this study still has some weaknesses, especially in choosing variables of resilience both for capacity and performance components. Having more variables in both components would provide better information about the resilience level and their components. Similarly, having more units of analysis would provide better comparison for aggregating the resilience of rural tourism.

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acquisition, NA. All authors have read and agreed to the published version of the manuscript.

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