

RESEARCH ARTICLE



Strategic Policy Framework for Sustainable Geopark Development Aimed at Advancing Village Independence within the UNESCO Global Geopark Gunung Sewu Region

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ABSTRACT

Indonesia's diverse cultural, natural, and geological resources boost tourism. Geoparks are key to sustainable development, and the Gunung Sewu Geopark is recognized by UNESCO. However, its main use in tourism does not yet fully affect the village's independence. This study addresses research gaps by proposing an integrated policy framework that uses multi-criteria analysis to consider economic, social, and environmental factors as an effort to improve village self-sufficiency and governance geopark. Using the multi-criteria policy analysis (MULTIPOL) method, this research examines the alignment among the priorities of scenarios, policies, and action plans. The findings reveal that priority scenarios in Gunung Kidul and Wonogiri enhance GSUGGp community advantages by increasing community awareness (*CpcityBhav*), with the highest average values of 17.4 and 17, respectively. In Pacitan, two priority scenarios are identified: strengthening regulations and institutions for sustainable GSUGGp management (*InstituReg*) and *CpcityBhav*, both with average value of 16.8. Policy and action plan priorities across the three regencies show that Gunung Kidul and Pacitan focus on marketing and boosting tourism activities to stimulate local economies, while Wonogiri emphasizes community-based initiatives through tourism and local entrepreneurship. At the program level, regional differences emerge in priority actions, including partnerships, green investments, education-based tourism, and university collaboration. This study highlights the importance of locally adaptive, integrated policies to overcome institutional fragmentation and promote sustainable Geopark development that strengthens village independence. The strategic framework developed offers practical relevance for geoparks facing similar cross-jurisdictional challenges.

Introduction

Geoparks are increasingly seen as tools for environmental governance within global sustainable development goals, serving not only as tourist destinations but also as territorial frameworks that integrate conservation, education, local economies, and ecosystem services to protect geoheritage while boosting community well-being [1–3]. From this perspective, geoparks act as platforms that balance natural resource management with inclusive rural development. The Gunung Sewu UNESCO Global Geopark (GSUGGp), which spans Gunung Kidul (Yogyakarta), Wonogiri (Central Java), and Pacitan (East Java), serves as a notable example because of its vast karst landscape, rich geodiversity, and unique biodiversity, as well as its important geoheritage assets [4,5]. These characteristics position the region as both a conservation priority and a strategic site for

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community-based development; however, village development within GSUGGp varies greatly, requiring targeted strategies to ensure the geopark benefits are fairly shared across both geosite and satellite villages while enhancing village independence in line with UNESCO's pillars [6,7].

Despite these objectives, geopark implementation in the GSUGGp remains mainly focused on tourism-driven economic growth, while conservation efforts, ecosystem protection, and institutional coordination still receive relatively little attention and are mostly limited to "business-as-usual" practices. Tourism activities are primarily managed by local tourism awareness groups and youth community organizations (*Karang Taruna*), and the expected socioeconomic benefits have not been shared equally among villages within the geopark area. The region also faces several strategic challenges, including post-COVID tourism recovery [8], uneven benefit distribution [9], infrastructure and accessibility limitations [10], weak institutional performance [9], environmental degradation [11], lack of data transparency [12], and low public awareness and participation [13]. These challenges are further compounded by the geopark's cross-regional configuration across three administrative provinces, which fragments planning authority and contributes to inconsistent policy implementation [14,15]. Given the complexity of tourism-related issues in the GUGGp area, it is essential to develop an integrated policy framework that strengthens institutional coordination, fosters interregional collaboration, and empowers local communities through inclusive development strategies and innovative geopark flagship products or geoproducts [16,17].

Overall, research on GSUGGp continues to grow. However, current research primarily focuses on specific topics, such as tourism and biophysical factors. These include karst geomorphology [18], extractive industries and agricultural expansion [19], ecosystem services [20], and the development of virtual tourism to enhance accessibility [21]. Community participation in geopark management is also fairly limited due to a low level of understanding of the governance structures [22]. Disparities in development and village independence within the GSUGGp area persist, ranging from Development to Advanced status. This suggests that the geopark's presence has not yet ensured regional growth. While numerous community-driven innovations have been introduced [23], the benefits remain localized and have not yet led to comprehensive (multi-aspect) change. This highlights an ongoing gap in decision-support methods that systematically develop policy priorities, strategies, and action plans to achieve inclusive and sustainable development.

An analytical framework is necessary to assess alternative development policies that focus on the tourism sector recovery, conservation success, ecosystem management, and socio-economic resilience. This study employs the multi-criteria analysis method to develop and compare various policy options based on the overview provided above. The primary objectives of this research are: (1) which policy priorities can facilitate sustainable geopark development in each GSUGGp area? and (2) what action plans should be implemented to effectively support these priorities while balancing conservation, ecosystem management, and village independence?

This study contributes to environmental governance and natural resource management within the GSUGGp geopark system. The proposed approach provides a comprehensive set of scenario, policy, and action-plan support tools based on multiple criteria. These tools aim to improve the sustainable independence of villages within GSUGGp and can serve as a replicable model for other geopark areas facing similar challenges.

Materials and Methods

Study Area

This study examined villages within the GSUGGp area, divided into two types: geosite villages, where an administrative geosite is located, and non-geosite villages, which do not contain an administrative geosite, as shown in Figure 1. The focus is on villages in Gunung Kidul Regency (Special Region of Yogyakarta Province), Wonogiri Regency (Central Java Province), and Pacitan Regency (East Java Province). A total of 100 villages were sampled across these regions. The study was conducted from April to December 2024.

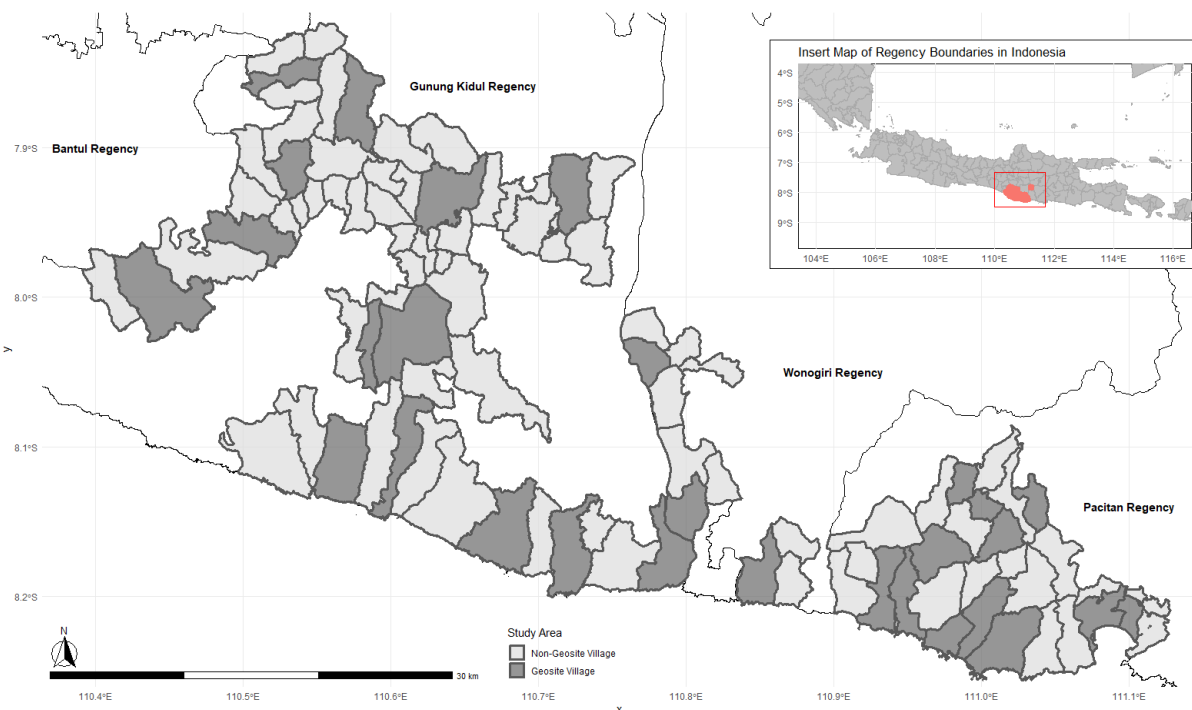


Figure 1. Research Location Map within the Gunung Sewu UNESCO Global Geopark Area. This map illustrates the spatial distribution of GSUGGp alongside the three districts involved in the study: Gunung Kidul, Wonogiri, and Pacitan Regencies. It also indicates the locations of the sampled villages, including both geosite sites and non-geosite.

Methodology

This study utilized both primary and secondary data sources. Primary data were collected through structured questionnaires during Focus Group Discussions (FGDs) and in-depth interviews conducted from August to September 2024. A total of 50 key stakeholders participated in the study, representing regional planning agencies (*Badan Perencanaan Pembangunan Daerah/BAPPEDA*), environmental offices (*Dinas Lingkungan Hidup/DLH*), tourism offices (*Dinas Pariwisata/DISPAR*), tourism awareness groups (*Kelompok Sadar Wisata/POKDARWIS*), village heads, tourism businesses, micro-enterprises (*Usaha Mikro, Kecil, dan Menengah/UMKM*), village-owned enterprises (*Badan Usaha Milik Desa/BUMDES*), and academic experts in geology. Stakeholders were selected using a proportionate stratified sampling design to ensure balanced representation across institutional groups and territorial units within the GSUGGp. Sampling proportions were determined by the number of villages in the GSUGGp area. Gunung Kidul Regency has the largest share of villages within the GSUGGp, followed by Pacitan Regency, while Wonogiri Regency has the smallest share. Consequently, the number of stakeholders differed across regencies. In addition, the number of respondents was influenced by stakeholders' availability and willingness to participate in interviews and FGDs, with access to some respondents relatively limited. The distribution of respondents comprised 26 from Gunung Kidul, 18 from Pacitan, and 6 from Wonogiri. Participants were recruited based on stakeholder availability within each stratum. Accordingly, the final sample reflected a combination of proportionate stratification and practical field constraints commonly encountered in participatory policy research. Given the governance-oriented nature of the study, the sampling strategy aimed to capture informed stakeholder perspectives rather than achieve statistical generalization.

Secondary data included regulatory documents, spatial plans, Regional Medium and Long-Term Development Plans (*Rencana Pembangunan Jangka Menengah Daerah/RPJMD*, *Rencana Pembangunan Jangka Panjang Daerah/RPJPD*), strategic plans (*Rencana Strategis/Renstra*) of relevant agencies, and the GSUGGp master plan. The data analysis in this study was conducted using the MULTIPOL analytical approach, supported by Microsoft Excel and MULTIPOL La Prospective software. MULTIPOL is a participatory, multi-criteria decision-support framework designed to evaluate alternative policies and action plans under complex regional development contexts [24–27]. This approach also enables a structured comparison of three key elements—scenarios, policies, and programs/action plans—using an influence matrix. It assists policymakers in making

evaluative judgments to prioritize strategies. The framework offers two types of evaluation: (1) Action-to-Policy, which ranks action plans based on their relevance to specific policies; and (2) Policy-to-Scenario, which identifies the most appropriate or prioritized policies for each development scenario [25,26]. In this study, the application of the MULTIPOL method involves six stages. First, secondary data (from literature, social media, and statistics) and primary data (from field visits and interviews) are collected to assess the current conditions of the GSUGGp area. Second, this data serves as the basis for scenario development. Third, Focus Group Discussions (FGDs) and in-depth interviews with key stakeholders are conducted, using questionnaires to gather information, establish evaluation criteria, identify policy options, assign weights, and map relationships among elements. Fourth, stakeholder consultations validate and refine the analytical results. Fifth and sixth, the data are analyzed using the MULTIPOL software by entering matrix weights and conducting structured evaluations. This analysis produces scenario, policy, and action plan rankings based on average scores and standard deviations, facilitating the assessment of relevance and internal consistency with sustainable geopark development goals [26]. The analytical framework for this study is shown in Figure 2.

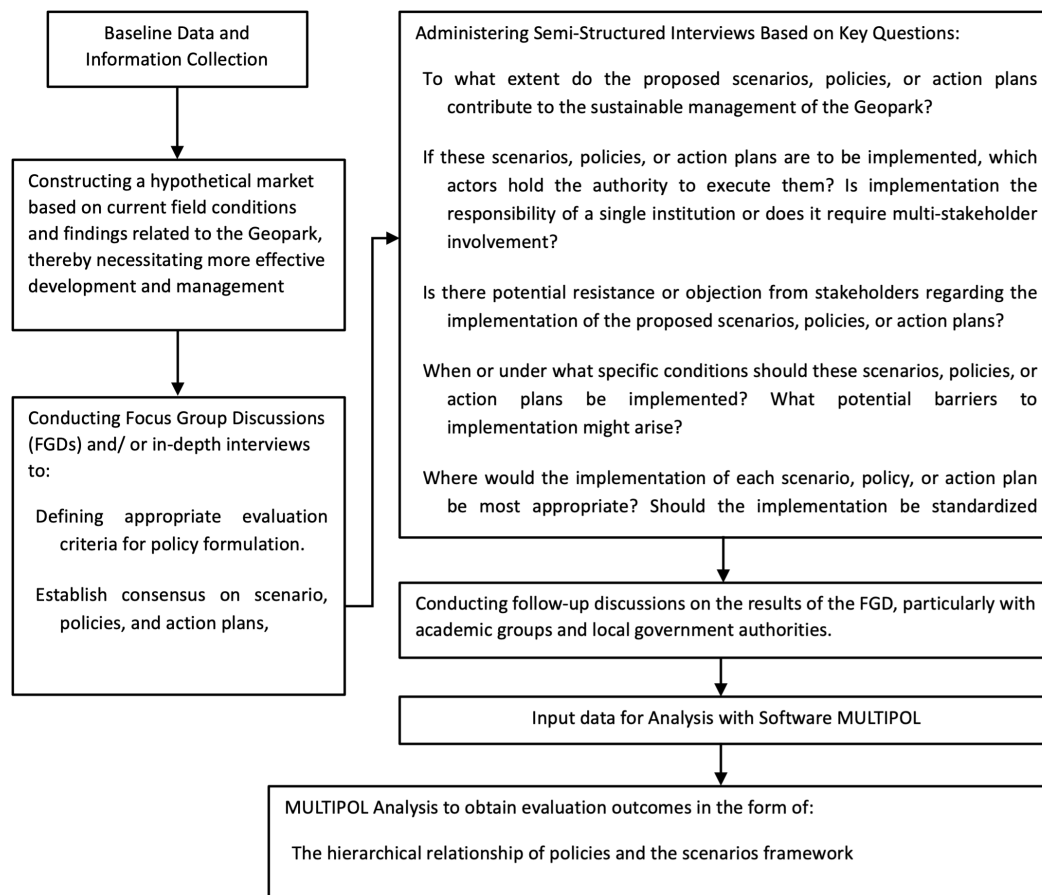


Figure 2. The procedural framework for applying the MULTIPOL analytical method in this study. This procedural framework outlines the steps for applying the MULTIPOL method, from gathering information and secondary data to the analysis itself.

Table 1 presents the descriptions and weights of the criteria, policies, and scenarios used in the MULTIPOL analysis, arranged according to the analytical stages of the MULTIPOL method applied here. Additionally, Table 2 details the formulation of action plans that support the identified policies. These components were developed based on the results of Focus Group Discussions (FGDs) and in-depth interviews with key stakeholders. It is important to note that Table 1 shows that all weights were assigned equal values. This equal weighting does not indicate a lack of importance; rather, it reflects the principle of balanced prioritization to prevent the dominance of any single policy or criterion [28]. Additionally, this research conducts a sensitivity analysis for each regency within the GSUGGp area to examine how policy priorities and action plans change when the weights assigned to criteria and policy options are modified. Sensitivity analysis is a well-known evaluation method in which input factors are systematically varied to assess their impact on

model outputs in a comprehensive and reliable manner [29,30]. By adjusting the relative weights of criteria and policy variables, this approach helps determine the stability, robustness, and responsiveness of the resulting actions and policy rankings. The sensitivity analysis of the scenarios employed in this study is presented in Table 3.

Table 1. Framework of criteria, policies, and scenarios used in the MULTIPOL analysis for the GSUGGp Region. The table presents the labels, descriptions, and weights assigned to each criterion, policy option, and development scenario used in the analysis. These components comprise the evaluation framework applied to assess the sustainable geopark development of the GSUGGp.

Label	Descriptions	Weight
Criteria		
<i>EcoInclsif</i>	Enhancement of Inclusive Economic Growth	1
<i>ColabInov</i>	Strengthening Collaboration and Innovation	1
<i>IncAccess</i>	Improvement of Accessibility	1
<i>IncCapacity</i>	Development of Human Resource Capacity	1
<i>CmntyPart</i>	Enhancement of Community Participation	1
<i>IncEnviro</i>	Improvement of Environmental Quality (vandalism, waste, and disaster management)	1
Policy		
<i>IncTrstAct</i>	Development of tourism activities within the GSUGGp area.	1
<i>Infrastruc</i>	Enhancement of core and auxiliary infrastructure in GSUGGp.	1
<i>EvaluatGS</i>	Assessment of Geosite and Non-Geosite zones in GSUGGp.	1
<i>Marketng</i>	Improvement of GSUGGp area marketing approaches.	1
<i>OrgStrengt</i>	Reinforcement of GSUGGp Management Body.	1
<i>CoorColab</i>	Institutional coordination and collaboration for GSUGGp management.	1
<i>UGGSewuReg</i>	Optimization of protection regulation enforcement in GSUGGp.	1
<i>CommCpcity</i>	Enhancement of community capacity and participation in GSUGGp.	1
<i>IncenDisin</i>	Application of competitive incentives and disincentives in GSUGGp.	1
<i>OVOC</i>	Empowerment of BUMDes via One Village One CEO model.	1
Scenario		
<i>IncVisitor</i>	Boosting tourist visits to revitalize post-pandemic tourism sector.	5-6
<i>InstituReg</i>	Reinforcing regulations and institutions for sustainable GSUGGp management.	5
<i>CpcityBhav</i>	Enhancing GSUGGp community advantages by increasing community awareness.	6

Table 2. Supporting action plans for policy alternatives in the MULTIPOL for the GSUGGp Region. The table outlines the action plans that could potentially support each policy alternative for sustainable geopark development at the research site. Each action plan includes an explanation and an abbreviation (label) used in the MULTIPOL analysis.

No.	Action Plan Descriptions	Action Plan Label
1	Promotion of cultural tourism based on local karst traditions.	<i>CulTourism</i>
2	Develop geo-ecological tourism through guided experiential education.	<i>EduTourism</i>
3	Upgrade and maintain core tourism facilities and services.	<i>TourFcilty</i>
4	Improve road and geosite access through better connectivity.	<i>Access</i>
5	Establish safety systems and SOPs for geosite hazards (Risk Management).	<i>RiskMngmnt</i>
6	Facilitate regular geosite manager meetings for shared learning.	<i>MngrMeet</i>
7	Develop digital platform for visitor feedback and evaluation (Tourism Utility).	<i>TourUtility</i>
8	Create digital app for real-time geosite environment monitoring and maintenance.	<i>EnvMonitor</i>
9	Enhance social media campaigns to promote GSUGGp uniqueness.	<i>SocMed</i>
10	Optimize official website and digital media for GSUGGp updates.	<i>IncWebsite</i>
11	Create integrated tourism packages with certified tour operators (tour agency).	<i>TourAgency</i>
12	Enhance management capacity through training and benchmarking visits.	<i>IncCpctyGS</i>
13	Strengthen PAWONSARI's role in transparent, accountable governance.	<i>PAWONSARI</i>
14	Develop transparent, accountable funding for GSUGGp sustainability.	<i>MgmtFund</i>
15	Align development programs with regulations and GSUGGp strategy.	<i>MasterPlan</i>
16	Promote PAWONSARI–government–business–university collaboration for innovation.	<i>Prtnrshp</i>
17	Build university collaboration for research and sustainable management.	<i>ColabUniv</i>

No.	Action Plan Descriptions	Action Plan Label
18	Enforce geodiversity protection via signs, campaigns, and outreach.	<i>SnctionGeo</i>
19	Prioritize green investment for sustainable Geopark development.	<i>GreenInves</i>
20	Assess carrying capacity and implement visitor limits for sustainability.	<i>CarryingCp</i>
21	Develop site-specific geosite plans for sustainable landscape management.	<i>SitePlan</i>
22	Offer training and mentorship to enhance community hospitality skills.	<i>Hospitality</i>
23	Conduct community outreach (socialization) on geoheritage and local diversity.	<i>Socializ</i>
24	Provide tourism governance training to empower geosite communities.	<i>GParkMgmt</i>
25	Introduce geopark education in schools for sustainable awareness.	<i>GeoSchool</i>
26	Organize village competitions to promote engagement and best practices.	<i>VillComp</i>
27	Host funding competitions to spur innovative tourism proposals program.	<i>ProgCompt</i>
28	Provide incentives and eco-certification for sustainable businesses.	<i>EnvCompCer</i>
29	Levy environmental taxes on impactful industries as deterrents.	<i>GreenTax</i>
30	Promote Payment for Environmental Services to support conservation.	<i>PES</i>
31	Provide training on rural business, product mapping, and marketing (smart village).	<i>SmartVil</i>
32	Conduct capacity-building for MSMEs to enhance product innovation.	<i>ProdInnov</i>
33	Provide MSME training on product development and packaging standards.	<i>PackProd</i>
34	Promote local products through Geoproduct branding initiatives.	<i>GeoBrand</i>

Table 3. Sensitivity analysis scenarios within the MULTIPOL evaluation. This table presents various weighting configurations used to assess shifts in policy priorities and action plans in the MULTIPOL analysis. Each scenario corresponds to a specific policy weight and a set of criteria. Evaluation outcomes—comparison action plans across policies and policies across scenarios—are assigned a code for each scenario.

No. of Scenario	Scenario (Policy, Criteria)	Weight (Policy, Criteria)	Result Code Action Across Policy	Result Code Policy Across Scenario
1	Ecolnclsif, IncTrstAct	5, 5	SA11	SB11
2	Ecolnclsif, UGGSewuReg	5, 5	SA12	SB12
3	Ecolnclsif, CommCpcity	5, 5	SA13	SB13
4	Ecolnclsif, OVOC	5, 5	SA14	SB14
5	IncCapacity, IncTrstAct	5, 5	SA21	SB21
6	IncCapacity, UGGSewuReg	5, 5	SA22	SB22
7	IncCapacity, CommCpcity	5, 5	SA23	SB23
8	IncCapacity, OVOC	5, 5	SA24	SB24
9	IncEnviro, IncTrstAct	5, 5	SA31	SB31
10	IncEnviro, UGGSewuReg	5, 5	SA32	SB32
11	IncEnviro, CommCpcity	5, 5	SA33	SB33
12	IncEnviro, OVOC	5, 5	SA34	SB34

Results

The MULTIPOL analysis produced three main outputs, namely: (1) evaluation of policies in relation to scenarios, (2) evaluation of action plans in relation to policies, and (3) prioritization of scenarios, policies, and action plans based on the evaluation results. These analytical outputs are derived from scoring values (Figure 3) that were collectively agreed upon by experts through FGDs [31], complemented by in-depth interviews with experts who were unable to participate in the forum. The evaluation results for policies across scenarios indicate that policies with the highest average weights and the lowest standard deviations—i.e., the highest numerical values—are considered ideal.

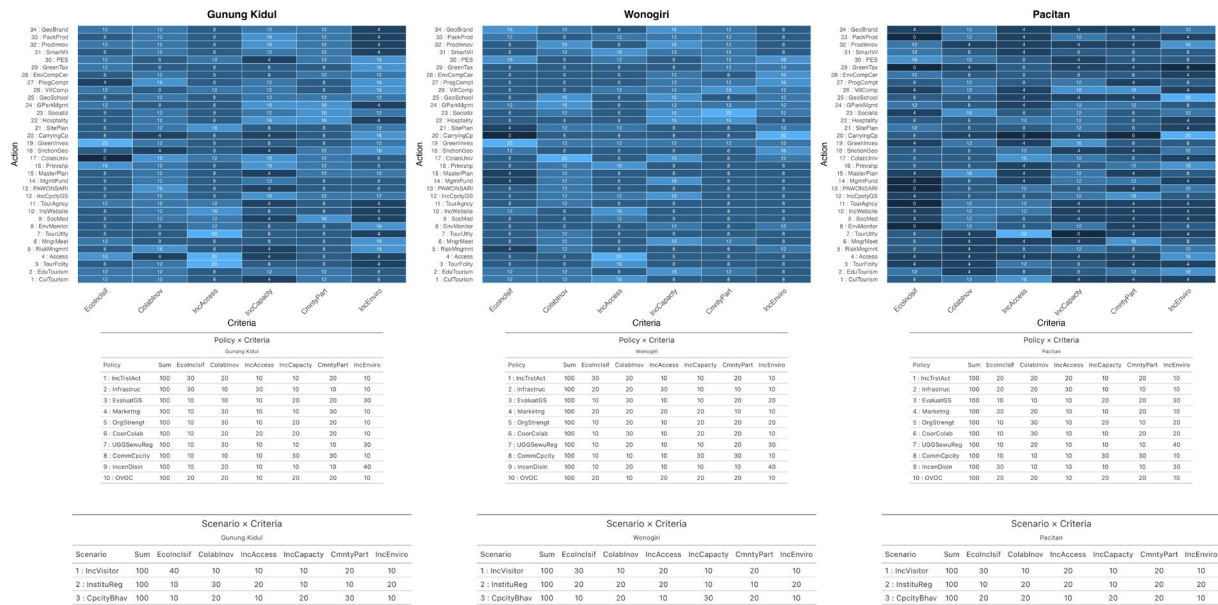


Figure 3. Evaluation weight matrix of actions, policies, and scenarios related to the criteria in the GSUGGp regions. This table shows the weights used to evaluate the relationship between actions, policies, and scenarios against the criteria applied in the MULTIPOL analysis. The weights listed for each GSUGGp Regency area (Gunung Kidul, Wonogiri, and Pacitan Regencies) are derived from FGDs and in-depth interviews with stakeholders.

An ideal policy is characterized by a high Moy. value and a low Ec.Ty, as well as a top position in the Number ranking. The four priority policies identified in order for each district are as follows (Figure 4): for Gunung Kidul Regency, they are *Marketng*, *IncTrstAct*, *OrgStrengt*, and *OVOC*; for Wonogiri Regency, *IncTrstAct*, *OVOC*, *Marketng*, and *Infrastruc*; and for Pacitan Regency, *Marketng*, *IncTrstAct*, *OVOC*, and *Infrastruc*. The policy-scenario evaluation across the GSUGGp reveals a consistent pattern, with *Marketng* and *IncTrstAct* emerging as the top two prioritized policies across Gunung Kidul, Wonogiri, and Pacitan Regencies. These findings support stakeholders' efforts to rejuvenate the GSUGGp tourism sector following the COVID-19 pandemic and to boost local economic benefits and regional revenue. Importantly, these results do not diminish the significance of other policies. The analysis also reveals a convergence of priorities in scenario choices: both Gunung Kidul and Wonogiri Regencies prioritize the *CpcityBhav* scenario, while Pacitan Regency considers two scenarios simultaneously, specifically *InstituReg* and *CpcityBhav*.

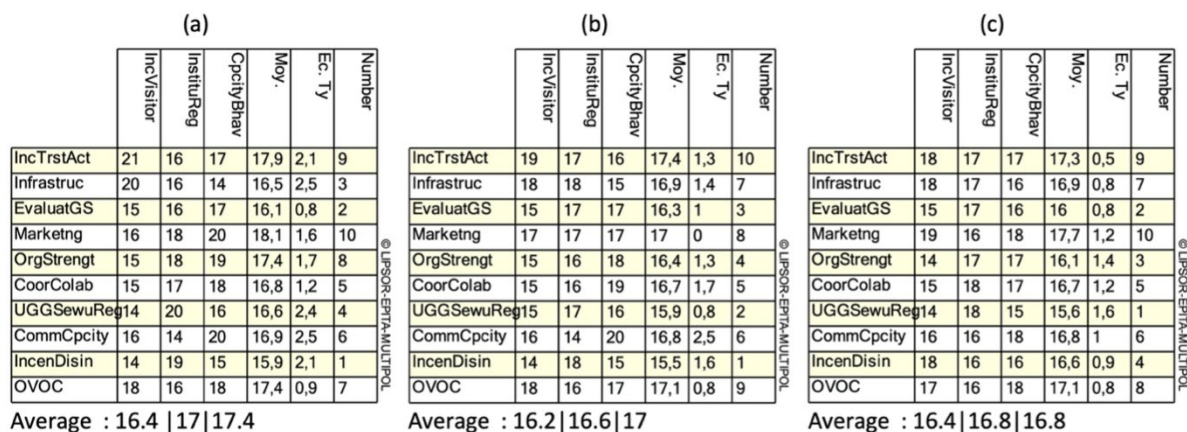


Figure 4. Evaluation results of policies across scenarios in the GSUGGp regions based on MULTIPOL Analysis. This figure presents the evaluation results for each policy across scenarios in three districts: Gunung Kidul (a), Wonogiri (b), and Pacitan (c). The analysis is based on stakeholder-assigned weightings. The results emphasize the relative policy priorities, identified by the highest Number, and also show the priorit scenarios, marked by the highest average in each scenario column.

The MULTIPOL method not only ranks policy priorities but also generates a closeness map illustrating the strength of relationships between policies and the scenarios used in this study (Figure 5). In Gunung Kidul, *IncVisitor* is closely linked to *IncTrstAct* and *Infrastruc*; *InstituReg* is supported by *UGGSewuReg*, *CoorColab*, *IncenDisin*, and *EvaluatGS*; and *CpcityBhav* aligns with *OrgStrengt*, *Marketng*, *CoorColab*, *CommCpcity*, and *OVOC*. In Wonogiri, *IncVisitor* is supported by *OVOC*, *Infrastruc*, and *Marketng*; *InstituReg* by *UGGSewuReg*, *EvaluatGS*, *IncenDisin*, and *OrgStrengt*; and *CpcityBhav* by *OrgStrengt*, *CoorColab*, and *CommCpcity*. Similarly, in Pacitan, *IncVisitor* aligns with *IncTrstAct*, *Infrastruc*, *IncenDisin*, and *EvaluatGS*; *InstituReg* with *CoorColab*, *UGGSewuReg*, and *OrgStrengt*; and *CpcityBhav* with *CoorColab*, *CommCpcity*, *Marketng*, and *OVOC*.

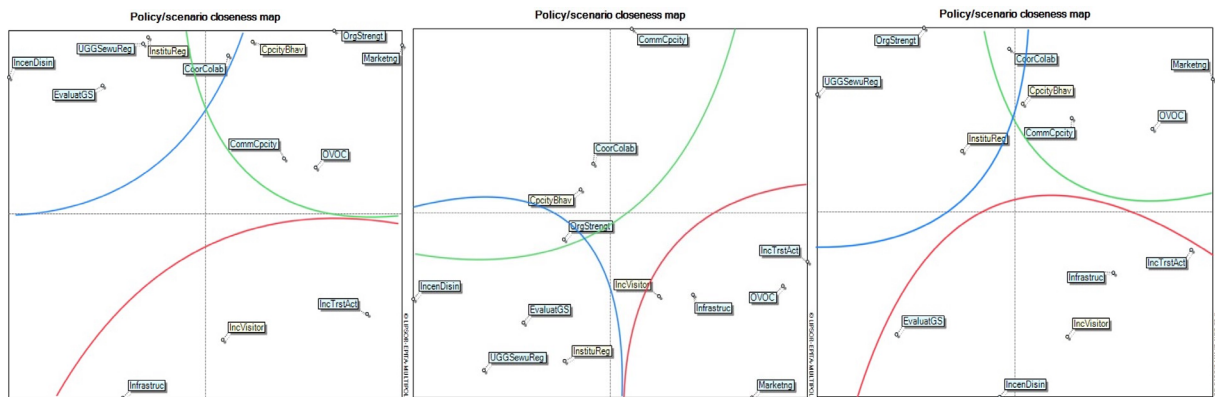
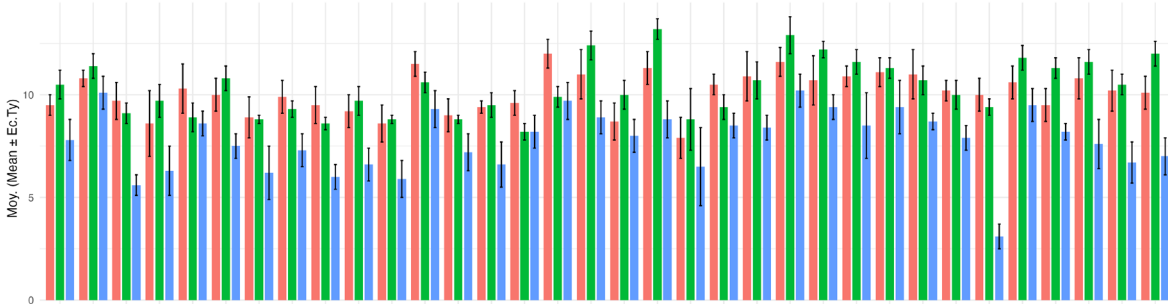


Figure 5. Closeness map between scenarios and policies in the GSUGGp regions based on MULTIPOL analysis. Closeness map indicates how well policies match the scenarios, based on the weights given by stakeholders in Gunung Kidul (a), Wonogiri (b), and Pacitan (c) regencies. Among the three scenario groups, the policies that overlap with two scenarios are *CoorColab* and *OrgStrengt*.

The MULTIPOL analysis results in Figures 4 and 5 reveal that certain policies are linked to multiple scenarios across the three regencies within the GSUGGp area. This indicates these policies are relevant to various sectors. For instance, the *CoorColab* is associated with the *InstituReg* and *CpcityBhav* scenarios in Gunung Kidul and Pacitan Regencies, while the *OrgStrengt* policy is connected to the *CpcityBhav* and *InstituReg* scenarios in Wonogiri Regency. The fact that policies overlap across multiple scenarios suggests they could similarly influence more than one development pathway.

The second stage of MULTIPOL analysis evaluates the alignment between programs (action plans) and policy objectives for sustainable geopark development, particularly in promoting village-level independence (Figure 6). The evaluation of the relationship between programs or action plans and policies uses three indicators: Moy. (average cumulative weight), Ec.Ty (standard deviation reflecting sensitivity level), and Number (a combined ranking based on Moy. and Ec.Ty). An action plan is considered ideal if it scores highly on Moy and has low Ec.Ty, and attains the highest Number ranking. Different regencies present diverse evaluation results. In Gunung Kidul Regency, the top five programs are *Prtnrshp*, *Socializ*, *IncCpctyGS*, *GreenInves*, and *VillComp*. In Wonogiri Regency, key programs include *GreenInves*, *Socializ*, *ColabUniv*, *GParkMgmt*, and *GeoBrand*. Likewise, Pacitan Regency's leading programs are *Socializ*, *EduTourism*, *Prtnrshp*, *PES*, and *GParkMgmt*. Overall, stakeholder assessments reveal a strong alignment between the top five priority action plans and the primary development goals of the Geopark—namely conservation, education, and economic growth. Although conservation is not listed as a separate action plan, the concepts of *PES* and *GreenInves* are closely associated with conservation efforts. The MULTIPOL analysis produces a Profile Map that evaluates 34 action plans against the policies used in this study for each regency within the GSUGGp area, as shown in Figure 7. This map displays how well each action plan aligns with the priority policies in each regency. A higher position of an action plan point relative to a specific policy indicates a greater potential to support policy implementation, while a lower position suggests a weaker potential. The figure also reveals that, in each regency within the GSUGGp area, some action plans share the same priority level across multiple policies. This indicates a convergence of perspectives and objectives among stakeholders across various regencies on how effectively these action plans can support the implementation of sustainable geopark development policies in the area.

Moy. ± Ec.Ty per Action Plan



Hierarchical Scores (Number) by Action Plan

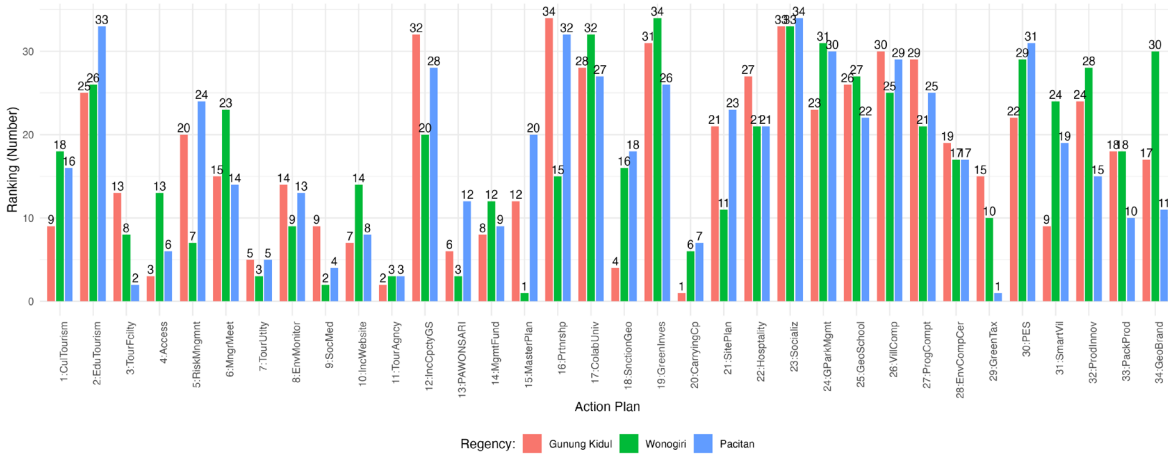


Figure 6. Results of the evaluation of programs/ action plans against policies in the GSUGGp regions based on MULTIPOL analysis. This figure illustrates the priority of programs/ action plans based on weights assigned by stakeholders in each regency of Gunung Kidul (red), Wonogiri (green), and Pacitan (blue). Priority action plans are influenced by high Moy., low Ec.Ty, and the highest Number.

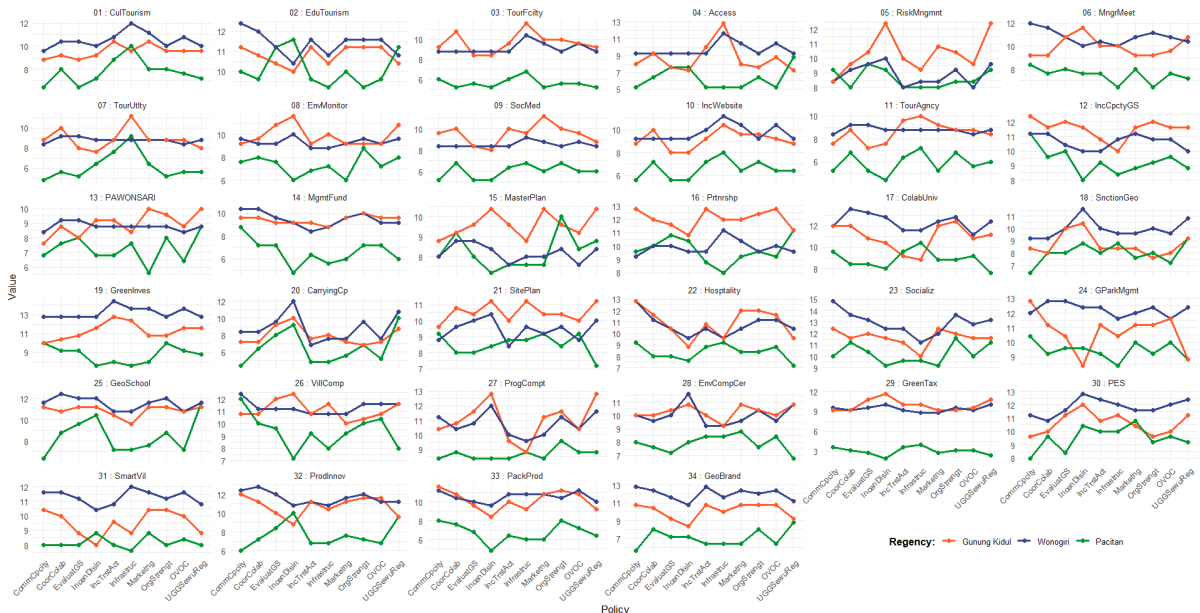


Figure 7. Profile the map against action plans and policies in the GSUGGp regions based on the results of the MULTIPOL analysis. This figure shows the ranking of each program/action plan against each policy alternative in the Gunung Kidul (red), Wonogiri (green), and Pacitan (blue) regencies. It can be seen that each action plan significantly influences several policies, and several priority action plans have relatively high values across almost all policy alternatives.

Sensitivity analysis was also conducted to show how changes in the weights assigned under the applied scenarios influence the results. Specifically, changes in weights only affect the evaluation outcomes of programs/ action plans in relation to policies. In contrast, the evaluation of policies against development scenarios remains unaffected, as indicated by the stable values of $Moy \pm Ec.Ty$ and the unchanged composite ranking (Number) (Figures 8 and 9). These sensitivity analysis results indicate that the relationships between policies and scenarios are highly robust to variations in the tested weights. Whereas the priorities of programs or action plans are more sensitive to changes in the evaluation process outcomes.

This graph illustrates the degree of alignment between each action plan and its policy, highlighting the strongest associations in each district. Moreover, the visualization shows that the higher the position of an action plan point relative to a policy, the greater the likelihood that the action plan aligns with and supports the implementation of that policy in the respective district. Conversely, the lower the point's position, the weaker the alignment between the action plan and the corresponding policy. The Profile Map also reveals that several action plans across the GSUGGp districts exhibit similar levels of relevance to a specific policy domain, reflecting a shared perspective among stakeholders regarding the contribution of these action plans to each policy within the context of sustainable geopark development in the GSUGGp region.



Figure 8. Results of sensitivity analysis for evaluating the program/ action plan across policies in the GSUGGp regions based on MULTIPOL analysis. This figure shows the sensitivity analysis scenario for this evaluation, reflected by changes in the $Moy \pm Ec.Ty$, and ranking (Number) values in Gunung Kidul, Wonogiri, and Pacitan Regencies. This scenario is also compared with the original results using the SA-ORI code. It demonstrates that in this evaluation, variations in weight will affect the evaluation outcomes of the action plan against the policy.

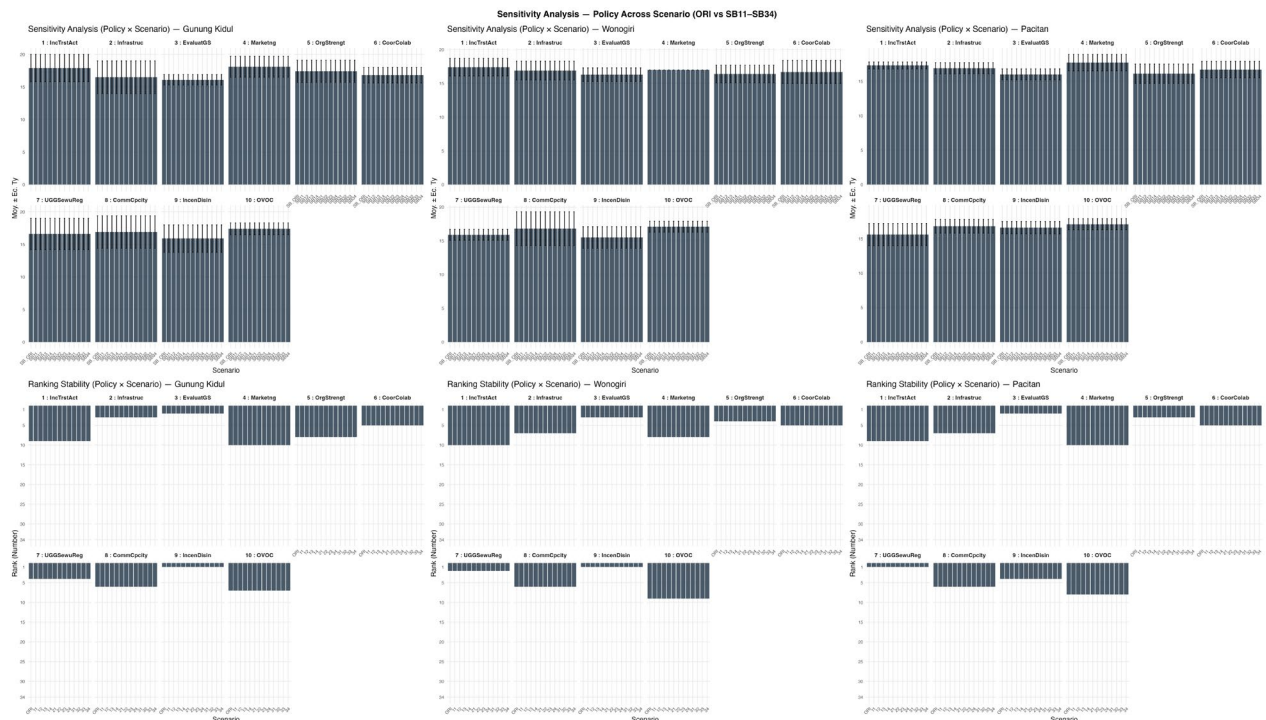


Figure 9. Results of sensitivity analysis for evaluating the policy across scenarios in the GSUGGp regions based on MULTIPOLE analysis. This figure shows the sensitivity analysis scenario for this evaluation, indicated by changes in the Moy. ± Ec. Ty and ranking (Number) values in Gunung Kidul, Wonogiri, and Pacitan Regencies. This scenario is also compared with the original results using the SB-ORI code. This analysis demonstrates that, in this evaluation, weight fluctuations will not affect the assessment results of the policy across scenarios.

Discussions

FGDs and in-depth interviews with stakeholders to analyze policy and development scenarios in each GSUGGp regency reveal that the primary scenarios in the MULTIPOLE analysis mainly emphasize economic, institutional, and social factors. The environmental aspect is not presented as a standalone scenario but is integrated into existing policies and action plans. Environmental considerations are implicitly incorporated into each scenario through an integrated policy and action-plan framework. This framework highlights the significance of environmental protection in the GSUGGp area, citing Ministerial Regulation No. 17 of 2012 regarding the determination of karst landscape areas and Ministerial Decree No. 3045 K/40/MEM/2014 regarding the designation of the Gunung Sewu karst landscape area, which designate karst regions as protected zones and provide the legal basis for spatial planning at both the provincial and regency levels.

Analyzing the relationship between policies and scenarios reveals that *Marketing* and *IncTrstAct* are key priorities in Gunung Kidul and Pacitan Regencies. Stakeholders view these policies as crucial for boosting local economic income through post-pandemic tourism revival. Field observations show that several geosites remain inactive in terms of management and tourism, while many MSMEs (Micro, Small, and Medium Enterprises) focused on local crafts and culinary products have experienced severe declines. Some MSMEs that entered international markets have experienced significant production declines and halted export activities. Therefore, policies aimed at improving marketing and tourism activities are expected to attract more tourists to geosites, generating economic benefits within the geopark area [32], aiding environmental conservation, fostering community involvement, and supporting infrastructure growth [33]. An analysis of how policies and scenarios relate in Wonogiri Regency indicates that *IncTrstAct* and *OVOC* are the top priorities. Unlike Gunung Kidul and Pacitan Regencies, Wonogiri has fewer geosites, mainly around the Indonesia Karst Museum, which saw tourism heavily affected by COVID-19. However, coastal geosites in southern Wonogiri continue to attract tourists due to strong local cultural traditions. This underscores the need to integrate cultural heritage with geoheritage and geodiversity in tourism planning. The *OVOC* policy promotes community-driven economic growth by empowering local communities as the primary agents of local enterprise, thereby increasing household income and employment [34]. Applying this policy in Wonogiri supports village independence by fostering community-led management of natural resources for product

innovation and sustainable tourism development. Based on the average values across all scenario columns (Figure 4), both Gunung Kidul and Wonogiri Regencies favor the *CpcityBhav* scenario. This reflects a common focus on enhancing the role of local communities in actively developing villages to foster self-reliance. Field observations reveal that many residents are unaware that their villages are part of the GSUGGp area or fully grasp the Geopark concept. Such understanding is generally confined to specific community groups involved in government, tourism, education, or those directly benefiting from geopark programs. Meanwhile, in Pacitan Regency, the two highest-rated scenarios are *InstituReg* and *CpcityBhav*. Unlike the other regencies, Pacitan emphasizes the *InstituReg* scenario more, considering institutional strengthening and a solid regulatory framework essential, especially since the GSUGGp spans three regencies and provinces, forming a single interconnected karst landscape. Additionally, the *CpcityBhav* scenario is seen as vital for promoting sustainable development within the GSUGGp area.

According to the second stage of the MULTIPOL analysis, Figure 6 indicates that *Prtnrshp* is the highest priority in Gunung Kidul Regency, as it can strategically enhance sustainable tourism governance through collaboration among institutions and stakeholders [35]. Interviews with village heads suggest that partnerships can boost local entrepreneurship and empower communities. For instance, two key geosites in the GSUGGp area, namely Mount Api Purba Nglanggeran and Jomblang Cave, have illustrated how partnership-driven geotourism development can yield significant tourism benefits, such as supporting the regional economy, strengthening community capacity, and conserving environmental integrity. This collaborative effort includes local communities, government, training and educational institutions, and the private sector, focusing not only on physical infrastructure support but also on capacity building through operational training tailored to specific natural environments (like caves) to ensure visitors' safety, comfort, and memorable experiences. Moreover, engaging local communities as vital participants in tourism activities is essential, including farmers, who can earn extra income outside planting seasons while waiting for harvest. This partnership approach holds strong potential for replication at other geosites in Gunung Kidul Regency, further promoting geopark development as a catalyst for village independence. The next priority, *Socializ*, arises from interview findings showing that understanding of the geopark is limited to certain groups, as previously mentioned. Many community members (particularly those relying on fishing and farming) are unaware that their villages are within the geopark area. This underscores the urgent need for inclusive socialization programs to raise awareness, foster ownership, and encourage community participation in protecting the Geopark, while also promoting the use of geoproducts for local development [36]. The third priority, *IncCpctyGS*, focuses on empowering tourism-awareness groups and youth organizations through training, education, and comparative studies. These initiatives can effectively enhance geopark management, especially since each geosite has unique features. For example, in Nglanggeran Village, youth groups have actively exchanged knowledge with educational institutions and learned about geosite tourism management elsewhere, applying these insights locally. This effort led to international recognition, with the village receiving the UNWTO Best Tourism Village award, highlighting the importance of building institutional capacity to promote sustainable geotourism [37].

The MULTIPOL evaluation of action plans in Wonogiri Regency reveals distinct program priorities from those in Gunung Kidul Regency, shaped by local environmental conditions and stakeholder perspectives. As shown in Figure 6, the leading priority in Wonogiri is *GreenInves*, which is essential due to the ecological importance of karst as a groundwater source for approximately 20-25% of the global population [38]. The 162.80 km² karst area in Wonogiri is protected under Ministerial Decree No. 1456 K/20/MEM/2000 regarding guidelines for the management of karst areas, which categorizes the land into three use levels: full protection (Class I), limited use (Class II), and controlled use (Class III). Economic pressures stemming from the COVID-19 pandemic have led to efforts to leverage karst resources for economic recovery. Boosting green investments, particularly through enhancing and expanding tourism, is viewed as a crucial, sustainable approach that balances ecological integrity with socio-economic development [39,40]. Other green investments can be supported via green finance mechanisms that integrate environmental and social considerations into financial decision-making [41,42]. The national policy framework (including Presidential Regulations and directives from the Ministry of Energy and Mineral Resources and the Ministry of Environment and Forestry) further promotes green financing through carbon trading and emissions reduction initiatives, opening avenues for low-carbon, climate-resilient investment [43–45]. The second priority is *Socializ*, which focuses on enhancing the public's understanding of the geopark concept in Wonogiri, where many residents view geosites merely as tourist attractions. Raising awareness of the geopark, geoheritage, and sustainable tourism is crucial for motivating community participation in conservation activities [46]. Field observations reveal opportunities for development around Wonogiri's geosites, notably in homestays, and show that the

local community is generally very friendly to visitors, whether for tourism or research. The third priority, *ColabUniv*, aims to strengthen academic collaboration to close knowledge gaps and integrate research into geotourism development [47,48]. Currently, academic collaboration related to the Wonogiri geopark is limited, especially in involving the local community. Field observations and interviews with village officials indicate that community programs focused on the geopark remain infrequent. Enhancing academic collaboration can increase public awareness, deepen understanding of geopark tourism, and facilitate educational initiatives, such as developing geomorphological and geoheritage interpretation boards.

The final evaluation of programs or action plans in Pacitan Regency (Figure 6) shows that *Socializ* is the top priority. This effort aims to increase public understanding of geoheritage, geodiversity, cultural heritage, and biodiversity within the GSUGGp area. Interviews indicate that, thus far, communities view the geopark primarily as a tourist destination, despite deriving economic benefits from geosite management by groups such as POKDARWIS and youth organizations [49]. Therefore, *socializ* is essential for raising community awareness, promoting involvement in geosite preservation, and educating visitors—despite the fact that museum-based knowledge centers such as Song Terus and the Pacitan Geopark Museum are still less popular compared to natural sites. The second priority, *EduTourism*, emphasizes the need for interpretive media that cover not just geological features but also biodiversity and cultural elements. This approach is particularly important given the strong links among Javanese culture, folklore, and cave geosites such as Tabuhan Cave. Additionally, biodiversity remains underrepresented outside museum settings, making it crucial to incorporate it into the development of educational tourism. The third priority is to strengthen the *Prtnrshp*. Since GSUGGp's strategy emphasizes geotourism, collaboration among local government, the private sector, and academic institutions is crucial for providing high-quality tourism services and preserving natural heritage [50]. Such partnerships can enhance trust, efficiency, innovation, and policy coordination across sustainability efforts [51]. Still, challenges remain, such as political power imbalances, limited resources, institutional complexity, and transparency issues that many hinder effective implementation and reduce long-term benefits, particularly if partnerships become superficial or bureaucratic rather than transformative. Partnerships are essential for the development of geotourism [52]. To ensure lasting success and positive outcomes, these partnerships need to address key issues by fostering strong, inclusive leadership, fair participation, consistent actions, and transparent, accountable governance [53]. An example is Watukareng Beach Geosite in Pacitan Regency, where partnerships have helped develop internationally recognized accommodations that draw international visitors.

The Profile Map, created from the MULTIPOL analysis that evaluates action plans against various policy options (Figure 7), shows that each regency within the GSUGGp area has distinct priorities for action plans. However, some priority actions are shared across all three regencies, indicating a common strategic direction to improve geopark development in a region with significant diversity. When comparing these results with policy evaluations against development scenarios (Figure 4), it is evident that economically focused policies—specifically *Marketng* and *IncTrstAct*—are consistently the top priorities in all regencies. This underscores the importance of local economic development in geopark governance. The emphasis on economic factors aligns with the characteristics of the GSUGGp area, which is primarily composed of karst landscapes that have historically experienced lower levels of regional development than non-karst areas [54]. Under these circumstances, the geopark concept is viewed as a strategic tool to foster regional economic growth [55] and reduce disparities through sustainable tourism development.

The MULTIPOL results analyze the connections between priority policies and their supporting action plans to determine which actions can effectively drive these initiative policies. In Gunung Kidul Regency, the *Marketng* policy is supported by *Socializ*, *Prtnrshp*, and *ColabUniv*, while *IncTrstAct* is supported by *Prtnrshp*, *GreenInves*, and *EduTourism*. In Wonogiri Regency, *Marketng* is supported by *GreenInves*, *ColabUniv*, and *GeoBrand*, whereas *IncTrstAct* is aligned with *GreenInves*, *GeoBrand*, and *Socializ*. In Pacitan Regency, *Marketng* is supported by *PES*, *EduTourism*, and *GParkMgmt*, while *IncTrstAct* is supported by *PES*, *EduTourism*, and *ColabUniv*. These findings highlight that, while tourism development can boost economic benefits, it may also impose environmental pressures like exceeding tourism carrying capacity, increasing waste, straining infrastructure, and heightening disaster risks [56,57]. This emphasizes the need for environmentally focused actions, including *GreenInves* and *PES*, as supportive strategies.

The sensitivity analysis of the MULTIPOL results shows that variations in the weights assigned to criteria and policy alternatives significantly affect only the evaluation outcomes of programs or action plans in relation to policies in each regency. In contrast, the relationships between policies and scenarios remain unaffected and show no observable changes. As shown in Figure 8, although some shifts occur in the relative values, the

highest-ranked action plans (Ranking/ Number in Figure 6) largely remain unchanged across the different weighting scenarios tested, indicating that these priority action plans are consistent and robust under the various sensitivity scenarios. For example, the highest-priority action plan is *Prtnrshp* in Gunung Kidul Regency, *GreenInves* in Wonogiri Regency, and *Socializ* in Pacitan Regency. These findings suggest that although scores and rankings may vary under different weighting schemes, the priority action plans at the regency level exhibit a high degree of structural robustness, according to the MULTIPOL analysis.

Conclusions

This study shows that the key priorities for developing a sustainable geopark in the Gunung Sewu UNESCO Global Geopark (GSUGGp) area are focused on economic recovery and empowering local communities. Environmental concerns are integrated into coordinated policies and action plans that support these goals. The MULTIPOL analysis emphasizes tourism marketing and expanding tourism activities within the GSUGGp region. Although opportunities for economic diversification are limited in karst landscapes—due to typical structural economic constraints—geopark initiatives are seen as strategic tools to promote local economic growth. At the action plan stage, MULTIPOL results across different regencies highlight the need for governance structures tailored to local conditions, including natural resources, environmental features, and socio-economic factors. In Gunung Kidul Regency, collaboration based on partnerships is prioritized; in Wonogiri Regency, green investments are the main focus; and in Pacitan Regency, raising community awareness is key. Despite different priorities, a shared focus on improving community capacity underscores that participation and strengthening local institutions are vital for fostering village self-reliance. The sensitivity analysis shows that, compared to policies, the evaluation of action plans indicates that the top-ranked plans remain consistent, demonstrating robust strategic choices. Conversely, policy evaluations across various development scenarios show no variation. Methodologically, this study highlights the importance of a participatory, multi-criteria approach that includes stakeholder input and knowledge in policy evaluation. While some subjectivity remains in the weighting process, involving diverse stakeholders helps produce more objective results. It is also crucial to recognize that building an effective cross-jurisdictional geopark governance area to support community-based economic development requires strong and cohesive inter-institutional collaboration. In the long term, policies need to become more adaptable and balanced, as over-reliance on tourism-driven growth can cause environmental problems. Ultimately, sustainable geopark development must better integrate economic incentives, institutional coordination, and conservation goals.

Author Contributions

RPN, AF, ER, SB: Conceptualization, Methodology, Formal Analysis, Writing – Review and Editing; **AF, ER, SB:** Software, Supervision, Validation; **RPN:** Data Curation, Funding Acquisition, Investigation, Resources, Visualization, Writing – Original Draft.

AI Writing Statement

During the preparation of this work, the author used ChatGPT and Grammarly to translate, correct grammar, and shorten explanatory narratives. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the publication's content.

Conflicts of interest

There are no conflicts to declare.

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References

1. Ríos, C.A.; Amorocho, R.; Villarreal, C.A.; Mantilla, W.; Velandia, F.A.; Castellanos, O.M.; Muñoz, S.I.; Atuesta, D.A.; Jerez, J.H.; Acevedo, O.; et al. Chicamocha Canyon Geopark Project: A Novel Strategy for the Socio-Economic Development of Santander (Colombia) through Geoeducation, Geotourism and Geoconservation. *International Journal of Geoheritage and Parks* **2020**, *8*, 96–122. doi: 10.1016/j.ijgeop.2020.05.002
2. Ferraro, F.X.; Schilling, M.E.; Baeza, S.; Oms, O.; Sá, A.A. Bottom-up Strategy for the Use of Geological Heritage by Local Communities: Approach in the “Litoral Del Biobío” Mining Geopark Project (Chile). *Proceedings of the Geologists’ Association* **2020**, *131*, 500–510, doi: 10.1016/j.pgeola.2020.06.001
3. Adom, D. The Place and Voice of Local People, Culture, and Traditions: A Catalyst for Ecotourism Development in Rural Communities in Ghana. *Sci. Afr.* **2019**, *6*, e00184, doi: 10.1016/j.sciaf.2019.e00184
4. Dousin, O.; Aralas, S.; Denis, J.I. Geopark Development and Community Well-Being: The Case of Kinabalu UNESCO Global Geopark, Sabah, Malaysian Borneo. *International Journal of Geoheritage and Parks* **2024**, *12*, 384–395, doi: 10.1016/j.ijgeop.2024.06.002.
5. Prakarsa, T.B.P.; Ahmadin, K. Diversitas Arthropoda Gua di kawasan Karst Gunung Sewu, Studi gua-gua di Kabupaten Wonogiri. *BIOTROPIC The Journal of Tropical Biology* **2017**, *1*, 31–36.
6. Mastika, I.K.; Harsono, S.S.; Khristianto, W.; Oktawirani, P.; Hutama, P.S. Creative Strategies of Local Resources in Managing Geotourism in the Ijen Geopark Bondowoso, East Java, Indonesia. *International Journal of Geoheritage and Parks* **2023**, *11*, 149–168, doi: 10.1016/j.ijgeop.2023.01.002
7. Vitrianto, P.N.; Nuryanti, W.; Rahmi, D.H. Dynamics of Tourism Development in Geosite, Gunungsewu Geopark. *Journal of Sustainable Tourism and Entrepreneurship* **2021**, *2*, 213–232, doi: 10.35912/joste.v2i4.836
8. Newsome, D.; Ladd, P. The Dimensions of Geotourism with a Spotlight on Geodiversity in a Subdued Landscape. *International Journal of Geoheritage and Parks* **2022**, *10*, 351–366, doi: 10.1016/j.ijgeop.2022.06.001
9. Sagala, S.; Rosyidie, A.; Sasongko, M.A.; Syahbid, M.M. Who Gets the Benefits of Geopark Establishment? A Study of Batur Geopark Area, Bali Province, Indonesia. In *IOP Conference Series: Earth and Environmental Science, Proceedings of 1st ITB Centennial and 4th PlanoCosmo International Conference, Bandung, ID*, 3–5 April 2018, Bandung; Institute of Physics Publishing: Bandung, Volume 158.
10. Molokáč, M.; Kornecká, E.; Tometzová, D. Proposal for Effective Management of Geoparks as a Tool for Sustainable Tourism in the Conditions of the Slovak Republic. *Land* **2024**, *13*, doi: 10.3390/land13071104
11. Ferreira, D.R.; Valdati, J. Geoparks and Sustainable Development: Systematic Review. *Geoheritage* **2022**, *15*, 6, doi:10.1007/s12371-022-00775-9
12. Wiencierz, C.; Lünich, M. Trust in Open Data Applications through Transparency. *New Media Soc.* **2022**, *24*, 1751–1770, doi: 10.1177/1461444820979708
13. Yuliawati, A.K.; Pribadi, K.N.; Hadian, M.S.D. Geotourism Resources as Part of Sustainable Development in Geopark Indonesia. In *Proceedings of the 2016 Global Conference Business, Management, and Entrepreneurship, Bandung, ID*, 8 August 2016.
14. Melica, G.; Bertoldi, P.; Kona, A.; Iancu, A.; Rivas, S.; Zancanella, P. Multilevel Governance of Sustainable Energy Policies: The Role of Regions and Provinces to Support the Participation of Small Local Authorities in the Covenant of Mayors. *Sustain. Cities Soc.* **2018**, *39*, 729–739, doi: 1016/j.scs.2018.01.013
15. Yu, H.; Lyu, Q.; Jiang, Y. Environmental Regulation, Regional Finance Development and Enterprises’ Cross-Regional Capital Flow. *International Review of Economics and Finance* **2025**, *99*, doi: 10.1016/j.iref.2025.103984
16. Butolo, I. Development of Micro, Small, and Medium Enterprises Through Geoproducts for Geopark Gorontalo. *Jurnal Bina Praja* **2022**, *14*, 251–262, doi: 10.21787/jbp.14.2022.251-262
17. Rahman, F.F.; Duli, A.; Mulyadi, Y. Development Strategy of Maros Geopark as a Geotourism Destination Community-Based in Maros Regency of South Sulawesi. *International Journal of Religion* **2024**, *5*, 3120–3128, doi: 10.61707/507w9926
18. Hartawan, B.S.; Erwandha, R.; Irsyadi, M.B.; Hidayat, M.R.A.; Sholih, D. Characteristics of Sewu Mountain Karst as Geopark Area. *Journal of Global Environmental Dynamics (JGED)* **2020**, *1*, 7–12.

19. Reinhart, H.; Putra, R.D.; Rafida, M.R. Karst Ecosystem Services and Their Roles in the Management of Gunung Sewu UNESCO Global Geopark. *Sustinere: Journal of Environment and Sustainability* **2023**, *7*, 220–233, doi: 10.22515/sustinere.jes.v7i3.349
20. Adji, T.N.; Haryono, E.; Fatchurohman, H.; Oktama, R. Diffuse Flow Characteristics and Their Relation to Hydrochemistry Conditions in the Petoyan Spring, Gunungsewu Karst, Java, Indonesia. *Geosciences Journal* **2016**, *20*, 381–390, doi: 10.1007/s12303-015-0048-8
21. Sekarsih, F.N.; Mustopa, A.; Dewi, M.M.; Pringgondani, R.; Kukuh, K. Wisata Virtual Di Geopark Gunungsewu Kabupaten Gunungkidul Sebagai Media Promosi Pariwisata Daerah. *Jurnal Pengabdian kepada Masyarakat Nusantara* **2024**, *5*, 2600–2608, doi: 10.55338/jpkmn.v5i2.3238
22. Prasetyo, A.H.; Widiyanto, N.; Soeroso, A. Pengembangan Geowisata Berbasis Partisipasi Masyarakat di Kawasan Geopark Gunung Sewu Gunungkidul. *ULIL ALBAB: Jurnal Ilmiah Multidisiplin* **2023**, *2*, 2749–2763.
23. Sulisty, A.; Rijanta, R.; Hadna, A.H.; Giyarsih, S.R. Konflik Dan Inovasi Kebijakan Pelestarian Dan Pengembangan Gunung Sewu UNESCO Global Geopark Di Bidang Pariwisata (Studi Di Kabupaten Gunungkidul, D. I. Yogyakarta). Available online: <https://etd.repository.ugm.ac.id/penelitian/detail/220796> (accessed on 6 July 2025).
24. Godet, M. *Creating Futures: Scenario Planning as a Strategic Management Tool*, 2nd ed.; Coates, J.F., Ed.; Economica: France, 2006; ISBN 2717852441.
25. Stratigea, A. Participatory Policy Making in Foresight Studies at the Regional Level: A Methodological Approach. *Regional Science Inquiry Journal* **2013**, *5*, 145–161.
26. Fauzi, A. *Teknik Analisis Keberlanjutan*; Gramedia Pustaka Utama: Jakarta, **2019**; ISBN 9786020630250.
27. Ariyani, N.; Fauzi, A. Pathways toward the Transformation of Sustainable Rural Tourism Management in Central Java, Indonesia. *Sustainability (Switzerland)* **2023**, *15*, doi: 10.3390/su15032592
28. Gomez, R.J.M.; Herrera, T.J.F.; Sierra, C.A.S. Applying MULTIPOL to Determine the Relevance of Projects in a Strategic IT Plan for an Educational Institution. *Tecnura* **2020**, *24*, 76–84, doi: 10.14483/22487638.16176
29. Razavi, S.; Jakeman, A.; Saltelli, A.; Prieur, C.; Iooss, B.; Borgonovo, E.; Plischke, E.; Lo Piano, S.; Iwanaga, T.; Becker, W.; et al. The Future of Sensitivity Analysis: An Essential Discipline for Systems Modeling and Policy Support. *Environmental Modelling and Software* **2021**, *137*, doi: 10.1016/j.envsoft.2020.104954
30. Miftakhova, A. Global Sensitivity Analysis for Optimal Climate Policies: Finding What Truly Matters. *Econ. Model.* **2021**, *105*, doi: 10.1016/j.econmod.2021.105653
31. Wijaya, H.; Kusmana, C.; Rusdiana, O.; Rushayati, S.B. Identification of Forest City Multi-Policy Using the MULTIPOL: A Study in The New Indonesian Capital, East Kalimantan. *Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan* **2024**, *14*, 866–874, doi: 10.29244/jpsl.14.4.866
32. Setiono, A.; Priyana, Y.; Sasmito, P.; Nurhajra, A. Analysis of the Impact of Increasing Tourist Visits on Economic Growth in Palabuhanratu Sukabumi Tourism Destinations. *West Science Journal Economic and Entrepreneurship* **2023**, *1*, 1–6.
33. Malatyinszki, S.; Kálmán, B.G.; Dávid, L.D. The Role of Geoparks in Sustainable Tourism Development: A Case Study Approach. *Geojournal of Tourism and Geosites* **2025**, *59*, 572–586, doi: 10.30892/gtg.59206-1438
34. Slamet, A.S.; Purwawangsa, H.; Prawiro, B.P.; Isbayu, M.; Irfany, M.I.; Haq, D.A. Community-Based Business Ecosystem of Coffee with the One Village One CEO Program at Cikajang Garut. *IOP Conf. Ser. Earth Environ. Sci.* **2024**, *1358*, 1–5, doi: 10.1088/1755-1315/1358/1/012040
35. Hulu, M.; Brian, R.; Pratiyudha, D.; Kusumo, E. Tourism Industry Partnerships: Partnership Opportunities for MSMEs and Large Business in Palembang City; **2021**.
36. Gretzinger, S.; Leick, B.; Jebesen, S.; Schramm, F. Engagement and Participation of Stakeholders in Regional Development Projects and the Emergence of Bridging and Bonding Social Capital. *Manag. Rev.* **2025**, *36*, 42871, doi: 10.31083/MRev42871
37. Ngo, T.H.; Tournois, N.; Dinh, T.L.T.; Chu, M.T.; Phan, C.S. Sustainable Community-Based Tourism Development: Capacity Building for Community; The Case Study in Cam Kim, Hoi An, Vietnam. *Journal of Sustainability Research* **2024**, *6*, 1–20, doi: 10.20900/jsr20240022

38. Ford, D.; Williams, P. *Karst Hydrogeology and Geomorphology*; Wiley: Chichester, 2007; ISBN 9780470849965.
39. Podovac, M.; Alkier, R.; Milojica, V. Green Investments in the Function of Development of Tourism and Hospitality of the Republic of Serbia. In Proceedings of the Eighth International Scientific Conference Tourism and Green Investments Conference Proceedings, Vrnjačka Banja, RS, 31 May–1 June 2024; pp. 280–289.
40. Roy, B.; Upadhyay, S.K. Green Investments as a Vital Tool to Maintain the Sustainability of Tourist Destination: Gangtok, Sikkim-A Case Study. *Annals of Multidisciplinary Research, Innovation and Technology (AMRIT)* **2024**, *3*, 154–158.
41. Thompson, S. *Green and Sustainable Finance: Principles and Practice in Banking, Investment and Insurance*, 2nd Edition.; Kogan Page: New Delhi, 2023; ISBN 9781398609259.
42. Li, Z.; Chen, P. Sustainable Finance Meets FinTech: Amplifying Green Credit's Benefits for Banks. *Sustainability* **2024**, *16*, 7901, doi: 10.3390/su16187901
43. Republic of Indonesia. Peraturan Presiden Nomor 98 Tahun 2021 tentang Penyelenggaraan Nilai Ekonomi Karbon untuk Pencapaian Target Kontribusi yang Ditetapkan Secara Nasional dan Pengendalian Emisi Gas Rumah Kaca dalam Pembangunan Nasional; Republic of Indonesia, 2021, pp. 279–288.
44. Ministry of Energy and Mineral Resources. Peraturan Menteri ESDM Nomor 16 Tahun 2022 tentang Tata Cara Penyelenggara Nilai Ekonomi Karbon Subsektor Pembangkit Tenaga Listrik; Ministry of Energy and Mineral Resources of the Republic of Indonesia: Jakarta, ID, 2022, p. 22.
45. Ministry of Forestry. Peraturan Menteri Lingkungan Hidup dan Kehutanan Nomor 7 Tahun 2023 tentang Tata Cara Perdagangan Karbon Sektor Kehutanan; Ministry of Forestry of the Republic of Indonesia: Jakarta, ID, 2023, pp. 1–18.
46. Hadian, M.S.D.; Barkah, M.N.; Khadidjah, U.L.S.; Yuliawati, A.K.; Aryanti, A.N.; Suhardiman, S. Urban Geotourism Development in the Perspective of Stakeholders. *International Journal of Geoheritage and Parks* **2025**, *13*, 102–116, doi: 10.1016/j.ijgeop.2024.12.001
47. Yang, S. The Role of University Students in Geoscience Activities: An Example from Qinling Zhongnanshan UNESCO Global Geopark, China. In Abstract Book: The 8th Asia Pacific Geoparks Network Symposium, Cao Bang, VN, 08-15 September 2024; p. 123.
48. Xiaoyuan, Z. Ningde UGGP's Explorations and Achievements in Science Popularization and Study Tours. In Abstract Book: The 8th Asia Pacific Geoparks Network Symposium, Cao Bang, VN, 08-15 September 2024; p. 113.
49. Wahyudin, Y.A.; Munir, A.M.; Rizki, K. Effectiveness of the UNESCO Global Geoparks Regime on Local Community Development in the Rinjani-Lombok UNESCO Global Geopark Area. In Proceedings of the Southeast Asian Conference on Migration and Development (SEACMD), Lombok, ID, 19–21 September 2023; pp. 251–263.
50. Djabbari, M.H.; Alwi; Suryadi. Public Private Partnership Model in Tourism Development in North Toraja District. *Enrichment: Journal of Management* **2021**, *11*, 378–382.
51. Mason, P. *Tourism Impacts, Planning and Management*; Butterworth Heinemann: Oxford, 2003; ISBN 075065970X.
52. Wondirad, A.; Tolkach, D.; King, B. Stakeholder Collaboration as a Major Factor for Sustainable Ecotourism Development in Developing Countries. *Tour. Manag.* **2020**, *78*, doi: 10.1016/j.tourman.2019.104024
53. Jackson, L.A. Community-Based Tourism: A Catalyst for Achieving the United Nations Sustainable Development Goals One and Eight. *Tourism and Hospitality* **2025**, *6*, doi: 10.3390/tourhosp6010029
54. Priatama, R.A.; Rustiadi, E.; Widiatmaka, W.; Pravitasari, A.E. Physical Geographical Factors Leading to the Disparity of Regional Development: The Case Study of Java Island. *Indonesian Journal of Geography* **2022**, *54*, 195–205, doi: 10.22146/ijg.66729
55. Lee, Y.J.; Jayakumar, R. Economic Impact of UNESCO Global Geoparks on Local Communities: Comparative Analysis of Three UNESCO Global Geoparks in Asia. *International Journal of Geoheritage and Parks* **2021**, *9*, 189–198, doi: 10.1016/j.ijgeop.2021.02.002

56. Leung, Y.-F.; Spenceley, A.; Hvenegaard, G.; Buckley, R. *Tourism and Visitor Management in Protected Areas: Guidelines for Sustainability*; Groves, C.R., Ed.; IUCN: Gland, 2018; ISBN 978-2-8317-1898-9
57. Baloch, Q.B.; Shah, S.N.; Iqbal, N.; Sheeraz, M.; Asadullah, M.; Mahar, S.; Khan, A.U. Impact of Tourism Development upon Environmental Sustainability: A Suggested Framework for Sustainable Ecotourism. *Environmental Science and Pollution Research* **2023**, *30*, 5917–5930, doi: 10.1007/s11356-022-22496-w