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Economic, Social, and Environmental Indicators of Mount Batur Geotourism Sustainability: A Governance-Based Case Study

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ABSTRACT

This study examines how economic, social, and environmental indicators, stakeholder experiences, governance capacity, and disaster vulnerability shape the sustainability of Mount Batur geotourism in Kintamani, Bali. Methodology. A qualitative case study combined semi-structured interviews with 33 purposively selected informants from seven stakeholder categories, field observations, and Bangli Regency statistics for 2021–2023. Data were examined through thematic coding and interpreted using the Triple Bottom Line, sustainability governance, environmental justice, and resilience perspectives. Tourism supports livelihood diversification across agriculture, fisheries, accommodation, food services, guiding, and microenterprises. However, benefits are unevenly distributed. Fragmented coordination, limited digital and service capacity, mining-related externalities, high visitor intensity, damaged roads, and risk-sensitive construction gaps weaken equity and long-term resilience. The study develops a governance-mediated interpretation of volcanic geotourism sustainability, showing that hazard intensity does not determine outcomes independently; coordination, participation, accountability, and risk communication shape how benefits and burdens are distributed. The single-case design, short average interview duration, perception-based evidence, and reliance on secondary indicators limit statistical generalization. The findings support an integrated destination governance forum, transparent benefit-sharing mechanisms, risk-sensitive spatial control, and joint environmental monitoring. The study offers a context-specific analytical framework that extends Triple Bottom Line assessment by making governance and disaster risk explicit mediating dimensions.

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1. Introduction

International tourism returned to approximately 1.4 billion arrivals in 2024, equivalent to 99% of the pre-pandemic level, renewing concerns about how destinations can accommodate demand without weakening ecological integrity, social equity, or local resilience (UN Tourism, 2025). Indonesia received 13.90 million international visitor arrivals in 2024, while Bali recorded 6.95 million direct foreign arrivals in 2025, 9.72% more than in 2024 (BPS-Statistics Indonesia, 2025; BPS-Statistics Indonesia Bali Province, 2026).

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These figures confirm tourism's renewed economic significance, but they also increase pressure on infrastructure, land, water, waste systems, and destination governance. The sustainability challenge is therefore not simply to increase visitor numbers. It is to manage the distribution of benefits, environmental burdens, and risks across residents, businesses, visitors, and public institutions.

This challenge is especially acute in geotourism destinations. UNESCO Global Geoparks are expected to combine the protection of geological heritage, education, community participation, and sustainable local development through a legally recognized management body and an agreed management plan (UNESCO, 2026a). The model is explicitly bottom-up and requires the involvement of local and regional actors. It also recognizes geological hazards as a core management concern. Consequently, the sustainability of a volcanic geopark depends on the interaction between tourism, livelihoods, conservation, risk governance, and institutional capacity rather than on environmental indicators alone.

Mount Batur UNESCO Global Geopark covers 36,640 hectares and supports a population of approximately 94,850. Agriculture and tourism form the principal livelihood base, while disaster-risk education and collaboration with volcanology and disaster-management institutions are integral to the geopark mission (UNESCO, 2026b). Mount Batur's caldera, Lake Batur, lava fields, geothermal resources, agricultural landscapes, temples, and local settlements form a closely connected socio-ecological system. Tourism products include sunrise trekking, jeep and black-lava tours, museum visits, hot springs, lake-based recreation, food and beverage services, accommodation, agriculture-based products, and cultural or spiritual experiences (Dwiyanti et al., 2023; Mudana et al., 2018).

The same resources that support tourism and local livelihoods also generate competing claims. The black-lava landscape attracts off-road activity. Fertile land supports horticulture. Lake Batur supports fisheries. Volcanic deposits support sand and stone extraction. Caldera viewpoints attract cafés, restaurants, and photography-oriented facilities. When these activities expand without coordinated spatial control, they can produce road damage, noise, dust, slope pressure, visual change, unequal market access, and heightened exposure in hazard-prone locations. The destination therefore illustrates a core sustainability problem: activities that generate income may simultaneously reduce ecological quality, infrastructure reliability, visitor safety, and community well-being.

Local statistics reinforce this tension. Tourist visits increased from 1,161,901 in 2022 to 1,742,454 in 2023. Accommodation and food-service gross regional domestic product increased to 964.55 billion rupiahs in 2023, while mining and quarrying reached 139.86 billion rupiahs. At the same time, 17.21% of roads were classified as damaged and a further 10.76% were in moderate condition (BPS-Statistics Bangli Regency, 2024). These indicators cannot prove that tourism or mining alone caused infrastructure deterioration, but they identify simultaneous growth and vulnerability that require integrated interpretation. The Mount Batur case is therefore relevant to Sustainable Development Goals 8, 11, 12, 13, and 15, which connect decent livelihoods, inclusive settlements, responsible production, climate and disaster resilience, and ecosystem protection.

Prior research provides important but fragmented insights. Studies of volcanic destinations document tourism disruption, livelihood loss, adaptation, and post-disaster recovery (Leoni & Boto-García, 2023; Medeiros et al., 2021; Partelow, 2021). Research on

Indonesian geoparks emphasizes geoconservation, community-based tourism, local products, interpretation, and institutional coordination (Aly et al., 2021; Astarini et al., 2024; Cahyadi & Newsome, 2021). Environmental justice research explains how benefits and environmental burdens may be distributed unevenly (Bennett et al., 2023; Gurney et al., 2021). Tourism-governance research also shows that participation, accountability, risk communication, and collaboration influence destination resilience (Bhaskara, 2022; Nurjanah et al., 2026; Zhang et al., 2024). However, these bodies of work are rarely integrated in a single place-based analysis of an active volcanic geopark.

Three research gaps follow. The theoretical gap is that the Triple Bottom Line (TBL) commonly categorizes economic, social, and environmental outcomes but does not adequately explain how power, coordination, regulation, and hazard governance mediate those outcomes. The empirical gap is the limited use of stakeholder narratives alongside contextual indicators to examine trade-offs rather than isolated sustainability dimensions. The contextual gap is the scarcity of governance-focused evidence from Mount Batur that simultaneously considers tourism, agriculture, fisheries, extraction, infrastructure, community capacity, and volcanic risk.

2. Literature Reviews

2.1 Triple Bottom Line and Destination Sustainability

The TBL framework organizes sustainability into economic prosperity, social well-being, and environmental integrity, commonly described as profit, people, and planet (Elkington, 1997; Slaper & Hall, 2011). In tourism, the economic dimension includes employment, household income, local enterprise, value creation, and destination competitiveness. The social dimension includes participation, equity, cultural continuity, skills, safety, and quality of life. The environmental dimension includes resource use, ecosystem integrity, pollution, carrying capacity, and conservation. The framework is valuable because it prevents economic performance from being treated as a sufficient measure of destination success.

TBL is nevertheless a classification framework rather than a complete theory of change. It can show that dimensions are unbalanced, but it does not automatically explain why the imbalance occurs or which actors have the authority and capacity to correct it. Reviews of TBL applications note problems of indicator selection, weak comparability, trade-off concealment, and the absence of clear rules for resolving conflicts among dimensions (Nogueira et al., 2023). In a volcanic destination, these limitations become more serious because hazards, emergency capacity, land-use decisions, and infrastructure standards influence all three pillars simultaneously.

Figure 1. Interconnection of the Triple Bottom Line dimensions. Adapted from Elkington (1997) and Slaper and Hall (2011).



2.2 Sustainability Governance and Socio-Ecological Systems

Sustainability governance shifts attention from outcomes to the institutions and processes through which actors define problems, allocate authority, coordinate action, enforce rules, and learn from changing conditions. Relevant capacities include participation, accountability, transparency, cross-sector coordination, regulatory effectiveness, information sharing, and adaptive management. In UNESCO Global Geoparks, these capacities are not optional additions. They are embedded in the requirement for a management body, a shared plan, local partnerships, conservation, education, and sustainable development (UNESCO, 2026a).

A socio-ecological systems perspective is useful because Mount Batur's tourism economy cannot be separated from the caldera landscape, lake ecology, agriculture, roads, settlements, resource extraction, cultural institutions, and volcanic processes. Changes in one subsystem can affect several others. For example, mining may create employment and construction materials while increasing truck traffic, noise, dust, and road maintenance costs. Tourism growth may expand markets for food and accommodation while increasing water use, waste, congestion, and exposure to hazards. Governance capacity determines whether these interactions produce reinforcing benefits or cumulative vulnerabilities (Deslatte et al., 2022; Pedroza-Arceo et al., 2022).

2.3 Environmental Justice and Community Participation

Environmental justice focuses on who receives benefits, who carries environmental and social burdens, who participates in decisions, and whose knowledge is recognized. Distributional justice concerns the allocation of income, access, pollution, damage, and risk. Procedural justice concerns participation, representation, and transparency. Recognition justice concerns respect for local knowledge, livelihoods, identities, and differentiated vulnerability (Bennett et al., 2023; Gurney et al., 2021). This perspective is central to geotourism because visitors, investors, local residents, farmers, guides, miners, government agencies, and customary institutions may have different interests and unequal decision-making power.

Community participation can improve legitimacy, local learning, conservation behavior, and livelihood resilience, but participation is not automatically equitable. It may remain symbolic when information is uneven, local groups lack organizational capacity, or decisions are dominated by stronger actors. Evidence from developing tourism destinations shows that participation requires institutional support, accessible information, meaningful roles, and mechanisms for resolving conflict (Aly et al., 2021; Reindrawati, 2023). Digital capability, market access, and collective organization are therefore social-governance conditions, not merely individual business skills.

2.4 Volcanic Tourism, Disaster Risk, and UNESCO Global Geopark

Volcanic environments create a dual tourism condition. Eruptions can interrupt mobility, reduce occupancy, damage assets, and weaken agricultural and tourism livelihoods. They can also create landscapes, fertile soils, geothermal resources, scientific interest, and post-eruption tourism products (Alfama et al., 2024; Leoni & Boto-García, 2023; Medeiros et al., 2021). Sustainability therefore depends on the capacity to convert geological value into education and livelihoods without normalizing unsafe development or ecological degradation.

Recent Indonesian research highlights a governance gap in disaster communication. Tourism actors and local businesses may not be fully integrated into official risk systems, while warning information, visitor communication, evacuation knowledge, and coordination remain fragmented (Nurjanah et al., 2026). In Bali, the Mount Agung eruption also

demonstrated the importance of collaboration among public authorities, tourism businesses, communities, and communication actors (Bhaskara, 2022). Risk governance must consequently be integrated into routine destination management rather than activated only during emergencies.

UNESCO's geopark model links geoconservation, education, local development, community participation, and hazard awareness. Studies of geopark management further emphasize destination coordination, cooperation, interpretation, and structured management as conditions for long-term performance (Kornecká et al., 2024; Rubira-Gómez et al., 2024). For Mount Batur, these principles imply that tourism promotion, visitor distribution, mining oversight, road management, environmental monitoring, community skills, and disaster preparedness must be treated as connected responsibilities.

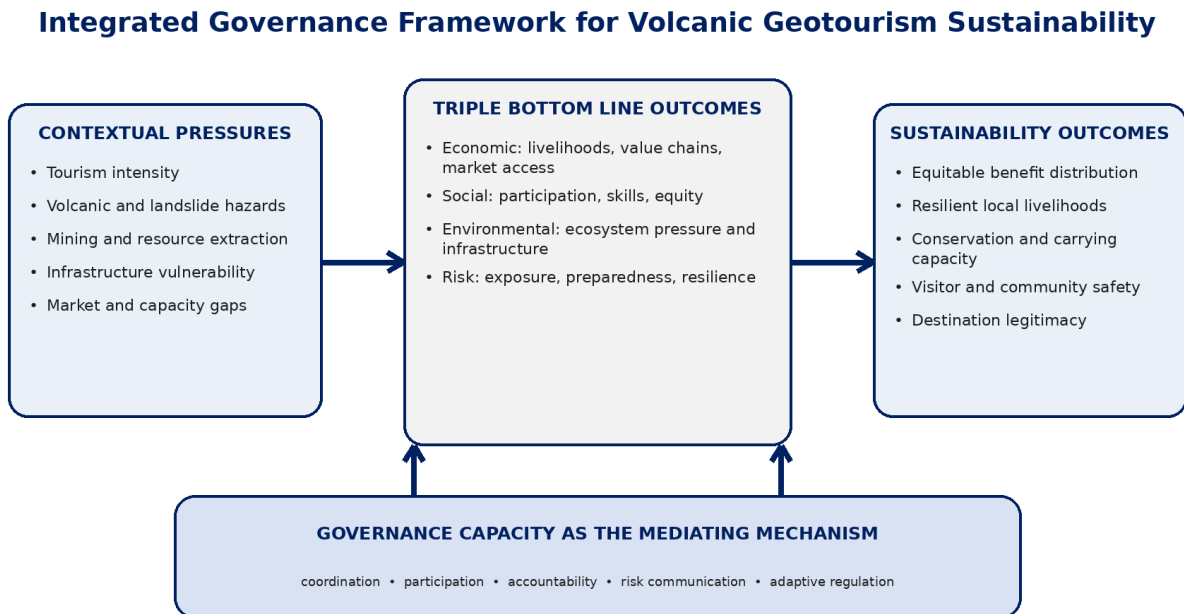
2.5 Integrated Conceptual Framework and Research Gap

This study treats economic, social, environmental, and risk indicators as observable outcome domains. It treats governance capacity as a mediating mechanism that shapes how contextual pressures are converted into sustainability outcomes. The framework does not assume that all indicators are equivalent or directly causal. Statistical indicators describe contextual trends. Interviews and observations explain mechanisms, perceptions, distributional effects, and governance failures. The analytical focus is therefore on convergence, divergence, and trade-offs across evidence sources.

Table 1. Operationalization of the integrated analytical framework

Analytical domain	Context-specific indicators	Key governance question	Expected sustainability outcome
Economic	Household livelihoods, MSMEs, tourism revenue, agriculture, fisheries, market access, value addition	Who obtains benefits, through which channels, and with what vulnerability?	Diversified and equitable local livelihoods
Social	Participation, service and digital capacity, education, conflict, cultural and community engagement	Who participates, whose knowledge is recognized, and which capacities are missing?	Social inclusion, legitimacy, and local capability
Environmental	Tourism intensity, resource extraction, road condition, pollution, ecosystem pressure	Who creates and bears environmental costs, and how are limits monitored?	Conservation, reduced externalities, and carrying-capacity control
Disaster risk	Hazard exposure, building resilience, evacuation information, infrastructure reliability	How is risk integrated into planning, communication, and daily operations?	Visitor safety and community resilience
Cross-cutting governance	Coordination, accountability, participation, regulation, information sharing	Can institutions align stakeholders, enforce rules, and adapt to change?	Balanced, equitable, and resilient destination development

Figure 2. Integrated governance framework for volcanic geotourism sustainability



The resulting research gap is specific: existing studies identify individual economic, social, environmental, geological, or disaster-management issues, but limited evidence explains how governance capacity connects these issues and shapes the distribution of benefits, burdens, and resilience in Mount Batur. The framework guides the case-study design, coding, results, and discussion.

3. Methodology

3.1 Research Design and Case Selection

The study used an embedded qualitative case-study design. A case-study approach is appropriate when the research asks how and why contemporary processes occur within a real-life setting and when the boundaries between the phenomenon and its context are not clearly separable (Yin, 2018). Mount Batur was selected purposively because it combines five analytically relevant characteristics: UNESCO Global Geopark status, an active volcanic setting, high tourism intensity, dependence on natural-resource-based livelihoods, and visible governance trade-offs involving tourism, agriculture, fisheries, mining, infrastructure, and community well-being.

The case was bounded geographically around Mount Batur and its tourism-related activity system in Kintamani District. It was bounded analytically around economic, social, environmental, governance, and disaster-risk conditions. The unit of analysis was destination sustainability as experienced and governed by stakeholders. The purpose was analytical generalization to governance concepts, not statistical representation of all residents or businesses.

3.2 Participant and Sampling

Thirty-three informants were selected through stakeholder-based purposive sampling. Eligibility required direct knowledge of at least one of the following: destination governance, community livelihoods, tourism operations, visitor activities, agriculture or fisheries, mining

and resource use, environmental conditions, infrastructure, or research and education in the Mount Batur area. The sample covered seven main stakeholder categories to capture institutional, community, market, operational, resource-use, and academic perspectives.

Table 2. Stakeholder categories and relevance to the study

Stakeholder category	Examples of perspective represented	Primary analytical relevance
Government and village authorities	Regulation, planning, public services, destination priorities	Coordination, accountability, infrastructure, policy implementation
Local community representatives	Resident experience, customary and community interests	Participation, benefit distribution, social cohesion
MSMEs and small businesses	Food, souvenirs, coffee, agricultural products, household enterprise	Income, value chains, market access, digital capacity
Tourism and hospitality operators	Hotels, homestays, restaurants, museum-related services	Demand, investment, service quality, environmental pressure
Tourism activity providers	Guides, trekking, jeep and black-lava tours	Visitor allocation, competition, safety, carrying capacity
Resource-based industry actors	Agriculture, fisheries, sand and stone extraction	Resource dependence, externalities, ecological pressure
Academics and local experts	Tourism, community, environmental and governance knowledge	Contextual interpretation and triangulation

Note: The total sample was N = 33. The source manuscript did not report a numerical breakdown for each category; this should be added if the original recruitment log is available.

3.3 Participant and Sampling

Semi-structured interviews lasted approximately 15 minutes on average. The protocol used common core questions with follow-up prompts adapted to each stakeholder's role. Core domains covered: (1) tourism-related economic benefits and livelihood changes; (2) access to tourists, markets, technology, and business opportunities; (3) community participation, skills, service standards, and conflict; (4) environmental change, mining, traffic, roads, waste, and landscape pressure; (5) volcanic and landslide risk, building safety, preparedness, and visitor information; and (6) coordination, regulation, responsibility, and proposed improvements. The focused duration enabled access to operational stakeholders but limited the depth available from each interview, which is acknowledged as a methodological limitation.

Interviews were conducted on site in tourism businesses, farms, homestays, museums, villages, and activity locations. In several cases, the interview was accompanied by direct observation of jeep-tour areas, agricultural activity, accommodation, visitor facilities, roads, and resource-use locations. Secondary evidence consisted of Bangli Regency statistical indicators for 2021–2023, geological and disaster-risk maps, official UNESCO information, and relevant tourism and geopark literature. The data-collection period was [Author To Insert Month/Year Range From The Fieldwork Log].

Field observations were used as contextual evidence rather than as independent measurements of environmental quality. Likewise, regional statistics were used to describe

trends and proxies, not to attribute causality to individual sectors. This distinction reduces the risk of presenting descriptive indicators as direct proof of sustainability performance.

3.4 Thematic Analysis and Integration of Evidence

The analysis followed a structured thematic process informed by Braun and Clarke (2021). First, interview notes and excerpts were organized by stakeholder category and evidence source. Second, initial descriptive codes were assigned to livelihood benefits, market access, capacity, participation, conflict, environmental pressure, infrastructure, hazard exposure, and coordination. Third, related codes were grouped into economic, social, environmental, disaster-risk, and governance themes. Fourth, themes were reviewed against the complete evidence set, including contradictory or less favorable accounts. Fifth, theme definitions were refined and mapped to the integrated conceptual framework. Finally, cross-theme relationships were examined to identify trade-offs and governance mechanisms.

A structured coding matrix linked evidence excerpts, source categories, initial codes, analytical themes, TBL dimensions, and governance interpretations. Statistical indicators were analyzed descriptively and triangulated with interview and observational evidence. Convergence increased confidence in a theme. Divergence was retained and interpreted rather than removed, especially where aggregate growth coexisted with stakeholder reports of unequal access or environmental burdens.

3.5 Trustworthiness, Reflexivity, and Ethics

Methodological rigor was addressed using the trustworthiness criteria of credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985; Nowell et al., 2017). Credibility was strengthened through triangulation of interviews, field observations, official statistics, maps, and stakeholder categories. Dependability was supported by the coding matrix and an explicit analytical sequence. Confirmability was strengthened by retaining direct quotations and checking whether interpretations were supported by more than one source or by contextual data. Transferability was supported through a detailed description of the volcanic, tourism, livelihood, and governance setting. The revised report also follows relevant COREQ principles for transparent qualitative reporting (Tong et al., 2007).

Participants were informed of the study purpose, participation was voluntary, and identifying details were excluded from the manuscript. Quotations are attributed only by stakeholder role to protect confidentiality. The institutional ethical approval or formal exemption reference was not stated in the source manuscript and must be inserted before resubmission: [AUTHOR TO INSERT ETHICS COMMITTEE, APPROVAL/EXEMPTION NUMBER, AND DATE].

4. Results

4.1 Case Context and Hazard Setting

Bangli Regency comprises the districts of Susut, Bangli, Tembuku, and Kintamani. Kintamani District includes 48 villages, 175 hamlets or definitive neighborhoods, and 62 traditional villages (BPS-Statistics Bangli Regency, 2024). Mount Batur and Lake Batur form the principal geotourism landscape. The destination's scenic and geological assets are spatially connected to settlements, farms, fisheries, tourism facilities, roads, and extraction activities. This proximity creates opportunities for integrated local development but also places economic activity and visitor movement within areas exposed to geological hazards.

The landslide map indicates widespread susceptibility across Bangli Regency, including locations connected to geotourism activity. The volcanic disaster hazard map places the central Mount Batur area within differentiated hazard zones. These maps do not predict the timing of an event, but they demonstrate that tourism planning, construction standards, road access, evacuation information, and visitor management must incorporate hazard exposure.

Figure 3. Landslide susceptibility map of Bangli Regency, 2021.

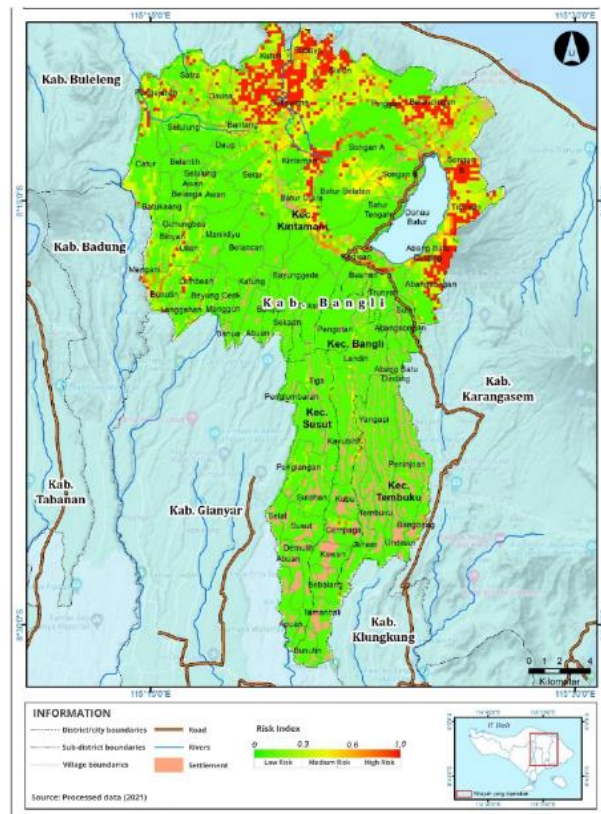
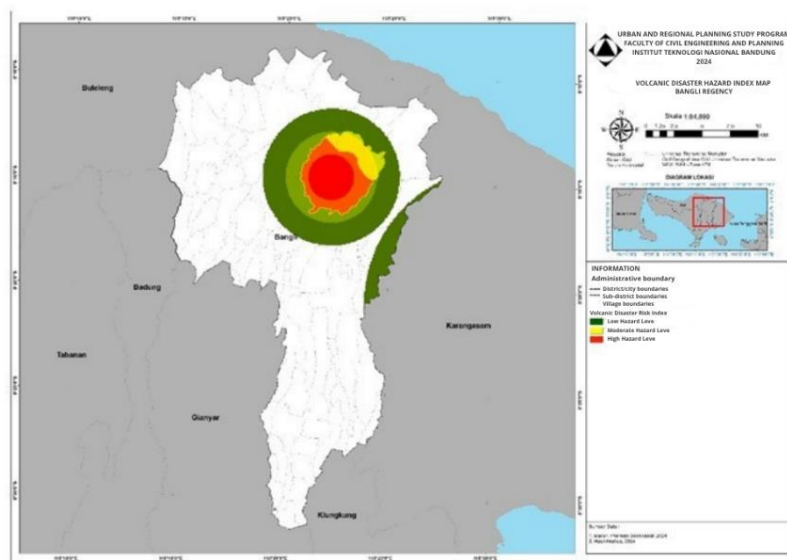


Figure 4. Volcanic disaster hazard zones in Bangli Regency, processed map, 2025.



4.2 Contextual Sustainability Indicators

Table 3 summarizes regional economic and social indicators and Kintamani-specific production, infrastructure, tourism, mining, and accommodation indicators. The series shows economic recovery after 2021. GRDP increased from 6,825.56 billion rupiahs in 2021 to 7,908.31 billion rupiahs in 2023, and economic growth rose from -0.33% to 3.50%. GRDP per capita also increased. Labour-force participation remained above 82%, while the unemployment rate declined to 0.75%. However, the number and percentage of people in poverty did not decline over the same period, indicating that aggregate recovery did not automatically translate into uniform social improvement.

Table 3. Stakeholder categories and relevance to the study

Indicator	Unit	2021	2022	2023
ECONOMIC				
Gross regional domestic product (GRDP)	Billion rupiahs	6,825.56	7,337.99	7,908.31
Economic growth	%	-0.33	2.80	3.50
GRDP per capita	Thousand rupiahs	26,318.86	28,181.53	30,255.87
SOCIAL				
Population growth	%	0.45	0.40	0.38
Life expectancy	Years	73.36	73.67	73.98
Labour-force participation	%	82.09	83.36	83.04
Unemployment rate	%	1.80	0.76	0.75
People in poverty	Thousand	11.68	12.17	12.24
Poverty rate	%	5.09	5.28	5.28
Human Development Index	Index	70.60	71.47	71.99
Literacy rate, age 15+	%	89.16	89.92	90.77
ENVIRONMENTAL, RESOURCE, AND INFRASTRUCTURE PROXIES, KINTAMANI DISTRICT				
Shallot production	Quintals	–	–	334,308
Chilli production	Quintals	–	–	21,757
Cabbage production	Quintals	–	–	204,577
Tomato production	Quintals	–	–	21,207
Chayote production	Quintals	–	–	115,691
Kintamani orange production	Quintals	–	–	730,627
Total road length	Km	–	–	905.81
Paved roads	%	–	–	94.15
Roads in good condition	%	–	–	72.03
Roads in moderate condition	%	–	–	10.76
Damaged roads	%	–	–	17.21
TOURISM AND RESOURCE-BASED ECONOMY				
Tourist visits	Visitors	1,702,130	1,161,901	1,742,454
Mining and quarrying GRDP	Billion rupiahs	125.21	131.51	139.86
Accommodation and food-service GRDP	Billion rupiahs	704.73	821.60	964.55

Tourist visits recovered to 1,742,454 in 2023, while accommodation and food-service GRDP increased by 36.9% between 2021 and 2023. Mining and quarrying also increased by 11.7%. In 2023, 72.03% of roads were in good condition, while 27.97% were moderate or damaged. The coexistence of tourism growth, extractive activity, and infrastructure vulnerability does not establish a direct causal relationship, but it identifies a management problem that was repeatedly raised in stakeholder accounts.

4.3 Economic Findings

4.3.1 Livelihood Diversification

Stakeholders consistently described tourism as an additional or primary source of household income. Economic activity extended beyond hotels and restaurants to coffee, souvenirs, local food, agriculture, fisheries, guiding, jeep tours, black-lava tours, museum visits, and homestays. MSMEs were generally small and livelihood-oriented rather than capital-intensive. One account summarized their role as follows:

"Their businesses are small-scale, but they still provide a source of income for their households." (MSME-related interview)

The evidence indicates that geotourism broadens the local livelihood portfolio. The benefit is important because households can combine tourism with agriculture, fisheries, or small-scale trade. However, diversification does not remove vulnerability when income depends on seasonality, visitor flows, raw commodities, and access controlled by intermediaries or informal networks.

4.3.2 Market Access, Value Addition, and Unequal Benefits

Kintamani oranges illustrate the difference between production and value capture. High production creates income potential, but seasonal oversupply, limited processing, and weak market coordination can reduce prices and increase waste. A village authority emphasized the need for innovation:

"Orange farmers desperately need new ideas, creativity, and innovation to manage the large number of oranges that are wasted during the main harvest." (Village authority)

Tour providers also reported unequal access to tourists and strong competition for guests. Digital capability was identified as a barrier to direct market access and coordinated promotion:

"There is often inequality in obtaining tourists and competition for guests." (Jeep-tour guide)

"The community's digital literacy still needs to be improved." (Local academic)

These accounts show that increased visitor demand does not guarantee equitable distribution. Actors with stronger networks, locations, online visibility, investment capacity, or booking access can capture more value. The finding links market inequality to governance because collective platforms, allocation rules, training, and product-development support were limited or fragmented.

4.3.3 Resource Dependence

Lake Batur fisheries, fertile volcanic soils, and eruption deposits support livelihoods and tourism products. Restaurants use local tilapia, agricultural landscapes supply food and identity, and volcanic materials provide mining income. A fisheries-related account described tilapia cultivation as promising. These activities demonstrate the productive value of the volcanic environment. They also create dependence on ecological quality, access to natural resources, and long-term carrying capacity.

“The income from cultivating Lake Batur tilapia is quite promising.” (Fisheries-related interview)

Mining presented the clearest economic-environmental tension. It creates income and construction materials, but stakeholders connected truck movements and extraction to road damage, dust, noise, and visitor disturbance. The economic finding is therefore mixed: resource-based income contributes to livelihoods while shifting part of the cost to public infrastructure, residents, and tourism businesses.

4.4 Social Findings

4.4.1 Capacity and Service-Quality Gaps

Stakeholders described rapid tourism growth alongside uneven service capacity. Competition for visitors encouraged some providers to reduce prices or accept guests without adequate service differentiation. Village officials summarized the issue as becoming less selective in accepting guests and charging prices below appropriate service standards. The problem was not presented as individual misconduct alone. It was associated with limited training, weak coordination, fragmented standards, and pressure to secure short-term income.

“Some providers become less selective in accepting guests and charge prices below appropriate service standards.” (Village authorities)

The findings indicate a capacity gap in digital marketing, product design, interpretation, hospitality standards, language, safety communication, and business collaboration. This gap affects visitor experience and can intensify social competition within the community.

4.4.2 Participation, Education, and Community Engagement

Stakeholders recognized the importance of community and customary-group involvement in destination planning. The Batur Geopark Museum was identified as an educational asset that can connect geological history, disaster awareness, conservation, and local identity. School and university visits provide a pathway for building knowledge and stewardship. However, education and participation were not yet described as a fully integrated destination-wide system linking tourism operators, villages, businesses, conservation, and risk management.

4.4.3 Conflict and Social Cohesion

Social tensions arose where residents, tourism providers, investors, resource users, and regulators pursued competing interests. Unequal access to guests, price competition, land and resource use, tourism-related crowding, and perceived regulatory inconsistency contributed to conflict. These tensions were not always formal disputes, but they reduced trust and made collective destination management more difficult. The evidence suggests that social sustainability depends on credible forums for representation, shared rules, and accessible conflict-resolution mechanisms.

4.5 Environmental and Disaster-Risk Findings

4.5.1 Tourism and Landscape Pressure

High visitor intensity and rapid facility development created pressure around viewpoints, lava fields, roads, and settlement areas. Stakeholders contrasted older small-scale accommodation with photography-oriented cafés and facilities that attract concentrated visitor flows. The issue was not the presence of new tourism products itself. The concern was development without a common carrying-capacity framework, coordinated parking and traffic management, landscape design guidance, waste control, and risk-sensitive siting.

“Small-scale homestays with outdated designs tend to be quiet, while highly visible cafés attract excessive crowds.” (Hospitality-related interviews)

4.5.2 Infrastructure and Disaster Vulnerability

The hazard maps and interviews indicate that tourism infrastructure operates within a risk-prone volcanic landscape. Stakeholders mentioned building strength, road access, and the consequences of concentrating visitors in exposed areas. One hotel manager highlighted structural vulnerability:

“Buildings made with less sturdy structures risk endangering visitors.” (Hotel manager)

The results reveal a gap between hazard awareness and routine governance. Risk information was recognized, but stakeholders did not describe a fully integrated system of tourism zoning, building compliance, operator training, visitor communication, route management, and emergency coordination. Road damage also creates a compound risk because it affects daily mobility and may reduce access during disruption.

4.5.3 Environmental Injustice

Mining-related truck traffic generated the most direct account of an environmental burden being transferred across sectors. Tourism and residents experienced noise and road impacts, while the economic benefits of extraction were concentrated among actors participating in the mining chain. A hotel manager reported:

“The main complaint from guests is the noise of trucks transporting sand at night, which prevents them from enjoying a good night’s rest.” (Hotel manager)

This finding identifies a distributional issue. Extraction may be legally and economically important, but operating schedules, truck routes, road-maintenance responsibilities, dust control, rehabilitation, and monitoring determine whether costs are fairly managed. Without transparent accountability, public infrastructure and nearby communities absorb external costs.

4.6 Cross-Cutting Governance Findings

Across the economic, social, environmental, and risk themes, five governance problems recurred: fragmented coordination, unequal access to tourism benefits, limited community and business capacity, weak control of environmental externalities, and incomplete integration of disaster risk into routine destination management. [Table 4](#) summarizes the relationships among evidence, consequences, and required governance responses.

[Table 4. Integrated findings and governance implications](#)

Cross-cutting theme	Evidence from the case	Sustainability consequence	Governance response indicated
Fragmented coordination	Stakeholders operate across tourism, villages, agriculture, fisheries, mining, roads, environment, and disaster management	Policies and activities remain sectoral; cumulative impacts are not managed	Permanent multi-stakeholder destination forum with shared targets, roles, and monitoring

Cross-cutting theme	Evidence from the case	Sustainability consequence	Governance response indicated
Unequal benefit distribution	Competition for guests, uneven digital capacity, limited value addition for agricultural products	Aggregate growth coexists with unequal market access and livelihood vulnerability	Transparent booking and promotion mechanisms, cooperative product development, local value-chain support
Capacity gaps	Variation in service standards, marketing skills, interpretation, and risk communication	Reduced service quality, price competition, and weak participation	Joint training, certification, mentoring, and accessible destination data
Environmental externalities	Mining traffic, noise, road damage, concentrated visitors, uncoordinated facility growth	Costs shift to residents, public infrastructure, tourism businesses, and ecosystems	Operational regulation, road-use responsibility, restoration funding, carrying-capacity controls
Risk-governance gap	Hazard zones overlap with tourism activity; concern about building strength and access	Visitor and community exposure may increase despite hazard awareness	Risk-sensitive zoning, building standards, evacuation information, drills, operator protocols

5. Discussion

5.1 Sustainability Trade-Offs and the Limits of Indicator Balance

The results confirm that Mount Batur geotourism produces meaningful economic benefits, but they challenge any interpretation of sustainability based only on growth in GRDP, visitor numbers, or sectoral revenue. Livelihood diversification is real, yet poverty did not decline during the period shown and stakeholders reported unequal access to tourists, limited value addition, and market competition. Environmental and infrastructure pressures also accompanied growth. The TBL dimensions therefore do not move in parallel. Economic expansion can coexist with social inequality, environmental externalities, and increased risk exposure.

This finding supports the use of TBL as an organizing structure but demonstrates its limitation as a balancing metaphor. The relevant question is not whether the destination has economic, social, and environmental indicators. It is how decisions, institutions, and power relations connect them. A destination can report positive indicators in each domain while still shifting costs to less powerful groups or postponing risks. The case therefore extends TBL analysis by treating governance capacity as the mechanism through which trade-offs are recognized, negotiated, regulated, and monitored.

5.2 Governance Capacity as a Mediator of Volcanic Geotourism Sustainability

The central theoretical contribution is a governance-mediated sustainability proposition: contextual pressures such as tourism intensity, volcanic hazard, resource extraction, and infrastructure vulnerability do not produce fixed outcomes. Their effects depend on coordination, participation, accountability, adaptive regulation, and risk communication. Where these capacities are weak, livelihood gains become uneven, externalities remain unpriced, and hazard awareness is not translated into routine operational controls. Where they are stronger, the same geological and tourism resources can support education, local enterprise, conservation, and resilience.

This proposition is consistent with disaster-tourism research showing that governance and communication shape recovery and preparedness (Bhaskara, 2022; Nurjanah et al., 2026; Zhang et al., 2024). It also aligns with UNESCO's requirement for a management

body and a jointly agreed plan involving relevant actors (UNESCO, 2026a). Mount Batur's challenge is therefore not a lack of stakeholders or economic activity. It is the absence of an adequately integrated system that can align sectoral decisions and hold actors accountable for cumulative effects.

5.3 Environmental Justice and the Distribution of Benefits, Burdens, and Risk

The findings add an environmental-justice explanation to the TBL framework. Unequal access to tourists and digital markets represents distributional inequality in economic benefits. Mining-related noise, road wear, and disturbance illustrate environmental burdens transferred to residents, accommodation businesses, visitors, and public infrastructure. Limited participation and fragmented coordination raise procedural-justice concerns because affected actors may lack an effective forum for influencing operational rules. Risk-sensitive construction and visitor management also involve recognition justice because residents, workers, small businesses, and visitors have different exposure and capacities.

This interpretation corresponds with environmental-governance studies that define equity through the fairness of distribution and decision-making (Bennett et al., 2023; Gurney et al., 2021). It also explains why aggregate economic indicators are insufficient. Sustainability requires mechanisms that disclose who benefits, who pays, who decides, and how compensation, mitigation, or redistribution occurs.

5.4 Comparison with Previous Studies

The economic findings are consistent with studies showing that geoparks can support MSMEs, agriculture-based tourism, local products, and livelihood resilience (Astarini et al., 2024; Cahyadi & Newsome, 2021). The Mount Batur case adds that livelihood diversification remains fragile where producers have limited processing capacity, direct market access, or collective organization. The social findings support research emphasizing community participation and destination legitimacy (Aly et al., 2021; Reindrawati, 2023), while showing that participation must be supported by skills, information, and conflict-resolution arrangements.

The environmental and risk findings correspond with research on volcanic tourism disruption, hazard exposure, and the need for resilient planning (Alfama et al., 2024; Leoni & Boto-García, 2023; Ziegler et al., 2023). The case differs from studies focused mainly on eruption impacts because current vulnerability is also produced during normal tourism operations through land use, infrastructure, extraction, and visitor concentration. This shifts attention from emergency response to everyday risk governance.

The governance findings align with geopark-management research that emphasizes cooperation, destination management, interpretation, and stakeholder networks (Kornecká et al., 2024; Rubira-Gómez et al., 2024). Mount Batur provides a specific example of why these functions must extend beyond promotion. They must include benefit distribution, environmental accountability, road and traffic management, data sharing, spatial control, and disaster preparedness.

5.5 Policy and Practical Implications

First, Bangli Regency and the geopark management body should establish a permanent Mount Batur Geotourism Governance Forum. Membership should include district and village authorities, customary institutions, geopark management, disaster-management and volcanology agencies, tourism and hospitality associations, guides and activity providers, MSMEs, farmers, fisheries actors, mining representatives, environmental

groups, and academics. The forum should use a public work plan with responsible agencies, deadlines, indicators, and a conflict-resolution process.

Second, the destination should create a shared sustainability and risk dashboard. Indicators should include visitor concentration by site and time, waste and water pressure, road condition, truck movements, business participation, local procurement, product value addition, complaints, building compliance, evacuation information, and training coverage. This would correct the current reliance on broad regional indicators and support early intervention.

Third, spatial planning and operational permits should be risk-sensitive. Tourism facilities and activities in exposed zones require clear siting rules, structural standards, maximum group sizes, safe routes, multilingual warnings, operator protocols, evacuation maps, and periodic drills. Risk communication should be integrated into booking, guiding, accommodation, museum education, and destination signage rather than treated as a separate emergency function.

Fourth, economic inclusion should be strengthened through a joint digital marketplace, transparent visitor-allocation or booking arrangements for local activity providers, cooperative product development, and value-added processing for Kintamani oranges and other agricultural products. Training should link digital capability, service standards, pricing, interpretation, safety, financial management, and market access.

Fifth, mining and heavy-vehicle externalities require explicit accountability. Operational hours, routes, axle-load enforcement, dust and noise controls, road-maintenance contributions, environmental rehabilitation, and public complaint mechanisms should be transparent. A defined share of relevant fees or contributions should support road repair, landscape restoration, monitoring, and community protection in affected areas.

6. Conclusion

Mount Batur geotourism supports diverse livelihoods and a growing tourism economy, but sustainability outcomes remain uneven. Economic indicators show recovery and rising tourism-related activity. Stakeholder evidence shows that these gains are constrained by unequal market access, limited value addition, social and digital capacity gaps, competition, environmental externalities, damaged infrastructure, and incomplete integration of disaster risk into routine destination management. The first research question is therefore answered by a mixed pattern of livelihood opportunity and cumulative vulnerability across economic, social, environmental, and risk dimensions.

The second research question is answered by the central role of governance. Hazard intensity alone does not explain sustainability outcomes. Coordination, participation, accountability, regulation, information sharing, and risk communication determine how benefits and burdens are distributed and whether development strengthens or weakens resilience. Governance capacity functions as a mediating mechanism between contextual pressures and TBL outcomes.

The third research question points to five priorities: an integrated multi-stakeholder governance forum, a shared sustainability and risk-monitoring system, risk-sensitive spatial and operational controls, inclusive market and capacity-development mechanisms, and accountable management of mining and heavy-vehicle externalities. Together, these measures can connect geoconservation, local livelihoods, visitor experience, community well-being, and disaster preparedness.

Theoretically, the study extends TBL analysis by incorporating governance capacity, environmental justice, and disaster risk as explicit explanatory dimensions. Practically, it provides a place-based governance agenda for an active volcanic geopark.

Methodologically, the study is limited by its single-case design, the short average interview duration, the absence of a reported stakeholder-count breakdown, reliance on stakeholder perceptions, and the use of secondary proxy indicators rather than direct measurements of carrying capacity, ecosystem quality, or exposure. The findings offer analytical transferability, not statistical generalization.

Future research should compare multiple active volcanic geoparks, repeat measurements longitudinally, and use mixed methods. Survey-based measures of governance capacity, benefit distribution, trust, risk communication, and preparedness should be combined with ecological carrying-capacity assessment, spatial analysis, road and traffic monitoring, visitor-flow data, and business-network analysis. Governance interventions should also be evaluated to determine whether they reduce inequality, externalities, and risk over time.

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