

Research Article

Insular Geoparks as Catalysts for Sustainable Local Development: A Bibliometric and Critical Analysis

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ABSTRACT

This study examines the role of Insular Geoparks in stimulating local development within island communities. It combines bibliometric analysis of 176 peer-reviewed articles (2004-2023) from Scopus and Web of Science databases, and a critical review of empirical studies across 20 Insular Geoparks globally. The Bibliometrix R-Tool was employed for science mapping, including keyword co-occurrence networks, citation analysis, and research trend identification. Key bibliometric findings show rapid growth in publications since 2010, disciplinary concentration in geosciences, geographic clustering in Asia-Pacific and Europe, and limited international collaboration (17.6% MCP). The critical review shows that Insular Geoparks contribute to economic diversification, social cohesion, and environmental conservation through geotourism, geobranding, geogastronomy, and geoeducation initiatives. However, significant variations exist in development outcomes based on community engagement levels, governance structures, and stakeholder participation mechanisms. Communities with robust co-management frameworks and inclusive decision-making processes demonstrate relatively greater socio-economic benefits. Existing research is limited by the predominance of descriptive studies, the absence of control groups, and insufficient interdisciplinary perspectives. The study therefore argues that while Insular Geoparks can support sustainable local development, equitable and widespread benefits depend on effective governance and meaningful participation. Future research should adopt stronger causal designs (e.g., difference-in-differences, matched controls, or randomized interventions where feasible) and broaden interdisciplinary engagement with social sciences to strengthen evidence and policy relevance. This study provides the first bibliometric and critical analysis synthesizing global Insular Geopark research.

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1 Introduction

Many remote islands face significant challenges regarding socioeconomic development and limited livelihood opportunities for their residents (Halim et al., 2011). These issues are complex, particularly when considering the sensitive coastal environments and limited natural resources characteristic of many small islands (Otokiti, 2026; Jackson, 2006). In response, a growing number of island communities are turning to tourism-based activities to promote growth and prosperity, rather than more traditional economic activities centered on fisheries and agriculture (Royle, 2008).

Tourism is widely acknowledged as one of the primary tools for community development in small island states, given its potential to create employment opportunities, boost local incomes, and stimulate demand for local products and industries (Mason, 2008). However, tourism may also negatively impact the islands' local environment and society (Otokiti et al., 2026; Yoon et al., 2001). Such impacts can range from environmental degradation to social and cultural changes that can have far-reaching consequences for local communities. These potential drawbacks and the burgeoning interest in geological terrains and geodiversity have catalysed the adoption of Geoparks as

a strategy to stimulate socio-economic development (Wójtowicz et al., 2011), promote geotourism, and safeguard and promote geological conservation concurrently (McKeever & Zouros, 2005).

Unsurprisingly, establishing Geoparks is contingent upon their capacity to exhibit the potential to incite local development. This is reflected in the evaluation process for aspiring Geoparks, wherein applicants must demonstrate how their Geoparks can propel local development through "geotourism," "sustainable development policy," "partnership," and "full and effective participation of local communities and indigenous people." These criteria also apply to the revalidation process, which established Geoparks must undergo every four years (UNESCO, 2015). This focus on local development highlights the importance of Geoparks to promote sustainable economic growth that benefits local communities. Furthermore, Richards and Hall (2003) contend that achieving sustainable tourism development necessitates adopting a comprehensive approach that ensures enhanced welfare of human communities in terms of their social, cultural, and economic well-being.

Despite the growing global network of Insular Geoparks and their purported contributions to local development, several critical questions remain

underexplored:

- i. What are the prevailing research trends, thematic foci, geographic distributions, and knowledge structures in Insular Geopark scholarship?
- ii. Through which specific mechanisms and pathways do Insular Geoparks contribute to local development across economic, social, and environmental dimensions?
- iii. What are the critical methodological limitations in current research assessing Insular Geopark impacts, and what alternative approaches could yield more robust causal evidence?
- iv. What are the key areas for improvement in Insular Geopark management, policy, and research to maximize equitable and sustainable local development outcomes?

To address these questions, this study adopts a combined approach of bibliometric analysis and critical review, ensuring comprehensive examination. The bibliometric analysis investigates various dimensions, including publication trends, journal distributions, geographic patterns, author productivity, historiographic developments, and keyword co-occurrence networks. Subsequently, the critical review component explores the potential of Geoparks as community development tools, addresses research limitations, and identifies potential avenues for future research. By employing this bibliometrics-led and critical review-assisted approach, the study aims to provide both a broad overview and in-depth insights, enhancing the academic robustness of the research.

The remainder of this paper is structured as follows: Section 2 presents the literature review; Section 3 provides an overview of Insular Geoparks and their geographical distribution; Section 4 presents the analytical approach; Section 5 presents findings from the bibliometric analysis; Section 6 examines empirical evidence on Insular Geoparks and local development; Section 7 offers critical reflections on the findings; and Section 8 presents conclusions, theoretical and practical implications, limitations, and future research directions.

2 Literature Review

2.1 Geoparks as a Community Development Tool

With the evolution of the Geopark concept, the focus has shifted towards using restricted and protected areas as a means of local development or branding. The concept prioritises striking a balance between the conservation of Geo-heritage, promoting geo-tourism activities, and ensuring the welfare of local communities (Komoo, 2010). Accordingly, community development is at the core of the Geopark concept.

Geoparks may have both tangible and intangible impacts on local development (Fassoulas & Zouros,

2010), with geobranding, geo-gastronomy, and geoeducation and recreational activities (Lee & Jayakumar, 2021) being some of the specific pathways through which this impact might be accomplished. Geobranding may stimulate creativity and innovation within local communities, producing unique and high-quality geoproductions (Farsani et al., 2017). For instance, Fassoulas and Zouros (2010) argue that the Lesvos Geopark contributes significantly to community development by directly and indirectly creating new jobs and boosting the economic conditions of makers of handicrafts and ceramic fossil casts, carpenters, and blacksmiths whose products are sold within the Geopark's museum and promoted to visitors.

Geobranding has the potential to benefit both visitors and local communities alike. For instance, Geobranding showcases the unique identities and characteristics of a particular region (Freire & Crowther, 2007) and could attract more visitors and enrich the travel experience (Rodrigues et al., 2020). Furthermore, tourist enterprises, small hotels, guest houses, and restaurants in the Geopark area benefited from the increased tourist flow due to the Lesvos Geopark. According to Han et al. (2018), over 50% of the residents in Tangkou town, located in the Huangshan Geopark in China, are employed in industries related to geotourism. Meanwhile, Rosado-González et al. (2020) found that local communities in Geoparks that were designated earlier perceived an improvement in their economic conditions.

Geo-gastronomy is a popular and creative strategy in many Geoparks (Burlando et al., 2011; Farsani et al., 2011, 2017; Henriques et al., 2011). It involves using local food products and traditional cuisine to create a distinctive culinary experience for visitors. According to Lee and Jayakumar (2021), the promotion of local food is one of the benefits of Geoparks, which is achieved through various measures such as granting Geopark label accreditation to local food, creating cookbooks featuring local cuisine, offering local food at visitor centers, supporting women's initiatives, and collaborating in organising local festivals. For instance, Lesvos Geopark held an Agrotouristic festival in 2007, which attracted around 28,000 visitors, providing opportunities for women involved in agrotourism and local organic food production to showcase their top-quality products, including pasta, olive oil, wine, ouzo, liquors, traditional sweets, and marmalades, which were available for purchase by visitors (Fassoulas & Zouros, 2010).

Geoparks offer a range of recreational activities like hiking, climbing, cycling, camping, skiing, bird watching, and rafting, which can attract more visitors. Additionally, they provide opportunities for initiatives related to geoconservation and geoeducation, such as setting up museums and visitor centers, vocational training centres,

identifying and designating geosites, creating geotrails, and producing educational materials. These undertakings can also generate employment opportunities in the regions (Lee & Jayakumar, 2021). For instance, the Natural History Museum's Vocational Training Centre, located at the Lesvos Petrified Forest, has provided extensive training to a large number of young unemployed individuals in areas related to conservation, excavation, fossil preservation, Geopark promotion, and visitor management. As a result of this training, a significant number of the trainees have either secured employment in the Lesvos Petrified Forest Geopark or were employed previously (Fassoulas & Zouros, 2010).

3 Insular Geoparks

As of the search date (11 July 2023), the UNESCO Global Geoparks network comprises about 195 members spanning 48 countries (UGGp, 2023). Insular Geoparks are a specific subset of Geoparks showcasing the unique geological, cultural, and natural heritage found within island environments. In general, Insular Geoparks are known for their remarkable landscapes and spectacular scenery, which are characterised by varying sizes, diverse climates, and geological/geographical features.

Based on geographic location, they are predominantly concentrated within the Asia-Pacific Geoparks Network and European Geoparks. The former encompasses a notable collection of ten Insular Geoparks, namely Leiqiong UNESCO Global Geopark (China), Hong Kong UNESCO Global Geopark (China), Langkawi Island UNESCO Global Geopark (Malaysia), Jeju Island UNESCO Global Geopark (Republic of Korea), Oki Islands UNESCO Global Geopark (Japan), Qeshm Island UNESCO Global Geopark (Iran), Rinjani-Lombok UNESCO Global Geopark (Indonesia), Batur UNESCO Global Geopark (Indonesia), Belitong UNESCO Global Geopark (Indonesia), and Gunung Sewu UNESCO Global Geopark (Indonesia). Likewise, the European Geoparks network is home to a range of Insular Geoparks, including Kefalonia-ithaca UNESCO Global Geopark (Greece), Lesvos Island UNESCO Global Geopark (Greece), Psiloritis UNESCO Global Geopark (Greece), Sitia UNESCO Global Geopark (Greece), Vis Archipelago UNESCO Global Geopark (Croatia), Shetland UNESCO Global Geopark (Scotland, United Kingdom), GeoMôn UNESCO Global Geopark (Wales, United Kingdom), Azores UNESCO Global Geopark (Portugal), El Hierro UNESCO Global Geopark (Spain), and Lanzarote and Chinijo Islands UNESCO Global Geopark (Spain) (Based on the classification on: <https://unescochairGeoparks.aegean.gr/en/Insular-and-coastal-Geoparks>).

The countries hosting Insular Geoparks generally

have a high to very high human development index. Greece, with an index of 0.887; Croatia with 0.858; the UK with 0.929; Portugal with 0.866, and Spain with 0.905 are examples of countries with high human development. China with 0.768, Malaysia with 0.803, South Korea and Japan both with 0.925, Iran with 0.774, and Indonesia with 0.705 (UNDP, 2022) are also among the countries hosting Insular Geoparks. However, the remote and isolated nature of the particular islands, combined with their smaller size, susceptibility to seasonality, and vulnerability to the impacts of climate change, may create development gaps between countries and communities hosting Insular Geoparks. Therefore, Insular Geoparks may bear a greater responsibility (compared to their counterparts on the mainland) in stimulating local development due to the unique circumstances of their hosting communities. Atkins et al. (2000) suggest that due to their vulnerability, Insular communities are exposed to political, social, and environmental external forces that can have significant, non-neutral implications for their economies. One may thus argue that exploring the role of Insular Geoparks in fostering local development remains a relevant area for further exploration.

4 Methods

For the first part of science mapping, this study adopted a bibliometric analysis, a quantitative approach for analysing academic literature, to examine the frequently used keywords in island Geopark research, keyword co-occurrence networks, and focuses on Insular Geoparks. The methodology involves utilising bibliographies to provide a description, evaluation, and monitoring of published research (Fan et al., 2023). The study employed the Bibliometrix R-Tool (Aria & Cuccurullo, 2017) for conducting the bibliometric analysis, which is a recent R package designed to facilitate comprehensive bibliometric analysis. This tool incorporates specific features and tools for conducting quantitative bibliometrics and scientometrics research. R, an open-source, powerful, and versatile statistical software environment, was chosen for this purpose. R functions as an integrated suite of software applications that enable data manipulation, calculation, and graphical representation (Crawley, 2012).

Employing transparent and reproducible search and review processes enhances the reliability of research findings and minimises the subjective bias often associated with literature reviews (Madiati et al., 2018; Zupic & Čater, 2015). The relevant literature pertaining to Geoparks and islands was collected from two scholarly databases, namely Web of Science (WoS) and Scopus. These databases have been previously employed in bibliometric analysis across various fields, occasionally in isolation, as seen in the case of WoS (Diem & Wolter, 2013; Falagas et al., 2006), and Scopus (Maharana, 2008), and at

times in conjunction. However, the joint utilisation of these databases is less frequent and typically reserved for comparative purposes (Durán-Sánchez et al., 2018; Gorraiz & Schloegl, 2008). For this research, the two databases were utilised to ensure comprehensive coverage of the existing literature.

To ensure a comprehensive search, the same search string ("Geopark AND Island") was applied to both databases. The search was conducted on 11/07/2023, resulting in a total of 220 samples (115 from Scopus and 105 from Web of Science). Inclusion criteria include anglophone peer-reviewed journal articles, conference proceedings, and book chapters that explicitly address geoparks in island contexts or use an insular geopark as a case study.

In the Scopus database, the search was specifically conducted within the article title, abstract, or keywords.

For the Web of Science database, the search encompassed all fields available. This approach allowed for a thorough exploration of relevant literature on Geoparks and islands, ensuring that articles from various aspects of the research were included in the analysis. The screening involved identifying and removing duplicate articles, resulting in the elimination of 44 duplicates. Ultimately, 176 unique articles were considered for the final analysis (Figure 1).

The second part of the study involves conducting a critical review of research that examines the impact of Geoparks as catalysts for local development on islands. To ensure a comprehensive analysis, studies from sources beyond Scopus and WoS were also incorporated into the review. By considering a wide range of relevant sources, the study aims to provide a thorough and inclusive evaluation of the role of Geoparks in driving local development on islands.

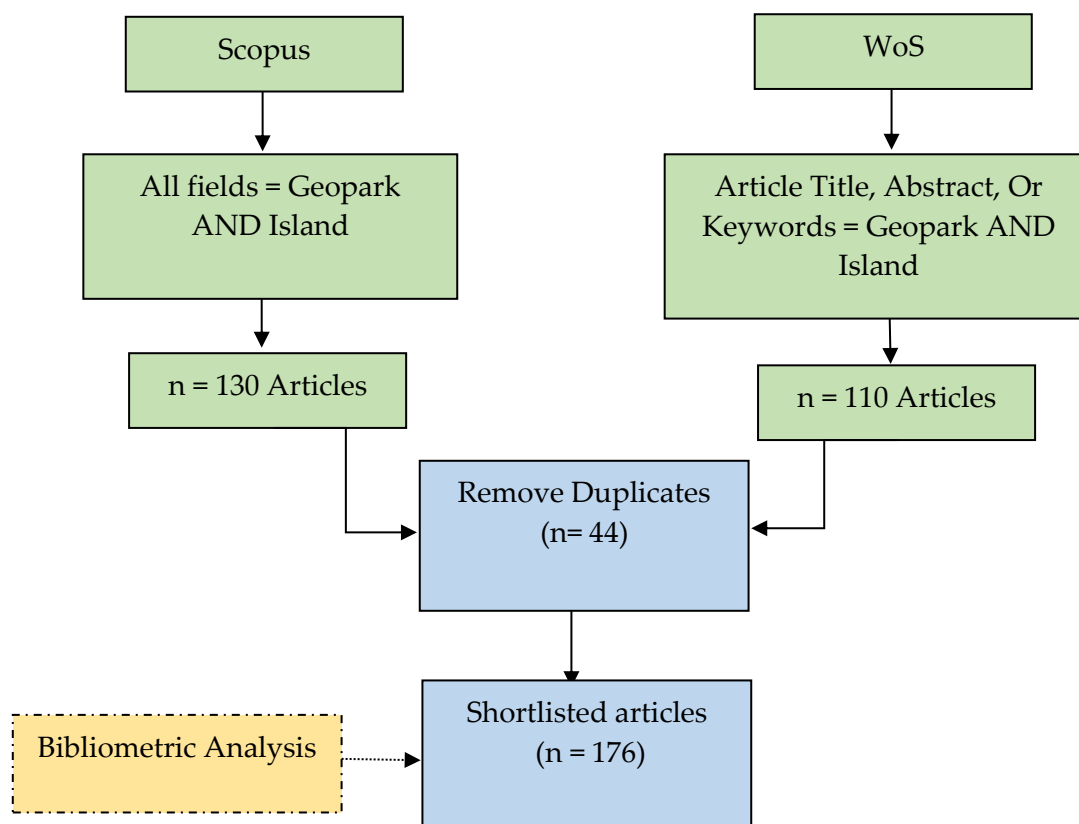


Figure 1: Schematic Framework for Bibliometric Analysis

5 Insular Geopark Research Overview

5.1 Research Trend

The result presented in Figure 2 reveals that 176 papers were distributed between 2004 and 2023. It shows that there were periods of no publication activity, particularly in 2005-2006 and 2008-2009. Between 2004 and 2009, there were very few articles published. Contrastingly, the number of articles started to increase in 2010 with 4 publications, followed by a gradual rise in subsequent years. Notably, the publication count reached its highest point in 2021 with 36 articles, indicating a peak in research productivity and a significant surge in research

interest. In 2022, the number of publications decreased slightly to 24, but it remained higher compared to the earlier years. This pattern indicates that Insular Geopark research has gained momentum, increased global attention to Sustainable Development Goals (2015 -2030), and the expansion of the UNESCO Global Geoparks network.

As of 2023, there have been 11 articles published so far. The cumulative publications since 2009 exhibited an exponential growth curve (Figure 3). This trend indicates a growing and sustained interest in research related to

Insular Geoparks, potentially leading to increased understanding and knowledge exchange. However, this growth remains geographically concentrated and

disciplinarily constrained, as evidenced by journal distribution patterns discussed subsequently.

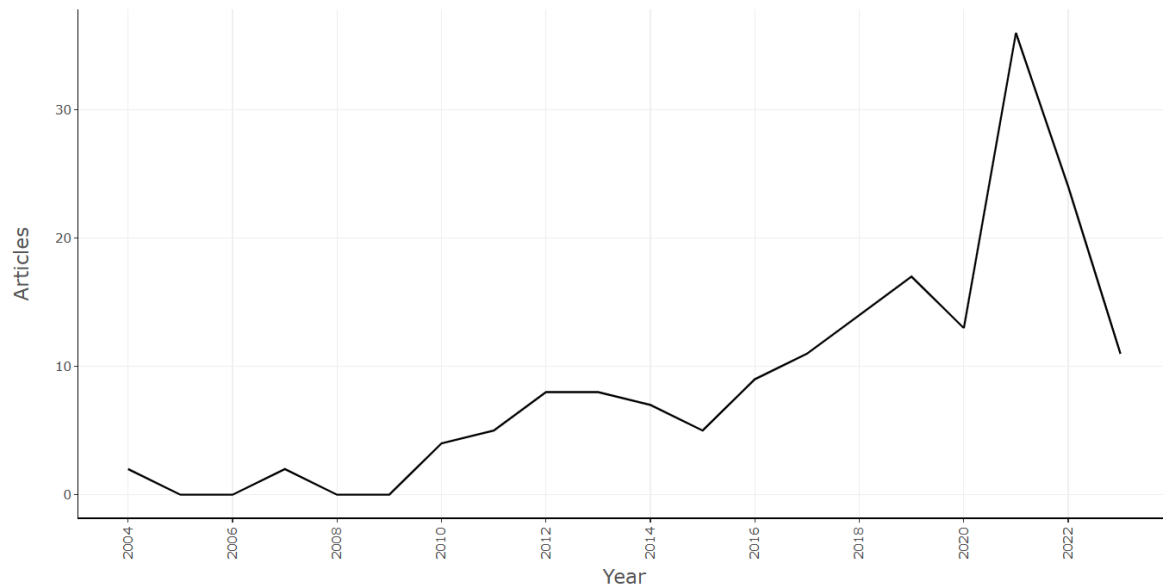


Figure 2: Annual Number of Publications

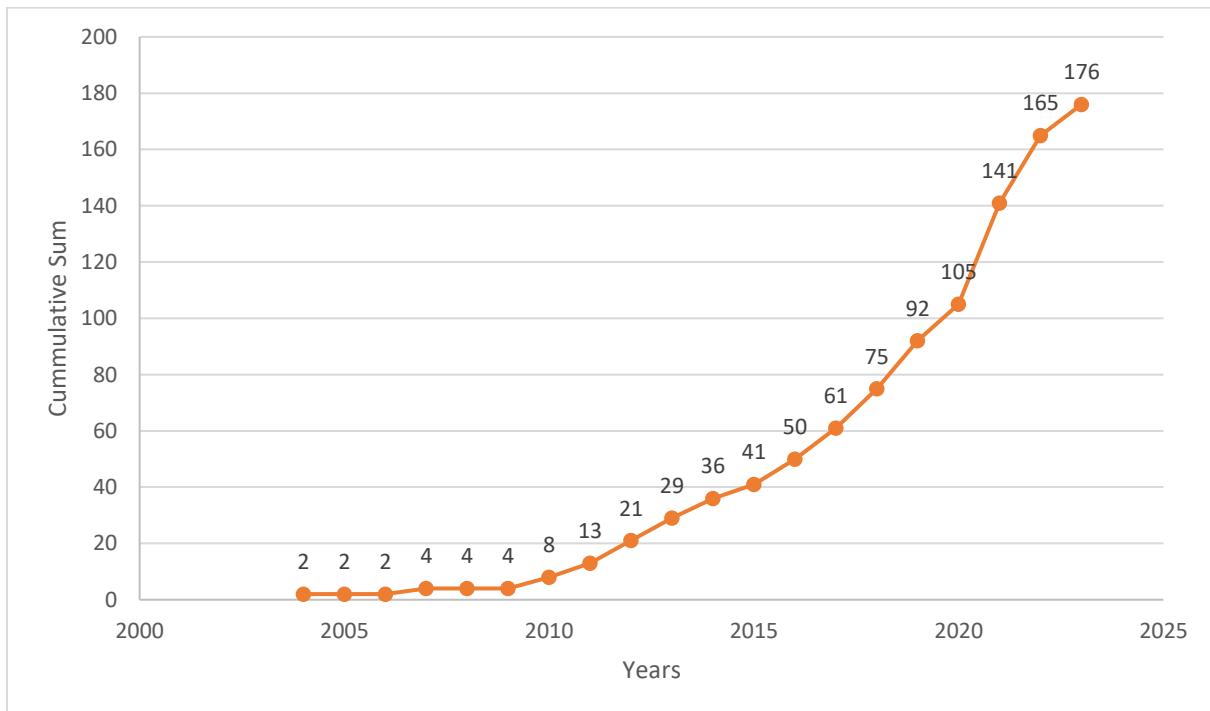


Figure 3: Cumulative Number of Publications

5.2 Publications by Journals

From 2004 to 2023, research on Insular Geoparks was disseminated across a variety of journals (N = 104). Figure 4 showcases the top 10 journals in which research on Insular Geoparks has been published. "GEOHERITAGE" appears to be the most prominent publication in research related to Insular Geoparks, with 26 articles. Following closely is the "IOP Conference Series: Earth and Environmental Science," with 12 articles. "GEOJOURNAL OF TOURISM AND GEOSITES" and

"GEOSCIENCES" both host 7 articles each.

Other journals include "GEOCONSERVATION RESEARCH" and "ISLAND ARC," with 6 articles each; "EPISODES" with 4 articles; and "BIODIVERSITAS," "INTERNATIONAL JOURNAL OF GEOHERITAGE AND PARKS," and "PLANNING MALAYSIA" with 3 articles each.

Regarding citations, it could be observed that two of the most cited sources, such as GEOHERITAGE and GEOSCIENCES, align with the journals that had the highest number of published articles. This indicates that

these sources have contributed significantly and been influential in shaping the research and understanding of Insular Geoparks (Figure 5).

While distribution across multiple journals may reflect the multidisciplinary nature and broad academic interest in Insular Geoparks, studies published in development-focused, social sciences, or humanities journals are generally lacking. This disciplinary imbalance is concerning as it suggests Insular Geopark research remains predominantly anchored in geosciences, with insufficient engagement from development studies, sociology, economics,

anthropology, and tourism management perspectives. Consequently, the socio-economic, cultural, political, and equity dimensions of Insular Geoparks may be undertheorized and empirically underexplored. This gap is particularly problematic given UNESCO's explicit emphasis on local development and community participation as core geopark objectives. The dominance of geoscience perspectives may inadvertently privilege geological conservation over community development concerns, potentially reproducing center-periphery knowledge hierarchies wherein natural scientists define priorities for social and economic interventions.

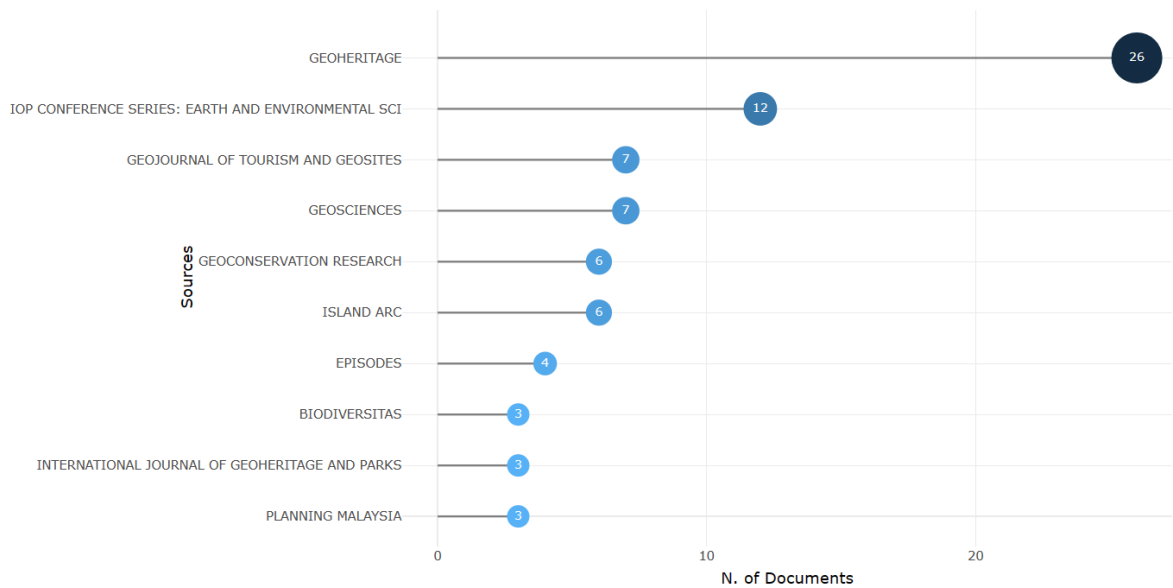


Figure 4: Top 10 Sources

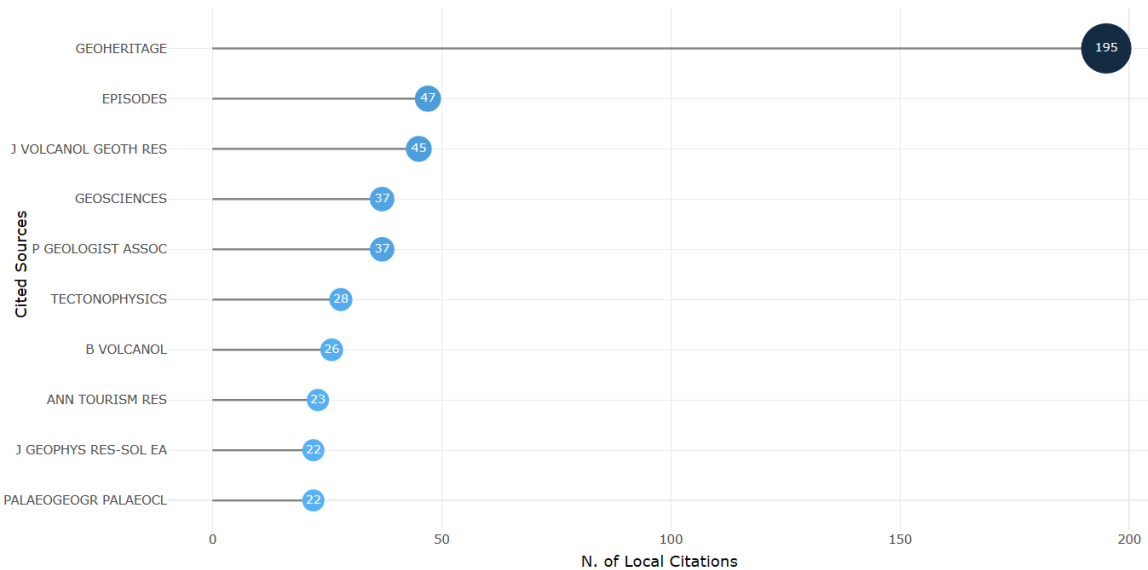


Figure 5: Top 10 Cited Sources (Local)

5.3 Geographic Distribution

The study evaluated the contribution of various countries based on the affiliations of corresponding authors. Results revealed that out of the total 176 publications, 145

(82.4%) were independent publications by a single country, while 31 (17.6%) were internationally collaborative publications involving multiple countries. Figure 6 shows the top 10 most productive countries in terms of total publications (SCP: single-country

publications and MCP: multiple-country publications). Notably, all the top 10 most productive countries involved had engaged in MCP, except for Indonesia.

Malaysia emerged as the most productive, with 28 publications (26 SCP and 2 MCP). Indonesia ranked second with 19 SCP. Japan followed with 14 articles (9 SCP and 5 MCP). Greece contributed 13 articles (12 SCP and 1 MCP). China had 11 articles (7 SCP and 4 MCP). Iran and South Korea both contributed 7 articles (6 SCP and 1 MCP each). Portugal had 7 articles (5 SCP and 2 MCP). Lastly, Romania had 6 articles (2 SCP and 4 MCP).

Surprisingly, Romania, despite not having Insular Geoparks, has made substantial contributions to academic discourse surrounding Insular Geoparks. However, the relatively low proportion of international collaboration (17.6%) suggests limited transnational knowledge exchange and potential missed opportunities for comparative research across different insular geopark contexts. Enhanced international collaboration could facilitate cross-learning, methodological innovation, and transferability of best practices.

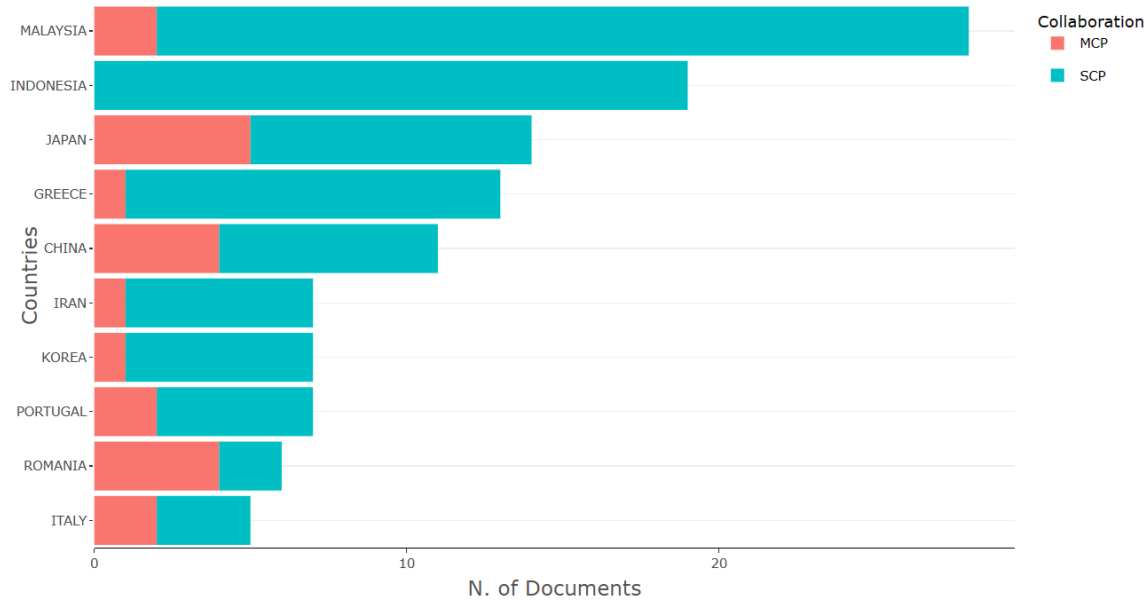


Figure 6: Corresponding Authors' Top 10 Geographic Distribution

5.4 Authors' Productivity

Examining the top 10 productive authors on Insular Geoparks (Figure 7), ZOUROS, N. emerges as a prominent author, having contributed a total of 9 articles, with 467 total citations. Articles published in 2004 and 2007 received the highest number of citations (276 and 159, respectively). HALIM, S. published a total of 5 articles, with multiple citations in 2011 (24), 2017 (12), 2018 (8), and 2019 (43). The research impact of ZOUROS, N. and HALIM, S. is further supported by their notable

H-index (Figure 8). The H-index, initially proposed by Hirsch (2005), measures the influence of a scientist based on the number of papers they have published that have been cited at least h times each (See Appendix A for additional productivity Metrics).

Other prominent authors include CSIKI-SAVA, Z., NORELL, M., BRUSATTE, S., and VREMIR, M., each with 5 articles. JAAFAR, M. and MARZUKI, A. contributed 4 articles each. RATNANINGRUM, Y. and NEMETH, K. published 3 articles each.

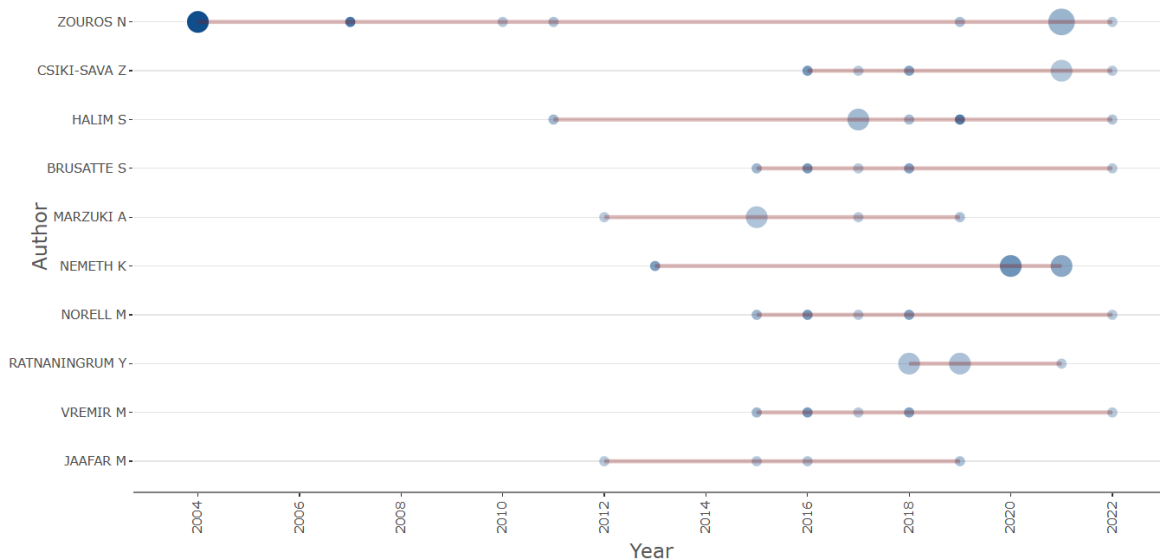


Figure 7: Top 10 Most Productive Authors

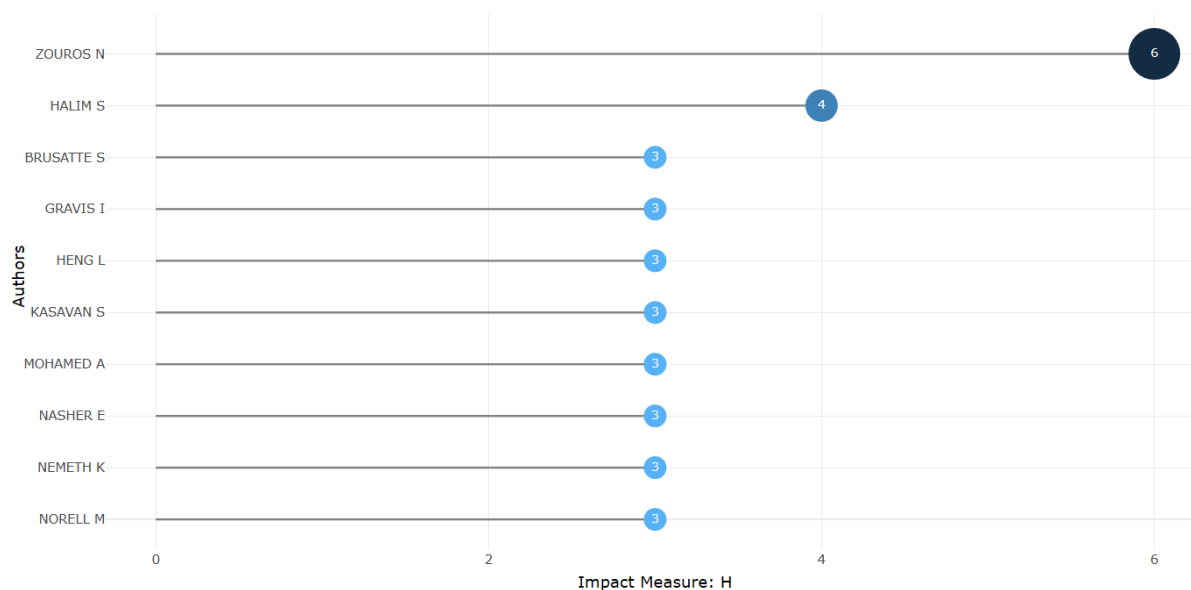


Figure 8: Authors with the Highest H-index

5.5 Historiographic Analysis

The historiographic citation analysis (see Appendix B for Co-citation Network) presents a timeline-based visualisation of the most relevant citations from a specific collection of bibliographic data (Aria & Cuccurullo, 2017), providing insights into the historical development and progression of literature related to a particular field. Studies related to Insular Geoparks were first carried out by Zouros (2004). Figure 9 indicates that discourse on Insular Geoparks so far has been shaped by two clusters.

In the main cluster (Red colour), the study of Zouros,

N. (2004) demonstrates significant relevance because its publication date predates the designation of many Insular Geoparks (e.g., Jeju Island UNESCO Global Geopark, 2010, Oki Islands UNESCO Global Geopark, 2013, Qeshm Island UNESCO Global Geopark, 2017 etc), serving as a fundamental reference upon which subsequent studies in the field build. The article uses the petrified forest of Lesvos as a case study, offers insights into joining the European Geoparks Network, and identifies Geoparks as instrumental in environmental protection, education, and local development.

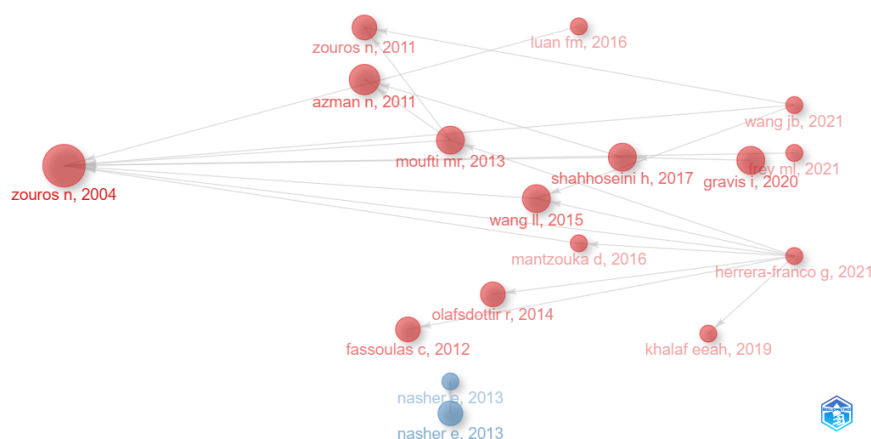


Figure 9: Historiographic Analysis

5.6 Trend Topic Analysis

Keywords Plus refer to frequently occurring words or phrases found in the titles of an article's references. They offer a more comprehensive and diverse representation of an article's content compared to standard Author Keywords (Garfield & Sher, 1993). Zhang et al. contend that Keywords Plus is equally effective as Author Keywords in bibliometric analysis for understanding the knowledge structure of scientific fields, although it may not capture all aspects of an article's content as comprehensively (Zhang et al., 2016). Thus, this study analyses the top 50 most commonly used words in Keywords Plus, Authors' keywords, and Abstracts to offer a more robust understanding of the trending topics. The resulting word cloud can be seen in Figure 10.

The most commonly occurring words in Keywords Plus are geotourism, evolution, UNESCO, island, and sustainable development. In Abstracts, the words with the highest frequency are global Geopark, UNESCO global, geological heritage, sustainable development, and global Geoparks. For authors' keywords, the top five terms are Geopark, geotourism, geoheritage, geoconservation, and geodiversity.

Although less emphasized, certain terms with direct or indirect relevance to local development are present in the Abstract, Keywords, and Keywords Plus sections. These words encompass "Geological heritage," "tourism industry," "tourism development," "sustainable development," "tourism," "geoeducation," "sustainable development," "cultural heritage," "geo product," "sustainable tourism," "tourist attraction," and "natural heritage." However, notably absent or underrepresented are terms central to contemporary development discourse, including equity, empowerment, governance, participation, poverty alleviation, income distribution, and gender. This absence suggests a potential gap

between geopark rhetoric emphasizing local development and actual research attention to development processes, mechanisms, and outcomes.

5.7 Co-occurrence Network

To analyse the relationships between keywords, abstracts, and keyword plus terms, a co-occurrence analysis was performed. Co-occurrence frequency indicates how often pairs of words appear together in the same research paper, revealing the knowledge structure of a particular research field (Hu et al., 2022). The higher the co-occurrence, the more frequently researchers use both keywords in combination (Aria & Cuccurullo, 2017; Zhang et al., 2016). The co-occurrence network visualises connections between the top 50 most frequent words in keywords, keyword plus, and abstract sections of the research papers (See Appendix C for three field plots showing links between Authors, Sources, Abstracts and Keywords and Countries of affiliation).

The knowledge map extracted from Authors' Abstracts (Figure 11), revolves primarily around "global Geopark" and "UNESCO global." Network connections indicate that global Geoparks have associations with local communities, sustainable tourism, the tourism industry, tourism development, geoheritage values, development, geological features, and sustainable development.

The knowledge map based on Authors' keywords revolves primarily around key terms like "Geoparks," "geotourism," and "geoheritage." Additionally, "Geoparks" are connected to "geoproduct," "geoeducation," "geodiversity," "geosite(s)," and "local community." The Keyword Plus analysis emphasises the central role of "geotourism" and reveals connections with "tourist attraction," "geodiversity," "tourism development," "geoconservation," "tourist destination," and "sustainable development." Generally, the identified



Figure 10: Word cloud for trending topics (a. Keyword Pus, b. Abstract and, c. Keywords).

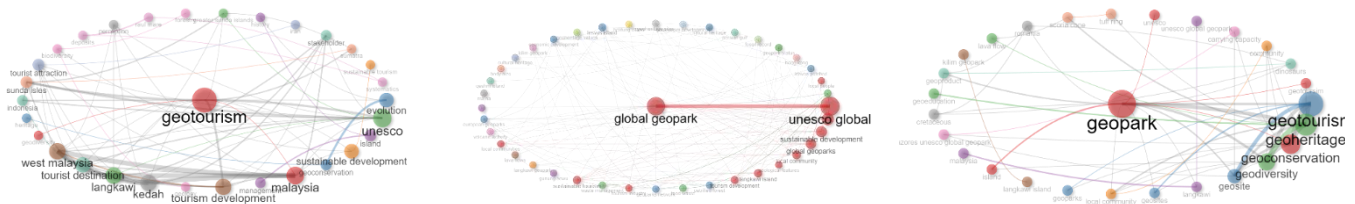


Figure 11: Co-occurrence network (a. Keyword Pus, b. Abstract and, c. Keywords).

6 Insular Geoparks and Local Development

The studies analysed in the review present compelling evidence of how Insular Geoparks positively contribute to the local development of their respective communities. However, the magnitude, sustainability, distributional equity, and attribution of these benefits vary across different geopark contexts.

In Jeju Island UNESCO Global Geopark, Jeon et al. (2023) highlight the significant impact of geotrail and other geobranding initiatives (Geohouse, Geofood, Geogift, Geoacademy, and Geoschool) on the community. Since the introduction of these activities, the community experienced a notable rise in tourist arrivals, the number of households in the village, and the emergence of new restaurants and coffee shops.

The revitalisation of old business premises by new enterprises targeting the tourism industry has injected new energy into the community, leading to a boost in local tourism revenue and overall economic activity. Simultaneously, the local economy has experienced a remarkable transformation, with squid sales, which used to be the primary source of income, breaking records every year with an increase of two to three times (Jeon et al., 2023). This economic diversification represents a critical shift from mono-sectoral dependence to a more resilient multi-sectoral economy.

Lee and Jayakumar (2021) maintain that the Geopark

had a substantial national economic impact in 2018, generating 286,000 job opportunities and contributing 11.59 trillion KRW through various initiatives, such as geosite and geotrail development, sightseeing tour development, geofood promotion, Geopark accreditation, and the organisation of cultural and recreation activities. Community participation is vital for the success of Insular Geoparks, especially through programs like Geoschool and Geoguide (Jeon et al., 2023). Yet, questions remain about whether employment opportunities primarily benefit locals versus external labour.

Concerning Batur UNESCO Global Geopark, Alfaritzy (2021) maintains that geoproduct development was employed by the Geopark to stimulate the economic activities of the local community. The Kintamani Coffee Festival, organised in partnership with the Bangli Regency government and the Ministry of Tourism and Creative Economy of Indonesia, enhances the current Geoproduct within the Batur Geopark region. Sagala et al. (2018) posit that there have been noticeable economic and infrastructure improvements in the Batur Geopark area since its establishment in 2012. Notably, the region has witnessed a remarkable growth in the number of restaurants, hotels, and other accommodations, reflecting the positive impact of the Geopark on community development. Furthermore, revenue generated by the local community from the Geopark is used for various common purposes, including environmental

management, purchasing prayer equipment, conducting traditional Adat ceremonies, constructing essential supporting infrastructure, covering the operational costs and salaries of employees (about 100 in Adat Village), and maintaining the revered Ulun Danu Batur Temple. This study highlights the tangible benefits of the Geopark, not only in terms of economic development but also in supporting essential cultural, religious and environmental endeavours. However, no explicit conclusions about the impact of the Geopark on local development were drawn in another qualitative study conducted by Insani et al. (2023). One potential explanation for the varying findings could be the relatively smaller sample size of four in Insani et al.'s (2023) study compared to the larger sample of 41 participants in Sagala et al.'s (2018) study. Thus, one may argue that while there may be some positive aspects, the overall impact of the Geopark on the community may require further investigation or consideration of other factors.

Langkawi UNESCO Global Geopark (LUGG) has been extensively studied regarding its impact on local development. Geobranding, specifically the BioGeotrail, is employed to enhance livelihoods and foster community collaboration for income generation (Halim et al., 2022). Various studies (Garnett et al., 2009; Hashim et al., 2011; Popa et al., 2017; Halim & Ishak, 2017) demonstrate the effectiveness of community-based or co-management approaches for natural resource management, leading to improved social capital and increased household incomes.

The presence of the Geopark attracts a higher number of tourists, resulting in increased income for locals engaged in small-scale businesses such as food, handicraft, and transportation services (Jaafar et al., 2012). This is supported by Azman et al.'s (2011) findings, which highlight the successful encouragement of traditional fishermen to participate in tourism-related activities after receiving training in geoheritage and geoforest park management. Locals perceive Geopark status as a means to revitalise their villages, create jobs through Geopark-based activities, and attract tourist spending from both international and national visitors (Halim et al., 2022).

The Geopark is seen as bringing added value to the community and Langkawi as a whole, particularly benefiting women cooperatives and those involved in tourism-based activities, such as taxi drivers, food stall owners, and souvenir shop owners (Halim et al., 2022). Additionally, the establishment of LUGG through ecotourism and educational programs is shown to contribute to resolving environmental, social, and economic issues.

Contrary to these studies, Ibrahim et al. (2021)

employed a mixed-method approach and found that a majority of the respondents were uncertain about the benefits of LUGG status on their livelihoods, with only 18.4% accurately understanding the Geopark concept. The respondents' mean score regarding whether Geopark status offered opportunities for tour operators to create new tourism products and packages received a rating of 3.76, indicating uncertainty. Similar results were also observed in the study of Tirtakusuma et al. (2021) for Gunung Sewu Global Geopark. The respondents' mean scores regarding whether tourism increases income (3.95), creates better job opportunities (3.90), and diversifies livelihood opportunities (3.85) are neutral rather than strongly positive assessments.

Ibrahim et al. (2021) attributed this uncertain outcome to inadequate engagement with the local community and a lack of strong attachment to the LUGG area. They stressed the importance of actively involving the locals in decision-making processes to address their needs and empower them as inhabitants of the Geopark. This finding suggests that geopark designation alone is insufficient; meaningful development outcomes require genuine community participation.

In another study, one interviewee expressed the belief that Geopark benefits were limited to the Kilim area, neglecting other localities (Azman et al., 2011). Moreover, many respondents felt that the positive effects of Langkawi Geopark on the local economy were still in the early stages, emphasising the necessity for more education and awareness on how to seize economic opportunities provided by the Geopark. Findings from Ibrahim et al. (2019) revealed that approximately 44.9% of respondents stated that they received benefits from tourism even before LUGG's recognition, indicating that Geopark status might not have been a decisive factor. The researchers suggested that this assertion could be due to the respondents' lack of knowledge about Geoparks, raising a question of attribution: are observed benefits caused by geopark designation or would they have occurred anyway due to broader tourism development trends?

Pediaditi and Moquay (2022) also found similar results, suggesting that limited interaction with the local community in the Sitia UNESCO Geopark might hinder two-way knowledge sharing, transfer, and capacity building. These findings suggest that the effectiveness of geopark interventions is mediated by governance quality, communication strategies, and the depth of community engagement.

Regarding the Belitung Island UNESCO Global Geopark, Alfarity (2021) and Yuliawati et al. (2019) emphasise the significance of ceramics and coffee as essential geoproducts that can foster local development. While the impact of geobranding coffee shops and coffee as geoproducts in Belitung remains elusive, Yuliawati et

al. (2019) express optimism about the potential of combining tourism and coffee plantations as an alternative for coffee farmers, promoting sustainable productivity and contributing to the local economy.

Additionally, this approach may serve as a valuable pedagogical tool for environmental education, training, and interdisciplinary research in geoscientific science, environmental issues, and sustainable development. Achieving this synergy involves providing education to coffee farmers on coffee processing and developing tourism areas. Moreover, effective coffee packaging and marketing strategies are essential to maximise the positive impact on the community's economic and environmental goals (Yuliawati et al., 2019).

Yuliawati et al. (2018) highlight the strong commitment of the Geopark to the local community, evident through active engagement with local administration, NGOs, and companies. Thus, the local community plays a central and vital role in facilitating geotourism activities on the Island. For instance, the study emphasises the significant contribution of local Small and Medium-sized Enterprises (SMEs) in meeting the diverse needs of tourists visiting the Geopark. These SMEs provide various products and services such as lodging, restaurants, local transportation, geo-trekking tour packages, island hopping, and souvenirs. Geoproducts available on the island encompass tour and travel services, agricultural and fishery products, a variety of handicrafts, and local cuisine.

Similar to Belitong, Lesvos Geopark promotes traditional gastronomy and local handicrafts and products (e.g., pottery and woodcarving). Furthermore, women's cooperatives benefit by supplying catering for Geopark events, using traditional recipes and selling their products at the museum snack bar. Additionally, Lesvos Geopark organises agrotourism festivals during the summer, showcasing high-quality local products and beverages, including pasta, organic olive oil, wine, ouzo, liquors, traditional sweets, and marmalades, prepared by women's agrotourism cooperatives and local organic food producers (Zouros, 2004; Zouros, 2010). Again, collaborations with local hotels, tourist enterprises, and restaurants have resulted in an increase in bed and breakfast accommodations in the village of Sigri over recent years (Frey, 2021; Zouros, 2010).

Geoeducation also plays a pivotal role in stimulating local development within Lesvos Island Geopark. Wang and Zouros (2021) argue that educational activities, encompassing formal and informal education, as well as vocational training, provide essential skills to young individuals aspiring to work in Geoparks. This approach boosts the local economy and fosters overall development within the community. For example, in 2000, the Vocational Training Center of the Natural

History Museum of the Lesvos Petrified Forest was established to train young unemployed people in various techniques, such as fossil conservation, excavation, preservation, visitor reception, and Geopark promotion. By 2007, this initiative had successfully delivered five courses, training 108 young individuals residing in the Geopark's area, with 34 of them finding employment within the Geopark (Zouros, 2010).

Moreover, Frey (2021) highlights that Lesvos Geopark has established twinning agreements with nine UNESCO Global Geoparks in China and one in Japan to promote capacity-building activities. Such 'inter-Geopark' partnerships may assist the Geopark authorities in learning best practices, further enhancing their ability to foster local development and create sustainable economic opportunities for the community.

Shahhoseini et al. (2017) provide compelling evidence supporting the role of Qeshm UNESCO Global Geopark as a catalyst for local development. In their study, 81% of respondents agree and strongly agree that geotourism has led to a significant increase in job opportunities in the area. Similarly, Khodayar (2023) confirms the positive socio-economic impacts of geotourism reported by locals, improving local festivals, providing additional income, and opportunities for cultural exchange. Additionally, Farsani et al. (2011) conducted a survey involving 3 Insular Geoparks (Qeshm Geopark, Langkawi Geopark, and Psiloritis Geopark) alongside 23 other Geoparks, examining the role of Geoparks in driving local development. The study revealed that by the end of 2009, Geoparks across all territories employed an average of about 18 local individuals within the Geopark structure.

In addition to creating employment opportunities, Fassoulas and Zouros (2010) posit that Psiloritis Geopark promotes local gastronomy and local products by establishing the "Land of Psiloritis" project. It is carried out in cooperation with local stakeholders (taverns, accommodation places, agrotouristic enterprises, etc.) who formed a non-profit organisation that uses the logo of Geopark as the brand name for a network of cooperating enterprises. Moreover, the project also includes organising local workshops and events aimed at promoting local products.

Although Hong Kong Geopark is free to visit and restricts large-scale economic activities within its boundaries, it still contributes to local development through strategic collaborations. For instance, Geopark partners with the Hong Kong Geopark Hotel, where a specially designed Geopark menu is available in the restaurant for tourists. This collaboration between Geopark and the business sector creates a range of local development opportunities, including business growth, job creation, and increased profits, benefiting both the local communities and society at large (Ng, 2014). The

extent to which these benefits reach local communities versus external investors and corporations remains unknown, particularly in high-income contexts like Hong Kong where land values and business ownership patterns may limit local benefit capture.

7 Critical Reflections

Local development has emerged as a prominent and increasingly influential topic of discussion across academic, industry, and governance domains. Through the literature review, it becomes evident that Insular Geoparks hold substantial potential as a transformative channel for fostering sustainable local development. The study underscores the simultaneous positive influence of Insular Geoparks across societal, economic, and environmental dimensions, primarily facilitated through geotourism, geobranding, geogastronomy, and geoeducation initiatives (Figure 12). This has engendered a confluence of favourable local development outcomes, encompassing local economy diversification, infrastructural development, bolstered social cohesion, cultural exchange, heightened sense of identity, facilitated return migration, enriched social capital, reinvigoration of local communities, employment generation, effective environmental stewardship, preservation of traditional ceremonies, and safeguarding religious and cultural heritage.

However, several critical issues warrant careful consideration. First, the absence of control groups or quasi-experimental designs in reviewed studies makes it methodologically problematic to conclusively attribute observed outcomes solely to geopark interventions. Without counterfactual analysis, the literature risks overstating geopark contributions.

Second, while studies document aggregate benefits, they rarely examine distributional consequences. Who specifically benefits from geopark-induced development? Do benefits accrue primarily to those with pre-existing capital, education, and social networks, potentially exacerbating inequalities? The literature's silence on these questions is problematic given sustainable development's explicit emphasis on equity and inclusion.

Third, the review reveals that Insular Geoparks partnering with community members, local administration, government ministries, and local SMEs generate greater local development impact (Figure 12). However, limited interaction with local communities and inadequate engagement in decision-making processes may hinder positive impact on community development. This suggests that geopark governance structures and power relations may critically mediate development outcomes. Yet, the literature provides limited analysis of governance quality, accountability mechanisms, elite

capture risks, or power asymmetries between geopark authorities and local communities. Without understanding these political dimensions, recommendations for "greater community engagement" remain superficial.

Fourth, the reviewed studies are predominantly cross-sectional, providing snapshots of geopark impacts at specific points in time. Longitudinal evidence on whether benefits persist, diminish, or amplify over time remains scarce. Do communities maintain economic gains if tourist flows decline? Are infrastructure investments adequately maintained? Do capacity-building initiatives produce sustained human capital development, or do trained individuals migrate elsewhere? The sustainability of geopark-induced development outcomes requires empirical verification through longitudinal research designs.

Fifth, lack of knowledge and understanding about Geoparks among certain segments of local populations raises concerns about the effectiveness of Insular Geoparks' communication and awareness strategies (Ibrahim et al., 2021; Tirtakusuma et al., 2021). This suggests the need for better public awareness campaigns and more inclusive educational programs ensuring all locals can actively participate and benefit from geopark initiatives. However, low awareness may also reflect inadequate consultation during geopark designation processes, suggesting top-down governance approaches that fail to meaningfully engage communities as co-creators of geopark visions and strategies.

Sixth, geoproduct development, innovation, and marketing also require attention. While several cases document geoproduct initiatives, systematic analysis of factors enabling successful geoproduct development is lacking. What conditions facilitate innovation? How can geoparks support product quality enhancement, market access, and value chain upgrading for local producers? How can intellectual property rights protect local innovations while preventing appropriation by external actors?

Seventh, bibliometric analysis underscores that the majority of studies are conducted by authors in geological domains. Co-occurrence analysis shows that terms directly or indirectly relevant to local development are relatively underemphasized. This suggests a need for more extensive and diverse exploration of Insular Geoparks' effects on local development, particularly through engagement of authors from domains associated with development studies, planning, economics, sociology, anthropology, and political science. This disciplinary imbalance has methodological implications. For example, geoscientists may lack training in causal inference methods, household survey techniques, participatory research approaches, or political economy

analysis that are essential for robust development impact assessment.

Many existing studies are descriptive and anecdotal, making it challenging to establish robust evidence-based connections between geopark activities and local development outcomes. More importantly, none of the reviewed articles adopted matching approaches involving control groups to mitigate the impact of confounding variables and potential biases. Consequently, the extent to which reported outcomes can be attributed to Insular Geoparks may be questioned.

There is a need to conduct further research using robust statistical tools and research methods to gain holistic views of Insular Geopark local development impact. The "difference-in-differences" approach or randomized controlled trials may address this concern, allowing analysis of geopark impact by incorporating control and treatment groups, addressing selection biases, and assessing whether outcome changes are due to geoparks or external factors. Considering these methodologies are not devoid of inherent limitations, Morvant-Roux et al. (2014) suggest randomized approaches should be complemented by qualitative research. Social network analysis can also be employed to understand collaboration patterns among diverse stakeholders.

Ninth, literature on Insular Geoparks and local

development exhibits uneven distribution. Some geoparks remain unstudied regarding potential local development impact, suggesting a missed opportunity to learn from other relevant contexts. Furthermore, this study may have overlooked valuable insights, perspectives, and empirical evidence documented in non-Anglophone sources. These studies could offer rich and contextually nuanced viewpoints crucial for better understanding the multifaceted implications of Insular Geoparks on local development. Subsequent investigations should incorporate relevant non-English sources (e.g., through translation), providing more holistic, culturally sensitive, and comprehensive analysis of Insular Geopark impact on local development. The dominance of English-language publications may reproduce linguistic hegemonies marginalizes local knowledge systems and indigenous perspectives.

Despite these critical limitations, the review substantiates that when properly governed, inclusively managed, and strategically leveraged, Insular Geoparks can contribute meaningfully to local development across economic, social, and environmental dimensions. Governance quality, institutional capacity, stakeholder collaboration, community empowerment, and equitable benefit-sharing mechanisms can further enhance geoparks' impact.

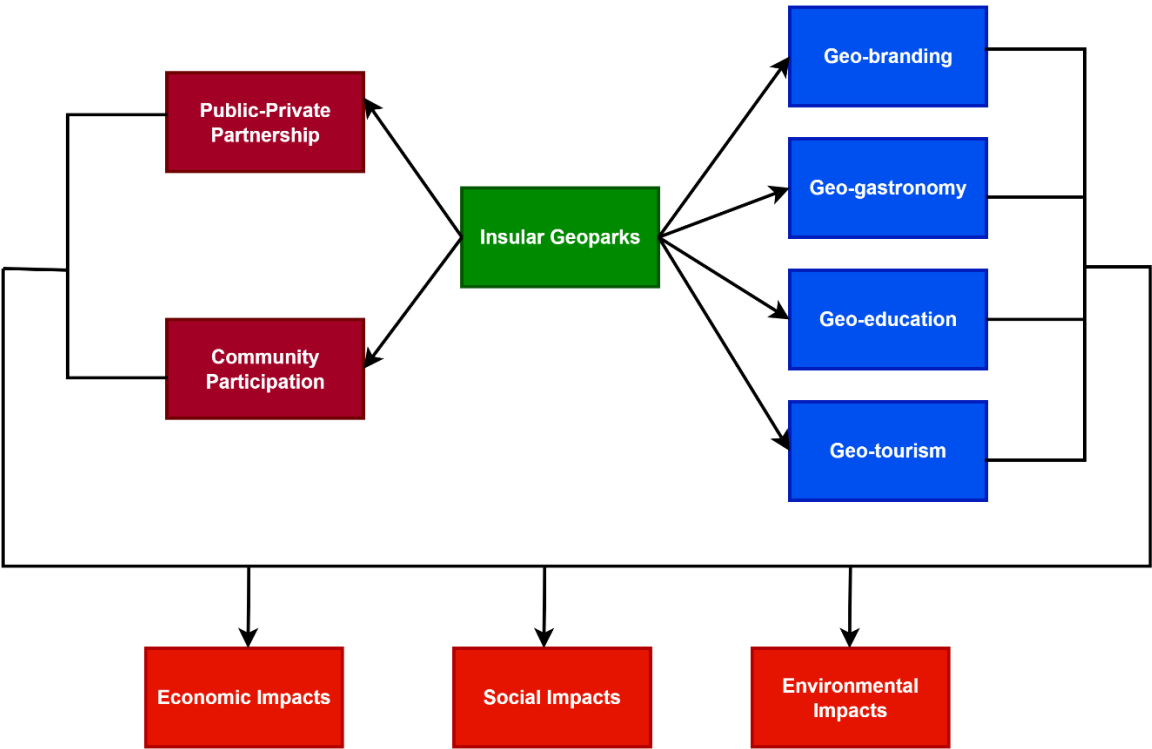


Figure 12: Insular Geopark and Local Development

8 Conclusion

The study reveals exponential growth in Insular Geopark scholarship since 2009, with publication peaks in 2021,

predominantly concentrated in geoscience journals and geographically concentrated in Malaysia, Indonesia, Japan, Greece, and China. The knowledge structure emphasizes geotourism, geoheritage, and

geoconservation, but underemphasizes socio-economic development dimensions. International collaboration remains limited at 17.6%, suggesting missed opportunities for cross-context learning.

Furthermore, it identifies four primary mechanisms through which Insular Geoparks contribute to local development: (1) geotourism, attracting visitors and generating tourism-related revenues and employment; (2) geobranding, creating distinctive territorial identities and positioning for local products; (3) geogastronomy, valorising culinary heritage while creating market opportunities for local food producers; and (4) geoeducation, building human capital through formal and informal education and vocational training. These mechanisms operate across economic (diversification, employment, income), social (cohesion, identity, capacity-building, return migration), and environmental (conservation, stewardship) dimensions, generating multidimensional development outcomes.

The study reveals that governance structures, community engagement levels, and stakeholder participation mechanisms critically mediate geopark effectiveness in stimulating local development. Therefore, some key areas of improvement include: (1) enhancing community engagement through meaningful participation in governance and decision-making; (2) strengthening geoproduct development, innovation, and marketing support; (3) improving communication and awareness strategies to address knowledge deficits; (4) fostering international collaboration for cross-context learning; and (5) increasing interdisciplinary research engagement.

While the study identifies some methodological limitations undermining confidence in the current evidence base, it holds important implications:

8.1 Theoretical Implications

Current geopark research lacks robust theories explaining how, why, and under what conditions geoparks translate geological heritage into equitable, sustainable, and inclusive development outcomes. This study advances theoretical understanding of Insular Geoparks as development interventions by underscoring the importance of governance, power, and participation in determining development outcomes. The evidence suggests that outcomes depend critically on who governs, how decisions are made, who participates, and how benefits are distributed. This aligns with political ecology and critical development theory perspectives emphasizing that conservation and development interventions are inherently political, shaped by power relations, institutional arrangements, and distributional conflicts. Incorporating these political dimensions into geopark theorization moves beyond technocratic

assumptions toward more critical, politically informed understandings.

Therefore, a conceptual shift toward a "socio-geological" framework that explicitly situates geoheritage within political economy, local governance, and development processes is urgently needed. By identifying governance and participation as mediating variables for development outcomes, the paper offers a parsimonious causal model that can be operationalised in future causal studies. This model extends existing place-branding and sustainable tourism theories by centring institutional arrangements and community agency as core mechanisms.

8.2 Practical Implications

For policymakers and geopark authorities, establishing robust, transparent, accountable governance structures that meaningfully engage local communities as partners and co-decision-makers rather than passive beneficiaries is increasingly needed to advance local development outcomes.

For researchers, the study underscores the need for more rigorous, interdisciplinary, equity-focused research employing robust causal inference methodologies. Collaboration between natural scientists, social scientists, and local communities can generate more holistic, actionable knowledge.

For local communities, the findings suggest that active engagement, collective organization, and strategic positioning are crucial for maximizing benefits and minimizing risks. Communities should proactively seek participation in geopark governance, demand transparency and accountability, organize cooperatives or associations for collective bargaining and market access, and leverage geopark platforms for capacity-building and entrepreneurship while safeguarding cultural integrity and environmental sustainability.

8.3 Limitations

Three key limitations can be identified in this study. First, the search strategy ("Geopark AND Island") may have missed relevant studies using alternative terminology or focusing on broader themes within which geoparks are embedded. Second, bibliometric analysis captures publication patterns but cannot assess research quality, rigor, or validity. Third, the critical review, while comprehensive, remains interpretive and subject to the author's analytical lens and potential biases.

8.4 Future Research Directions

Building on this study's findings and limitations, rigorous impact evaluations employing quasi-experimental designs or, where feasible, randomized controlled trials are urgently needed to establish causal links between geopark interventions and development outcomes. These

should be complemented by qualitative research exploring mechanisms, processes, and lived experiences.

Governance and political economy research analysing power relations, institutional arrangements, accountability mechanisms, elite capture dynamics, and decision-making processes can illuminate the political dimensions shaping geopark outcomes. Furthermore, interdisciplinary research bringing together geoscientists,

development scholars, economists, sociologists, anthropologists, and local knowledge holders can generate more holistic, nuanced understandings transcending disciplinary silos.

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