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Sustainable Scientific Tourism Development Planning using Micmac-Mactor in Bogor City, Indonesia

Wasissa Titi Ilhami[a], Hadi Susilo Arifin[b], Bambang Pramudya[c], Nandi Kosmaryandi[d]

[a] Study Program of Natural Resources and Environmental Management, Graduate School of IPB University, IPB Baranangsiang Campus, Bogor, 16153, Indonesia

[b] Department of Landscape Architecture, Faculty of Agriculture, IPB University, IPB Darmaga Campus, Bogor, 16680, Indonesia

[c] Department of Mechanical and Biosystem Engineering, Faculty of Agricultural Technology, IPB University, IPB Darmaga Campus, Bogor, 16680, Indonesia

[d] Department of Conservation of Forest Resources and Ecosystem, Faculty of Forestry and Environment, IPB University, IPB Darmaga Campus, Bogor, 16680, Indonesia

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ABSTRACT

Bogor is a city in Indonesia with a variety of potential scientific tourism objects, such as historical buildings, educational institutions, and research institutions. Although its existence is always needed by various parties as a reference for learning, the object has not been managed optimally in an integrated system, so it does not have a significant impact on tourism activities in Bogor City. This study aims to analyze the variables that influence tourism planning and the pattern of relationships between actors to build a sustainability strategy for scientific tourism in Bogor City. This study was conducted using the Micmac and Mactor methods. The results showed six important variables for developing sustainable scientific tourism in Bogor City: infrastructure, tourism resources, promotion, investment, regulation, policy, and research and education institutions. Meanwhile, the Government, *Badan Riset dan Inovasi Nasional* (BRIN), the Ministry of Environment and Forestry, the Ministry of Agriculture, and the Regional Council are important institutions/actors in the development of sustainable scientific tourism. This research provides an overview of the key variables and actor roles that are most influential on the success of tourism development in the future and provides a basis for policymakers to prioritize the development of a scientific tourism development strategy in Bogor City.

Introduction

Bogor is a potential tourist city in West Java with an area of ± 11,800 ha. Bogors' proximity to national capital provides strategic potential for economic growth, services, and community mobility. Bogor City has many highly reputable institutions such as IPB University, Bogor Botanical Gardens, and many more agricultural science research institutions in a broad sense. The city also has Bogor Palace, which has a high historical and cultural value and is supported by various science museums [1]. The environmental potential of the city of Bogor is then defines the role of the city of Bogor, and this is very important in the development of a city [2]. The idea in the policy brief on Bogor Science City launched by the Board of Professors of IPB is the basis for scientific tourism planning and will be important in supporting this idea. In line with the Bogor Science City policy brief, Bogor City is known to the public by its long-standing name as Bogor Science City. It was even stated in the book Buitenzorgh Scientific Center, published by Arcipel Drukkerij and T Bofkhluis Buitenzorg Java in 1948, and received support from The United Nations Educational, Scientific and Cultural Organization (UNESCO).

Corresponding Author: Hadi Susilo Arifin hsarifin@apps.ipb.ac.id Department of Landscape Architecture, Faculty of Agriculture, IPB University, IPB Darmaga Campus, Bogor, Indonesia.

Research on scientific tourism in Bogor City has not been conducted before; therefore, an in-depth study is required for the development of scientific tourism. In this study, scientific tourism is defined as a tourist activity that is a special-interest tour accompanied by a scientifically motivated guide from various tourist categories. It aims to gain new knowledge of history, culture, and agricultural science in a broad sense by conducting experimental research activities, expeditions, and adventures to seek new knowledge and participation in scientific events [3–5]. Literature tests and expert discussions were conducted to identify the variables that determine the success of sustainable tourism plans. According to Wardana et al. [6], success factors for improving tourism performance with quality and sustainable experiences include local community involvement in tourism, the conservation of biodiversity and natural resources, economic and infrastructure development, and tourism services and supervision. Dewi [7] added that a key factor to consider in tourism development is to create engagement between local governments, investors, and communities.

According to the Tourism Department of Bogor City [8], the availability of supporting tourism infrastructure is an important concern for increasing tourist visits, including tourist buses/trams, tourist bicycles, and the provision of festivals and new tourist destinations; thus, Bogor City remains attractive and supported by effective promotional media. This study aims to identify the most influential key variables and actors with the strongest influence on the successful development of scientific tourism. This study is important because no previous studies have examined variables such as promotion, infrastructure, governance, and regulation in the context of scientific tourism. This study used two analytical methods, Micmac and Mactor. The results of this study can be a recommendation for the Bogor City Government to sustainably develop scientific tourism in terms of economic, socio-cultural, and environmental aspects.

Methods

Study Area

This study was conducted in Bogor City, an area with scientific tourism destinations. Figure 1 shows the distribution of scientific tourism in Bogor City, which consists of various tourist destinations: both historical and cultural tourism and educational and research tourism**.** This study was conducted between September 2021 to April 2022.

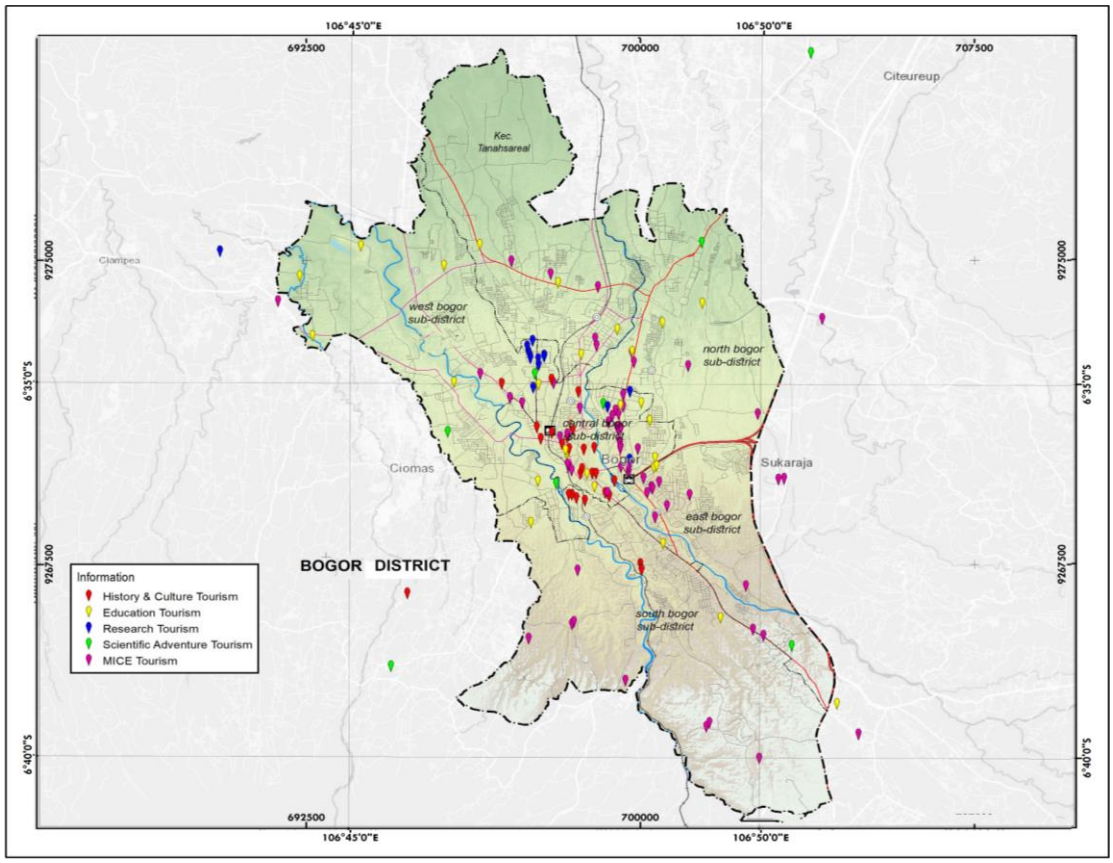


Figure 1. Distribution map of scientific tourism destination.

Figure 2 shows the locations of the scientific tourism destinations for the education and research categories. Figure 2a shows the Digital Agricultural Library and Knowledge (Colocasia Buitenzorg), a library under the Ministry of Agriculture. Figure 2b shows the Science Techno Park owned by the IPB University. Both destinations can be visited daily during working hours. Figure 3 shows the locations of the cultural and historical tourist destinations in Bogor. Figure 3a shows Klenteng Hok Tek Bio, which is located on Suryakencana Street and one of the oldest temples in Bogor. Figure 3b shows the PETA Museum, a museum of relics of old PETA soldiers with a high historical value. Scientific tourism invites both local and foreign tourists to visit Bogor.

(a) **(b)**

Figure 2. Educational and research tourism destinations in Bogor city; (a) Digital Agricultural Library and Knowledge (Colocasia Buitenzorg), (b) Science Techno Park IPB University.

(a) **(b)**

Figure 3. Cultural History Tourist Destinations in Bogor City; (a) *Hok tek Bio* Temple, (b) PETA Museum.

Data Collection

The primary data collection used interview techniques with purposively selected stakeholders based on the extent of involvement and understanding of key informants related to scientific tourism development planning in Bogor City [9]. Additionally, information was gathered by identifying pertinent variables for the study issue through literature reviews published in a variety of international journals with a Scopus Index, as well as literature (books, online media). The variables were confirmed and ranked based on expert opinions and then continued with a Focused Group Discussion (FGD) consisting of policymakers (stakeholders) based on expertise in internal or external fields [10]. The experts were selected from the Ministry of Environment and Forestry, IPB University, Ministry of Agriculture (Science Techno Park-Cimanggu), Mulyaharja Thematic Village (local communities in tourist destinations), Bogor Historical Walk Activists (Scientific Tourism Community), Land and Agriculture Museum, Bogor City Tourism and Culture Office, *Badan Riset dan Inovasi Nasional* (BRIN), *Politeknik Pembangunan Pertanian Bogor* (Polbangtan), and other private parties.

Data Analysis

A prospective study was used for data analysis. Micmac (Matrix of Cross Impact Multiplications Applied to a Classification) and Mactor (Matrix of Alliances and Conflicts: Tactics, Objectives, and Recommendations) were used in this data analysis tool. "Strategic Foresight" is a framework that François Bourse and Michael Godet developed in 1989–1990 to analyze development scenarios, including sustainable development within them. [11,12]. In line with previous research, Andrea et al. [13] used the Micmac application as a quantitative approach to the application of prospective tools to identify strategic variables and factors to determine the position of actors concerning each strategic variable. The Mactor analysis method was utilized to ascertain the impact of performance and relationships between actors in the planning of scientific tourism development in Bogor City, while the Micmac analysis method was employed to ascertain the relationship between variables grouped by dependence and influence categories.

Micmac

One method that can be used to determine the key variables of many variables is the matrix of cross-impact multiplication applied to a classification (Micmac) method. Micmac analysis was conducted using a prospective analysis approach created by Michael Godet as part of the "Strategic Outlook," which focuses on analyzing development scenarios, including sustainable development [12,14]. Micmac has an advantage over other structural methodologies, as it allows one to determine how a system's strategic factors affect one another, and to organize and prioritize them. Because it facilitates the focus on policymaking, this element is highly advantageous in the formulation of policies. The Micmac data-processing process begins with the formulation of the problem, followed by identification of internal and external variables, analysis of the relationships between the variables, and weighting of these relationships according to the degree of interdependence and mobility between the variables [12,15,16]. The following steps constitute the Micmac Method: first, define the issue and determine the internal and external variables; second, assess the degree of impact and dependency between the variables, which is done by grading the variables on a scale from 0 (no influence) to 3 (strong influence).

Based on their driving and dependent powers, the components were grouped into four clusters in Micmac analysis. The four clusters consist of: (1) autonomous factors, which are isolated from the system and depend on other factors either weakly or not at all; (2) dependent factors, which are highly dependent on other factors; (3) bridging factors, which are unstable and have a significant influence on other factors; and (4) independent factors, which are weakly influenced by other factors and should be regarded as strong key factors [16,17]. Relationships between variables in Micmac were generically calculated using a cross matrix [12], as shown in Table 1.

Table 1. Correlation between Micmac Variables.

	Var 1	Var 2	Var n	Influence (Y-Axis)
Var 1	0	(v1,2)	(v1, n)	$\sum_{j=1}^{n} \text{var}(1,j)$
Var 2	(v2,1)	0		
Var n	(vn, 1)		0	
Dependency (X-Axis)				

Mactor

According to this research, the goal of the Mactor technique is to help actors make decisions that enable them to implement alliances and conflict policies. The Mactor technique has the benefit of being applicable to many strategies that involve multiple actors with various pertinent stakes and objectives. There are six crucial elements, (1) Issue: a matter of widespread attention; (2) an actor is a party with a stake in the outcome and a function in gathering resources to affect it; (3) Position: the actor's inclination to resolve the problem; (4) Salience: the degree to which the actor feels the problem is important; (5) Clout: the ability of a performer to affect results; and (6) Influence: the capacity of an actor to exert control over other performers [12]. The stages of Mactor's analysis include preparing key questions and conducting stakeholder FGDs to identify actors, goals, potential alliances, and conflicts. In stakeholder FGD, the strategic issues that arise in this research are discussed. Subsequently, the Matrix of Direct Influence (MDI) table was filled into the 3 matrix of valued positions Actor X Objective (MAO) table. After running and analyzing, we obtained the results of the most influential key actors and their interpretations in the form of graphs and diagrams [12,16]. Micmac and Mactor analyses produce a matrix with four quadrants, each of which has a different status and role [12,18]. An explanation of this quadrant is presented in Table 2.

Table 2. Relationship between variables in Micmac.

Quadrant	Status and role	Implications
I - Input/Influential Variables/Actors	High and Independent Influence	Prioritization in plans and actions
II - (Intermediate/Key Variables/ Actors)	High influence and high dependency (unstable variable)	The dynamics of the system are impacted by actions taken on these variables, which have a cascade effect
III - Output/Dependent Variable/Actors)	Small but highly dependent influence	This variable is the outcome of input and intermediate variables
IV - Excluded/Autonomous Variables/Actors)	Small influence, small dependencies, and low system impact	Even if this variable is ignored, the impact on the system is not significant

Results and Discussion

Analysis of Key Variables (Micmac)

In this study, the Matrix of Direct Influences (MDI), which characterizes the relationship in the system, was used to evaluate each variable in the Micmac analysis. The impact is a number between 0 and 3, where possible, mild, moderate, and strong effects are denoted by the numbers 0, 1, 2, and 3, respectively. The variables chosen and categorized according to the dimensions of the Micmac analysis are listed in Table 3. The ecological dimension includes factors such as temperature comfort and the plethora of tourist sites with scientific value, infrastructure, buildings, and transportation. The amount of money received by the community, funding, investment, and tourist traffic fall under the economic category. The social component encompasses various aspects, such as the nature of the visitor, accessibility of information and advice regarding scientific tourism locations, level of satisfaction with the experience, assessment of service and facility quality, promotion, security, and community involvement. The institutional dimension includes partner and network organizations, tourism communities, research and education institutions, destination governance, and rules and policies. In line with Diaz and Espino-Rodríguez [19], the success of a tourism destination is determined by many variables, such as environmental resources, destination governance, complementary factors that enhance the competitiveness of the destination, and dimensions related to security.

Table 3. Variables used in Micmac analysis.

No	Variables	Codification	Dimensions
1	Climate comfort	climate_am	ecology
2	Wealth of tourism destinations (museums, laboratories, bogor botanical gardens, etc.)	Trsm_resou	ecology
3	Infrastructure, building and transportation	infra	ecology
4	Community income	com_income	economy
5	Level of tourist visits	trsm_visit	economy
6	Investment and funding	invest_fin	economy
7	Type of travelers	Tourist	social
8	Availability of information and guidance on scientific tourism destinations	inform_gui	social
9	Satisfaction with the scientific tourism experience	satisfacti	social
10	Perception of service quality and facilities	qual_serv	social
11	Promotion	Promotion	social
12	Safety	safety	social
13	Community engagement	Com_Engmt	social
14	Destination governance	Desti_Gove	institutional
15	Tourism community	toursm_com	institutional
16	Research and education institutions	Research_E	institutional
17	Partners and networks	Networks	institutional
18	Regulation and policy	Regul_Poli	institutional

The results of the Micmac analysis in Figure 4 show the movement between variables from the direct to indirect influence/dependence maps. The relationship between these factors lies in four quadrants. Each quadrant has its own characteristics and implications for the approach to be used by policymakers. The four quadrants are shown in Figure 4. In Quadrant I, the promotion variable was one of the driving forces of scientific tourism development planning in Bogor. Other crucial variables include infrastructure, tourism resources, investments, regulations and policies, and research and education institutions.

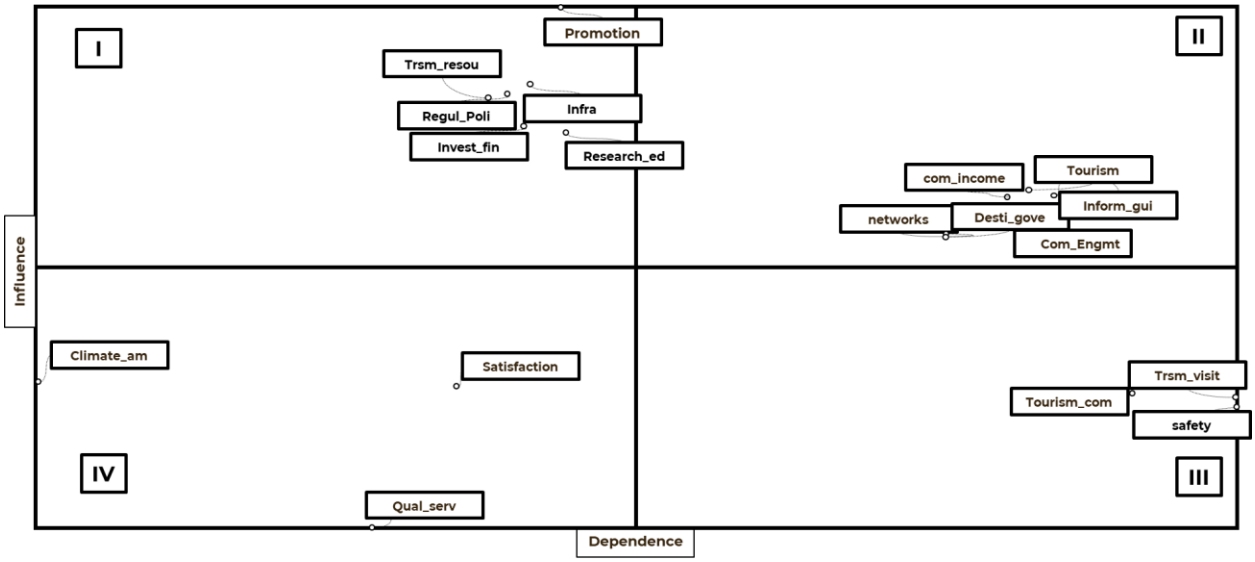


Figure 4. Changes in the relationship between variables (direct and indirect influences/maps) using Micmac analysis).

In line with Sari and Suyuthie [20] and Stukalo et al. [21], promotion can be defined as an activity or effort that aims to provide information and encourage others to buy the products offered, and is a very important component in making tourism products. The promotion indicators include a combination of advertising, sales, public relations, and direct marketing. Promotion and destination image have a major influence on tourist trust. Another driving variable is that infrastructure is an important aspect that must be improved to maintain natural and cultural resources and support the local tourism industry around the tourist area to be in line with tourism development, one element of regional tourism products is tourism infrastructure, which consists of the fundamental structures, buildings, and service organizations that power the economy and society. Infrastructure development is the link between resident participation, conservation, and the tourism industry [22].

Investment variables are those that support other variables such as infrastructure development, which can support tourism activities that attract more tourists. Funding or investment will be obtained from tourism activities where tourists come and obtain a high-quality tourist experience; these tourists can then pay higher fees that can be utilized for the conservation of the tourism environment. In line with the study results of Suryade et al. [23] and Sasela [24], the flow that occurs is that investment will provide space for infrastructure development that can support activities that attract tourists.

Quadrant II (relay), is a quadrant that is considered very important and requires special attention from policymakers because the variables located in this quadrant are elements of the process that will greatly determine the final result later. According to Ariyani and Fauzi [25], these factors are highly vulnerable and unpredictable in achieving sustainable development because any interference with these elements will have a significant impact on the entire system. In the results of this analysis, the variables included in quadrant II were types of tourists, community income, networks, destination governance, tourist information, and guidance. The types of tourists visiting Bogor City have varied backgrounds. Scientific tourism is a type of special-interest tourism whose target markets are academics, researchers, students, lecturers, and educators who are curious and interested in conducting scientific activities in Bogor City. Therefore, this type of tourist is very important but depends on the promotion or information provided by various objects and attractions of scientific tourism. Community income is important because, if a tourist area is developed, it will affect the income of the community around the area. Therefore, this variable is highly dependent on the investment made to improve the infrastructure of the tourist area to support the economy of the local community.

The third quadrant (bottom right) is referred to as the "output" factor, which is characterized by a small influence but a large dependency. In this study, three factors were identified: the tourist community, level of visitation, and security. The fourth quadrant (bottom left) is a variable referred to as "autonomous" which is characterized by a small influence and a small dependency. In this study, three variables fell into this category: climate comfort, tourist satisfaction, and service quality. As Figure 5 shows, the wealth of tourist destinations strongly influences the number of visits, networks, information and services, and destination management. Climate comfort had the weakest influence among the other variables. The motivation of scientific tourism tourists may be very strong, so they are not affected by existing climate conditions.

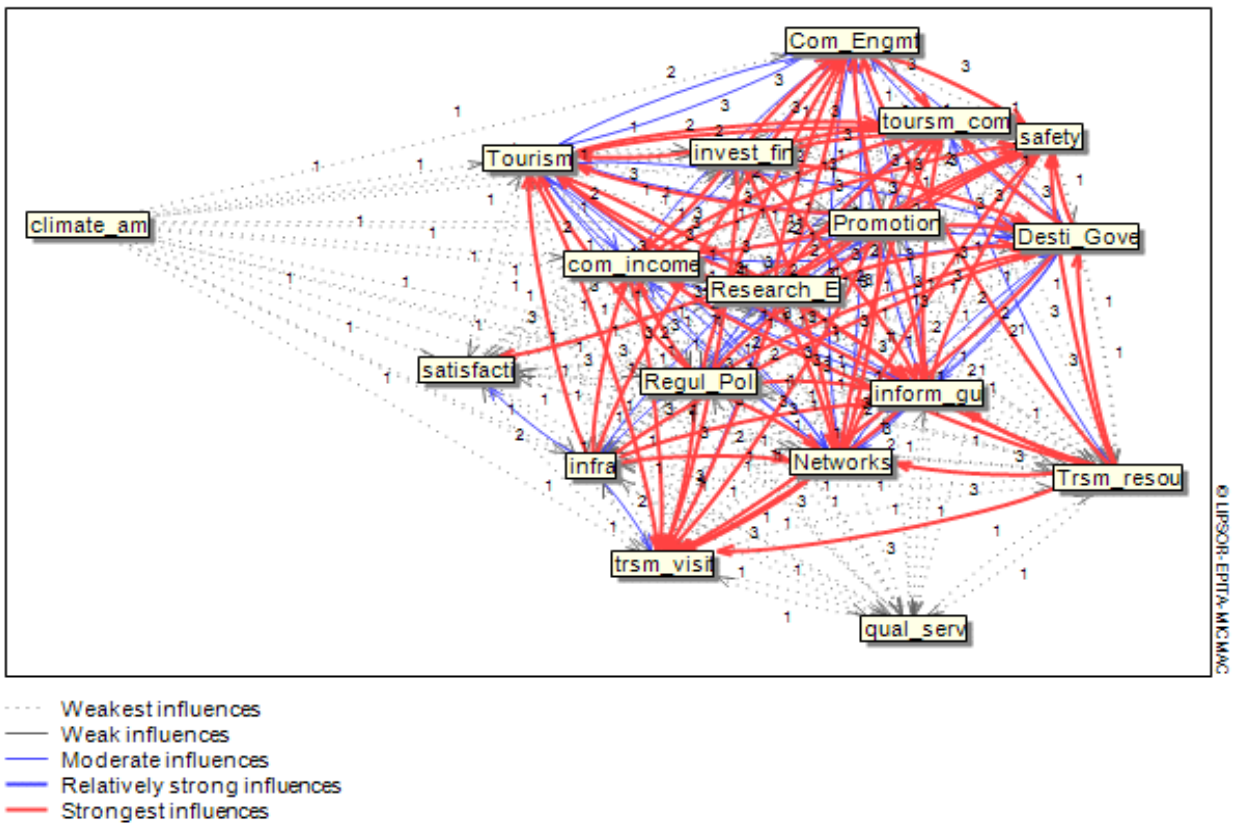


Figure 5. Seventy-five percent of the direct influence graph from the MDI matrix (Micmac analysis).

MDI Matrix			MII Matrix
Rank	Variabel		Variabel
1	11-Promotion		11 – Promotion
2	2-Trsm_resou		18 - Regul_Poli
3	18 - Regul_Poli		2-Trsm_resou
4	3 – Infra		6 – Invest_fin
5	6 – Invest_fin		3 – Infra
6	16 – Research_E		16 – Research_E
7	7 – Tourism		7 – Tourism
8	4 – Com_Income		4 – Com_Income
9	8 – Inform_guid		8 – Inform_guid
10	13 – Com_Engmt		13 – Com_Engmt
11	14 – Desti_Gove		14 – Desti_Gove
12	17 – Networks		17 – Networks
13	1 – Climate_am		1 – Climate_am
14	5 – Tourism_visit		5 – Tourism_visit
15	9 – Satisfacti		9 – Satisfacti
16	15 –Tourism_com		15 –Tourism_com
17	12 – Safety		12 – Safety
18	10 – Qual_serv		10 – Qual_serv

Figure 6. MDI Matrix and MII Matrix comparative ranking based on their respective influences (Micmac analysis).

Figure 6 explains the scores between variables based on their influence and transfer, after accounting for indirect impacts. For example, tourism resources originally located in the 2nd position, were moved to the 3rd position and replaced with regulations and policies. After considering indirect effects, other variables, such as infrastructure changed from 4th to 5th position, while investment and funding increased from 5th to 4th position. These results indicate that promotion, regulation and policy, tourism resources, investment and funding, infrastructure, research, and educational institutions are the six most important variables in the planning of scientific tourism development in Bogor.

Analysis of the Most Influential Actors (Actors)

The selected actors are listed in Table 4 based on the analysis results. There are 18 actors involved in planning the development of scientific tourism in Bogor, which are divided into three organizational groups: government, society, and the private sector. The Variable Objectives identified in the preliminary study are divided into four dimensions: (1) the ecological dimension, which pertains to enhancing the standard of tourism locations and augmenting the deficiency of infrastructure networks; (2) the economic dimension, which is to develop tourism business investment; (3) social dimension increasing promotion, and brand image; and (4) enhancing governance and forming partnerships and networks with research and education organizations.

Table 4. Actors influencing the planning of scientific tourism development in Bogor City.

No.	Actor	Codification	Group
1	*Dewan Perwakilan Rakyat Daerah* (DPRD)	DPRD	Government
2	Bogor City Government	Govern	Government
3	Bogor City Tourism and Culture Office	Disparbud	Government
4	Public Works and Spatial Planning Office	DPUPR	Government
5	Bogor City Education Office	Disdik	Government
6	Ministry of Agriculture	Kementan	Government
7	Ministry of Environment and Forestry	KLHK	Government
8	*Badan Riset dan Inovasi Nasional* (BRIN)	BRIN	Government
9	IPB University	IPB	Government
10	*PT Kereta Api Indonesia* (KAI)	KAI	Government
11	PT POS Indonesia	POS	Government
12	Entrepreneur	bsnsman	Private
13	Tourism Support Sector (Hotels, Restaurants, etc.)	Trsm_sect	Private
14	Tourism Destination Manager	Tourism Dest_man	Private
15	Cultural Figure	cultural_fig	Community
16	*Lembaga Swadaya Masyarakat* (LSM)	LSM	Community
17	Tourists	tourists	Community
18	Local community	Local_com	Community

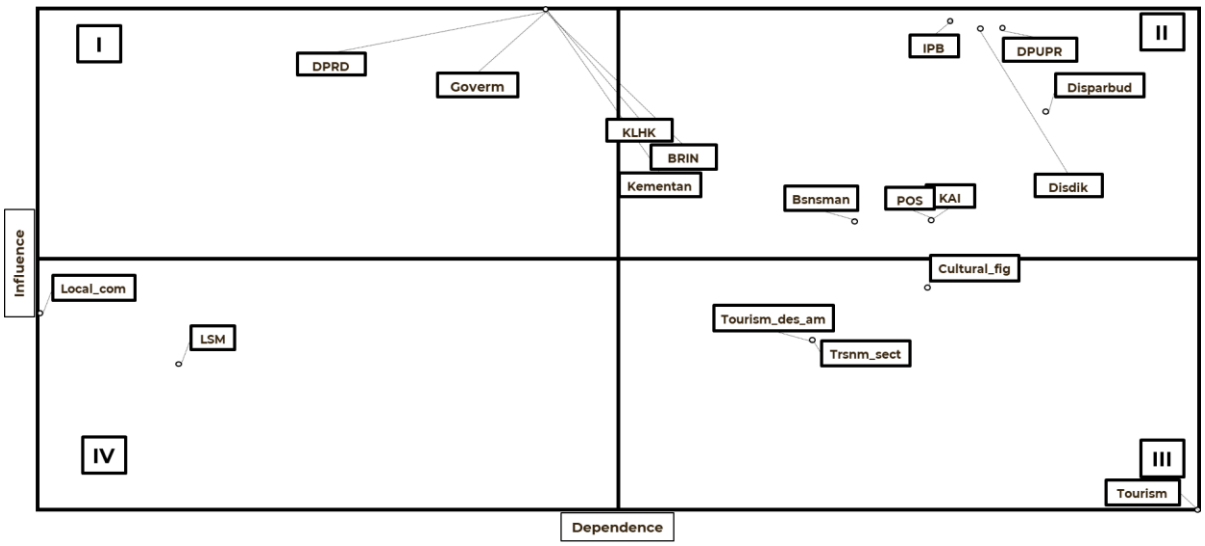
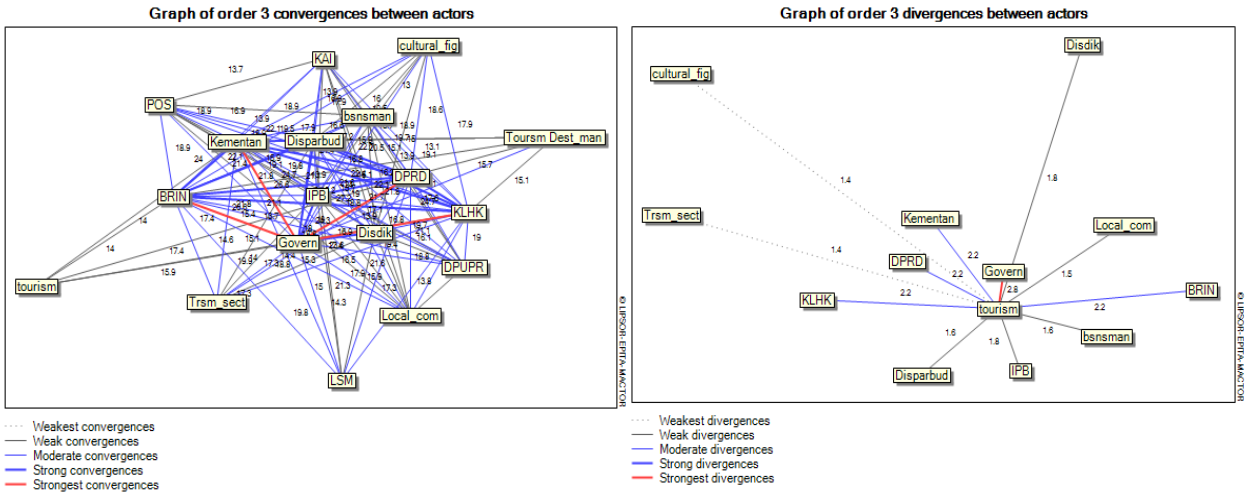


Figure 7. Level of impact and interdependencies among the parties participating in Scientific Tourism Planning in Bogor City.

In Figure 7, the actors in quadrant I (i.e., those with high influence and low dependency) are the Bogor City Government, DPRD, BRIN, and Ministry of Agriculture and Ministry of Environment and Forestry. Consistent with the results of Flórez et al. [17], sustainable tourism development should be planned and managed by community stakeholders. Local governments should solicit broad and direct community participation, which can influence decision making and ensure an equitable distribution of benefits to all stakeholders. To maximize community participation, citizens should have adequate access to various communication channels such as the Internet, email, and mass and print media. In quadrant II, actors that have high influence and dependency are the Education Office, IPB, Bogor City Tourism and Culture Office, Entrepreneurs, PT POS, PT KAI, *Dinas Pekerjaan Umum dan Penataan Ruang* (DPUPR). This means that actors in this quadrant in carrying out their functions on scientific tourism depend on policies issued by actors in quadrant I.



(a) (b)

Figure 8. (a) Graph of order 3 convergences between actors, (b) Graph of order 3 divergences between actors at 75% percentage (Mactor analysis).

Actors in quadrant II in the influence of scientific tourism are related to quadrant III, low influence, and high dependence, that is, Cultural Figures, Tourism Support Sector (hotels, restaurants, etc.), and Tourism Destination Managers. Quadrant IV, low influence, and low dependency refer to Local Communities and NGOs. The convergence graph (Figure 8a) shows the proximity of the actors to each other. The strongest convergence is with the Bogor City government, which is connected to BRIN, the Ministry of Agriculture, the DPRD, and KLHK. The four actors have close interests. These actors play a significant role in supporting the success of scientific tourism development. Policies by the actors in an agency affect other actors. The divergent graph (Figure 8b) shows the tension between tourists and the government (a strong divergent relationship). This is because the development of scientific tourism requires strong synergy between the government and tourists, where tourists are the most affected users. Figure 9 shows that the government had the highest mobilization score of 29.1. This is consistent with the results reported by Rahardjo et al. [9], where the score indicates that the government plays a vital role in mobilizing the goal of improving promotion and brand image with a score of 58.2. Improving promotion is a priority because promotion is the key to whether tourism development continues.

The results of the mobilization analysis (bottom row) show the objectives expected to be the main strategic issues in obtaining responses from stakeholders. In this analysis, the goal considered important by stakeholders was to improve promotions. The next priority is to improve tourism governance and develop networks/partnerships with research and education institutions to build tourism resource capacities. In line with research by Yuniarti et al. [26], tourist attractions can be developed with efforts to make promotional and marketing efforts and minimize accessibility constraints through the provision of transportation capital infrastructure, followed by development and good management, and the availability of sufficient supporting facilities and infrastructure because tourists not only enjoy the attraction but also want to enjoy facilities that can provide satisfaction. Promotion is crucial to the growth of the tourism industry. The number of foreign and local tourists visiting Bogor City is greatly impacted by the marketing initiatives that are run [27].

3MAO	Richness	Infrastructure	Investation	Promotion	Governance	network	Mobilisation
tourism	1.6	-0.5	1.6	2.1	1.0	1.6	8.3
DPRD	3.8	3.8	3.8	3.8	5.1	5.1	25.3
Govern	3.8	5.1	5.1	5.1	5.1	5.1	29.1
Disparbud	3.7	2.7	2.7	3.7	3.7	3.7	20.2
DPUPR	2.0	2.0	2.0	2.0	3.0	3.0	14.0
Disdik	3.0	3.0	3.0	3.0	3.0	3.0	18.1
Kementan	3.8	3.8	3.8	5.1	3.8	3.8	24.0
KLHK	3.8	3.8	3.8	5.1	3.8	3.8	24.0
BRIN	3.8	3.8	3.8	5.1	3.8	3.8	24.0
IPB	3.1	3.1	3.1	4.1	3.1	3.1	19.5
KAI	1.7	1.7	2.6	2.6	2.6	2.6	13.7
POS	1.7	1.7	2.6	2.6	2.6	2.6	13.7
bsnsman	2.7	2.7	2.7	2.7	1.8	1.8	14.2
cultural_fig	2.4	2.4	1.6	2.4	1.6	1.6	11.8
LSM	2.1	2.1	1.1	3.2	1.1	1.1	10.5
Trsm_sect	2.3	2.3	1.5	1.5	1.5	1.5	10.7
Toursm Dest_man	0.8	1.5	1.5	0.8	0.8	0.8	6.1
Local_com	2.5	2.5	1.2	3.7	1.2	2.5	13.6
Number of agreements	48.4	47.9	47.4	58.2	48.4	50.1	
Number of disagreements	0.0	-0.5	0.0	0.0	0.0	0.0	
Degree of mobilisation	48.4	48.5	47.4	58.2	48.4	50.1	

Figure 9. 3 MAO Matrix: Weighted locations of objectives between actors (Mactor analysis).

Figure 10 shows that the four objectives have a strong attachment or closeness related to the position of the actor: improving tourism governance, improving the quality of tourist destination wealth, developing networks/partnerships with research and education institutions in the context of tourism resource capacity, and improving promotion and brand image. This means that achieving these four objectives did not result in significant obstacles. Regarding other objectives, coordination and collaboration are needed to reach an understanding so that the objectives can be achieved. The governance required here is in the form of a strategic tourism plan that aims to ensure effective governance to build tourism development, and the challenge is to manage the increasing number of tourists and markets [28]. Meanwhile, the Promotion variable, according to Gunn [29], is one of the important components in planning tourism in the supply aspect, in addition to other components, such as tourist attractions (tourist destinations), services, information, and transportation. Therefore, the promotion of scientific tourism is very important to support the success of its development in Bogor. In addition, increasing destination wealth here is in line with Fandeli [30], who showed that more potential tourist attractions in an area will attract more tourists to visit the area.

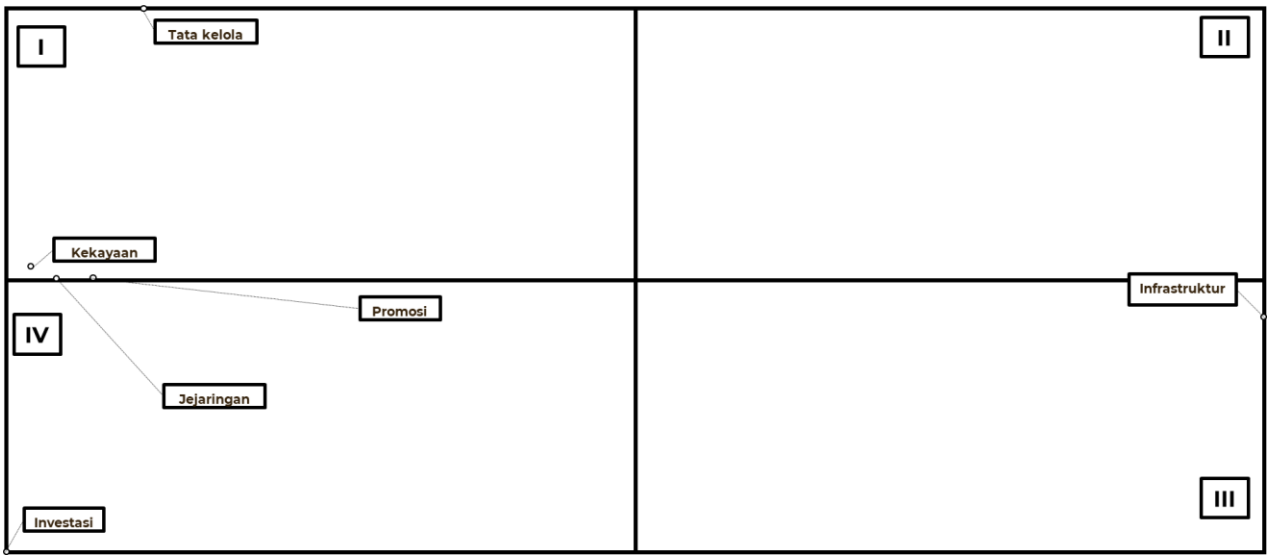


Figure 10. Linkages between objectives related to Scientific Tourism Development Planning in Bogor City.

Scientific Tourism Development Planning Strategy

The results of the Micmac and Mactor analysis above can be synthesized and made into a pattern of recommendations in the form of a sustainable scientific tourism development planning strategy in Bogor City by considering economic, socio-cultural, and environmental elements (Figure 11). The figure shows that all components of scientific tourism influence each other. Key variables and actors are interrelated in shaping sustainable tourism destinations. This strategy was developed by examining the sociocultural aspects of scientific tourism areas in the form of historical buildings and the involvement of surrounding communities associated with the development of tourist destinations and infrastructure to increase the income and economy of local communities without negatively impacting the physical, social, and cultural environment of a tourist destination [28].

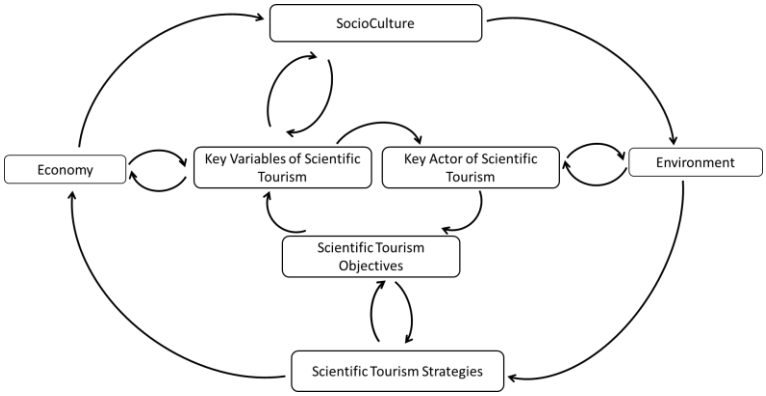


Figure 11. Sustainable scientific tourism strategy in Bogor City.

As a key actor, the government can determine the policies carried out to preserve the scientific tourism environment to be sustainably contained in planning documents, which are in accordance with applicable regulations, space management, development planning, and land use or landscape protection [31]. As in the development of tourism in Iran, the government plays a very important role Choi and Sirakaya [32], which should include sustainable planning and development of destinations, facilities, and services to meet the needs of current and future travelers [15]. Similar to the findings of this study, destination development and infrastructure are important variables, as are the roles of the government [33] in formulating this tourism policy. In addition, developing smart and real tourism requires progress in all areas, including the economic, environmental, and sociocultural areas [34].

Conclusions

This study identified six key variables that support the success of scientific tourism development planning in Bogor City: promotion, additional infrastructure, tourist destinations, investments, regulations and policies, and research and education institutions. Good tourism promotion increases the number of tourist visits. To increase promotion, it is necessary to develop the quality of scientific tourism destinations both physically (infrastructure and accommodation facilities) and non-physically (interpretation paths and tour packages with different alternative themes) so that the number of tourist visits increases and can attract people to invest. Meanwhile, the key actors that have the most influence on the success of scientific tourism development planning in Bogor City are the Bogor City Government, DPRD, Ministry of Agriculture, Ministry of Environment and Forestry, and BRIN. This actor will later implement policies for actors in quadrant II, namely the Tourism Office, Education Office, IPB as one of the educational institutions, and other institutions that have a large influence but high dependence. The Micmac actor analysis can be synthesized into a strategy formulation that connects the influence of actors and factors seen from the sustainable dimensions of economic, social, cultural, and environmental to realize the goals and produce a sustainable scientific tourism strategy in Bogor City.

Author Contributions

WTI: Conceptualization, Methodology, Software, Investigation, Writing - Review & Editing; **HSA**: Writing - Review & Editing, Supervision; **BP**: Methodology, Writing - Review & Editing; **NK**: Writing - Review & Editing.

Author Contributions

There are no conflicts to declare.

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