

# Stakeholders and network analyses in Tambora National Park, Sumbawa Island, Indonesia

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**Abstract.** Anshor M, Basuni S, Arief H, Sunarminto T. 2023. Stakeholders and network analyses in Tambora National Park, Sumbawa Island, Indonesia. *Biodiversitas* 24: 5446-5463. The complexity of managing Tambora National Park (Tambora NP), West Nusa Tenggara Province, Indonesia poses a challenge to be overcome effectively by Tambora NP Office alone, thus the involvement of broader stakeholders is needed. These stakeholders have their respective levels of influence and interests which affect the relationship between them and Tambora NP Office. Therefore, this study aimed to identify the stakeholders related to the management of Tambora NP, and investigate their interests and influence using social network analysis. A stakeholder analysis was conducted by the following steps: (i) identifying the stakeholders, (ii) mapping the stakeholders, and (iii) assessing the relationship among stakeholders. The analysis identified 38 stakeholders related to Tambora NP management. Tambora NP Office is the primary stakeholder with the highest level of influence and interest. The relationship established in the management network of Tambora NP is still weak and centralized among several stakeholders in which Tambora NP Office is the most central stakeholder. The relationship among stakeholders is dominated by five stakeholders, namely Tambora NP Office, Natural Resources Conservation Agency of West Nusa Tenggara (BKSDA NTB), Executive Board (DP) of Geopark Tambora, Forest Management Unit (KPH) Tambora and the Environment and Forestry Provincial Service of West Nusa Tenggara Province (Dinas LHK NTB). These five institutions also dominate the proximity between stakeholders, so the information flow is not evenly distributed to all stakeholders. The weak relationships among stakeholders could be overcome by enhancing the flow of information and communication which could be facilitated by Tambora NP Office, BKSDA NTB, and DP Geopark Tambora.

**Keywords:** Management effectiveness, protected area, stakeholders, Social Network Analysis (SNA), Tambora National Park

## INTRODUCTION

Across the world, the majority of protected areas are managed by governments, either at national or sub-national levels, but in many cases, the management such protected areas do not involve local communities who have been living prior the establishment of the protected areas (Wells and McShane 2004; West et al. 2006; Adams and Hutton 2007; Stacey et al. 2013). In Indonesia, almost all protected areas are funded and managed by central government through the Ministry of Environment and Forestry (Hartono 2008; Pattiro 2020). However, protected area management is not only the matter of forestry and environment sectors since there are various parties which have influences and interests on the protected area including local communities, tourism sector, research and education institution, etc. Therefore, collaborative management by integrating various stakeholders with various interests is important and essential in protected area management (Miller and Hamilton 1999; Saout et al. 2013; Oldekop et al. 2016; Sagie and Orenstein 2022; Nugroho and Sari 2023).

The current state of protected area management has many limitations, mainly due to the lack of resources (e.g., staff and funding), implying a need of support and involvement from a broader stakeholders, especially local governments and communities (Wiratno et al. 2022).

Adequate resources in protected area management are critical to achieving management objectives (Geldmann et al. 2018; Graham et al. 2021) and to overcome problems effectively. Management effectiveness is one of the elements in sustainability standards in area-based conservation management practices to result in successful conservation outcomes (Oldekop et al. 2016; Gong et al. 2017; Hockings et al. 2019; Rodrigues and Cazalis 2020; Chung et al. 2023).

The success of protected area management is frequently influenced by the participation and support of local stakeholders. Nonetheless, the level of participation and support is determined by stakeholder perceptions of the impacts of protected area experienced by them which could be positive or negative (Bennett and Dearden 2014). The participation of stakeholders also require clarity of roles and responsibilities among them to be effective (Sobhani et al. 2022). This effective participation can lead to high stakeholder satisfaction in protected area management. Stakeholders' participation can also be involved in decision-making (Izurieta et al. 2011; Stacey et al. 2013) which influence stakeholders' perceptions and actions, including activities which could threaten biodiversity in protected areas (Chaffin et al. 2014; Coelho et al. 2020; Albert 2022; Ihsannudin and Antriyandarti 2022). Since the stakeholder support is vital, the relationship among stakeholders in

protected area management needs to be improved (Bennett and Dearden 2014; Kusumawati and Huang 2015).

Stakeholders are individuals or groups who can influence or be influenced to achieve the objectives of the management process (Freeman 1979). The roles and activities of the stakeholder represent their interest level including in protected area management (Muntasib et al. 2021). Understanding the roles and interests of stakeholders as well as the relationships among them is important to empower stakeholders in which such relationships can be assessed using stakeholder analysis. The analysis is carried out by identifying, categorizing and assessing the relationship among stakeholders (Reed et al. 2009). Stakeholder identification is carry out to differentiate and categorize the profile, characteristics, roles and interests of each stakeholder. The relationship among stakeholders is mapped to see the flow of information, communication, power structure and influence which can be assessed using social network analysis. In protected area management, stakeholder analysis can be used for decision-making by identifying and mapping the relevant stakeholders (Chaffin et al. 2014; Nastran 2014; Mbaru and Barnes 2017; Heslinga et al. 2019; Lucrezi et al. 2019; Coelho et al. 2020; Rasheed and Abdullah 2020). Stakeholder analysis is also a simple and effective method for uncovering the strength and weakness of social networks/relationships among stakeholders in protected area management (Rastogi et al. 2010).

The Tambora National Park (Tambora NP) is a protected area located in Sumbawa Island, West Nusa Tenggara (NTB) Province, Indonesia. Before being designated as a national park, since 1937 the area was a conservation area consisting of a nature reserve covering an area of 23,840.81 ha, wildlife reserves covering an area of 21,674.68 ha, and a hunting park covering an area of 26,130.25 ha. In 11 April 2015, Tambora NP was inaugurated as the 51<sup>st</sup> national park by the President of the Republic of Indonesia, Joko Widodo at the "2 Centuries of Tambora Greeting the World 2015" event. In accordance with the Decree of the Minister of Environment and Forestry Number SK. 111/Menlhk-II/2015 dated April 7, 2015, the Tambora NP area has an area of 71,645.64 Ha, which is under the authority of Tambora NP Office. The Tambora NP area is included in the Mount Tambora area which is unique with its history of eruptions and extensive caldera. Mount Tambora is recognized as the volcano with the largest eruption ever recorded in the historic era which was happening on 10 April 1815, forming a wide caldera with a diameter of 9 km and a depth of 1551 m. The eruption killed approximately 85,000 local residents and wiped out four major kingdoms in Sumbawa Island. The volcanic ash spread globally to the northern hemisphere, including Europe and America, causing climate anomaly and experiencing year without summer (Sutawidjaja et al. 2006; Behringer 2017).

The area of Tambora NP is a unified landscape of Mount Tambora which has various statuses and functions including as geopark, biosphere reserve and tourist destination. Tambora NP has various potential natural resources, thus attracting many stakeholders. Nonetheless, as Tambora NP is newly established national park, it has many limitations,

including the lack of human resources, funds and infrastructure to support the management, promotion and involvement of stakeholders, especially the local government and communities. Also, it is not clear the roles, interests and relationships among stakeholders to achieve the management objectives of the park. Therefore, this study aimed to identify the stakeholders related to the management of Tambora NP, and investigate their interests and influence using social network analysis. The research results are expected to provide information regarding the relationships among stakeholders which can be used to formulate strategies for better collaborative management by integrating various interests.

## MATERIALS AND METHODS

### Study area and period

The study location was Tambora NP in Bima District and Dompu District, West Nusa Tenggara (NTB) Province (Figure 1). The study was carried out from January 2022 to July 2022. Tambora NP is geographically located at - 8.272448739172734, 117.98194106939735. The area of Tambora NP has an altitude range of 50-2,851 meters above sea level. Tambora NP has a tropical climate, with 3 climate types, namely: climate type D (moderate), climate type E (rather dry), and climate type F (dry). The average regional rainfall is only 92 mm per month with a total of 14 rainy days/month. Vegetation cover in the Tambora NP area consists of several forms of cover, namely: primary forest (8,904.29 ha), secondary dry land forest (5,500.97 ha), and savanna/shrubs (5,7240.38 ha). Tambora NP has high level of biodiversity including 277 plant species classified into 103 families consisting of 103 tree species, 18 epiphyte species, 68 herbaceous species, 39 liana species and 49 shrub species. Several unique plant species in Tambora NP include *dau* (*Indigofera* sp.) and *buah odaq* (*Prunus arborea*). There are also several protected fauna species in Tambora NP including timor deer (*Cervus timorensis*), yellow-crested small cockatoo (*Cacatua sulphurea*), red-footed gosong (*Megapodius reinwardt*), australian/brown honeyeater (*Lichmera indistincta*), scaly-crowned honeyeater (*Lichmera lombokia*), and helmeted friarbird/cikukua (*Philemon buceroides*) (Balai TN Tambora 2017).

### Data collection procedures

The analysis of stakeholders related to the Tambora NP was carried out in the following steps: identifying the stakeholders, categorizing and mapping the stakeholders, and assessing the relationship between stakeholders (Reed et al. 2009).

#### Identification of stakeholders

Stakeholder identification was carried out by collecting stakeholder data available in the Tambora NP Office using in-depth interviews to purposively selected informants (Table 1). Furthermore, in-depth interviews were conducted with other informants using non-probability sampling with the snowball sampling method to obtain representative

samples of stakeholders. In doing so, the initially selected stakeholder provided recommendation of other informants until it stopped when the stakeholders provided similar recommendation. To obtain a list of valid and credible stakeholders, crosscheck was performed through a triangulation method to achieve agreement of information resulted from the informants, field observations and documents.

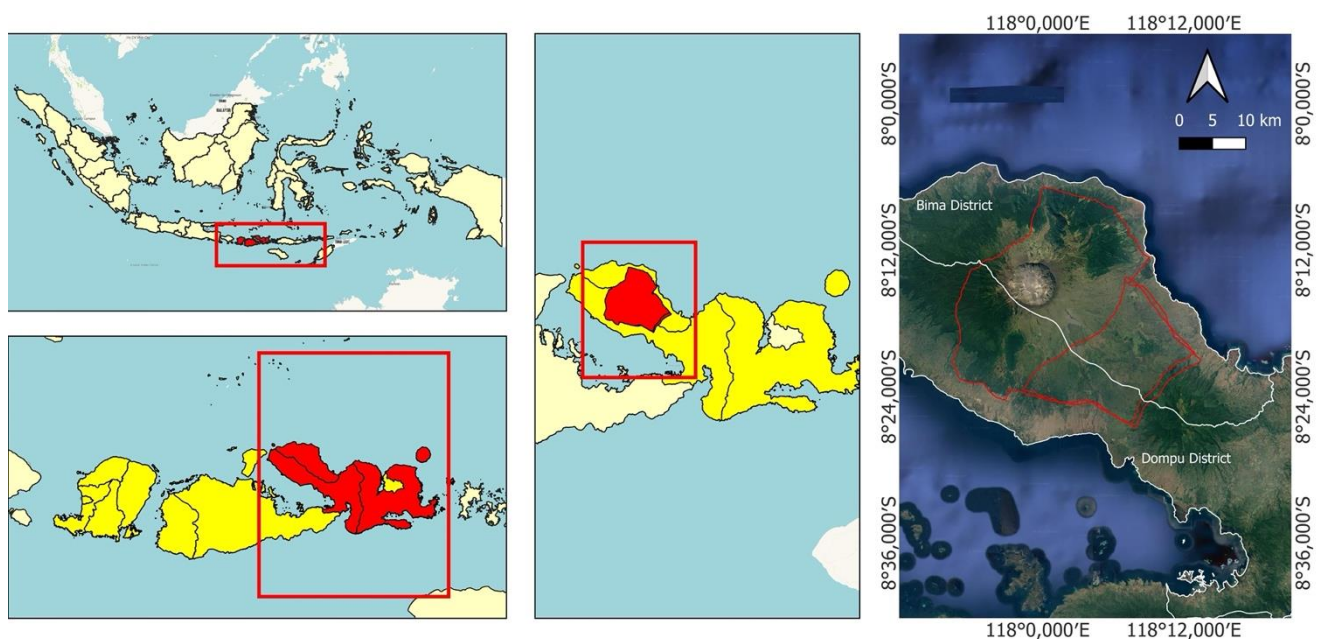
*Categorization and mapping of stakeholder*

The categorization and mapping of stakeholders related to the Tambora NP were completed by interpreting the stakeholder data into a score of 1-5 according to the criteria that had been prepared. The level of influence was assessed based on the criteria for the stakeholders' ability to fight for their aspirations (P1), the contribution of facilities provided by stakeholders related to the Tambora NP management (P2), institutional/HR capacity assigned by stakeholders related to the Tambora NP management (P3), the budget

support of stakeholders used for the Tambora NP management (P4), and the stakeholders' ability to implement the Tambora NP management program (P5). The interest level was assessed based on the criteria of stakeholder involvement in the Tambora NP management (K1), the authority of stakeholders related to the Tambora NP management (K2), stakeholder programs related to the Tambora NP management (K3), the benefits of Tambora NP for stakeholders (P4), and the level of stakeholders' dependence related to the Tambora NP management (P5). The score measurement adopted the model developed by Abbas (2005) into the five-tiered data measurement as presented in Table 2. Furthermore, each stakeholder's influence and interest scores were mapped into matrix quadrants using the interest-influence matrix analysis to classify key players, context setters, subjects and crowds, as presented in Figure 2 (Eden and Ackermann 1998).

**Table 1.** Initial identification of stakeholders related to Tambora NP, Sumbawa Island, Indonesia

Category	Initial Stakeholders
Central government	Tambora NP Office, West Nusa Tenggara Natural Resources Conservation Agency (BKSDA NTB), Watershed Management Agency (BPDAS), Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM), Climate Change Control Agency (Balai PPI)
Local government	Environment and Forestry Service of West Nusa Tenggara Province (Dinas LHK NTB), Tambora Forest Management Unit (KPH Tambora), Provincial and District Tourism Offices, Tambora Geopark Executive Board (DP Geopark Tambora), Surrounding Sub-districts and Villages of Mount Tambora
Civil society/local community	Forest Ranger Partner Community (MMP), Fire Care Community (MPA), Nature Lovers Group (KPA)
Academics, researchers	Study and Development Agency of Mataram, University of Mataram (UNRAM)
Private, Non-Governmental Organization (NGO), Media	PT Sanggar Agro, PT UTL, PT SMS, PT AWB, Gerilya, Suara NTB



**Figure 1.** Map of the study location of Tambora NP, Sumbawa Island, West Nusa Tenggara Province, Indonesia

The category of each quadrant describes each stakeholder's position and role according to Eden and Ackermann's category (1998), namely: (i) key player is a group that has high interest and influence. This group is usually the owner and other authorized officeholders to make decisions. (ii) subject is a group with a strong interest but a weak influence. This group has little influence on a decision. However, it does not have a significant impact but is interested and willing to be actively involved. (iii) context setters are a group that has a strong influence but weak interest. This group has the authority to make decisions but has no interest and willingness to be actively involved. (iv) crowd is a group that has weak influence and little interest. This group does not (and is not expected) to be actively involved, even if it does not know or want to know.

*The relationship among stakeholders*

The relationship among stakeholders was analysed out using the Social Network Analysis (SNA) method. SNA was carried out by using the relationship matrix between stakeholders. The code "1" indicates a unique relationship between stakeholders, for example, communication, closeness, conflict, trust, etc.; the code "0" indicates no relationship (Wasserman and Faust 1994).

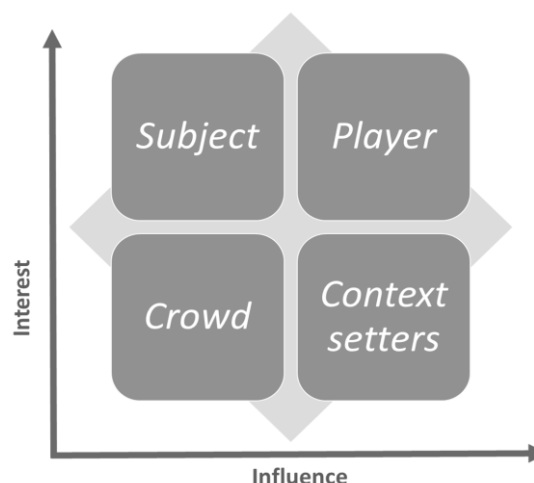
**Data analysis**

SNA analysis was conducted using UCINET 6.755 software and stakeholder relationships was visualized using NetDraw 2.179 software (Borgatti et al. 2002). Measurement of the relationship between stakeholders used Freeman's Centrality Metrics based on the calculation of eigenvector centralities, degree centralities, closeness centralities, and betweenness centralities (Freeman 1979). Degree centrality was the level of stakeholder centrality in the network, both *indegree* (getting more relationships than other stakeholders) and *outdegree* (providing more relationships to other stakeholders). Closeness centrality was the stakeholders' proximity to other stakeholders, and *betweenness centrality* was the ability of stakeholders to bridge to other stakeholders.

**RESULTS AND DISCUSSION**

**Stakeholders related to Tambora NP**

There were 38 stakeholders related to the Tambora NP with various influence and interest levels (Table 3). The stakeholders were classified into five groups: (i) central government; (ii) local government; (iii) local communities; (iv) academics and researchers; (v) private sector, media, and NGOs (World Bank 1999). Tambora NP Office is the Technical Implementation Unit under the Ministry of Environment and Forestry (MoEF), which is currently responsible for managing Tambora NP. Consequently, all Tambora NP management activities could not be separated from Tambora NP Office as the primary stakeholder. In Indonesia, the management of protected areas in is under the authority of the central government and almost all initiatives and management activities are carried out and financed by the central government (Pattiro 2019; Sabar et al. 2023).



**Figure 2.** The influence and interest matrix quadrant (Modification from Eden and Ackermann 1998)

**Table 2.** Quantitative measures of stakeholders' interest and influence in the Tambora NP, Sumbawa Island, Indonesia management

Score	Value	Criteria	Description
Stakeholder's interest			
5	21-25	Very high	Very dependent on Tambora's natural resources
4	16-20	High	Highly dependent on Tambora's natural resources
3	11-15	Quite high	Fairly dependent on Tambora's natural resources
2	6-10	Low	Slightly dependent on Tambora's natural resources
1	1-5	Very low	Not dependent on Tambora's natural resources
Stakeholder's influence			
5	21-25	Very high	Having a tangible influence on Tambora
4	16-20	High	Having a significant influence on Tambora
3	11-15	Quite high	Having enough influence on Tambora
2	6-10	Low	Having a slight influence on Tambora
1	1-5	Very low	Having no influence on Tambora

Note: Modified from Abbas (2005)

**Table 3.** Stakeholders related to the Tambora NP, Sumbawa Island, Indonesia

Stakeholder	Influence Level	Interest Level
<b>Central Government</b>		
Tambora NP Office	Very high	Very high
NTB Natural Resources Conservation Agency (BKSDA NTB)	High	Low
Ecoregional Development Control Center (P3E) of Balinusra	Quite high	Low
Watershed Management Agency (BPDAS)	Quite high	Low
Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnusra	Quite high	Low
Climate Change Control Agency (Balai PPI) of Jabalnusra	High	Low
Forest Area Consolidation Agency (BPKH) of Denpasar	Low	Low
<b>Local Government</b>		
Provincial Environment and Forestry Service (DLHK NTB)	Quite high	Low
Tambora Forest Management Unit (KPH Tambora)	Quite high	High
Development Planning Agency at Sub-National Level (Bappeda) of Bima District	Quite high	Low
Development Planning Agency at Sub-National Level (Bappeda) of Dompu District	Quite high	Low
Provincial Tourism Office (Dinas Pariwisata) of West Nusa Tenggara	Quite high	Low
Tourism Office (Dinas Pariwisata) of Bima District	Quite high	Quite high
Tourism Office (Dinas Pariwisata) of Dompu District	Quite high	Quite high
Environmental Services (DLH) of Bima District	Low	Low
Environmental Services (DLH) of Dompu District	Low	Low
Tambora Geopark Executive Board (DP Geopark Tambora)	High	High
Center for Volcanology and Geological Hazard Mitigation (PVMBG)	Low	Low
District Police Office (Polres) of Bima	Low	Low
District Police Office (Polres) of Dompu	Low	Low
Military District Command (Kodim) of Bima	Low	Low
Military District Command (Kodim) of Dompu	Low	Low
Regional Agency for Disaster Management (BPBD)	Low	Low
Surrounding sub-districts of Mount Tambora (Sanggar, Pekat, Tambora, Kempo Sub-districts)	Low	High
Surrounding villages of Mount Tambora (Doropeti, Tambora, Kawinda Toi, Oi Katupa, Piong Villages)	Low	Very high
<b>Civil society/local community</b>		
Forest Ranger Partner Community (MMP)	Low	High
Fire Care Community (MPA)	Low	High
Citra Madu Lestari Group	Low	Very high
Nature Lovers Group (K-PATA, Algura, HUMPA)	Low	High
Indonesian Mountain Guide Association (APGI) of Tambora	Low	High
Indonesian Mountain Tour Guide (PWGI) Tambora	Low	Low
<b>Academics, researchers</b>		
Agency of Application of Environmental and Forestry Instrument Standards (BSIP KLHK) Mataram	Quite high	Low
University of Mataram (UNRAM)	Quite high	Low
Sumbawa Techno Park	Low	Low
Research Innovation and Agency (BRIDA) of West Nusa Tenggara	Low	Low
<b>Private, NGO, Media</b>		
Forest Concession Rights/Industrial Plantation Forest (HPH/HTI) Companies (PT Sanggar Agro, PT UTL, PT SMS, PT AWB)	Low	Low
Gerilya NGO	Low	Low
Media Suara NTB, Dompu bicara	Low	Low

Note: Source: Primary/processed data (2022)

There are several stakeholders with influence and interest levels of high or very high as follow. Tambora NP was established relatively recently (in 2015). Prior as national park, Tambora NP was a mix of protected areas (hunting parks, nature reserves, wildlife reserves) managed by the NTB Natural Resources Conservation Agency (BKSDA NTB). After the establishment, the Tambora NP is managed by a new institutional unit, namely the Tambora NP Office. Even though it has been managed by a new institution, its management cannot be separated from the BKSDA NTB.

Climate Change Control Agency (Balai PPI) of Jabalnusra is a technical implementation unit under the Ministry of Environment and Forestry. One of its functions is overseeing and controlling forest and land fires. The presence of this institution is important since the condition of land cover in the Tambora NP area is almost 80% in the form of savanna/bush/shrubs that are prone to fires (Balai TN Tambora 2017). Thus, Balai PPI of Jabalnusra has a high level of influence on the Tambora NP especially in terms of overseeing and controlling forest and land fires.

Tambora Geopark Executive Board (DP Geopark Tambora) is the manager of the Tambora Geopark whose task is to preserve geological heritage, biodiversity and cultural diversity for the welfare of the community through three pillars, namely conservation, education and sustainable community development (Pemprov NTB 2016). Tambora Geopark area is dominated by Mount Tambora and mostly overlaps with the Tambora NP area. Among the ten geological sites managed by the DP Geopark Tambora, six sites are located in the Tambora NP area, so the DP Geopark Tambora has a high interest in the Mount Tambora area.

Tambora NP area is surrounded by forests under the status of watershed protection (*Hutan Lindung*), production (*Hutan Produksi*) and limited production forest (*Hutan Produksi Terbatas*). The surrounding forest is the working area of the Forest Management Unit Office of Tambora (KPH Tambora), that has an interest in the management of Tambora NP, especially in terms of securing forest areas. Citra Madu Lestari is a community group that collects natural honey, and the settlement is close to the Tambora NP area.

#### **Categorization and mapping of stakeholders to Tambora NP**

The assessment of the level of influence and interest of stakeholders related to the Tambora NP was based on the criteria as explained in the Methods. The level of influence was assessed based on the stakeholder's ability to fight for their aspirations, the stakeholder's contribution to facilities, institutional/HR capacity assigned by stakeholder related to the Tambora NP, stakeholder's budget support used for the Tambora NP management, and the stakeholder's ability to implement the Tambora NP program. The outcome of calculating the level of stakeholder influence is presented in Table 4. Tambora NP Office is the primary stakeholder with the most substantial level of influence, followed by the BKSDA NTB, DP Geopark Tambora, and the Balai PPI of Jabalnusra.

Tambora NP Office has a high level of influence, from the ability to fight for aspirations to running Tambora NP management activities. This influence is because Tambora NP Office is the primary stakeholder who has full authority over the Tambora NP management. The BKSDA NTB has a high level of influence regarding the ability to fight for aspirations and carry out Tambora NP management activities. Because the BKSDA NTB is a stakeholder that was involved in the establishment of the Tambora NP, thus it still has high enough access to influence and adequate capacity to support the implementation of Tambora NP management activities.

The DP Geopark Tambora has a high level of influence regarding the ability to fight for aspirations. It is because the DP Geopark Tambora is a responsible stakeholder for managing national geoparks. In addition, the DP Geopark Tambora is also in charge of managing the Satonda-Moyo-Tambora World Biosphere Reserve (SAMOTA), where the Tambora NP area was included. The SAMOTA Biosphere Reserve was inaugurated and declared on June 19, 2019, at the 31<sup>st</sup> Session of the Man and the Biosphere (MAB) Program International Coordinating Council in Paris. The

position and authority of the DP Geopark Tambora allows high access to fight for aspirations related to the Tambora NP management.

The Balai PPI of Jabalnusra has a high level of influence in terms of the contribution of facilities and budget support provided to Tambora NP management activities. This agency is a technical implementation unit under the Ministry of Environment and Forestry responsible for controlling forest and land fires. The role of the Balai PPI of Jabalnusra is crucial since it provides intensive budget facilitation and support in the Tambora NP area fire control activities.

The level of interest was assessed based on the stakeholder's involvement in the Tambora NP management, the stakeholder's authority related to the Tambora NP management, stakeholder's programs related to the Tambora NP management, the benefits generated from Tambora NP for stakeholders, and the level of stakeholder's dependence on Tambora NP. The outcome of the calculation of the stakeholder interest level is presented in Table 5.

Tambora NP Office, the surrounding Villages of Mount Tambora, and the Citra Madu Lestari group were the stakeholders with the highest interest level. Tambora NP Office has a high-interest level because it has the responsibility for its management. So, it must be directly involved in Tambora NP management activities. The high level of interests of the surrounding villages of Mount Tambora and the group of natural honey collectors Citra Madu Lestari is related to their dependence on natural resources in the Tambora NP area. Furthermore, the scores of the level of influence and interest of each stakeholder were mapped into the matrix quadrant as presented in Figure 3. Figure 3 shows that based on the level of influence and interest of 38 stakeholders related to the Tambora NP management, they are mapped into four categories, namely: (i) key players are stakeholders who have high levels of influence and interest. Stakeholders in this category include: the Tambora NP Office, KPH Tambora, DP Geopark Tambora, Tourism Office (Dispar) of Bima District, and Tourism Office (Dispar) of Dompu District.

(ii) subjects are stakeholders with a high level of interest but a weak level of influence. Stakeholders in this category include: surrounding villages of Mount Tambora, Citra Madu Lestari group, Fire Care Community (MPA), Forest Ranger Partner Community (MMP), Nature Lovers Group (KPA), Indonesian Mountain Guide Association (APGI) of Tambora, and surrounding sub-districts of Mount Tambora. (iii) context setters are stakeholders with a high level of influence but a low level of interest. Stakeholders in this category include: the BKSDA NTB, Balai PPI of Jabalnusra, Provincial Environment and Forestry Service (Dinas LHK) of NTB, Provincial Tourism Office (Dispar Propinsi) of NTB, Development Planning Agency at Sub-National Level (Bappeda) of Bima District, Development Planning Agency at Sub-National Level (Bappeda) of Dompu District, Ecoregional Development Control Center (P3E) of Balinusra, Center for Implementation of Standards for Environmental and Forestry Instruments (BSIP), University of Mataram (UNRAM), and Watershed Management Agency (BPDAS).

(iv) crowds were stakeholders who have a weak level of influence and interest. Stakeholders in this category include: Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnusra, Forest Area Consolidation Center (BPKH) of Denpasar, Regional Agency for Disaster Management (BPBD), Center for Volcanology and Geological Hazard Mitigation (PVMBG), Indonesian Mountain Tour Guide (PWGI) Tambora, Gerilya

NGO, Media, District Police Station (Polres) of Bima, District Police Station (Polres) of Dompu, Military District Command (Kodim) of Bima, Military District Command (Kodim) of Dompu, Companies, Environmental Services (Dinas LH) of Bima District, Environmental Services (Dinas LH) of Dompu District, Research Innovation and Agency (BRIDA) of NTB, and Sumbawa Techno Park.

**Table 4.** The level of influence of stakeholder related to the Tambora NP, Sumbawa Island, Indonesia

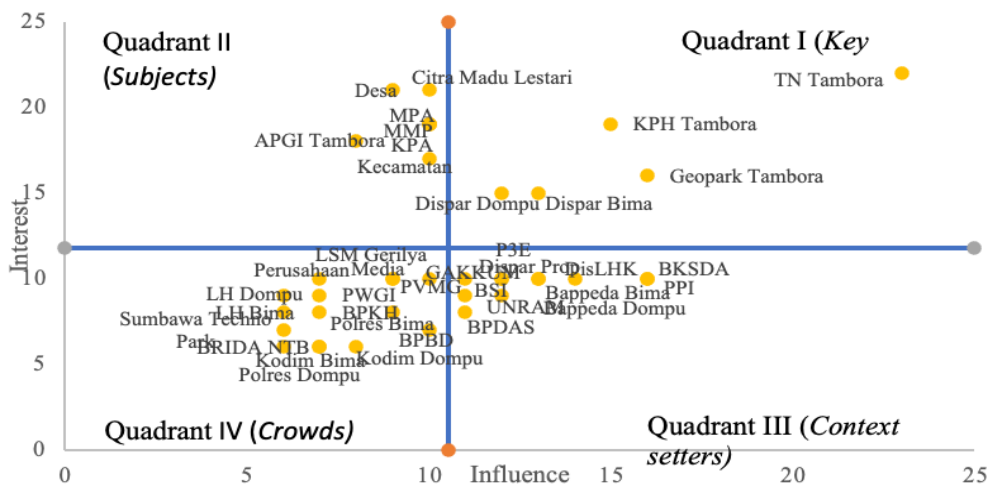
Stakeholder	Score					Total
	P1	P2	P3	P4	P5	
Tambora NP Office	4	5	4	5	5	23
NTB Natural Resources Conservation Agency (BKSDA NTB)	4	3	3	2	4	16
Ecoregional Development Control Center (P3E) of Balinusra	3	3	2	2	2	12
Watershed Management Agency (BPDAS)	2	3	2	2	2	11
Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnusra	2	2	3	2	2	11
Climate Change Control Agency (Balai PPI) of Jabalnusra	3	4	3	4	2	16
Forest Area Consolidation Center (BPKH) of Denpasar	2	1	1	1	2	7
Provincial Environment and Forestry Service (DLHK NTB)	4	3	3	2	2	14
Tambora Forest Management Unit (KPH Tambora)	3	3	4	2	3	15
Development Planning Agency at Sub-National Level (Bappeda) of Bima District	2	3	2	3	3	13
Development Planning Agency at Sub-National Level (Bappeda) of Dompu District	2	3	2	3	3	13
Provincial Tourism Office (Dinas Pariwisata) of West Nusa Tenggara	2	3	2	3	2	12
Tourism Office (Dinas Pariwisata) of Bima District	2	3	3	3	2	13
Tourism Office (Dinas Pariwisata) of Dompu District	2	3	3	2	2	12
Environmental Services (DLH) of Bima District	1	2	1	1	1	6
Environmental Services (DLH) of Dompu District	1	2	1	1	1	6
Tambora Geopark Executive Board (DP Geopark Tambora)	4	3	3	3	3	16
Center for Volcanology and Geological Hazard Mitigation (PVMBG)	2	3	2	1	2	10
District Police Station (Polres) of Bima	1	2	3	1	2	9
District Police Station (Polres) of Dompu	1	1	2	1	2	7
Military District Command (Kodim) of Bima	1	1	2	1	2	7
Military District Command (Kodim) of Dompu	1	2	2	1	2	8
Regional Agency for Disaster Management (BPBD)	2	3	2	1	2	10
Surrounding sub-districts of Mount Tambora (Sanggar, Pekat, Tambora, Kempo Sub-Districts)	2	2	3	1	2	10
Surrounding villages of Mount Tambora (Doropeti, Tambora, Kawinda Toi, Oi Katupa, Piong Villages)	2	2	2	1	2	9
Forest Ranger Partner Community (MMP)	2	2	2	1	3	10
Fire Care Community (MPA)	2	2	2	1	3	10
Citra Madu Lestari Group	1	2	3	1	3	10
Nature Lovers Groups (K-PATA, Algura, HUMPA)	1	2	3	1	3	10
Indonesian Mountain Guide Association (APGI) of Tambora	1	1	2	1	3	8
Indonesian Mountain Tour Guide (PWGI) Tambora	1	1	2	1	2	7
Agency of Application of Environmental and Forestry Instrument Standards (BSIP KLHK) Mataram	1	2	3	2	3	11
University of Mataram (UNRAM)	2	2	3	2	3	12
Sumbawa Techno Park	1	1	1	1	2	6
Research Innovation and Agency (BRIDA) of West Nusa Tenggara	1	1	1	1	2	6
HPH/HTI Companies (PT Sanggar Agro, PT UTL, PT SMS, PT AWB)	1	2	1	2	1	7
Gerilya NGO	1	1	3	1	3	9
Media Suara NTB, Dompu bicara	2	2	2	1	2	9

Note: P1 = Stakeholder's ability to fight for their aspirations regarding the Tambora NP management; P2: Stakeholder's contribution to facilities related to the Tambora NP management; P3 = Institutional/HR capacity assigned by stakeholders related to the Tambora NP management; P4 = Stakeholder's budget support used for the Tambora NP management; P5 = Stakeholder's ability to carry out the Tambora NP management programs. (Source: Primary data 2022)

**Table 5.** The level of stakeholder’s interest related to the Tambora NP, Sumbawa Island, Indonesia management

Stakeholder	Score					Total
	K1	K2	K3	K4	K5	
Tambora NP Office	5	5	4	4	4	22
NTB Natural Resources Conservation Agency (BKSDA NTB)	2	2	2	2	2	10
Ecoregional Development Control Center (P3E) of Balinusra	3	2	3	1	1	10
Watershed Management Agency (BPDAS)	2	1	2	2	1	8
Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnusra	3	2	3	1	1	10
Climate Change Control Agency (Balai PPI) of Jabalnusra	3	2	3	1	1	10
Forest Area Consolidation Center (BPKH) of Denpasar	2	2	2	1	1	8
Provincial Environment and Forestry Service (DLHK NTB)	2	2	2	2	2	10
Tambora Forest Management Unit (KPH Tambora)	4	3	4	4	4	19
Development Planning Agency at Sub-National Level (Bappeda) of Bima District	2	2	2	2	2	10
Development Planning Agency at Sub-National Level (Bappeda) of Dompu District	2	2	2	2	2	10
Provincial Tourism Office (Dinas Pariwisata) of West Nusa Tenggara	2	3	2	2	1	10
Tourism Office (Dinas Pariwisata) of Bima District	3	2	4	4	2	15
Tourism Office (Dinas Pariwisata) of Dompu District	2	3	4	4	2	15
Environmental Services (DLH) of Bima District	1	1	2	2	2	8
Environmental Services (DLH) of Dompu District	2	1	2	2	2	9
Tambora Geopark Executive Board (DP Geopark Tambora)	3	3	4	4	2	16
Center for Volcanology and Geological Hazard Mitigation (PVMBG)	2	1	2	3	2	10
District Police Station (Polres) of Bima	2	1	2	2	1	8
District Police Station (Polres) of Dompu	1	1	1	2	1	6
Military District Command (Kodim) of Bima	2	1	1	1	1	6
Military District Command (Kodim) of Dompu	2	1	1	1	1	6
Regional Agency for Disaster Management (BPBD)	2	1	1	2	1	7
Surrounding sub-districts of Mount Tambora (Sanggar, Pekat, Tambora, Kempo Sub-Districts)	3	2	4	4	4	17
Surrounding villages of Mount Tambora (Doropeti, Tambora, Kawinda Toi, Oi Katupa, Piong Villages)	5	2	4	5	5	21
Forest Ranger Partner Community (MMP)	5	2	4	4	4	19
Fire Care Community (MPA)	5	2	4	4	4	19
Citra Madu Lestari Group	5	2	4	5	5	21
Nature Lovers Groups (K-PATA, Algura, HUMPA)	5	2	4	4	4	19
Indonesian Mountain Guide Association (APGI) of Tambora	4	2	4	4	4	18
Indonesian Mountain Tour Guide (PWGI) Tambora	1	1	2	3	2	9
Agency of Application of Environmental and Forestry Instrument Standards (BSIP KLHK) Mataram	2	1	3	2	1	9
University of Mataram (UNRAM)	3	1	2	2	1	9
Sumbawa Techno Park	1	1	1	3	1	7
Research Innovation and Agency (BRIDA) of West Nusa Tenggara	1	1	1	2	1	6
HPH/HTI Companies (PT Sanggar Agro, PT UTL, PT SMS, PT AWB)	1	1	2	3	3	10
Gerilya NGO	3	1	3	2	1	10
Media Suara NTB, Dompu bicara	3	1	3	2	1	10

Note: K1 = Stakeholder’s involvement in the Tambora NP management; K2 = Stakeholder’s authority related to the Tambora NP management; K3 = Stakeholder’s programs related to the Tambora NP management ; K4 = Benefits of Tambora NP for stakeholders; K5 = The level of stakeholder's dependence related to the Tambora NP management. (Source: Primary data 2022)



**Figure 3.** Quadrant of stakeholder’s influence and interest related to the Tambora NP, Sumbawa Island, Indonesia management

Mapping the stakeholder categories can be an input in developing management strategies by paying attention to the role and position of each stakeholder. The quadrant I group is commonly the owners and other officeholders authorized to make decisions (Eden and Ackermann 1998). In this case, the Tambora NP Office is the officeholder who has the authority and responsibility for the Tambora NP management. Another stakeholder who also has the officeholder's role in the Mount Tambora area is the DP Geopark Tambora which has the authority and responsibility for managing the Tambora Geopark and the SAMOTA Biosphere Reserve, which included the Tambora NP area. From the local government side, the district tourism offices directly have the authority and responsibility related to tourism management in their administrative area, and Tambora NP is included in the administrative area of the Bima and Dompu Districts. In this regard, making Mount Tambora the leading destination for mountain tourism (Balai TN Tambora 2017) is the vision for the Tambora NP management, which is listed in the Tambora NP Long Term Management Plan document. While it will, in authority, influence the decision-making process, it is in line with the interest of the Bima and Dompu District Tourism Offices to develop tourism in their administrative areas.

Then, the quadrant II group commonly has little influence on a decision. However, it has interest and willingness to be actively involved (Eden and Ackermann 1998). In this case, stakeholders such as the surrounding villages of Mount Tambora, the Citra Madu Lestari group, Fire Care Community (MPA), Forest Ranger Partner Community (MMP), Nature Lovers Group (KPA), Indonesian Mountain Guide Association (APGI) of Tambora, and surrounding Sub-districts of Mount Tambora are actively involved in managing Tambora NP because of their interest in the potential of natural resources in the Tambora NP area. However, they do not have a tangible influence on a decision.

The quadrant III group commonly has the authority to make decisions but do not have the interest and willingness to be actively involved (Eden and Ackermann 1998). In this case, stakeholders such as BKSDA NTB, Balai PPI of Jabalnungsa, Provincial Environment and Forestry Service (Dinas LHK) of NTB, Provincial Tourism Office (Dispar Propinsi) of NTB, Development Planning Agency at Sub-National Level (Bappeda) of Bima District, Development Planning Agency at Sub-National Level (Bappeda) of Dompu District, Ecoregional Development Control Center (P3E) of Balinusra, Center for Implementation of Standards for Environmental and Forestry Instruments (BSIP), University of Mataram (UNRAM), and Watershed Management Agency (BPDAS) tend to be passive and wait for the primary stakeholders in the Tambora NP management. It is because although these stakeholders have influence in the decision-making in the Tambora NP management they are not specifically responsible on the management of Tambora NP.

The quadrant IV group is commonly not (and is not expected) to be actively involved, even do not know, and do not want to know (Eden and Ackermann 1998). In this case, such stakeholders wait for the primary stakeholders in the

Tambora NP management because they have a broader interests and not only specific to Tambora NP. These stakeholders include Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnungsa, Forest Area Consolidation Center (BPKH) of Denpasar, Regional Agency for Disaster Management (BPBD), Center for Volcanology and Geological Hazard Mitigation (PVMBG), Indonesian Mountain Tour Guide (PWGI) Tambora, Gerilya NGO, Media, District Police Station (Polres) of Bima, District Police Station (Polres) of Dompu, Military District Command (Kodim) of Bima, Military District Command (Kodim) of Dompu, Companies, Environmental Services (Dinas LH) of Bima District, Environmental Services (Dinas LH) of Dompu District, NTB Research Innovation and Agency (BRIDA NTB), and Sumbawa Techno Park. They tend to be passive and do not have a tangible influence on a decision.

### Relationship between stakeholders

The relationship between stakeholders and the Tambora NP management was assessed based on the communication, closeness, conflict, and trust among stakeholders (Wasserman and Faust 1994). The relationship between stakeholders in the social network was represented in the form of relationship matrix between stakeholders as depicted in Table 6.

Social relations were analyzed using the SNA approach based on the relationship matrix between stakeholders. SNA calculations were carried out using UCINET 6.755 software and for visualization of relationships using NetDraw 2.179 software (Borgatti et al. 2002). The outcome of visualization of the relationship between stakeholders is presented in Figure 4. The nodes in Figure 4 showed stakeholders related to Tambora NP with the size of the nodes resembling the strength of the stakeholders while the lines between nodes showed the stakeholders' relationships, outgoing relationships (out arrows), and incoming relationships (in arrows).

The levels of stakeholder's centrality and strength in the network were determined by measuring the levels of density, eigenvector centralities, degree centralities, closeness centralities and betweenness centralities. The density level was used to obtain an overview of the number of relationships given and received by each stakeholder to form the strength of the relationship density in the network. Ilham et al. (2016) stated that a complete network has a density level of 1 or 100%. The average density of the relationship (matrix average) calculations using UCINET 6.755 software is 0.153 or 15.3%. It showed that the relationship established in the entire network is not very high and tends to be concentrated in a few stakeholders or not evenly distributed to all stakeholders involved in the network.

The measurement of the relationship between stakeholders using Freeman's Centrality Metrics was based on the calculation of eigenvector centralities, degree centralities, closeness centralities, and betweenness centralities (Freeman 1979). The outcome of calculating the relationship between stakeholders using UCINET 6.755 software is presented in Table 7.

Eigenvector centralities show the weight of stakeholder centrality in a network. Based on Table 7, the eigenvector column showed that the Tambora NP Office is the stakeholder with the strongest eigenvector centralities value, namely 0.433. It shows that the Tambora NP Office is the central stakeholder in the network. It is reasonable because the Tambora NP Office is the primary stakeholder in the Tambora NP, so it has access to all stakeholders involved in the Tambora NP management. Other stakeholders with strong eigenvector centralities are the BKSDA NTB and KPH Tambora. The visualization of the power of stakeholder centrality is presented in Figure 5.

Degree centralities are the degree of stakeholder roles in the network. Stakeholders with a high degree of centrality indicate that these stakeholders have many relationships

with other stakeholders, both providing outgoing relationships (outdegree) and receiving incoming relationships (indegree). Based on Table 7, the outdegree column shows that four stakeholders have the most outgoing relationships, namely Tambora NP Office (34 relationships), BKSDA NTB (23), DP Geopark Tambora (14), and KPH Tambora (14). The visualization of the stakeholder’s outdegree strength is presented in Figure 6. Based on Table 7, the indegree column showed that five stakeholders have the most incoming relationships (indegree), namely Tambora NP Office (34 relationships), BKSDA NTB (22), DP Geopark Tambora (14), KPH Tambora (13), and Provincial Environment and Forestry Office (Dinas LHK Propinsi) (12). The visualization of the stakeholder’s indegree strength is presented in Figure 7.

**Table 6.** Matrix of relationships between stakeholders related to the Tambora NP, Sumbawa Island, Indonesia

Pemangku kepentingan	TN Tambora	BKSDA	P3E	BPDAS	GAKKUM	PPI	BPKH	Dis LHK Prop	KPH Tambora	BAPPEDA	BAPPEDA	DISPAR Prop	DISPAR Bima	DISPAR	LH Bima	LH Dompu	Geopark	PVMBG	Polres Bima	Polres Dompu	Kodim Bima	Kodim Dompu	BPBD	Kecamatan	Desa	MMP	MPA	Madu Lestari	KPA	APGI Tambora	PWGI Tambora	BSI	UNRAM	Sumbawa TP	BRIDA NTB	Perusahaan	LSM Gerilya	Media			
TN Tambora	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	1	1			
BKSDA	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1		
P3E	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
BPDAS	1	1	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GAKKUM	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PPI	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BPKH	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Dis LHK Prop	1	1	0	1	1	1	1	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
KPH Tambora	1	0	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BAPPEDA Bima	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BAPPEDA Dompu	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DISPAR Prop	1	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DISPAR Bima	1	1	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
DISPAR Dompu	1	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	
LH Bima	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
LH Dompu	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Geopark	1	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1		
PVMBG	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Polres Bima	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Polres Dompu	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Kodim Bima	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Kodim Dompu	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BPBD	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Kecamatan	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Desa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
MMP	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
MPA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Citra Madu Lestari	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
KPA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
APGI Tambora	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
PWGI Tambora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSI	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
UNRAM	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sumbawa Techno Park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
BRIDA NTB	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perusahaan	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
LSM Gerilya	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Media	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Note: 1 = There is relationship; 0 = No relationship. (Source: Primary data processed 2022)

**Table 7.** The calculation of relationship between stakeholders using UCINET 6.755 software

Stakeholder	Eigenvalue	Outdegree	Indegree	inCloseness	outCloseness	Betweenness
Tambora NP Office	0.433	34	34	93	93	796.615
NTB Natural Resources Conservation Agency (BKSDA NTB)	0.358	23	22	71	73	190.483
Ecoregional Development Control Center (P3E) of Balinusra	0.076	2	2	49	49	0.000
Watershed Management Agency (BPDAS)	0.177	7	4	51	53	0.617
Environmental and Forestry Security and Law Enforcement Agency (Balai GAKKUM) of Jabalnusra	0.129	4	4	51	51	0.083
Climate Change Control Agency (Balai PPI) of Jabalnusra	0.129	4	4	51	51	0.083
Forest Area Consolidation Center (BPKH) of Denpasar	0.129	4	4	51	51	0.083
Provincial Environment and Forestry Service (DLHK NTB)	0.249	11	12	60	59	26.097
Tambora Forest Management Unit (KPH Tambora)	0.312	14	13	61	62	44.550
Development Planning Agency at Sub-National Level (Bappeda) of Bima District	0.171	7	7	55	55	16.560
Development Planning Agency at Sub-National Level (Bappeda) of Dompu District	0.156	6	7	55	54	14.127
Provincial Tourism Office (Dinas Pariwisata) of West Nusa Tenggara	0.191	7	7	55	55	1.283
Tourism Office (Dinas Pariwisata) of Bima District	0.202	10	6	54	58	17.560
Tourism Office (Dinas Pariwisata) of Dompu District	0.201	10	6	54	58	17.560
Environmental Services (DLH) of Bima District	0.162	4	6	53	51	0.950
Environmental Services (DLH) of Dompu District	0.177	4	7	54	51	1.350
Tambora Geopark Executive Board (DP Geopark Tambora)	0.250	14	14	62	62	186.079
Center for Volcanology and Geological Hazard Mitigation (PVMBG)	0.046	2	2	49	49	0.000
District Police Station (Polres) of Bima	0.105	3	2	49	50	0.000
District Police Station (Polres) of Dompu	0.076	2	2	49	49	0.000
Military District Command (Kodim) of Bima	0.076	2	2	49	49	0.000
Military District Command (Kodim) of Dompu	0.076	2	2	49	49	0.000
Regional Agency for Disaster Management (BPBD)	0.046	2	2	49	49	0.000
Surrounding sub-districts of Mount Tambora (Sanggar, Pekat, Tambora, Kempo Sub-Districts)	0.157	5	6	53	51	4.417
Surrounding villages of Mount Tambora (Doropeti, Tambora, Kawinda Toi, Oi Katupa, Piong Villages)	0.146	4	8	54	51	7.000
Forest Ranger Partner Community (MMP)	0.061	3	3	50	50	0.000
Fire Care Community (MPA)	0.061	3	3	50	50	0.000
Citra Madu Lestari Group	0.041	1	1	49	49	0.000
Nature Lovers Group (KPA)	0.102	3	4	51	50	0.500
Indonesian Mountain Guide Association (APGI) of Tambora	0.090	2	4	51	49	0.000
Indonesian Mountain Tour Guide (PWGI) Tambora	0.062	1	3	39	39	0.000
Agency of Application of Environmental and Forestry Instrument Standards (BSIP KLHK) Mataram	0.076	2	2	49	49	0.000
University of Mataram (UNRAM)	0.099	3	3	52	52	0.000
Sumbawa Techno Park	0.024	1	1	39	39	0.000
Research Innovation and Agency (BRIDA) of West Nusa Tenggara	0.055	3	1	39	41	0.000
HPH/HTI Companies (PT Sanggar Agro, PT UTL, PT SMS, PT AWB)	0.071	2	1	49	49	0.000
Gerilya NGO	0.041	1	1	49	49	0.000
Media	0.099	3	3	52	52	0.000

Note: (Source Primary data processed 2022)



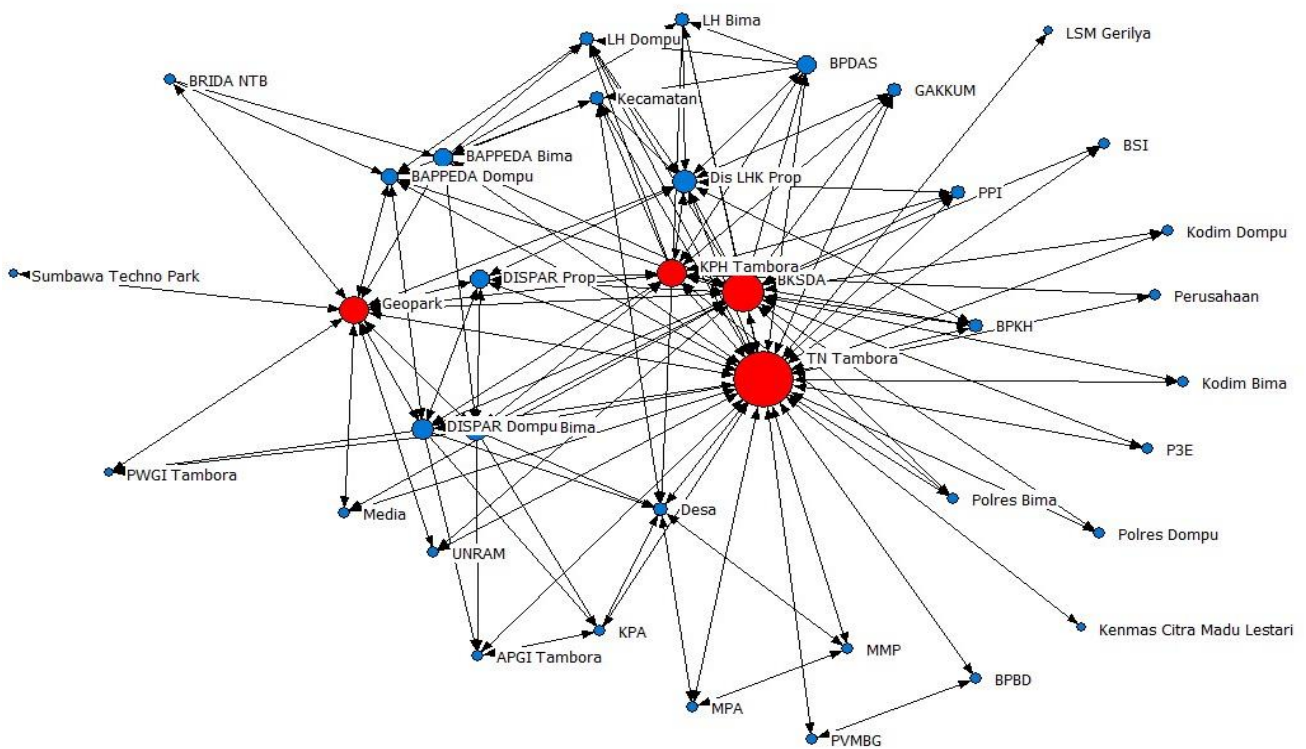


Figure 6. Visualization of the stakeholder's *outdegree* strength related to the Tambora NP, Sumbawa Island, Indonesia

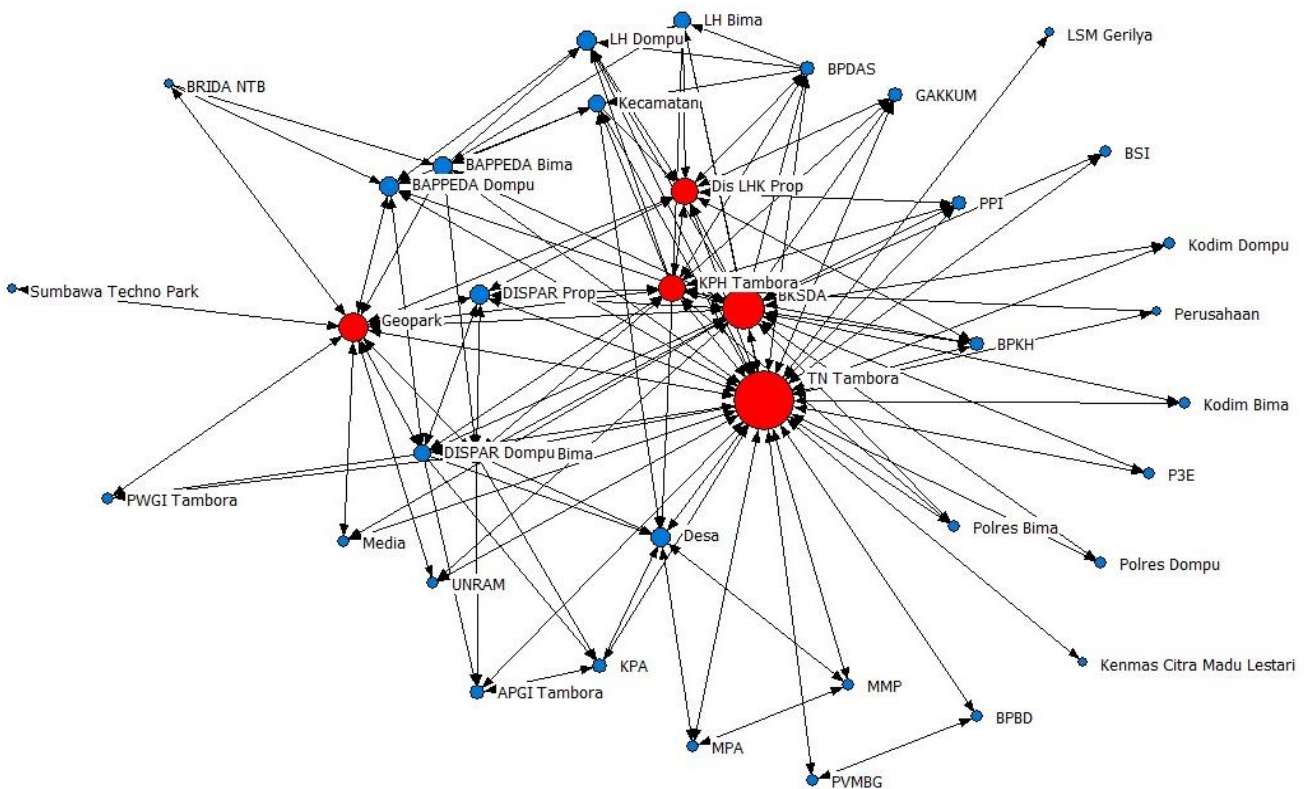


Figure 7. Visualization of the stakeholder's *indegree* strength related to the Tambora NP, Sumbawa Island, Indonesia

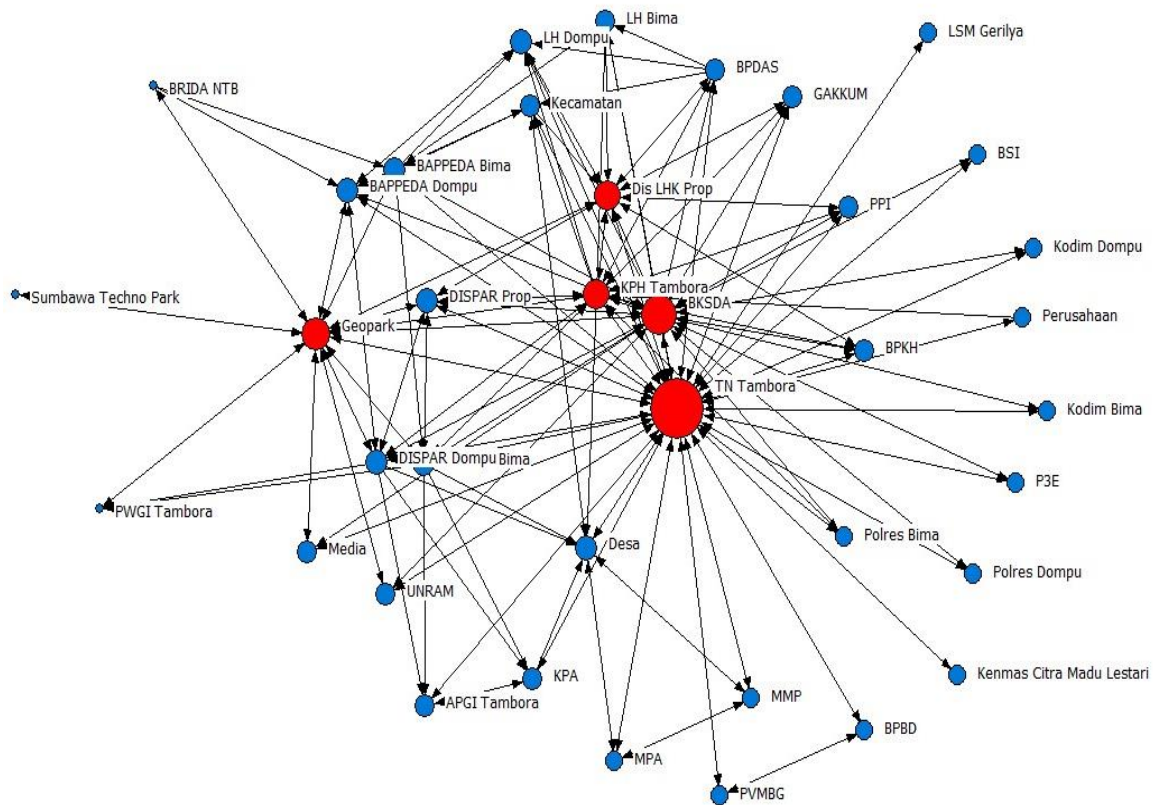
Closeness centralities are an affordable distance between stakeholders. With this proximity and where information and knowledge received by these stakeholders would influence how these stakeholders would be involved, it could be a measure of how far information could be spread from one stakeholder to another, whether it was the ease of receiving information (incloseness) or the ease of disseminating information (outcloseness) (Freeman 1979; Borgatti et al. 2002). Based on Table 7, the incloseness column showed that five stakeholders have the closest relationship in terms of ease of receiving information, namely Tambora NP Office (93 relationships), BKSDA NTB (71), DP Geopark Tambora (62), KPH Tambora (61), and Dinas Propinsi LHK (60). Visualization of the proximity of stakeholders in receiving information is presented in Figure 8. Based on Table 7, the outcloseness column shows that there are five stakeholders with the closest relationships in providing information, namely Tambora NP Office (93 relationships), BKSDA NTB (73), DP Geopark Tambora (62), and KPH Tambora (62), and Dinas Propinsi LHK (59). Visualization of the proximity of stakeholders in providing the information is presented in Figure 9.

Betweenness centralities are the ability of stakeholders to bridge other stakeholders. Stakeholders with betweenness centralities show the ability to control and facilitate communication of information flows among other stakeholders (Freeman 1979; Borgatti et al. 2002). Table 7 shows that the Tambora NP Office is the stakeholder with

the strongest betweenness centralities value, namely 796,615. It indicates that the Tambora NP Office is the most capable stakeholder for bridging other stakeholders. Other stakeholders with strong betweenness centralities include the BKSDA NTB and the DP Geopark Tambora. The visualization of stakeholders' ability to bridge with other stakeholders is presented in Figure 10.

**Discussion**

There are 38 stakeholders related to Tambora NP. These stakeholders were mapped based on their level of influence and interest; thus, each role and position could be identified. Identification and mapping of the stakeholders involved is crucial because it has the potential to affect the effectiveness of the protected area management (Nastran 2014; Mbaru and Barnes 2017; Giglio et al. 2019; Heslinga et al. 2019; Rasheed and Abdullah 2020). Management effectiveness is one of important elements in area-based conservation management practices to achieve optimal conservation outcomes (Hockings et al. 2019). The conservation outcomes can be measured from the protection of biodiversity contained in the conservation area and the socioeconomic impacts on the local community's lives around it (Wells and McShane 2004; Hockings et al. 2019). Furthermore, the impacts on local communities as resource users should be a major component in assessing the effectiveness of protected areas (Webb et al. 2004).



**Figure 8.** Visualization of the proximity of stakeholders in receiving information related to the Tambora NP, Sumbawa Island, Indonesia



Tambora NP Office is the main stakeholder responsible for managing the Tambora NP; hence, it has the highest influence and interest. It is reasonable because the Tambora NP Office is a central government agency that manages the Tambora NP, where almost all initiatives and activities are carried out and funded by central government (Pattiro 2020). Since it is newly established, the Tambora NP Office has many limitations, especially human resources, funds and infrastructure, requiring support and involvement of stakeholders, especially the local government and the community. The number of human resources of Tambora NP Office in 2020 consisted of 33 people which 16 people worked in six resorts or fields. Appleton et al. (2022) stated that the ratio of the number of rangers should be one person per 1,300 hectares. This means that 55 rangers are minimally required to cover an area of 71,645.64 ha in Tambora NP. Therefore, it can be implied that the number of Tambora NP management personnel is still insufficient for the effective management since adequate human resources is an essential element in achieving management goals (Geldmann et al. 2018; Graham et al. 2021; Powlen et al. 2021). When established in 2016, funding for the management of Tambora NP was still lacking, namely USD 0.73/ha. Then, it increased to USD 14.18/ha in 2017 and became USD 21.24/ha in 2018. It fell again in 2019 to USD 9.27/ha (KSDAE 2020). Jefferson (2014) estimated that protected areas in Indonesia require an average conservation funding of USD 18.6/ha per year in 2010-2020. According this number, the protected areas in Indonesia is insufficiently funded; thus, it must be increased by approximately four times from the 2019 budget. New policies involving other stakeholders, such as public-private partnerships and more innovative funding mechanisms, could be implemented to close the funding gap (Bitariho et al. 2022). In addition, funding fluctuations occur due to budget policies; hence, there is no certainty of adequate funding. Despite inadequate funding, protected areas play a major role in biodiversity protection (Leverington 2010). However, increased funding would directly improve the national parks' capacity in protecting biodiversity (Bruner et al. 2001; Geldmann et al. 2015; Feng et al. 2021; Graham et al. 2021). These limitations have caused the Tambora NP Office to collaborate with other stakeholders (Berardo et al. 2014).

The 38 stakeholders related to Tambora NP form a social network with one another. However, the relationships in the entire network are weak, and the network is still concentrated in a few stakeholders, namely the Tambora NP Office, the BKSD NTB, the DP Geopark Tambora, and the KPH Tambora. Meanwhile, the four stakeholders and the Dinas Propinsi LHK dominate the incoming relationships. These stakeholders also dominate the closeness between stakeholders, both in receiving and providing information; thus, the information flow is not spread evenly (Prayudi 2020). The relationship between stakeholders is unclear or disconnected, and the involvement of stakeholders is unbalanced or unequal; hence, the achievement of objectives and management of the protected areas is also unclear (Cárcamo et al. 2014; Havard et al. 2015; Mbaru and Barnes 2017; Katikiro et al. 2021).

Improving the relationship and communication between Tambora NP Office and stakeholders is important to gain local community support in decision-making (Bennett and Dearden 2014). Making management decisions would be more effective through participatory approach that could influence community actions, including activities that could threaten biodiversity in the protected areas (Nita et al. 2017; Albert 2022). The network gaps among stakeholders and uneven levels of knowledge and information could be overcome if stakeholders could bridge other stakeholders to facilitate the flow of information and communication (Rastogi et al. 2010; Prayudi 2020). The analysis shows that the Tambora NP Office is the most potential to bridge other stakeholders along with the BKSDA NTB and the DP Geopark Tambora. Mapping stakeholder strengths and relationships among stakeholders with a measurable social network analysis are important for the government to understand the stakeholders with their roles and positions (Petursson and Kristofersson 2021). More large-scale natural resource conservation initiatives adopt this networked governance framework; thus, it has the potential to enhance management effectiveness by encouraging collaborative management (Bixler et al. 2016). When the management process with a top-down traditional government approach encountering difficulties in effectively managing and preserving ecosystems, governance arrangements are needed that encourage multi-stakeholder collaboration (Bodin et al. 2016). In the future, appropriate management strategies need to be developed based on input from identifying and mapping stakeholders and their relationship. It is a new thing to apply in managing the protected areas in Indonesia; hence, the effectiveness of management to achieve management goals and governance becomes clearer.

In conclusion, 38 stakeholders related to the Tambora NP are identified in this study. Among them, the Tambora NP Office is the primary stakeholder responsible for managing Tambora NP. Relationship formed in the whole network is not very strong. Network is still concentrated among several stakeholders and not evenly distributed to all stakeholders related to Tambora NP. Therefore, we recommend that the research results in the form of information about stakeholders and relationships between stakeholders can be used to formulate better collaborative management strategies by integrating various interests.

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## REFERENCES

- Abbas R. 2005. Mekanisme Perencanaan Partisipasi Stakeholder Taman Nasional Gunung Rinjani. [Dissertation]. Institut Pertanian Bogor, Bogor. [Indonesian]
- Adams WM, Hutton J. 2007. People, parks and poverty: Political ecology and biodiversity conservation. *Conserv Soc* 5 (2): 147-183.

- Albert HJ. 2022. Protected area network expansion and management: Economics to improve conservation outcomes. *Environ Resource Econ* 83 (4): 955-972. DOI: 10.1007/s10640-022-00653-6.
- Appleton MR, Courtiol A, Emerton L, Slade J, Tilker A, Warr LC, Malvido MÁ, Barborak JR, de Bruin L, Chapple R., Daltry JC, Hadley NP, Jordan CA, Rousset F, Singh R, Sterling EJ, Wessling EG, Long B. 2022. Protected area personnel and ranger numbers are insufficient to deliver global expectations. *Nat Sustain* 5 (12): 1100-1110. DOI: 10.1038/s41893-022-00970-0.
- Balai TN Tambora (Tambora National Park Office). 2017. Tambora National Park Long Term Management Plan for the 2018-2027 Period. Balai TN Tambora, Dompu. [Indonesian]
- Behringer W. 2017. Climate and history: Hunger, anti-semitism, and reform during the Tambora crisis of 1815-1820 In: Lederer D (eds). *German History in Global and Transnational Perspective*. Palgrave Pivot, London. DOI: 10.1057/978-1-137-53063-9\_2.
- Bennett NJ, Dearden P. 2014. Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Mar Pol* 44: 107-116. DOI: 10.1016/j.marpol.2013.08.017.
- Berardo R, Heikkilä T, Gerlak AK. 2014. Interorganizational engagement in collaborative environmental management: Evidence from the South Florida ecosystem restoration task force. *J Public Adm Res Theory* 24 (3): 697-719. DOI: 10.1093/jopart/muu003.
- Bitariho R, Akampurira E, Mugerwa B. 2022. Long-term funding of community projects has contributed to mitigation of illegal activities within a premier African protected area, Bwindi impenetrable National Park, Uganda. *Conserv Sci Pract* 4 (9): e12761. DOI: 10.1111/csp2.12761.
- Bixler RP, Wald DM, Ogden LA, Leong KM, Johnston EW, Romolini M. 2016. Network governance for large-scale natural resource conservation and the challenge of capture. *Front Ecol Environ* 14 (3): 165-171. DOI: 10.1002/fee.1252.
- Bodin Ö, Robins G, McAllister RRJ, Guerrero AM, Crona B, Tengö M, Lubell M. 2016. Theorizing benefits and constraints in collaborative environmental governance: A transdisciplinary social-ecological network approach for empirical investigations. *Ecol Soc* 21 (1): 40. DOI: 10.5751/ES-08368-210140.
- Borgatti SP, Everett MG, Freeman LC. 2002. *Ucinet 6 for Windows: Software for Social Network Analysis*. Harvard, Massachusetts.
- Bruner AG, Gullison RE, Rice RE, Da Fonseca GAB. 2001. Effectiveness of parks in protecting tropical biodiversity. *Science* 80-291 (5501): 125-128. DOI: 10.1126/science.291.5501.125.
- Cárcamo PF, Garay-Flühmann R, Gaymer CF. 2014. Collaboration and knowledge networks in coastal resources management: How critical stakeholders interact for multiple-use marine protected area implementation. *Ocean Coast Manag* 91: 5-16. DOI: 10.1016/j.ocecoaman.2014.01.007.
- Chaffin BC, Gosnell H, Cosens BA. 2014. A decade of adaptive governance scholarship: Synthesis and future directions. *Ecol Soc* 19: 56. DOI: 10.5751/ES-06824-190356.
- Chung LW, Chao CL, Liao MC, Kao CW, Lu DJ. 2023. Effectiveness and appropriateness of core areas in an integrated protected area: A case study of Ecological Protected Areas in Yangmingshan National Park, Taiwan. *Environ Sci Pol* 145: 175-187. DOI: 10.1016/J.ENVSCL.2023.04.012.
- Coelho JMG, Biju BP, Silva Neto EC da, Oliveira AL de, Tavares AA de O, Basso VM, Turetta APD, Carvalho AG de, Sansevero JBB. 2020. Improving the management effectiveness and decision-making by stakeholders' perspectives: A case study in a protected area from the Brazilian Atlantic Forest. *J Environ Manag* 272: 111083. DOI: 10.1016/j.jenvman.2020.111083.
- Eden C, Ackermann F. 1998. *Making Strategy: The Journey of Strategic Management*. Sage Publications, London. DOI: 10.4135/9781446217153.
- Feng C, Cao M, Wang W, Wang H, Liu F, Zhang L, Du J, Zhou Y, Huang W, Li J. 2021. Which management measures lead to better performance of China's protected areas in reducing forest loss? *Sci Tot Environ* 764. DOI: 10.1016/j.scitotenv.2020.142895.
- Freeman LC. 1979. Centrality in social networks conceptual clarification. *Soc Netw* 1: 215-239. DOI: 10.1016/0378-8733(78)90021-7.
- Geldmann J, Coad L, Barnes MD, Craigie ID, Hockings M, Knights K, Leverington F, Cuadros IC, Zamora C, Woodley S, Burgess ND. 2015. Changes in protected area management effectiveness over time: A global analysis. *Biol Conserv* 191: 692-699. DOI: 10.1016/j.biocon.2015.08.029.
- Geldmann J, Coad L, Barnes MD, Craigie ID, Woodley S, Balmford A, Brooks TM, Hockings M, Knights K, Mascia MB, McRae L, Brugges ND. 2018. A global analysis of management capacity and ecological outcomes in terrestrial protected areas. *Conserv Lett* 11 (3): e12434. DOI: 10.1111/conl.12434.
- Giglio VJ, Moura RL, Gibran FZ, Rossi LC, Banzato BM, Corsso JT, Pereira-Filho GH, Motta FS. 2019. Do managers and stakeholders have congruent perceptions on marine protected area management effectiveness? *Ocean Coast Manag* 179 March: 104865. DOI: 10.1016/j.ocecoaman.2019.104865.
- Gong M, Fan Z, Zhang X, Liu G, Wen W, Zhang L. 2017. Measuring the effectiveness of protected area management by comparing habitat utilization and threat dynamics. *Biol Conserv* 210: 253-260. dDOI: 10.1016/j.biocon.2017.04.027.
- Graham V, Geldmann J, Adams VM, Grech A, Deinet S, Chang H-C. 2021. Management resourcing and government transparency are key drivers of biodiversity outcomes in Southeast Asian protected areas. *Biol Conserv* 253: 108875. DOI: 10.1016/j.biocon.2020.108875.
- Havard L, Brigand L, Cariño M. 2015. Stakeholder participation in decision-making processes for marine and coastal protected areas: Case studies of the south-western Gulf of California, Mexico. *Ocean Coast Manag* 116: 116-131. DOI: 10.1016/j.ocecoaman.2015.06.017.
- Heslinga J, Groot P, Vanclay F. 2019. Strengthening governance processes to improve benefit-sharing from tourism in protected areas by using stakeholder analysis. *J Sustain Tour* 27 (6): 773-787. DOI: 10.1080/09669582.2017.1408635.
- Hockings M, Hardcastle J, Woodley S, Sandwith T, Wilson J, Bammert M, Valenzuela S, Chataigner B, Lefebvre T, Leverington F, Lopoukhine N, MacKinnon K, Londoño JM. 2019. The IUCN green list of protected and conserved areas: Setting the standard for effective area-based conservation. *Parks* 25 (2): 57-66. DOI: 10.2305/IUCN.CH.2019.PARKAS-25-2MH.en.
- Ihsannudin, Anriyandarti E. 2022. Stakeholder participation in conservation of yellow-crested cockatoo (*Cacatua sulphurea abbotti*) and its habitat in Masakambang Island, Indonesia. *Biodiversitas* 23 (8): 3950-3959. DOI: 10.13057/biodiv/d230812.
- Ilham QP, Purnomo H, Nugroho T. 2016. Analisis pemangku kepentingan dan jaringan sosial menuju pengelolaan multipihak di Kabupaten Solok, Sumatera Barat. *Jurnal Ilmu Pertanian Indonesia* 21 (2): 114-119. DOI: 10.18343/jipi.21.2.114. [Indonesian]
- Izurita A, Sithole B, Stacey N, Hunter-Xenie, Campbell B, Donohoe P, Brown J, Wilson L. 2011. Developing indicators for monitoring and evaluating joint management effectiveness in protected areas in the Northern Territory, Australia. *Ecol Soci* 16 (3): 9. DOI: 10.5751/ES-04274-160309.
- Jefferson J. 2014. *Strategi Mobilisasi Pendanaan Keanekaragaman Hayati Indonesia*. [https://ksdae.menlhk.go.id/assets/publikasi/Buku\\_IBSAP%202015-2020.pdf](https://ksdae.menlhk.go.id/assets/publikasi/Buku_IBSAP%202015-2020.pdf). [Indonesian]
- Katikiro RE, Kweka OL, Minja R, Namkesa F, Ponte S. 2021. Stakeholder engagement and conservation outcomes in marine protected areas: Lessons from the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) in Tanzania. *Ocean Coast Manag* 2020: 105502. DOI: 10.1016/j.ocecoaman.2020.105502.
- KSDAE (Conservation of Natural Resources and Ecosystems Ministry of Environment and Forestry). 2020. *Statistics of the Directorate General of Natural Resources and Ecosystem Conservation for 2019*. Jakarta: Directorate General of KSDAE. [Indonesian]
- Kusumawati I, Huang HW. 2015. Key factors for successful management of marine protected areas: A comparison of stakeholders' perception of two MPAs in Weh island, Sabang, Aceh, Indonesia. *Mar Pol* 51: 465-475. DOI: 10.1016/j.marpol.2014.09.029.
- Leverington F. 2010. A global analysis of protected area management effectiveness. *Environ Manag* 46: 685-98. DOI: 10.1007/s00267-010-9564-5.
- Lucrezi S, Esfehiani MH, Ferretti E, Cerrano C. 2019. The effects of stakeholder education and capacity building in marine protected areas: A case study from southern Mozambique. *Mar Pol* 108: 103645. DOI: 10.1016/j.marpol.2019.103645.
- Mbaru EK, Barnes ML. 2017. Key players in conservation diffusion: Using social network analysis to identify critical injection points. *Biol Conserv* 210: 222-232. DOI: 10.1016/j.biocon.2017.03.031.
- Miller KR, Hamilton LS. 1999. Future steps. *Parks* 9 (3): 46-49.
- Muntasib H, Rahayuningsih T, Aminsyah A. 2021. Identification of Stakeholders and Their Roles in Ecotourism Hazard Management in Mount Rinjani National Park. *Media Konserv* 26 (1): 28-35. DOI: 10.29244/medkon.26.1.28-35.

- Nastran M. 2014. Stakeholder analysis in a protected natural park: Case study from Slovenia. *J Environ Plan Manag* 57 (9): 1359-1380. DOI: 10.1080/09640568.2013.808608.
- Nita A, Ciocanea CM, Manolache S, Rozyłowicz L. 2017. A social network approach to diagnose public participation in protected areas management insights from a natura 2000 case study. *Proceedings of the 2017 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining, ASONAM 2017*, 771-774. DOI: 10.1145/3110025.3110124.
- Nugroho AW, Sari UK. 2023. Stakeholder Identification for collaborative management of ecotourism and proboscis conservation. *Intl J Conserv Sci* 14 (2): 713-730. DOI: 10.36868/IJCS.2023.02.23.
- Oldekop JA, Holmes G, Harris WE, Evans KL. 2016. A global assessment of the social and conservation outcomes of protected areas. *Conserv Biol* 30 (1): 133-141. DOI: 10.1111/cobi.12568.
- PATTIRO (Pusat Telaah dan Informasi Regional). 2020. Badan Layanan Umum Taman Nasional untuk Pengelolaan Kawasan Konservasi Berkelanjutan. PATTIRO, Jakarta. [Indonesian]
- Pemprov NTB (West Nusa Tenggara Provincial Government). 2016. Mount Tambora Geopark, Proposal Document to Become a National Geopark and Membership in the 2017 Indonesian National Geopark Network. Pemprov NTB, Mataram. [Indonesian]
- Petursson JG, Kristofersson DM. 2021. Co-management of protected areas: A governance system analysis of Vatnajökull National Park, Iceland. *Land* 10 (7): 681. DOI: 10.3390/land10070681.
- Powlen KA, Gavin MC, Jones KW. 2021. Management effectiveness positively influences forest conservation outcomes in protected areas. *Biol Conserv* 260: 109192. DOI: 10.1016/j.biocon.2021.109192.
- Prayudi Y. 2020. Penerapan Tools Ucinet untuk Social Network Analysis guna mendapatkan pola interaksi manusia pada organisasi. <https://dspace.uui.ac.id/bitstream/handle/123456789/29735/14523287/BimoPratBim.pdf?sequence=1&isAllowed=y>. [Indonesian]
- Rasheed AR, Abdulla A. 2020. Evaluating stakeholder participatory processes in policy development for Marine Protected Areas. *Mar Pol* 112: 103737. DOI: 10.1016/j.marpol.2019.103737.
- Rastogi A, Badola R, Hussain SA, Hickey GM. 2010. Assessing the utility of stakeholder analysis to Protected Areas management: The case of Corbett National Park, India. *Biol Conserv* 143 (12): 2956-2964. DOI: 10.1016/j.biocon.2010.04.039.
- Reed SM, Graves A, Dandy N, Posthumus H, Huback K, Morris J, Prell CH, Quin CH, Stringer LC. 2009. Who's in and why? A typology of stakeholder analysis methods for natural resources management. *J Environ Manag* 30: 1-17. DOI: 10.1016/j.jenvman.2009.01.001.
- Rodrigues ASL, Cazalis V. 2020. The multifaceted challenge of evaluating protected area effectiveness. *Nat Commun* 11 (1): 5147. DOI: 10.1038/s41467-020-18989-2.
- Sabar A, Maulany RI, Yusran, Kurniawan A, Rahmatullah RA, Syam MA, Syawal MA, Halis A, Rafiadi MT. 2023. Stakeholder and social networks analysis of conservation partnership in Bantimurung Bulusaraung National Park, South Sulawesi, Indonesia. *Biodiversitas* 24 (2): 1017-1024. DOI: 10.13057/biodiv/d240242.
- Sagie H, Orenstein DE. 2022. Benefits of Stakeholder integration in an ecosystem services assessment of Mount Carmel Biosphere Reserve, Israel. *Ecosyst Serv* 53: 101404. DOI: 10.1016/j.ecoser.2021.101404.
- Saout LS, Hoffmann M, Shi Y, Hughes A, Bernard C, Brooks TM, Bertzky B, Butchart SHM, Stuart SN, Badman T, Rodrigues ASL. 2013. Protected areas and effective biodiversity conservation. *Science* 342 (6160): 803-805. DOI: 10.1126/science.1239268.
- Sobhani P, Esmaeilzadeh H, Sadeghi SMM, Wolf ID, Deljouei A. 2022. Relationship analysis of local community participation in sustainable ecotourism development in protected areas, Iran. *Land* 11 (10): 1871. DOI: 10.3390/land11101871.
- Stacey N, Izurieta A, Garnett ST. 2013. Collaborative measurement of performance of jointly managed protected areas in northern Australia. *Ecol Soc* 18 (1): 19. DOI: 10.5751/ES-05273-180119.
- Sutawidjaja IS, Sigurdsson H, Abrams L. 2006. Characterization of volcanic deposits and geoarchaeological studies from the 1815 eruption of Tambora volcano. *J Geosci* 1 (1): 49-57. DOI: 10.17014/ijog.1.1.49-57.
- Wasserman S, Faust F. 1994. *Social Network Analysis: Methods and Applications*. Cambridge University Press, Cambridge. DOI: 10.1017/CBO9780511815478.
- Webb EL, Maliao RJ, Siar SV. 2004. Using local user perceptions to evaluate outcomes of protected area management in the Sagay Marine Reserve, Philippines. *Environ Conserv* 31 (2): 138-148. DOI: 10.1017/S0376892904001377.
- Wells MP, McShane TO. 2004. Integrating protected area management with local needs and aspirations. *AMBIO: J Human Environ* 33 (8): 513-519. DOI: 10.1579/0044-7447-33.8.513.
- West P, Igoe J, Brockington D. 2006. Parks and peoples: The social impact of protected areas. *Ann Rev Anthropol* 35: 251-277. DOI: 10.1146/annurev.anthro.35.081705.123308.
- Wiratno W, Withaningsih S, Gunawan B, Iskandar J. 2022. Ecotourism as a resource sharing strategy: Case study of community-based ecotourism at the Tangkahan Buffer Zone of Leuser National Park, Langkat District, North Sumatra, Indonesia. *Sustainability (Switzerland)* 14 (6): 1-18. DOI: 10.3390/su14063399.
- World Bank 1999. Report from the International Workshop on Community-Based natural Resource Management (CBNRM), Washington DC, 10-14 May 1998. <http://www.worldbank.org/wbi/conatrem/>