

Vegetation diversity, structure and composition in nature-based recreation sites as a potential tourist attraction in Banyuwangi, Indonesia

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Abstract. *Habibah LN, Hakim L, Pangestuti E, Siswanto D, Rahardi B. 2024. Vegetation diversity, structure and composition in nature-based recreation sites as a potential tourist attraction in Banyuwangi, Indonesia. Biodiversitas 25: 3273-3285.* The presence of vegetation in nature-based tourism sites plays an important role in adding natural scenic beauty and creating comfortable local climates. However, the potential of vegetation in the recreation landscape for conservation and educational aspects is less studied. This research aims to identify vegetation diversity, structure and composition of plant species in nature-based tourism recreation sites in Banyuwangi District, East Java. Vegetation survey was conducted at 16 recreation sites, ranging from coastal to lower mountain ecosystems with varying management types from national parks, state and privately owned enterprises and community-private ownerships. Research shows that recreation sites contain diverse plant species that can support nature-based tourism attractions. The recreation sites in the national parks harbor native vegetation in, which it is important for biodiversity education through nature-based tourism programs. Fewer exotic plant species are found in nature-based recreation sites, especially in conservation areas. Conversely, nature-based recreation sites managed by community and private are dominated by exotic plant species. The existence of exotic plant species in nature-based recreation sites can add economic value by providing agrotourism activities, yet it requires special attention to protect the native habitats in those sites.

Keywords: Attraction, conservation, edutourism, exotic species, vegetation

Abbreviations: NBT: Nature-Based Tourism, IVI: Important Value Index, D: Dominance index, E: Evenness index, DBH: Diameter at Breast Height, SOE: State-Owned Enterprise

INTRODUCTION

Natural vegetation is one of the crucial resources in ecotourism or nature-based recreation (Fyall et al. 2022). Nature-based recreation is a type of tourism with the main objective to experience nature in areas with abundant vegetation. With its abundance and unique natural vegetation, Indonesia offers many nature-based recreation sites with unique vegetation structure and composition, ranging from coastal to sub-alps ecosystems. In 2022, international visitors arriving in Indonesia increased three times than 2021, reaching 3.3 million by air (55.97%), 1.73 million by sea (29.32%), and 0.87 million by land (14.71%). Most of them were reported to visit natural areas (Central Statistic Agency 2022). The growth of the tourism sector in Indonesia significantly contributes to economic earnings in many areas. Tourism provides many benefits to support local community development, ranging from providing jobs to stimulating economic growth. In the Indonesian tourism industry, the trend to visit natural environment has grown significantly. This positive trend has become the momentum for local economic development and nature conservation (Hakim and Soemarno 2017).

The positive development of tourism faces serious problems related to nature conservation. There have recently been identified many threats to the tourism industry, ranging from social, economic, and environmental problems (Weaver 2007). Climate change is one of the significant problems in the tourism industry (Gössling and Scott 2008). For example, during 2009-2021, there were an increased number of accumulated climate disasters, such as floods, land slides, drought, and climate extreme, totaling 92 disaster events and resulting 26.799 victims (The National Disaster Management Agency 2024). Many countries have tried to formulate policies and strategies in the tourism sector in response to climate change issues such as green subsidies, green loans, green financing, and cultural and social policies (Jane Luzar et al. 1995; Shang et al. 2023). One example of management strategies to mitigate climate change in tourism industry is by maintaining the existence of vegetation due to its importance in storing carbon and maintaining local climates by calming the high temperatures and providing outdoor thermal comfort. Unfortunately, the aspect of vegetation in nature-based recreation sites is rarely discussed in tourism development. In some cases, mass

tourism development has damaged the trees and vegetation by replacing them with modern and built infrastructures. Considering this problem, increasing awareness of vegetation conservation is crucial in sustaining nature-based tourism recreation sites (Pickering and Hill 2007; Hill and Gale 2009; Majeed et al. 2022; Meili et al. 2021).

In each natural and human-influenced area, there is a broad range of types and conditions of vegetation in terms of structure and composition. Environmental variables, such as climate and altitude, determine vegetation structure, composition, and species diversity. Further, anthropogenic activities ultimately affect vegetation in human-influenced areas. Humans use plants and modify landscapes to support and sustain their living, especially in settlement areas. Many plants have been introduced in new geographical areas as agricultural crops. In addition, ornamental exotic plants have been also introduced to improve environmental beauty of gardens and recreation sites. The introduction of ornamental exotic plant species in nature-based recreation sites potentially contributes to the native ecosystem degradation, thus monitoring and evaluation of exotic plant species are prerequisites in nature-based recreation sites (Pickering and Hill 2007; Hakim 2017b; Hakim et al. 2019).

Banyuwangi District, East Java, Indonesia is home to mega biodiversity which also has great potential in tourism sector. The socio-cultural uniqueness, the beauty of natural landscape and seascape, and the presence of several conservation areas are the main tourist attractions in this region (Hakim 2017a; Febrian et al. 2023). Nowadays, Banyuwangi has witnessed the increasing trends of massive tourism development, however, the potential of vegetation as a tourism attraction has been rarely discussed. The existence of vegetation in recreation sites is crucial for several purposes, ranging from the natural scenic beauty, and comfortable climates, to natural disaster mitigation. The development of tourism in natural area with diverse vegetation in Banyuwangi is supported by the existence of Ijen Global Geopark program and Blambangan Biosphere Reserve. Ijen Geopark was declared by UNESCO in 2016. This status is crucial for Banyuwangi to promote a sustainable tourism industry in the eastern area of East Java (Hakim 2017a; Febrian et al. 2023).

The basic data on vegetation in nature-based recreation sites are prerequisites to support ecotourism programs, especially in terms of nature conservation and environmental education. Providing material for biodiversity education is crucial in ecotourism for visitors to increase biodiversity knowledge and awareness (Powell and Ham 2008; Hakim 2017b; Juma et al. 2020). There are various types of vegetation occurring on various ecosystems in Banyuwangi from coastal, lowland tropical forests, agroforestry systems, and rural settlements with different diversity, structures and compositions (Hakim 2017a). This diversity offers potential resources for edutourism, yet the assessment of vegetation in nature-based tourism has not been broadly mapped. Therefore, this study aims to identify vegetation structure and local plant species in nature-based tourism recreation sites in Banyuwangi District, East Java. The results of this study might be useful to extend the opportunity of tourist attractions in the region.

MATERIALS AND METHODS

Study area

The field survey was conducted in Banyuwangi District, East Java Province, Indonesia. The district has biodiversity importance since there are several conservation areas in Banyuwangi such as Ijen Nature Reserve in the west, Alas Purwo National Park, and Meru Betiri National Park in the southern region (Hakim et al. 2022). Banyuwangi District is a semi-dry region with an average monthly rainfall of 153.47 mm with an average minimum and maximum temperature ranging between 22.05°C and 32.80°C (Central Statistic Agency 2023). Banyuwangi is rich in natural and cultural diversities, making this district attractive to be visited by both domestic and international tourists. Local government supports tourism development seriously through many attractions accommodation and accessibility improvement. Nature-based tourism area in Banyuwangi District has been managed by smallholder community groups, private sector, and government. In this study, 16 nature-based tourism areas were visited and field research was conducted to collect data. These recreation sites were located in diverse ecosystem types, ranging from lowland to mountainous areas (Figure 1).

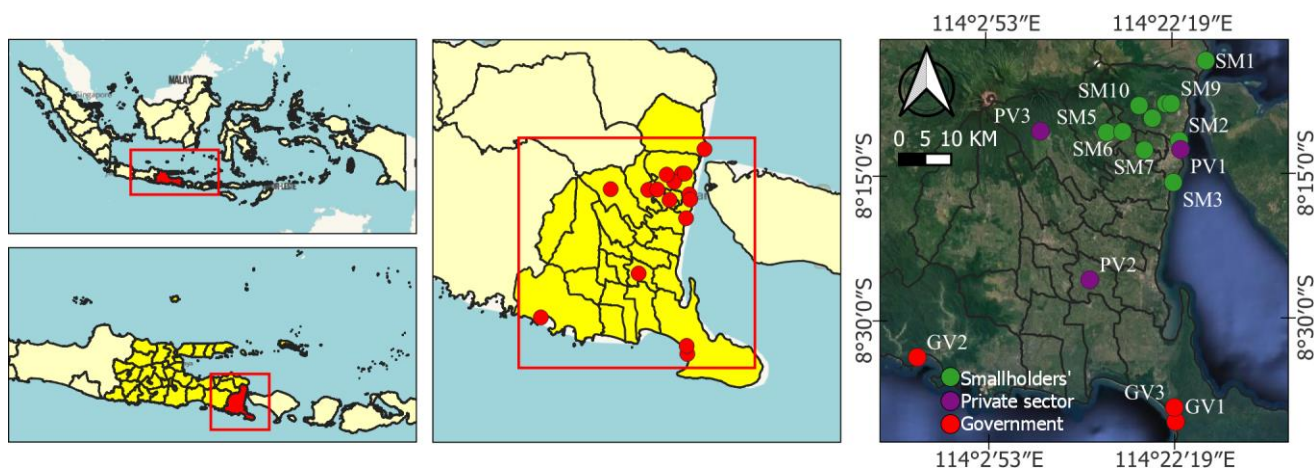


Figure 1. The distribution of the sampling areas in Banyuwangi District, East Java, Indonesia

Data collection

Field surveys were performed from August 2023 to February 2024 to collect data on plant vegetation structure and composition across 16 sampling sites in Banyuwangi District, ranging from coastal to highland areas. In each site, vegetation sampling was conducted by establishing five quadratic plots with size of 20×20 m plot for trees (woody plants with a Diameter at Breast Height (DBH) of >20 cm) and 5×5 m for shrubs (woody plants with a DBH of <20 cm). Plant identification was conducted based on local people's knowledge of plant species, then further examined and cross-check the morphological characteristics and identified the correct name of plant species using online sources references, such as The Plant List (www.theplantlist.org), Grin Global (<https://npgsweb.ars-grin.gov>), and Royal Botanic Garden Plants (<https://powo.science.kew.org>).

Data analysis

The abundance of each species found in the research area was calculated to analyze vegetation structures, such as Diversity Index (H'), Important Value Index (IVI), Dominance Index (D), and Evenness Index (E) using the following equations (Fachrul, 2007; Majeed et al. 2022):

Density

Dominance = number of species i / total plot

Relative Dominance (RD) = total number of species i / total number all species × 100%

Frequency

Frequency = number plot of species i / total plot

Relative frequency (RF) = frequency of species i / total frequency all species × 100%

Dominance

Dominance = total area of species i / total area

Relative Dominance (RDo) = dominance of species i / total dominance all species × 100%

Important Value Index (IVI)

$VI = RD + RF + RDo$

Diversity Index Shannon-Wiener (H')

$H' = -\sum[(n_i/N) \times \ln(n_i/N)]$

Where: H' = Shannon-Wiener diversity index; n_i = number of species i ; N = total species.

Evenness Index (E)

$E = H' / H_{\max}$

Where: E = Evenness index; $H_{\max} = 2 \cdot \log S$; H' - Shannon-Wiener value.

Simpson Dominance Index (D')

$D' = (IVI_i / \sum IVI)^2$

Where: D' -Dominance index; IVI_i -IVI number of species i ; $\sum IVI$ -total IVI number.

RESULTS AND DISCUSSION

Overview of nature-based recreation in Banyuwangi

Banyuwangi District has experienced significant growth in natural-based tourism. Flock of tourists visit many recreation sites in highland, lowland, and marine areas. This study selected 16 nature-based recreation sites under three management types, namely recreation sites managed by the government (three sites), state and private-owned enterprises (SOEs) (three sites), and community or personals (ten sites) (Table 1). Three recreation sites managed by the government are part of the conservation areas: the Alas Purwo National Park and Meru Betiri National Park, which are favorite nature-based tourism destinations, visited by both local and international tourists. Some Indonesian SOEs have many places and forest areas with vegetation resources to support nature-based tourism destinations in Banyuwangi, including Boom Beach, De Djawatan, and Telunjuk Raung which also have been visited both by national and international tourists. The abundance of natural and cultural resources in community or privately owned areas also has the potential for tourism development. The local community began to build nature-based tourism destinations.

National parks in Banyuwangi host diverse ecosystems ranging from forests, mountains, coasts, and savannahs, which have been developed as tourism sites under strict control under government law. Besides its main purpose to conserve and maintain life-supporting systems for plants and animals, the government also acknowledges and supports the development of tourism sites that are officially designated for use within the utilization zone. In this study, the nature-based tourism is located on the coastline and lowland such as Pancur Beach (GV1) and Sadengan Savanna (GV3) in Alas Purwo National Park, whereas Green Bay (GV2) is located in Meru Betiri National Park. Pancur and Green Bay offer spectacular coastal landscapes that are visited both by domestic and international tourists. The Sadengan Savanna is a crucial site for wildlife conservation.

Perhutani is one of the State-Owned Enterprises (SOE) with forestry sector as the main business. It has developed several tourist sites within the production and protection forest areas. De Djawatan was previously solely used for timber production, but now it also serves as a recreational destination. De Djawatan is a forest area managed by Perhutani and developed as a tourist site due to the presence of several large old rain trees (*Samanea saman* (Jacq) Merr). Another state-owned enterprise in port management, PT Pelindo, has developed Boom Beach as nature-based recreation area in which visitors enjoy Bali street and Bali Island. Apart from the national SOEs, there is a private enterprise such as PT Tirta Harapan, which is actively engaged in sugarcane processing and plantation, and now is also expanding its business on tourism by developing Telunjuk Raung Waterfall. This waterfall is located in the highland and has been established as a tourist site in 2016. In all of the natural attraction areas managed by SOE and private enterprises, the communities

surrounding the location have opportunities to be involved in tourism development.

Rapid tourism development in Banyuwangi stimulates some communities and local people to be involved in the tourism sector. In Banyuwangi, there are many groups involved in tourism, consisting of farmers, tourism awareness members, and fishermen. Farmer groups usually develop tourist sites related to agricultural practices such as agritourism. In addition, tourism awareness groups have also been widely known as an agent and supporters of tourism development in rural areas in Banyuwangi. The local community organized their involvement in a tourism business called *Kelompok Sadar Wisata*, a local community organization in tourism. Meanwhile, fishermen groups have developed many tourist areas located on the coast. According to local communities, the development of tourist sites has been able to provide side income options as a solution to problems of income uncertainty. Community involvement in tourism has been considered crucial in community-based tourism implementation (Rahman and Usman 2022).

Vegetation structure and species composition

The tree vegetation structure and composition at the studied nature-based recreation sites in Banyuwangi are shown in Figure 2. Species with the highest Important Value Index (IVI) at each site is as follow: Ketapang (*Terminalia catappa* L., 62.04%) in Pancur (GV1); Legaran (*Alstonia spectabilis* R.Br., 96.83%) in Green Bay (GV2); Beringin

(*Ficus benjamina* L., 64.04%) in Sadengan (GV3); Trembesi (*Samanea saman* (Jacq.) Merr., 79.91%; 146.95%) in Boom (PV1) and De Jawatan (PV2), Mindi (*Melia azedarach* L., 110.5%) in Telunjuk Raung (PV3); Cemara laut (*Casuarina equisetifolia* L., 130.58%, 300%) in Bangsring (SM1) and Cemara (SM3); Kelapa (*Cocos nucifera* L.; 123.39%; 160.54%; 59.72%; 167.86%) in Batara Village (SM4), Gandrung (SM5), Kemiren Village (SM7), and Peno (SM8); Waru laut (*Thespesia populnea* L., 110.58%) in Cacalan Beach (SM2); Rambutan (*Nephelium lappaceum* L., 68.5%) in Jagir Waterfall (SM6); and Pinus (*Pinus merkusii* Jungh. and de Vriese, 160.88%; 162.80%) in Sewu Sambang (SM9) and Sumber Manis (SM10). The species with high IVI indicate their high adaptability to dominate in environmental conditions. These numbers also correlated with the manager's effort to conserve such specific plant species for several reasons regarding their local wisdom.

Kelapa (*Cocos nucifera* L.) dominates four locations (SM4, SM5, SM7, SM8), representing the importance of coconut in recreation sites. Based on the topology of condition, these locations share the same type of land cover, which is agroforestry. Coconut is cultivated as a commodity by managers due to its economic value and high harvest frequency, which occurs once every 2 months. Moreover, coconut can be processed into various products such as coconut shell for charcoal, coconut water, coconut meat for food products, coconut husk, and coconut stem for furniture (Alouw and Wulandari 2020).

Table 1. The characteristics of nature-based tourism sites in Banyuwangi, East Java, Indonesia

Location	Characteristics			
	ID	Average temp. (°C)	Elevation (m asl.)	Attractions
Government				
Pancur Beach	GV1 (-8.677578 114.373901)	26.25	20	Sunset Beach Point and wildlife
Green Bay	GV2 (-8.563129 113.924530)	25.25	0-5	Beach with green torque water, hiking
Sadengan Savanna	GV3 (-8.653061 114.371622)	26.5	40	Wildlife animals, savanna landscape
State and private owned enterprises				
Boom Beach	PV1(-8.207358 114.385666)	26	0-5	Sightseeing of Mt. Agung and the Bali Strait landscape, Marina Boom
De Djawatan	PV2 (-8.431599 114.225708)	23	80	Giant and old <i>Samanea saman</i> trees
Telunjuk Raung	PV3 (-8.174038 114.141991)	22.5	770	Natural waterfall, tropical forest, fresh air
Community and personal				
Bangsring	SM1 (-8.054052 114.430603)	25.75	0-5	Snorkling, underwater living
Cacalan Beach	SM2 (-8.192001 114.383286)	26.75	10	Sightseeing of Mt. Agung and the Bali Strait landscape
Cemara Beach	SM3 (-8.264135 114.372688)	26	0-5	Sightseeing of <i>Casuarina equisetifolia</i> vegetation
Batara Village	SM4 (-8.128113 114.360825)	25.25	340	Cultural activities of indigenous community and youth
Gandrung Terakota	SM5 (-8.176850 114.257195)	24.5	600	Thousand Terocratic Gandrung Statue
Jagir Waterfall	SM6 (-8.175917 114.285065)	24	430	Natural waterfall
Kemiren Village	SM7 (-8.207809 114.322539)	25	191	Traditional village, cultural activities of the Osing tribe
Peno	SM8 (-8.153386 114.336975)	25.75	270	Homestay and coffee farm tour
Sewu Sambang Hill	SM9 (-8.128012 114.369919)	24.5	205	Sightseeing Banyuwangi landscape from highland
Sumber Manis	SM10 (-8.130767 114.313982)	22.75	500	Camping ground and spring water site

Note: m asl.: meter above sea level

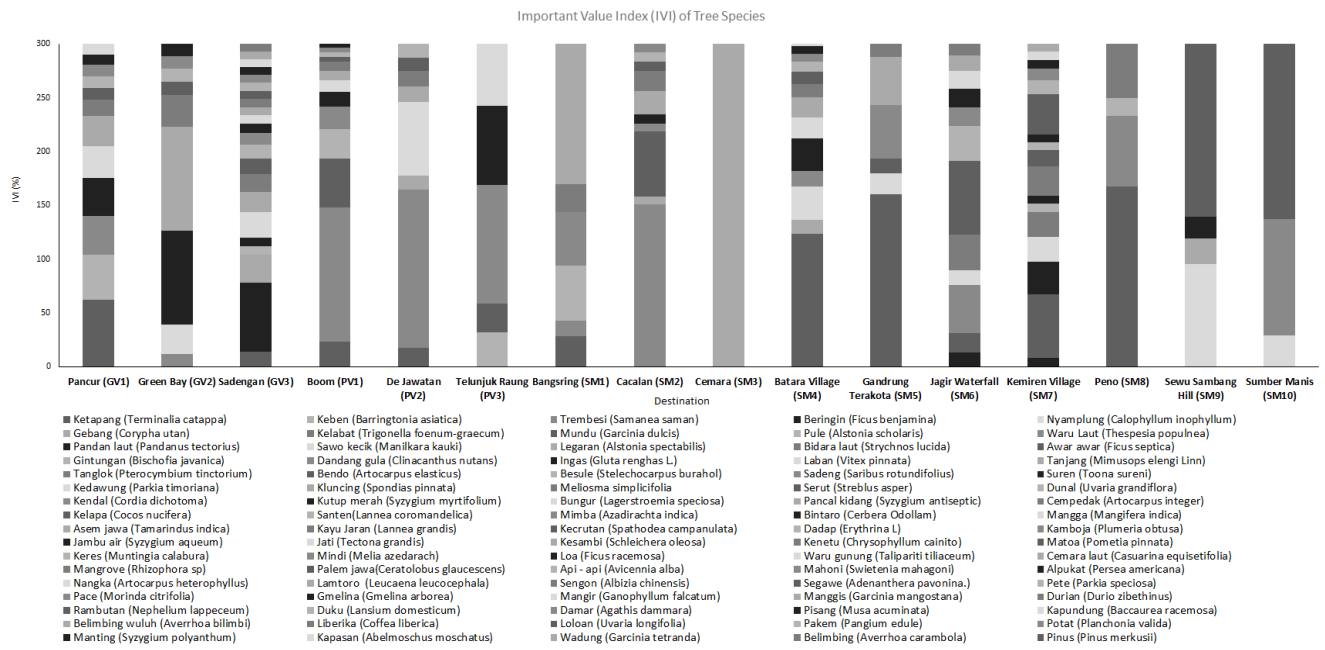


Figure 2. Important Value Index (IVI) of tree species at 16 nature-based recreation sites in Banyuwangi, East Java, Indonesia

In the tourism areas along the coastline, cemara laut (*Casuarina equisetifolia* L.) has the highest IVI score in two recreation sites managed by smallholders, namely Bangsring (SM1) and Cemara (SM3). *Casuarina equisetifolia* L. is an exotic species planted by the managers in SM1 and SM3 due to seedling availability. It protects the land from abrasion and maintain cool temperatures in coastal areas. Lin et al. (2023) mentioned that *Casuarina equisetifolia* L. is a vital species for coastal protection due to their high tolerance to salt environments, able to block wind, and high adaptability to harsh environmental conditions.

Pine (*Pinus merkusii* Jungh. and de Vriese) provides benefits for environmental and recreation activities, such as preventing landslides and regulating hydrological aspects. Pine trees are widely planted to rehabilitate forests and critical land due to the availability of seeds, fast growth rates, and pioneering characteristics that can grow on marginal land. The value of forest ecosystem services as an ecotourism area is part of the forest’s contribution to community welfare (Food and Agricultural Organizations 2012). Under some conditions, forests composed of native species for restoration purposes can be used to support biodiversity conservation and provide ecosystem services (Imanuddin et al. 2020).

Nature-based tourism locations with good-quality vegetation can attract tourists who are seeking relaxation in cool and fresh air. Trembesi (*Samanea saman* (Jacq.) Merr.) is a species commonly used as shade trees at tourist locations because it has an excellent canopy structure and complements the aesthetics of tourist location such as in De Djawatan (PV2). Trembesi tolerates low-quality soil nutrients and is considerably efficient in providing a cooling effect when tourists usually stay outside and is

exposed to outdoor climate conditions (Ow et al. 2019; Karlinasari et al. 2021).

The structure and composition of shrubs are shown in Figure 3. The highest IVI at each site are nyamplung (*Calophyllum inophyllum* L., IVI = 153.54%) in GV1, bidara laut (*Strychnos lucida* R.Br., IVI = 104.31%) in GV2, *Chydenanthus excelsus* (Blume) Miers (IVI = 41.99%) in GV3, bintaro (*Cerbera odollam* Gaertn, IVI = 66.30%) in PV1, jati (*Tectona grandis* L.f, IVI = 30.62%) in PV2, waru gunung (*Talipariti tiliaceum* L., IVI = 109.55%) in PV3, mimba (*Azadirachta indica* A. Juss, IVI = 192.55%) in SM1, cemara laut (*Casuarina equisetifolia* L., IVI = 283.93%) in SM3 robusta coffee (*Coffea canephora* Pierre ex A.Froehner, IVI = 38.17% and 139.23%) in SM4 and SM8, mangrove (*Rhizophora* L, IVI = 79.23%) in SM2, sembilang (*Dendrocalamus giganteus* Munro, IVI = 83.55% and 90.13%) in SM5 and SM6, pisang (*Musa acuminata* Colla, IVI = 67.95%) in SM7, pinus (*Pinus merkusii* Jungh. and de Vriese, IVI = 63.33%) in SM9, and ampel kuning (*Bambusa vulgaris* Schard. Ex J.C.Wendl, IVI = 111.35%) in SM10.

Coffea canephora Pierre ex Froehner has the highest IVI score at nature-based tourism locations managed by the community. This is an implication of the development of agriculture-based tourism often called agritourism. Smallholders frequently offer coffee farm tours and gastronomy tourism as part of their coffee-based agritourism practices (Hakim et al. 2019). The availability of coffee vegetation at tourist locations is a unique and valuable feature for tourist attractions, especially if they provide the final product of coffee processing, such as at locations SM4 and SM8.

Moreover, Sembilang (*D. giganteus*) also has the highest IVI score in nature-based tourism that is managed

by smallholders. *D. giganteus* is the biggest bamboo species usually found in hilly areas in the subtropic climate zone as in the SM5 and SM6 tourism sites. The distribution of *D. giganteus* has declined due to a lack of exploration of its benefits, which has led to its replacement by other species. To prevent further decline, bamboo could be propagated and used in various economic products, such as construction materials, handicrafts, and sustainable cutlery (Manandhar et al. 2019; Kumar et al. 2021). *Cerbera odollam* Gaertn (sea mango) is a tropical mangrove plant that occupies marine ecosystems such as seashores and rivers. Sea mango was reported to have advantages such as pharmacology and toxicology ingredients, meditation therapy, biofungicide, and biodiesel production (Lie et al. 2018; Saxena et al. 2023).

The nature-based tourism sites studied here have moderate and low plant diversity (Figure 4). The highest diversity index for trees was recorded in Sadengan GV3 (2.93), whereas that for shrub habitus was in Kampung Batara SM4 (3.00). According to the standard, the category for plant diversity is low if the H' value is <1 , medium if $1 < H' < 3$, and high if $H' > 3$ (Retnaningdyah et al. 2022). The highest diversity index in Sadengan represents the undisturbed and natural conditions of habitat, as the habitat is integral to the conservation area. The protection of the area leads to less disturbance. Sadengan is a place for wildlife watching, and therefore, it is crucial to minimize tourism impact that can change wild vegetation structure (Hakim 2017a).

In Batara Village, the community frequently cultivates a diverse range of woody plants using agroforestry system

to support their daily needs. As a result, there is a high diversity of shrubs. Batara Village, formally known as the Papring area, has recently grown as a cultural and educational site that is interesting among tourists who want to learn about culture, nature, and village life. It is crucial to conserve vegetation in Batara Village because vegetation is important material to support environmental education. The management of Batara Villages argues that it is vital to preserve local vegetation in order to maintain the village's identity. This has become crucial in sustainable nature-based tourism implementation in rural areas (Hill and Gale 2009; Hakim 2017a).

The vegetation of trees and shrubs shows almost similar distribution pattern across all sampling sites according to the Evenness Index (E'), which is valued above 0.6 (>0.6) except cemara (CS4) (Figure 4). The area with an evenness index (E) below 0.6 indicates that the species are not evenly distributed and should be developed further (Kvålseth 2015). Moreover, the Dominance Index (D') of the tree and shrub species ranges from 0 to 1. The highest value of Dominance Index (D') is shown in the location cemara (CS4), meaning that the area contains very low species diversity; therefore, only one species dominated the area. This condition needs serious attention relating to the frequency of human disturbance such as tourism activities and human-made changes on the natural conditions. The dominance of a species is also affected by the number of interacting species between environmental factors, availability of nutrients, and microclimate conditions (Tripathi and Tripathi 2010).

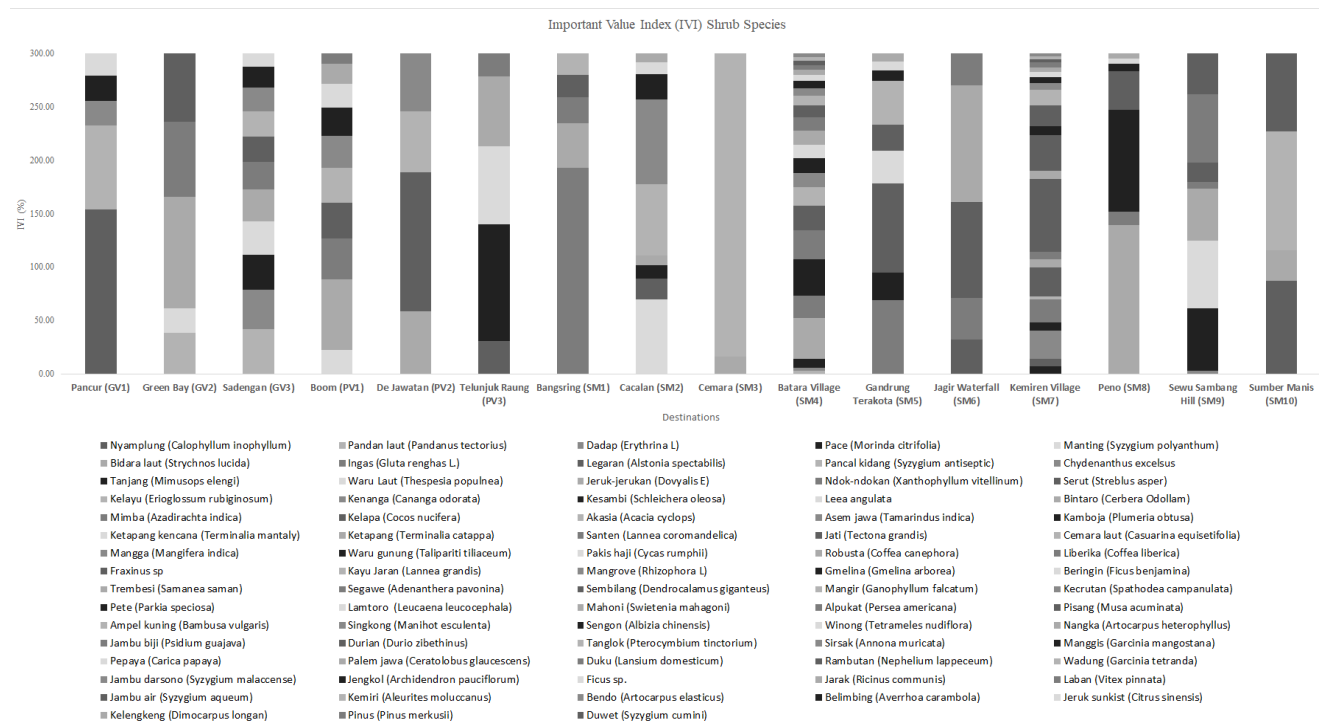


Figure 3. Important Value Index (IVI) of shrub species at 16 nature-based recreation sites in Banyuwangi, East Java, Indonesia



Figure 4. Ecological indices of trees and shrubs species at 16 nature-based recreation sites in Banyuwangi, East Java. A) Diversity Index (H'); B) Evenness Index (E); C) Dominance Index (D')

Plant species in recreation sites

Nature-recreation sites in Banyuwangi District are rich in terms of native plant species (Table 2). This data shows that Banyuwangi District has crucial position in national biodiversity conservation. The endemic and native plants have been reported to be crucial to attract tourist, including providing resources for education, in which it is important for biodiversity conservation program (Sinclair-maragh and Gursoy 2020). In this study, at least 25 plant species native to Java Island were found, in which many of them are rarely found in urban and rural areas. In Kemiren Village (SM7), 25 local and native plant species were also found and cultivated by local people. However, there are also some species with origin outside the Indonesian archipelago found in nature-based recreation sites (Table 3). The existence of introduced species needs attention for biodiversity conservation since these plants have potential to disturb native habitat. The introduction of such species in Banyuwangi is related to the human needs, such as for food, timber and ornamental plants (Hakim 2017a).

Located in national park, Sadengan is home to many flora and fauna, including endemic species. Sadengan (GV3) is a wildlife-feeding ground that offers tourists the opportunity to view various wild animal species, such as buffalo, birds, and deer. The Sadengan area is also home to several native forest plant species including (*Spondias pinnata* (L.f.) Kurz), dunal (*Uvaria grandiflora* Roxb. ex Hornem), kenanga (*Cananga odorata* (Lam.) Hook. & Thomson), sadeng (*Saribus rotundifolius* (Lam.) Blume), kedawung (*Parkia timoriana* (DC.) Mer), laban (*Vitex pinnata* (DC.) Merr), *Chydenanthus excelsus* (Blume) Miers, bungur (*Lagerstroemia speciosa* (L.) Pers.), tanglok (*Pterocymbium tinctorium*), bendo (*Artocarpus elasticus* (Blanco) Merr), serut (*Streblus asper* Lour.), kutup merah (*Syzygium myrtifolium* Walp), pancal kidang (*Syzygium antiseptic* (Blume) Merr. & L.M.Perry), ndok-ndokan (*Xanthophyllum vitellinum* (Blume) D.Dietr), kelayu (*Erioglossum rubiginosum* Blume), kesambi (*Schleichera oleosa* (Lour.) Oken), tanjung (*Mimusops elengi* Linn), and *Leea angulata* Korth. Ex Miq. The plants in the Sadengan area are abundant due to regulations set by the Indonesian Ministry of Environment and Forestry, which prohibit the addition or removal of species in national parks. This is different from the distribution of plant species found at tourist locations managed by smallholders, including Kemiren Village (SM7). Most of the plants documented are edible, such as pete (*Parkia speciosa* Hassk), durian (*Durio zibethinus* L.), pisang (*Musa acuminata* Colla), pace (*Morinda citrifolia* L.), and rambutan (*Nephelium lappaceum* L.). The managers are committed to the conservation of natural resources as necessary. By planting economically valuable crops, including fruit plants, communities can increase profits and attract tourists. However, the vegetation is impacted by biophysical processes, which pose challenges due to human intervention and climate change. According to the managers, vegetation plays a significant role to maintain the stability of natural tourism areas while also providing economic benefits such as fruit plants that can be sold or consumed.

Some species found in this study have been identified as protected species. These species are listed in the national regulation for plant protection as stated in Permen 106/MENLHK/SETJEN/KUM.1/12/2018 in the year 2018 (Tables 2 and 3). Some species have been intensively exploited from wild habitats leading to the decrease of population in natural habitats. Actions to protect such species are needed, and knowledge related to the species should be improved. Nature-based tourism programs have important roles in such strategy. Managers should do conservation efforts since there are many protected species distributed in the recreation sites in Banyuwangi.

Recreation sites are habitats for many species with origins beyond Malesian phytoregion (Table 3). Recreation sites adjacent to the rural community settlement often contain introduced or exotic plant species. These species have many functions, ranging from food, raw material, and animal feeds to ornamental plants. The existence of exotic plants has received serious attention because many exotic species have the potential to be invasive and destroy native ecosystems. However, there are exotic species with valuable functions especially plants as food resources. These species are crucial to support community living in rural areas. However, the harmful exotic species can grow wild and fast. These species potentially become weeds in many native ecosystems and agricultural lands (Hettinger 2001; Randall 2002).

Vegetation as an attraction in nature-based recreation sites

This study confirms that, basically, nature-based recreation sites contain many plant species and diverse vegetation structure and composition that can support biodiversity and conservation education in recreation areas. As far, the utilization of vegetation as an interesting tourist attraction is still lacking. This research provides basic data for vegetation and allows opportunities for recreation site managers to develop more innovative programs, ranging from education and restoration programs in recreation sites. In the educational aspect, there are opportunities to use vegetation as educational materials. Since plant species names and identities are lacking, developing specific routes and putting species names or identities will provide educational material, thus interpretation activities is crucial.

The dominant and unique species in nature-based recreation sites as shown in Figures 2 and 3 and Table 2 provide opportunities to develop plant flagship species to attract tourists to come to the recreation sites. Flagship species are important factors for the attraction and tourism identity. There are also potential plants to be explored into processed products, which is crucial for souvenir development (Walpole and Leader-Williams 2002; Butarbutar et al. 2015). Several tourist locations managed by the community have developed products and souvenirs from important species such as coffee robusta (*Coffea canephora*), as shown in Kampung Batara (SM4) and Peno (SM8). Moreover, Kampung Batara (SM8) also have been known as "Paping Village" which means Bamboo's Village due to the availability of bamboo resources and been utilized in unique handcraft products as a tourist marketing strategy.

Table 2. List of native species in 16 nature-based recreation sites in Banyuwangi, East Java, Indonesia

Scientific name	Common name	IUCN Conserv. status	Presence in recreation site
Acanthaceae			
<i>Avicennia alba</i> Blume	Api api	LC	SM2
<i>Clinacanthus nutans</i> (Burm.f.) Lindau	Dandang gula	NA	GV2
<i>Manilkara kauki</i> (L.)	Sawo kecil	DD	GV1
Achariaceae			
<i>Pangium edule</i> (Reinw)	Pakem	LC	SM7
Anacardiaceae			
<i>Spondias pinnata</i> (L.f.) Kurz	Kluncing	NA	GV3
<i>Gluta renghas</i> L	Ingas	NT	GV2
Annonaceae			
<i>Stelechocarpus burahol</i> (Blume) Hook.f. & Thomson	Besule	NA	GV2, PV3
<i>Uvaria grandiflora</i> Roxb. ex Hornem	Dunal	NA	GV3
<i>Cananga odorata</i> (Lam.) Hook. & Thomson	Kenanga	LC	GV3
Apocynaceae			
<i>Cerbera odollam</i> Gaertn	Bintaro	LC	PV1
<i>Alstonia spectabilis</i> R.Br.	Legaran	LC	GV2
<i>Alstonia scholaris</i> (L.) R.Br.	Pule	LC	GV1, GV3, PV3
Araucariaceae			
<i>Agathis dammara</i> (Lamb.)	Damar	VU	SM6
Arecaceae			
<i>Cocos nucifera</i> L.	Kelapa	NA	PV1, PV3, SM2, SM6, SM7, SM10
<i>Corypha utan</i> lam	Gebang	LC	GV1
<i>Ceratolobus glaucescens</i> Blume	Palem Jawa	NA	SM2, SM5
<i>Saribus rotundifolius</i> (Lam.) Blume	Sadeng	NA	GV3
Casuarinaceae			
<i>Casuarina equisetifolia</i> L.	Cemara laut	LC	SM1, SM2, SM3
Clusiaceae			
<i>Garcinia dulcis</i> (Roxb.) Kurz	Mundu	LC	GV1
<i>Garcinia tetrandia</i> Pierre	Wadung	LC	SM7
<i>Garcinia mangostana</i> L.	Manggis	DD	SM5, SM7
Combretaceae			
<i>Terminalia catappa</i> L.	Ketapang	LC	GV1, GV3, PV1, PV2, PV3, SM1, SM2, SM3
Cycadaceae			
<i>Cycas rumphii</i> Miq.	Pakis haji	VU	PV3
Euphorbiaceae			
<i>Aleurites moluccanus</i> (L.) Willd	Kemiri	NA	SM7
Fabaceae			
<i>Archidendron pauciflorum</i> (Benth.) I.C.Nielsen	Jengkol	LC	SM7
<i>Erythrina</i> L.	Dadap	LC	GV1, PV1
<i>Parkia timoriana</i> (DC.) Merr.	Kedawung	LC	GV3, SM7
<i>Leucaena leucocephala</i> (Lam.) de Wit	Lamtoro	NA	SM1, SM4, SM9
<i>Parkia speciosa</i> Hassk.	Pete	LC	SM4, SM7, SM8
<i>Adenanthera pavonina</i> L.	Segawe	VU	SM4
<i>Albizia chinensis</i> (Osbeck) Merr.	Sengon	LC	SM4, SM6, SM7
Guttiferae			
<i>Calophyllum inophyllum</i> L.	Nyamplung	LC	GV1, GV2
Lamiaceae			
<i>Vitex pinnata</i> L.	Laban	LC	GV3, SM7
Lecythidaceae			
<i>Chydenanthus excelsus</i> (Blume) Miers	-	NA	GV3
<i>Planchonia valida</i> (Blume)	Potat	LC	SM7
<i>Barringtonia asiatica</i> (L.) Kurz	Keben	LC	GV1
Loganiaceae			
<i>Strychnos lucida</i> R.Br.	Bidara laut	LC	GV2
Lythraceae			
<i>Lagerstroemia speciosa</i> (L.) Pers.	Bungur	NA	GV3
Malvaceae			
<i>Durio zibethinus</i> L.	Durian	NA	SM5, SM6, SM7, SM8
<i>Abelmoschus moschatus</i> Medik.	Kapasan	LC	SM7
<i>Pterocymbium tinctorium</i> (Blanco) Merr	Tanglok	LC	GV3, SM4
<i>Thespesia populnea</i> L.	Waru Laut	LC	GV1, GV3, PV1, SM1, SM2

Meliaceae			
<i>Lansium domesticum</i> Correa	Duku	NA	SM6, SM7
<i>Azadirachta indica</i> A.Juss.	Mimba	LC	PV1, SM1, SM2
<i>Melia azedarach</i> L.	Mindi	LC	PV3
<i>Toona sureni</i> (Blume) Merr.	Suren	LC	GV3
Moraceae			
<i>Artocarpus elasticus</i> Reinw.ex Blume	Bendo	LC	GV3, SM6, SM7
<i>Ficus benjamina</i> L.	Beringin	LC	GV1, GV3, SM1, SM2, SM7
<i>Ficus septica</i> Burm.f.	Awar awar	LC	GV2
<i>Artocarpus integer</i> (Thunb.) Merr.	Cempedak	LC	GV3
<i>Ficus sp.</i>	-	LC	SM7
<i>Ficus racemosa</i> L.	Loa	LC	PV3, SM7
<i>Streblus asper</i> Lour.	Serut	LC	GV3
<i>Uvaria longifolia</i> Sonn	Loloan	NA	SM7
Musaceae			
<i>Musa acuminata</i> Colla	Pisang	LC	SM4, SM5, SM6, SM7, SM8, SM9
Myrtaceae			
<i>Syzygium cumini</i> (L.) Skeels	Duwet	LC	SM9
<i>Syzygium aqueum</i> (Burm.f.) Alston	Jambu air	LC	PV1, SM2, SM7
<i>Syzygium malaccense</i> (L.) Merr. & L.M.Perry	Jambu darsono	LC	SM7
<i>Syzygium myrtifolium</i> Walp.	Kutup merah	NA	GV3
<i>Syzygium polyanthum</i> (Wight) Walp.	Manting	EN	GV1, GV2, SM7
<i>Syzygium antiseptic</i> (Blume) Merr. & L.M.Perry	Pancal kidang	NA	GV3
Oleaceae			
<i>Fraxinus Tourn. ex L</i>	-	LC	SM1
Oxalidaceae			
<i>Averrhoa bilimbi</i> L.	Belimbing wuluh	NA	SM6
<i>Averrhoa carambola</i> L.	Belimbing	NA	SM8
Pandanaceae			
<i>Pandanus tectorius</i> Parkinson	Pandan Laut	LC	GV1, GV2
Phyllanthaceae			
<i>Baccaurea racemosa</i> (Reinw.) Müll.Arg.	Kapundung	NA	SM6
<i>Bischofia javanica</i> Blume	Gintungan	LC	GV2
Pinaceae			
<i>Pinus merkusii</i> Jungh. & de Vriese	Pinus	VU	SM9, SM10
Polygalaceae			
<i>Xanthophyllum vitellinum</i> (Blume) D.Dietr	Ndok-ndokan	VU	GV3
Rhizophoraceae			
<i>Rhizophora</i> L.	Mangrove	LC	SM2
Rubiaceae			
<i>Morinda citrifolia</i> L.	Pace	NA	GV1, SM4
Sabiaceae			
<i>Meliosma simplicifolia</i> (Roxb.) Walp.	-	NA	GV3
Sapindaceae			
<i>Erioglossum rubiginosum</i> Blume	Kelayu	NA	GV3, SM4
<i>Dimocarpus longan</i> Lour.	Kelengkeng	DD	SM8
<i>Schleichera oleosa</i> (Lour.) Oken	Kesambi	LC	GV3, PV2
<i>Ganophyllum falcatum</i> Blume	Mangir	LC	SM4
<i>Pometia pinnata</i> J.R.Forst.& G.Forst	Matoa	LC	PV2
<i>Nephelium lappaceum</i> L.	Rambutan	LC	SM6, SM7
Sapotaceae			
<i>Mimusops elengi</i> Linn	Tanjung	LC	GV3, SM7
Tetramelaceae			
<i>Tetrameles nudiflora</i> R.Br.	Winong	LC	SM4
Vitaceae			
<i>Leea angulata</i> Korth. Ex Miq.	-	NA	GV3

Note: NA: Not available, LC: Least concern, DD: Data deficient, VU: Vulnerable, EN: Endangered, NT: Near Threatened. GV1: Pancur Beach, GV2: Green Bay, GV3: Sadengan, PV1: Boom Beach, PV2: De Jawatan, PV3: Telunjuk Raung, SM1: Bangsring, SM2: Cacalan Beach, SM3: Cemara Beach, SM4: Batara Village, SM5: Gandrung Terakota, SM6: Jagir Waterfall, SM7: Kemiren Village, SM8: Peno, SM9: Sewu Sambang Hill, SM10: Sumber Manis

Table 3. List of species with origin beyond the Malesia region in 16 nature-based recreation sites in Banyuwangi, East Java, Indonesia

Scientific name	Common name	Origin	Conserv. status	Presence in recreation site
Anacardiaceae				
<i>Lannea grandis</i> (Dennst.) Engl.	Kayu jaran	India	LC	PV1, SM1
<i>Mangifera indica</i> L.	Mangga	Myanmar	DD	PV1, PV2, SM4, SM7, SM9
<i>Lannea coromandelica</i> . Merr.	Santen	India	LC	PV1, SM1
Annonaceae				
<i>Annona muricata</i> L.	Sirsak	Mexico	LC	PV2, SM4, SM7, SM9
Apocynaceae				
<i>Plumeria obtusa</i> L.	Kamboja	Florida	LC	PV1, SM2
Bignoniaceae				
<i>Spathodea campanulata</i> P.Beauv	Kecrutan	Africa	LC	PV1, SM4
Boraginaceae				
<i>Cordia dichotoma</i> G.Forst	Kendal	India	LC	GV3
Caricaceae				
<i>Carica papaya</i> L.	Pepaya	Mexico	DD	SM5
Combretaceae				
<i>Terminalia mantaly</i> H.Perrier	Ketapang Kencana	Madagascar	LC	PV1
Euphorbiaceae				
<i>Ricinus communis</i> L.	Jarak	Africa	NA	SM7
<i>Manihot esculenta</i> Crantz	Singkong	America	DD	SM4
Fabaceae				
<i>Acacia cyclops</i> A.Cunn. ex G.Don	Akasia	Australia	LC	PV1
<i>Tamarindus indica</i> L.	Asem Jawa	Madagascar	LC	PV1, PV2, SM4
<i>Trigonella foenum-graecum</i> L.	Kelabat	Iraq	NA	GV1
<i>Samanea saman</i> (Jacq.) Merr.	Trembesi	America	LC	GV1, GV2, PV1, PV2, SM2
Lamiaceae				
<i>Tectona grandis</i> L.f.	Jati	Cambodia	EN	PV2, SM4, SM5
<i>Gmelina arborea</i> Roxb. ex Sm	Gmelina	Pakistan	LC	SM2, SM4, SM5, SM7, SM8, SM9
Lauraceae				
<i>Persea americana</i> Mill	Alpukat	America	LC	SM4, SM7, SM9
Malvaceae				
<i>Talipariti tiliaceum</i> L.	Waru Gunung	Bangladesh	LC	PV3, SM4, SM7, SM10
Moraceae				
<i>Artocarpus heterophyllus</i>	Nangka	India	NA	SM4, SM6, SM7
Muntingiaceae				
<i>Muntingia calabura</i> L.	Keres	America	NA	PV2
Myrtaceae				
<i>Psidium guajava</i> L.	Jambu Biji	America	LC	SM4
Poaceae				
<i>Bambusa vulgaris</i> Schard. Ex J.C.Wendl	Ampel Kuning	China	NA	SM4, SM5
<i>Dendrocalamus giganteus</i> Munro	Sembilang	India	LC	SM4, SM5, SM6, SM7
Rubiaceae				
<i>Coffea liberica</i> W.Bull	Kopi Liberika	Arica	LC	PV3, SM4, SM5, SM6, SM7, SM8
<i>Coffea canephora</i> Pierre ex A.Froehner	Kopi Robusta	Africa	LC	PV3, SM4, SM8
Rutaceae				
<i>Citrus sinensis</i> (L.)	Jeruk Sunkist	Mediterrania	NA	SM8
Salicaceae				
<i>Dovyalis e.Mey. ex Arn</i>	Jeruk-jerukan	Africa	VU	GV3
Sapotaceae				
<i>Chrysophyllum cainito</i> L.	Kenetu	Panama	LC	PV2

Note: NA: Not available, LC: Least concern, DD: Data deficient, VU: Vulnerable, EN: Endangered. GV1: Pancur Beach, GV2: Green Bay, GV3: Sadengan, PV1: Boom Beach, PV2: De Jawatan, PV3: Telunjuk Raung, SM1: Bangsring, SM2: Cacalan Beach, SM3: Cemara Beach, SM4: Batara Village, SM5: Gandrung Terakota, SM6: Jagir Waterfall, SM7: Kemiren Village, SM8: Peno, SM9: Sewu Sambang Hill, SM10: Sumber Manis

This survey confirms that nature-based recreation sites in conservation areas show native vegetation composition and structure, indicating less human intervention in recreation areas. The natural vegetation structure shows the basic characteristics of the environment, which is crucial for biodiversity education in the ecotourism program. For instance, Pancur and Green Bay are located on coastal areas, with keben (*Barringtonia asiatica* (L.) Kurz) and pandan laut (*Pandanus tectorius* Parkinson) as key to determining the coastal ecosystem characteristics (Whitten et al. 1996). Other recreation sites located in man-influenced areas are characterized by the abundance of economic species, mainly species that produce fruits, food, and wood. Some species documented in the studied areas have conservation importance, such as Segawe (*Adenanthera pavonina* L.) and Manting (*Syzygium polyanthum* (Wight) Walp.), which are listed as EN under the IUCN Red List. Interestingly, despite the conservation status, these species often exist in agroforestry systems. Therefore, the diversity and uses of species in recreation sites are important resources for edutourism. It is especially crucial since many local but rare species are not known by recent generations (Gayford 2000; Handayani et al. 2017).

Tourist attractions reflect the resource/supply (the attractions) and demand (tourists who get attracted). Awareness of tourism managers in managing tourist locations is the main key to developing natural tourist attractions, maintaining biodiversity stability, and opportunities to improve the economy. It is also important for managers to promote awareness among visitors about the importance of preserving local diversity by showcasing the production results from available plants. This activity can enhance the satisfaction of individuals who visit natural destinations (Gu et al. 2022). Thus, promoting a species identity for destination branding can also enhance the visitation of tourists, and the implementation is based on the manager's willingness (Alam et al. 2022). Other nature-based recreation areas in Banyuwangi District should start to develop strategy of introducing species identity as a branding strategy by documenting the information on species and vegetation structure as conducted in this study.

The conservation of native vegetation in nature-based recreation is important. Tourism is able to introduce plant to visitor and therefore significant to increase tourism appreciation to native plants in recreation sites. There are basic biolocal, ecological, and cultural information needed in recreation area as it is important for interpretation. Another aspect related to the conservation of native plant species and vegetation in recreation sites is species protection from vandalism and disturbance. Protection from forest fire is crucial, especially in conservation area. Forest fire not only destroys native plants species, but also destroys wildlife habitat. For rare and EN species with limited population, tourism activities by involving visitor to carry out reintroduction program is a crucial strategy to increase the population as well as to raise awareness (Pickering and Hill 2007; Hill and Gale 2009).

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