Preliminary study: potential of tropical forest and coastal area for eco-edutourism on pesanggrahan beach, Malang Regency

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Abstract. The purpose of this preliminary study is to investigate and explore the potential that exists in the Pesanggrahan Coastal Forest area for eco-educational planning. The indicators of this preliminary study are divided into three: the potential of tropical forests, the potential of coastal areas, and the potential of socio-economic conditions. This study was carried out along the coast. and Pesanggrahan Forest, administratively located in Srigonco Village, Bantur District, Malang Regency. Analysis of the potential of coastal areas using the Tourism Suitability Index with conditional results for coastal tourism. These results indicate that from a preliminary study of the potential of the Pesanggrahan Coastal Forest area suitable for eco-educational planning, it is supported by other potentials in the form of potential socio-economic conditions, physical and biophysical potentials.

1. Introduction

Forest is an ecosystem dominated by trees with parameters set by FAO, namely an area of at least half or one-quarter of a hectare [1]. Based on latitude, forests can be divided into three types: boreal, temperate, and tropical. Indonesia's tropical forests are the world's third largest, from previously being the second largest in the world [2]. Tropical forests in Indonesia can be divided into six types, namely lowland tropical forests, highland forests, monsoon forests, savannas, peat swamp forests, and mangrove forests so that forests in I which includes approximately 11% of the world's plant species, 10% of mammalian species, and 16% of bird species Indonesia can contribute to the world's biodiversity, which consists of about 11% species world's plant species, 10% of mammal species, and 16% of bird species [3].

One type of forest, namely forests in coastal areas, has an important role for local communities and the environment. Indonesia as an archipelagic country has more than 17,500 islands with a sea surface area of more than 5.8 million km^2 and the second longest coastline in the world, which is 99,083 km^2 [4]. Forest areas in coastal areas include mangrove forests, coastal forests, periodic swamps (tidal forests and flood plains) and freshwater swamps [5]. Forests in coastal areas can reduce the impact of tsunamis with their survivability. The survivability of forests in coastal areas depends on the density of trees in the area [6]. Coastal forests are also important habitats for many species and support multiple food chains through the decomposition of the tons of leaves that fall from every hectare of mangrove forest each year [7].

In general, forests are useful as a source of wood products, a source of biodiversity, a home for indigenous peoples, a carbon storage repository, and as a socio-ecological system. [8]. Meanwhile, based on its function, forests have functions in a sustainable manner such as, conservation, protection, production, and tourism functions [9]. There have been many cases where natural resources have been intensively exploited in the tourism industry, and tourism activities frequently have a negative effect on the environment, ecosystem, economic system, society, and culture [10]. Therefore, the preservation of natural resources and nature-based tourist sites need to be maintained and improved. Improving the quality of human resources can be done through education about environmentally friendly behavior. Such as the behavior of tourist attraction managers, communities around tourist objects, tourists, and the government as regulators [11].

The shift in interest in conventional tourism towards sustainable tourism has become a trend and opportunity to take advantage of the potential of forests and coastal areas into ecotourism [12] especially inland ecotourism and marine ecotourism which are still underdeveloped [4]. Ecotourism is different from the mass or conventional tourism industry [13] because it is affects social, environmental, and economic aspects, also contributes to biodiversity conservation [12]. Then came the term Eco-edutourism (Eco-edutourism) which is a combination of ecotourism and edutourism. The concept provides services to visitors in the form of natural wealth and education on how to preserve the environment with the involvement of local communities [14].

Forest areas with an ecotourism attraction object, such as protected forests and production forests, can be used for the development of eco-edutourism. Likewise, the use of eco-educational tourism in natural areas of water ecosystems. The development of eco-educational tourism in forest and coastal areas can ensure the integrity and sustainability of these ecosystems. Eco-educational activities indirectly provide access for everyone to see, learn about, and enjoy the local community's natural, intellectual, and cultural experiences [15]. Eco-educational activities also aim to get a fun hands-on learning experience related to the locations visited. In addition, eco-edutourism can also promote sustainability and turn tourists, especially young tourists, into responsible consumers who are able to conserve nature [16]. The coastal forest area of Pesanggrahan is administratively was located in Srigonco Village, Bantur District, Malang Regency. The coastal forest area of Pesanggrahan is considered very strategic and has great potential as an eco-educational area. The coastal forest area of Pesanggrahan can be used as a learning tool for the academic community on the topic of biodiversity, forest potential and resources, forest conservation, community social culture, coastal areas, and tourism. Learning can be done by using observation, survey, practicum, and field test methods.

However, eco-edutourism development in coastal forest areas of Pesanggrahan can have a negative impact on destinations and the lives of local people. An ongoing monitoring or preliminary study on the Pesanggrahan coastal forest area is needed in terms of understanding the existing conditions and potential and creating awareness for further actions that may be needed [17]. Preliminary studies are expected to create local communities' and tourist destinations' quality of life must be balanced [18].

Based on the description that has been explained, a preliminary study on the Pesanggrahan coastal forest area includes an analysis of the potential of the Pesanggrahan forest, which consists of physical aspects including forest biodiversity, geological and geomorphological conditions, hydrological conditions and social aspects, namely the economic conditions of local communities. The scope of this

research is limited to certain areas within a certain period of time. However, it is important to conduct preliminary studies to provide direction for further studies in the future [19]. Talking about the potential for developing eco-educational areas, the main points are matters relating to the requirements of a tourist place [20]. Then the assessment of the coastal potential of Pesanggrahan as a tourist destination will be reviewed through the assessment of the Tourism Feasibility Index with several parameters such as type of beach, length of the beach, seabed material, the coastal slope, the coastal land cover, and the availability of fresh water.

2. Materials and methods

This study was conducted from January to July 2022 in the coastal area and Pesanggrahan Forest which is located in Srigonco Village (figure 1), Bantur District, Malang Regency. This area is 66.3 km from Malang City or in approximately two hours by car. Astronomically, the Protected Forest Area of Pesanggrahan is located at 8°23'34" S - 8°24'15" S and 112°32'58" E -112°33'42" E.
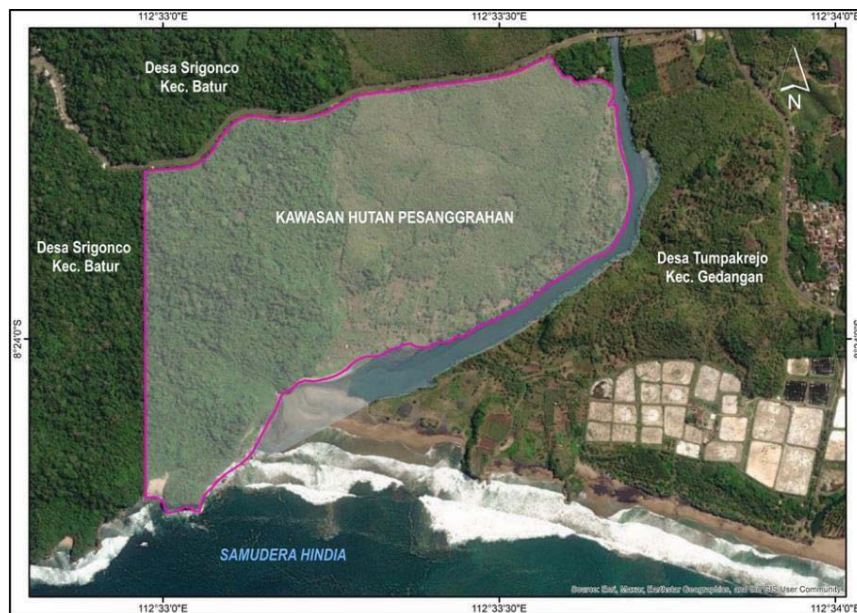

Figure 1. Satellite imagery of research area

The preliminary study in this study aims to examine and explore the potential of the Pesanggrahan Coastal Forest area in eco-educational planning. The indicators of this research are divided into three, namely the potential of tropical forests, the potential of coastal areas and the potential of socio-economic conditions. Sub-indicators of the potential of the Tropical Forest of Pesanggrahan include biodiversity potential, geological potential, geomorphological potential, topographic potential and hydrological potential. The potential of coastal areas is a preliminary study obtained from the assessment of the Tourism Suitability Index in the field of beach recreation. Meanwhile, the potential socio-economic conditions were obtained from observations at the research site. Furthermore, situation analysis and participatory analysis were carried out to gain further understanding.

Data collection is obtained through surveys, observations and secondary data processing. The potential of tropical forests in the geological potential section is obtained from the observation of the geological map on the Turen sheet. The topographic potential is obtained from the Alos Palsar Alaska Satellite Facility DEM

$$TSI = \sum \left(\frac{Ni}{Nmax} \right) . 100\% \tag{1}$$

TSI   : Tourism Suitability Index
Ni   : Parameter value (i) (Weight × Score)
Nmax : Maximum value of tourism category

This study has seven parameters, namely beach type, beach width, beach slope, coastal land cover, seabed material, fresh water availability and hazardous biota. The beach width parameters were obtained from Google Earth, the beach slope was obtained from DEM data processing, land cover was also obtained from Google Earth observations and then validated through observations. As for the beach type, seabed material, fresh water availability and hazardous biota are measured by direct observation in the field. Yulianda [21] and Domo [22] explained that the suitability class in coastal recreational tourism is divided into three classes, namely: the range of 75 - 100% is a suitable class, a range of 50 - <75% is a conditionally suitable class, and <50% is an unsuitable class. As for the parameter category, there are four categories of tourism suitability, namely: S_1 (Very Suitable) S_2 (Suitable) S_3 (Almost Suitable) S_n (Not Suitable). Table 1 shows the TSI matrix table.

Table 1. Tourism Suitability for Beach Recreation Category.

Parameters	Weight	S_1	Score	S_2	Score	S_3	Score	S_n	Score
Beach type	5	white sand	3	white sand, few corals	2	black sand, many coral, little steep	1	mud, rocky, steep	0
Beach width (m)	5	>15	3	10-15	2	3-10	1	<3	0
Seabed material	3	sand	3	Corals and sand	2	Sand and mud	1	Mud	0
Seabed slope	3	<10	3	10-15	2	>25-45	1	>45	0
Coastial land cover	1	Open space, coconut tree	3	Scrub, savana	2	tall bush	1	mangroves, settlements, ports	0
Access to fresh water (km)	1	<0.5	3	0.5-1	2	1-2	1	>2	0
Hazardous biota	1	nothing	3	Sea urchins	2	Sea urchins, stingray	1	sea urchins, stingray, shark	0

Source: Modified from Yulius, et al [23].

3. Results and discussion

3.1. The Potential of Pesanggrahan Coastal Forest

3.1.1. Biodiversity. Studies on the potential for biodiversity in Pesanggrahan forest areas are still rarely carried out where the types of flora that exist can be distinguished from protected forest areas and production forests. The coastal forest area of Pesanggrahan can be seen on the 97-g plot map where the vegetation is mixed forest. Plants that are often found as constituents of vegetation include *Pometia pinnata*, *Ficus variegata*, *Ficus retusa*, *Munung*, *Kleinhovia hopita L*, and *Ficus benjamina*. The Protection Forest in the Pesanggrahan area is adjacent to a production forest that has the main vegetation, namely Teak (*Tectona grandis*). The location of the production forest research in the Pesanggrahan forest area when viewed from the class category is divided into two. The 97-h plot on the map is included in Age Class I (KUI) with a standard area of 42.80. The type of vegetation is row of teak which was planted in 2005 with good growing conditions, rather flat. Some of the intercropping plants that grow are *Schleichera oleosa*, *Swietenia mahagoni*, and *Musa sp* which are found on the side of the land near the

coast of Pesanggrahan. Meanwhile, in plot 97-i, it belongs to the production forest category of Age Class II (KUII) with an area of 1.3 ha. The plants in this plot, namely the Teak row planted in 1994, grew well rather evenly.
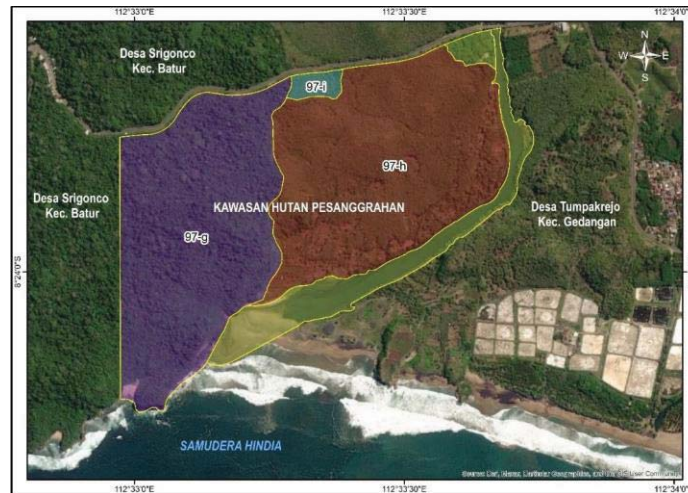

Figure 2. Plot map of the Pesanggrahan Forest Area

The number of plant species found from the results of the initial survey was 444 species belonging to 94 families. In general, the biodiversity in the coastal forests of Pesanggrahan has six potential benefits, including medicinal plants, food sources, plants for household needs, plants for industrial purposes, plants for ritual purposes, and plants for ecological conservation purposes. In fact, there is still one rare plant species in the world, its conservation status is endangered according to the IUCN *Red List of Threatened Species* that is *Myristica teysmannii (amended version of 1998 assessment)*. *The IUCN Red List of Threatened Species* 2018: e.T31998A125919196. In local terms, this plant is known as *Pala Jawa*.

The diversity of fauna around the Pesanggrahan Forest shows the running of the ecological pyramid. Parameters in the form of population, biomass, and energy appear to be very adequate and available. Fauna from the lowest level (prey) to the highest level (top predator) can be found in this area. The data inventory has been identified from the fauna groups of Class Mammal, Class Aves, Class Amphibians and Class Reptiles. The existence of a protected forest area with a very dense flora cover, provides space for the Aves Class to interact. Therefore, from the Aves class it can be identified that there are 54 species of birds consisting of 25 families, 15 of which are protected by the government. The top predators of the Aves class are known to have four species of eagles, namely: *Elanus caeruleus*, *Spilornis cheela*, *Nisaetus bartelsi*, and *Ictinaetus malaiensis*. These bird species are animal species that are protected by Indonesian Government Regulation number 7 of 1999 concerning the preservation of plant and animal species, and the regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.20/menlhk/setjen/kum.1/6/2018 about protected plant and animal species.

There are bird species in the research area which are included in the species protected by theGovernment of Indonesia Regulation No. 7 year 1999, P.20/menlhk/setjen/kum.1/6/2018 tentang jenis tumbuhan dan satwa yang dilindungi, serta IUCN. The bird species is *Spilornis cheela*, *Nisaetus bartelsi*, *Ictinaetus malaiensis*, *Pernis ptilorhynchus*, *Halcyon cyanoventris*, *Todiramphus chloris*, *Centropus nigrorufus*, *Anthracoceros albirostris*, *Hydrornis guajana*, *Microhierax fringillarius*, *Elanus caeruleus*, *Pavo muticus*, *Alcedo meninting*, *Anthreptes malacensis* and *Cinnyris jugularis*. While other species are species that according to IUCN: *International Union for Conservation Nature and Natural Resources*, categorized LC: *Least Concern*/ less worrying, i.e. species that do not have to worry about becoming endangered.

Herpetofauna or animals belonging to the Class Amphibians and Reptiles are mostly nocturnal or nocturnal animals [27]. Based on the initial survey, 12 species of reptiles and four species of amphibians were found. *Rhacophorus reinwardtii* is one type of amphibian that has the status of *Near Threatened*

by IUCN Redlist. Conservation measures to preserve this species can also be taken to attract tourists. In addition, the large population *Cynocephalus Variegatus* or Squirrel Krendo (Mammals) which are also active at night can be used as an attraction in night tracking activities [28].

3.1.2. Geology. The geological conditions at the research site in the observation of the geological map of the Turen sheet are composed of two formations, namely the Wonosari (Tmwl) and Alluvium (Qa) formations. The Wonosari Formation is composed of limestone, sandy marl, and claystone inserts. Alluvium deposit formations are composed of gravel, gravel, sand and mud. In both formations Wonosari is the main constituent.

The Wonosari Formation itself is well exposed in and around the Wonosari area, forming the Wonosari subdivision landscape and the Gunung Sewu subdivision karst terrain. The thickness of this formation is estimated to be more than 800 meters. Its stratigraphic position at the bottom is intertwined with the Oyo Formation and at the top with the Kepek Formation. This formation is dominated by carbonate rocks and consists of layered limestones and reef limestones. According to Surono in Aslami [29], the Middle Miocene to Pliocene is the age of the Wonosari formation where the sedimentary environment is a shallower neritic sea in the south, namely the shallow sea zone.

3.1.3. Topography and Geomorphology. The impact of physical conditions that are geologically located on the geological structure of Karst, resulted in the geomorphological condition of the research area in the form of hilly and undulating land. Karst areas are characterized by drought in the dry season [30]. This happens because the structure above the rock causes rainwater to not be accommodated on the surface for a long time. The filtration of surface water through rock crevices causes the dissolution of karst rock and the formation of underground rivers and caves [31]. This phenomenon is quite interesting to study in the context of geography in relation to the impact of physical conditions on socio-economic conditions, vegetation, hydrological systems, flora and fauna, local climate, tourism and various other impacts.

The morphological conditions of an area that form the slope conditions can be seen on the map above that the dominant slope is in the flat class or in the sense that it is in the 0-8% range considering the research location is adjacent to the beach. Then the diversity of other landforms that can be observed in the coastal area of Pesanggrahan is the form of coastal land. This landform is formed as a result of processes that are influenced by energy originating from land or from the sea. The energy can form different characteristics according to its intensity. In addition, marine landforms can also be affected by the intervention of local residents [32]. However, in its development, marine landforms are more influenced by several forces originating from the ocean, such as wave diffraction and tides [33]. The beach in the Pesanggrahan area has been opened and used for beach tourism activities for the public (mass tourism) with access to the beach in the form of macadam roads and dirt roads. The beach tourism activities are managed by the community with many limitations, so it has the potential to be developed.
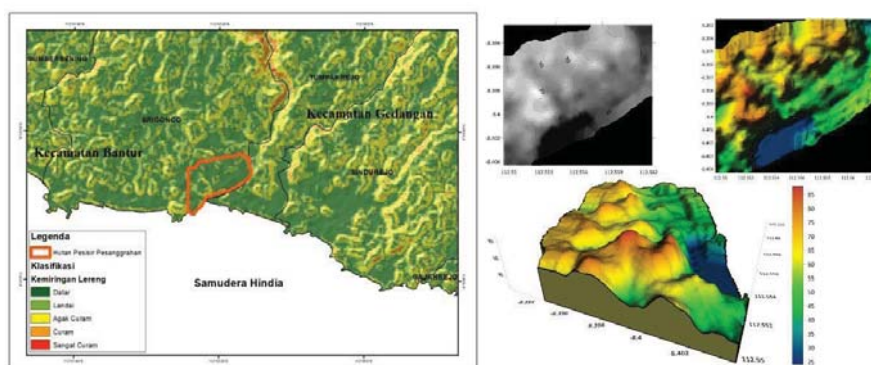

Figure 3. Map of the Slope of the Coastal Forest Area of Pesanggrahan (left), Visualization of the Topography and Morphology of the Pesanggrahan Coastal Forest Area (right)

Topography is one of the elements of physical potential in the Pesanggrahan Coastal Forest area where this potential also increases education that can be used as material for more in-depth studies, either through research or educational tourism in Eco-edutourism. Figure four shows several visualizations of the research location in 3D, namely contour visualization and 3D morphology. Judging from the range of visualization contours, with major contours of 70m and minor contours of 45m, which indicate lines that are getting closer together, namely steep classes, while lines that move away from each other indicate sloping classes. The morphology in the 3D visualization above shows the dominant category of undulating or hilly considering that the research location is a karst landform. The dominant altitude in the research area is at an altitude between 40-50 m.

3.1.4. Hidrology. The hydrological condition of the coastal forest area of Pesanggrahan includes areas with poor hydrological conditions. This condition is a consequence of the region's complex geological and geomorphological configuration has resulted in variations in aquifer minerals, including their types, physical properties, and chemical properties [34]. The porosity of limestone is that it cannot hold surface water well [35]. The surface of this area has a permanent river basin system. The permanent river in question is the Berek River which is located to the east of the research location. In addition to rivers, this area also has a tidal swamp water system (swale) located in the estuary area.

Based on geohydrological conditions, this area is composed of local Productive Aquifers and Medium Productive Aquifers. This means that the area has a limited aquifer. This situation is caused by the karst rock system which has a high porosity, so it has a high vulnerability to drought. The existence of a protected forest is very helpful for the hydrological system in the area as a conservation measure for water resources in the karst area. The potential for high water resources is in the deep layers so that it is difficult to use. This means that fresh water for this area is still a problem if needed in large capacities.

3.2. Tourism Suitability Analysis
The assessment of the Tourism Suitability Index in this study was carried out at Pesanggrahan Beach with the value of each parameter as follows:

Table 2. Parameters on Pesanggrahan Beach

Parameters	Weight	Score	Category
beach type	5	1	black sand, many corals, little steep
beach width (m)	5	3	>15
seabed material	3	2	corals and sand
beach slope (%)	3	3	<10
coastal land cover	1	2	scrub, savanna
access to fresh water (km)	1	0	>2
hazardous biota	1	3	None

Based on the weights and scores in the table above, the IKW calculation can be carried out as follows:

$$TSI = \sum \left(\frac{Ni(Weight \; x \; Score)}{Nmax} \right) x100 \tag{2}$$

Based on these calculations, it is known that the TSI in the coastal area of Pesanggrahan is 68% which is included in the category according to conditions for beach tourism. Judging from the research objective, namely a preliminary study on the potential of the Pesanggrahan Coastal Forest area according to eco-edutourism planning, according to Nugroho [36] explained that ecotourism has its own characteristics, namely promoting environmental protection, environmental education, welfare of local residents and respect for local culture.

3.3. Socio-Economic Condition

Malang Regency has a culture influenced by the development of the dominant ethnic culture that developed in the East Java region. The influence of ethnic culture is Mataraman Culture, Tengger Culture, Rek Culture, Madura Culture. Bantur sub-district is influenced by Mataraman and Madurese culture. So that social conditions in the Pesanggrahan area are still influenced by Madurese culture. The influence of Madurese culture is closely related to fishing activities. This culture affects the way and lifestyle of the surrounding community, including their social and economic activities. In addition to Madurese culture, the social conditions of the people in the Pesanggrahan area are also influenced by the people who come from Kediri-Jombang. This development was influenced by the historical development of the Jawi Wetan Church, which came from the Ngoro area (Jombang Regency).

The people of Srigonco Village continue to preserve the existing culture. One of them is Srigonco Village preserving the Jaranan dance. This dance is played by the dancers by riding an imitation horse made of woven bamboo. In addition, there is a traditional ritual procession of Larung Sesaji celebrating One Suro. Larung Sesaji is placed on wooden frames that are shaped like small boats and carried by the community whose job is to carry and parading the Larung offerings to the south coast. The offerings are carried from the shores of the coast to the sea accompanied by musical singing from the beginning of the event, departure until finally the offerings are thrown into the sea. This activity is a form of gratitude for the sustenance that has been received. In addition to attractive natural attractions, the Pesanggrahan area also has religious tourism. On certain days, thousands of visitors come to the beach to perform rituals. For people who are Muslim, most of them carry out rituals by visiting the tomb of Sheikh Abdul Jalil, who was the first person to clear the forest in the Balekambang Beach area. Every 1st of Sha'ban, many people perform rituals on the banks of Kali Berek, which is about 1 km before entering Balekambang Beach from Bantur.

In addition to religious tourism for Muslims, the Pesanggrahan area also has tourism for Hindus. This is because Amerta Jati Temple, which is located on the island of Ismoyo, has become the destination of 35 ceremonies by Hindus who live in the city of Malang. The Nyepi Day ceremony is an interesting spectacle for tourists because it provides cultural knowledge to tourists. The tourists are required to adhere to the existing norms when watching the ceremony up close.

Based on the analysis of the socioeconomic situation of the community in the research location, the potential needed for eco-edutourism is very supportive where in addition to the diverse physical potential, the Pesangrahan Coastal Forest area has cultural assets that need to be maintained and disseminated through the eco-edutourism model. This is in accordance with the explanation of the concept of ecotourism according to Nugroho (2011) [36] that the concept and implementation of ecotourism cannot be separated from the development of conservation areas. Ecotourism services are seen as one of the entry points, as an economic method that examines and assesses the benefits of natural resources and the environment from a conservation perspective. Ecotourism services are the leading real sector that packs environmental and cultural services.

4. Conclusions

Utilization of the coastal forest area of Pesanggrahan as an eco-edutourism area can have a positive impact on the surrounding environment, including: (1) The development of the area into eco-edutourism is expected to help protect protected forest areas from various activities that threaten endemic flora and fauna. (2) The research location which is a karst area and the downstream area of the Berek River has control over water resources in the surrounding environment. (3) The characteristics of the forest bordering protection and production forests can reduce the number of encroachments on protected forests in the South Malang area. By using the TSI calculation in the coastal area of Pesanggrahan, it is obtained a value of 68% which is included in the category according to conditions for beach tourism. So based on

the research objectives, namely preliminary studies, the potential of the Pesanggrahan Coastal Forest area according to eco-edutourism planning is supported by other potentials in the form of potential socio-economic conditions, physical and biophysical potential.

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