MAKABUT (mangroves-bekantan-gambut): a solution for the development of integrated eco-tourism area in mangrove-proboscis monkey’s habitat in Batu Ampar, Kubu Raya Regency, West Kalimantan

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Abstract. The Batu Ampar mangrove area, Kubu Raya, West Kalimantan Province is a distinct swamp site for the endemic proboscis monkey’s habitat located in a micro-KHG (Peat Hydrological Unit) zone. The MAKABUT ecotourism presents an integrated development between water, intertidal areas and land through tourist attractions as a reflection of the unique characteristics of mangroves, proboscis monkeys and peat by incorporating the surrounding community as the environment-friendly and sustainable management solutions covering an area of 3049.20 ha. The methods for the development of the MAKABUT ecotourism area is a combination of suitability and carrying capacity analysis, Triple A analysis, and SWOT analysis. The MAKABUT ecotourism is feasible to be developed into an ecologically based, participatory and sustainable tourism area which results in a very suitable zone 923.41 ha and not suitable zone 2125.79 ha. Potential attractions for ecotourism in MAKABUT were Mangrove Hiking, Education Planting Ground, Mangrove Crab Cultivation, Mangrove Mania Fishing, Floating Restaurant, Mangrove Herping, Peat River Exploration, Proboscis Monkeys Observation, and Birding. The MAKABUT ecotourism area have been planned for 23 units of facilities and infrastructures. The main strategies for developing MAKABUT ecotourism area was the management clearance for institutional strengthening, facilities and infrastructure development, and human resources empowerment.

1. Introduction
Ecotourism is a concept using nature by considering its sustainability as the efforts not only to protect the ecosystem but could also have an economic impact on local communities [1,2]. An ecotourism area is an area of exploiting the natural beauty that has economic value, socio-cultural impact and can help preserve the surrounding environment [3-5]. Indonesia has a large number of areas that have the potential use as natural tourism extends throughout its archipelago which can increase opportunities for regional economic growth [3,6]. One of these areas is located in Kubu Raya Regency, West Kalimantan, which has both peat and mangrove ecosystem, and a distinct habitat for proboscis monkeys may provide an attraction for natural tourism [7].

The mangrove area of Kubu Raya Regency has unique characteristics, where the mangroves in this area are spread over several islands in the Kapuas river basin ecosystem [8]. This area is classified into
a riparian forest type which is composed of 22 mangrove species [9]. The various types of mangroves in this area are the main source of food for endemic species of proboscis monkeys [10,11] and seven species of migratory birds [8]. This mangrove area has the status of Protected Forest (HL) and Limited Production Forest (HPT). From a soil type perspective, the Ministry of Environment and Forestry has designated part of this area as a Peat Hydrological Unit (KHG) zone that needs protection from the threat of land use degradation.

Nowadays, mangrove, proboscis monkey, and peat (wetland) ecosystem resources are used as tourism activities, where visitors can get ecological experiences [5,12,13]. Ecotourism in Indonesia generally presents a variety of tourism activities, such as Nature Tourism Park based on mangroves of Angke Kapuk [15], Marine National Park based on mangroves and coral Bunaken [16], Nature Tourism based on proboscis monkey Margasari, Tapin Regency [5,17], Bukit Batu peat swamp-based Wildlife Reserve [13], Bantimurung Bulusaraung butterfly-based National Park [18] and orangutan Tanjung Puting [19].

The ecotourism above only focuses on one potential area but lacks attractions as a tourism product. It is important to develop integrated ecotourism between water, intertidal, and land areas through the development of tourist attractions as a reflection of the unique characteristics of mangroves, proboscis monkeys, and peatlands that involve local communities

2. Methods
This study was conducted from May - July 2020. The research location was in the tourist area of Batu Ampar sub-district, Kubu Raya Regency, West Kalimantan Province. This study uses secondary data derived from the results of research and studies as well as data provided by government agencies, such as the Ministry of Environment and Forestry (KLHK), Ministry of Energy and Mineral Resources, Geospatial Information Agency (BIG), Agency for Meteorology Climatology and Geophysics, United States Geological Survey, and IUCN Redlist. Secondary data consists of planning documents, laws and regulations, spatial data (in the form of maps and satellite images), books, journals, archives, and research reports. Secondary data consists of Documents and Maps of Peatlands of West Kalimantan Province at a scale of 1: 50,000, Maps of Peatlands of Kubu Raya District at a scale of 1: 50,000, Maps of Peat Hydrological Units at a scale of 1: 2,300,000, Maps of Forest Determination of 1: 31,000,000 scale Indicative Map and Area of Social Forestry of West Kalimantan Province 3rd revision scale 1: 1,500,000, Administrative Map of Kubu Raya Regency, Rupa Bumi Indonesia Map (Kubu Raya Regency, Landak Regency, Pontianak Regency, Sanggau Regency, and North Kayong Regency), Landcover Map, Land use Map, Land system Map, Geological Map, and Proboscis Monkey Species Distribution Map.

These data will be processed using cloud computing-based spatial techniques with the help of the google earth engine and Arc. View 10.5 software. The data was analyzed to determine the conditions of mangrove density and the level of suitability and carrying capacity of the ecotourism area. Furthermore, these results will be used to develop zonation in the planned area, analysis of tourism product potential, and analysis of strategies to be used in accordance with the conditions of the study area.
2.1 Mangrove canopy density analysis
Analysis of condition at mangrove vegetation canopy density using the NDVI (Normalized Difference Vegetation Index) analysis method with data sources in the form of Sentinel-2 satellite imagery which has a spatial resolution of 10 m. The NDVI analysis method is an image calculation technique used to determine the level of greenness on a land cover. The NDVI value is obtained from the results of vegetation index processing from satellite imagery of the infrared channel and the red channel which shows the relative density level of vegetation for each pixel. Based on the analysis process, the NDVI value is obtained using the following formula:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

(1)

The NDVI index analysis uses sentinel-2 imagery consisting of Band-8 (NIR) and Band-4 (Red) with image capture times from January to December 2020. Image processing using cloud computing-based methods through Google Earth Engine to separate the image from the cloud image. The results of the NDVI analysis were downloaded and then reprocessed by correcting polygon errors and classifying the crown density using Arc. view 10.5 software. The classification of mangrove canopy follows the Guidebook for Inventory and Identification of Critical Mangrove Lands 2005, Directorate General of Land Rehabilitation and Social Forestry, Ministry of Forestry Indonesia (table 1).

| Density class | Value       |
|---------------|-------------|
| Abundant      | >0.42       |
| Moderate      | 0.32 – 0.42 |
| Low           | < 0.32      |

2.2 Suitability and carrying capacity analyses
Mangrove tourism suitability analysis was based on [20], which considered several parameters such as mangrove thickness, density and type, tidal wave, and fauna. All parameters are then weighted, categorized, and scored (table 3) to obtain suitability classes based on Equation 2 and Table 2.
\[ IKW = \left( \sum \frac{N_i}{N_{\text{max}}} \right) \times 100 \% \]

Where,

\( IKW \) = Tourism Suitability Index

\( N_i \) = The value of the \( i^{th} \) parameters (score x weight)

\( N_{\text{max}} \) = Maximum value of tourism category

### Table 2: Suitability class based on Tourism Suitability Index.

| Suitability class | IKW % |
|-------------------|-------|
| Very Suitable     | 83 – 100 |
| Suitable          | < 83 |
| Not suitable      | < 50 |

### Table 3: Mangrove tourism suitability matrix.

| No. | Parameter                  | Weight | Category                        | Score |
|-----|----------------------------|--------|---------------------------------|-------|
| 1.  | Mangrove thickness (m)     | 5      | >500                            | 3     |
|     |                            |        | >200 – 500                      | 2     |
|     |                            |        | 50 – 200                        | 1     |
|     |                            |        | <50                             | 0     |
| 2.  | Mangrove density (tree, 100 m\(^{-1}\)) | 3     | >15 – 20                        | 3     |
|     |                            |        | >10 – 15; >20                   | 2     |
|     |                            |        | 5 – 10                          | 1     |
|     |                            |        | <5                              | 0     |
| 3.  | Mangrove type              | 3      | >5                              | 3     |
|     |                            |        | 3 – 5                           | 2     |
|     |                            |        | 1 – 2                           | 1     |
|     |                            |        | 0                               | 0     |
| 4.  | Tidal wave (m)             | 1      | 0 – 1                           | 3     |
|     |                            |        | >1 – 2                          | 2     |
|     |                            |        | >2 – 5                          | 1     |
|     |                            |        | >5                              | 0     |
| 5.  | Fauna                      | 1      | Fish, shrimp, crab, mollusk, reptile, bird, and fauna endemic | 3 |
|     |                            |        | Fish, shrimp, crab, mollusk     | 2 |
|     |                            |        | Fish, mollusk                   | 1 |
|     |                            |        | One species                     | 0 |

Source: [20].

Analysis of the carrying capacity of mangrove ecotourism was used at the Regional Supporting Capacity (DDK) approach. DDK is the calculation of the maximum number of visitors who can physically be accommodated in the area provided at a certain time without causing disturbance to nature and humans. DDK calculation uses the following formula (3):

\[ DDK = k \times \frac{L_p}{L_t} \times \frac{W_t}{W_p} \]

Where,

\( DDK \) = Carrying Capacity (person hour\(^{-1}\))
k = Ecological potential of visitors per unit area (person)
Lp = Area/Length of the usable area (m² or m)
Lt = Unit area for a certain category (m² or m)
Wt = Time provided by the area for tourist activities in one day (hours)
Wp = Time spent by visitors for any particular activity (hours)

Table 4. The ecological potential of visitors, the area of activity, the time of the visit, and the time provided by the tourist attraction.

| No. | Type activities     | K (sum tourist) | Area unit (Lt) | Time activities Wp - (h) | Time total in one day Wt – (h) |
|-----|---------------------|-----------------|----------------|--------------------------|--------------------------------|
| 1.  | Diving              | 2               | 2000 m²        | 2                        | 8                              |
| 2.  | Snorkelling         | 1               | 500 m²         | 3                        | 6                              |
| 3.  | Seagrass tourism    | 1               | 250 m²         | 2                        | 4                              |
| 4.  | Mangrove tourism    | 1               | 50 m           | 2                        | 8                              |
| 5.  | Beach recreation    | 1               | 50 m           | 3                        | 6                              |
| 6.  | Sports tourism      | 1               | 50 m           | 2                        | 4                              |

Source: [20,21].

The analysis of zoning suitability and carrying capacity was carried out in planning the development of ecotourism areas by measuring the maximum limit of area use which is influenced by several limiting factors (biophysical parameters) [22]. This is done to reduce the impact of damage to the environment [21]. The parameters that will be identified in the mangrove ecotourism suitability analysis refer to the Marine Research Center, Ministry of Marine Affairs and Fisheries (KKP) [23]. Meanwhile, the zoning carrying capacity of ecotourism development planning was analyzed through the identification of parameters such as soil type, topography, land use, land status, buffer zone (coastal and river boundaries), and climate. The analysis results were specified using ArcMap 10.2 software and produced a zoning direction map.

2.3 Triple-A analysis: potential of tourism products
The development of an ecotourism area must have tourism products that are presented as a tourism commodity in introducing the uniqueness of the tourist area [24]. The analysis of tourism products uses the triple-A analysis method (attractions, amenities, and accessibility) developed by the Center for Tourism Studies, Gadjah Mada University (UGM) [25]. Development programs that will be developed through tourist attractions, amenities, and accessibility are formulated and produce planning recommendations by referring to the ecotourism area zoning map that has been made previously. The development of facilities in the Makabut ecotourism area is modeled in 3D using the 2018 SketchUp software with reference to the Tourism Regulation No. 3 2018 concerning Operational Guidelines for the Management of Physical Special Allocation Funds in the Tourism Sector (Permenpar 3 2018) by considering the value of local wisdom.

2.4 SWOT analysis: regional development strategy
The development of an area into an ecotourism destination requires analysis to determine the influence factors so that an ideal planning strategy is created [26]. One of the analytical methods used in measuring regional development planning strategies is the SWOT analysis (strengths, weaknesses, opportunities, threats) [27,28]. The SWOT analysis method provides an overview of the strategies that will be created by identifying the factors that affect internal factors (strengths and weaknesses) and external factors (opportunities and threats) [14,29,30,31].
3. Results and discussion

3.1 Location research

The Kubu Raya mangrove ecosystem is a mangrove forest ecosystem that is a delta landscape and is right at the mouth of the Kapuas Sub-watershed [8]. From various research sources, the mangrove ecosystem in the Kubu Raya Mangrove area is still very natural with a fairly high-density level [9],21. This is by the results of the NDVI analysis carried out to identify the density level of the mangrove vegetation canopy at the planned location. The results of the analysis revealed that there was a vegetation canopy with a low density of 731.08 ha, moderate 1,774.51 ha, and Abundant 547.74 ha. Thus, the moderate density of the canopy is the dominant canopy condition as a whole (Figure 2: Map A).

Mangrove vegetated land cover is a type of plant that can live in the ecotone area, namely the border between land and sea. In the land-use map, this location has 6 types of land use including secondary mangrove forest, swamp, swamp forest, and secondary swamp forest. In particular, the mangrove ecosystem at this location has an area of around 923.41 ha which is spread evenly along the Jenu Kecil River and along the banks of the Kelabu River, there are separate mangrove ecosystems (figure 2: Map B). This mangrove ecosystem has a canopy density level of 342.15 ha of low, 513.81 ha of moderate, and 67.44 ha of abundant (figure 2: Map C). Classification on the evenness level of mangrove vegetated canopy is a parameter in providing limits on the recommendations given. At a low and medium level of mapping, an ecotourism area will be planned by rehabilitating mangroves. Meanwhile, at a high level of evenness, this area will be used as a protected area, and ecotourism activities can be closely monitored.

Figure 2. Mangrove analysis.
3.2 Suitability and carrying capacity

3.2.1 Mangroves condition. The high level of biodiversity in the mangrove ecosystem in the study site greatly supports the development of ecotourism. Mangrove needs a particular site for its growth and development, which is influenced by the tidal wave in coastal areas or estuaries. The study site had tidal frequencies ranging from 0.4 to 1.7 m [21]. Spatial analysis in the planned area for ecotourism development in Makabut found mangrove thicknesses ranging from 231 to 840 m. The mangrove density in the mangrove area of Batu Ampar District was identified ranging from 23 to 39 trees per 100 m², 100 trees, m⁻², the IVI value at the tree level was 204.79%; IVI stake rate was 248.36%; and IVI for seedlings at 162.08% (for mangroves *Rhizophora apiculata*). The mangrove ecosystem in this location consisted of 22 mangrove species.

As a distinct ecosystem, mangrove has a certain relationship with biotic life processes. Fauna diversity in the mangrove ecosystem is divided into two groups which are faunas that spent their entire life in the aquatic mangrove ecosystem and faunas that spent part of their life in the terrestrial mangrove ecosystem. In addition, the biota community in the study area found 10 types of aquatic animals and 18 species of terrestrial animals [21]. According to Hernowo [8], there were 11 mammal species (30 %), 57 bird species (28 %), 10 reptile species (9 %), and one amphibian species recorded in the study area. This area also has Borneo-endemic fauna such as proboscis monkey (*Nasalis larvatus*; endangered), Irrawaddy dolphin (*Orcaella brevirostris*; endangered), and lesser adjutant (*Leptoptilos javanicus*; vulnerable). Thus, the biodiversity in the form of protected fauna species in the Batu Ampar mangrove area has a high level of importance to be preserved.

Proboscis monkey (*Nasalis larvatus*) is one of the endemic animals of the island of Kalimantan, whose habitat is in wetlands, especially mangrove forest types [10,11]. According to research by Kartono et al. [11], mangroves in Batu Ampar District are used by proboscis monkeys (*Nasalis larvatus*) only to find food and rest. The parts of mangrove plants consumed by proboscis monkeys (*Nasalis larvatus*) include leaf shoots (*Rhizophora mucronata, Rhizophora apiculata, Bruguiera gymnorrhiza, Bruguiera parviflora, and Acrostichum speciosum*), leaves (*Ardisia humilis & Alsophila sp*), fruit (*Ardisia humilis, Elaeocarpus sp. and Calamus sp.*), flowers (*Nypa fruticans*), and umbut (*Oncosperma sp.*)

3.2.2 Suitability of ecotourism. In general, mangrove ecotourism is very suitable to be developed in small islands with calm ocean currents, as well as in planning locations. Mangrove areas with many small rivers, good natural scenery, and good proboscis monkey habitat will attract tourists to visit [39]. Also, this area is included in a peat swamp ecosystem which has its characteristics with brownish-red river water. The land cover classification in the mangrove area of Batu Ampar is mostly in the form of brackish forests (mangroves) and lowland forests, and peat swamp forests [8]. So that this area has a potential beauty in the development of ecotourism areas as well as contributing to the preservation of natural resources around.

The uniqueness of the biodiversity contained in this mangrove area has an important role in saving the wetland ecosystem in Indonesia [8]. The area of mangrove forest that grows in peat swamp areas is land-cover that is prone to damage [13]. Seeing from the role of the strategy in the form of carbon storage and improving water quality, it is very useful for the future of the earth. Uncontrolled use of resources in the mangrove ecosystem is very possible in this area. The economic value of the area is a major factor in the process of changing land cover which is often carried out by human hands. Also, the status of the area in the form of Limited Production Forest (HPT) which has been established by the government has provided opportunities for deforestation of mangrove forests. For this reason, this area requires caution in utilizing this area. Sustainable development is one of the concepts needed in maintaining the condition of the area's ecosystem so as not to eliminate the ecological function of mangroves and peat swamps. So that it will always be considered in planning the development of ecotourism in Makabut later.

Based on the description of each parameter such as mangrove thickness, mangrove density, number of mangrove species, tides, and biodiversity, scores and assessments for the suitability of mangrove ecotourism can be made using the Geographical Information System (GIS) approach. After overlaying
all the parameters, the results of the suitability of mangrove ecotourism can be seen in figure 1. The spatial analysis of mangrove ecotourism suitability resulted in the development of mangrove ecotourism in the study location divided into 923.41 ha with very suitable criteria (S1) and 2,125.79 ha with unsuitable criteria (N). Zones that have a very suitable area value (S1) will be designated for the development of mangrove tourism by paying attention to the level of canopy density. Meanwhile, areas that are not suitable will be rehabilitated by replanting.

3.2.3 Mangrove ecotourism supporting capacity. The carrying capacity of mangrove ecotourism development in this study carries the concept of regional carrying capacity [20,21]. The total area of mangroves that is very suitable is 3,617.97 hectares. According to Yulianda [20], the ecological potential of visitors (K) in the unit area for mangrove tourism is one person for a 50 m (L) track. The time spent by each visitor to tour the mangrove is 2 hours (Wp). The average length of time provided by the area to travel in 1 day is 8 hours (Wt). Thus, the carrying capacity (DDK) of mangrove forests in the Batu Ampar area for mangrove ecotourism is 519 people day⁻¹.

3.2.4 The sustainability of development of the Makabut eco-tourism area. The location of the Makabut ecotourism area has various types of land uses such as swamps, shrub swamps, secondary swamp forests, and secondary mangrove forests. According to the PP, mangrove areas on each coast have a protected status to maintain the stability of the surrounding waters. The Makabut ecotourism development area is also located right in the Peat Hydrological Unit (KHG) zone which requires treatment and prevention in order to guarantee the sustainability of the designated area’s function. The location of the area is around Kapuas tributary delta and is still included in the Kapuas watershed has a condition in which spatial use must be 50 m from the river and 100 m from the coast.

3.3 Potential of tourism products
The development of an ecotourism area certainly requires a plan to increase the ability to attract large numbers of tourists [6]. Providing tourist attraction programs, improving facilities (amenities), and expanding the accessibility of tourists, are expected to have a real impact on the development of ecotourism areas [14]. In the analysis of the potential for tourism products, there are 3 important aspects that must be identified, among them:
3.3.1 Tourist attractions. Tourist attractions are an idea programmed in developing tourism that can satisfy tourists [32]. According to Nobela and Rahmanelli, [33], tourist attractions are divided into two groups, namely natural attractions and artificial attractions. After analyzing the mangrove, proboscis monkey, and peat areas of Batu Ampar, they have potential tourist attractions that can be developed to meet tourist satisfaction. Potential natural tourist attractions including:

Show utilization zoning consisting of an intensive use zone covering an area of 2094.34 ha and a jungle zone covering an area of 923.58 ha following the directions of Muryono [34]. Meanwhile, in zoning, the development of the area is divided into transaction zones (ports, offices, restaurants, etc.), association zones (pergolas and stages), resting zones (villas/cottages), attraction zones (fishing piers, mangrove paths, river bridges, and others) and support zones (equipment warehouses, water pumps, etc.).

3.3.1.1 Mangrove hiking. The expanse of the Batu Ampar mangroves is so wide that the area has the potential for mangrove tourism. One of the tourist attraction packages that can be adopted is the mangrove roaming tour. This tourist attraction provides visitors with an experience of how the mangrove stands. Tourism activities that can be provided include exploring mangroves using a wooden bridge (mangrove access pedestrian) equipped with mangrove species information boards and walking between stands and mangrove roots. By exploring mangroves, visitors are expected to feel the importance of the mangrove ecosystem as a protection for the mainland coast.

3.3.1.2 Education planting ground. Utilization of the area with the concept of ecotourism Makabut comes in an effort to maintain and increase the stability of the mangrove ecosystem in the area considering its status as an HPT area. In the study area, there are areas that are not yet in the form of mangroves, so mangrove planting efforts are needed to increase the area of the mangrove ecosystem. In addition to increasing the conservation insight of tourists, this program also has a positive impact on the mitigation of flood disasters that occur in this area [36]. The area planned as the program area is 34.06 ha.

3.3.1.3 Cultivation of mangrove crabs. Mangrove crab (Scylla serrata) is one of the mangrove ecosystem resources that can be used for ecotourism areas. Mud crab hatchery is an effort to rehabilitate this species. In addition, this program also features the use of mangrove crabs to support the supply of seafood in floating restaurants. The activities offered are hatchery, seedling release, and catching mangrove crabs.

3.3.1.4 Fishing mania. One of the concepts offered in the development of the Makabut ecotourism area is fishing. The fishing program is one of the tourist commodities that has a high enough tourist attraction [36]. This activity presents a tour package in the form of fishing and the results can be given to the servants of the floating restaurant to be processed.

3.3.1.5 Mangrove floating restaurant. The floating restaurant is an effort to use in supporting the desires of tourists and is believed to be able to provide comfort and pampering for tourists [6]. The floating house concept that is presented is in the tourist attraction zone by utilizing fishing docks. The catch of fish and mangrove crabs can be given to the waiter and processed directly in this floating restaurant. So that tourists can feel the simple sensation of using fish and crabs in the ecotourism area.

3.3.1.6 Mangrove herping (mangrove herpetofauna). The concept of herping is to promote activities to find and observe herpetofauna groups at night or during the day in certain habitat types by 2 - 4 people. These tourist groups are guided by tour guides from the local community who have been given knowledge about herpetofauna and conservation. Mangrove herping is expected that visitors can find out the herpetofauna animals that inhabit the mangrove ecosystem in the Makabut ecotourism area.
3.3.1.7 Follow a peat river. The concept offered is an activity in the form of exploring the tourist area using a canoe or boat with a certain capacity. Tour boats are flexible in exploring mangrove forests through water and transportation for various aspects such as bird watching, proboscis monkeys, dolphins, fishing, and related programs.

3.3.1.8 Observation of proboscis monkeys. The proboscis monkey habitat in the form of riparian forest along rivers, peat swamp forest, and dryland forest upstream of the river adds to an important opportunity in the development of ecotourism areas in the Batu Ampar area [37]. The concept of a proboscis monkey observation tour is to observe the proboscis monkey population in the ecotourism area via a boat or wooden bridge (wooden trail), a floating dock, and a viewing tower with a certain route and time. In efforts to conserve proboscis monkeys, this program is expected to be able to provide education about the behavior of the presence of proboscis monkeys as seed spreaders.

3.3.1.9 Birding. The presence of endemic and migrant birds in the ecotourism area of Makabut provides a potential that can be offered in the development of ecotourism. This program presents tourism activities by observing the behavior and activities of the birds. Tour packages are equipped with binoculars and information boards as a guide for tourists. This tourism program is expected to be able to provide education to tourists about the importance of the presence of birds as seed spreaders [38].

3.3.2 Amenities. Amenities are all supporting facilities that can meet the needs and desires of tourists whilst at their destination [6][32]. The physical design of the ecotourism area refers to the Regulation of the Minister of Tourism of the Republic of Indonesia Number 3 of 2018 concerning Operational Guidelines for the Management of Physical Special Allocation Funds in the Tourism Sector and is in accordance with local wisdom values. Zoning directions and the development of tourism production potentials produce a recommendation for physical development such as supporting infrastructure for ecotourism. In addition, supporting facilities for ecotourism in Batu Ampar Village are still very minimal, however, this village already has basic facilities such as ports and others. The Lack of supporting facilities for ecotourism is an obstacle that often occurs in the development of areas that have the potential to become tourist destinations [6]. Utami [6] states that the role of the community in helping to provide supporting facilities is very important. Recommendations for the construction of facilities include the main port, security posts, parking lots, prayer rooms, changing rooms and toilets, souvenir kiosks, pedestrian paths (wooden bridges), camping ground area, landscape overview, and proboscis monkey observation towers, Pagoda, Gazebo, mini villa (cottage), river suspension bridge, educational planting ground, and a floating restaurant.

3.3.3 Accessibility. Accessibility is the ease of visitor’s access to their destination, including comfort, security, and travel time [32]. The planned development site of Makabut tourist area is located in the strait which provides its own support capacity for shipping and making a dock for berthing ships. The closest access to the development location of the Makabut ecotourism area (Mangrove, Bekantan, and Peat) is from Peninjau Hamlet, Batu Ampar Village, as far as 7 km.

3.4 Regional development strategy
Regional Development Strategy (RDS) is the development of an area into an ecotourism destination. RDS requires in-depth analysis to determine factors that can slow down planning [26]. The study of the suitability and carrying capacity level of zoning, visual modeling, as well as the potential for tourism products, produces a priority projection for the planning strategy for the development of the Makabut ecotourism area. The projected planning strategy priorities are analyzed using the SWOT method considering the internal and external factors of the area. This analysis provides an overview of where an area is managed using strengths, increasing opportunities, reducing weaknesses, and avoiding threats. The SWOT analysis and the results of the strategy are presented in Table 5 and Table 6.
Table 5. SWOT analysis.

| Helpful | Harmful |
|---------|---------|
| Strengths | Weaknesses |
| Internal | |
| - Regional status: HPT | - Lack of public facilities |
| - Mangrove forest | - Lack of supporting facilities for ecotourism |
| - Proboscis monkey habitat | - There is no sustainable use of the proboscis monkey habitat |
| - Wetlands | - Lack of professional staff in the fields of tourism, conservation, and ecology. |
| - Geographical location (topography) | |

| Opportunity | Threats |
|-------------|---------|
| External | |
| - Mangrove tourism | - Mangrove forest encroachment |
| - Bekantan tourism | - Proboscis monkeys |
| - Tourism wetlands: peat | - Disruption of the KHG system |
| - River cruising tour | - Climate: potential for flooding |
| - Utilization of mud crabs | |
| - Many rivers | |
| - The location is easy to reach | |
| - Conservation of mangroves, proboscis monkeys, and peat | |
| - Place of research | |

Table 6. Regional development strategy.

| Opportunities (O) | Weaknesses (W) |
|-------------------|----------------|
| S - O Strategy | W - O Strategy |
| - Management license | - Complete public facilities in accordance with the conditions of the access point and ecotourism located. |
| - Make use of mangroves, proboscis, and peat areas. | - Development of supporting facilities for mangrove, proboscis, and peat ecotourism. |
| - Utilization of the access network through the water. | - Development of research and conservation centers. |
| - Conservation based and useful for the world of research | - Provision of professional staff |

| Threats (T) | |
|-------------|----------------|
| S - T Strategy | W - T Strategy |
| - Sustainable management of mangrove, proboscis, and peat areas | - Development of public facilities and supporting facilities for ecotourism to harmonize people's understanding of the importance of mangrove, proboscis, and peat areas |
| - Management of ecotourism areas that do not interfere with the KHG system | - Provision of professional staff in guarding the community for sustainable use of the area. |
| - Ecotourism management that anticipates flood disaster mitigation | - Improved flood disaster mitigation |
Results of the SWOT analysis resulted in a development strategy for the Makabut ecotourism area consisting of an SO strategy. The SO strategy provides strategic recommendations, mainly utilizing the condition of mangroves, proboscis monkeys, and peat as tourism potential, resolving land status problems, utilizing accessibility networks through waterways, and sustainable conservation-based ecotourism. This strategy was chosen by considering the strengths and opportunities in the area so that all the potential of the area can be utilized as well as possible whilst considering the limitations of this ecotourism development.

4. Conclusions

The MAKABUT eco-tourism is feasible to be developed into an ecologically based, participatory, and sustainable tourism area which results in a very suitable zone 923.41 ha and not suitable zone 2,125.79 ha. Potential products for ecotourism in MAKABUT include 9 attractions, 23 amenities, and 1 accessibility. The main strategies for developing the MAKABUT ecotourism area including the management clearance for institutional strengthening, facilities and infrastructure development, and human resources empowerment.

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