Landscape Design for Coastal Ecotourism of Jati Beach, North Sipora Island, Mentawai West Sumatera.

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Abstract Coastal area in Mentawai Islands has natural diversity ranging from coral reefs, great waves for surfing and the beauty of the beaches. However, facilities, infrastructure and human resources are still limited. Facilities and infrastructure are the most important things in developing a tourism. This research was conducted to determine the character of the landscape, potentially of constraints and analysis of user behaviour, perception and provide design recommendations for ecotourism development on Jati Beach in North Sipora Island. The method used the physical-biophysical, social, economic, cultural, tourism, oceanography, and conservation approach aspects using quantitative and qualitative descriptive analysis. The basic concept of the site is Arsa Metarpa is an extension of Arat Sabulungan and 3 principles of nature conservation efforts in Mentawai, metanoia, catharsis, and paripatia which are adaptations of the Mentawai indigenous beliefs in preserving the environment to develop aspects of conservation, education and recreation. The resources are flat landforms, typical Jati beach plants such as Barringtonia and pes-caprae coastal plants formation. The design concept that applied in the site is transformation from one of the symbols of the Mentawai, jaraik. Jaraik is a traditional element of Mentawai, commonly used in uma’ as welcoming. Its distinctive shape is transformed into the circulation pattern and the pattern of landscape elements in the site. The output of this research is limited to the landscape design phase, with the final product as site plan and other supporting technical drawings that can be used in design reference in the landscape of the ecotourism coastal in Jati beach.

Keywords: coastal, ecotourism, landscape design

1. Introduction

Indonesia is an archipelago that has a long coastline with diverse landscape characters. Based on data from the Geospatial Information Agency (BIG) in 2013 that referred to the results of the study of the Mapping of the Island Name Standardization Team, Calculation of the Coastline and the Area of Indonesia, it was stated that the total length of the Indonesian coastline was 99,093 km. With this coastline, Indonesia has a large potential of coastal resources. The beach is a landscape that is unique because it is an area where the meeting between the sea and land (ecotone). A beach can be developed as tourist area by providing services in the form of facilities for tourism needs in addition to a beautiful panorama to be enjoyed.[1]

Ecotourism development is managed by nature conservation and ecosystem balance. Tourism development at this time, still see from the short term with regard to the material benefits but does not pay attention to the long-term effects that will being damage. According
to Basyuni et al. [2] an effort to optimize the use of local resources is to develop tourism with the concept of ecotourism.

Mentawai was assigned as the Indonesian Marine Tourism Destination by the Ministry of Tourism, Post and Telecommunications of the Republic of Indonesia in 1998. The Jati Beach in Mentawai Islands has a diversity of marine nature, and the beauty of beaches. Communities around Mentawai coastline make the beaches in Mentawai island chain become places for recreational activities. However facilities and infrastructure are still limited in supporting tourism activities. Therefore, further studies are needed related to landscape in accordance with existing conditions on the site regarding the landscape design of coastal ecotourism areas on the Jati Coast of Sipora Island in the Mentawai Islands in West Sumatra so as to create an aesthetic, functional and sustainable landscape.

The objectives of the study of landscape design for coastal ecotourism in West Sumatra’s Sipora Beach are:
1. to identify, site characteristics and aspects related to ecotourism,
2. to analyze the potential and constraints on the site and develop concepts and,
3. to design a coastal ecotourism landscape in Jati Sipora Beach, North Sumatera.

2. Methods

2.1 Study site and period

This research was conducted in the Jati coastline of Sipora Island in the Mentawai Islands in West Sumatra. This research was carried out in November 2018 until July 2019. The location of the research area can be seen in Figure 1.

Figure 1 Research site

2.2 Research methods

The method used in this design research activities are as follows: 1. Inventory includes: (a) site observations; (b) to study literature from books/journals of reference data and maps information from various government agencies; (c) conducting interview (in-depth interviews) in the form of a questionnaire addressed to the 30 respondents of locals as potential users of the park; 2. Analysis and synthesis includes: (a) biophysical aspect ; (b) social aspects; (c) oceanographic, (d) tourism and (e) conservation aspects, (f) levels of comfort, and (g) Tourism Suitability Index (IKW). Measure of comfort level used the following formula:

\[ \text{Thermal Humidity Index (THI)} = \frac{(0.8 T + RH T)}{500} \]

\[ T : \text{air temperature (°C)} \]
\[ RH: \text{relative humidity of air (°C)} \]

2.3 Research Stage

Steps being taken in this research activity, namely: (1) preparation, formulation of the problem, research objectives, literature review, research proposal development; (2) data
collection which was conducted through site survey and studio activities in the form of desk study; (3) data processing, including process of analysis using descriptive and spatial approach, synthesis, and design.

3. Results and Discussion

3.1 Analysis and Synthesis

3.1.1 General Condition

Jati Beach is one of the public beaches frequently visited by surrounding communities, especially those who live on Sipora Island. Jati Beach is a beach whose coastline is found in Jati beach, Tuapejat Village. Before being used for tourist activity, Jati Beach was only a beach on which the shores consisted of coconut, mangrove and swampy production plants. The initial condition of Jati Beach was not well maintained, until finally there was a surfing community called Aggau surfing. The activity was carried out to form a comfortable place, because Jati Beach is where the Aggau surfing community gathered.

3.1.2 Physical and Biophysical Aspects

Site and Site Boundaries. Jati Beach is located in Tuapejat Village, North Sipora District, Mentawai Islands District, West Sumatra. The beach is located at coordinates 2°1'48.36" South Latitude and 99°35'3.98" East Longitude. The area of this research is 5.5 ha with a coastline length of 762 m. The northern part is bordered by the kampong settlement, the eastern part is bordered by the Jati hamlet and Tuapejat hamlet, the southern part is bordered by mangrove forests and coconut plantations, and the western part is bordered by the Hawera Strait.

Climate. The climate in Jati Beach is tropical with an average temperature of 26.75°C and an average relative humidity of 80.9%.[3] The THI value obtained at the site is 25.72. That value is still said to be comfortable according to Laurie [4] but is on the verge of an uncomfortable boundary. Therefore, these conditions must be maintained, one of them is by managing and planting several other vegetation. The use of vegetation is to maintain and improve the existing conditions. The type of vegetation used is the type of vegetation suitable for the beach area. Suitable coastal vegetation provides solutions for maintaining and lowering temperatures, and windbreak.

Topography and Slope. The slope of Jati Beach is 0-5% and included in the flat category. Jati Beach is located at an altitude of 2-5 meters above sea level.[5] According to Booth [6] site with a slope of 0-5% can provide maximum flexibility for development and accommodate large site elements such as the main building, parking lot, field, without causing equipment problems. Based on the classification of the Mid-Term Investment Program Plan (RPIJM) in Mentawai Islands Regency, the topography of Jati Beach includes coastal land flat land to low land areas. This type of coastal land/flat land topography is an area located near the coastal and which is lowlands and marshy. This type of coastal land/flat land topography can only be used for recreational activities on the beach, without any other supporting facilities because this area is an area that has the potential to be exposed to tidal areas. Meanwhile, to place the beach tourism supporting facilities can be done in the low land area because this area is an area that is free of tides.

Soil and Hydrology. The soil type in the coast of Jati Beach is alluvial soil. Alluvial soils are young soils originating from deposition results. Its nature depends on the origin brought by the river. Land in this area is classified as not sensitive to erosion. The drainage system in Jati Beach consists of an open irrigation system that directly flows to the beach. Inlet comes from the disposal of each resident's home in Jati Village. The open drainage system is located on the border of the administrative area of Jati Village in the north and south. Some drainage conditions have suffered damage from the concrete drainage built by the local village
government so that the water that will come out leading to the beach has blocked and settles in the channel. Poor hydrological conditions in Jati Beach cause stagnant water at several points when it rains.

**Circulation and Accessibility.** Circulation on the site consists of secondary and tertiary primary circulation. There are roads that can be passed by motorbikes and cars. In addition to the road car and motorbike, there is also a tertiary road that can only be passed by walk. The condition of primary roads traversed by cars and motorbikes is damaged, so that when it rains the road conditions become flooded. The primary road is a road made of concrete, the condition of the road to the tourist centre of Jati Beach is damaged, but the road that limits tourism and settlement is still good. Jati Beach tourism can be accessed by sea, land and air. Visitors from outside the Mentawai Islands, the journey starts from the Port of Bungus, the Port of Muara Padang, and the Minangkabau International Airport in Padang, West Sumatra. The location can be taken approximately 15 minutes from the pier Tuapejat.

**Visual and Acoustic.** The visual character of the landscape that dominates is the visual scenery of white sand beaches and beach vegetation of the natural landscape. Landscapes can provide positive and negative impressions for tread users. Natural landscape objects outside the site that give a natural impression as borrowing landscape, are the existence of two islands, Hawera and Alloita islands, which can be enjoyed from the ocean waves on the Jati Beach, which are part of the dominant acoustics felt on the Jati Beach. The waves give a soothing impression and become the main attraction when recreation to the coastal area.

**Facilities and Utilities.** The facilities at Jati Beach are available consisting of public and private facilities. Public facilities on the site are made and managed by the Mentawai Islands District Tourism Office, while other private facilities are facilities owned by residents around the coast. The types of public facilities found in Jati Beach are one signage, one skateboarding place for children and a viewing tower. Facilities that are managed privately by residents are eight eating places, three homestays namely Jati Beach Homestay, TJM Homestay and Aggau surfing Homestay. Homestay in Jati Beach consists of several types of sizes. Jati beach Homestay consists of two floors, on the first floor consisting of a terrace, dining room, and three bedrooms, on the second floor there are four bedrooms and one balcony. Jati Beach Homestay has two bathrooms, two garden lights, four spotlights, three gazebos. In addition to these facilities, there are facilities in the form of public toilets but are not managed properly so that all public toilets on the site are damaged and neglected.

**Vegetation and Animals.** The vegetation in Jati Beach is diverse and forms the Barringtonia Pes-caprae and mangrove coast vegetation formations. The characteristics of a succession of coastal forests are usually preceded by the dominance of vines namely Ipomoea pes-caprae in Jati Beach. Identification of types and functions in the vegetation site are vegetation functions proposed by Booth [6] consisting of structural functions (environmental uses), environmental functions (environmental uses), and visual functions (visual uses). The animals found on the site are animals that are maintained by the local and animals that live wild. The types of animals found are dogs, chickens, pigs, cows, lizards, and squirrels. The presence of animals on this site provides a natural atmosphere. The existence of Barringtonia vegetation formations and pes-caprae helps animals on the site to become a shelter and finding food.

### 3.1.3 Social
The social conditions on the site were identified to determine the characteristics of visitors and the community, the activities and intensity of users on the site, the desires and needs of site users from the questionnaire results from 30 visitors and 30 people around Jati Beach. Visitors
who come to Jati Beach come from the local community and from outside the Mentawai area to foreign countries. Some of the respondents’ activities on the site included enjoying the scenery, swimming, snorkeling, guiding tours, patrolling, culinary tours, traveling, surfing, taking pictures, and selling. The activity most frequently performed by users is enjoying the view on the Jati Beach, it is seen from the large percentage that reaches 29%. The intensity of users on site is most often done in the afternoon, as much as 74%. In the user desires questionnaire, 37% of respondents expect ecotourism designs on Jati Beach to be designed with many plants and 54% choose those plants to have lush leaves. Type of circulation desired 39% chose circulation with stepping stone. Material used as many as 73% of respondents want to use natural materials. The preferred shape to be applied on the site is organic formation.

3.1.4 Oceanography

The hydro-oceanography analysis is to determine the condition of each oceanographic element which is the scope of marine science that specifically studies the properties of sea water dynamic and the physical conditions of coastal biology that can support aspects of the development of coastal tourism in the Jatí Beach. The data will be analysed to determine the value of the Tourism Suitability Index (IKW) with the scoring method in the development of coastal ecotourism and Jati Beach. The results of the assessment matrix can be seen in Table 1.

| No  | Parameter                  | Condition          | Point | Suitable class | Suitable Score | Ni |
|-----|----------------------------|--------------------|-------|----------------|----------------|----|
| 1   | Depth                      | 0.96 m             | 5     | S1             | 3              | 15 |
| 2   | Beach type                 | Pantai Pasir putih | 5     | S1             | 3              | 15 |
| 3   | Beach width                | 10-12m             | 5     | S2             | 2              | 10 |
| 4   | Ocean base material        | sand and coral     | 5     | S2             | 2              | 10 |
| 5   | Ocean current              | 0.22 m/s           | 5     | S2             | 2              | 10 |
| 6   | Availability of water      | 100m               | 5     | S1             | 3              | 15 |
| 7   | Coral cover                | 26.27%             | 5     | S2             | 2              | 10 |
| 8   | Sea brightness             | 16.5 m             | 4     | S1             | 3              | 12 |
| 9   | Slope                      | 3                   | 4     | S1             | 3              | 12 |
| 10  | Coral life form            | *Porites, Montipora Acropora* and fungia | 3 | S3 | 1 | 3 |
| 11  | Coral depth                | 5 m                | 3     | S1             | 3              | 9  |
| 12  | Coral width                | 124 m2             | 1     | S2             | 2              | 2  |
| 13  | The dangerous biota        | sea urchins        | 1     | S2             | 2              | 2  |
|     | **Total**                  |                    |       |                |                | 125|
|     | **N Max**                  |                    |       |                |                | 153|
|     | **IKW**                    |                    |       |                |                | 81%|

S1 = very suitable
S2 = suitable
S3 = conditional
N = unsuitable

The analysis results of the Tourism Suitability Index (IKW) for beach tourism obtained IKW value of 81%. This value indicates the feasibility of Jati Beach ecotourism as an ecotourism area. Based on the results of the analysis the value of 81% is a value that is included in the S1 category or a category very suitable to be used as beach ecotourism, snorkeling and diving from the oceanographic aspect.

3.1.5 Tourism

The aspects that affect tourism on the Jati Beach namely, accessibility, circulation, objects and attractions of tourist attractions, supporting facilities, visitor perceptions, information and
promotions. Transportation that can be used to get to Jati Beach is diverse. For tourists who come from outside the Mentawai Island can use ships from the Port of the City of Padang, and aircraft that go to Rokot Mentawai Airport. Whereas transportation that can be motorized vehicles and cars. Minimum public transportation is a barrier in the development of tourism in Mentawai. Information related to tourism in Jati Beach is still limited to get complete information. The information currently available is still obtained by visitors who upload it on social media. Promotion conducted by those responsible for tourism development in Jati Beach in this case the local government in the form of opening a booth for tourist information at the Minangkabau International Airport and using brochures, magazines and conducting online promotions in the West Sumatra Province through the website sumbar.travel.com. Objects and attractions developed in Jati Beach are still limited to tourism on the beach and culinary. Natural resources found in the site such as the existence of coconut plantations and mangrove forests to the social activities of surrounding communities can be used as a tourist area.

The ecotourism aspect is very influential on the carrying capacity of the region to determine the maximum site requirements to be managed as an ecotourism area while still preserving the condition of the Jati Beach landscape.

3.1.6 Conservation aspect
The analysis of conservation aspects refers to research [8] conducted to find out the areas identified as protected areas so that continue to be maintained. Ecotourism development is very influential on the sustainability aspects of the area. The parameters of conservation aspects that are used are: (1) critical resources, (2) rare and endangered vegetation and fauna (3) disaster prone areas and (4) protected areas and protected functions.

| No. | Conservation Aspect | Condition |
|-----|---------------------|-----------|
| 1   | Critical Resources  | Critical resources identified in the Jati Beach are coral reef ecosystems. Jati Beach is generally a massive live coral of the Porites group, while on the reef slopes it is generally forked and Fungia Montipora [9] |
| 2   | Rarely of flora and fauna | Rare flora and fauna are not found in the Jati Beach area. Vegetation found in Jati Beach is pes-caprae beach formation, Barringtonia and cultivated plants owned by residents around the coast. |
| 3   | Disaster area       | Based on data from the Regional Disaster Management Agency in the Mentawai Regency, the Jati Beach area is an area that has the potential for earth quake and tsunami disasters. |
| 4   | Protected area      | Jati Beach is an area that is included in the utilization zone conservation area. utilization zone is a zone that can be developed as a habitat for fish habitat and population protection, tourism and recreation, research and development and education. Conservation that has been done in the waters of Jati Beach is the conservation of clams which is also used as a place of research and typical tourist attraction of the Jati Beach |

3.2 Basic Concept
The basic concept that will be developed in this research is Arsa Metarpa. Arsa Metarpa is an extension of Arat Sabulungan and 3 principles of nature conservation efforts in Mentawai, namely metanoia, catharsis, and paripatia. Arat Sabulungan is the belief of the Mentawai indigenous people in preserving nature. Arat means tradition Sa means bundle and bulungan means leaf. They call it Arat Sabulungan because in every ritual they always use leaves that are believed to be able to connect humans with the Almighty or referred to as Ulau Manua.
Basically, Arat Sabulungan teaches a balance between nature and humans. This belief teaches that humans must treat nature, plants, water, and animals as he does.

### 3.3 Design concept
The design concept of the Jati ecotourism landscape design is jaraik. Jaraik is a highly artistic ornament made of holes, this decoration is the place to put the bokkoi oak skull in the first hunting after the inauguration ceremony aboard the uma, and is related to a powerful talisman. Jaraik is often used by the Mentawai District Government as a symbol of tourism. Jaraik has become an object of great importance for the Mentawai people as a form of gratitude for nature that has provided many benefits, so it is used as a place to put the skulls of game animals. The jaraik design concept is used as a concept to determine the appropriate lines as a design of landscape patterns and other landscape elements.

![Figure 2. Design Concept](image_url)

### 3.4 Development concept
The concept of development is a concept that is compiled in full in accordance with the basic concepts created previously at this research stage. The concept of development describes each concept specifically which includes the concept of space, the concept of sequence, the concept of circulation, the concept of vegetation, the concept of ecotourism, and visual concepts. The concept of spatial development in the research site is formed from the function of space, the type of space and activities to be developed. Spaces that will be developed are reception room, service room, recreation room and conservation room. Circulation that will be developed at the site are primary, secondary and tertiary circulation. Placement of the primary circulation at the site is carried out to make it easier to control the flow and safety at the site. Primary circulation width is 6.5 to 8 m for the parking area. Secondary circulation is a circulation that can be accessed inside the site by bicycle and pedestrians. Secondary circulation width is 1.5 to 2 m. Tertiary circulation is a circulation that can be accessed on foot. Tertiary circulation is intended for mangrove conservation areas in the form of decks and pedestrian paths in homestay areas, and culinary areas. The concept of sequences explains the sequence of activities and the duration of time spent starting from entering the tourist area to the end. This concept is planned to bring the movement of tourists so that they can enjoy all the space, activities and attractions contained in the site. The concept of sequence is based on the tourist attractions that will be proposed and the time required by visitors to carry out tourist activities on Jati Beach.
The concept of vegetation refers to the results of vegetation analysis which is based on vegetation functions proposed by Booth [6] which consists of structural functions (structural uses), environmental functions (environmental uses) and visual functions (visual uses). The hydrological concept that will be developed is by utilizing the constraints on the site by maximizing the potential of the coastal landscape. Constraints on the site that occur several puddles and several places form a swamp, the hydrological concept designed is related to stormwater management.

In this study, three alternative designs were made prior to making a site plan and one would be selected based on the results of analysis and synthesis, as well as the preferences of respondents (Figure 3). The final design selection is done by distributing questionnaires to 30 respondents.

Figure 3 Design Alternatives

From the results of these preferences it can be concluded that the most preferred alternative design is alternative design 3 with the percentage of respondents who chose it 54.5% of the total respondents. Alternative design 3 chosen by respondents is not all used directly. That is because some respondents gave input to add the traditional impression of Mentawai in the design, and the addition of several facilities such as toilets in all planned spaces.

The design of ecotourism in Jati Beach has four different areas based on the function. It consists of welcome area, service areas, recreation areas, and conservation areas (Figure 4). The reception area is welcomed with signage made to resemble two poles found in a traditional ‘uma’ house, located in the parking entrance area of the outer part of the Jati Beach tourist area with a combination of reliefs typical of Mentawai animals as a welcome at Jati Beach. Then after that pass through the road to enter the tourist area which is located along the coast and planted with coconut vegetation as a steering function and facilities in the form of information boards, signage, and lights. Then, when entering the tourist area there is a panoramic view that is designed in the form of decking to enjoy the sunset view on Jati Beach. This panoramic view has a level difference of about 3 m from the ground. This is because the area is an area that will be exposed to ocean tides so to avoid this the deck is designed higher. After the spot of panoramic view there is a surfing training area designed for surfing training activities before surfers going directly to the high seas. This area is equipped with information boards in the form of interpretation boards and amphitheatre for the end. Around the recreation area there are several gazebos designed by taking the concept of the Mentawai traditional house into consideration. Along the border of the beach visitors can enjoy views of the white sand sea by doing beach stretching activities, walking, swimming and taking
photographs. Outbound activities can also be done in recreational areas. After the recreation area, there is a service area consist of a culinary area, lodging, and several gazebo facilities.

(a) Block plan; (b) Site plan; (c) Overall perspective; (d) Section

Figure 4 Illustration of some functional areas

The conservation and education room is the main space that is developed in the Jati Jati ecotourism. The conservation room is in the form of an area of water which is a place of conservation of clams and mangrove forests that have been associated with other coastal formation plants. Mangrove conservation area is a space developed for nature interpretation
activities by looking at mangroves and other coastal plants. The interpretation of nature in mangrove areas can be an educational area for knowledge of coastal plants. Facilities to be developed in the mangrove conservation area are interpretation boards, signage, garden lights, sky-walk. The kima conservation room is an area below sea level which is an area for research, education and recreation activities. The facilities needed to support the kima conservation activities are diving centre, snorkeling centre, signage, gazebo, bench, changing room and toilet.

4. Conclusion and Suggestion

4.1 Conclusion
Jati Beach has a flat topography so it is potential to be designed without interference from the height difference. The existence of abrasion and tidal water in certain areas causes some facilities to be designed with a higher altitude to avoid this. The design of the Jati Jati ecotourism landscape has the basic concept of Arsa Metarpa. Arsa Metarpa is an extension of Arat Sabulungan and 3 principles of nature conservation efforts in Mentawai namely metanoia, catharsis, and paripatia which are adaptations of Mentawai traditional beliefs in preserving the environment to develop aspects of conservation, education and recreation. The design concept was inspired by the cultural elements of Mentawai. The jaraik formations are applied to design patterns, and other forms of landscape element design. Development concepts developed are the concept of space, the concept of sequences, the concept of circulation, the concept of vegetation, the concept of ecotourism, and the visual concept.

4.2 Suggestion
The Jati Beach landscape is a beach that has terrestrial and underwater ecotourism potencies. Some of the natural resources found in Jati Beach are protected natural resources. So that in the development of ecotourism must pay attention to the sustainability of the landscape on the Jati Beach. Therefore, it is necessary for the intervention of the local government and the community in the development of tourism in Jati Beach so that it can provide benefits in terms of the economy and landscape sustainability aspects.

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