The coastal design of the Sumur Tiga beach as a coastal tourism destination

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Abstract. The East Coast of Weh Island, Aceh has good ecological conditions with high coral fish biomass. The coastal tourism activities spread over the east coast of Weh Island, especially at Sumur Tiga Beach. The tourism activities in Weh Island especially Sumur Tiga Beach can certainly contribute to the development and economic sectors and also have an impact on the surrounding environment. Thus, an alternative landscape design is needed for structuring the site to create environmental preservation, and sustainable tourism. This study aims to identify the elements and characteristics of the site, analyze-synthesize the potential and constraints of its coastal landscape, and create the concept and design of the landscape. The study was located in Sumur Tiga Beach, Sabang City, Ie Maulee District, Sukajaya Village, Weh Island, Aceh. The method includes several aspects, such as physical and biophysical, tourism, social, and hydro oceanography which is using both qualitative and quantitative descriptive and spatial analysis. The basic concept is "Adat ngon hukom lagee dzat ngon sifeuet" which is implemented into three concepts, such as hablumminallah, hablumminannas, and hablumminalalam. This concept is used to determine the design concept. then the development concept and block plan are determined then used as a reference in developing alternative designs for the site. And from these alternatives, the final design for the site is concluded. The design concept is a metaphor of "Ragam Hias" refer to the Acehnese motifs, such as pucuk reubong, awan si on, awan meucanek, putra taloe dua, and sulur. Such as gazebo, main gate, main hall, main signage by a form that comes from a pucuk reubong motif with the additional pattern of acehnese culture, also plantation and circulation patterns using a combination of pucuk reubong, awan si on, awan meucanek, putra taloe dua, and sulur motifs. There are also seawalls on the shoreline to avoid abrasion due to high sea waves and wind speeds that blow quite fast during the east season.

Keywords: coastal landscape, coastal tourism, sumur tiga beach

1. Introduction
Indonesia was an archipelago that consists of 17,508 islands and a shoreline of 81,000 km with potential for enormous coastal and marine resources. Indonesia’s natural marine and coastal resources such as fishery resources, biological resources (biodiversity), and mineral resources. One of the potentials that can be utilized from these resources is coastal tourism. Coastal tourism activities are [1] recreational activities around the coastline while enjoying natural surroundings. Thus, it can be an option for utilizing coastal landscape resources in Indonesia. One of these coastlines was located on Weh Island, Aceh.

The beauty of the coastline founded in Weh Island has become the point of interest for tourism destinations for both local and foreign tourists [2] which was proved by the increasing number of foreign tourist visits to Weh Island in 2016-2018 (0.6%). One of these coastline zones in Weh Island was the east coast. The east coast has a coral reef ecosystem with 54.33% for the percentage of living in the conservation area and classified as "good" category, as well as around of conservation area with a percentage of 33.05% [3]. Meanwhile,
the abundance of reef fish reached 214 species in conservation areas and 159 species outside the conservation areas and classified as good conditions with high reef fish biomass. One of the beaches included on the east coast was Sumur Tiga Beach.

Sumur Tiga Beach was well known for its beautiful scenery on the east coast of Weh Island. It was a flat and white sandy beach with ocean waves and overgrown Barrington trees along with the site. Some of the tourist activities that can be done at Sumur Tiga Beach are swimming, playing, snorkeling, diving, relaxing, photography, walking along the beach, enjoying the beauty of nature, and more.

The high number of tourism visits can certainly benefit the surrounding beach. One of them was improving the welfare of the surrounding community, especially in the tourism sector. Also, increasing tourism activities can advance infrastructure and facilities that support these tourism activities. However, the increasing number of visitors harms the environment, such as shifting the existence of natural ecosystems on the site. The increasing development activities and the population on the mainland will lead to depletion of land resources, thus coastal areas and surrounding islands will become the foundation of hope for future economic development [4]. If there is no proper arrangement, especially on Sumur Tiga Beach, it will disturb the natural ecosystem on the site and decreasing the quality of the landscape. Thus, to overcome this problem, we must set the plan for designing Sumur Tiga Beach as a sustainable coastal tourism destination. One of them is through research on the landscape design of Sumur Tiga Beach on Weh Island.

2. Methods

2.1 Research location and term
The study was located at Sumur Tiga Beach, which is located on Weh Island, Le Maulee Village, Sukajaya District, Sabang City, Aceh Province. The coordinates was 5 ° 53'35.54 "U & 95 ° 20'18.58" T (Figure 1). The research was held for ten months (November 2019 -August 2020).

![Figure 1 Research site](image)

2.2 Research methods
There are four approaches used for the research, physic & bio-physic, social, tourism, and
hydro-oceanography. The research stages [5] are project acceptance, research/analysis, concept, construction drawing, implementation and post-construction, and evaluation maintenance. However, the steps are limited to construction drawing in this study. The concept stage started with basic concepts, then used to determine the design concept. Furthermore, the development concept is selected and the block plan is used as a reference in developing 3 alternative designs for the site then the final design for the site is determined from these alternatives.

3. Result and discussion

3.1 General condition

Sumur Tiga Beach is usually visited by tourists and local people on Weh Island. It is located in Le Maulee Village, Sukajaya District, Sabang City, Aceh. Based on interviews from several stakeholders, it has a reasonably complex management system because of its position in the center of Sabang City and the presence of several facilities that have the potential to be developed into tourism interest. However, some potential aspects, both in terms of natural resources, tourist attractions, availability of facilities, and management which involving many parties, have not been able to make the site become good coastal tourism because of the management system is not running properly. This problem must be explored to find a solution to this problem and become a reference in structuring the landscape of Sumur Tiga Beach.

4. Analysis

4.1 Physical and biophysical aspect

4.1.1 Location and boundaries

Based on the survey, the site is close to residential areas and the city which eases the accessibility and ensures the availability of facilities and utilities. The existing element that has the potential to become a barrier is *Pterocarpus macropilus* which is planted in rows. The location of the site is included in the red zone for tsunami and abrasion disasters and also the red zone for ground movement disasters [9]. The level of disaster vulnerability is one of the limiting factors in the identification of conservation and tourism zones. The location of the beach in the disaster zone can be an inhibiting factor for the development of coastal tourism and needs to be considered carefully. The strategic location of the city can be an advantage in the landscape design of Sumur Tiga Beach by improving the visual quality of the entrance and utilizing natural boundary vegetation. However, disaster zone aspects need to be attended to in landscape development by controlling elements of the site that affect the disaster, such as slopes, vegetation, hydrology, and so on.
4.1.2 Climates
The criteria for comfortable temperature and humidity can be found through the Thermal Human Index (THI) equation. Comfort criteria have an index value of 21-27°C and uncomfortable > 27°C. Based on the data obtained, the average temperature on the site is 27.40°C with a humidity of 84.3%, and the comfort index value is 26.53 which is included in the comfortable category. The average wind speed reaches 7.02 knots (13.11 km/hour) and is included in the very weak wind category [10] on the Beaufort scale with the effect of the wind being felt on the face. The average rainfall is included in the moderate category, which is 142.9 mm³.

The higher the albedo value, the higher the temperature and reduces the level of comfort [11]. Based on the survey results, the site climate conditions which are dominated by vegetation cover have a low albedo value and have a good level of comfort. Some of the factors that reduce comfort on the site are sun intensity, wind speed and rainfall. High sun intensity with moderate rain can reduce comfort on the site, especially in arid land cover conditions, so it is necessary to provide shade in the form of a gazebo or shade vegetation. A practical canopy shape is used to prevent temperature increases, such as around and open canopy shape that can reduce the average temperature by about 20°C and increase RH by 5% [12] while a gazebo can block direct sunlight on the site. Wind speed affects wave speed and tourist activities on land, so it is necessary to add barrier vegetation and wave retaining walls along the shoreline to prevent abrasion.

4.1.3 Topography and slope
Topographic and slope analysis refers to slopes [13], topographic conditions, and slopes at site divided into 2 types, 2-5% slope, which is included in the flat, and sloping 15-40% which is included in the steep category. 0-5% slope is an ideal area with various spatial functions and does not need to face problems in terms of grading or land engineering [5]. However, it can give the impression of being monotonous because there is no variation in the surface of the ground, there is no room for protection from disturbances so that access to one's privacy is blocked. Also, sites that have a slope of 0-5% have a chance of problems with drainage because of the flat ground surface. The 10-15% slope of the land can provide a broad direction of view and is a potential for site development, but is considered too steep for various land uses.

According to the survey results, the site has a sloping and steep topography. Sloping topography is located around the welcome area and sandy area that has the potential to become the center of inland coastal tourism activities, while the steep topography is located in the middle of the site which is limited in its development. The synthesis of the analysis results needs to pay attention to the site slope conditions. Flat topographical sections can be utilized to support general footprint factors such as central buildings, parking areas, yards, externally making facilities difficulties. At a slope of 1% the footprint can be used for lawn use, while at a slope of 2% it can be used for making pavements and sidewalks. Steep topography requires site engineering through cut and fill or creating retaining walls to minimize and avoid erosion problems.

4.1.4 Hydrology and soil
Analysis of soil refers to the classification of soil types [13]. Types of soil composition at Sumur Tiga Beach consist of brown podsolic soil, red yellow podsolic, and grumosol which are sensitive to erosion and soil class 4 so that they can be an inhibiting factor in the landscape design of Sumur Tiga Beach. The synthesis of the analysis is the arrangement of other landscape elements such as the use of slopes, vegetation and different existing potentials to compensate for these weaknesses.

The source of water for residents at Sumur Tiga Beach which is located in Ie Maulee Village is obtained through springs and groundwater extraction / dug wells with a distance
of 0.01-0.1 km from the coastline [14]. Based on survey, the drainage at site used open drainage system with inlets originating from settlements and outlets leading to the sea. There are two open drainage streams found on the site with size 20-50 cm in cement cover covered with leaf litter. This condition causes the possibility of blockage of the drainage outlets on the site. Also, there is a runoff flow on sloping and steep soil conditions. This runoff flow can cause inundation on sloping areas, and erosion on steep areas.

The synthesis of hydrological analysis is to maximize the absorption of rainwater to maintain the volume of groundwater around the coast. By preserving the volume of groundwater, it can prevent the erosion of fresh groundwater by salt water. The absorption of rainwater can be realized by maintaining vegetation in a steep area to increase the absorption of runoff flow into the soil and prevent erosion, constructing infiltration wells, and adding drainage networks.

4.1.5 Accessibility and circulation
Analysis of circulation and accessibility refers the level of site accessibility based on the total distance traveled [15]. The distance from Sabang City to the site is 2.1-2.3 km and Balohan Port to Sabang City is 10-11 km, so the accessibility from Sabang City to the site is in the high category, while the accessibility from Balohan Port to the Sabang City is in the very low category. The synthesis of the accessibility analysis is the addition of public transportation modes such as buses and public transportation to make it easier for tourists for accessing the site. Also, the provision of bicycle rental facilities by the Sabang City government can be a transportation solution to a site that is close to the Sabang City.

Based on the survey, the condition of circulation path on the site is divided into two types, pedestrian and vehicular. The pedestrian path is still natural in the form of land and grass cover without any apparent pattern. The vehicular line is only in the welcome area to the main parking and signage with truepave cover. The lack of circulation paths with a clear pattern causes user activity to focus only on the welcome area, as well as the sandy area along the beach. Synthesis in circulation analysis is defining the vehicular road type for the Pantai Sumur Tiga design must have a road width of 6.5 meters [13]. Based on the map of the Weh Island ring road development plan, there is a planned road area to pass through Sumur Tiga Beach, so it needs to be planned in the development of the landscape design.

4.1.6 Facilities and utilities
Based on the survey, it is necessary to utilize the Sabang fisheries culinary center building as a restaurant, marine gallery, and art market. The survey results also recommend to utilize a fishermen information center building as a management office and club house and a lawn area as a play and recreation area. It also recommends constructing several new facilities such as a wooden deck, welcome area, panoramic spots, gazebo, benches, shelters, gates, and wayfinding. The survey also recommends replacing prominent signage for supporting coastal tourism activities. Analysis of utilities explain the provision of electricity networks sourced from PLN or generators, providing lighting on the site, procurement of waste disposal systems to city landfills and addition of landfills on-site, and planning additional drainage such as absorption wells and water channels [16].

4.1.7 Visual and acoustic
Analysis of visual and acoustic is based on on-site observation. Good views become potential aspects that must be maintained and developed, bad views become an obstacle in the site. Good views on the site are available such as a white sandy beach with rows of coconut trees along the shoreline. This goodview needs to be maintained by preserving the vegetation on the beach and adding a panoramic spot as a place to watch the view. There is also a Bad view of garbage and household waste such as plastic, wood, paper, and others piled up on the
beach and around the homestay. The bad view can be solved by adding trash can facilities at several points to prevent people from littering. Also, several facilities such as gazebos and viewing towers have been damaged so it is necessary to maintain the facilities by involving residents. The source of the acoustics on the site is the ocean waves sound from the site. These sources are potential that gives a natural impression on the site, thus the synthesis is maintaining the acoustic source and add other acoustic sources such as friction sounds such as coconut, sea cypress and others with the plantation around the coast.

4.1.8 Vegetations and animals
Analysis of vegetation refers to vegetation function [5] which consists of fundamental values, environmental values and visual values. In terms of the structural function of vegetation such as coconut (Cocos nucifera), beach naupaka (Scaevola taccada) planted on steep topography giving the barringtonia landscape character to site. Based on environmental functions, sea cypress (Casuarina equisetifolia), banyan (Ficus citrifolia), and ketapang (Terminalia catappa) on the site play a role in climate amelioration and windbreak. Barringtonia tree formations also function as a deterrent to erosion on steep topography and increase the absorption of rainwater. Vegetation rows of Pteropilus macrocarpus at several points on the site act as natural boundaries. In terms of visual functions, the stretch of biduri (Calotropis gigantea) around the fishermen’s information center building provides a good visual. The expanse of Zoysnia matrella around the main signage gives an expansive visual feel.

The synthesis of vegetation analysis is maintaining and increasing the presence of existing vegetation and increasing vegetation with certain functions on the site, such as vegetation with visual functions in welcome areas and recreation, environmental functions in recreational areas as windbreaks, and structural functions in the form of barriers on the boundary of the footprint, as well as on the circulation route. Analysis of animal refers to site survey. Existing animals such as cows, goats and chickens are livestock that are kept by residents and spread in the site, causing some dirt which scattered on the site and reducing the beauty. The synthesis is the addition of a grassy area for livestock and the addition of vegetation boundaries in that area.

4.2 Tourism aspect
In this study, the tourism aspect [7] divides the tourism aspects into tourist attractions, tourism services, transportation, information, and promotions. Based on on-site observations, halal tourism services have met the requirements on the site. Various written rules [17] governing halal tourism in Sabang City and accordance with the values of local wisdom of the community. Transportation to Weh Island only through fast boats and ferries. Based on on-site observations, there are no public transportation due to the large number of vehicle rental services in Sabang City. Synthesis of this problem by making tourist rules that equalize vehicle rental prices, and tour packages coordinated by pokdarwis of each village in promoting tourism in their area. Information related to the advantages and natural resources of Sumur Tiga Beach is still limited regarding the sloping white sand, even though there are many other advantages can be known by users when visiting the site. The promotion of tourism activities at Sumur Tiga Beach can be increased through good cooperation between parties in providing tourism services, both government and non-government actors. One of them is through the Sabang Calendar of Events which features events at Sumur Tiga Beach. Promotional activities can also be carried out by the community using social media through the use of commonly used hashtags, such as #visitsabang, #wonderfulsabang, #sumurtigabeach, and others. The tourism activities proposed as tourist attractions are coast walk, camping site, culinary center, panoramic spot, and coastal garden.
4.3 Social aspect
Analysis of social aspect refers to the user's perception on the site which is based on the characteristics, hopes, desires, complaints and activities that they carry out on the site. Based on the results of questionnaire, the most familiar coastal tourism activity on the site is relaxing in the beach area (83.3%). Then playing activities around the beach and along the beach sand (75%) and (71.1%), enjoying culinary around the beach (61.7%), looking for shells and unique rocks (50%), swimming around the beach (45%), snorkeling (38.3%), staying at hotels / homestays (35%), diving (28.3%), and fishing (15%). Also, there are other activities such as camping and drinking coconut water. Most complaints when at Sumur Tiga Beach are a lot of rubbish (25%). Also, there are respondents' perceptions about expectations for landscape design of Sumur Tiga Beach. The questionnaire's results show that the most desirable type of land cover is grass, leafy vegetation, natural material, non-paved circulation, organic pattern, analogue colors, tropical garden style, and terraces land type.

4.4 Hydro-oceanography aspect
The hydro-oceanographic aspect is a physical parameter used in determining the suitability of resources for coastal tourism purposes. Study from propriety of resources for coastal tourism destinations Sumur Tiga Beach [1] divides the assessment into two categories, namely coastal tourism activities and marine tourism activities. The results of the analysis of the Tourism Suitability Index (IKW) value for the Sumur Tiga Beach tourism in tables 2,3 and 4 obtained the IKW value of 81.86% for the suitability of coastal tourism and 86% for the suitability of marine tourism. Based on the results of the analysis, the values of 81.89% and 86% are values that fall into the the appropriate category to be used as a coastal tourism area.

5. Concept
5.1 Primary concept
The concept in the development of Sabang City tourism [17] was stated as a development of marine tourism products with history and geology refer on the principle of halal values and local wisdom values. The connection between halal values and local wisdom in Aceh law cannot be separated from the slogan "Adat ngon hukom lagee substance ngon sifeuet" which is a reflection that local wisdom and Islamic Sharia law, become one such as substances and nature, and cannot be separated each other [18]. It because Aceh's culture was based on Islamic law which comes from the Al Quran and Hadith. This motto become the primary concept in developing the landscape design for Sumur Tiga Beach. From these concepts, there are three Islamic concepts in human behavior that can be adopted in the development of landscape designs on Sumur Tiga Beach. These are hablumminallah (human interaction with their God), habluminannas (human interaction with each other), and hablumminalalam (human interaction with nature and surrounding creatures). These three interactions are applied to the three concepts of developing the landscape design for Sumur Tiga Beach.

5.2 Design concept
Based on the primary concept derived from "Adat ngon hukom lagee substances ngon sifteuet", it provides an overview of the design concepts that will be applied in the landscape design of Sumur Tiga Beach. The design concept must provide design and cultural linkages with cultural centers such as Banda Aceh, Aceh Besar and others. Thus the design concept adopted is a metaphor from Ragam Hias which originates from the richness of Acehnese motifs, such as pucuk reubong, awan si on, awan meucanek, putra taloe dua, and sulur. For example, Putra Taloe Dua as the roof formation in the gazebo, shelter,tents, main gate.
and hall roof, *sulur* on the main signage, and the combination of these patterns in planting patterns and circulation patterns.

### 5.3 Concept development

Concept development is compiled after determining the primary concept and design concept. In this research, several development concepts that will be described specifically consisting of the concept of space, the concept of circulation, the concept of sequences, the concept of vegetation, the visual concept, and the concept of hydrology. The concept of spatial development divides the landscape into zones according to their activities and functions on the site, which are reception zone, recreation zone, service zone, and conservation zone.

Circulation planned at the site is divided into primary, secondary, and tertiary circulation. The primary circulation is 5 meters wide to accommodate vehicular and pedestrian circulation with asphalt and Classico tile cover. This circulation is planned with a maximum slope of 4% and grading at several points to facilitate people with disabilities. Secondary circulation accommodates pedestrian circulation and becomes a link between one room and another so that it is planned that it is mainly located on the site. To support user activity, this circulation must be equipped with a ladder, ramp and handrail. Tertiary circulation is a type of circulation that foot travelers can only enter, so it is only equipped with stairs and handrails. The Circulation path utilizes materials such as pavement and wooden decks.

The concept of sequence describes the array of motions carried out by users in enjoying tours on the site. The planned sequence concept is 20-40 minutes in the reception zone, 2-3 hours in the recreation zone, 1 hour in the conservation zone, and 60-90 minutes in the service zone. With the concept of sequence, it is hoped that the user can understand the meaning and pattern of space in a sequential site arrangement in the tourist area.

The concept of vegetation divides the types of vegetation based on the functions that are on the site. There are five types of functions planned in the development of Sumur Tiga Beach design, display function, barrier function, shelter function, conservation function, and windbreak function. The visual concept developed refers to the synthesis of visual analysis on the site, by maintaining and increasing the presence of good views and eliminating bad views by adding landscape elements such as trash cans, vegetation screens, and others.

The hydrological concept aims to preserve the availability and quality of water in the three old wells at Sumur Tiga Beach by increasing groundwater absorption when it rains. The vegetation was planted on steep topography to conserve groundwater. The effort to conserve groundwater are also obtained by constructing retaining walls, terraces, implementing permeable
pavement material, infiltration wells, retention ponds, and open drainage networks that can drain water to infiltration wells.

6. Design
The final design siteplan begins with making three design alternatives by the results of the block plan and the concepts that have been made by considering the functions, activities, and supporting facilities. These three alternative designs refer to design concept that is applied through decorative compositions in determining vegetation patterns, circulation, building forms, and landscape furniture. Furthermore, the three design alternatives were selected through the questionnaire results that had been distributed to 30 respondents.

Based upon those issues of poll respondents' preferences for those three alternative designs, the most chosen alternative design is alternative design 2 at 43.3%. The site plan made in this final design is based on the development of an alternative design 2. The landscape design of "Sumur Tiga Beach" was performed by a predetermined design concept, including the gazebo, main gate, main hall, prominent signage, the pattern of the plantation, and circulation networks. The form of the "pucuk reubong" motif with an additional pattern of Acehnese culture patterns was implemented in the main gate design. The form is a combination of pucuk reubong, awan si on, awan meucanek, putra taloe dua, and sulur motifs. There are also seawalls on the shoreline to avoid abrasion due to high sea waves and wind speeds that blow quite fast during the east season.

7. Conclusion and Suggestion

7.1 Conclusion
Sumur Tiga Beach is one of the white sandy beaches on Weh Island which has coastal tourism potential. There needs to be a landscape design to support tourism activities and maintain sustainability of the landscape. Sumur Tiga Beach has lying in a smooth plain and steep topography, therefore that is necessary to pay attention to the difference in height in the design process. The THI value received at the place, was 26.53, and classified as comfortable category, but the wave height at Sumur Tiga Beach is strong enough during the east season thuss seawall and coastal plantation are needed to prevent abrasion. The presence of abrasion and wave height at certain times means that any equipments must do planned with a more substantial construction to anticipate that. This landscape design of Sumur Tiga Beach has a basic concept of "Adat ngon hukom lagee substance ngon sifeuet" which means that local wisdom and Islamic Sharia law are one, such as substances and properties, which cannot be separated. The design concept used is a metaphor of Ragam Hias, such as pucuk reubong, awan si on, awan meucanek, putra taloe dua, and dan sulur to determine suitable patterns for landscape design, as well as for deciding vegetation patterns, circulation, and other elements. The development concept contains the concept of zones, the concept of sequence, the concept of circulation, the concept of
vegetation, the concept of hydrology and the concept of visuals.

7.2 Suggestion
Sumur Tiga Beach has tourism potential. Sources observed in Sumur Tiga Beach remain a conservation area for the East Waters of Weh Island. So that in developing tourism, we need return awareness on the preservation of the landscape on Sumur Tiga Beach. One of the problems in Sumur Tiga Beach is garbage. Therefore, local government and the community to intervene to maintain the cleanliness of the beach and the development of tourism on Sumur Tiga Beach so that it can afford advantages from the economic side including the aspect of landscape preservation.

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Attachment

Siteplan