Landscape design of "Tanjung Budaya Pemuteran" coast area based on landscape engineering

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Abstract. "Tanjung Budaya Pemuteran" is a place of coastal tourism and alternative tourism based on community culture in Pemuteran Village, Bali. The landscape characteristic and inherent local wisdom make this bay is a unique place. Gebug ende is the native rain harvesting ritual of Pemuteran society, which can be suggestive evidence. Currently, Tanjung Budaya Pemuteran landscapes not suitable to support the site function. This research aims to identify the existing landscape to make Tanjung Budaya Pemuteran use optimally without disregarding inherent local wisdom. Landscape analysis spatial with the quantitative and qualitative approach used to know the potential and constraint. The landscape engineering approach is used to measure the volume of rainwater to optimize the result of Gebug ende rain harvesting. The basic concept of this landscape design is named "Identities of Pemuteran". Design concept generated through the transformation of Gebug ende. The block plan becomes a schematic design product that consists of a welcome area, a culture tourism area, a recreation area, and a service area. Each area is connected by primer and secondary circulation. Plants on-site are regulated based on vegetation groups of Barrington, Pes caprae, Mangroves, and existing. Visuals on the site are also arranged according to the design plan. The landscape engineering method produced the construction of a rainwater harvester with a volume of 10 m³. Site plan interpretations are explained in more detail through the site section, design details, and some illustrations.

Keywords: local wisdom, spatial design, sustainable design

1. Introduction

Tanjung Budaya Pemuteran is a public space located in Pemuteran Village, Bali. Tanjung Budaya has functioned as a place of coastal tourism and alternative tourism based on community culture. Besides, this place is also often used to implement traditional rituals, which is developed into an annual festival named Pemuteran Bay Festival. Besides the potential it has, the functions and possibilities of Tanjung Budaya Pemuteran are not supported by existing conditions. It can be seen from the irregular arrangement of landscape elements and unfocused management [1]. The place is also included in one of the areas with the longest rainless days in Indonesia, 249 days. Gebug ende becomes one of many iconic rituals held in this place. The villagers believed this ritual could summon rain when the drought-hit Pemuteran village.

The research aims to identify the potential and constraint Tanjung Budaya Pemuteran that will be used to make sustainable landscape design as consideration for solving existing problems. This landscape design is also designed to support local village customary rituals, especially in utilizing the potential for calling the rain named Gebug ende. Landscape engineering methods are also used to predict the optimal volume of rainwater that can be accommodated.
The research objective is to identify existing conditions, analyze and synthesize the potential and constrain of the site, and make a concept of sustainable landscape design of Tanjung Budaya Pemuteran based on landscape engineering. Hopefully, the research result can be used in developing and maintaining the landscape of Tanjung Budaya Pemuteran.

2. Method

2.1 Research Site and Period
The research was carried out in Tanjung Budaya Pemuteran, Pemuteran Traditional Village, Bali, Indonesia, from December 2019 to September 2020 (Figure 1).

![Figure 1 Research Site](image)

2.2 Research Method
The method used in this design research activities is as follows: 1. Data Inventory include: (a) survey; (b) distribution of questionnaires to the 30 respondents; (c) interview (snowball sampling); and (d) observation; 2. Analysis and synthesis include: (a) physical and biophysical aspect; (b) levels of comfort; (c) tourism aspects; (d) social and cultural aspect (e) oceanography; (f) carrying capacity; (g) and landscape engineering. The measure of comfort level used the following formula:

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

T: air temperature (°C)
RH: relative humidity of air (%)

2.3 Research stage
The method used in the study combines the six stages of planning and recreational landscape design by Gold and the six stages of the planning and design process by Simond [2]. The modifications resulted in the following four stages of landscape design as follows: (1) Preparation; (2) Data inventory; (3) Analysis and synthesis; and (4) Design.

3. Result and Discussion

3.1 General Condition
Tanjung Budaya Pemuteran designated as coastal recreation area. After Pemuteran Bay Festival was held, the government of Pemuteran Village starts to develop this place by built some Balinese-themed facilities. Patung Baruna becomes the newest facility that was built in 2019. However, existing facilities are not quite adequate and well maintained.
3.2 Analysis and synthesis

3.2.1 Physical and Biophysical Aspect

Location and Site Boundaries. Tanjung Budaya Pemuteran is located in Pemuteran Village, Buleleng District, Bali, Indonesia. This research area is 2.3 ha. On the north and east sides, the research site is directly bordered by the Sea. Glass House Hotel borders the site on the western part. The garbage treatment plant borders the site on the southern side.

Climate. The tropical comfort criteria are in the temperature range of 21-27°C [3]. The Tanjung Budaya Pemuteran has an average temperature at the value of 26.30°C with a humidity level of 84%. Based on those data, the calculation shows the importance of THI (Thermal Humidity Index) on site is 25.46. These results prove Tanjung Budaya Pemuteran is convenient area.

Topography, Slope, and Soil. Topography is influential in placing the object to be built. The slope of Tanjung Budaya Pemuteran is at a value of 0 - 20% with an altitude of -3 - 6 mas. Land with a 0-8% slope is the soil classified as flat land [4]. The land is ideal for active open spaces and massive buildings. The open land area on the site gets into this classification. Besides, flat land has a variety of monotonous views [5]. It can be overcome by adding vertical elements to the site. The diversity of opinions has been represented by the shape of the coastal landscape and Pantung Baruna.

Hydrology. In general, Tanjung Budaya Pemuteran land is covered by sandy soil. It causes the infiltration process on the site to run well. Based on observation results, the runoff flows from the south of the site to the north. There are two puddles caused by damaged asphalt and soil erosion. These puddles can be resolved by fixing the asphalt and filling the soil.

Accessibility and Circulation. Tanjung Budaya Pemuteran can be accessed from various directions, either via the Pura Dalem Pemuteran street or from the west and east sides by following the Pemuteran coastline. The place can be visited using a wheeled vehicle with a distance of 32.9 km from Gilimanuk Harbor and 134 km from Ngurah Rai International Airport. The circulation on the site consists of vehicle circulation and pedestrian circulation. There is damage to the vehicle circulation that needs to be repaired.

Visual and Acoustic. Objects with high visuals in Tanjung Budaya Pemuteran are views of the hills, a mangrove tree, a swing, and the Baruna Statue. Those objects are often used as photo spots. Low visuals are owned by the garbage treatment plant and the entire toilet on the site. Tanjung Budaya Pemuteran has a source of noise that comes from waste processing activities. The noise that occurs does not interfere with user activity. It is due to the open character of the site and the sound of the waves, which tend to be calm.

Vegetation and Animals. The selection of vegetation on the site has an essential effect on on-site development. The selected vegetation type will later be adjusted based on the functions of the vegetation itself. The existing vegetation selection was adapted from the three plant formations on the site, namely the *Barringtonia*, *Pes caprae*, and *Mangrove*. Birds and fish dominate the animals found on the site. Also, there are dogs (*Canis familiaris*) which are the pets of visitors or the community. The vegetation arrangement is maintained according to the existing conditions to preserve the habitat of the animals.

3.2.2 Tourism

Facilities and Utilities. Existing facilities and utilities on the site are not yet fully managed. It can be seen in the toilet facilities, food stores, and signboards on the site. The light utility and wifi hotspot on the site is not operating correctly. Periodic maintenance is necessary to maintain the condition and function of existing facilities and utilities.
Object and Tourist Attraction. The research site has a significant draw on cultural attractions for the people. The community's cultural attractions are displayed at each Pemuteran Bay Festival as the main agenda. The activity was initiated based on the commitment of the Pemuteran Village community to environmental conservation and the development of alternative tourism based on community and cultural empowerment. According to Jero Ketut Wirdika as a traditional leader, cultural attractions displayed at Tanjung Budaya Pemuteran are the main activities for alternative tourism in Pemuteran Village. Cultural attractions that can be seen on the site are the Gebug ende, the Dewa Ayu dance, and the Ngaben. Gebug ende and Dewa Ayu dance are cultural attractions that are often featured at the Pemuteran Bay Festival.

3.2.3 Social and Culture

User. The results of the questionnaires that have been distributed show several perspectives of visitors to the site. As many as 50% of respondents stated that the site conditions were excellent. Site cleanliness needs to be improved. It can be seen from 51% of respondents who said their site was still dirty. The additional facilities that the respondents wanted were signage and photo spots with a percentage of 30% and 25%.

The design of a research site requires consideration of the preferences of the end. Respondents most like the calm atmosphere with a percentage of 45%. There are 67% of respondents stated that the Baruna Statue object was a distinctive element on the site. The majority of respondents wanted a natural landscape design with a questionnaire percentage of 70%. It is also evident from the ratio of 73% for selecting natural materials and 46% for leafy plants to put into the landscape design. Besides, respondents wanted the use of paving blocks as land cover with a percentage of 53%.

Activities. Based on the questionnaire results, relaxing activity is the main goal of respondents visiting the site with a large percentage of 53%. The majority of tourists who fill out the questionnaire visit Tanjung Budaya Pemuteran in the afternoon, reaching 77%. There are 63% of respondents see the beach on weekends and 37% on weekdays.

Management. Tanjung Budaya Pemuteran is managed directly by the village government and Pemuteran Village customary stakeholders. The current management focuses on the cleanliness handled by the employee garbage treatment plant and site safety aspects. Employee garbage treatment plant is assigned to keep the area clean. The Security aspect itself is guarded directly by Pecalang segara. All management parties Tanjung Budaya Pemuteran, using Awig-awig in carrying out its duties.

Culture. The interview results depict Pemuteran Village implementing the Tri Hita Karana and Tri Angga philosophy on spatial planning in Pemuteran Village. In a macrocosmic order, Tanjung Budaya is included in Palemahan, where this area describes the relationship between humans and nature. Apart from that, The management has been regulated in the norms of community life of Pemuteran Village (Awig-awig).

3.2.4 Oceanography

This aspect is carried out through the matrix suitability of beach tourism for recreation from Yulianda [6]. As a result, the site has a total index value of 67 [Table 1]. The value shows that Tanjung Budaya Pemuteran Beach is a suitable beach area for recreational activities. The availability of raw water on the site needs to be considered for landscape engineering.
Table 1 Matrix of the Suitability of Beach Tourism for Recreation

| No. | Parameter                  | Condition          | Point | Class | Score | Iv  |
|-----|----------------------------|--------------------|-------|-------|-------|-----|
| 1   | Depth                      | 1 – 2 m            | 5     | S1    | 3     | 15  |
| 2   | Ocean base material        | Fine black sand    | 3     | S1    | 2     | 6   |
| 3   | Beach type                 | Beach with coral   | 5     | S2    | 1     | 5   |
| 4   | Beach width                | 22-25 m            | 5     | S2    | 2     | 10  |
| 5   | Ocean current              | 0 – 0.17 m/s       | 3     | S1    | 3     | 9   |
| 6   | Beach slope                | 11.30°             | 3     | S2    | 2     | 6   |
| 7   | Sea brightness             | 8 – 9 m            | 1     | S2    | 2     | 2   |
| 8   | Land cover                 | Tall shrubs        | 1     | S2    | 2     | 2   |
| 9   | Dangerous biota            | -                  | 3     | S1    | 3     | 9   |
| 10  | Availability of raw water  | <500 m             | 1     | S1    | 3     | 3   |

Total index value 67

Very suitable (S1)= 71 – 90  Not Suitable (S3)= <50  Suitable (S2)= 51 – 70

3.2.5 Site Carrying Capacity

The carrying capacity is based on a space plan that suits the needs of the user's activity. Space is divided into four spaces, the welcome area, cultural tourism area, recreation area, and service area [7]. The site carrying capacity refers to international standards and can be seen in Table 2.

Table 2 Site Carrying Capacity

| Area                        | Facilities     | Σ Spacious (m²) | Standard     | Capacity |
|-----------------------------|----------------|----------------|--------------|----------|
| Welcome area                | Signage        | 1              | 11.4         | n/a      |
| Car park                    |                | 1              | 121          | 25.28 m²/unit | 4       |
| Motorcycle park             |                | 1              | 121          | 5 m²/unit | 24     |
| Entrance                    |                | 1              | 20           | 1.5 m²/person | 13     |
| Bale                        |                | 1              | 40           | 2 m²/person | 20     |
| Gazebo                      |                | 1              | 6.25         | 2 m²/person | 3      |
| Bench                       |                | 5              | 0.675        | 0.27 m²/person | 12   |
| Service area                | Toilet         | 8              | 4            | 2 m²/person | 16     |
| Food store                  |                | 1              | 105          | 1.5 m²/person | 70     |
| Cultural tourism area       | Outdoor theater| 1              | 2,356.80     | 6.2 m²/person | 380 |
| Curve bench                 |                | 1              | 58.86        | 0.27 m²/person | 218 |
| Baruna statue               |                | 1              | 395.15       | 6.2 m²/person | 63     |
| Shelter                     |                | 1              | 8            | 2 m²/person | 4     |
| Sand box                    |                | 1              | 112          | 1.86 m²/person | 60     |
| Beach                       |                | 1              | 40           | 2 m²/person | 20     |
| Gazebo                      |                | 1              | 6.25         | 2 m²/person | 3      |
| Recreation area             | Swing          | 1              | 0.32         | 0.27 m²/person | 1       |
|                             | Beach          | 1              | 13,628       | 12.96 m²/person | 1,051 |

3.2.6 Landscape Engineering

The landscape engineering analysis of this research focuses on rainwater harvesting. This is based on the potential of Gebug ende traditional rituals and site constraints included in one of the areas with the longest rainless day in Indonesia.

Water Needs. According to the standard from the Ministry of Public Works and Public Housing of Indonesia, which rea, it is assumed that the site requires 0.15 L/sec/ ha to fulfill the site's water needs [8]. The land area of 0.75 ha is used in calculating this water
requirement. Based on the plan, the site's operational time is 06.00-21.00 WITA. Therefore the total water requirement obtained is 6,075 L/day.

**Frequency of Rainfall.** Frequency analysis uses rainfall data for the last ten years of the study area. The distribution test was carried out using the Chi-square and Smirnov-Kolmogorov test approach. The Result Chi-square test shows that lognormal distribution is acceptable because of \( x < \bar{x} \), with value \( \bar{x} = 4 \) and critical \( \bar{x} = 5.991 \). Testing with the Smirnov-Kolmogorov test with results obtained \( d_{max} < d_{critical} \) with \( d_{max} = 0.18 \) and \( d_{critical} = 0.41 \). The rainfall used is probability \( P(x) = 80\% \) or equal to 1.25 with rainfall of 44 mm.

**Reservoir Volume Analysis.** The site has a food storage facility with a roof area of 179 m\(^2\). The potential volume of rainwater that the roof can accommodate after being influenced by the roof runoff coefficient of 80\% is 6,301 liters. If every day the water stored is used to meet the operational needs of Tanjung Budaya Pemuteran, there is an excess of 226 L/day. The excess water will be held for five days (weekdays) as a reserve for holidays (weekends). The total volume of planned water collected after being harvested for five days is 7,431 liters.

### 3.3 Concept

#### 3.3.1 Basic Concept

The basic concept of the Tanjung Budaya Pemuteran landscape design is "Identities of Pemuteran" (figure 2). This concept elevates Pemuteran Village's identity through the cultural aspects and natural fascination of Pemuteran Village. Cultural elements are chosen to introduce culture and customs in Pemuteran Village. The development of cultural factors is carried out through spatial planning that supports cultural activities. Nature will be preserved in the aspect of natural fascination.

![Figure 2 Basic Concept](image-url)

#### 3.3.2 Design Concept

*Gebug ende* was chosen as a design concept in the Tanjung Budaya Pemuteran landscape design (Figure 3). The attribute used in the *Gebug ende* ritual is implemented into the design element. Rattan (*Penyalin*) becomes a weapon, which is transformed into a straight line. The shield (*Ende*) used to defend against attacks is transformed into a circle and arch. Apart from that, the knight uniform (*Saput Poleng*) is transformed into the square.
3.3.3 Development Concept
The concept of developing the Tanjung Budaya Pemuteran landscape design consists of the concept of space, the concept of circulation, the concept of vegetation, and the concept of view. The concept of space is divided into four main areas. The design of this study is reception areas, cultural tourism areas, recreation areas, and service areas.

The circulation concept used in the site design is divided into two categories, primary and secondary circulation. The primary circulation is designed using asphalt material on the main road and green pavement for parking. Secondary circulation is designed semi-modern. The material used in the secondary circulation is concrete, sand, and conwood.

The concept of on-site vegetation applies to the existing vegetation formation arrangement. Three formations are the vegetation formation of Barrington, Pes caprae, and Mangrove. Also, this concept is also designed to maintain vegetation that has been planted.

Potential views on the site are developed in the reception area, cultural tourism, and recreation. The view in the reception area is focused on the Tanjung Budaya Pemuteran new signage. View area cultural tourism is directed reciprocally from the direction of the Baruna Statue and in the opposite. The recreation area has a natural landscape on the north, east, side west sites. The view of the recreation area is also focused on an iconic mangrove tree that grows on the reef.

3.4 Schematic Design
The output of the schematic design is a block plan. Development concepts are generated by combining and overlying development concepts. The development concept combined includes the concept of space, the concept of circulation, the concept of vegetation, and the concept of view.

3.5 Design
The planning stage for the Tanjung Budaya Pemuteran tourism spatial plan begins with creating three alternative designs. The design alternatives referred to the development concepts, block plan and adjusted to the results. All three designs have the same design pattern. The difference between the three design alternatives lies in the material and landscape elements used. The first alternative design was chosen as the Tanjung Budaya Pemuteran site plan. This site plan has also been evaluated by a team of experts from coastal research and development, the Ministry of Public Works and Public Housing of Indonesia, and the Head of Pemuteran Village.

There is a cut and fill method in the land arrangement of the site. The cut and fill method is used to plain the for developing Cultural Plaza. This is done to simplify the process of building existing facilities. Also, it can support the implementation of more
comfortable attractions for visitors. The cut and fill method also affects the shape of the land in the coastal area. The Block plan and site plan is provided in Figure 4.

![Figure 4 Image of (a) Block Plan; (b) Site Plan; and (c) Site Section](image)

Tanjung Budaya Pemuteran landscape design focuses on beach recreation activities and community-based alternative recreation. For the recreation area, changes in landform are carried out using cut and fill to suit development needs. The facilities added to the welcome area are a parking lot for two-wheeled and four-wheeled vehicles, a small gazebo, an entrance, and signage. Rainwater Harvesting Building (RHB) is located in the service area, to the east of the food store. The harvested water will be connected to a toilet on the southeast side of the food store. Cultural Plaza I and II were built to support ritual activities and alternative tourism on the site. Cultural Plaza I made with partially cut circular shape with bench facilities that follow the pattern. This curved bench is designed as a seat that can be used to visually focus on the Baruna statue as the main stage of the show. Plaza Budaya II is made smaller on the southeast side of the site. The plaza functions as a playground, a place for cultural performances, a place for event preparation. The design illustration can be seen further in Figure 5.
Rainwater harvesting on-site is carried out in an integrated system (Figure 6). The food store roof functions as a rainwater catchment area. The rainwater is flown to the Rainwater Harvesting Building (RHB) on the east side of the food store through the gutter pipe's inlet. Once clean, the water is stored in an RHB. The stored water can be drained to the food store on the west side and toilets on the south side through a connecting pipe if it is to be used. If there is excess capacity, the water will be flowed out into the infiltration hole.

**Figure 5** Illustration of Landscape Design of Tanjung Budaya Pemuteran

**Figure 6** Rainwater Harvesting Building (RHB) System

4. Conclusion and Suggestion

4.1 Conclusion

Tanjung Budaya Pemuteran has potential that needs to be developed. Such potential is the character of the natural landscape and the local wisdom. The development aims to produce recommendations for landscape arrangements that can support user activities and site
functions. This research landscape design combines physical and biophysical aspects, hydro-oceanography, tourism, culture, and landscape engineering to produce ideal and sustainable arrangements. It resulted in recommendations for Tanjung Budaya Pemuteran's landscape design with a Rainwater Harvesting Building with a capacity of 10,000 L as a place of coastal recreation and alternative tourism based on community culture.

4.2 Suggestion
This research is expected to be material for thought and reference for the managers of Tanjung Budaya Pemuteran. Besides, the local wisdom of an area needs to be developed through a scientific approach. It will produce new insights and outcomes useful for the community, especially in the scientific development of landscape architecture.

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