Suitability and carrying capacity analyses for marine ecotourism development of the Medang Deras Subdistrict, Batubara district, province of North Sumatera

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Abstract. Medang Deras sub district is one of the attractions in the Batubara Regency which has appeal for the Batubara public and surrounding area. Increasing the number of visitors each year can reduce the comfort of tourists at the tourism attractions. It makes the researcher want to analyze the suitability and carrying capacity Medang deras coast region. This research used a descriptive method with an accidental random sampling technique. The results showed the suitability of marine ecotourism in Medang Deras included in the conditional category, two categories of suitability namely beach and swimming tourism. This is because the utilization and management of the area is not maximized yet, especially in terms of facilities and infrastructure. The number of tourists that can be accommodated by the tourist area is still adequate. However, if visitors have reached these numbers, the comfort and sustainability of tourism in the District of Medang Deras will be disrupted.

1. Introduction
Medang Deras sub district is one of regions in North Sumatera that has tourism potential. The sub district has two coasts and become tourism destination for local people namely Sujono and Alam Datuk coast. Tourism growth (visitors and infrastructure) doesn’t always connect with positive toward tourism industry on the other hand it can exceed threshold limit value of environment carrying capacity that has effect social destruction and economy [1].

The coastal region contained big potential resources in tourism. A coastal region can improve economy of people by developing tourism concept [2] of three pillars namely economy, social, culture and environment [3]. Tourism sector can attract tourist to come and their coming impacts into tourism environment.

Land suitability is land adaptation ability for the purpose through land value determination (class) / valuing vacant land and the use pattern of land relate to area potential. So, the use pattern of land can be planned and continue [4].

Environment carrying capacity has become an assessment in the concept of continuing maritime tourism management [4] include four aspects namely physic, production, ecology and social capacity
carrying. A total explosion of tourist that attendance is the main problem in ecotourism activity so limitation must consider the total is suggested by region [5].

An advanced tourism region in capacity development is became system application [6]. System application keeps environment quality, attract tourist [7] and advocate comfort with community cohesiveness in development area [8] which mass tourism and has limit space for visitors [9].

Management planning of maritime ecotourism based on suitability area and carrying capacity is expected to be solution to solve the problem. The purpose of research was to analyse suitability and carrying capacity area for maritime ecotourism in coast category.

2. Methodology
The research located in Medang Deras sub district coastal of Batubara regency. The research used survey descriptively and evaluation approach. The collecting data with directly (primer) that held in November until December 2019 by using survey method and direct measurement in the area. Descriptive research is to analyse and solve a problem by giving real interpretation at the time [10]. Explorative research is to analyse and state thing in the area.

![Figure 1. Study location of Medang Deras Subdistrict.](image)

Medang Deras Subdistrict have two location which is suitable to be used as a tourist location, the location name are Sujono beach and Alam Datuk beach, a suitable coast as tourism area was analyzed for area suitability while carrying capacity to know area ability in accommodating the total maximum of tourist. The research data is gathered from direct observation, interview, manager and polices that relate with activity and tourist total.

The Measurement Index of Suitability Tourism according to [11]. The parameter of tourism suitability observation and swimming is explained into Table 1 and Table 2.
### Table 1. The parameter suitability index of coast tourism (IKW).

| No | Criteria                      | Quality | S1 | Suitability Class (Score)          | N     | Explanation                                                                 |
|----|-------------------------------|---------|----|-----------------------------------|-------|-----------------------------------------------------------------------------|
| 1  | Deep water (m)                | 5       | 0-3| >3-6                              | >6-10 | >10                                                                          |
|    |                               |         |    |                                   |       | Score value Category S1=3                                                   |
|    |                               |         |    |                                   |       | Category S2=2                                                               |
|    |                               |         |    |                                   |       | Category S3=1                                                               |
|    |                               |         |    |                                   |       | Category N=0                                                                |
|    |                               |         |    | Maximum value Quality x Score = 120 |
| 2  | Types of Coast                | 5       | White sand | White sand, coral | Dark sand, coral | Mud, stone, steep |
|    |                               |         |    | S2                               | S3    |                                                                               |
| 3  | Weight coast (m)              | 5       | >15 | 10-15                            | 3-<10 | <3                                                                           |
|    | Base substance coast          | 4       | Sand | Sandy coral | Muddy sand | Mud |
| 4  | Current speed (cm/dtk)        | 4       | 0-0.17 | 0.17-0.34 | >0.34-0.51 | >0.51 |
| 5  | Coast obliqueness(°)          | 4       | <10 | 25-10                             | >25-45 | >45                                                                          |
| 6  | Coast brightness (%)          | 4       | >100 | >85-100                           | 85-50  | <50                                                                          |
| 7  | Covering coast area           | 3       | Opened area, Coconut | Bushes Low | Bushes high | Mangrove, settlement |
| 8  | Danger Biota                  | 3       | Not exist | Sea Urchins | Sea Urchin, Lion fish, shark | |
| 9  | Fresh water availability      | 3       | <0.5 (km) | >0.5-1 (km) | >1-2 | >2                                                                          |

### Table 2. The Matrix suitability of swimming tourism.

| No | Criteria                        | Quality | S1 | Suitability Class | N  | Explanation                                                                 |
|----|---------------------------------|---------|----|-------------------|----|-----------------------------------------------------------------------------|
| 1  | Deep water (m)                  | 5       | 0-3| >3-6              | >6-10 | >10                                                                          |
|    | Base water material             | 5       | Sand | Coral | Sand Mud | Mud |
| 3  | Speed current (m/det)           | 5       | 0-0.17 | 0.17-0.34 | 0.34-0.51 | >0.51 |
| 4  | High waves (m)                  | 5       | 0-0.5 | 0.5-1 | 1-1.5 | >1.5 |
| 5  | Tipe Pantai                     | 3       | White sand | White sand, coral | Black sand, Precipitous coral | Mud, stony, precipitous |
| 6  | Large coast (m)                 | 3       | >15 | 10-15 | >5-10 | >2 |
| 7  | Water brightness (m)            | 3       | >10 | >5-10 | >5-10 | >2 |
| 8  | Danger Biota                    | 3       | Not exist | Jellyfish | Sea Urchin, Jellyfish | Snake, Air, Sea Urchin, Jellyfish |
| 9  | Fresh water availability        | 3       | <0.5 (km) | >0.5-1 (km) | >1-2 | >2 |
The data analysis used Index Suitability of Tourism with suitability matrix. It is arranged based on the importance in every parameter to support activity at area. The formula is suitability coast tourism [11][12].

\[ I_{KW} = \sum \left( \frac{N_i}{N_{max}} \right) \times 100 \% \]  

(1)

Explanation: \( I_{KW} \) = Index Suitability of Tourism (%); \( N_i \) = Parameter value to-I (quality x score); \( N_{max} \) = Maximum value of a tourism category; Based on the formula above will be a value is obtained where the value is mention the class/suitability of the tourist land beach; S1 = Very much by the value 83-100%; S2 = In accordance with the value of 50 - <83%; S3 = Conditionally subject to values 17 - <50%; and TS = do not match the value <17%.

Carrying capacity is counted to know total maximum of visitors with specific that can be accommodated in available area at certain time without cause annoyance to nature and human [11][12][13]. Carrying capacity analysis to nature tourism development using carrying capacity concept area with the formula:

\[ D_{DK} = K \times \frac{L_p x W_t}{L_t x W_p} \]  

(2)

Explanation: \( D_{DK} \) = Carrying capacity district; \( K \) = Maximum ecology potency of visitors per unit area; \( L_p \) = Large district or long district that can be used; \( L_t \) = Unit area of specific category; \( W_t \) = Available time by district for tourism activity in one day; \( W_p \) = Completed time by visitors in every specific activity.

Visitors ecology potency is determined by resource condition and kind of activity that is developed. Long and large a district is used by visitors depend on nature ability. The ecology total of visitors, district unit, visitors time, tourism time in the Table 3.

| Kinds of Activity | \( K (\sum \text{Visitors}) \) | District Unit (Lt) |
|-------------------|-----------------------------|------------------|
| Coast Recreation  | 1                           | 50 meter Long Coast |
| Swimming          | 1                           | 50 meter Long Coastal Waters paralleling with coast line |

Source: Yulianda (2007) in modification

3. Results and discussion
The capacity of Medang Deras sub district is about 6.547 Ha or 7.1 % from the total all of areas in Batubara regency. Based on region typography, Batu Bara province in the height 0 – 100 meter in above the sea level, it is dominated by 7 – 25 meter in above the sea level and the low height is 0 – 7 meter in above the sea level [14].

3.1. Tourism suitability
Medang Deras sub district has two tourisms location potential, two tourisms location potential are Sujono and Alam Datuk coast that it is famous by local people. Suitability data analysis is collected by the result calculation of suitability index coast tourism with Arcgis software (Picture 1 and 2).

Table 3. Ecology potency of visitors (K) and large activity (Lt).

The characteristic result of tourism suitability value in Medang Deras sub district has suitability value into coast and swimming tourism with some parameter that shows variant value. Water condition with high TSS value (104mg/l) makes the water is not suitable to be diving tourism location. Natural condition and nature scenery have possibility for visitors to do tourism activity such as swimming and enjoy the nature scenery.
The coast obliqueness can impact toward fitness and safety in tourism particularly swimming. Medang Deras sub district has flat coast with 16° obliqueness, speed current is 0.19 m/s and it is suitable enough to support tourism coast activity [12].

A covering of coast area is pine tree, coconut tree, bare ground, a danger biota could not be found and suitability of fresh water in 0.2 km – 0.5 km from the coastal area. So, this location has potential to develop coast tourism in the future. Based on observation result can be known suitability of tourism in Medang Deras waters from the table 4 below:

Table 4. Calculation results of suitability of in Medang Deras Subdistrict

| Location          | Tour  | Category              | Percentage (%) |
|-------------------|-------|-----------------------|----------------|
| Medang Deras      | Beach | Suitable              | 4.86           |
| Subdistrict       |       | Conditionally Suitable| 95.14          |
|                  |        | Not Suitable          | -              |
|                  | Swimming | Suitable         | 10.06          |
|                  |         | Conditionally Suitable| 89.94          |
|                  |         | Not Suitable          | -              |

Figure 2. Suitability index for beach recreation in Medang Deras Subdistrict.
Based on picture 1 and 2, it can be seen coast location in Medang Deras has high suitability value of suitability requirement. It is caused by length coast in Medang Deras sub district and government has not managed yet. The coast location is still managed by local people.

3.2. Carrying capacity region
The concept of carrying capacity is a basic that environment has maximum capacity in supporting a environment sustainability [15][16] is limited tourist movement in tourism activity[17][18]. The development of coastal area, coast and tourism can be integrated based on human activity that has impact toward environment ecology [19]. A quality of environment can be increased to take preventive action [20]. A preventive can decrease resource quality, disturbance or the loss of habitat, threatened wild animal [21] periodically [22].

Table 5. Calculation results of marine carrying capacity in Medang Deras Subdistrict.

| Tour               | Area (m²) | Area (Ha) | PCC (People/day) | RCC (People/day) |
|--------------------|-----------|-----------|------------------|------------------|
| Swimming           | 20.110    | 20.11     | 121              | 108              |
| Beach Recreation   | 10.100    | 10.1      | 107              | 96               |

4. Conclusion
In generally, based on the result of tourism suitability analysis is coast waters environment quality in Medang Deras is suitable to do coast tourism and swimming. The real carrying capacity when it is compared to physical carrying capacity is still smaller and accommodate tourist who visit.

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