Peat Dome Conservation and Its Problems Based On Geomorphometry: Case Study in Tebing Tinggi Island

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Abstract. Peat domes are peatland units that have an important role in hydrological aspects and its conservation. The important role is shown from the peat thickness which is more compared to the surrounding peatlands. In the other side, the morphology of the peat dome is not easily identified in the field. To recognize it is done by reconstructing the contour interval to a smaller level. The appearance of the resulting peat dome, produces information on the distribution and extent of the peat dome. This information is used as material to conserve peatland which is expected to be more effective. The aim of this study are 1. To calculate the number and distribution of peat domes; classification of peat domes. The method used is spatial and geomorphometry analysis. Data used: DEM, RBI map, land cover, village administration, distribution of peat thickness. The results of this study indicate that a). Tebing Tinggi Island areas is mostly included in the peat dome area; b) Tebing Tinggi Island area has a high level of vulnerability to land and forest fires. Recomendation, that the DEM which downloaded from the DEMNas can support the identification of peat domes in areas where the relief variations are small and the topography is relatively flat. DEMNas can be used to support the availability of information in order to reduce the occurrence of forest fires

1. Introduction
Concerning the issue of forest fires, and the use of land for plantations, making peatlands into the public spotlight. The occurrence of forest fires becomes a problem that is not easy when it occurs on peatlands [1]. The problem is in terms of handling, the impact caused requires great effort. The role of peatlands is very large from many sides. From the economic, social, especially from the environmental side. [2]. Peatlands are divided into several land units, one of which is the peat dome. Peat dome is a unit of land on peatland that has several characteristics. Based on the thickness of the peat, peatland has a thickness that is more than that of the surrounding peatlands area. [3] With these characteristics, the peat dome can store more water than the surrounding land units in the same area. Considering the characteristics possessed makes peat dome must be inventoried. Peat dome inventory covers the location of its distribution, its extent, and the potential it has in its role in the environmental aspects, especially in the hydrological aspect.

The problem that arises in the peat dome area is if there is a drought, then the area has a very severe potential for burning. In dry conditions, the availability of fuel is quite a lot. The most common form of fuel is bush [4]. Drought can occur due to natural factors such as dry season, and it can also be due to human factors through reclamation activities. Fires in peatlands can occur in the form of surface fire, crown fire, and ground fire. (See figure 1) Of the three types of fires, ground fire is a typical type of fire occurring on peatlands. Ground fire requires a longer, more difficult and also more expensive handling. [5].
Geomorphometry is a study of landforms which emphasizes aspects of its dimensions which include the length, width, and slope \[7\]. The aim of this study are to calculate the number and distribution of peat domes; indicate its distribution, classification of peat domes.

2. Material and Method

2.1 Study Site
Tebing Tinggi Island is one of the islands of the Meranti Islands District which has an area of 132,378.12 ha or 36\% of the total area of the Meranti Islands district. Administratively, Tebing Tinggi Island has 3 (three) districts, namely Tebing Tinggi Barat sub-district, Tebing Tinggi Timur sub-district, and Tebing Tinggi sub-district [8]. The capital of the Kepulauan Meranti Islands District (Selat Panjang) is located in Tebing Tinggi island (figure 1).

2.2 Peat Dome
Peat dome is a peat land unit that has characteristics higher elevation compared to surrounding peatlands area [9] (see figure 2). Hydrologically, the peat dome is located within the peat hydrological unit (KHG). Peat dome is included in the conservation function because it stores a very high carbon and water content [10]. Peat has the ability to store water 13 times its volume [11]. Thus the peat dome is a peatland unit that is able to store more water than the surrounding peatlands.
2.3 The Material Used
The method used is spatial and geomorphometry analysis. Data used: DEM, RBI map scale 1:50,000, land cover map scale 1:50,000. From that data can be resulted new information: land form, and distribution of peat dome. Software use GIS software.

2.4 Geomorphometry
Geomorphometry is a study of landforms that emphasizes aspects of its dimensions which include the length, width, and slope [13]. Geomorphometry also comprises the measurement and analysis of specific surface features defined by one or more processes and separated from adjacent parts of the land surface according to clear criteria of delimitation [14]. In this study, geomorphometry is used as a land analysis tool to produce the presence of peat dome.

2.5 Spatial Analysis
Spatial analysis is used to get the final results of the objectives of this study. The material analyzed consisted of: DEM (digital elevation model), RBI (Rupa bumi Indonesia/topographic) Map scale 1:50,000, mophology map, geology map, hotspot, and land cover map. The stages carried out for spatial analysis [15] are shown as in Figure 3

3. Results and Discussion
In Tebing Tinggi island, the presence of peat dome has been identified. Peat dome is obtained through extraction from landform, in which there are several types of landforms. The geomorphometry analysis is performed after contour maps are obtained with 50 cm contour intervals. (see figure 4)

Figure 3.

Figure 4. Contour map with contour interval 50 cm

This was done because from the 1:50,000 scale RBI map, peat dome was difficult to identify. Then engineering the making of a more tightly contoured interval contour, so that relief on the land surface can be known. This step is also carried out, because in peatlands generally have a flat relief, so
identification of peat dome in the field is also difficult. For this reason, geomorphometry analysis can be used to identify peat dome in the field[16].

![Figure 5. Distribution of Peat dome](image)

There are two peat domes with a total area of 9,399,177.94 ha. The distribution of peat dome and its area based on administrative area is located in West Tebing Tinggi sub district and East Tebing Tinggi sub district. (see figure 5).

Based on the potential ability to store water, that peat can store 13 times its volume, the calculation is so that the depth of peat reaches > 3 meters or an average of 4 meters. With a wide dome area of 9,399,177.94 ha or 93,991,779,400 m². Then the potential for storing peat dome water is 93,991,779,400 m² x 4 m x 13 = 4,887,572,528,800 m³. With the potential of the peat dome from environmental functions especially hydrology, the peat dome should be conserved.

Be aware that in the peat dome area there are various land covers. Of all the land covers, shrubs are the most high-risk land cover for burning. [17] and [18] Based on the results of the land cover analysis in the presence of peat dome, it shows that there is a shrub area of 3,199,877.83 ha. Land cover data in the peat dome area as in Figure 6, and in tabular form as in table 1.

![Figure 6. Distribution land cover type in peat dome](image)
Tabel 1. Distribution land cover type in peat dome

| No | Land Cover Type                           | Large (Ha)  |
|----|------------------------------------------|-------------|
| 1  | Shrubs and Thickets                      | 3.199,877,83|
| 2  | Wetland Seasonal Plants                  | 34,806,11   |
| 3  | Dry Seasoned Plants                      | 672,748,92  |
| 4  | Plantation with hard woody plants        | 2,215,396,78|
| 5  | Other Natural Open Land                  | 811,973,36  |
| 6  | Plantation Forest                        | 139,224,44  |
| 7  | Swamp / Peat Forests                     | 1,681,872,30|
| 8  | Mangrove forest                          | 214,426,17  |
| 9  | Lowland Forest                           | 28,962,79   |
| 10 | Residential / Mixed Buildings            | 399,889,55  |
|    | Total                                    | 9,399,178,25|

Source: land cover map BIG (2015)

This wide area needs to get priority in overcoming the fire. This is important considering the hydrological function of peat dome in storing water that is so large, will not function optimally when the peat dome becomes damaged.

Based on the characteristics of the peat dome which has a hydrological function role in storing more water than the surrounding peatlands, an inventory of peat dome must be carried out. Inventory is carried out to maintain the sustainability of peat lands. Peat dome inventory can be done through geomorphometry analysis. Land cover and hotspot information is integrated information, where shrub land cover type is an effective fuel for burning. Hotspot information serves as supporting information that illustrates the problems that arise when peat dome is not managed properly.

4. Conclusions

Based on the characteristics of the peat dome which has a hydrological function role in storing more water than the surrounding peatlands, an inventory of peat dome must be carried out. Inventory is carried out to maintain the sustainability of peat lands. Peat dome inventory can be done through geomorphometry analysis. Land cover and hotspot information is integrated information, where shrub land cover type is an effective fuel for burning. Hotspot information serves as supporting information that illustrates the problems that arise when peat dome is not managed properly.

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