Land Development Recommendation of Bunguran Island as One of the National Border Areas Based on Level of Land Suitability and Land Capability

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Abstract. According to PP no 26 of 2008 concerning National Spatial Planning documents, Bunguran Island as national border areas must be monitored and regulated as the front yard of Indonesia. This study used analytical method based on matching between land suitability criteria and land quality data that considered the most severe factors. Data were being analyzed by the criteria of land capability using the classification by The Ministry of Public Works Regulation (20/PRT/M/2007). The results obtained the form of land capability classes in Bunguran Island, which in turn resulted in land capability as the reference in determining land use directives. The direction of land capability was analyzed based on the results of land capability compared to the land use conditions that can be used as a basis for recommendations or directives for land use in Bunguran Island. The parameters used in the classification of land capabilities are slope, drainage conditions, soil permeability, soil type, texture of soil depth, and erosion data. The descriptive analysis process by data parameters were carried out according to the classification of land capabilities. The result of this research was used to compose spatial pattern planning of Bunguran Island based on the land suitability and land capability.

Keywords: Development-land-recommendation, land-suitability, land-capability

1. Introduction

In Indonesia, the majority of national border areas are being the backyard of the country with lack of development, neither in spatial nor physical development. According to PP no 26 of 2008 [1] and PP no 13 of 2017 [2] (concerning of the National Spatial Plan), Bunguran District must be monitored and regulated as the front yard of the country. Bunguran District as one of national border area, needed detailed plan to accommodate 20-year development planning (RDTR). It also must be implemented as an instrument for developing public service facilities, infrastructure, utilities, and many more. Development
always raises a paradox e.g. decreasing the quality and the carrying capacity of the environment. It happened because of the improper management between natural resources and human needs. Therefore, we need to manage the land rationally [3].

The Law of Republic of Indonesia No 32 of 2009 (concerning Environmental Protection and Management) stated that environmental carrying capacity is defined as the ability of the environment to support the balancing life of human and other living things [4]. Land capability evaluation is one of the important components in land use planning process [5]. Evaluation of land capability needs to be done on both land use plan within the RTRW, as well as on current land use. The results of the evaluation of land capability provides alternative land uses and limits possible uses and the management actions needed so that the land can be used sustainably in accordance with obstacles or threats.

2. Methods
This research was located in Bunguran Island. Its delineation of national border area (based on the deal of ATR Ministry and BIG of Indonesia) as PKSN Ranai was divided into 2 sides; southern Bunguran Island and Northern Bunguran Island. This study used analytical method based on the matching between land suitability criteria and land quality data that considered the most severe factors. A land use adjustment map was prepared by superimposing present composite land use map on land capability map through GIS [6]. Data were being analyzed according to the criteria of land capability which are foundation, drainage, morphology-slope, general geology including structure, shallow underwater, safe from natural disasters[7]. Every criteria has each weight. all values are multiplied by the weight of each unit of land capability classification by The Ministry of Public Works Regulation No. 20/PRT/M/2007 (Table1) [8].

Table 1. Land Capability Units’s Weight

| Land Capability Units                  | Weight |
|---------------------------------------|--------|
| Unit of morphological land capability | 5      |
| Unit of easy to do                    | 1      |
| Unit of slope stability               | 5      |
| Unit of foundation stability          | 3      |
| Unit of water availability            | 5      |
| Unit of against erosion               | 3      |
| Unit of drainage                      | 5      |
| Unit of water disposal                | 0      |
| Unit of natural disasters             | 5      |

Source: The Ministry of Public Works Regulation No. 20/PRT/M/2007

Table 2. Land Capability Classification

| Amount | Land Capability Classification | Land Capability |
|--------|--------------------------------|-----------------|
| 32 - 58| Class A                         | Very Low        |
| 59 - 83| Class B                         | Low             |
| 84 - 109| Class C                        | Moderate        |
| 110 - 134| Class D                       | Rather High     |
| 135 - 160| Class E                        | High            |

Source: The Ministry of Public Works Regulation No. 20/PRT/M/2007
The evaluation of land use suitability forms can be classified by comparing the land form with capability class scheme with intensity and type of land use [9]. The core of land evaluation is comparing the requirements demanded by the type of land use that will be applied with the properties or quality of land. Thus, it will be known the potential of land and its carrying capacity which includes the ability class and land suitability for several types of land use [10]. The results obtained was in the form of land capability classes in Bunguran Island, which in turn, resulted in land capability as a reference in determining land use directives. The direction of land capability was analyzed based on the results of land capability compared to the existing land use conditions in Bunguran Island. The results obtained were used as a basis for recommendations or directives for land use in Bunguran District. The parameters used in the classification of land capabilities are slope, drainage conditions, soil permeability, soil type, texture of soil depth, and erosion data. From the data parameters, the descriptive analysis process was carried out according to the classification of land capabilities.

3. Result and Discussion

Based on land classification parameter’s overlay, land capability in Bunguran Island was classified as somewhat high, medium, low, and very low. The high development capability covered the smallest part of the Bunguran Island, which was 27.2 ha. Areas with rather high capabilities have very small areas so that their utilization needs to be considered for prioritized activities that required land with high capability values. The land capability that was rather high is located in Cemaga Selatan Village. The other part was an area of 3255.25 ha in the Bunguran Island, which is a land that has the ability to develop land. Land capability was being spread throughout all parts of the Bunguran Island, especially in the Northern of Bunguran Island. The rest consisted of low land capability having an area of 3021.5 ha, and the very low land capability having an area of 640.0 ha which occupied a large part of the Bunguran Island, mainly occupying the Southern Bunguran Island.

![Figure 1. Land Capability Map of Bunguran Island in 2018](image)

**Table 3. Land Capability of Bunguran Island in 2018**

| Land Development Capability | Area  |
|-----------------------------|-------|
| Rather High                 | 27,25 |
| Moderate                    | 3,255,26 |
| Low                         | 3,021,26 |
| Very low                    | 640,01 |
| Total                       | 6,943,77 |
The result of Bunguran Island land capability was being used to plan the suitability land based on The Ministry of Public Works Regulation no. 20/PRT/M/2007. Suitability land’s recommendation is divided into Land Cover Ratio Recommendation, Direction for Utilization of Raw Water, and Agricultural Spatial Arrangements, i.e.:

1) The recommendation of land cover ratio. The map of Bunguran Island’s land cover ratio is divided into 4 classifications, i.e. non-building, maximum land cover of 10%, 20%, and 30%. The homogeneity of land cover ratio is defined by the slope of land in Bunguran Island. The northern Bunguran Island can be built up to a maximum of 20% land cover. The coastline has a land cover of a maximum of 10% lower than the upstream part, due to the sloping difference compared to the surrounding area. But the differences were actually not significant. The slopes on the Northern Bunguran Island coast of Buton bay are still in landau class, which means more intensive closure was still possible. But in the Southern Bunguran Island showed more various result based on the slope of this area. The east coast section showed the value of landing ratio stating that land cover can be built up to 30% coverage. The eastern coastal area has land slope stability and the land capability was higher than the surrounding area. The land cover ratio was expected to be smaller towards the area that is tilted towards upstream. In parts with hilly morphology, the land was directed to allocate 10% for non-buildings in mountainous areas.

![Figure 2. The Recommedation of Bunguran Island’s Land Cover Ratio.](image)

2) The recommendation of Agricultural Spatial Arrangement. Agricultural utilizations in Bunguran Island area were divided into 4 directives, namely: 1. Protected Areas, 2. Buffer Areas, 3. Annual Plant Areas, 4. Yearly / Seasonal Plant Areas. The direction of the agricultural area was strongly related to land that needed to be conserved and land that can be utilized intensively. Similar to land cover directives, agricultural directives made slope and topography as their main factors caused by the homogeneity of other factors. The northern Bunguran Island was directed to become a buffer zone and annual crop cultivation. This region is a relatively flat area but its soil conditions have a high erosion rate. Land use for annual crops was directed at areas that are flat in the upstream area, while those on steeper slopes were directed to become buffer zones with non-intensive cultivation of hard plants. Whereas the southern Bunguran Island was directed to become a protected area in the mountainous section with a buffer around it on the hilly morphology. The direction for coastal lands can be used for annual agriculture. Seasonal agriculture can be done in the eastern part of the southern village.
Figure 3. The recommendation of Bunguran Island’s Agricultural Spatial

3) Direction for Utilization of Raw Water. The directives for raw water in Bunguran Island were divided into 3 classes, namely: 1. Good, 2. Enough, 3. Low. In general, the use of water in Bunguran Island can be utilized adequately both in the northern and in the southern regions. Water in the northern part of Bunguran Island can be used intensely in the upper reaches of this region. Whereas in the coastal part, the water was directed to be utilized with low intensity. The southern section showed a more varied class. Precisely, part of the east coast can be utilized in good intensity. The upstream was directed not to be used with high intensity. The area in Bunguran Island which has good water carrying capacity has a very small area of 27.24 ha in the southern region. An area of 3,255.09 ha spreaded in parts of Bunguran Island can also be used quite well with certain requirements to maintain the capacity of raw water. While the remaining area needed to be conserved, because of the limited water availability.

Figure 4. The recommendation of Bunguran Island’s Raw Water Utilization

4) Recommendation of Building Height. The height of the building in Bunguran Island was directed to no more than 4 floors. There were two classes of building heights in the Bunguran Island, namely Non Buildings and Buildings less than 4 floors. The area in Bunguran Island which can be built to a height of less than 4 floors spanned over 3,282.5 ha. The remaining 3,661 ha was allocated to Non-Buildings. The area that is capable of being built is on the inside of the Northern Bunguran Island, where on the steep coast, it was directed not to be built. Whereas on the
Southern Bunguran Island in the coastal part, buildings with less than 4 floors can be built. The steep upstream section was directed to not built.

Figure 5. The recommendation of Bunguran Island’s Building Height

There were five main constraints in the urban development in Bunguran Island i.e.; mountainous morphology, steep slopes, high erosion, foundation stability, and ease of work. The combined land that can be developed for urban areas in the Bunguran Island is 2,806 ha located on Northern Bunguran Island and Southern Bunguran Island. The upstream area in the Southern Bunguran Island has limited steep slopes and mountain morphology, this region also has a high erosion rate. In the Northern Bunguran Island, region steep areas are on the coast. The transitional part of the coast with hilly areas has a low foundation stability with difficult workability.

Land Capacity of Bunguran Island provided information about the ability of existing land in accommodating a number of residents and population activities. Capacity made the population in one area as part of the analysis. High capacity meant that the area can still be given additional population and community activities at a considerable level. On the contrary, low capacity of the region indicated that it is getting smaller. Unsuitability meant that the region was indeed directed to be emptied of the population. The area that is directed not to be used for population activities has the largest area in the Bunguran Island (73%), which is 5,077 ha (73%). This area is in the Southern Bunguran Island where it is located in an area with a high slope. Areas with high capacity and very high capacity occupied 8% of the Bunguran Island area located in the coastal part of the southern area and parts of northern area which showed a large capacity.

Figure 6. Land Suitability of Bunguran Island
This research was limited to just analyzing the land suitability and land capability to compose spatial pattern planning of Bunguran Island. Based on those, Bunguran Island’s spatial pattern planning was divided into Protected Areas and Cultivation Area. Protected area has spacious area at 87%, which is bigger than the cultivation area. As a national border area, Bunguran Island has many potential agriculture and fisheries to support the national economy. The next development in Bunguran Island needs a spatial plan which supports agricultural and fisheries concept.

4. Conclusion

Spatial planning is a tool to make a regional regulation on detailed spatial planning and it should be an on going activity to drive the stakeholders on pursuing the goals. It also can be proposed in the annual revision agenda through zoning regulations [11]. The results of the evaluation of land capacity based on land capability and suitability are expected to be used as a basis in the formulation of the border management policy as land development recommendation of Bunguran Island as one of national border area. The spatial pattern planning of Bunguran Island consists of 87% of protected area that cant be transferred as cultivation area. The rest of selected cultivation area in Bunguran Island can be managed and developed as settlement area, commercial area, industrial area, and more based on Agrarian and Apatial Planning Ministry Regulation no 16 of 2018 about detailed spatial planning.

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