Land aspects of environmental aspects in using space in Kotamobagu city, North Sulawesi province

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Abstract. The land is an important resource for human survival. Its utilization must be following the capacity of the environment, the resources owned and the ability of the land, or the other words according to the carrying capacity of the environment. This study aims to determine the conditions of actual land use and investigate the class of land capacity in Kotamobagu City of North Sulawesi Province, so the suitability between the class of land capacity and the plan of actual land use and the plan of land use of RTRW can be known, determine whether the environmental carrying capacity is already overcapacity or not, and arrange the land use directive based on the carrying capacity of the land resources environment in Kotamobagu City of North Sulawesi Province. The research method uses a combination of qualitative methods and quantitative methods. The results of the research indicate that the actual use in Kotamobagu City of North Sulawesi Province, in general, 20.38% of the total area is built up, and the rest has not been built. The class of land capacity in Kotamobagu City consist of Class II (75.93%), Class III (11.57%), Class IV (5.33%), Class VI (5.7%), Class VII (0.59%), and Class VIII (0.91%). The suitability between the class of land capacity and the actual land use is 90.13%. The suitability between the class of land capacity and the plan of land development of RTRW is 95.85%. The status of the environmental carrying capacity of land resources in Kotamobagu City at present is not exceeded since the amount of land availability is still greater than the land needs. Thus, it is recommended that the land use direction be divided into three functions namely, protected area, cultivated area, and limited cultivated area.

1. Introduction

Environmental support is related to three things, namely the pressure of the population (the population), the need for land/space, and resource availability. The land is an important resource for human survival. Land use must be following the capacity of the environment, available resources, and the ability to exist land. In other words, land use must be based on environmental carrying capacity. Kormondy in [1] arguesthat in the context of the environment, bearing capacity generally means the maximum number of individuals that can be supported in the environment without decreasing the ability to support future generations in the region [2]. Taiwo and Feyisara (2017) [3] explained that if the maximum amount is passed then, nature will react with pressure against population growth and
development to the point of equilibrium. This pressure can be in the form of floods, drought, famine, landslides, and others [4].

Land has a limit carrying capacity. Rapid development has led to changes in land use patterns. This phenomenon generally occurs in urban areas, where changes in land use take place very dynamically. Changes in land use due to the development of uncontrolled settlements have an impact on decreasing environmental quality [3–5]. Therefore, it is important to prepare land use planning that allows the inheritance of land resources for future generations well that can be done through land use in a planned and sustainable manner, and in a way that suits their abilities and potential [6].

Assessment of land capability is the process of evaluating land potential according to the ability for sustainable land use [7]. This evaluation aims to assess the performance or performance of land if used for specific purposes including the implementation and interpretation of surveys and studies of landforms, soil, vegetation, climate in order to be able to identify and make comparisons of various land uses[7].

In Indonesia, one method for measuring land capability is regulated in Minister of Environment Regulation No. 17 of 2009 concerning Guidelines for Determination of Environmental Support Capacity in Regional Spatial Planning. And to determine the environmental carrying capacity of urban land resources using the Guidelines for Carrying Capacity of Urban Environment Capability from the Ministry of Environment of the Republic of Indonesia.

Kotamobagu City is one of the urban areas that has experienced significant development since autonomy. The availability of facilities and infrastructure as well as economic growth attracts residents to move and live. This results in an increase in land requirements, leading to land conversion. The proportion of developed land continues to increase, reducing the existence of natural and undeveloped land. From the description above, it is necessary to study the aspects of land in Kotamobagu in relation to the management of natural resources and the environment and spatial use of urban areas, which include how: (1) actual land use in Kotamobagu; (2) land capability class; (3) the suitability of the land-use class with the actual land use and RTRW land use plan; (4) the carrying capacity of land in urban areas; and (5) direction of environmental management in the utilization of urban space.

2. Methods
2.1. Location and time in research
The research location was Kotamobagu City, North Sulawesi Province with an area of 6,806 Ha (figure 1). The study was conducted in July to December 2017.
2.2. Materials and research tools
Materials used are Landsat 8 satellite imagery captured Kotamobagu City December 20, 2017, as well as the base map in the form of digital maps from the map Kotamobagu administrative and topographic maps scale 1: 25.000, map the morphology, land use maps, maps of land use planning and other supporting maps. The tool used is a set of computers with ArcGIS 10.3 software, Google Earth, Microsoft Word, and Excel. Other supporting tools are stationary, cameras, and printers.

2.3. Data collection
Primary data in the form of field checking results to verify the results of land cover interpretation from Landsat Image 8. Landsat 8 Kotamobagu satellite image data is downloaded from www.earthexplorer.usgs.gov. Secondary data in the form of 2014-2034 Kotamobagu City RTRW document, population data, data on the number of settlement facilities, and maps. Secondary data sources from collecting and tracking data through the book, the result of this research and journals, legislation, and per set other governments, as well as the mass media articles both in print and on the (online) and of the relevant agencies, such as BappedaKotamobagu.

2.4. Data analysis
The analytical method in this research is quantitative and qualitative analysis using spatial analysis. Current land use is determined by the correction of geometric and radiometric on Landsat 8. land capability analysis conducted by using an overlay on to the maps of the slope, soil texture maps, drainage map of tan ah, and maps of soil erosion. Land suitability analysis by using an overlay to map land capability class, the actual land use maps, and map plan land use. The environmental carrying capacity of urban land resources uses a comparison between land availability (S) and land requirements (D) using SNI 03-1733-2004. Then make the direction of environmental management in the use of urban space based on land capability and consider the results of the analysis in the previous stage which is described descriptively.

3. Results
And the geographical conditions of the study area Kotamobagu is located between 00 0 30 'NU and 123 0 124' East, and administratively consists of 4 District customs, namely North Kotamobagu covering an area of 1038.18 ha, West Kotamobagu covering 1254.33 ha, South Kotamobagu covering an area of 3005.52 ha and East Kotamobagu 1507.96 ha. Topographical conditions: flat (20.54%), sloping (55.45%), slightly sloping (11.58%), hilly sloping (5.24%), rather steep (5.65%) and steep to very steep (1.54%). Soil types consisted of inceptisol (77.87%), inceptisol and ultisol (12.65%) associations, inceptisol and alfisol associations (8.17%), and associations of alfisol, entisol and inceptisol (1.31%).

The actual land use verification in Kotamobagu City was obtained from the interpretation of Landsat Image 8. Geometric corrections were made to equalize the projection system or adjust it to the actual coordinate points on earth. The projection system used is UTM Zone 51 North WGS 1984. Radiometric correction is performed to improve the appearance of the image so that it is easier to distinguish objects. The combination band or channel used is 4-3-2 (RGB). The use of bands produces colors that can be used to identify land uses on an image map. The type and extent of land use in Kotamobagu can be seen in Table 1. P use of total land for k Ebun / plantation had the largest proportion of which 2726.96 ha or 40.07%. While the use of land for settlements and places of activity covering an area of 1387.14 ha or 20.38% of the total area of Kotamobagu.

| No. | Types of Land Use          | Area (ha) | Percentage (%) |
|-----|---------------------------|-----------|----------------|
| 1   | Empty / open land         | 3.84      | 0.06           |
| 2   | Land/pond fisheries      | 16.23     | .24            |
| 3   | Green Open Space (RTH)    | 33.48     | 0.49           |
Analysis land capability using the method contained in Peppermint Environment Number 17 Year 2009, namely the technique of overlaying a map of the four limiting factor, namely the maps of slope (l), soil texture (t), soil drainage (d), and soil erosion (e) to determine the land capability class consisting of land classes I to VIII. Land capability classification is basically referred to the land capability classification of the United States Department of Agriculture (United States Department of Agriculture / USDA). Slope and soil texture data in Kotamobagu was obtained from the morphological map of the Kotamobagu RT/RW. Texture soil, soil drainage, and soil erosion are soil characteristics that can be interpreted from the soil type, soil parent material and landform. The limiting factor of slope in Kotamobagu consists of 6 categories, namely: flat (0-3%) covering an area of 1397.90 ha or 20.54% of the area; ramps / choppy (3-8%) covering 3773.95 ha or 55.45%; slightly tilted / bumpy (8-15%) covering 788.16 ha or 11.58%; hilly sloping (15-30%) covering an area of 356.88 ha or 5.24%; rather steep (30-45%) covering 384.31 ha or 5.65%; and steep to very steep (>45%) covering 104.81 ha or 1.54%. The limiting factors of soil text consist of 7 categories, namely: slightly rough / fine, rough / somewhat rough, smooth / fine covering an area of 6036.36 ha or 88.69% of the area; slightly fine / fine, slightly fine / fine, moderate / somewhat rough covering an area of 556.04 ha or 8.17%; subtle / subtle, subtle / subtle, moderate / subtle at an area of 89.51 ha or 1.32%; rather coarse / medium, rather delicate / a rather delicate area of 67.82 ha a tau 1%; smooth / fine, smooth / fine, smooth / fine covering an area of 37.91 ha or 0.56%; fine / fine, moderate / fairly fine measuring 9.71 ha or 0.14%; and rather fine / fine, rather fine / somewhat fine, somewhat fine / fine covering an area of 8.65 ha or 0.13%.

Limiting factors for soil drainage consist of 4 categories, namely: either 486.14 ha or 7.14% of the area; rather a good area of 363.31 ha or 5.34%; rather bad area of 4556.05 or 66.99%; and bad 1397.50 or 20.53%. Whereas limiting factors for soil erosion consist of 5 categories, namely: no erosion covering 1397.25 ha or 20.53%; light in the area of 4303.22 ha or 63.23%; medium area of 427.46 ha or 6.28%; heavy area of 341.30 ha or 5.01%; and very heavy area of 336.76 ha or 4.95%. Using the map overlay technique for the 4 limiting factors, 6 land use classes in Kotamobagu were identified, namely class II land area of 5168.03 ha or 75.93% of the area; class III covering 787.72 ha or 11.57%; class IV covering 385.57 ha or 5.67%; class VII covering 39.83 ha or 0.59%; and class V III covering 61.95 ha or 0.91%. Visually the distribution of land capability classes in Kotamobagu can be seen in the picture.

The results of the land suitability analysis between the land capability class and the actual land use found that the actual land-use area that corresponds to the land capability class is 6134.1 ha or 90.13% of the total area, not according to the area of 671.79 ha or 9.87 %. The results of the analysis capability between land capability class with the land use plan spatial find that the planned use of land which is in accordance with the land capability class area of 6523.9 ha or 95.85% of the area, not in accordance covering 282.10 ha or 4.14 % (figure 2).
Analysis of the environmental carrying capacity of urban land resources in Kotamobagu uses the method contained in the Guidelines for Carrying Capacity of Urban Environmental Capability from the Ministry of Environment. Land availability is a delineation between protected areas and cultivation areas based on the land capability class found in the previous stage. Land availability is obtained in the cultivation area. Land availability (S) which were identified by 5702.05 ha or 83.79% of the area. Setare land requirement (D) obtained from the calculation of required land for housing and supporting facilities and land requirement for economic activity and supporters based Urban Settlement Planning Guidelines (SNI 03-1733-2004) amounted to 596.62 ha. The environmental carrying capacity of urban land resources in Kotamobagu shows that it has not been exceeded because of $S > D$.

The direction of environmental management in the use of urban space in figure 3, divides space utilization into 3 functions, namely: protected areas, cultivation areas, and limited cultivation areas (table 2) based on land capability classes by considering actual land use and RT/RW land use plans.

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**Figure 2.** Map of Land Capability Classes in Kotamobagu City.
Figure 3. Map of Direction for Environmental Management in Spatial Use in Kotamobagu City

Table 2. Area and percentage of environmental management directives in spatial use in Kotamobagu City.

| Direction of Spatial Use         | Area (ha) | Percentage (%) |
|----------------------------------|-----------|----------------|
| Protected area                   | 1370.43   | 20.16          |
| Cultivation area                 | 5309.50   | 78.01          |
| Limited cultivation area         | 126.07    | 1.85           |

4. Discussion
This research shows that generally, Kotamobagu City is suitable or suitable for urban areas according to the land capability class. In terms of land use allowed in each land-use class, namely: class I = all types of land use; class II = all types of land use, except for very intensive agriculture (psi); class III = all types of land use except psi and moderate intensive agriculture (psd); class IV = limited agriculture (pt), all grazing types, all forest types; class V = all grazing types, all forest types; class VI = moderate grazing, limited grazing, all forest types; class VII = limited grazing, forests; and class VIII = nature reserves and protected forests. Land class capability II - VI can be cultivated or used for public land use. However, the higher the land class, the greater the land limiting factors that limit its use. For urban land that is dominated by buildings, according to its function as a center of activity and non-agricultural areas, based on the physical aspects of land, the appropriate land class for urban buildings is on land classes II - III. Higher land classes require technical engineering to be safe to use but with limited functions. But even land suitable for urban development is not without obstacles. Class III land is ideal because its sloping topography makes drainage easier, so it is not prone to flooding. However, in class II land with flat topography, it is prone to flooding due to poor drainage.

To maintain the carrying capacity of the urban environment, the proportion of protected areas must be in accordance with the terms of the spatial planning law, which is 30% of the area, consisting of 20% of public green space and 10% of private green space. In the direction of managing the urban environment, the proportion of protected areas is 20.16% from the previous 13.73% in the RTRW plan [2]. The proportion of protected areas is considered as public green space. Whereas a private green space of 10% can be obtained from the area of cultivation in the form of the area of the
population and population. Restricted cultivation areas are areas that are no longer permitted to add settlement functions due to limiting factors in the land capability class.

Efforts to manage the environment in the use of space for what can be done include: (1) To maximize urban water catchment areas: in residential areas is done by making a biopori hole and applying the infiltration well method; on undeveloped land: building conservation ponds and applying river side polder methods; controlling the construction of buildings that cover the ground so that it does not prevent water from seeping in; making situ or reservoir in the city [8]; (2) river border areas: control of buildings around river borders and riverbanks with zoning arrangements, licensing provisions from relevant agencies and community participation [9]; (3) flooding in residential areas: individually by making biopores, infiltration wells, increasing vegetation (runaway water coefficient in vegetated areas is of less value than non-vegetated ones [4], and complying with compliance KDB determined by the government; the role of the government by improving the drainage system and the upholding of space use regulations by controlling buildings and controlling land use ; (4). Preventing and rehabilitating landslides: management that can be carried out with vegetative engineering and soil conservation measures, including avoiding / reducing tree felling, planting light vegetation with intensive rooting, reducing the mechanical burden of large-rooted trees.

5. Conclusion and suggestions

Land resources in Kotamobagu City are sufficient to develop as urban areas, but there are land uses that are not in accordance with the land capability class and RTRW land use plans, especially in protected areas. Environment management efforts early in the utilization of urban spaces are the direction of the appropriate land use capability classes of land and conduct technical engineering and vegetative on the environment, supervision and control of the environment in areas Blocking Reception as a protected area. We suggest a review of the RT/RW, because the actual conditions are starting to deviate from the planned land-use plan. In addition, community participation in environmental management is expected to be maximized by the government by providing assistance so that together can realize ideal environmental management.

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