Identification and Mapping of Areas Indicated Violating Spatial Use in The North Bandung Region

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Abstract. North Bandung Region (KBU) is a conservation area, water catchment and investment magnet attracting high due to its strategic location at an altitude level above 750 meters above sea level. Developments at KBU have a disastrous impact on the below highland. This research was conducted to identify mismatches in spatial use and indications of violations of spatial use with the superimpose method of spatial plan maps with existing land cover maps. Continued spatial analysis, object / point filtering, field observations, focus group discussions, spatial performance analysis and impact calculations. The results stated that there were 4,414 polygons and 42 typologies of spatial mismatch and 108 points of indication of violation. Found four typologies of violations of spatial use; spatial use that is not in accordance with the spatial plan, is not in accordance with the spatial use permit granted by the authorized official, is not in accordance with the permit requirements, and issues a permit that is not in accordance with the spatial plan. Recommendations for law enforcement measures in the form of administrative and / or criminal sanctions are given to points of activity that are indicated to have experienced violations of spatial use.

1. Introduction

Massive development in the North Bandung Region is increasingly causing problems with floods, scarcity of raw water, declining groundwater quality, sedimentation and the threat of drought in the Bandung basin [1][2][3][4]. Public reports emerged in the form of rejection of the construction of buildings, vertical buildings and licensing issues granted by the authorities. The concern of the community around the KBU and the area below it was also triggered by the reason for the KBU’s vulnerability to natural disasters, landslides, volcanic eruptions and land movements. At present there has been a change of land use from protected forest areas to concrete forests of 70% or around 28,000 hectares from a total area of 40,000 hectares [5].

The water crisis that occurs in the dry season is caused by a decrease and loss of water supply from the spring at KBU. At present there are around 500 hectares of springs in the City of Bandung area out of an area of 3000 hectares. The loss of 149 springs in the Bandung City Region due to conversion into a property area and 20 springs in the Bandung Regency Area due to privatization [5]. Based on news from the media, the flash flood disaster accompanied by mud occurred in the Jatihandap and Cicaheum Regions on March 20, 2018, which achieved substantial material losses. Similar floods in
the same location with material losses occurred in 1980 and 2014. Flash floods with 3 fatalities occurred in the Pasirjati area in 2018. Factors causing flash floods are due to land use change and high rainfall in KBU, up to 45 cm [6]. Data from CNN, Indonesia in 2018 states that KBU is no longer a water catchment area and can no longer bind surface runoff water, so it immediately slides into the area under the KBU and makes many embankments burst. Continuous exploitation at KBU has the potential to cause flash floods in the Greater Bandung Area. The condition of flash floods in Jatihandap and Cicaheum Regions in 2018 is shown in figures 1 and 2 [6].

If the exploitation of development in KBU is not immediately limited, the possibility of catastrophic floods and loss of water catchment areas for the Greater Bandung Area will be even greater. Research on the identification and mapping of areas that experience violations of spatial use becomes very important to be carried out, as a special form of control and supervision for KBU. By knowing the area and location of activities that have experienced space use violations, the government and policy makers will have a basis for giving sanctions to violators. Another urgency if this research is not done is the potential of the Greater Bandung Area as a basin area under the KBU in the future fully covered by surface runoff water.

Studies on land use change in several areas have been carried out, including studies of land use change in the Mount Halimun National Park Area, Salak with a spatial model in 2014 [7], and an analysis of land use change in Bantul District using the Global Moran’s I method in 2017 [8]. Study of land use change in Bandung Regency with spatial analysis, identification of discrepancies with space allocation using the scalogram method and multiple regression in 2017 [9]. Research on spatial deviations was conducted in 2009 in South Sulawesi Province with descriptive analysis [10]. To study the suitability of land use and the consistency of spatial plans carried out in 2016 in Baubau City, Southeast Sulawesi Province with a GIS approach, land resource balance, factor analysis and multiple regression [11]. The evaluation of spatial planning products was carried out in Kudus District with the overlay method for spatial data prone to disaster in 2016 [12], in Tegal City in 2017 with quantitative analysis methods [13] and in the coastal area of Bulukumba City with description analysis methods, superimpose, regression in 2018 [14]. The direction of conformity of area functions was carried out in Pati City in 2016 with a tiered quantitative analysis approach [15], identification of land use suitability in Ambon City in 2016 with qualitative descriptive methods and spatial analysis [16]. The implementation of spatial control and administrative sanctions in the Sidoarjo Regency Spatial Plan will be conducted in 2017 with a descriptive qualitative method [17].
Previous research and studies have not yet resulted in impacts from land use change, locations that violate spatial use and recommendations for legal sanctions that must be given. The author considers that it is important to do because it will be able to limit the activities of violations of the planned spatial patterns and provide a deterrent effect for the offenders of the use of space. The Ministry of Agrarian Affairs and Spatial Planning in 2015 conducted a spatial audit in Mataram City using the method of overlaying maps, field observations and focus group discussions [18]. This research has never been done before because did of screening, spatial performance analysis and impact calculations for locations indicated to violate spatial use.

2. Material and Methods
The research location is the North Bandung Region with an area of 38,548.33 hectares. Consists of four regional entities, namely part of West Bandung Regency, part of Bandung City, part of Cimahi City Region and part of Bandung Regency. The data used is in the form of a spatial plan map and the latest existing land cover map which is patched. The results of overlap in the form of a map of the discrepancy in the use of KBU space consisting of the area of polygons and points of activity that are not in accordance with their designation. An examination of the indications of points of violation of spatial use activities is carried out based on the permit issued and the permit requirements requested by the competent authority documents. The study period lasted for eight months from April to November 2018. Tools and materials used are Global Positioning System (GPS) Tracker, computer equipment, Aerial Photo Capturing Drone, voice or image recording equipment, communication equipment, stationery and other equipment that supports technical needs. The location of KBU is shown in figure 3 (source: results of analysis, 2018).

![Figure 3. Delineation of research sites in the North Bandung Region](image-url)

Indications of spatial violations that occur are visualized through aerial photographs for the location of activities at KBU. Samples of aerial photographs using drones can be seen in figures 4, 5, 6 and 7. The four stages of the research activity covering the basis of the activity, data collection, spatial analysis, and the audit activity process are shown in figure 8 (source: results of analysis, 2018). The flow of research and typology of violations is shown in figure 9 (source: results of analysis, 2018). Typology of violations of spatial use is determined based on the rules that become the reference. The estimated magnitude of the impact caused by changes in spatial performance determines the category of violation. Figure 10 shows the process (source: results of analysis, 2018).
Figure 4. Indications of violation of the designation of community forest into sand excavation in West Bandung Regency (source: aerial photo, June 23, 2018)

Figure 5. Indications of violation of the allotment of green open space into an expansion of developer housing in the city of Bandung (source: aerial photography, 13 August 2018)

Figure 6. Indications of violation of the designation of water catchment areas into housing developers in the City of Cimahi (source: aerial photography, September 5, 2018)

Figure 7. Indications of violation of the allotment of protected forest into settlements in Bandung Regency (source: aerial photo, 6 September 2018)
Figure 8. Process of research stages

Figure 9. The process of conducting research in the North Bandung Region, 2018
3. Results and Discussion
In the analysis phase, identifying the findings of indications of spatial use discrepancies are based on the results of spatial analysis using the superimpose map method between the spatial plan map and the latest existing land cover map. The mismatch of spatial use is visualized in the form of a red area, and the appropriate spatial use is visualized by a green area. Visualization of the intended area is shown in Figure 11 (source: results of analysis, 2018).

![Figure 11. Indications of non-conformity with spatial use in the North Bandung Region](image-url)
The results of the spatial analysis revealed the findings of an indication of the mismatch of spatial use of 4,414 polygons with a total area of 5,694 hectares. Bandung City ranks highest, followed by West Bandung Regency in second place. Types of space allotment that experienced the most violations occurred in the Bandung City Region, a number of 7 types of space allotment of 31 types of total space allotment. The second most occurred in the West Bandung Regency Area with 6 types of spatial allocation from 21 types of total space allotment. The findings of indications of non-conformity at KBU can be seen in table 1 (source: results of analysis, 2018).

**Table 1. Indications of discrepancy in spatial use at KBU in 2018**

| Regions            | Number of polygon | Area (hectares) | Type of designation of space | Number of types of existing land cover |
|--------------------|-------------------|-----------------|------------------------------|----------------------------------------|
| Bandung City       | 1,839             | 120.66          | 7 out of 31                  | 11                                     |
| Bandung Regency    | 263               | 2,836.17        | 3 out of 19                  | 9                                      |
| Cimahi City        | 730               | 579.61          | 4 out of 16                  | 6                                      |
| West Bandung Regency| 1,582             | 2,158.24        | 6 out of 21                  | 8                                      |
| Total              | 4,414             | 5,694.67        |                              | 34                                     |

To get an indication of violation of spatial use activities, screening is carried out with four criteria: complaints data regarding indications of spatial use discrepancies, activities on land that have been designated as protected areas under the authority of the central government, activities on land with state land status, and activities that are above disaster prone areas. The screening results state the most indication of the location of violations of spatial use in West Bandung Regency with 35 locations. A total of 20 types of land use change activities that are not in accordance with their designations are shown in table 2 (source: results of analysis, 2018).

**Table 2. The results of the filter indicating the location of violations of spatial use in KBU in 2018**

| Regions     | Indication of location violations of spatial use (points of activity) | Information on land functions (Spatial plan vs. existing land cover) |
|-------------|---------------------------------------------------------------------|-------------------------------------------------------------------|
| Bandung City| 22 activity points : 9 Developer housing, 1 school, 1 swimming pool, 1 convection site, 2 hotels, 8 apartments | 1. Allotment of green open space of urban forest becomes: nuclear area |
|             |                                                                     | 2. Allotment of green open space for germplasm protection areas is as follows: settlement zone |
|             |                                                                     | 3. Allotment of green open space preservation of nature into: sports arena area, education area, rice fields, farm spatial area, settlement zone |
|             |                                                                     | 4. Allotment of road network border becomes: settlement zone |
|             |                                                                     | 5. Allotment of river border into: sports arena area, cemetery area, education area, worship area, residential zone |
|             |                                                                     | 6. Allotment of SUTET border is as follows: cultivation building area, sports arena area, industrial area, education area, residential zone |
7. Allotment of toll borders becomes:
   public facility area, residential zone

Bandung Regency

19 activity points:
2 tourist attractions, 1 cafe, 11 community settlements, 3 developer housing, 1 residential residence, 1 sports activity site

1. Allotment of protected forest becomes:
   jungle, plantation / garden, settlement and place of activity, paddy field, rainfed field, shrub, empty land, dry field / field
2. Allotment of green open space becomes:
   jungle, plantation / garden, settlement and place of activity, paddy field, rainfed field, shrub, fields
3. Forest parks become: lake / situ, jungle, plantation / garden, settlement and place of activity, rice fields, shrubs, vacant land, fields

Cimahi City

32 activity points:
24 housing developers, 3 offices, 2 schools, 1 industrial activity site, 2 sports activity venues

1. Allotment of water catchment areas into:
   buildings, plantations / gardens, settlements and places of activity, rice fields, rain-fed rice fields, fields
2. Allocation is prone to lava flow into:
   buildings, settlements and places of activity, fields
3. Allotment of green open space becomes:
   settlements and places of activity, rice fields
4. The designation of the river border becomes: buildings, gardens, settlements and places of activity, rice fields, rain-fed rice fields, fields

Bandung Barat Regency

35 activity points:
6 housing developers, 13 villas / resorts / cottages / homestays, 1 tourist attraction, 1 school, 1 sand mining, 4 BTS, 3 restaurants and cafes, 6 residential houses

1. Allotment of nature reserves becomes:
   settlements and places of activity,
2. The allotment of protected forest areas becomes: buildings, land dunes, gardens, settlements and places of activity, rice fields, rain-fed rice fields, empty land, fields
3. Allotment of the nature reserve area is:
   building
4. Allotment of water catchment areas into:
   buildings, land dunes, settlements and places of activity, rice fields, rain-fed rice fields, vacant land
5. The allocation of border is as follows:
   building, settlement and place of activity
6. Allotment of urban forest park becomes:
   settlement and place of activity

Total 108

20 types of space allotment have switched functions

4. Conclusions
The results showed that there were 4,414 polygons of spatial mismatch in KBU from the overlay of the spatial plan map with the existing land cover map. A total of 1,839 polygons in Bandung, 1,562 polygons in West Bandung Regency, 730 polygons in Cimahi City and 263 polygons in Bandung Regency. Based on the screening results with four criteria, 22 points were indicated for violations of
space use in Bandung, 19 points indicated violations of space use in Bandung Regency, 32 points in Cimahi City and 35 points in West Bandung Regency. The results of the examination of document permits and permit requirements, found four typologies of violations of spatial use; spatial use that is not in accordance with the spatial plan, is not in accordance with the spatial use permit granted by the authorized official, is not in accordance with the permit requirements, and issues a permit that is not in accordance with the spatial plan. Transfer of land functions that occurred as many as 34 types of existing land cover from 20 types of land allotment that should.

Bandung City and West Bandung Regency experienced the most land use conversion activities at KBU. The results of the analysis of spatial performance, the calculation of the impact found that all indications of violations location of spatial use have decreased the quality of the environment and have a major impact physically, economically and socially. This means that the North Bandung Region currently has an increasingly high level of potential disasters.

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