REGIONAL LAND SUPPORT OF FLOW CIMANUK RIVER

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**Abstract**

Flood events that occur in the Cimanukwatershed of Garut Regency in September 2016 indicate that erosion has occurred in the upper reaches of the Cimanuk River. In addition, high rainfall and the inability of vegetation in the upper Cimanuk river which is unable to store water. The purpose of this study was to look at the environmental carrying capacity of the Upper Cimanuk watershed in Garut Regency. The scoring method by conducting surveys is used in this study to obtain the potential of existing land in Upper Cimanuk so that the carrying capacity of the environment can be known. The results of this study indicate that surface runoff in upstream areas is not able to be retained by existing vegetation. land use in the Upper Cimanuk area is dominated by agriculture which causes the ability of land to escape water is low. Specific strategies are needed in dealing with these issues including conducting critical land rehabilitation, by building public awareness, zoning determination and firmness according to carrying capacity, and coordination between sectors.

**Keywords: 3**–**5 words**

***carrying capacity, watershed, Cimanuk river***

**INTRODUCTION**

The Watershed Existence (DAS) is important in maintaining the balance of the ecosystem and the needs of water resources for humans. Good environmental conditions of the watershed will have an impact on the sustainability of human life and other living things, Law on Water Resources Number 7 of 2004 article 20 paragraph 1 which is meant by carrying capacity of water resources is the ability of water resources to support the life span of humans and living things others. Thus the quality and quantity of water produced from nature must be able to guarantee the survival of human life and other living things.

Watershed conditions affect the amount of water available in the region, data from Bappenas (2004) cited by Dermoredjo et al (2011) show that the water crisis that occurred on Java Island with fresh water reserves is only 4.5 percent of national reserves with an amount of population which reaches 65 percent of the total population in Indonesia. This condition shows that the water crisis that occurred in Java is very worrying, so that ongoing maintenance efforts are needed. In addition, Raharsiani (2013) revealed that changes in land use in the Upper Cimanuk watershed significantly affected flow and sedimentation, namely the reduction of forest area of ​​3,284 ha, an increase in agricultural land of 2,881 ha, and an increase in urban land of 403 ha increasing debits the average flow is 11.3 m3 / second and the sediment increase in the river is 41,085 tons. Decreasing environmental quality in watersheds will have an impact on the environment around the watershed. According to Pawitan (2004) changes in land use which resulted in the loss of forest land cover to other types of land use, proved to have a more limited carrying capacity of the environment, so that the threat of floods and droughts is increasingly common. Whereas, the results of Mawardi's (2010) study show that the damage and criticality of the watershed greatly influences the carrying capacity of water resources, this can be seen by the increasing frequency of floods, landslides and droughts that affect the availability for the community. In addition, de la Cretaz and Barten 2007 in As-Syakur (2010) revealed that changes in land use will affect the hydrological conditions of watersheds.

The destruction of forest land in the Cimanuk watershed is an integral part of the flood disaster. As is known that the Cimanuk watershed is one of the main pillars of water resources in West Java. The area of ​​Cimanuk watershed is 3,493 km2 which is divided into three parts of the watershed, namely the Upper Cimanuk watershed, the Central Cimanuk sub-watershed and the Lower Cimanuk watershed sub-watershed. The Upper Cimanuk sub-watershed has an area of ​​145,677 Ha in Garut and Sumedang Regencies.

**METHODS**

Land status carrying capacity obtained from the value of slope, surface erosion, surface drainage, depth of groundwater, soil texture. Then also overlapping slope maps, soil type maps, average rainfall maps and disaster-prone maps. From the stacking overlap will produce a map of land capability. This study uses some data in the form of a boundary map of the Upper Cimanuk Watershed, topographical maps of Indonesia and statistical data of Garut Regency.

**FINDINGS AND DISCUSSION**

**Findings**

The objectives of the management of the Upper Cimanuk watershed are determined in advance, namely the fulfillment of community needs and the preservation of natural resources to meet the needs of future generations. Basically, watershed management is the management of natural resources to meet human needs for the present and future, the sustainability and harmony of ecosystems and control the reciprocal relationship between natural resources and humans. Based on the results of interviews with managers, experts in watershed management, and policy makers who have experience in watershed management, several alternatives were obtained for the management of the Upper Cimanuk watershed, namely: the establishment of an authority / coordination body; building community awareness; explore and utilize local wisdom; forest establishment and conservation; implementation of regulations and policies; sustainable infrastructure development; zoning determination and firmness of the RTRW that matches the carrying capacity; coordination between institutions and sectors; fairness of water allocation; management pattern based on carrying capacity; restoration of environmental functions and infrastructure systems to optimize system performance, rehabilitate critical land; community empowerment. To support the achievement of goals, criteria are needed as a supporting factor for the running of alternatives in achieving goals. Based on the results of the interview obtained the criteria specified in the management of the Upper Cimanuk watershed, namely: the mechanism of incentives and disincentives (sharing); effective socialization (program); HR expertise; quality index; education and culture; condition of the population (community); synchronization and optimization; carrying capacity and carrying capacity; good management system (planning, implementation, monitoring, evaluation); data and information.

The program needs to be socialized in an effort to build shared understanding and participation in its implementation. In managing the Upper Cimanuk watershed to deal with environmental degradation, a coordinated management system is needed from planning, organizing, implementing, and monitoring and evaluation. The system needs to be complemented by the presence of a watershed quality index as a parameter or indicator to determine progress or achievement of objectives.

**Characteristics of the Upper Cimanuk Watershed**

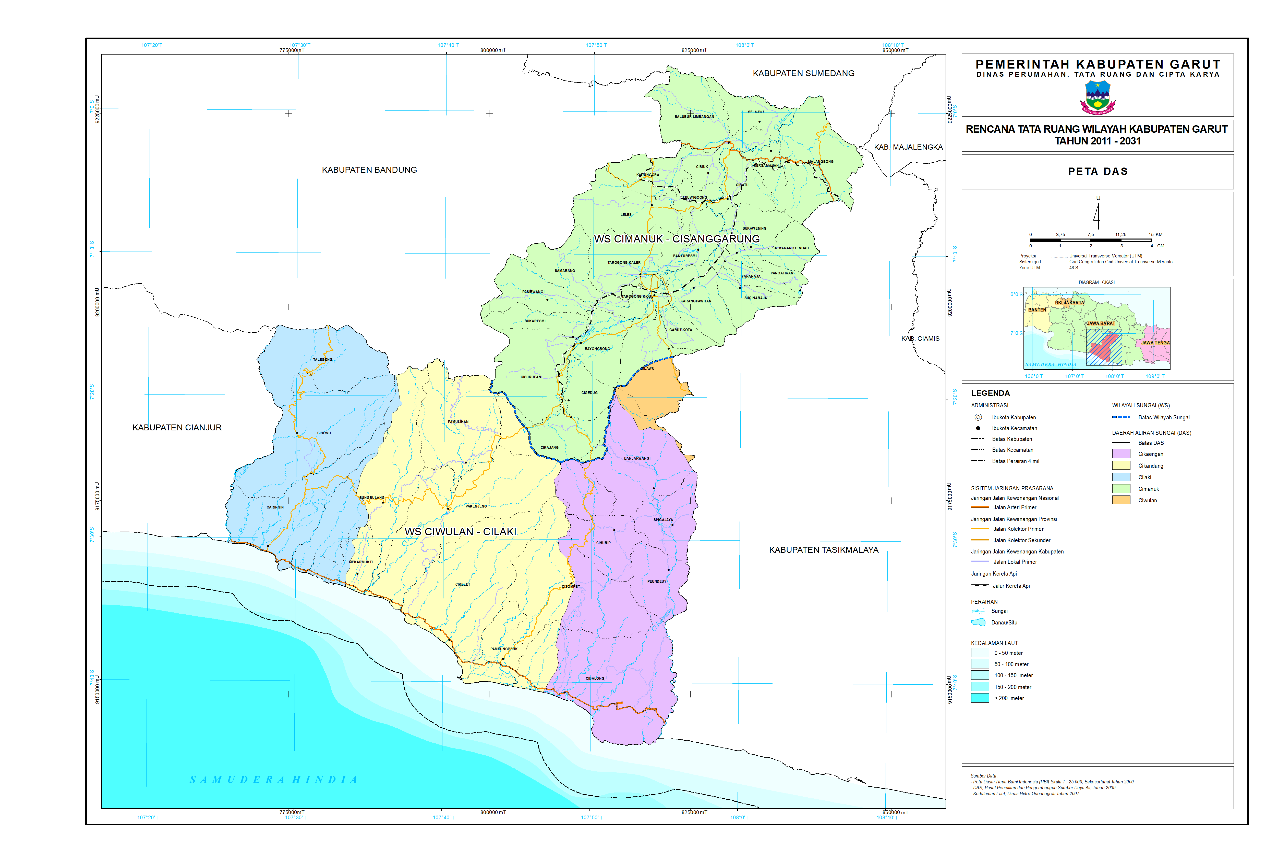
The upstream part of the Cimanuk River Region has a complex geological order, both lithological and tectonic variations. Since the early 1980s the management of the Cimanuk watershed was mainly to meet irrigation needs in agriculture. In 1992, in this region, research was also carried out to support the plan for the construction of the Jatigede Multipurpose Reservoir (Anonim, 1992). The increasing demand for electricity in Java and the increasing problem of meeting water resources for irrigation, industry and domestic needs are the reasons for the construction of reservoirs in the region. Therefore, the upstream part of the Cimanuk watershed has strategic value and must be handled specifically. Research that has been conducted in relation to the Cimanuk watershed has been carried out by many previous researchers. Some of the geological maps of this region have been published on a scale of 1: 100,000 (Budhitrisna, 1986; Alzwar et al., 1992; Djuri, 1995, and Silitonga et al., 1996).

Figure 1. Map of watersheds in Garut Regency

The land use map in Figure 1 shows that agriculture is the most dominant. According to Strahler (2011), the processing of agricultural land can change the physical properties of land which auses the ability to escape water to be reduced.



Gambar 2. Penggunaan Lahan di DAS Cimanuk Hulu

Vegetation cover on non-dense agriculture causes rainwater to fall directly on the ground. This triggers splash erosion which can close the soil pores, so that the ability of the soil to escape water is reduced. Land processing techniques, use of fertilizer types, and types of agricultural crops are also important factors in analyzing surface runoff. Discussions on this matter will be detailed below. Meanwhile, soil characteristics are a key factor besides land use when analyzing surface runoff. Texture (composition of grain size of particles) is a basic physical property that affects other physical characteristics (Sartohadi at al, 2012). The size of the constituent grain is divided into three, namely sand, dust, and clay. These three sizes always compose the composition of the soil (never stand alone). The difference in soil texture is influenced by geographical position, basic material, and human processing (Strahler, 2011 and Sartohadi at al, 2012). Detailed analysis of the type of texture is discussed in geomorphology and soil reports. The type of soil texture will affect the ability of the soil to pass water. The sand fraction has a large particle size, thus forming a macro pore in the soil (Sartohadi at al, 2012). This causes the soil to escape water better than the clay fraction. Based on this concept, the type of soil soil texture can be classified into certain hydrological soil groub (HSG). So that soil types can be classified according to HSG, the type of soil in the Upper Cimanuk watershed is dominated by Clay Loam. Whereas in the middle part the type of loam soil dominates that part.

**Subdas condition**

The majority of soil texture in the subdas is loam (38%) (Figure 6.10). This type of texture has a bond between medium particles so that the water is quite easily absorbed. Therefore, the texture of this soil is very suitable for agricultural land. The disadvantage of this soil texture is that it erodes easily. This is also triggered by the presence of other dominating textures, namely sandy coil (27.7%). The condition between soil particles that are not strongly bound causes the soil to easily erode following the flow of water.

The watershed morphometry parameters are also important to be seen as one of the reasons to strengthen the arguments that have been described by other parameters. The parameters of the concentration time (Tlag) and flow density in subdas 9 can be used to describe the relationship of the watershed morphometry with the resulting surface flow discharge. Subdas 9 has a high flow density with a value of 3.19 km / km2. This is indicated by the number of existing river branches. High flow density indicates that the material is easily eroded and is less able to absorb water.

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| Figure 3. Use of forest land, moor, coffee plantation of Mount Papandayan | | |

The concentration time in a watershed includes a medium class with a value of 3.96 minutes / km. The concentration time is influenced by one of the main river lengths and the slope of the watershed. Subdas 9 has a main river length of 13.62 km and a watershed slope of 2.58%. Based on this, the concentration time is strongly influenced by the length of the main river which is quite long. The longer and sloping a watershed will increase the concentration time and will ultimately affect the occurrence of flooding. Rice fields became the dominant land use, which amounted to 99.12% (Figure 2). This is very logical because subdas 14 is located in a river valley between two mountains. The existing soil and water conditions are very supportive for rice farming.

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| Figure 4. Extensive Percentage of Land Use and Type of Soil Texture | | |

The agricultural conditions are also supported by the texture of sandy soil (84.5%) which is very suitable for rice. Sandy sandy soil texture besides being a good growing medium also has disadvantages. The character of the soil which is dominated by the coil is that the soil has moderate porosity and infiltration rate. However, the soil with this texture is not able to hold longer water so that water will be quickly released into surface runoff. The use of dominating paddy fields will contribute to large surface flows. Rice fields that are already saturated with water will no longer be able to absorb falling rainwater, so rainwater will become surface runoff.

Land-processing behavior also needs to be considered to obtain an accurate surface runoff analysis. Agricultural lands are in relatively flat areas. No significant land conservation efforts were found. Farmers process land using conventional methods. This will worsen the condition of the land and also the condition of surface runoff.



Figure 5. Paddy Field Use and Gardens with Terraced Systems

The parameters of the concentration and flow density times are used to describe the relationship of the watershed morphometry to the surface flow generated. Subdas 14 has a high flow density with a value of 3.92 km / km2 which is indicated by the number of river branches. The time of concentration in a watershed is influenced by the length of the main river and the slope of the watershed, the length of 2.57 km and the concentration time of 2.807 minutes / km, the time the concentration is relatively fast because with 2,807 minutes the water can run at every kilometer. The time of concentration other than influenced by the main river length can also be influenced by the slope of the watershed. The watershed slope in subdas 14 is 13.56%, this figure is very high. Based on this, it can be concluded that with a short river length and high watershed slope can contribute to the time of rapid flow concentration.

**Discussion**

The definition of carrying capacity in an ecological context is the number of populations or communities that can be supported by the resources and services available in the ecosystem. Sana, like Cargille (1975), said that carrying capacity is the basic concept of ecology in which it explains the maximum population that provides support for the environment. If the population overlaps the carrying capacity, there will be significant environmental changes. Factors that influence the limitations of ecosystems to support livelihoods are factors in the amount of available resources, population numbers and consumption patterns. The concept of environmental carrying capacity in an ecological context is closely related to natural capital. However, in the context of sustainable development, a community not only has natural capital, but also human capital, social capital and artificial environmental capital. Therefore, in the context of the continuation of a city, the carrying capacity of a city environment is the number of population or community that can be supported by available resources and services because of its natural, human, social and environmental environment. The definition of environmental carrying capacity according to Law Number 23 of 1997 concerning Environmental Management is the ability of the environment to support the lives of humans and other living beings. Environmental carrying capacity is the maximum number of people that can be supported by the earth with available natural resources. The maximum amount is the amount that does not cause damage to the environment and life in the wild can take place in a sustainable manner. In its later development, the concept of environmental carrying capacity was applied as a calculation method to determine the number of living organisms that can be supported by an ecosystem continuously, without destroying the balance in the ecosystem. Decreasing the quality and damage to the ecosystem is then defined as an indication that the carrying capacity of the environment has exceeded. On a website carrying capacity, an ecosystem is a population that can be supported by the availability of resources and services in the ecosystem. Ecosystem carrying capacity limits depend on three factors: a. The amount of natural resources available in the ecosystem b. Number / size of population or community c. The amount of natural resources consumed by each individual in the community. The definition of natural capital based on the website includes: 1. Natural resources which are all taken from nature and used with or without going through a production process which includes water, plants, animals, and natural materials such as fossil fuels, metals and minerals. The use of natural resources will produce final products and waste. 2. Ecosystem services are natural processes needed for life, such as fisheries resources, land for cultivation, water and air assimilation capabilities and so on. 3. Aesthetics and natural beauty that have contributed to improving the quality of life and are economic potential for the development of tourism and recreation.

Natural capital has the ability to produce the resources needed to absorb the waste produced (biocapacity). Based on this understanding, natural resources have the ability to assimilate waste. The ability to assimilate waste is called bioasimilation which is defined as the ability of the natural environment to absorb various materials including anthropogenic waste in certain concentrations without degradation. Environment has the ability to assimilate waste called environmental capacity. Environmental capacity based on Law 23 of 1997 concerning Environmental Management is the ability of the environment to absorb substances, energy, and / or other components that enter or are incorporated into it. Whereas actually the capacity of the environment can be covered in terms of environmental carrying capacity because "supporting livelihoods" can be interpreted as supporting the availability of the resources needed while assimilating the waste from the consumption of these resources. From this understanding, the carrying capacity of the environment is something that is dynamic, can be degraded or extinct if it is not preserved and vice versa can be increased its ability.

The existence of the Upper Cimanuk River Basin which has an impact on people's lives needs to be preserved. The decreasing carrying capacity conditions threaten the Upper Cimanuk River Basin ecosystem. Sustainable river management needs to be improved, O’Keeffe (2009) uses Environmental flows in maintaining and using water resources. The results obtained from this method of sustainable river management are successful. Communities and political policy makers are the key to the success of sustainable river management. This is very necessary in the management of the Upper Cimanuk watershed because good river conditions will provide benefits to the community and the existing ecosystem. As stated by Blue (2018) that good river quality is carried out through river water conservation management that continues to reach. The concept of river health represented this is a good value for environmental values ​​and intervention for intervention in freshwater.

**CONCLUSION**

The priority strategy in managing the Cimanuk Hulu sub-watershed is rehabilitating critical land by paying attention to criteria such as incentive and disincentive mechanisms, effective socialization, HR expertise, watershed quality index, education and culture, population conditions, synchronization and optimization, carrying capacity and capacity , a good management system, and data and information. The pririotity strategy needs to be supported by building public awareness (social aspects), the determination and firmness of the zoning of the RTRW according to carrying capacity (regulations and policies), and coordination between institutions (agencies) and sectors (institutional aspects). To complement efforts to formulate a management strategy in a watershed, it is recommended to optimize the study of hydrological conditions in the Upper Cimanuk watershed. A more detailed land use study needs to be carried out. Developing a more implementable and comprehensive watershed management strategy can be used in a combination of methods. The value of surface runoff in the upstream areas of Papandayan and Cikuray Mountain is caused by high rainfall, poor soil ability to escape water, and watershed morphometry that is prone to flooding. The annual average rainfall for five years shows a value of 2941-3154 mm. This area is dominated by hydrological soil group type clay. Land use which is dominated by agriculture also causes the ability of land to escape water is low. Meanwhile, time concentration and the density of watershed flows are dominated by medium to high class. The combination of several aspects causes this upstream region to have a high surface runoff value.

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