CONSERVATION STRATEGY ANALYSIS IN UPSTREAM WATERSHEAD: CASE STUDY IN CIMANDIRI WATERSHEAD

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ABSTRACT

The calibration result of Tank Model on DTA SPAS Cumucang-Cimandiri by using rainfall data, evapotranspiration and land cover in 2009 shows that the determination coeffient equal to 0,77 to aktual discharge and model output discharge. Validation results using 2014/2015 datas shows a strong relationship between the actual discharge and the model output discharge with a determination coefficient of 0,805 and generate an average daily discharge value of 1,057 m^3sec^{-1}, a maximum discharge value of 6,68 m^3sec^{-1}, and minimum discharge value of 0,072 m^3sec^{-1}. The Model show the hydrological conditions are in moderate category with KRS value of 93,2238. Based on the analysis of internal and external factors using SWOT analysis, it was found that the management strategy of DTA SPAS Cimuncang-Cimandiri was in the SO position (Quadran I). The conservation strategy is to keep the forest area in a state of > 30% and optimize environmental funds and services to foster people's creativity to improve welfare. As an alternative strategy that can be applied to keep the DTA SPAS Cimuncang-Cimandiri remains in good conditions is to make efforts of soil and water conservation such as absorption wells on settlements and making terraces on rice fields. The implementation of this conservation strategy can reduce the value of KRS to obtain of 54,326.

Keywords: Tank model, SWOT, Strategy of conservation.

INTRODUCTION

The upstream part of the river should be an area that functions as area absorption water but in some countries there has been a lot of severe damage. Over exploitation by human activities, as well as water consumption around the upstream areas have drastically increased due to the commercialization of water resources, resulting in shrinkage of catchment areas, water shortages, soil erosion, climate anomalies and other natural disasters (Ouyang et al., 2011). Changes in water availability have major impacts on most social aspects, especially for agriculture, industry and domestic water supplies. This of course is very contrary to the importance of the upstream watershed which is the main source of ecosystem services and plays an important role for water storage to prevent flooding in the downstream area (Suwarno, 2011).

The upstream watershed area is a water catchment area. The rain that falls should be absorbed into the ground as groundwater reserves in the dry season. At this time, the environmental quality in the upper watershed Area has decreased, this is due to the conversion of land functions in the area. Changes in land cover have implications for changes in the water system in a watershed. So that accurate information is needed about hydrological characteristics with parameters in quantity and quality. One of the technologies used to obtain these data is the construction of SPAS (River Flow Observation Station) and as a model to analyze these parameters can use the Tank Model which is one of the hydrological models that can describe the hydrological characteristics of a watershed (Nurroh and Arifjaya, 2015). The Tank model has been widely used in various watersheds such as the Cidanau watershed (Hermailis, 2001) and the Konawe watershed (Surya, 2014) to model the daily discharge for one year. Based on the daily discharge, the river regime can be known, so the model is tank used as an analytical tools in this study. Efforts to solve the problem are to analyze the watershed management strategy by calculating the coefficient value of the river regime with existing conservation measures with the Tank Model. The formulation of the upstream watershed management strategy is carried out using a SWOT analysis. Rangkuti (2000) stated that the SWOT analysis is based on the logic that maximize the strengths and opportunities,but simultaneously to minimize weakness and threats.

Based on the problems above, the purpose of this study is to determine the effect of conservation measures on the Upper Watershed, the case study of Upper Cimandiri based on Tank Model analysis and to analyze the management strategy using SWOT analysis.

METHODOLOGY

This research was carried out from October 2016 to January 2017, in the water catchment area (DTA) of the Cimuncang-Cimandiri SPAS sub-watershed. with the length of the main river 11,604.56 m. The materials used in this study are the Cimuncang-Cimandiri SPAS DTA Map, 2009 and 2015 land use maps, 2009 and 2014 climate data, and 2009 and 2015 rainfall and river discharge data.

Conservation Strategy Analysis using SWOT

Analysis of Internal and External Factors

The formulation of the upstream watershed management strategy is carried out using a SWOT analysis. Rangkuti (2000) states that the SWOT analysis is carried out based on logic that maximizes strengths and opportunities, but simultaneously minimizes weaknesses and threats. Strategy formulation is carried out by identifying internal and external factors in upstream of the watershed, where these internal and external factors are determined as the basis for identifying and evaluating the relationship between factors.

In the stage of determining the weights and rankings in this study, three sources from relevant agencies were used, namely the Head of the Citarum Ciliwung Management Center, the Head of the Program and Evaluation Section and the Head of the Management Sub-Directorate of the Directorate of Soil and Water Conservation.

Ranking of each factor based on its level of importance. The ranking value of the positive factors (strengths and opportunities) is inversely proportional to the negative factors (weaknesses and threats).

Preparation of Alternative Strategies

After finishing compiling the IFE and EFE matrices, the next step is to create a SWOT Matrix. Each element of the existing SWOT is linked to obtain alternative strategies. The strategy formulation stage is a step to determine the possible alternative strategies that can be taken in implementing conservation in the upstream watershed, described in the SWOT matrix as shown in Table 1.

Table 1. SWOT Analysis Model

IFAS / **EFAS**	**STRENGTHS (S)** Determine internal strength factors	**WEAKNESSES (W)** Determine internal weakness factors
OPPORTUNIES (O) Determine external opportunity factors	**Strategy S-O** (Strategy to use strengths and take advantage of opportunities)	**Strategy W-O** (Strategy to minimize weaknesses to take advantage of opportunities)
TREATHS (T) Determining external threat factors	**Strategy S-T** (Strategy to use strengths to overcome threats)	**Strategy W-T** (Strategy to minimize weaknesses to avoid threats)

Internal and external analysis through the Strengths analysis method Strengths, Weaknesses, Opportunities, and Threats or abbreviated as SWOT. The SWOT diagram is the result of a combination of the comparison of strengths and weaknesses represented by a horizontal line with a comparison of opportunities and threats which is represented by a vertical line (Figure 1). In the figure, strengths and opportunities are given a positive sign, while weaknesses and threats are given a negative sign. The difference in the value of strengths (S) - Weaknesses (W) is placed on the X axis, and the difference in the value of Opportunities (O) – Threats (T) are placed on the Y axis. The ordinates on X, Y will occupy one cell of the SWOT diagram. The location of SW and OT in the diagram will determine the direction of the policy strategy that will be taken by a decision maker (Hasibuan, 2005).

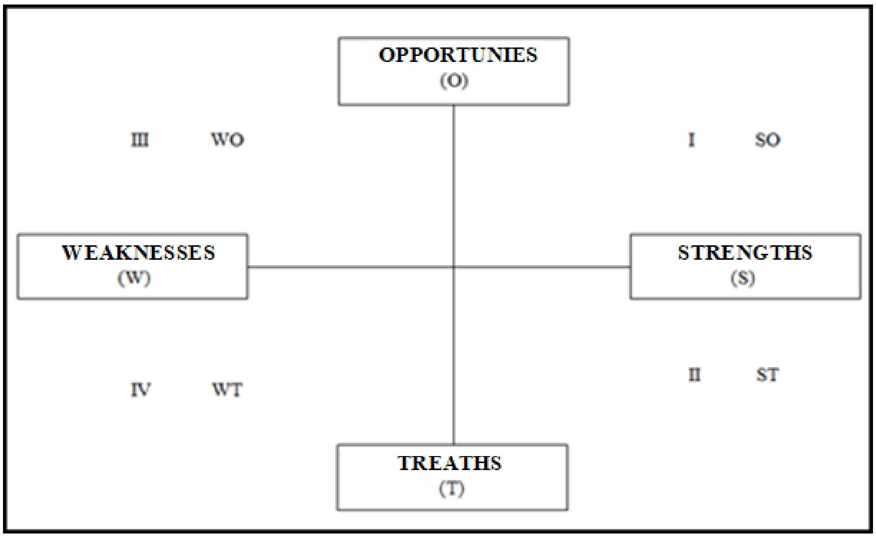


Figure 1. SWOT Quadrant Diagram (Rangkuti, 2002)

According to the State Administration Institute (2001a; 2001b), Hunger & Wheelen (2001), and Rangkuti (2002) in Hasibuan (2005), the strategies resulting from the SWOT analysis can be grouped into four categories. Strategy I (SO) is the most profitable situation because it has opportunities and strengths (support and aggressiveness). Strategy 2 (ST) has strength but faces an unfavorable threat (support a diversification strategy). Strategy 3 (WO) means that the system has opportunities but is hampered by internal weaknesses (support a turnaround oriented strategy). Meanwhile, strategy 4 (WT) means that the system faces the most unfavorable situation, namely it has internal threats and weaknesses (support a defensive strategy). From the grouping of the SWOT analysis, WO is a solution (problem solving), because it is necessary to reduce weaknesses to take advantage of existing opportunities, while WT is to reduce weaknesses to prevent and overcome threats carried out in the form of suggestions and recommendations for the future in the long term.

Analysis of strategic implications on the Tank Model

Hydrological analysis of the Cimuncang-Cimandiri SPAS DTA was carried out using the Tank Model, which is a non-linear mathematical method based on the hypothesis that runoff and infiltration are functions of the amount of water stored in the soil. The tank model is the closest model for each watershed. The tank model is based on four interconnected tanks arranged vertically (Figure 1). In this tank model, the output from the first tank represents surface runoff, the output from the second tank represents the intermediate flow, and the output from the third and fourth tanks represents the base flow (Surya et al., 2014)

1. The equation for the first tank is:

   xx1(t)=xx1(t-1)+CH–Etc–z1.xx1(t-1)–[(xx1(t)-h11)a11+ (xx1(t) - h12)a12] ....(1)

2. The equation for the second tank is:

   xx2(t) = xx2(t-1)-z2.xx2(t – 1) + z1.xx1 (t – 1) – [(xx2(t) – h2) a2] ....(2)

3. The equation for the third tank is:

   xx3(t) = xx3(t – 1) – z3.xx3(t – 1) + z2.xx2 (t–1) – [(xx3(t)a3] ....(3)

4. The equation for the fourth tank is:

   xx4(t) = xx4(t – 1) – z3.xx3(t – 1) – [(xx4(t) a4] ....(4)

while the runoff discharge from the river (Q) is calculated by the following equation:

Q(t) = [(xx1(t) - h11) a11 + (xx1(t) - h12) a12] + [(xx2(t) - h2) a2] + xx3 (t).a3 + xx4(t).a4 ....(5)

information:

xx : High groundwater content (AT)

h : High stored water (tinggi lubang outlet)

Z : Infiltration hole coefficient

a : outlet hole coefficient

CH : Rainfall

Etc : Actual evapotranspiration

t : time (days)

i : 1, 2,.., 4.

The effect of strategy implications obtained from SWOT analysis can be seen through the analysis of the Tank Model, which is in the form of changes in the maximum and minimum discharge values in the upstream watershed.

RESULTS AND DISCUSSION

General Condition of the Research

The Cimuncang-Cimandiri SPAS catchment area is located approximately 4 km from the Sukaraja intersection, Sukaraja District, precisely in Limbangan village, Sukaraja district, Sukabumi district. The altitude of the Cimuncang-Cimandiri SPAS catchment area is between

750 m and 2.450 m above sea level. The area of the Cimuncang-Cimandiri SPAS catchment area based on the map delineation results is 1395.736 Ha, with a main river length of 11.604,567 m.

The main river DTA SPAS Cimuncang-Cimandiri has the highest elevation point at an altitude of 2.362,5 m above sea level with the lowest point (outlet) at 750 m above sea level, so the slope of the main river is 13.90%. The length of all tributaries of the Cimuncang-Cimandiri SPAS catchment reaches 5,3610 km, with a river density of 3.87 km km^{-2} and belongs to the category of rather dense river density values. The conditions of land cover for the Cimuncang-Cimandiriin 2015 are presented in Table 2.

The water catchment area of the Cimuncang-Cimandiri SPAS in 2015 consists of four types of land cover, with 49% forest area, 7% rice fields, 33% dryland agriculture and residential areas 11% of the total area.

Table 2. Land Cover Area of Upstream Cimuncang-Cimandiri SPAS

No	Land Cover	Area	
		ha	%
1	Forest	688,0	49,3
2	Rice Fields	99,8	7,2
3	Dryland Agriculture	454,6	32,6
4	Settlement	153,3	11,0
Total		1.395,736	100

Source: Analysis Results, 2019

Table 3. Slope Area of Upstream Cimuncang-Cimandiri SPAS

No	Slope Type	Area	
		ha	%
1	0 - 8%	107	8
2	8 - 15%	355	26
3	15 - 25%	348	25
4	25 - 45%	384	28
5	> 45%	177	13
Total		1.371,87	100

Source: Analysis Results, 2019

Based on DEM data in Table 3 the slope conditions of the DTA Cimuncang-Cimandiri SPAS are in the flat to steep slope class. Most areas are in the 8-45% slope class. The type of soil found in the Cimuncang-Cimandiri SPAS catchment area is Latosol at 58% and Regosol at 42% of the total area.

Conditions of Hidrologi

Based on the data on the SPAS equipment, it is known that the rainfall that occurred during 2014 was 4.438.04 mm, with a total of 240 rainy days. The largest rainfall occurred on September 17, 2014 at 123.96 mm. Large maximum discharge at 8,051 m^3sec^{-1}, while the minimum flow of 0,0813 m^3sec^{-1}, so that the coefficient of river regime (KRS), which is the ratio of maximum and minimum flow amounted to 99,076 which was included in the medium-class category (KRS: 50 - 120).

Conservation Strategy analysis using SWOT DTA SPAS-Cimandiri Cimuncang

Environmental analysis in the area DTA SPAS Cimuncang Cimandiri Hulu aims to provide general information and basic essentials needed in the process of formulating the strategic direction in conservation. From the current condition of the Cimuncang-Cimandiri Hulu SPAS DTA area, both hydrological conditions, land cover, slope, various issues can be systematically identified, so that various important factors can be identified that form the basis for the preparation of conservation strategies in the Upper Cimandiri Sub-watershed. Determination of strategic direction in conservation in the Upper Cimandiri Sub-watershed begins with identifying and analyzing internal factors, namely in the form of strengths and weaknesses owned by the Upper Cimandiri Sub-watershed, as well as external factors, namely opportunities and threats. These factors are summarized in several variables that have weight and rating values. Internal and external factors as strategic variables are very influential in the formulation of policy directions for the management of the Upper Cimandiri Sub-watershed which in this case is in the form of conservation efforts in the Cimuncang-Cimandiri Hulu SPAS watershed area as described in Table 4 and Table 5.

Internal factors in Table 4 are based on conditions in the Cimuncang-Cimandiri Hulu SPAS catchment are both biophysical and socio-economic conditions of the community, while other than that it is categorized as external factors as shown in Table 5. Based on the evaluation results on internal and external factors, weighting and ranking are obtained which produce a total score on each internal and external factors. In Table 4, the total score for strength (S) is 2,15 and for weakness (W) is 1,11 then the difference from the internal variables is 1,04. Meanwhile, for external factors as shown in Table 5, the score for opportunity (O) is 1,67 and the score for threat (T) is 1,44, so that the difference in value between opportunities and threats is 0,23. Based on the difference in values for internal factors and external factors, the position on the SWOT diagram (Figure 2) is in quadrant I with the SO strategy, where the SO strategy supports an aggressive, which is the most profitable situation because it has strengths and opportunities.

Results of the SWOT analysis in Figure 2 show that the Upper Cimandiri Sub-watershed still has a fairly good condition, where strengths and opportunities are still more influential in this area. So the strategy needed is to maintain forest areas so that they remain at least > 30%

and optimize funds and environmental services to foster community creativity to improve welfare levels. Several alternative strategies that can be carried out in order to better maintain the internal and external conditions of the Cimuncang-Cimandiri SPAS catchment area can be seen in Table 6.

Table 4. Matrix of evaluation of internal factors (IFE) for Sub-watershed of Cimandiri Hulu

No	Internal factor evaluation matrix (IFE) Strength (S)	Weight	Rating	Score
1	Class flat - steep slope	0,09	3,00	0,26
2	Public understanding of legislation /perda/technical guidelines for watershed management	0,08	2,33	0,19
3	It is a water catchment area	0,13	4,00	0,52
4	Emotional, social, and local cultural relationships of the community that encourage land defense	0,06	2,33	0,13
5	The area of vegetated areas above 30%	0,13	4,00	0,52
6	The KRS value is in the medium category	0,13	4,00	0,52
	Total			2,15
No	Weaknesses (W)	Weight	Rating	Score
1	Utilization forest is still limited to timber forest products	0,04	1,33	0,06
2	Economic conditions of people with low income levels	0,06	1,67	0,09
3	Land management does not apply soil and water conservation	0,13	4,00	0,52
4	Low legal awareness of the community	0,07	2,67	0,17
5	Changes in the community's paradigm regarding land conversion as a result of changes in land values	0,09	3,00	0,26
	Total			1,11
	Total Internal Factors			1,04

Source: Analysis Results, 2019

Table 5. Matriks evaluasi faktor eksternal (EFE) Sub DAS Cimandiri Hulu

No	Matriks evaluasi faktor eksternal Opportunity (O)	Weight	Rating	Score
1	The existence of legislation/perda/technical instructions for watershed management	0,09	3,00	0,27
2	The existence of support from other parties (Perhutani)	0,10	2,67	0,27
3	Contributions/Environmental services by downstream communities and water companies to upstream communities	0,08	1,33	0,10
4	Funding support for soil and water conservation program	0,15	4,00	0,61
5	Existence of organization for watershed management	0,12	3,33	0,42
	Total			1,67
No	Threat (T)	Weight	Rating	Score
1	An increase in the standard of decent needs that drives an increase in financial needs	0,09	1,67	0,15
2	Land conversion offer	0,09	3,33	0,29
3	Illegal logging	0,11	3,67	0,39
4	Weak control and supervision	0,06	3,00	0,18
5	Population increase due to Ruralization	0,11	4,00	0,43
	Total			1,44
	Total Internal Factors			0,23

Source: Analysis Results, 2019

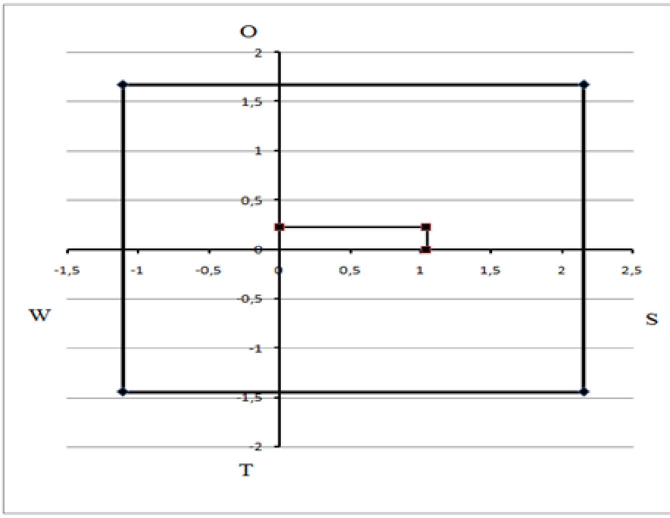


Figure 2. SWOT Analysis Diagram of the Upper Cimandiri Sub-watershed

Based on the SWOT analysis of the Cimuncang-Cimandiri Hulu SPAS catchment area, it can be seen that the internal condition of this area is still quite good and is supported by good conditions. externally, but did not rule if the few next year's,internal and external conditions the area is subject to change, in which the possibility of weakness will be more influential factor when compared to the power factor.

Some of the pressures that exist are dynamic such as population growth, land use change, and shifts in water demand which are characterized by uncertainty and take place at various complex time and space scales, causing watershed management to pose great challenges (Subarna, 2015). Therefore, as an anticipation, several strategies can be applied to minimize weaknesses by taking advantage of existing opportunities, such as the application of soil and water conservation technology, for example, infiltration wells can be applied. Another function of infiltration wells is to improve ground water conditions or to shallow the well water surface, so that it is expected that more rainwater is absorbed into the soil into reserve water in the soil (Wahyuningtyas et al., 2011). Infiltration wells are wells or holes on the ground surface that are made to collect rainwater so that it can seep into the ground. Infiltration wells are dug to a depth above the groundwater level. The main purpose of this infiltration well is to increase the entry of water into the ground as infiltration water. Thus, more water will enter the soil and less will flow as surface runoff. The more water that flows into the ground means that a lot of groundwater will be stored under the earth's surface (Kusumadewi et al., 2012). According to Surya (2015), several water resource conservation efforts to increase the infiltration capacity of land cover that can be carried out in forest land use are in the form of reforestation activities (reforestation), especially in forest areas that have been deforested due to illegal logging activities. On mixed agricultural land conservation efforts that can be done are by making mounds and making terraces. In paddy fields, conservation efforts that can be done are by making bench terraces and improving irrigation. In residential areas, conservation efforts that can be done are by applying water absorption technology such as making infiltration wells and biopore infiltration hole technology around residential areas.

Table 6. Analysis of SWOT DTA SPAS Cimuncang-Cimandiri Hulu

INTERNAL / EKSTERNAL	STRENGTH (S) 1. Slope class from flat to steep 2. Community understanding of statutory regulations/perda/technical guidelines for watershed management 3. It is a water catchment area 4. Emotional, social, and local cultural relationships that encourage people to defend the land 5. Forest area area above 30% 6. KRS value is in the medium category	WEAKNESSES (W) 1. Forest use is still limited to timber forest products 2. Economic conditions of people with low income levels 3. Land management does not apply soil and water conservation 4. Low public legal awareness 5. Changes in community paradigm regarding land use change as a result of changes in land value
OPPORTUNITY (O) 1. The existence of legal regulations/perda/technical guidelines for watershed management 2. Support from other parties (Perhutani) 3. Contributions/environmental services by downstream communities and water companies in upstream communities 4. Funding support for soil and water conservation programs 5. The existence of a management UPT organization a Watershed	STRATEGY S-O 1. Maintaining forest areas (S1, S3, S4, S5, S6, O1, O3, O4) 2. Optimizing funds and environmental services to foster community creativity to improve welfare levels (S3, O3,O4)	STRATEGY W-O 1. Increasing community skills and income through non-timber forest product management (W1, W2, W4, O1, O2, O5) 2. Application of water and soil conservation technology in land management (W3, T1, T3, T4, T5)
THREATS (T) 1. Rising standards of decent needs that encourage increased financial needs 2. Land conversion 3. Illegal logging 4. Weak control and supervision 5. Population increase due to Ruralization	STRATEGY S-T 1. Application of silvicultural multisystems in management wood potential (S5,T1, T3)	STRATEGY W-T 1. Increase supervision and control of land use change (W3, W4, W5, T2, T3, T4, T5) 2. Implementation of land use regulations in accordance with the provisions of the RTRW (W2, W5, T2,T4, T5)

Source: Analysis Results, 2019

Analysis of Strategic Implications on Tank Models

The arrangement of the Tank Model in the DTA is Cimuncang-Cimandiri SPAS divided into 5 groups of tanks, each tank representing land cover. As input data on the Tank Model used rainfall data obtained from data SPAS installed in the research area and climate data in the form of temperature and duration of sunlight obtained from the Goalpara climatology station, this data is used to obtain evapotranspiration data. The value of each parameter in each tank is presented in Table 7.

Based on the analysis of land cover changes in 2009 and 2015, it is known that the area of forest and rice fields decreased in 2015 while open land has changed to dry land agriculture and settlements. This is due to the increasing number of settlements and dry land agriculture in the research area in 2015. Changes in land cover in 2009 and 2015 can be seen in Table 8. The application of the model using 2015 data obtained a coefficient of determination of 0,805 and resulted in an average daily discharge value of 1,057 m^3sec^{-1}, the maximum discharge value is 6,68 m^3sec^{-1}, and the minimum discharge value is 0,072 m^3sec^{-1}.

Table 7. Coefficient values of Z, xx, a, and h

Parameters	**Tank**				
	1	**2**	**3**	**4**	**5**
xx1	145	60	90	50	60
xx2	200	90	100	75	70
xx3	300	100	200	90	90
xx4	450	200	390	150	150
a11	0,0059	0,57	0,0515	0,75	0,83
a12	0,016	0,3	0,04	0,9	0,9
a2	0,003	0,005	0,0008	0,004	0,002
a3	0,00025	0,0008	0,0007	0,0009	0,0008
a4	0,00003	0,00008	0,00005	0,00009	0,00009
h11	110	100	110	100	100
h12	60	40	40	30	35
h2	130	100	120	120	110
z1	0,04672	0,02382	0,03598	0,0129	0,01273
z2	0,0046	0,00187	0,0029	0,0012	0,00166
z3	0,00176	0,00139	0,00152	0,0009	0,00012

Source: Analysis Results, 2019

Table 8. Land Cover Changes in DTA SPAS Cimuncang-Cimandiri 2009 – 2015

No	Land Cover	Year			
		2009		2015	
		ha	Percent	ha	Percent
1	Forest	750,4	53,8	688,0	49,3
2	Rice Fields	186,1	13,3	99,8	7,2
3	Dryland Agriculture	362,6	26,0	454,6	32,6
4	Settlements	54,4	3,9	153,3	11,0
5	Open Land	42,2	3,0	0,0	0,0
Total		1395,736	100	1395,736	100

Source: Analysis Results, 2019

Based on sightings simulation results using data in 2014/2015 shown in Figure 3, it can be seen that the discharge simulation results are responsive along with the increase or decrease in rainfall that occurs.

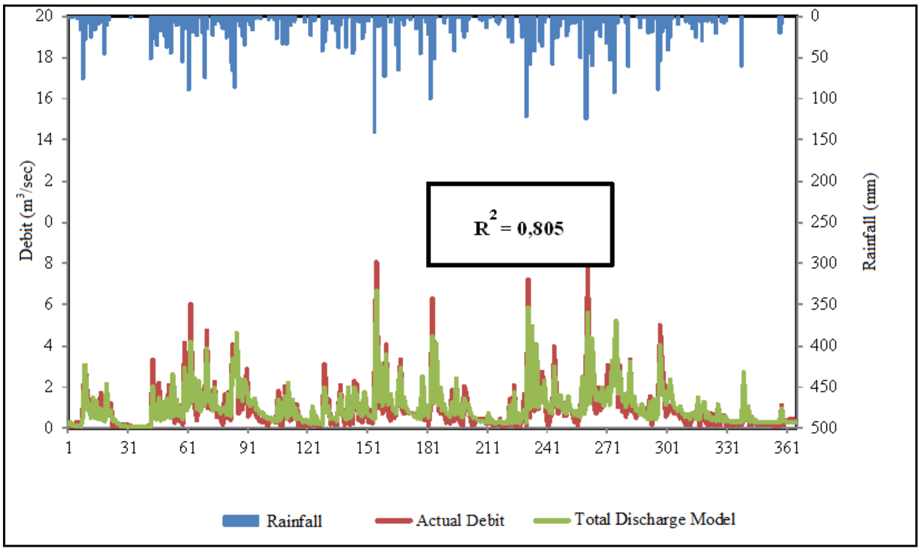


Figure 3. Graph of Analysis Results of the Tank Model DTA SPAS Cimuncang -Cimandiri using data of year 2014/2015

Based on the analysis of land cover changes in the Cimuncang-Cimandiri SPAS DTA area in 2009 and 2015, it is known that the forest area only experienced a slight reduction, from 53,8% in 2009 to 49,28% of the forest area in 2015. reduction of the area, but this condition still meets the regulations set by the government through Law no. 41 of 1999 Part Five concerning forest management in watershed areas, namely the forest area of at least 30% of the watershed area. In addition, the results of the Tank Model analysis show that the coefficient of the river regime in this region is in the medium category, which is 93,2238. This shows that the forest area is able to affect the hydrological condition of a watershed.

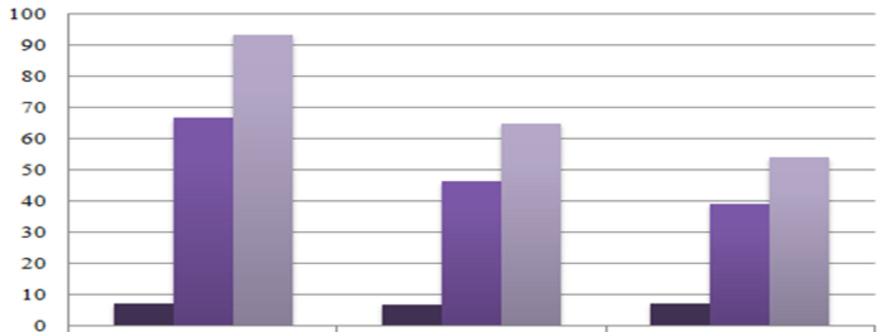
The Cimuncang-Cimandiri SPAS catchment area shows a fairly good condition, so that conservation efforts for both soil and water are not too urgent, this is supported by the forest area above 30% and the condition of the river regime which is still in the moderate category. However, to prevent the increase in the value of KRS, conservation efforts can be carried out as a form of application to legal regulations, so that the hydrological conditions of the Cimuncang-Cimandiri SPAS DTA can be maintained and even better.

Several conservation simulations that can be carried out in the DTA Cimuncang-Cimandiri SPAS through the analysis of the previously validated Tank Model, namely:

1. Conservation I: Application of infiltration wells in settlements, which serves to increase the infiltration capability of residential areas.
2. Conservation II: Application of terraces in paddy fields to slow down surface runoff, accommodate and channel surface runoff with a force that does not damage and increase

infiltration rate (Minister of Agriculture Regulation Number: 47/Permentan/OT.140/10/2006).

The simulation results of this soil and water conservation strategy are presented in Figure 4.



	Existing	Conservation I	Conservation II
Qmin (x 10^{-2} m^3/sec)	7,170	7,120	7,240
Qmax (x 10^{-1} m^3/sec)	66,800	46,350	39,310
KRS	93,224	65,069	54,326

Figure 4. Simulasi strategi konservasi DTA SPAS Cimuncang-Cimandiri

Based on Figure 4, it can be seen that the existing condition of the Cimuncang-Cimandiri SPAS catchment area has changed after the implementation of the conservation strategy. On the application of the first conservation namely the application of recharge wells obtained a minimum flow condition of 7,17 x 10^{-2} m^3sec^{-1}, the maximum discharge of 66,8 x 10^{-1} m^3sec^{-1}, and KRS value reached 65,069. Then after the next simulation was carried out, namely the application of terraces to rice fields, it was found that the KRS discharge conditions of the Cimuncang-Cimandiri SPAS decreased to 54,326. This situation shows that the more conservation is carried out, the more the hydrological conditions of a watershed will improve, especially in the Upper Watershed.

The Implications of Strategic Policy

Successful implementation of strategies for soil and water conservation efforts in the Cimuncang-Cimandiri SPAS catchment area can be done by increasing the main capabilities of the Upper Watershed, namely increasing the water catchment function by maintaining vegetation areas in the water catchment area. Besides that, it also improves coordination and integration of water resources among related stakeholders (Surya, 2015).

Conservation efforts can be carried out by involving the role of the community and related stakeholders. One effort to involve the community's role in the application of conservation can be done in the form of mass community service, field schools, technical assistance, pilot projects and finally a more holistic concept is developed, namely the establishment of a conservation village model. The establishment of conservation village model was initially seen as the right effort, because it could unite various interests by prioritizing conservation as the estuary of all activities in one area (Kustamar, 2016).

Conservation Village is a conservation model approach that provides opportunities for communities living around conservation areas to be actively involved in conservation area management efforts. This model also provides opportunities for communities to gain safe access to the use of the area, so as to ensure their long-term commitment to support forest area conservation. The development of conservation villages is one of the programs initiated by the Directorate General of Forest Protection and Nature Conservation, Ministry of Forestry. According to data from the Directorate General of Forest Protection and Nature Conservation, in 2008 there were around 2.040 villages in the buffer zone of conservation areas, with a population of around 660.845 families. Most of the population is very dependent on natural resources in forest areas, therefore, community involvement is one of the keys to the success of conservation efforts in areas with high biodiversity value (Ministry of Forestry Press Release, 2008).

Based on Law Number 7 of 2004 concerning Water Resources and Government Regulation Number 42 of 2008 concerning Management of Water Resources, the main objective of conservation of water resources is to maintain the continuity of existence, carrying capacity, capacity, and function of water resources through conservation protection. water resources, water preservation and water quality management and water pollution control, in the form of maintaining the continuity of water catchment functions and water catchment areas, controlling the use of water resources, forest and land rehabilitation and conservation of protected forests, nature reserves areas, and nature conservation areas. The protection and preservation of water resources in question is carried out by the Minister or ministers related to the field of water resources and/or local governments in accordance with their authorities and responsibilities.

Based on the watershed area, the Cimuncang-Cimandiri SPAS DTA located in Sukabumi Regency is included in the work area of the Citarum Ciliwung BPDAS. Some of the policies implemented related to water resource management and improving the welfare of the population by BPDAS Citarum Ciliwung are the existence of water structures, where several activities are carried out in the form of continuing repair and improvement of existing networks, continuing and increasing the construction of new irrigation networks where prioritize simple irrigation networks, intensify work on securing agricultural production areas against natural disasters such as floods. intensify water resources development planning with comprehensive watershed development planning and intensify research and investigation efforts in irrigation technical issues. These basic policies are implemented through irrigation improvement and improvement programs, new irrigation networks development programs, river and swamp regulation and development programs and research, survey, investigation and design programs for the development of water sources.

CONCLUSION

Based on the analysis of internal factors and external factors using SWOT analysis, it was found that the management strategy of the DTA Cimuncang-Cimandiri SPAS is in the SO position, with support and aggressive, which is the most profitable situation because it has strengths and opportunities. The recommended conservation strategy is to maintain forest areas in a condition >30% and optimize funds and environmental services to foster community creativity to improve welfare levels. An alternative strategy that can be done to maintain the condition of the Cimuncang-Cimandiri SPAS catchment area remains good is to carry out soil and water conservation efforts such as infiltration wells in settlements and making terraces in rice fields. The implementation of conservation strategies through the analysis of this Tank Model can reduce the KRS value until the KRS value is obtained at 54,326.

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