Conference Paper

Sustainable Settlement Development in the Upstream Watershed Area (Case Study: Kampung Cikapundung, Suntenjaya Village, Lembang District, West Bandung Regency)

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Abstract

The upstream watershed area is a very vital area because of its protective function for the entire watershed. One of the activities that develop quite rapidly in various upstream watersheds in Indonesia is a settlement. The rapid development of settlement activity has been frequently blamed for the decline in the hydrological function of watershed areas. In order to achieve sustainable development in the upper part of the watershed, it is necessary to develop settlements - which are often already grown - and manage the natural resources sustainably. Kampung Cikapundung, Suntenjaya Village, Lembang District, West Bandung Regency is one of the most rapidly increasing settlement area in the upstream part of Cikapundung River. In addition to its rapid development of the built environment, the activity of dairy farms in this village causes considerable negative impacts to Cikapundung River watershed downstream areas, especially through organic waste as the dairy farms waste product that floats on the body of Cikapundung River. The purpose of this paper is to assess the sustainability level of settlements in Kampung Cikapundung and formulate the direction of development. Eco Degree (E) rating model is used to assess the sustainability of settlement areas in Kampung Cikapundung. The results of the analysis show that the settlement areas are categorized as Semi Eco Settlements. Several suggestions are given as some efforts to create more sustainable settlements.

Keywords: upstream watersheds, settlements, sustainable development

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1. Introduction

According to Law no. 7 of 2004 on Water Resources, Watershed is a land area that is a unity with the river and its branches, which serves to accommodate, store, and drain water that comes from rainfall to the lake or to the sea naturally, land boundaries constitute topographical separators and boundaries in the ocean up to the water areas that are still affected by land activities.

Although development in the upper watershed is limited, however, the facts indicate the different situation. Since 1972, which is the beginning of the implementation of the Five-Year Development Plan (Pelita) I, there has been rapid development in various locations in Indonesia, including in watershed areas. As one of the excesses, there has been a decline in the hydrological function of watersheds that can be found in several parts of Indonesia, such as in Java, Sumatra Island and Borneo since then [1].

Rapid development occurred in the upper watershed areas in Indonesia. The settlement is one component of the ecosystem in the upper watershed which was being developed rapidly [2, 3]. The development of settlement areas is also often blamed for the decline in hydrological functions of watersheds. For illustrations, the effect of land use changes from unlogged regions, such as forested areas and agriculture, to settlement areas, with an increase in Ciliwung river discharge in the rainy season [4]. Meanwhile, conversion of forests into open land (agriculture and settlements) in the southern Citarum Basin watershed has increased the rate of annual sediment exports [5].

Suntenjaya Village, Lembang District, West Bandung Regency is one of the most rapidly growing settlement areas in the upstream part of Cikapundung River. In addition to its rapid development of the built environment, the activity of dairy farms in this village causes considerable negative impacts to the downstream part of Cikapundung watershed areas. The main source of pollution comes from cattle farms owned by 732 farmers whose cattle' waste is immediately disposed to the river without prior processing.

The area of Suntenjaya Village is located between Mount Palasari and Gunung Tangkuban Perahu. The Village is the result of the expansion of the villages of Cibodas, Cikadut, and Cimenyan. Suntenjaya Village has an area of 1456.65 Ha consisting of settlements covering 50 Ha, agricultural land 310 Ha, forestry land 889 ha, plantation land 220 Ha. The total population of Suntenjaya in 2012 was 2,774 people. The village itself is divided into 9 RWs, and 12 kampungs.

This study is conducted at Kampung Cikapundung, an area where the spring of the Cikapundung river located. As well as the rest 11 kampung in Suntenjaya, dairy farming is the main economic activities of people living in this village. The purpose of this paper is to assess the sustainability level of settlements in the Kampung of Cikapundung and formulate the direction of development of settlement areas in the village. Eco Degree (E) rating model is used to assess the sustainability of settlements in this area.

The concept of eco-settlements has been developed as guidance to pursue sustainable settlements in the rural area of the upstream watershed. Meanwhile, the concept

of eco-degree is later developed as an instrument to identify the level of settlements sustainability in the area [6, 7]. Eco-Degree measurement is based on biophysical, social, economic and institutional.

2. Method

The determination of the value of E is based on the fulfillment of eco-settlements principles, which are divided into biophysical, social, economic, and institutional aspects [8]. Each of which is further divided into sub-criteria and attributes. This instrument will be used for assessing the level of eco-degree. The instrument is presented in **Table 1** through **Table 4**.

The results of data acquisition based on the parameters presented in Table 1 through Table 4 are used as inputs in calculating the economic value of residential areas (E). The procedure for evaluating E values through the following stages:

1. The primary and secondary surveys are based on data requirements for each assessment parameter and calculation of values for each parameter;

2. Weighting values based on a Likert scale for each parameter. Likert scale weights are presented in Table 1 to Table 4;

3. Calculate the value of E

To calculate the value of E, the formula is used in Equation (1):

$$E = \sum_{i=1}^{N} \frac{R_i}{5} \times S_{i\ max} R_i \in [1, 5] \tag{1}$$

With E = the eco-level, Ri = rating for the *i* attribute stated in the Likert 1-5 scale, $S_i max$ = the maximum possible score for attribute *i* (Table 1). The categorization of residential areas based on the value of E can be seen in Table 2.

4. If the E $\leq$75 value is obtained, then various program have to be conducted to increase the E value

5. If the E $>$ 75 the area can be categorized to be eco-settlement

Parameters used in assessing condition of each attribute explained in Table 3, 4, and 5.

Table 1: Maximum Weight of Sub Criteria and Attribute in Determining E Rating for Settlements in the Upper Watershed [9].

Subcriteria	Max Weight	Attribute	Max Weight
Land Use	17.00	Vegetation Cover	8.50
		Land Suitability	8.50
Water	13.00	Quality of drinking water	5.00
		Quality of waste water	2.00
		Quantity of raw water	3.50
		Surface run off	2.50
Land	11.00	The Erosion Index	11.00
		Type of soil	0.00
Air	6.50	Quality of air	0.00
Housing	7.00	Infrastructure of drinking water and sanitation	3.50
		Building density	3.50
Behavior of society	17.00	Society Participation	17.00
Community capacity	11.00	Level of Education (formal)	5.50
		Education (informal)	5.50
		Livelihood	0.00
Economic Condition of Society	16.00	Income Levels	8.00
		Local Potentials that support environmental sustainability	8.00
Institutional	8.00	Formal Institutional	3.00
		Informal Institutional	5.00
Total	**100**		**100**

Source: Research Institute for Housing and Human Settlements (2011)

Table 2: Eco-degree Categorization [9].

Category	Eco Degree (E) Value
Eco-settlements	$75 < E \leq 100$
Semi Eco-settlements	$50 < E \leq 75$
Not Eco-settlements	$20 \leq E \leq 50$

Source: Research Institute for Housing and Human Settlements (2011)

Table 3: Parameters Used for Assessing Biophysical Aspects [9].

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
Land Use	Vegetation Cover	IPL: Land Closure Index	5 =IPL ≥ 75% 3= 30≤IPL<75% 1= IPL < 30%	Director General of Land Rehabilitation and Social Forestry Regulation on Watershed Monitoring and Evaluation Guidelines No. P.04 / V-SET / 2009
	Land Suitability	KP: land suitability index	5= KP 12-15 3= KP 7-11 1= KP 3-7	Minister of Public Works Regulation No. 41 / PRT / M / 2007 concerning Guidelines for Technical Criteria for Cultivation Areas

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
Water	Quality of drinking water	Quality standards (color, turbidity, TDS, pH, sulfate, Nitrate as N. E-coli, total coliform bacteria)	5= fulfilled 1= not fulfilled	Minister of Health Decree No. 492 / MENKES / PER / IV / 2010 concerning Drinking Water Quality Requirements
	Quality of waste water	Quality standards (pH, TSS, BOD, oil and fat)	5= fulfilled 1= not fulfilled	Minister of Environment Decree No. 112 of 2003 concerning Domestic Wastewater Quality Standards
	Quantity of raw water	Water Use Index (IPA)	5=IPA<0.3 4=0.3≤IPA<0.5 3=0.5≤IPA<0.8 2=0.8≤IPA<1.0 1=IPA≥1.0	[10]
	Surface run off	run off coefficient *(R)*	5= R< 10% 4=10≤R<20 % 3=20≤R<30 % 2=40≤R<50% 1=≥ 50%	*Federal Interagency Stream Restoration Working Group* in [11]
Air	Air Quality	Quality standards (TSP - dust, PM10, SO2, NO2, Hydrocarbons -HC)	5= fulfilled 1= not fulfilled	Government Regulation No. 41 of 1999 concerning Air Pollution Control
Soil	Erodibility level	IE: Erosion Index based on erosion class USDA-*Soil Conservation Service*	5=0≤ K <0.10 4=0.11 ≤ K < 0.20 3=0.21≤ K <.0.32 2=0.33 ≤ K < 0.43 1=K≥ 0.43	USDA – *Soil Conservation service*
	Type of soil		5 = Alluvial, soil Glei, Planosol, Hydromorf, lateric 4 = Latosol 3 = Brown forest soil, non calcic, brown, mediteran 2 = Andosol, laterite, grumosol, podsol, podsolic 1 = Regosol, litosol, organosol, renzine	[10]
Housing	Infrastructure	Quantity of drinking water infrastructure	5= exist 1= not exist	SNI 03-1733-2004 concerning procedures for planning the housing environment in urban areas and team justification
		Quantity of sanitation infrastructure	5= exist 1= not exist	
		Quality of drinking water infrastructure facilities	5= exist 1= not exist	
		Quality of sanitation infrastructure	5= exist 1= not exist	

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
	Building density	Basic Building Coefficient (KDB)	5=KDB ≤ 10 % 4=10< KDB≤25% 3=25< KDB≤50% 2=50< KDB≤75% 1=75< KDB≤100	*Federal Interagency Stream Restoration Working Group* in [11]
		Settlement Pattern	5= Spreading 1= Grouping	[12]

Table 4: Parameters for Assessing Social Aspects [9].

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
Community behavior	Society participation	% presence in joint activities related to watershed environmental sustainability (P)	5=P> 70% 3=40% ≤P<70% 1=P< 40%	Director General of Land Rehabilitation and Social Forestry Regulation on Watershed Monitoring and Evaluation Guidelines No. P.04 / V-SET / 2009
		Independent community activities related to watershed environmental sustainability	5= exist 1= not exist	
Community Capacity	Level of education	Number of people based on education level **(>75%)**	5= graduated from D1 or higher 4= graduated from high school or equivalent 3=graduated from junior high school or equivalent 2=graduated from elementary school or equivalent 1= not graduating from elementary school	Team justification
	Education	Number of (informal) training programs for the community related to the maintenance of upstream watershed preservation	5=there is 1=there is no	Minister of Forestry Decree No. 52 / Kpts-II /2001 concerning Guidelines for Implementing Watershed Management
	Livelihood	Number of livelihoods of farmers and plantations (M)	5=M< 50% 3=50≤M<75 % 1=M≥75%	Team justification

The data is collected by field survey that conducted in Kampung Cikapung at the Village of Suntenjaya, Lembang, West Bandung Regency in October 2012 (see **Figure 1**). Household survey through questionnaire was carried out to identify the profile of the community, especially their socio-economic condition. Test also conducted to identify the character of water and soil condition in Kampung Cikapundung, Suntenjaya.

Table 5: Parameters for Assessing Economic Aspects [9].

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
Community economic conditions	Community income level	Per capita income / year (R)	5=R>City Minimum Wage 3=R= City Minimum Wage 1=R< City Minimum Wage	Director General of Land Rehabilitation and Social Forestry Regulation on Watershed Monitoring and Evaluation Guidelines No. P.04 / V-SET / 2009
	Local resources that supports environmental sustainability	Forestry / agriculture / plantation products	5=Yes 1=No	Team justification

Table 6: Parameter for Assessing Institutional Aspect [9].

Subcriteria	Attribute	Parameter	Standard and Rating	Standard Reference
Institutional system	Formal institution	Integrated program in upstream watershed conservation efforts	5= exist 1= not exist	[10]
		The number of programs realized was related to watershed conservation efforts (F)	5=90% < F≤ 100% 3=70%< F≤ 90% 1=F≤70%	Team justification
	Informal institution	Program from the community in efforts to conserve upstream watersheds	5= exist 1= not exist	Team justification
		The number of programs realized was related to watershed conservation efforts (I)	5=90% <I≤ 100% 3=70%< I≤ 90% 1=I≤70%	Team justification
		Number of community organizations related to watershed conservation efforts	5= exist 1= not exist	[10]

Additional data, such as research report, and thesis are used to substitute the data that cannot be collected through a survey.

3. Result and Discussion

The location of study is Kampung Cikapundung, Suntenjaya Village, Lembang District, West Bandung Regency. The village is one of the most rapidly growing settlement areas in the upstream part of Cikapundung River. In addition to its rapid development of the built environment, the activity of dairy farms in this village causes considerable negative impacts to the downstream areas of Cikapundung River watershed, especially through

Figure 1: Location of Kampung of Cikapundung at Suntenjaya VIllage.

organic waste as the dairy farms waste product that floats on the body of Cikapundung River.

Based on the data gathered through a survey, the rating of each attribute of Suntenjaya Village is presented in **Table 7**.

TABLE 7: Basic Data of Study Location Conditions.

Attribute	Existing Condition	Rating
Vegetation Cover	Analysis on Kampung Clkapundung's data taken from Google Earth software data on 20 September 2012, shows: •total area is 91.352.87 sqm (LP) •the area of vegetation cover is 0 sqm (LVP) Based on the data, we can get the IPL value of 0%	1

Attribute	Existing Condition	Rating
Land Suitability	1. The following is the value of the parameters used in determining conservation area, and its weight. •The level of slope is about 20-25% (field observation, 2012). KL = 60 •Type of soil study location is the association of brown andosol and regosol. JT = 60 •The rainfall of Cikapundung Village is 2,129.2 mm / year. CH = 30 •Protected area value (BKL) = 150. Therefore, the weight of Suntenjaya's conservation area is 3. 2. Study location is on a ridge with a fairly steep slope. Therefore, this area has a high level of vulnerability to landslide. Bnc: 1 3. Suntenjaya village is located along the bank of Cikapundung River upper stream area. PT: 1 4. The total KP value is the sum of 1) + 2) + 3) = 5	1
Quality of drinking water	In general, people in the study sites use spring as the source of raw water for drinking water. Based on the results of field observations and the results of the questionnaires from the community in the study sites, it was found that the water quality of the springs relatively complied with the quality standard of drinking water water (60.5% of respondents expressed that they were satisfied with the raw water quality of drinking water they take advantage).	5
Quality of waste water	The pH and BOD values at the location are obtained from Shinta (2009): 1. pH= 7,15 (standard quality: 6-9) 2. BOD=6.075 mg/l (standard quality: 100 mg/l) Meanwhile, the value of TSS in the study site is assumed to be equal to the value of TSS obtained by Masri (2009) in Cilimus River in Kecamatan Lembang, ie 50 mg / l (standard quality: 100 mg / l). Therefore, all parameters assessed meet the required quality standards	5
Quantity of raw water	The people of Kampung Cikapundung utilize spring waters spread across the region. They use the springs communally. Based on the observation result, one sample of springs with debit of 0.496 Liter / second served five families (kk) in Kampung Cikapundung. From the data, it can be calculated, in one day, the spring produces 42,854.4 Liter / day. Assuming each family consists of 4 family members, these five families require raw water as much as 60 l / day / soul x 5 kk x 4 soul / kk = 1200 Liter / day. Therefore, it can be obtained that IPA value is 0.028002. It can be concluded that the quantity of raw water for drinking water is sufficient enough. In addition, based on the results of interviews with the community, almost all respondents stated that the quantity of raw water they use is sufficient	5

Attribute	Existing Condition	Rating
Surface run off	Area mapping by GPS tracking that overlaid with maps obtained through Google Earth shows these conditions: 1. Area of grouped settlement: 27,857.55 sqm (runoff coefficient = 0,75) 2. The total settlement area of a single family is 559.22 sqm (runoff coefficient = 0,5). 3. Area of plantation: 50,396.23 sqm. This land is assumed to have the same Runoff Coefficient range as the park and the graveyard. In this study, the runoff coefficient chosen is 0,25. 4. Area of vacant land: 12,539.87 sqm. This land is assumed to have the same runoff coefficient range as the vacant land. In this study, the runoff coefficient for vacant land is 0.30. Based on these data, it can be obtained the runoff coefficient of Kampung Cikapundung is: 0,411	1
The Erosion Index	In this study, the value of erosion index of Kampung Cikapundung is taken from Intania (2009). The value of the selected index is the ersion index of with has the same physical characteristics as Kampung Cikapundung:is a residential area, has a slope of between 15-25%, and owns land with andisol type. Based on the literature, the value of the erosion index corresponding to Kampung Cikapundung was 0.058618.	5
Infrastructure of drinking water and sanitation	1. Based on survey, it is found that all respondents (100%) have access to drinking water (springs) sources permanently. PAB=5 2. Meanwhile, only 5.3% of respondents have access to wastewater infrastructure with a septic pipe system. Most of the respondents dispose household waste directly to the river (44.7%) and the rest using cubluk system (34.25%) and other systems (15.8%). PAL= 1	3
Building density	1. Based on the analysis of land use data (see the surface runoff section), it is obtained that its building coverage percentage to land parcel is 31.11%. KDB= 3. 2. From the land use map obtained from software Google Earth it can be identified that the pattern of housing in this location is in groups. PP=1	2
Society Participation	More than 90% of citizens of Kampung Cikapundung are bound by kinship. Therefore, they have close relationship one another. It is possible that this condition may lead to high levels of citizen participation in development activities. Based on the narrative of Head of Village, almost all citizens (more than 80%) participated in the communal activities. So far, the programs related to the upstream watershed conservation in Kampung Cikapundung are always related to the issue of Cikapundung River contamination that caused by the activity of the fairy farming. Some of the programs include the construction of 10 units of biogas installations initiated by the Ministry of Energy and Mineral Resources of the Republic of Indonesia, and composting house constructed by by Agency for the Assessment and Application of Technology (BPPT). Based on information obtained from interviews with Head of Village and former head of RW, it was learned that from approximately 30 families of dairy farmers in this village, almost entirely participate actively in the programs, including through attending meetings as part of the implementation of these programs.	5
Level of Education (formal)	Most of the respondents stated that their last level of education was elementary school (82.1%)	2

Attribute	Existing Condition	Rating
Education (informal)	Generally training programs held in Suntenjaya Village (Parent Village of Kampung Cikapung) are related to issues of increasing agricultural productivity and livestock breeding and watershed area conservation. These programs are implemented at the village level. Meanwhile, the parties invited are usually community leaders, including among others: RT, RW and Head of Village in Suntenjaya Village, including those from Kampung Cikapundung	5
Income Levels	1. Based on the decision of West Java Governor. 561 / Kep.1540-Bangsos / 2011 on City Minimum Wage in West Java In 2012, the amount of West Bandung Regency Minimum Wage (UMK) in 2012 is IDR 1,236,991 per month. Meanwhile, based on questionnaires, the average of respondent's family income is IDR 1,081,000. It appears that the income per family per month is less than the UMK (87.4%). rPK:2 2. Based on the questionnaire analysis, the average proportion of food consumption expenditure on total household expenditure per month is 60.96%. Meanwhile, based on Central Agency on Statistics - BPS publication on Indonesian Consumption Expenditure (2011), the proportion of rural community expenditure in Indonesia for monthly consumption is 58% compared to their total monthly expenditure. rPLK: 1 3. The level of per capita consumption per month of survey respondents in Kampung Cikapundung is 7.66 kg. rKP: 1	1.33
Local Resources that support environmental sustainability	The data obtained to assess these attributes are obtained by interviews with Kampung Cikapundung community and observation results at the study sites. 1. Communities in Kampung Cikapundung generally work in agriculture and animal farming, whether as owners or as laborers. In the livestock sector, dairy farming is the main business undertaken by the community (33% of respondents active this field, either as business owners or livestock workers). Dairy products are marketed outside Kampung Cikapundung, through the services of North Dairy Farmers Cooperative (KPSBU). In addition to farming, agricultural products, such as cabbage and broccoli, also tend to be sold outside Kampung Cikapundung (export-oriented). KU:5 2. Diversification of commodity development has been carried out on agricultural business in Kampung Suntenjaya. Various types of vegetable crops (such as cabbage, broccoli) are developed in the area. In addition, there is also a rotation effort of plants in order to maintain soil fertility throughout the year. DK:5 3. Livestock and plantation business are developed export-oriented and the community tends to not consume the commodities. In order to meet the needs of consumption - especially food (eg staple food, fish, meat) and clothing - community in Kampung Cikapundung imports these products. SW:1. 4. Dairy farm business at Kampung Clkapung has caused pollution for the upstream area of Cikapundung. The contamination generally comes from cow dung being dumped directly into the river body. Despite efforts to develop biogas infrastructure to reduce the level of pollution, based on observations made in October 2012, the contamination is clearly visible	3.67

Attribute	Existing Condition	Rating
Formal Institutional	1. In 2012, the Ministry of Energy and Mineral Resources has conducted program to construct 10 units of biogas to process cow dung into biogas energy that can be utilized by the community and reducing pollution of Cikapundung in the same time. PKonF:5 2. These ten processing units have been completed and relatively can reduce the pollution level of Cikapundung River. PPKonF:4	4.50
Informal Institutional	1. Until now, there is no environmental management program independently from the community groups. PKonIf:1 2. Therefore, the rating value given is (PPKonIf):1	1

Equation (1) is used to calculate the E value, the results of which are presented in **Table 8**. As presented in the table, the E value is 65.12. Based on the regional eco-categorization (**Table 2**) the study location can be categorized as semi eco-settlements.

Table 8: Calculation of E Value.

Attribute	Rating	Score	Max Score	Δ Score
Vegetation Cover	1	1.70	8.50	6.80
Land Suitability	1	1.70	8.50	6.80
Quality of drinking water	5	5.00	5.00	0.00
Quality of waste water	5	2.00	2.00	0.00
Quantity of raw water	5	3.50	3.50	0.00
Surface run off	1	0.50	2.50	2.00
The Erosion Index	5	11.00	11.00	0.00
Infrastructure of drinking water and sanitation	3	2.10	3.50	1.40
Building density	2	1.40	3.50	2.10
Society Participation	5	17.00	17.00	0.00
Level of Education (formal)	2	2.02	5.50	3.48
Education (informal)	5	5.50	5.50	0.00
Income Levels	1.33	2.13	8.00	5.87
Local resources that support environmental sustainability	3.67	5.87	8.00	2.13
Formal Institutional	4.5	2.70	3.00	0.30
Informal Institutional	1	1.00	5.00	4.00
Total E Value		**65.12**		**34.88**

According to the assessment, attributes of quality of drinking, waste, and raw water; erosion index; community participation; and informal education showed to have perfect scores. The quality of these attributes is the main contributor to total E value of Kampung Cikapundung.

The analysis also shows that the scores of attributes of the infrastructure of drinking water and sanitation, building density, level of education; and potential local area are

moderate. These scores indicate the provision of drinking water and sanitation can reasonably meet the demand of community in Kampung Suntenjaya – while it still not sufficient enough.

The attributes that considerably degrades the level of sustainability of Kampung Cikapundung are vegetation cover, land suitability, surface runoff, and income levels. Therefore, the cause for low performance of sustainability condition of Suntenjaya can be classified into nature-based and socio-economic factor. Land use and topography condition of Kampung Cikapundung are two nature-based factors that deteriorate the sustainability of the village. It seems that rapid land use conversion to built-environment in Kampung Cikapundung, Suntenjaya can be blamed for this condition. Meanwhile, the community's lack of financial income (poverty) is a socio-economic factor that worsen the sustainability of this village. The fulfillment of basic needs is still the priority of the community while maintaining environmental condition probably still in the community's secondary or tertiary priority list.

According to Deviana & Rachman [7] improving (informal) education and local resources may have significant ameliorate settlement in the upstream of the watershed area. Therefore, despite enhancing and maintaining the quality of attributes that perform well, moderately and unsatisfactory – through land use rehabilitation as well as infrastructure provision and upgrading – serious action in providing training for the community as well as assisting community's economic activities to have to be carried out.

4. Conclusion

Eco Degree (E) rating model used to assess the sustainability of settlements in Kampung Cikapundung shows that the settlement areas in this village is categorized as Semi Eco Settlements. The assessment indicates that there is no substantial effect of livestock farming in this village to the level of sustainability of the area. The assessment shows that serious concern has to be focused on land use rehabilitation, such as replanting to improve surface run-off of the area as well as infrastructure provision and upgrading. Social-economic improvement of a community also has to be carried out systematically in the form of training and access to financial capital local business community.

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