

Determination of Hydrologic Soil Group from Soil Map Unit of Indonesia in Pataruman Water Catchment Area

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Abstract. Hydrologic Soil Group (HSG) for each region is different depending on soil conditions. It is one of the key elements in the NRCS-CN determination to account for the rain-runoff relationship. But unfortunately in Indonesia there is no map of HSG. Adidarma (2013) has conducted the research about HSG determination by using hydrogeology map. However, the map has a long process of pedotransfer and HSG parameter approach is still generally and qualitative. Furthermore, Ramadan (2017) has done research of HSG determination with HWSD map; the map is a global map which depth of information type of soil is less profound. Related to those problems, the researcher will conduct the determination of HSG in accordance with the condition of land in Indonesia by using Land Map Unit (SPT) Indonesia. HSG will be overlay with the transparent of land in Pataruman Water Catchment Area (WCA) until obtained the value of NRCS-CN and then the discharge plan will be calculated and will be calibrated with debit recording in Bendung Pataruman.

1. Introduction

The relationship between precipitation-runoff to estimate discharge in a river is very dependent on the characteristics of the Watershed. To calculate the precipitation-runoff relationship there are many methods, one of which is the Natural Resources Conservation Service Curve Number (NRCS-CN). This method is easy to use with physical watersheds, namely soil type, land use, hydrological conditions, and Antecedent Moisture Conditions (AMC) [1].

Determination of NRCS-CN which is required by the approved Hydrologic Soil Group (HSG) map must be made through another map containing parameters required by HSG. However, HSG maps are not available in Indonesia. Research on the selection of HSG has been carried out by the Hydrogeology Map, but the map has a long pedotransfer process and requires HSG parameters that are still general and qualitative [2]. HSG determination is also used by Harmonized World Soil Database (HWSD) maps, the map is a global map where the depth of soil type information is less deep [3]. For this reason, transfer will be carried out from another map, namely the Indonesian Land Map Unit (SPT). The Indonesian SPT has information about land surface and permeability so that this information can be used to achieve HSG. Also, the Rupa Bumi Indonesia (RBI) map is used to determine Pataruman sub-Water Catchment Area (WCA) and to understand land use data. The HSG and land use data will be searched for value into NRCS-CN and calculated flood discharge in the Citanduy River and then calibrated with the evaluation discharge at Pataruman Dam.



2. Materials

In general, HSG group A has a high water transmission, group B has a medium water transmission, group C has a low water transmission, and group D has the lowest water transmission[4]. Classification of soil texture according to USDA can be seen in table 1[5][6].

Table 1. Soil texture classification

HSG	Soil Texture
A	Sand, loamy sand, or sandy loam
B	Silt or loam
C	Sandy clay loam
D	Clay loam, silt clay loam, sandy clay, silty clay, or clay

For determining the NRCS-CN values can be seen from Table 2[3].

Table 2. Landuse and NRCS-CN

No.	Landuse	<i>Hydrologic Soil Group</i>			
		A	B	C	D
1	Water	98	98	98	98
2	Forests	57	73	82	86
3	Gardens/plantations	57	73	82	86
4	Meadow \ Empty Land	72	82	87	89
5	Settlement	61	75	83	87
6	Swamp	98	98	98	98
7	Irrigated rice fields	62	71	78	81
8	Rain-Filled Rice Fields	72	81	88	91
9	Shrubs	48	67	77	83
10	Field	66	77	85	89

CN composite calculation is used using the following formula[7]:

$$CN_c = \frac{CN_1A_1 + CN_2A_2 + \dots + CN_iA_i \dots + CN_nA_n}{\sum_{i=1}^n A_i} \quad (1)$$

where :

CN_i : CN valure at i's WCA,

A_i : i's WCA (m^2), and

n : total WCA.

3. Method

The method used is the study of literature first, then conducted data collection including Indonesian SPT, RBI maps, and observation discharges at Pataruman Dam. The diagram of this research can be seen in Figure 1. From the Indonesian SPT, the pedotransfer will be made into an HSG map, and the RBI map is used to determine the land use and Pataruman sub-WCA.

To get NRCS-CN values, HSG data and land use data are combined. Then the flood discharge in the river is calculated and calibrated by observation discharge in Pataruman Dam.

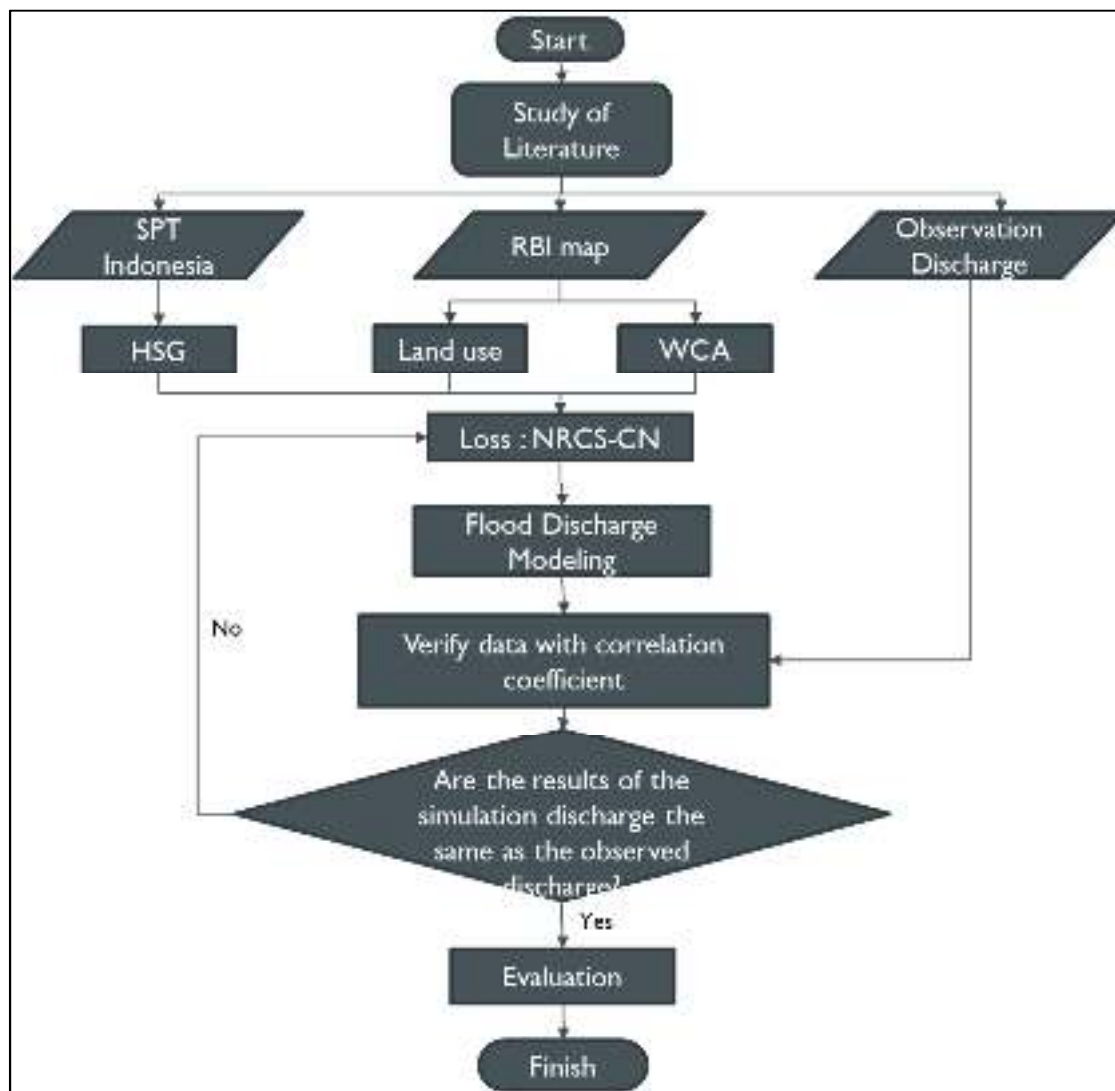


Figure 1. Methodology for determination hydrologic soil group

4. Results

The results of the pedotransfer in Figure 2 show that from SPT Indonesia has varying HSG values. But most of the soil conditions are included in the HSG with a D value according to Table 3. There are differences in the HSG from the same SPT number, this is because one SPT number is in a different administrative area so that the soil type is different.

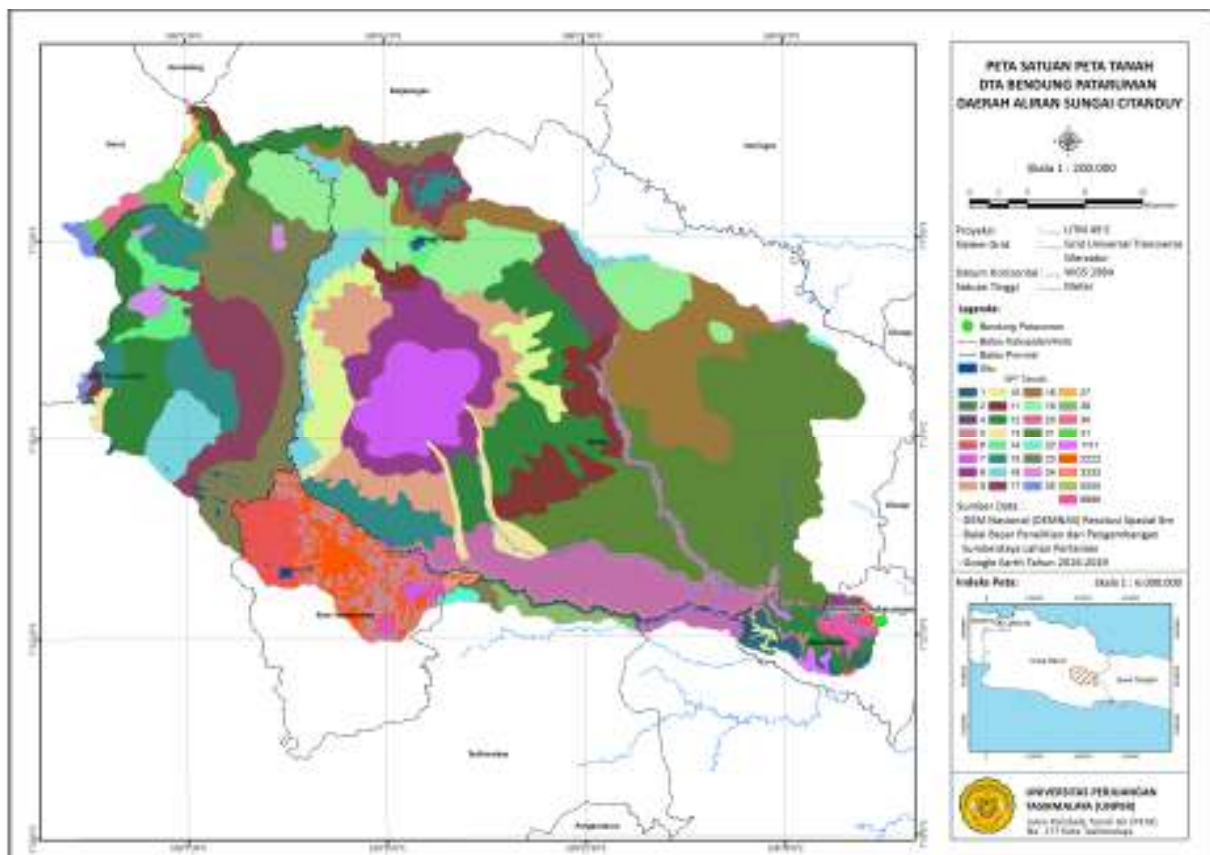


Figure 2. SPT Indonesia DTA Pataruman

Table 3. HSG classification

SPT	HSG	SPT	HSG	SPT	HSG	SPT	HSG	SPT	HSG
1	D	10	D	16	D	24	D	5555	D
2	D	10	C	16	C	26	D	9999	D
4	D	11	D	17	D	27	D		
5	D	12	D	18	D	27	C		
5	C	12	A	19	D	28	D		
6	C	12	C	20	D	30	D		
6	D	13	D	21	D	31	D		
7	D	14	D	21	C	1111	D		
8	D	15	D	22	D	2222	D		
9	D	15	C	23	D	3333	D		

Pataruman WCA consists of different types of land use. These include forests, gardens/plantations, fields/drylands, swamps, rice fields, shrubs, rivers/lakes/reservoirs/situ, ponds/ponds, built according to Figure 3. NRCS-CN values can be seen in Table 4. The average NRCS-CN in the Pataruman WCA is 85.15.

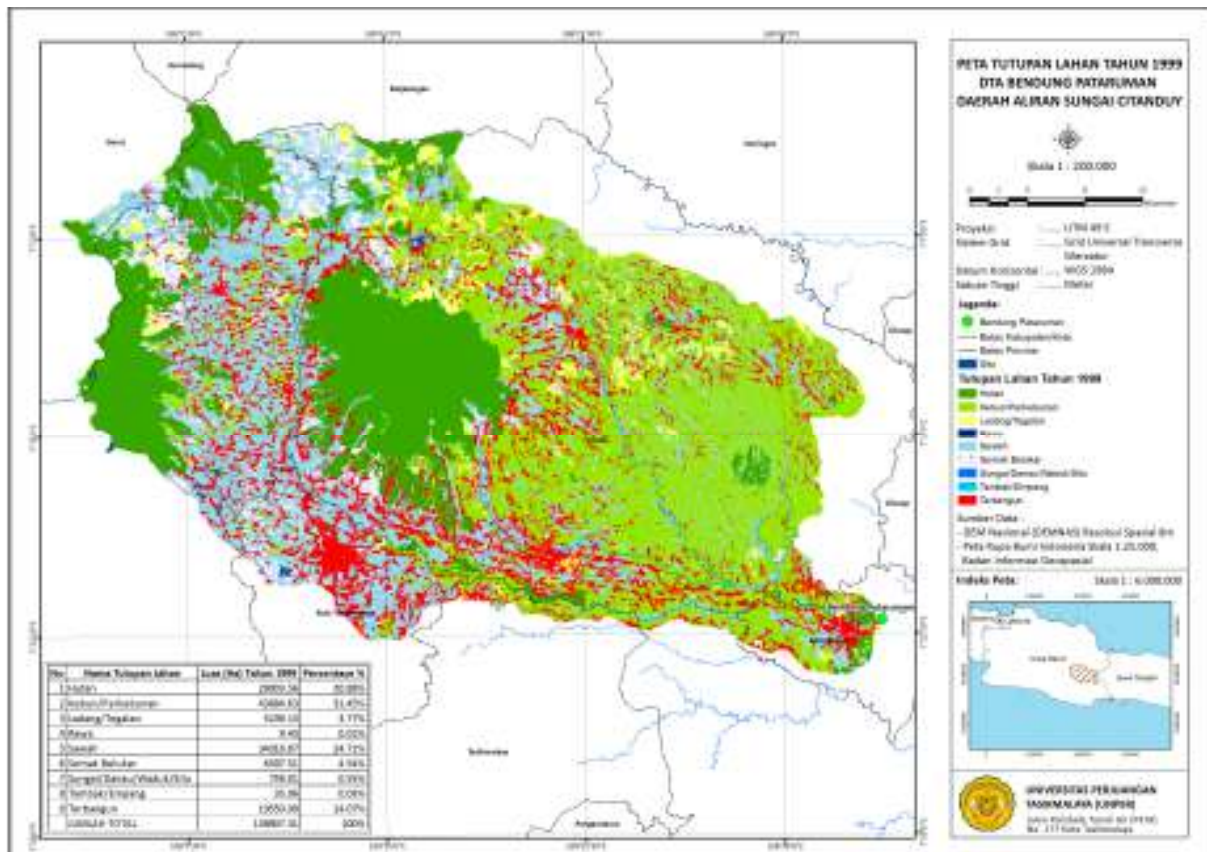


Figure 3. Pataruman WCA landuse

Table 4. NRCS-CN Pataruman WCA.

Water Cactcment Area (WCA)	Area (Hektare)	CN composite
Cikali sub-WCA	1,075.58	85.20
Cileueur sub-WCA	15,519.82	85.52
Ciliung sub-WCA	8,832.36	85.51
Cimuntur sub-WCA	26,441.82	85.55
Cipalih sub-WCA	3,085.39	84.96
Cirende sub-WCA	8,439.27	85.33
Citanduy sub-WCA	73,752.26	84.04
Citeras sub-WCA	1,853.82	85.12
Pataruman WCA	139,000.32	85.15

Simulated flood discharge analysis used SCS method and the results are as shown in figure 4. The calibration results between the simulated discharge and the observed discharge are quite good with a correlation coefficient value of 0.73352.

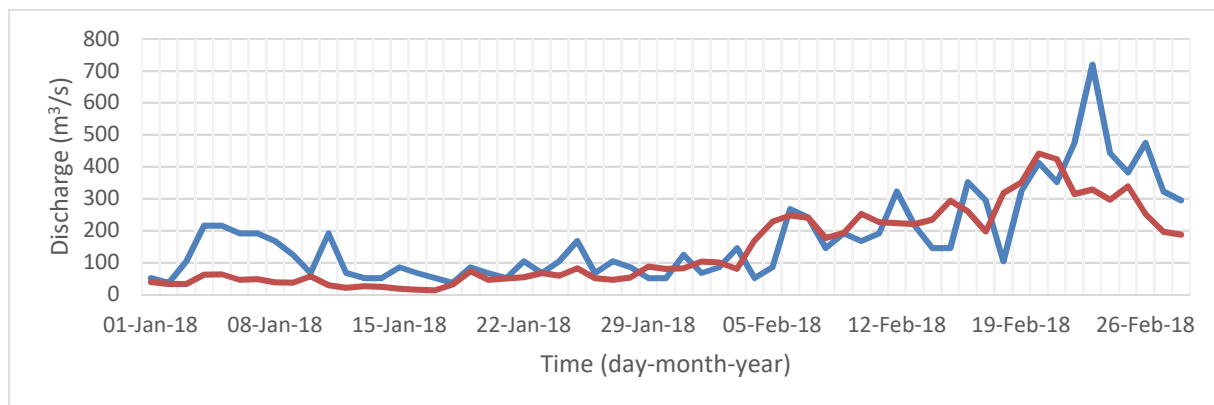


Figure 4. Simulated discharge and observed discharge calibration

5. Conclusion

Indonesian SPT can be used as a determinant of HSG by using information on soil texture and soil permeability. The results of the calibration correlation coefficient between simulation discharges with observed discharges are 0.73352.

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