ASEAN Engineering Journal

Full Paper

ESTIMATION OF LENGTH AND SLOPE FACTOR (LS) AS EROSION PREDICTION IN WAY PUBIAN SUB WATERSHED

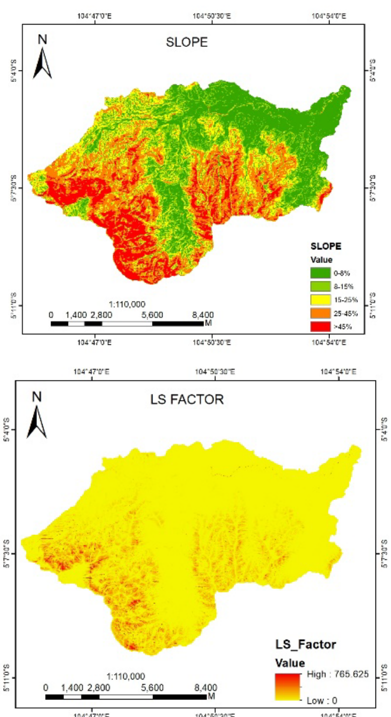
Yuda Romdania*, Ahmad Herison

Department of Civil Engineering, Faculty of Engineering, University of Lampung, Bandar Lampung City, Lampung, 35141 Indonesia

Article history
Received
20 September 2023
Received in revised form
28 November 2023
Accepted
26 March 2024
Published online
31 August 2024

*Corresponding author
yuda.romdania@eng.unila.ac.id

Graphical abstract



Abstract

Erosion caused by land degradation is one of the main challenges to soil quality around the world. One way to prevent erosion is by analyzing the length and slope factor (LS). The increasing length of the slope causes the higher amount of cumulative runoff and also the increasing steepness of the soil slope causes the higher speed of runoff that contributes to erosion. The purpose of this research is to analyze the LS factor value of Moore and Burch (1986) method and LS Nomograph for Way Pubian Subwatershed. The research method was done with Moore and Burch method and Nomograf LS. Moore and Burch (1986) method used the flow accumulation on DEM data as the main input in ArcGIS and the result shows the LS value ranged from 0 to 765.625 with an average (mean) value of 4.427. Meanwhile, the nomograph LS method resulted in high LS values and is not compatible with the Jakarta RTL-RLKT Preparation Implementation Guidelines (1986). Slope conditions affect the amount of surface flow so that it also affects the contribution of erosion and LS value. Way Pubian sub-watershed also classified as steep, resulting in a high LS value. Based on the method of Moore and Burch (1986) using ArcGIS software, we can conclude that the results of LS factor values can be used in Indonesia compared to the nomograph LS method which the results are less suitable due to topographic factors. As a result, the LS value from Moore and Burch (1986) method can be used in erosion prediction calculation.

Keywords: Slope and length factor (LS), Moore and Burch Method, LS Nomograph, Way Pubian Subwatershed

1.0 INTRODUCTION

Erosion is a naturally occurring soil erosion process [1]. It is one of the causes of land degradation that has become a major challenge for soil quality worldwide in the 21st century [2]. Indonesia has a high rate of soil erosion on agricultural land with slopes of 3-30%, ranging from 60-625 t/ha/year, whereas many agricultural lands have slopes of more than 15% and even more than 100% so that soil erosion rate is classified as very high [3]. This problem may become more serious in the future due to climate variability and change as well as land use development due to rapid population growth [4]. Therefore, soil conservation is necessary.

In watershed areas, erosion is also common to occur. Watersheds have characteristics associated with the causes of erosion, namely soil type, land use, topography, and length and slope. Erosion prediction can be done by analyzing each watershed characteristics. Erosion prediction is considered a standard for the scientific implementation of soil conservation studies [5].

Slope is one of the factors that have a dominant major influence on erosion. Erosion increases as the slope gets steeper [6]. Slope affects the speed of surface runoff. The greater the slope the lower the chance of water infiltrates the soil which can cause an increase in the volume of surface runoff and causes erosion.

One way to prevent erosion in the watershed is to analyze the value of the length and slope factor (LS). The length and slope factor (LS) expresses the influence of topography, which combines the influence of slope length (L) and slope steepness (S) on soil erosion rates [7][8]. Therefore, estimation of slope length and slope steepness factor calculation is very important in an area.

ArcGIS is necessary to help estimate the value of the LS factor in this reseasrch. ArcGIS is capable of handling various spatial analysis, data management, and mapping operations [9]. Digital Elevation Model (DEM) is used as the main input parameter in ArcGIS [10]. ArcGIS can perform spatial analysis to obtain the slope steepness [11].

The study area is a sub-watershed where most of the area is protected forest. Protected forests have an important role in human life, especially as a producer of oxygen and also as a control against erosion [12]. Therefore, the calculation of LS factor is necessary to gain an understanding of the characteristics of topographic factors as well as the appropriate model for LS factor estimation. The estimation of the LS factor may has been widely done but with the Moore and Burch (1986) and Nomogfraf LS (1976) methods which has never been done in Way Pubian Subwatershed before. As a result, it is important to do the research in obtaining the LS Factor value as an erosion estimator.

The purpose of the research is to analyze the LS factor value of the Moore and Burch (1986) method and the LS Nomograph for the Way Pubian Subwatershed. So that the results obtained can be used to predict soil erosion and make management plans in the Way Pubian Subwatershed..

2.0 METHODOLOGY

2.1 Research Location

The research location was the Way Pubian Subwatershed area which is part of the Way Seputih Watershed, Lampung Province. Way Pubian Subwatershed is mostly located in Pubian Subdistrict. See Figure 1. The Way Pubian Subwatershed area consists of plantation area, rice fields, residential areas, and mostly protected forest area.

2.2 Research Equipment

The equipment used in the research is ArcGisPro Software No License 28_17 7688, which were used for simulation and data compilation.

2.3 Research Data

The data used in this study were:

2.3.1 DEM Data

DEM data is a raster data format and contains topographic information data from an area. DEM data is obtained from the National DEM website which will be used in ArcGIS to process data.

2.3.2 SHP Data

SHP data, which is the border of the area, were obtained from the Watershed Management Center (BPDAS) Way Seputih - Way Sekampung. The border data was used to cut the DEM data in general so that DEM data can be produced only for the research area which can then be analyzed on the slope of the Way Pubian Subwatershed area.

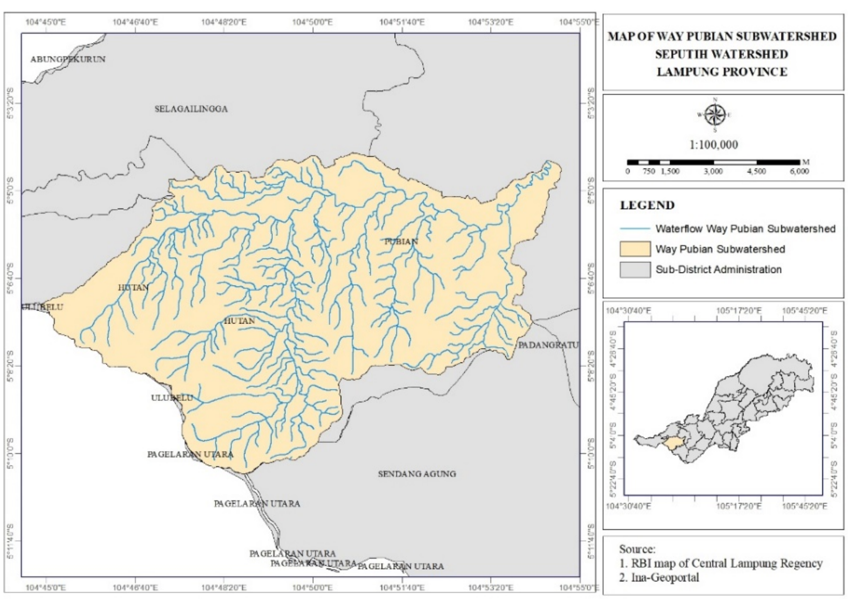


Figure 1 Research Location Map

2.4 Research Flow Chart

The flow chart below was used as the Way Pubian Sub-watershed area, Way Seputih Watershed, Lampung Province research reference. Flow chart of the research is shown in Figure 2.

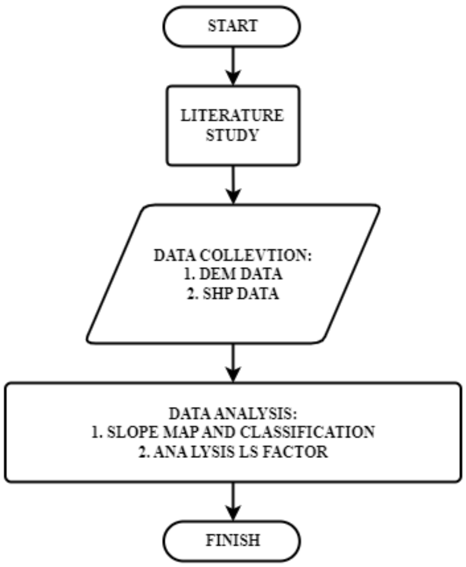


Figure 2 Research Flow Chart.

2.5 Slope Steepness Analysis

Slope steepness is the ratio of slope and plane expressed in percent or degrees. The greater the percentage of slope, the greater the surface flow and the transport energy that occurs. Low slope results in the accumulation of water that can cause inundation in the region, especially the basin area within the watershed [13].

Slope steepness can be calculated with ArcGIS using DEM data in the desired area. The stages of making the slope steepness data are as follows:

- Download DEM data of the research location on the website https://tanahair.indonesia.go.id or what is often called the Ina-Geoportal website.
- Open the ArcGIS application and enter the DEM data that has been downloaded from Ina-Geoportal and input the Way Pubian Subwatershed border data.
- Use the extract by mask feature in ArcGIS to cut the large DEM data of the research location into DEM data of the Way Pubian Subwatershed border.
- Change the coordinate system from CGS to UTM zone 48S by using the project raster feature in ArcGIS. The 48S zone was chosen because it is in accordance with the research location which is included in the 48S zone.
- Use the slope feature to change the steepness rate into percentage and classify into 5 classes according to Table 1 using the reclassify feature.

After the slope steepness is obtained, the determination of the slope steepness classes classification can be done using ArcGIS software based on the area and percentage of the resulting area with the following stages:

- Change the slope steepness raster data into polygon data using the raster to polygon feature.
- Export the data and open the attribute table to fill in the description table columns and slope steepness based on the slope classification class grid code using add field feature to the attribute table.
- Use the geometry calculator to calculate the slope length and area from the slope classification table.
- The results of the slope classification were tabulated for each classification to make it easier to see.

2.6 LS Factor Analysis

The position of the slope affects the amount of surface flow that occurs on the land. The movement of water will carry the collected particles of soil down the slope and accumulate at the bottom of the slope. Soil chipped by the kinetic energy generated by rain will be carried by surface flow to the bottom of the slope, so that the bottom of the slope will become the output due to the transportation process caused by land erosion.

Slope length and steepness are interrelated. The length of the slope (L) influences the magnitude of the LS value, because it affects the volume of surface flow and the ability of soil erosion although the influence is not as great as the influence of the steepness (S). So, generally a long and very steep slope will result in a large LS value, which results in higher erosion. The LS factor value can be analyzed by various methods. In this research, two methods will be used. They are:

2.6.1 Moore and Burch method (1986)

This method was invented by Moore and Burch (1986) to estimate the LS factor [14]. In this method, the slope length (L) is calculated in the ArcGIS domain using the accumulated flow and the DEM pixel size. The pixel size of the DEM can be known by using ArcGIS. Since this method relies on flow accumulation and DEM pixel size, the part of the slope that has high flow accumulation will be very important for calculating soil loss [15].

The formula of this method calculated in ArcGIS is:

$$LS = \left(\frac{X \times CZ}{22{,}13}\right)^{0{,}4} \times (0{,}065 + 0{,}045\, S + 0{,}0065\, S^2) \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

Description:
LS = Slope Length and Steepness factor
X = Flow Accumulation
CZ = Pixel Size
S = Slope Steepness (%)

Flow accumulation is the pixel value that is affected by the flow on the slope. As a result, this method is influenced by the shape of the existing topography in a place. The Moore and Burch method can integrate Geographic Information System (GIS) technology, which is a digital modeling technology of the earth's surface with spatial models, to determine the magnitude of LS values. ArcGIS application is used to analyze the steepness of an area with DEM data. The flowchart of the process of processing DEM data into LS factors can be seen in Figure 3.

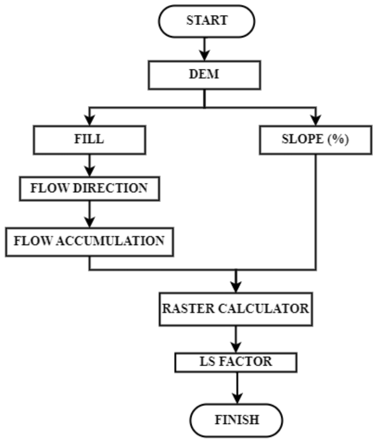


Figure 3. Moore and Burch method flowchart (1986)

The first step in this method is to ensure that the DEM data has already been downloaded. Then, create a fill using the fill feature on ArcGIS, which is a feature useful for filling in sinking surface raster data and for removing small imperfections in the data. After that, create a flow direction that is useful for getting the value of water flow direction that passes through the pixel when heading downstream. Then, based on the flow direction value, the accumulated flow value for each pixel will be obtained which is the sum of all flows from upstream of the pixel, or the amount of flow that flows over the pixel. The accumulated flow value and the value of the steepness are entered into equation (1) using the raster calculator in ArcGIS to get the LS factor value for the whole and not for each slope classification.

2.6.2 LS Nomograph Method

The LS nomograph method is a method developed by Wischeimeier and Smith (1978) [16]. The x-axis represents the slope length and the y-axis represents the LS factor value. The percentage of slope steepness is on the transverse graph. The slope length in the LS nomograph has a value of 1-10000 m with the percentage of 0.5-50 % and LS value of 0.1-100%.(see figure 4)

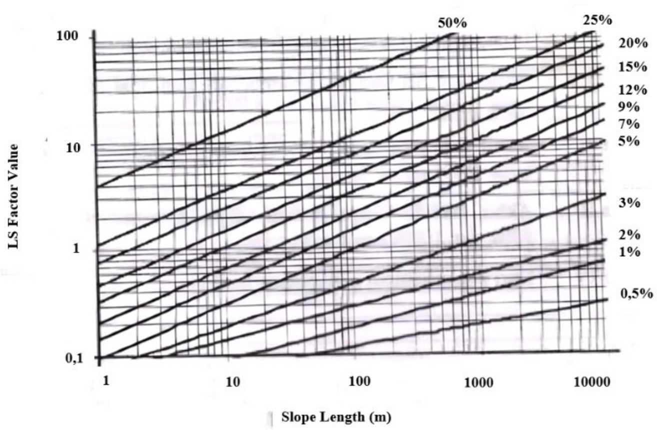


Figure 4. Nomograf LS
(*Sumber: Wischeimeier dan Smith, 1978*)

The Nomograph LS method can be done in the following steps:

- Use the accumulated slope length value of each classification and the percentage of slope steepness obtained from processing DEM data with the slope and geometry calculator feature in ArcGIS.
- Input the slope length and steepness data for each classification class into the LS nomograph. On the x-axis input the slope length value and draw a vertical line until it intersects the slope percentage graph and then draw a horizontal line until the LS value is obtained.
- LS values were obtained for each classification and the results were made into a table.

This method used the length of the slope obtained from ArcGIS per slope steepness classification and also uses the percentage of slope steepness that has been obtained per class slope steepness classification. Reference of slope steepness classification used is based on the Minister of Agriculture Decree No.837 [17]. See Table 1.

Table 1 Classification of Slope Classes

Class	Slope (%)	Classification
I	0 – 8	Flat
II	8 – 15	Ramps
III	15 – 25	A bit steep
IV	25 – 45	Steep
V	>45	Very steep

(Source: Minister of Agriculture Decree No. 837, 1980)

The LS values generated from these two methods were referred to the LS factor values from the Jakarta RTL-RLKT Preparation Implementation Guidelines prepared by the Center for Land Rehabilitation and Soil Conservation [18] used in Indonesia. See Table 2.

Table 2 LS Factor Value

No	Slope	LS Factor Value
1	0 – 8 %	0,4
2	8 – 15 %	1,4
3	15 – 25 %	3,1
4	25 – 45 %	6,8
5	>45 %	9,5

(Source: Center for Land Rehabilitation and Soil Conservation, 1986)

3.0 RESULTS AND DISCUSSION

3.1 Moore and Burch Method (1896) LS Factor Analysis

The LS factor value in Moore and Burch Method (1986) was analyzed using ArcGIS software. It was explained in the Methodology that this method uses flow accumulation and slope steepness as the main input in the formula. Therefore, the DEM and SHP data of the Way Pubian Subwatershed borders were analyzed to calculate flow accumulation. The first step in making flow accumulation is to make a fill in the DEM data of the research location. See Figure 5.

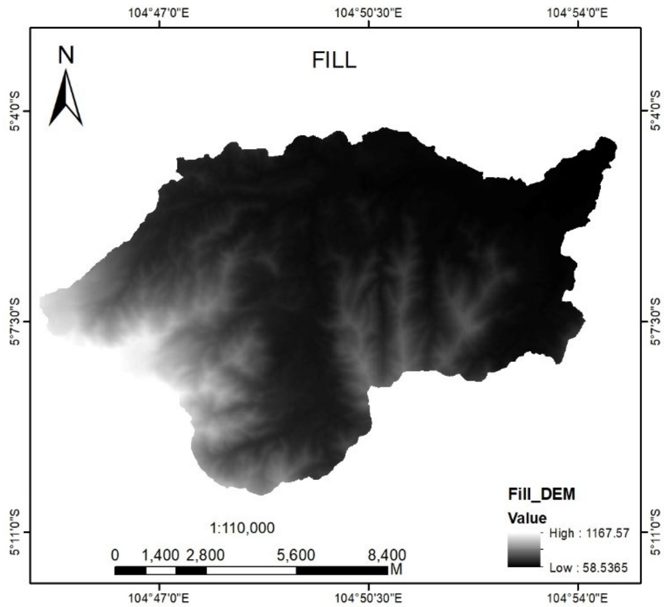


Figure 5. DEM Fill

The results of the DEM fill have the highest value of 1167.57 which is shown in gray and the lowest value is 58.5365 which is shown in black. The lighter the color, the higher the DEM fill value. Based on the fill data, a flow direction can be created which is useful for getting the value of the direction of water flow that passes through the pixel when heading downstream. Flow direction uses fill as its input. The flow direction results see Figure 6.

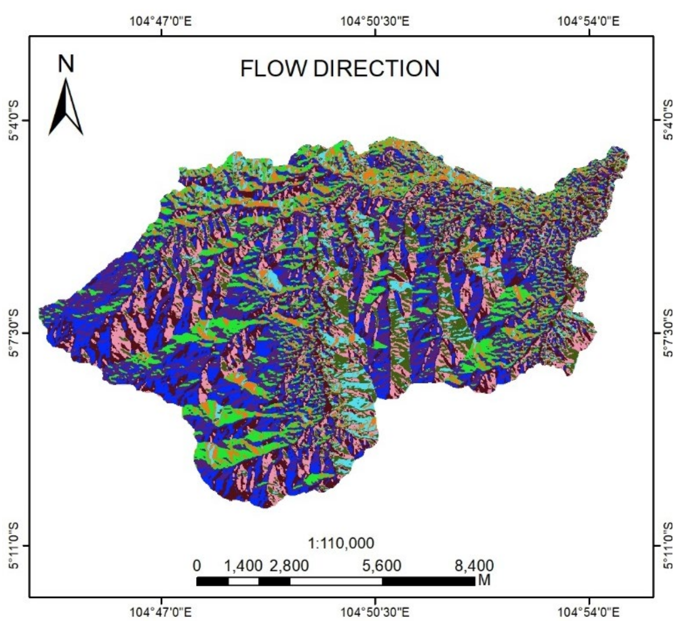


Figure 6. Flow Direction

Flow direction produces the direction of water flows located at each pixel in the fill data. The flow direction result can be used as input to calculate the flow accumulation value. Flow accumulation is the accumulation of flow that occurs due to the flow direction that were made.

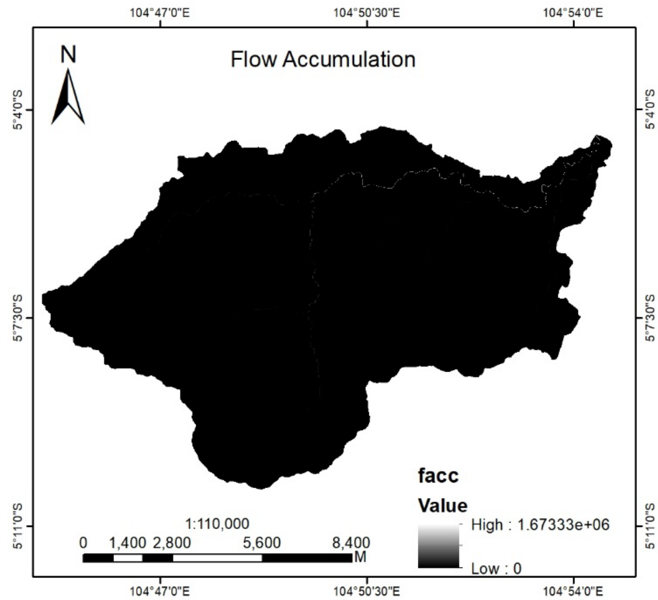


Figure 7. Flow Accumulation

Flow accumulation in the Way Pubian Subwatershed produces a value of 1.673 x 106 as the largest value. This means that there was a significant accumulation of flow in the area. In addition to flow accumulation, the data needed to calculate the LS factor is the slope steepness in percentage. Therefore, the slope steepness data was made using ArcGIS with slope feature. Results can be seen in Figure 8. The classification results of the slope steepness obtained can be seen in Table 3.

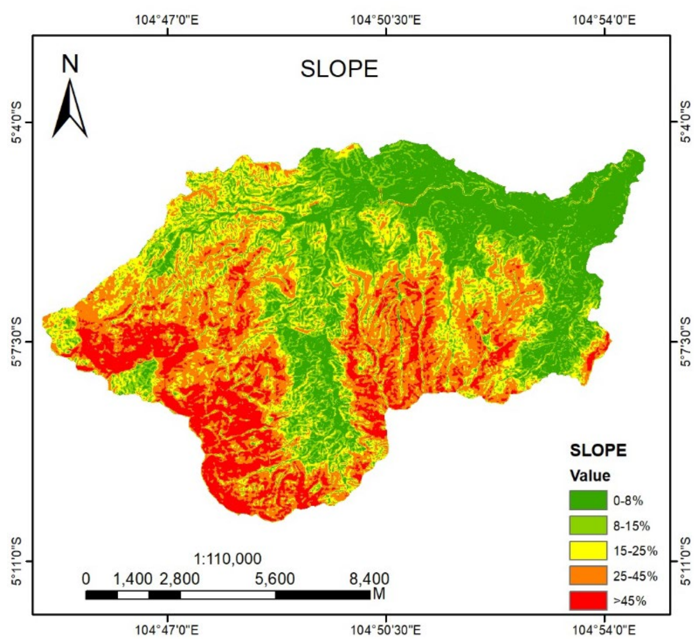


Figure 8. Slope

When the flow accumulation and slope have been made, the calculation of the LS factor value can be executed using a raster calculator according to the formula in equation 1. The results of the LS factor analysis with ArcGIS can be seen in Figure 9.

Table 3 Classification of Slope Steepness Classes in the Way Pubian Subwatershed

No	Steepness	Classification	Area (Ha)	Percentage (%)
1	0-8 %	Flat	2.890,019	24,994
2	8-15 %	Ramps	2.037,355	17,620
3	15-25 %	Slightly Steep	2.100,528	18,166
4	25-45 %	Steep	3.026,785	26,177
5	>45 %	Very steep	1.508,189	13,043
		Total	11.562,876	100,000

In Way Pubian Subwatershed, the smallest area is in the slope class >45% (Very Steep) with the value of 1,508.189 Ha (13.043%) while the largest area is in class 25-45% (Steep) with the value of 3,026.785 Ha (26.177%). The ramps and slightly steep slope steepness classification did not have too much difference. See Table 3.

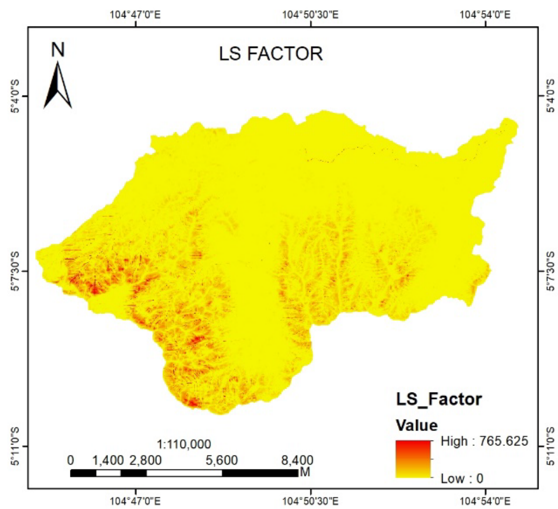


Figure 9. LS Factor

The Moore and Burch method used flow accumulation as the main input to calculate the LS value. The value is high only near or on the streamline while other areas have low LS values as shown in Figure 7. In the figure, the LS value ranges from 0 to 765.625 with an average (mean) value of 4.427. This mean value indicates that the value of the LS factor was classified as slightly steep to steep slope in accordance with the rules in the Jakarta RTL-RLKT Preparation Implementation Guidelines (1986).

3.2 LS Factor Analysis with LS Nomograph

In this method, the data required is the length of the slope from the output data of the slope steepness classification from ArcGIS and the percentage of slope steepness. The data then were manually plotted into the LS nomograph to obtain the LS value on each classification of slope steepness class. The results of the calculation of LS values are based on LS nomograph. See Table 4.

Table 4 LS Value in Way Pubian Subwatershed

No	Slope	Classification	Slope Length (m)	LS Value
1	0-8 %	Flat	369,5114	4,22
2	8-15 %	Ramps	293,1506	8,11
3	15-25 %	A bit steep	424,182	20,67
4	25-45 %	Steep	926,3243	90,11
5	>45 %	Very steep	492,8084	80,22

Table 4 shows that the results of LS values using the LS nomograph method were not in line with the Jakarta RTL-RLKT Guidelines (1986). This is a natural difference because the nomograph LS is a method proposed by Wischmeier and Smith (1978) for areas that are flat slope and have a non-tropical climate. Meanwhile, in the Way Pubian Subwatershed area has the highest percentage of slope steepness is in the steep classification. It can be concluded that the calculation with the LS nomograph produces larger results.

3.3 Comparison of the Two Methods

Moore and Burch's (1986) method is suitable to use in Indonesia due to its geographical conditions and topography. Several studies that have been conducted previously in various countries using similar methods with conditions of land characteristics and topography similar to Indonesia resulted in LS values that are similar or not much different from the LS values produced. The Indian region which has almost the same topography and also the same seasonal pattern has LS values ranging from 0 to 54.21 with an average value of 0.11 in the Palar Subwatershed [19] and for the Kuttiyadi River has LS values ranging from 0 to 23.41 with an average value of 2.04. Afghanistan, which also has topographic conditions similar to Indonesia, also has LS factor values for the entire region ranging from 0 to 3985 with an average value of 7.16 [20].

In the Moore and Burch (1986) method, slope length (L) is calculated in the ArcGIS domain using flow accumulation and pixel size based on DEM data. Therefore, the part of the slope that has high flow accumulation will be the main consideration in the calculation of soil loss. The more the LS factor increases, the more the flow accumulation and slope steepness rise [21].

The difference in LS value results in these two methods is because the Moore and Burch method considers flow accumulation, slope steepness in percentage, and pixel size as inputs in ArcGIS. In the Nomograph LS method, the analysis was done manually using only the slope length output and slope steepness percentage in ArcGIS. Because of the different treatment of the two methods, the Moore and Burch method produces a more precise LS value than the LS nomograph method. In the nomograph LS method, the analysis is more subjective because it was done manually. Another difference between the two methods is that the Moore and Burch (1986) method produces LS values in intervals and average value of all sub-watersheds to be used. In the nomograph LS method, the results are based on the classification class of slope steepness.

The result of a large LS factor value will contribute to high soil erosion due to the length of the slope and the steepness of the slope [22]. Based on this theory it can be concluded that the condition of the slope affects the amount of surface flow which also affects the contribution of erosion and LS value. Way Pubian Subwatershed also includes areas with steep classification, resulting in a high LS value, which is in accordance with the theory described. At the end of the analysis, the LS value that can be used are from the results from Moore and Burch method because it has a value in accordance with the rules and has considered the flow accumulation in the calculation.

4.0 CONCLUSION

The conclusion is that based on the Moore and Burch (1986) method using ArcGIS software, the LS value results can be used in Indonesia, in contrast to the nomograph LS method which results were less suitable due to topographic factors. Therefore, the calculation of erosion estimator that can be used is the LS value from the Moore and Burch Method (1986).

Acknowledgement

Thank you to the Institute for Research and Community Service (LPPM), University of Lampung.

References

[1] Taslim, R.K., Mandala, M. and Indarto, I., 2019. Prediksi Erosi di Wilayah Jawa Timur: Penerapan USLE dan GIS. *Jurnal Ilmu Lingkungam.* 17(2): 323-332. DOI: http://10.14710/jil.17.2.323-332

[2] Das, S., Bora, P.K. and Das, R., 2022. Estimation of slope length gradient (LS) factor for the sub-watershed areas of Juri River in Tripura. *Modeling Earth Systems and Environment*: 1-7. DOI: http://dx.doi.org/10.11113/jt.v79.9987

[3] Sutrisno, N. and Heryani, N., 2013. Teknologi konservasi tanah dan air untuk mencegah degradasi lahan pertanian berlereng. *Jurnal Penelitian dan Pengembangan Pertanian*. 32(3): 122-130. DOI: http://10.21082/jp3.v32n3.2013.p122-130

[4] Tanuma, K., Suif, Z., Komsai, A. and Liengcharernsit, W., Modeling Distributed Hydrological and Sediment Processes to Assess Land Use Effects In Chao Phraya River Basin. *ASEAN Engineering Journal*. 4(1): 30-47.DOI: https://doi.org/10.11113/aej.v4.15431

[5] Deb P., Kiem A.S., 2020. Evaluation of rainfall-runoff model performance under non-stationary hydroclimatic conditions. *Hydrological Sciences Journal.* 65: 1667–1684 DOI: https://doi.org/10.1080/02626667.2020.1754420

[6] Dunggio, I. and Ichsan, A.C., 2022. Efektifitas Pembuatan Tanaman Vegetatif dalam Menanggulangi Erosi dan Sedimentasi (Studi kasus di daerah aliran sungai Limboto Provinsi Gorontalo). *Jurnal Belantara*, 5(1): 45-58. DOI: http://10.29303/jbl.v5i1.882

[7] Lu. S, Liu B, Hu Y, Fu. S., Cao. Q., Shi. Y, Huang T., 2019. Soil erosion topographic factor (LS): accuracy calculated from different data sources. *CATENA*. 182(1): 104334. DOI: https://doi.org/10.1016/j.catena.2019.104334

[8] Andriyani, I., Wahyuningsih, S. and Suryaningtias, S., 2019. Perubahan tata guna lahan di Sub DAS Rembangan-Jember dan dampaknya terhadap laju erosi. *AgriTECH*, 39(2): 117-127. DOI: https://doi.org/10.22146/agritech.42424

[9] Nurdiawan, O., 2018. Pemetaan daerah rawan banjir berbasis sistem informasi geografis dalam upaya mengoptimalkan langkah antisipasi bencana. *INFOTECH Journal*. 4(2): 6-14. DOI: http://dx.doi.org/10.31949/inf.v4i2.837

[10] Choudhari, P.P., Nigam, G.K., Singh, S.K. and Thakur, S., 2018. Morphometric based prioritization of watershed for groundwater potential of Mula river basin, Maharashtra, India. *Geology, Ecology, and Landscapes*. 2(4): 256-267. DOI: https://doi.org/10.1080/24749508.2018.1452482

[11] Sabado-Burlat, C., T. Ignacio, M. T., & Guihawan, J., 2022. Inventory of High Value Crops Using Lidar Data and Gis In Lanao Del Norte Philippines. *ASEAN Engineering Journal*.12(1): 183-187. DOI: https://doi.org/10.11113/aej.v12.17822

[12] Nuraida, 2019. Analisis Spasial Tingkat Erosi Tanah di DAS Ciliwung Hulu. *AGROSAMUDRA*. 6 (2): 67–75. DOI: http:// 10.33059/jupas.v6i2.1768

[13] Farida, A. and Irnawati, I., 2020. Kajian Karakteristik Morfometri Daerah Aliran Sungai Klawoguk Kota Sorong Berbasis Sistem Informasi Geografis. *Median: Jurnal Ilmu Ilmu Eksakta*. 12(2): 74-86. DOI: http://doi.org/md.v12i2.941

[14] Moore I.D., Burch G.J., 1986. Physical basis of the length slope factor in the universal soil loss equation. *Soil Science Society America.* 50(5): 1294-1298. DOI: https://doi.org/10.2136/sssaj1986.03615995005000050042

[15] Lahlaoi, H., Rhinane, H., Hilali, A., Lahssini, S. and Khalile, L., 2015. Potential erosion risk calculation using remote sensing and GIS in Oued El Maleh Watershed, Morocco. *Journal of Geographic Information System*, 7(2):128. DOI: http:// 10.4236/jgis.2015.72012

[16] Wischmeier W.H., and Smith D.D., Predicting rainfall erosion losses: a guide to conservation planning. Washington, *DC: USDA*; 1978. (Agricultural Handbook, 537).

[17] Kementerian Pertanian, 1981. Kriteria dan Tata Cara Penetapan Hutan Lindung. In: SK Menteri Pertanian No 683/Kpts/Um/8/1981. 1–15.

[18] Balai Rehabilitasi Lahan dan Konservasi Tanah, 1986. Petunjuk Pelaksanaan Penyusunan RTL-RLKT. Jakarta: Departemen Kehutanan RI.

[19] Sujatha, E.R. and Sridhar, V., 2018. Spatial Prediction of Erosion Risk of A Small Mountainous Watershed Using RUSLE: A Case-Study of The Palar Sub-Watershed in Kodaikanal, South India. *Water (Switzerland)*.10(11):1–17. DOI: https://doi.org/10.3390/w10111608

[20] Ansari, A. and Tayfur, G., 2023. Comparative Analysis of Estimation of Slope-Length Gradient (LS) Factor for Entire Afghanistan. *Geomatics, Natural Hazards and Risk*. 14 (1):1-17. DOI: https://doi.org/10.3390/w10111608

[21] Ganasri, B.P. and Ramesh, H., 2016. Assessment of Soil Erosion by RUSLE Model Using Remote Sensing and GIS - A Case Study of Nethravathi Basin. *Geoscience Frontiers*. 7(6): 953–961. DOI: https://doi.org/10.1016/j.gsf.2015.10.007

[22] Widyantara, I.G.A.L., Merit, I.N., and Adnyana, I.W.S., 2015. Arahan Penggunaan Lahan dan Perencanaan Konservasi Tanah dan Air di DAS Yeh Empas, Tabanan, Bali. *ECOTROPHIC: Journal of Environmental Science*. 9(1): 54-62. DOI:https://doi.org/10.24843/EJES.2015.v09.i01.p07