Erosion Analysis of Sandy Clay Soil from Rurukan Village

Agnes.Tekla. Mandagi
Fakultas Teknik Jurusan Sipil, Universitas Sam Ratulangi, Manado

Fabian Johanes Manoppo
Fakultas Teknik Jurusan Sipil, Universitas Sam Ratulangi, Manado

ABSTRACT: Effect of global warming was changed of the rainy season in North Sulawesi. Field test was conducted to analysis the effect of the erosion sandy clay soil. Erosion in rainy season were given effect some direct and indirect flaws. The field test was conducted to examine the erosion level on sandy clay soil. The soil sample was taken from a plantation field in Rurukan village. The soil sample was computed by using USLE theory and field test was done with various treatments such as compacting and smoothing also traditional terrace treatment. The erosion analysis by using USLE theory was shown that the lowest result occurs with rainfall rate of 0.2 mm is 0.0001 kg/m2/day (compacted and smooth) and 0.0004 kg/m2/day (terrace treatment) while the lowest results in field sample was immeasurable despite of the rainfall rate was 0.2 mm. According to the USLE theory, the highest erosion was given 5.22 kg/m2/day (compacted and smooth) and 1.61 kg/m2/day (terrace treatment) on the rainfall rate of 56.4 mm. The field test results were shown that the erosion 5.23 kg/m2/day (compacted and smooth) and 3.45 kg/m2/day (terrace treatment) on the rainfall rate of 56.4 mm. Those results shown that the erosion level of terrace treatment was lower than the compacting and smoothing one.

Keywords ; Erosion, Rainfall, Sandy Clay, Treatment, USLE Theory

RESEARCH BACKGROUND :

The Province of Sulawesi Utara with capital city in Manado is located between 0°5°34' North Latitude and 123°07'– 127o10' Longitude. This province is bounded by Sulawesi Sea, Republic of Philippines, and Pacific Ocean at the north side and Maluku at the east side. Bound of south and west Gulf of Tomini and the Province of Gorontalo.

The area of province Sulawesi Utara is 15,221.06 square km which include six regencies and three cities. Bolaang Mongondow are widest regency with 8,358.04 km2 or 54.91 percent of total area of Sulawesi Utara. Sulawesi Utara has 41 mountains. This

mountains stands in three regencies, that is Bolaang Mongondow, Minahasa, and Sangihe Talaud. There are 17 lakes and 30 rivers in Sulawesi Utara.

According to the data from Sam Ratulangi Meteorogical Station average temperature in Manado and around recorded 26.7 0C along 2008. The problem in North Sulawesi is decreasing the area of forest cause of population and also the contour consist of slope, unduly and hilly. Every year North Sulawesi was occurred disaster such as earth quake, landslide and flood. A lot of victims was occurred and also material. In order to mitigate the problem of landslide and flood, the effect of erosion was play important role. Research about erosion was conducted in the laboratory and compared with the field test based on the USLE theory.

RESEARCH AIMS :

1. To compute the amount of soil erosion cause of the change of rainfall
2. To analysis the effect of terrace method to reduce the soil erosion
3. To check if the USLE Theory could be abel to use in North Sulawesi soil

MODEL TEST :

Flow chart of laboratory test

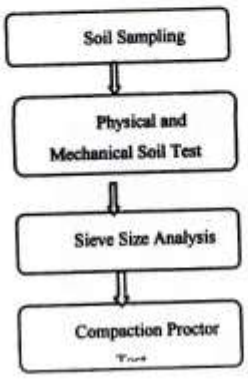


Figure 2. Compacted and Smooth Surface before rainfall (November 1st 2008)

Flow chart of field test

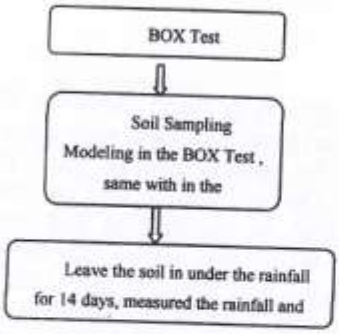


Figure 3. Compacted and Smooth Soil after rainfall (November 17th 2008)

BOX SIZE :

1. Compacted and Smooth soil
Length of Slope =3 m
Width=1 m
Thikness of soil=30 cm
Slope =10 %
2.Terrace Method
Length of Slope =3 m
Width=1 m
Thikness of soil=30 cm
Slope =10 %
Spacing of main pole =75 cm
Main Pole spacing to secand pole =37,5 cm
Width of drain =7 cm
Height of drain =3 cm

Figure 4. Terrace method before rainfall (November 1st 2008)

Figure 1. Box Test

Figure 5. Terrace method after rainfall (November 17nd 2008)

Figure 6. The rainfall measurement Tools (PH.OBS).

RESULTS AND DISCUSSION :

The amount of soil erosion was computed with USLE theory as follow,

a. Erosivity daily rainfall (Rd)

$$Rd = \frac{2{,}467(Pd)^2}{0{,}02727Pd + 0{,}0275}$$

Where,
Rd = erosivity daily rainfall
Pd = daily rainfall (cm)

b. Soil erodibility factor (K)
Sandy clay 0,1 – 0,7.

c. Length of slope factor (L) and Slope (S)

$$LS = \frac{65s^2L'}{s^2 + 10000} + \frac{4{,}6sL'}{s^2 + 10000^{0{,}5}} + 0{,}065L'$$

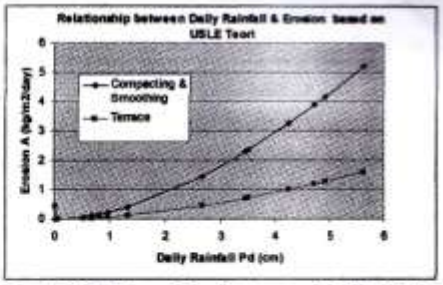
d. Vegetation factor (C)
C = 1 (without vegetation)

e. Erosion control factor (P)
P (Traditional terrace) = 0,40
P (Compacting and Smoothing) = 1,3

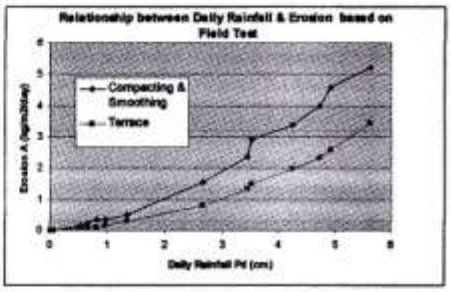
f. Soil erosion according USLE theory
A = R.K.LS.C.P

Comparison of total soil erosion between USLE theory and field test.

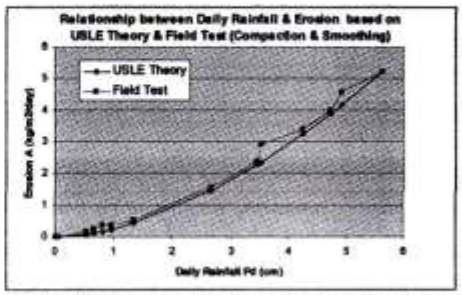
Σ A (kg/m²/hari)	Compacting & Smoothing	Traditional Terrace
USLE	23.52	7.23
Field Test	25.71	14.72



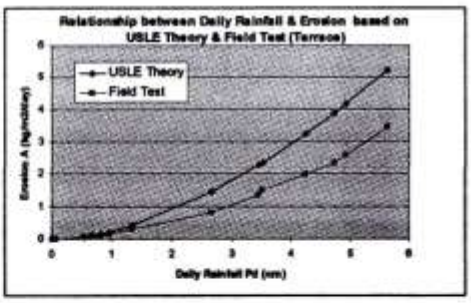
Graph 1. Relationship between Daily Rainfall & Erosion based on USLE Teori



Graph 2. Relationship between Daily Rainfall & Erosion based on Field Test



Graph 3. Relationship between Daily Rainfall & Field Test (Compaction & Smoothing)



Graph 4. Relationship between Daily Rainfall & Field Test (Terrace)

CONCLUSION :

The amount of erosion was given smaller value for terrace method compare then compaction and smoothing method. In orther to reduce the soil

erosion terrace method was given an alternative method.

Field test of soil erosion was shown that terrace methode quit different compare then USLE theory, on the other hand closed relation was shown for compaction and smoothing method.

REFERENCES :

1. Buchman, Harry O. & Nyle C. Brady. 1969. Ilmu Tanah.Bhratara Karya Aksara. Jakarta.
2. Das, B. M.1998. Principles of Geotechnical Engineering. PWS Publisher. International Thomson Publishing Inc.
3. Das, B.M..1988.Mekanika Tanah:Prinsip-Prinsip RekayasaGeoteknis.PWSPublisher Erlangga.Jakarta.
4. Hardiyatmo,H.C.2006.Penanganan Tanah Longsor dan Erosi.Gadjah Mada University Press.Yogyakarta.
5. Hausmann, Manfred. R. 1994. Engineering Principles of Ground.Mc Graw Hill.Tasmania Australia
6. NAVAC D.M-7. U.S Corps of Engineers. 1977, USA
7. Kartasapoetra,Ir.A.G.1989.Kerusakan Tanah Pertanian dan Usaha untuk Merehabilitasinya.Bina Aksara, Jakarta
8. Punmia B.C.1983.Soil Mechanics and Foundation.Standard Book House.New Delhi India.
9. Rahim, S.E.2000.Pengendalian Erosi Tanah.Bina Aksara.Jakarta.