COMPLETE PRACTICUM REPORT
SOIL AND WATER CONSERVATION TECHNIQUES
(19G04132401)

ALYA HAYU ING PAMBUDIAR
G041201065

SOIL AND WATER ENGINEERING LABORATORY
AGRICULTURAL ENGINEERING STUDY PROGRAM
DEPARTMENT OF AGRICULTURAL TECHNOLOGY
FACULTY OF AGRICULTURE
HASANUDDIN UNIVERSITY
MAKASSAR
202

ENDORSEMENT PAGE

TITLE : CONSERVATION ENGINEERING PRACTICUM COMPLETE REPORT SOIL AND WATER
NAME : ALYA HAYU ING PAMBUDIAR
NIM : G041201065
GROUP : VI (SIX)

This complete report is prepared as one of the requirements
To Complete the Practicum Course on Soil and Water Conservation Engineering
(19G04132401)

On

Agricultural Engineering Study Program
Department of Agricultural Technology
Faculty of Agriculture
Hasanuddin University

Makassar
2023

Approved,

Assistant Coordinator	Assistant
RESKYANTO ARI	**ASRIANTO**
NIM. G041191015	**NIM. G041191075**

Know,
Course Coordinator

Dr. ABDUL AZIS S, S.TP., M.Si
NIP. 198212209201212100 4

FOREWORD

Praise the presence of God Almighty for His abundant mercy, for the completion of the Complete Report on Soil and Water Conservation Engineering Practicum This report is made as a form of fulfilling the assignment requirements for the Soil and Water Conservation Engineering practicum course, Agricultural Engineering study program, faculty of Agriculture, Hasanuddin University.

Furthermore, I would like to thank the assistant coordinator and to all the assistants who have provided guidance and direction during the practicum and also during the writing of this report. Hopefully this report is expected to be useful in the future, especially used as a reference as a practicum in Soil and Water Conservation Engineering so that practicum is expected to be carried out properly and optimally in the future.

.

Makassar, 3 June 2022

Alya Hayu Ing Pambudiar

TABLE OF CONTENTS

EROSION MEASUREMENT TECHNIQUES

SURFACE EROSION

TERRACING

SWAT METHOD EROSION PREDICTION

FIGURE LIST

LIST OF ATTACHMENTS

TYPES OF EROSION

Alya Hayu Ing Pambudiar[1)] and Asrianto[2)]
[1)] Practicum Practice of Soil and Water Conservation Engineering Study Program, Hasanuddin University
[2)] Assistant Practicum for Soil and Water Conservation Engineering Study Program, Hasanuddin University

ABSTRACT

Erosion in the form of soil erosion that occurs then leads the soil to settle into a sediment. Erosion is divided into several types, namely splash erosion, sheet erosion, grooves and landslides. These types of erosion occur in different soils with different characteristics. The purpose of the Type of Erosion practicum is to be able to find out what erosion is, the influencing factors, the types of erosion and the impact caused by erosion. The results obtained from the practicum Types of Erosion, namely Based on the practicum carried out in the field, it can be seen that the erosion obtained is included in the type of groove erosion. This is because the erosion forms a groove. The erosion that occurs erodes the soil in the region continuously to form grooves. Based on the practicum Types of Erosion that has been carried out, it can be concluded that there are several types of erosion, namely splash erosion, groove erosion, surface erosion, wide erosion, landslides and others. Factors that affect erosion are vegetation, rainfall, slope slope and also humans. The process of erosion is divided into three, namely erosion, transportation and deposition.

Keywords: Grooves, erosion, factors.

INTRODUCTION

Background

Land is one of the natural resources that has many roles in the survival of creatures. Soil has many types with different characteristics. One of the important roles of soil is in the agricultural sector, where soil is the main thing for planting. Naturally, the soil is eroded by a continuous flow of water and can also be eroded by the wind. Erosion that occurs can make the soil steeper and also produce sedimentation that can reduce the volume of the river. Soil erosion is referred to as erosion which is one of the phenomena that often occurs on a land.

Erosion has many impacts on the soil used. The soil will lose nutrients and also increase sedimentation in the watershed. Erosion has various types depending on the characteristics possessed. Types of erosion such as groove erosion, splash erosion, surface erosion, landslides and others. Erosion itself is influenced by several factors such as rainfall that occurs in an area, the amount of vegetation around the land, land cover, the slope of existing slopes and is also influenced by human activities. Vegetatively erosion can be reduced by planting other plants on a land to cover the land while mechanically it can be done by making terracing.

Based on the description above, a practicum on Types of Erosion is carried out in order to find out the meaning of erosion, the factors that affect erosion to occur, how to overcome erosion, the impact of erosion, types of erosion and also the characteristics possessed and the process of erosion.

Purpose and Uses

The purpose of conducting the Type of Erosion practicum is to find out what erosion is, the influencing factors, the types of erosion and the impact caused by erosion.

The use of the Type of Erosion practicum is to be able to identify the types of erosion that occur and be able to control erosion that occurs on a land, especially in agriculture.

LITERATURE REVIEW

Definition of Erosion

Erosion is the process of detaching soil grains from their parents in one place and the transport of the material by the movement of water or wind then followed by the deposition of material transported in another place. Soil erosion has very important ecological and economic consequences, including surface *erosion* causing depletion of *the top-soil* layer which has an impact on decreasing land productivity and increasing *sediment loads*. Under natural conditions, the rate of soil erosion is proportional to the rate of weathering and soil formation. However, if environmental conditions are disturbed, there is *an acceleration of* erosion which is very damaging and requires great effort and cost to control it (Amri, 2020).

Soil erosion is a major land degradation problem often found on dry land. Dry land is a stretch of land that is never inundated or waterlogged at most times of the year or all the time. Erosion describes weathering that occurs on the soil surface that is destructive. Although not always erosion that occurs can cause losses. Erosion is the uplift of soil or sediment layers due to pressure exerted by wind or water movement on the soil surface or water floor (Daromes *et al*., 2021).

Types of Erosion

Erosion based on the process of occurrence is distinguished into normal erosion and accelerated erosion. Normal erosion, also called natural erosion, is the process of erosion of the earth's skin that occurs naturally. This erosion is not dangerous because the rate of soil loss is smaller or equal to the process of soil formation. This is due to errors in tillage. Rill erosion is erosion due to soil erosion by water flows that form trenches or waterways, where in that part there has been a concentration of rainwater flow on the ground surface. The flow of water causes soil erosion, forming shallow grooves on the soil surface whose direction from above extends downward. Sheet *erosion* is erosion that occurs when a thin layer of soil surface in a sloped area is eroded by a combination of rain and *run-off flow*. This erosion will produce a flow pattern above the ground, but has not shown a hole (Janna &; Amalia, 2021).

Spark erosion is erosion caused by the presence of rainwater that gives certain energy when it falls, then releases soil particles, therefore splash erosion occurs at the beginning of rain. Splash erosion occurs at maximum approximately 2-3 minutes after rain falls because at that time the soil is wet, so it is easy to sprinkle. After 2-3 minutes the splashing will decrease following the thickness of the water layer. The release of soil particles from the soil mass due to splash erosion is highly dependent on the type of soil affected by the erosion process. The intensity of splash erosion increases in the presence of stagnant water, but after a puddle with a depth three times the size of rain grains, splash erosion becomes minimal. Splash erosion will stop when raindrops are no longer able to penetrate the thickness of the layer from the soil (Sarminah *et al*., 2022).

Erosion Factors

According to Sugiyanto (2016), erosion events are influenced by four factors, namely:

a.Climate. Climateeffects on erosion can be direct or indirect. Direct influence through the kinetic power of rainwater, especially the intensity of rainwater and the diameter of raindrops. In intensive rain and lasts for a shorter time, erosion that occurs is usually greater than rain with a smaller intensity over a long period of time.

b. Topography. The slope and the length of the slope are two factors that determine the topographic characteristics of a watershed. Both of these factors are important in the process of erosion because they affect the speed and volume of runoff water. The lower slope is more easily eroded than the upper slope because the flow momentum is greater and the runoff velocity is more concentrated when it reaches the lower slope. Volcanic tropics with undulating topography and high rainfall are very potential for erosion and landslides. Therefore, in soil and water conservation programs in the tropics, land surface smoothing efforts such as the creation of agricultural land terraces, the allocation of lands with large slope camps for protected areas are often carried out. These efforts were made primarily to avoid accelerated erosion and increased landslides.

c. Soil properties. One of the properties of the soil is soil texture, where the soil with the dominant element clay, the bond between particles is strong so that the soil is not easily eroded. Soil with a predominant element of sand. The possibility of erosion is low because the infiltration rate can reduce the runoff water rate.

d. Vegetation. The influence of vegetation on erosion is to protect the soil surface of aquatic plants, reduce the speed and volume of flow water, hold soil particles in place through the resulting litter root system and maintain the strength of soil capacity to absorb water.

The process of erosion

Natural erosion can occur due to the process of soil formation and erosion processes that occur to maintain the natural balance of the soil. The erosion process occurs with 3 processes, namely destruction, transportation and deposition. Rainwater hitting the soil surface with a certain energy will destroy soil aggregates, high rain intensity will have great energy in destroying soil aggregates. As a further result, water will flow across the ground surface and is referred to as ground surface runoff. Surface runoff has the energy to erode and transport soil particles that have been destroyed. Furthermore, if surface runoff power is no longer able to transport the destruction, then these materials will be deposited (Janna &; Amelia, 2021).

According to Nurmaliyani *et al*. (2018), the process of erosion goes through 3 stages, namely:

a. Detachment, occurs due to rainfall points that hit the ground surface. These rainfall points have different overrides or kinetic energy, some are hard and some are weak. Hard kinetic energy will break the lumps of soil into small grains of soil and some are fine.

b . *Transportation*, small and fine grains of soil will be lifted and flow with the flow of water down the slopes. The slope of this slope is very influential on the rapid flow of water.

c. Sedimentation, *soil grains transported by water flow to flat places where the speed of water flow is greatly reduced, the soil grains will become sedimentation.*

PRACTICUM METHODOLOGY

Time and Place

The Practicum on Types of Erosion will be held on Thursday, March 9, 2023, at 16.00 WITA until it is completed. Located in the area of the Agricultural Technology Student Association, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar.

Tools

The tool used in the Erosion Types practicum is a *mobile phone* camera.

Practicum Procedure

The practicum procedures for Types of Erosion are as follows:

1. Setting up the tool.
2. Look for soil that has undergone erosion.
3. Identify erosion that occurs.
4. Document soil that is experiencing erosion.

RESULTS AND DISCUSSION

Result

Figure 1. Soil Subject to Groove Erosion.

Discussion

Based on the practicum of Types of Erosion that has been carried out, it can be seen that erosion is an event of soil erosion that occurs due to water and will produce sedimentation. Erosion that occurs will cause the soil to be continuously eroded, thereby reducing existing nutrients. This is in accordance with the statement from Amri (2020), which states that erosion is the process of detaching soil grains from their parent in one place and transporting the material by water movement followed by deposition of the transported material in another place.

Based on the practicum conducted in the field, it can be seen that the erosion obtained is included in the type of furrow erosion. This is because the erosion event formed a furrow. Erosion that occurs erodes the soil in the area continuously to form furrows. This is in accordance with the statement from Janna & Amelia (2021), which states that furrow erosion is erosion that occurs due to the flow of water which causes soil erosion and then forms shallow furrows in the soil. Then forms shallow furrows on the surface of the land whose direction is from top to bottom.

CONCLUSION

Based on the practicum on the types of erosion that have been carried out, it can be concluded that erosion is the process of detachment of soil grains from their parent in one place and the material is transported by water or wind movement followed by deposition of the transported material in another place. There are several types of erosion, namely splash erosion, furrow erosion, surface erosion, wide erosion, landslides and others. Factors that affect erosion are vegetation, rainfall, slope and humans. The process of erosion is divided into three, namely erosion, transportation and deposition.

LITERATURE

Amri, M. A. (2020). Analisis Tingkat Bahaya pada Kemiringan Lereng yang Berbeda di Desa Giririejo, Imogiri, Yogyakarta. *Skripsi*. Universitas Pembangunan Nasional "Veteran": Yogyakarta.

Daromes, M. S. B., Mawara, J. M. & Sinolungan, M. T. M. (2021). Pengaruh Mulsa Batang Jagung dan *Strip* Rumput Terhadap Erosi Tanah pada Lahan Kering. *Jurnal Soil Enviromental*, 2(3), 12-17.

Janna, N. & Amelia, R. (2021). Laju Erosi Di Bagian Hilir Sungai Pappa Kecamatan Polombangkeng Selatan. *Skripsi*. Universitas Muhammadiyah Makassar: Makassar.

Nurmaliyani, N., Diawati, C. & Setyarini, M. (2018). Pembelajaran Berbasis Masalah Erosi Email Gigi untuk Meningkatkan Kemampuan Penalaran dan Keterampilan Proses Sains. *Jurnal Pendidikan dan Pembelajaran Kimia*, 7(2), 1-15.

Sarminah, S., Gultom, U. A. & Ramayana, S. (2022). Estimasi Erodibilitas Tanah dan Identifikasi Jenis Erosi di Wilayah Pasca Tambang Batubara. *Agrifor*: *Jurnal Ilmu Pertanian dan Kehutanan*, 21(1), 13-26.

Sugiyanto. (2016). Tingkat Erosi Tanah di Kecamatan Ampel Kabupaten Boyolali Propinsi Jawa Tengah. *Skripsi*. Universitas Muhammadiyah Surakarta : Surakarta.

APPENDIX

Appendix 1. Documentation of Erosion Types Practicum

Figure 2. Documentation of Erosion Types Practicum.

EROSION MEASUREMENT TECHNIQUES

Alya Hayu Ing Pambudiar[1)] and Asrianto[2)]
[1)] Praktikan Praktikum Teknik Konservasi Tanah dan Air Program Studi Teknik Pertanian Universitas Hasanuddin
[2)] Asisten Praktikum Teknik Konservasi Tanah dan Air Program Studi Teknik Pertanian Universitas Hasanuddin

INTRODUCTION

Background

Soil is one of the natural resources that has many roles in the survival of creatures. Soil has many types with different characteristics. One of the important roles of soil is in the agricultural sector, where soil is the main thing for planting. Soil functions as a provider of nutrients and also a place for plant roots to grow. Soil will continue to experience changes caused by many factors both naturally and due to humans. Soil erosion is one of the phenomena that often occurs on land.

Erosion is influenced by several factors such as rainfall that occurs around the land, slope, vegetation around the land and can also be influenced by humans. Erosion can be overcome by conserving soil and water both vegetatively and mechanically. Vegetative soil and water conservation can be done by utilizing plants or crop residues to cover the land so as to minimize erosion that occurs. Mechanical soil and water conservation can be done by making terraces. Terracing is a method used to minimize erosion rates by reducing the length of slopes, retaining water and others.

The erosion hazard level is an estimate of maximum soil loss which is then compared to the thickness of the soil solum. The erosion hazard level can be determined based on the amount of soil eroded. Erosion can be predicted by various methods such as universal soil loss equation method, modified universal soil loss equation model, soil water assessment tool and measuring plot model. These methods have their own advantages and disadvantages.

Based on the above description, it is necessary to know about erosion, types of erosion, ways to overcome erosion, the process of erosion, the impact of erosion, the level of erosion hazard, methods that can be used and the model of measuring plots.

LITERATURE REVIEW

Definition of Erosion

Erosion is the process of detaching soil grains from their parent in one place and transporting the material by water or wind movement followed by deposition of the transported material in another place. Soil erosion has very important ecological and economic consequences, including surface erosion causing depletion of the top-soil layer which has an impact on reducing land productivity and increasing sediment loads. Under natural conditions, the rate of soil erosion is proportional to the rate of weathering and soil formation. However, if environmental conditions are disturbed, accelerated erosion occurs which is very destructive and requires great effort and cost to control (Amri, 2020).

Natural factors that greatly influence erosion include high rainfall, length and slope, soil properties that are less resilient to the threat of rainwater blows, inadequate soil cover. This situation is very influential for soil erosion to occur. The magnitude or size of the erosion is very dependent on the geographical conditions where the natural event occurs. While the last factor is influenced by human behavior in watershed management. People's habits that often act without knowing the negative impacts, for example cutting down trees for firewood and for building construction, wrong agricultural management will cause damage to land conditions in the watershed area which is increasingly alarming so that it can cause soil erosion (Kias et al., 2016).

Erosion Process

The process of erosion occurs by three processes: destruction, transportation and deposition. Rainwater hitting the soil surface with a certain energy will destroy soil aggregates. High intensity rainfall will have great energy in destroying soil aggregates. As a further consequence, the water will flow on the ground surface and is referred to as surface runoff. Surface runoff has the energy to erode and also transport the soil particles that have been destroyed. Furthermore, if the energy of surface runoff is no longer able to transport the destroyed materials, these materials will be deposited (Janna & Amelia, 2021).

Reduced storage capacity in a channel section occurs due to sediment at the bottom of the reservoir. The sediment is formed from the sedimentation process, where particles are carried by the flow and settle because the weight of the sediment cannot be transported by water, this sediment is known as bed load. While other types of sediment will move because the weight can be accommodated by water. In general, the sediment comes from

rock fragments or land surfaces that enter the river flow in large quantities or called erosion. The eroded part of the soil will move to another place and will be carried away by the flow or settle into sediment. This condition will have an impact on silting the riverbed or water reservoir (Azmeri, 2020).

Erosion Countermeasures

Some of the problems encountered such as erosion and sedimentation, destruction of agricultural facilities and infrastructure and public facilities by flooding, land damage due to logging, pollution and eutrophication of water and the environment are the result of socio-economic disparities, improper management and planning of land resources. According to Hafiz and Anwar (2021), efforts to prevent erosion and erosion control on a land can be done in two ways, namely:

1. Vegetation methods, Vegetation has a countervailing influence on the influence of erosive factors such as rain, topography, and soil characteristics. The vegetation used is in the form of ground cover plants. Ground cover plants are plants that are specifically planted to protect the soil from the threat of damage by erosion and to improve soil conditions.
2. Structural Methods, one of the structural methods that can be used to prevent erosion is retaining walls. Retaining loose or natural soil and preventing the collapse of sloping land or slopes whose stability cannot be guaranteed by the land slope itself. The retaining wall serves to support and prevent it from the danger of landslides. Both due to rainwater loads, the weight of the soil itself and due to loads acting on it, vegetative and structural soil conservation techniques in principle have the same goal of controlling erosion rates.

Erosion Hazard Level

The level of erosion hazard is an estimate of the maximum soil loss compared to the thickness of the soil solum in each land unit if crop management and soil conservation techniques do not change. Basically, it must be smaller or equal to the amount of soil formed through the process of soil formation, to determine the amount of erosion hazard level that occurs in an area or field of land can be by calculating the erosion hazard index (Amri, 2020).

The erosion hazard level is a prediction of the magnitude of erosion hazard of a land. If crop management and soil conservation techniques do not change, then TBE can be determined based on the amount of soil eroded with an effective depth compared to the

amount of erosion allowed on each land. Potential erosion is equal to actual erosion when the C and P factor values are equal to 1 (one). This means that land evaluated without crops and without soil and water conservation measures is mathematically potential erosion (Banuwa, 2013).

Erosion Model

The Universal Soil Loss Equation (USLE) method is an erosion model designed to predict erosion over a long period of time from sheet or furrow erosion under certain conditions, Usle can be applied to agricultural and non-agricultural land. Usle allows planners to predict the average erosion rate of a particular land on a slope with a certain rainfall pattern for each type of soil and land management application. The calculation of erosion hazard is strongly influenced by rainfall factors, slope length, slope, soil and land cover. The main factors are rainfall and surface flow. With these factors, the amount of erosion can be determined using the USLE formula (Hafiz and Anwar, 2021).

The Modified Universal Soil Loss Equuation (MUSLE) model is an empirical model modified from the USLE Method by replacing the rainfall erosivity factor (R) with a flow factor or surface runoff. The MUSLE method already takes into account both erosion and sediment movement in watersheds based on a single rainfall event (Krisnayanti et al., 2018).

The RUSLE (Revised Universal Soil Loss Equation) model is a type of empirical model that predicts sheet and furrow erosion associated with surface runoff. Differential equations are used and applied to soil erosion on a slope resistant segment. The RUSLE model is an erosion model designed to predict average soil loss over a long period of time carried by runoff water from a given land slope (Banuwa, 2013).

The Agricultural Non-Point Source Pollution (AGNPS) model is one of the distributed models that can predict land erosion and watershed-scale erosion (river sediment). AGNPS can be used to predict land erosion and watershed-scale erosion. The AGNPS model is a combination of distributed model and sequential model. That is, the mass balance equation is solved simultaneously in all cells and water and pollutants are traced in a series of flows on the land surface and in the channel sequentially. The basic components of the AGNPS model are hydrology, land erosion, sediment and nutrient transport (Krisnayanti et al., 2018).

The Soil Water Assessment Tool (SWAT) model is a type of model used to predict the effect of land use on the flow of water, sediment and other chemicals into rivers or

water bodies in a watershed by considering variations in soil types, land use, and management conditions of a watershed after a long period. SWAT allows it to be applied in various analyses and simulations in a watershed. Input data information in each sub-watershed is then grouped or organized into categories: climate, hydrological response units (HRUs), water bodies, groundwater, and main rivers to drainage in the sub-watershed (Nugroho, 2015).

Erosion Measurement Plot Model

The erosion plot measurement method is the observation of erosion in the field using a plot system with a certain size, slope, slope length and soil type (known), the flow of water and sediment out of the plot is collected and observed. One example of measuring erosion plots is by installing four plots with a plot size of 22 x 2m. The barrier used has a height of 15 cm above the soil surface and the bottom of the barrier is buried into the soil. For erosion measurements on terraced land, one of the plots was selected where the drainage flow was in one place at the outlet. To anticipate a large enough surface flow discharge, more than one holding tank was installed (Amri, 2020).

CLOSING

Erosion is the process of detachment of soil grains from their parent in one place and transport of the material by water or wind movement followed by deposition of the transported material in another place. The erosion process occurs with three processes, namely destruction, transportation and deposition. Erosion control can be done in two ways, namely vegetatively and structurally. The level of erosion hazard is a prediction of the magnitude of the erosion hazard of a land. Erosion can be measured using several methods such as the measuring plot model, *universal soil loss equation*, *modified universal soil loss equation, agricultural non-point source pollution, soil water assesment tool*.

LITERATURE

Amri, M. A. (2020). Analisis Tingkat Bahaya pada Kemiringan Lereng yang Berbeda di Desa Girirejo, Imogiri, Yogyakarta. *Skripsi*. Universitas Pembangunan Nasional "Veteran": Yogyakarta.

Azmeri. (2020). *Erosi, Sedimentasi dan Pengelolaannya*. Syiah Kuala University Press. Aceh.

Banuwa, I. S. (2013). *Erosi*. PT Fajar Interpratama Mandiri. Jakarta.

Hafiz, I. & Anwar, K. (2021). Pengendalian Erosi Secara Vegetatif dengan Memanfaatkan Formasi Tanam Rumput Gajah pada Riparian Sungai. *Skripsi*. Universitas Muhammadiyah Makassar: Makassar.

Janna, N., & Amelia, R. (2021). Laju Erosi Di Bagian Hilir Sungai Pappa Kecamatan Polombangkeng Selatan. *Skripsi*. Universitas Muhammadiyah Makassar: Makassar.

Kias, M. F., Ramlan. & Zainuddin, R. (2016). Prediksi Erosi Tanah di DAS (Daerah Aliran Sungai) Paneki Kecamatan Biromaru Kabupaten Sigi. *Jurnal Agrotekbis*. 4(6), 667-674.

Krisnayanti, D. S., Udiana, I. M. & Muskanan, M. J. (2018). Pendugaan Erosi dan Sedimentasi Menggunakan Metode USLE dan MUSLE pada DAS Noel-Puames. *Jurnal Teknik Sipil*. 7(2), 143-154.

Nugroho, P. (2015). Model *Soil Water Assesment Tool* (SWAT) untuk Prediksi Laju Erosi dan Sedimentasi di Sub DAS Keduang Kabupaten Wonogiri. *Skripsi*. Universitas Muhammadiyah Surakarta: Surakarta.

SURFACE EROSION

Alya Hayu Ing Pambudiar[1)] dan Asrianto[2)]
[1)] Praktikan Praktikum Teknik Konservasi Tanah dan Air Program Studi Teknik Pertanian Universitas Hasanuddin
[2)] Asisten Praktikum Teknik Konservasi Tanah dan Air Program Studi Teknik Pertanian Universitas Hasanuddin

ABSTRACT

Erosion is a form of soil erosion that occurs and then causes the soil to settle into sediment. Erosion is divided into several types, namely splash erosion, sheet erosion, furrows and landslides. These types of erosion occur on different soils with different characteristics. The purpose of the surface erosion practicum is to be able to know what erosion is and the factors that influence it and to be able to know the types of erosion and the impacts caused. The results obtained from the Surface Erosion practicum are that the plot that has the highest erosion rate is plot five. Then for the plot that has the steepest slope is plot two and for the relationship between erosion and vegetation is directly proportional. Based on the surface erosion practicum that has been carried out, it can be seen that the relationship between rainfall and sediment load is directly proportional where if the rainfall that occurs is large, the collision that occurs is also stronger so that the erosion of the soil that occurs more and more so that the sediment load is also more. Vegetation affects the level of erosion rate that occurs compared to non-vegetation.
Keywords: Rain, Plot, Sedimentation.

INTRODUCTION

Background

Living things are very dependent on natural resources. One of the natural resources needed by living things, especially humans, is land and water. Land and water are resources that must continue to exist. Land is used in several sectors such as the agricultural sector to grow crops which will then be consumed. Water is used for drinking and others so that land and water supplies must continue to be available to meet needs.

One of the phenomena that occurs in soil is erosion. Erosion is one of the phenomena that has a negative impact on soil. Erosion is a form of soil erosion that occurs and then delivers the soil to settle into sediment. Erosion is divided into several types, namely splash erosion, sheet erosion, furrows and landslides. These types of erosion occur on different soils with different characteristics. Erosion is influenced by several factors such as rainfall that occurs in the area, slope that determines the size of the erosion rate that occurs, vegetation that minimizes erosion that occurs and also human factors. Erosion rates can be measured using several methods and one of them is the measuring plot method.

Based on the description above, Surface Erosion Practicum 1 was conducted to find out the method of measuring plots, factors that affect erosion, the correlation between these factors such as rainfall to erosion rates, vegetation to erosion rates and others. In addition, to find out the final result of erosion in the form of sedimentation.

Purpose and Usefulness of Practicum

The purpose of the Surface Erosion I practicum is to know and be able to identify the correlation between rainfall and sediment load and between rainfall intensity and sediment load.

The purpose of practicing Surface Erosion I is to be able to identify the amount of erosion that occurs in an area so that it can be applied to agricultural land.

LITERATURE REVIEW

Erosion

Erosion is the process of detaching soil grains from their parent in one place and transporting the material by water or wind movement followed by deposition of the transported material in another place. Soil erosion has very important ecological and economic consequences, including surface erosion causing depletion of the top-soil layer which has an impact on reducing land productivity and increasing sediment loads. Under natural conditions, the rate of soil erosion is proportional to the rate of weathering and soil formation. However, if environmental conditions are disturbed, accelerated erosion occurs which is very destructive and requires great effort and cost to control (Amri, 2020).

Erosion hazards that have reduced soil productivity are a major problem that the government has to deal with year after year. Erosion hazards affecting agricultural lands and people often occur on lands with slopes of about 15% and above. This danger is caused not only by the actions of humans who are concerned with satisfying their own needs, but also because of poor soil management and irrigation. Rainfall is also divided into several types, one of which is design rainfall. Design rainfall is obtained from processed maximum average daily rainfall data obtained. The design rainfall is carried out to obtain rainfall data for a certain return period which is used to find the design flood discharge (Hertanto et al., 2014). design flood discharge (Hertanto et al., 2018).

Plot Measurement Method

The erosion plot measurement method is the observation of erosion in the field using a plot system with a certain size, slope, slope length and soil type (known), the flow of water and sediment out of the plot is collected and observed. One example of measuring erosion plots is by installing four plots with a plot size of 22 x 2m. The barrier used has a height of 15 cm above the soil surface and the bottom of the barrier is buried into the soil. For erosion measurement on terraced land, one of the plots was selected with the drainage flow in one place at the outlet. At the lower end of the plot, a gutter was installed to drain water from the plot to a holding tank. To anticipate a large enough surface flow discharge, more than one holding tank was installed (Amri, 2020).

Factors Causing Erosion

Some factors that affect soil erosion are slope, rainfall intensity, soil type, vegetation, permeability velocity and also human factors. Rain falling on the ground has great kinetic energy and has the potential to destroy soil particles and will make soil conditions unstable. The amount of rainfall determines the strength of dispersion, transportability and damage to the soil. Density 70% where the greater the slope, the greater the erosion rate. Larger slopes cause soil particles to break loose easily. Slope slope produces an effect that is directly proportional to soil erosion (Pasaribu et al., 2018).

The occurrence of high rainfall with poorly bonded soil conditions, in addition to increasing surface flow, also increases the transport of soil particles. Surface runoff will have the ability to move or transport or also wash away soil particles that have been released from their aggregates. So in terms of transporting So in terms of the transportation of soil particles, the flow of the soil surface plays a role, namely on sloping lands. The more sloping the land, the faster the flow of water and the further the soil particles will be transported due to the flow of water and will form a groove (Asdar et al., 2021).

According to Ropiyanto (2021), some of the factors of erosion mentioned above are as follows:

1. Climate

In wet climates like Indonesia, the climatic factor that most influences erosion is rainfall. The amount, intensity and distribution of rainfall determine the strength of rain dispersion on the soil, the amount and strength of surface flow and the extent of erosion damage that occurs.

2. Topography

Topographic features that affect surface flow and erosion are slope and slope length. Other elements that may also have an effect are slope configuration, uniformity and direction.

3. Vegetation

Vegetation is a protective layer or buffer between the atmosphere and the soil. A vegetated ground cover will eliminate the influence of rainfall and topography on erosion. Vegetation influences the hydrological cycle through its effect on rainwater falling on the land surface. Therefore, vegetation affects the volume of water entering rivers and lakes, into the soil, and underground water reserves.

4. Soil

Different soil types have different erosion sensitivities. Soil erosion sensitivity is a function of various interactions of soil physical and chemical properties. Soil physical and chemical properties that affect erosion are soil properties that affect infiltration, permeability, and water holding capacity, and soil properties that affect the resistance of soil structure to dispersion and destruction of soil aggregates by impact rain and surface runoff.

5. Human

Many factors determine whether people will treat and care for and cultivate the land wisely so that it becomes better and provides high income for an indefinite period of time with better processing.

Rainfall

Rainfall is also known as the amount of water that falls on a land surface in a certain period which can then be measured in units of height in millimeters above the surface. Rainfall is one of the rain parameters that can be measured. Rainfall shows the amount of water in an area. Rainfall is expressed in millimeters or inches. One millimeter means that an area of one square meter on a flat place holds one millimeter of water or one liter of water. Data that is often used in analyzing rainfall includes the maximum, minimum and average values. Rainfall that can be used for the preparation of a water utilization design is called the average rainfall in an area (Dwirani, 2019).

Rainfall errosivity is included in the factors that influence the value of soil erosion. Rainfall is a characteristic feature of the influence of the type of erosion that occurs in a place. The higher the intensity of rain, the higher the impact force and the splash, the more soil particles are released and then thrown along with water splashes. Rainfall is also divided into several types, one of which is design rainfall. Design rainfall is obtained from processed maximum average daily rainfall data obtained. Design rainfall is carried out to obtain rainfall data for a certain return period which is used to find the design flood discharge (Pasaribu et al., 2018).

Rain Intensity

Rainfall intensity is the amount of rain that falls, expressed in terms of rainfall height or rain volume per unit time. The amount of rainfall intensity varies depending on the

duration of the rainfall, geographical location, frequency of occurrence and so on. The length and intensity of large or heavy rainfall will cause a constant reduction in infiltration capacity. This is due to the compaction of the soil surface due to the beating of rain grains, swelling and clay, blockage of pores with small particles carried in with rainwater, and entanglement of air bubbles in the pores (Andriyani et al., 2019).

Sedimentation

Sedimentation is referred to as the result obtained from erosion carried by the flow of water in the form of soil along with particles of other small parts and stuck in water in a place that settles in a certain period of time, this sediment will flow and be deposited in a certain place. The most sediments found in rivers are on the banks or riverbanks, which consist of various sediments such as soil particles and products of weathering of parent rocks that are influenced by the environment. The amount of soil grains released depends on several factors such as rainfall, ground cover vegetation, slope and soil texture. Sediment contained in the river will affect the flow rate of the river. Measurement of river flow discharge and sediment samples will be Measurement of river flow discharge and sediment samples will be carried out by dividing the depth of the river into several sections and different surface widths (Neno et al., 2017).

PRACTICUM METHODOLOGY

Time and Place

Surface Erosion Practicum 1 was held on Wednesday, March 29, 2023, at 15.00 WITA until completion at the Soil and Water Engineering Laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar.

Tools

The tools used in Surface Erosion Practicum 1 are erosion measurement plots, buckets, meters, ovens, petri dishes, measuring cups, scales, stationery, Microsoft Excel and cellphone cameras.

Material

The materials used in Surface Erosion Practicum 1 are water and sediment samples from surface runoff.

Practicum Procedure

The procedure for practicing Surface Erosion 1 is:

A. Making erosion plots

1. Prepare tools and materials.
2. Measure the slope of the land.
3. Making plots with predetermined sizes using boards.
4. Boards are planted 10 cm deep.
5. The boards are covered with tarpaulin and tied to bamboo.
6. Make a hole right below the plot for a bucket that will hold water and sediment from erosion.
7. Install the pipe on the plot and on the lid of the bucket that has been perforated.
8. Putting duct tape on the end of the pipe and the lid of the bucket.

B. Sediment measurement

1. Stirring until homogeneous or water and sediment are mixed.
2. Measuring the volume of water collected.
3. Taking a sample of 10 ml.
4. Weighing the petri dish.
5. Putting the sample into a petri dish.
6. Putting the petri dish into the oven to dry the sediment.
7. Weighing the petri dish again after drying.
8. Performed documentation.Rumus yang Digunakan

1. Surface area

$$LTrapezoid = \frac{1}{2} x (a + b) x t$$

$$Lrectangle = p x l$$

$$Ltotal = LTrapezoid + Lrectangle$$

Information:
a and b = two parallel sides
p = Long
l = wide
t = high

1. Sediment weight

$$B = BC_2 - BC_1$$

Information:
B = sediment weight (kg),
BC_1 = cup weight before drying (kg),
BC_1 = cup weight after drying.

2. Massa tanah

$$W_s = B \times \frac{V_{ap}}{V_{sampel}}$$

Keterangan:
W_s = massa tanah (kg),
B = berat sedimen (kg),
V_{ap} = volume of water collected (m^3),
V_{sample} = volume of drained water (m^3).

3. Sediment charge concentration

$$C_s = \frac{W_s}{V_{ap}}$$

Information:
C_s = sediment charge concentration (kg/m^3),
W_s = soil mass (kg),
V_{ap} = volume of water collected (m^3).

1. The amount of soil eroded

$$E = \frac{C_s \times V_{ap} \times 10^{-3}}{A}$$

Informations:

E = the amount of eroded soil (ton/ha),
C_s = sediment charge concentration (kg/m^3),
V_{ap} = volume of water collected (m^3),
A = area of erosion (ha).

6. Slope

$$\alpha = \frac{\text{front}}{\text{side}} \times 100\%$$

7. Rainfall

$$H = \frac{V}{L} \times 10$$

H = Measurable rainfall (mm),
V = volume of collected water (mm),
L = funnel area (cm).

RESULTS AND DISCUSSION

Result

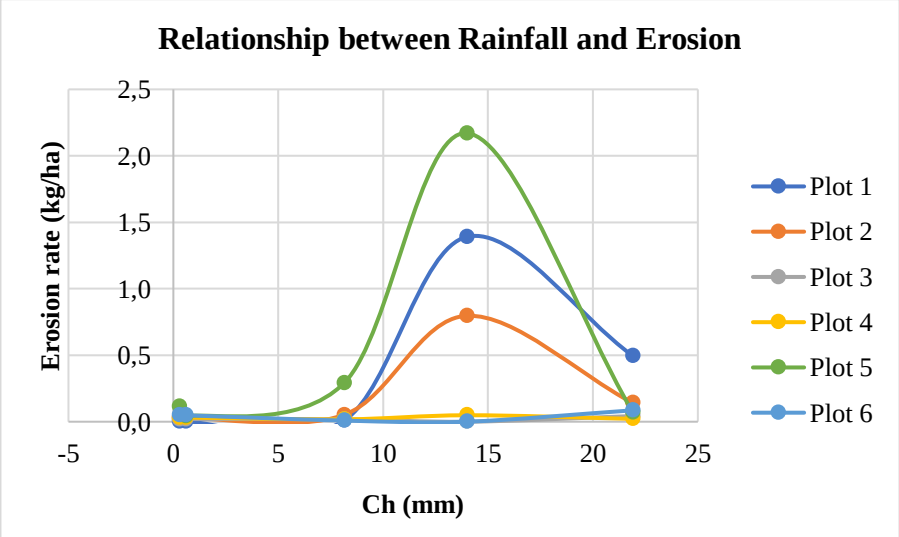

Figure 3. Graph of the Relationship between Rainfall and Erosion.

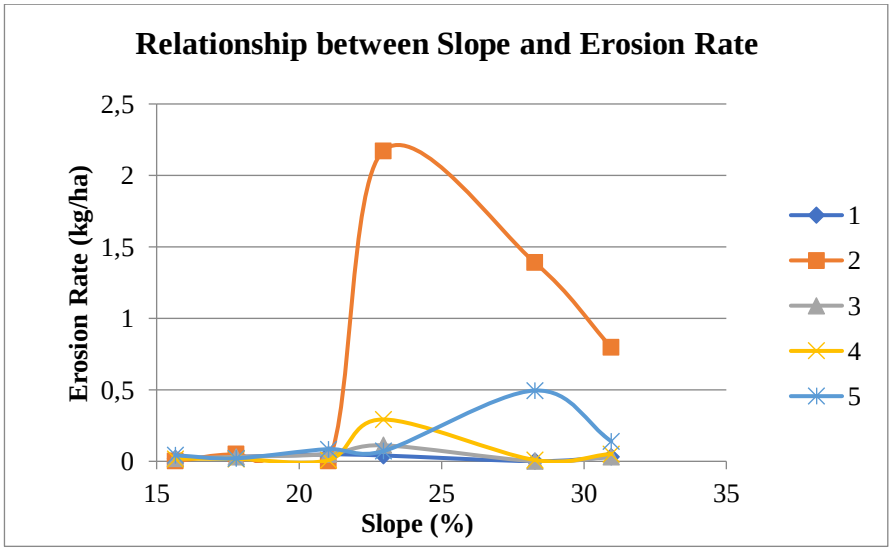

Figure 4. Graph of the Relationship between Slope and Erosion Rate.

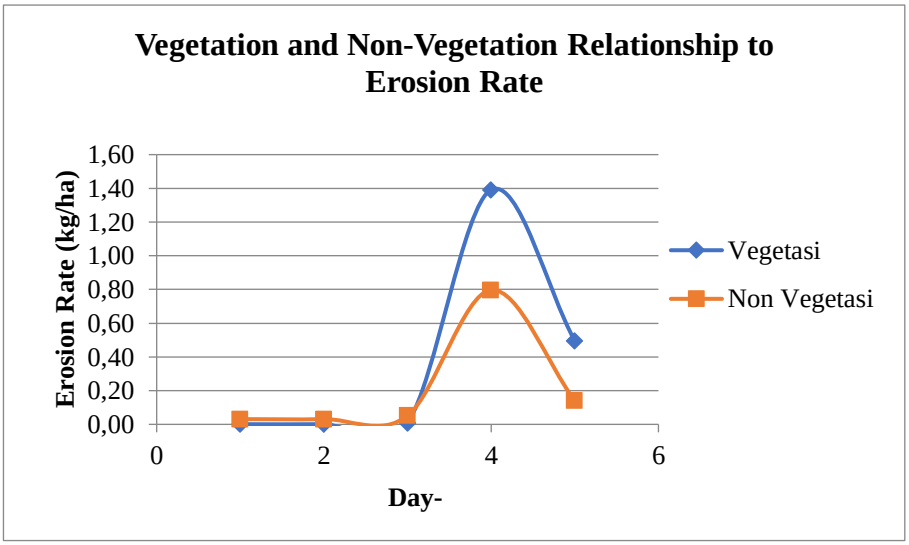

Figure 5. Graph of the Relationship of Vegetation and *Non-Vegetation to the Rate of Erosion.*

Discussion

Based on the first graph, namely the relationship between rainfall and erosion, it can be seen that plot 5 experienced the highest erosion rate point while for plot 6 the erosion rate that occurred only experienced a slight increase. This shows that the rainfall that occurs in plot 5 is greater than other plots. The rainfall data taken that occurred in plot 5 was very large compared to the rainfall that occurred in other plots. This is an erosion factor because it has a directly proportional relationship. If the rainfall that occurs is higher, the rate of erosion that occurs is also higher because more rainwater makes collisions on the soil or called erosion. This is because more and more water droplets touch the surface of the ground. The more water droplets that fall to the surface, of course, with more kinetic energy occurring on the ground surface which further increases the potential for destruction of soil aggregates. This is in accordance with the statement of Pasaribu *et al*. (2018), which states that the higher the rainfall that occurs, the higher the impact and splash force, the more soil particles are released and then thrown with water splashes or called erosion.

Based on the graph of the relationship between slope slope and erosion, plot 2 has the highest erosion rate because it has a steep slope compared to other plots. At a slope of 20-25%, plot 2 experienced an increase in erosion rate which was also influenced by rainfall. In addition, there is a decrease in the rate of erosion due to the decreasing soil density due to erosion that occurs, making the plot steeper. This is in accordance with the statement of Pasaribu *et al*. (2018), which states that the soil density of an erosion land where the greater the slope slope, the greater the rate of erosion produced. The greater slope slope causes soil particles to come off easily.

Based on the third graph, namely the graph of the relationship between vegetation and non-vegetation to *the rate of erosion, it can be seen that vegetation affects the rate of erosion that occurs compared to* non-vegetation. There was an increase in the rate of erosion on the fourth day due to high rainfall. The rate of erosion in plots that have higher vegetation is also influenced by the slope and also the type of soil that exists, so that plots that have higher vegetation have a higher erosion rate experienced than *non-vegetation*. This is in accordance with the statement of Pasaribu *et al*. (2018), which states that several factors that affect erosion in the soil are slope slope, rainfall intensity, soil type, vegetation, permeability speed and also human factors.

CONCLUSION

Based on the practicum of Surface Erosion I that has been carried out, it can be concluded that erosion is a erosion of soil on a land that can be caused by water and rain. The relationship between rainfall and sediment load is directly proportional where if the rainfall that occurs is large, the collision that occurs is also stronger so that soil erosion occurs more and more so that the sediment load is also increasing. The relationship between the intensity of rain to the sediment load is directly proportional where if the intensity of rain increases, the sediment load that occurs is also higher.

REFERENCES

Amri, M. A. (2020). Analisis Tingkat Bahaya pada Kemiringan Lereng yang Berbeda di Desa Girirejo, Imogiri, Yogyakarta. *Skripsi*. Universitas Pembangunan Nasional "Veteran": Yogyakarta.

Andriyani, I., Wahyuningsih, S., & Karim, M. D. (2019). Prediksi Laju Sedimentasi dan Erosi di Sub DAS Kemuning Menggunakan *Rainfall* Simulator. *AgriTECH*, 39(3), 179.

Asdar, A., Sangadji, M. F., & Abdullah, A. (2021). Laju Aliran Permukaan dan Erosi Terhadap Penggunaan Lahan Di Desa Batuboy Kabupaten Buru. Agritrop : *Jurnal Ilmu-Ilmu Pertanian (Journal of Agricultural Science)*, 19(1), 59–66.

Dwirani, F. (2019). Menentukan Stasiun Hujan dan Curah Hujan dengan Metode *Polygon Thiessen* Daerah Kabupaten Lebak. *Jurnal Lingkungan dan Sumberdaya Alam (JURNALIS)*, 2(2), 139-146.

Hertanto, H. B., Tawangmangu, K., Ngargoyoso, K., & Belakang, L. (2018). Bagian Hulu Kabupaten Karanganyar. 180–209.

Neno, A. K., Harijanto, H., & Wahid, A. (2017). Hubungan Debit Air dan Tinggi Muka Air di Sungai Lambagu Kecamatan Tawaeli Kota Palu. *Jurnal Warta Rimba*, 4(2), 1-8.

Pasaribu, P. H. P., Rauf, A., & Slamet, B. (2018). Kajian Tingkat Bahaya Erosi Pada Berbagai Tipe Penggunaan Lahan di Kecamatan Merdeka Kabupaten Karo. *Jurnal Serambi Engineering*, 3(1).

Ropiyanto, A. (2021). Pengaruh Guludan dan Pupuk Organonitrofos Terhadap Aliran Permukaan dan Erosi pada Pertanaman Singkong (*Manihot Esculenta Crantz*) Musim Tanam Keenam. *Skripsi*. Universitas *Lampung*: Lampung

TERASERING

Alya Hayu Ing Pambudiar[1)] and Asrianto[2)]
[1)] Practicum Practitioner of Soil and Water Conservation Engineering Agricultural Engineering Study Program Hasanuddin University
[2)] Practicum Assistant for Soil and Water Conservation Engineering, Agricultural Engineering Study Program, Hasanuddin University

ABSTRACT

Soil conservation has many types of management, one of which is terracing. Terraces are soil and water conservation structures that are mechanically made to minimize the slope or reduce the length of the slope by digging and burying soil across the slope. The purpose of the practicum is to find out how to make terraces and identify the correlation between making terraces in reducing the potential for erosion. The method used was to create a terrace design using *solidworks software*. The results obtained were that credit terrace is a type of terrace with mounds and ditches made parallel to the contour. Credit terraces are best used on land with a slope of 3-10% with a crumbly soil structure and high permeability so that surface flow does not pass through the mounds. Based on the Terraces practicum, it can be concluded that terraces are mechanical soil conservation structures made to shorten the length of the slope and or minimize the slope.

Keywords: Conservation, Credit, Terraces.

INTRODUCTION

Background

Soil is one of the natural resources that has many roles for human life. Soil requires management that must be considered. Conservation is one of the activities to prevent soil damage. Erosion has a very wide impact on environmental damage, both at the scene and the area receiving the results of erosion. Soil and water conservation are two things that are interrelated. Various soil conservation measures are automatically water conservation measures.

Soil conservation has many types of management, one of which is terracing. Terraces are soil and water conservation structures that are mechanically made to minimize the slope or reduce the length of the slope by digging and burying soil across the slope. Terraces are a pattern of farming with a terraced system to prevent soil erosion.

Terraces are divided into several types depending on the size of the land slope used. One type of terraces that is often used is credit terraces. Credit terraces are a type of terrace with mounds of soil or stones parallel to the contour. This terrace combines mounds and waterways into one. Credit terraces are made by creating terrace reinforcement plant paths. Credit terraces can overcome the high cost of building other terraces such as bench terraces.

Based on the description above, the Terracing practicum was conducted to determine the correlation between terracing in reducing the potential for erosion on land, knowing the types of terraces and their characteristics, how to make terraces and also the determining characteristics of terraces.

Purpose and Usefulness of Practicum

The purpose of the Terracing practicum is to find out how to make terraces and identify the correlation between terracing in reducing the potential for erosion.

The use of Terracing practicum is to be able to choose the right type of terracing in an area and be able to make terraces in accordance with the terms and conditions so as to reduce erosion.

LITERATURE REVIEW

Soil Conservation

Soil Conservation is an effort to protect, restore, improve, and maintain soil functions on land in accordance with the ability and designation of land to support sustainable development and sustainable life. The utilization of sloping drylands for food production requires the application of appropriate soil and water conservation technologies to increase land productivity in a sustainable manner and maintain environmental sustainability. Soil conservation through an agroecosystem approach can increase farm profits, improve food security, and increase land productivity in a sustainable manner. Another effort that can be made is to simultaneously apply three principles of soil and water conservation, namely minimum tillage, the use of permanent ground cover in the form of crop residues and or cover *crops*, and crop rotation (Lanka, 2019).

The agronomic or biological method utilizes vegetation to help reduce soil erosion. Mechanical or physical methods are conservation that concentrate on preparing land for dense vegetation and manipulating micro topography to control water and wind flow. While chemical methods are aimed at improving soil structure so that it is more resistant to soil erosion. So in short it can be said that agronomic methods are to protect the soil, mechanical to control the energy of erosive surface flows, and chemical methods to increase soil resistance (Mawardi, 2011).

Terrace*s*

Terracing is a concept used to place plants in a terraced system. The most suitable land for terracing is land that is sloping. This kind of land is usually found in hilly areas. The sloping shape of the land will make it easier for us to make the concept of arrangement, because it only needs to adjust the degree of slope, but this does not mean that flat land cannot be used to make terraces. There are many advantages to using this concept. There are various mechanical ways to resist water and wind erosion. The main ways are to mulch the soil by arranging a mixture of leaves and tree branches on the ground; and to form a barrier to water flow, for example by forming terraces on hills and contoured farms. Terracing is done to reduce the length of the slope and hold or minimize surface flow so that water can seep into the soil. Types of terraces include flat terraces, credit terraces, guludan terraces and bench terraces (Mawardi, 2011).

According to Mawardi & Setiawan (2022), states that broadly speaking terracing is a slope condition that is made up of steps that can be used in high embankments or excavations and serves to:

1. Increase slope stability.
2. Facilitates maintenance (slope conservation).
3. Extend the water catchment area.
4. Shorten the length of the slope and or reduce the slope.
5. Reduce surface flow velocity.

Credit Terrace

Credit terraces are one of the terrace-type mechanical techniques in soil and water conservation measures, in the form of mounds or mounds of soil and ditches or drains at the top of the mounds. The mounds and channels are made parallel to the contours,

without changing the slope of the original land surface between the mounds or ditches. Credit terrace is a terrace with earth or stone mounds parallel to the contour. Terraces combine mounds and drains into one. The requirements that must be met in making credit terraces are a slope of between 3 to 10% with a soil depth of more than 30 cm, the soil must have a high water absorption capacity and there are no channels that are prone to landslides. Credit terraces require a lot of labor and must be made in areas where heavy rains do not occur frequently (Lanka, 2019).

Credit terraces are created by cutting the slope of the field. The mounds are densely planted with hedgerows and or rows of ground cover grass. The purpose of credit terraces is to capture surface flow water from the cultivated area and reduce erosion. Credit terraces will form on their own after 3 - 7 years. The formation of the credit terrace is determined by the tillage method. If the tillage is done in such a way that the soil lumps are pulled to the bottom of the slope, the formation of the credit terrace becomes faster. This terrace is best used on land with a slope between 3-10%, with a crumbly soil structure and high permeability so that surface flow does not pass through the mound. The rather shallow depth of the soil solum (< 40 cm) does not hinder the use of this terrace. This type of terrace is not suitable for landslide-sensitive soils (Mujihah, 2021).

Terracing is one of the cheapest ways to minimize landslides on slopes. By terracing, it will extend the slope and minimize the slope (decrease the slope angle), by trimming or excavating the slope, it will reduce the volume of soil on the slope. The terracing will reduce the mass or weight of the slope and thus minimize the potential for slipping of the landslide plane of the slope, the safety of the slope will increase. This terracing technology can reduce the mass of soil that has the potential for soil slipping (Mawardi & Setiawan, 2022).

Slopes

A slope is a land surface that slopes and forms a certain angle to a horizontal plane and is not protected. There are two types of slopes: natural slopes and man-made slopes. Slopes are further divided into slopes of infinite length and slopes of finite length. Slope stability analysis is based on the general concept of limit equilibrium, to calculate the factor of safety (FK) that counteracts the collapse force on the stability of the slope. The factor of safety is the ratio between the maximum maximum shear strength and the shear strength required for stability, i.e. the strength at the state of equilibrium. Soil conditions on the earth's surface have different heights from one point to another. The materials that make up the soil have a bond that is not so strong, so that the force of gravity can make the soil crack so that landslides occur. Prevention can be done by making terraces (Wardana, 2011).

The effectiveness of plants in soil conservation is influenced by plant height, continuity of leaves as a canopy, plant density, and root system. The role of several types of conservation measures at each stage in the erosion process is divided into no control function, release, modern control, removal and strong control (Mawardi, 2011).

Reeds

Guludan is a pile of soil made lengthwise according to the direction of the contour line or cutting the slope. The height of the soil pile is about 25-30 cm with a base width of about 30-40 cm. The distance between the mounds depends on the steepness of the slope, the sensitivity of soil erosion and the erodicity of rain. The steeper the slope the shorter the mound spacing, the more erosion sensitive the soil the shorter the mound spacing, and the higher the rainfall erosivity the shorter the mound

spacing. On soils with low erosion sensitivity, mounds can be applied on slopes up to 8% and can be reinforced by planting grass or shrubs. On slopes steeper than 8% or soils that are more erosion sensitive, mounds may not be able to reduce erosion to the extent that erosion rates can still be tolerated, in which case another method can be used, namely grooved mounds (Mujihah, 2021).

PRACTICUM METHODOLOGY

Time and Place

Terracing Practicum was held on Wednesday, April 05, 2023 at 15.00 WITA until completion, located at the Soil and Water Engineering Laboratory and Court, Agricultural Engineering Study Program, Faculty of Agriculture, Hasanuddin University, Makassar.

Tools

The tools used in the Terracing practicum are *waterpass*, meter, stick, stationery, laptop and *mobile* camera.

Material

The material used in the Terracing practicum is soil.

Research Procedure

The Terracing practicum procedure is as follows:

1. Prepare tools and materials.
2. Install the stick on the land that will be used as a measurement benchmark.
3. Determine the straightness of the stick using a *waterpass.*
4. Measure the vertical distance and length of the field using a meter.
5. Record the measurement results.
6. Create a terrace design in 2D using solidworks *software in* accordance with the measurements obtained.

Formula Used

The formula used in the Terracing practicum is:

1. Sports Field

$$HI = \frac{IV}{S} 100\%$$

Where:
HI = Horizontal interval (m)
IV = Vertical distance (m)
S = Slope slope (%)

2. Number of Reeds

$$n = \frac{p}{HI}$$

Where:
n = Number of mounds
p = Land length (m)
Hi = Length of the olah field (m)

3. Number of Terraces

$$\text{Number of terraces} = \frac{\text{Lebar lahan}}{HI}$$

Where:
HI = Processing field (m)

4. Storage Width

$$Lt = wt - wb$$

Where:
lt = Storage width
wt = Bench width (m)
wb = Processing field (m)

RESULTS AND DISCUSSION

Results

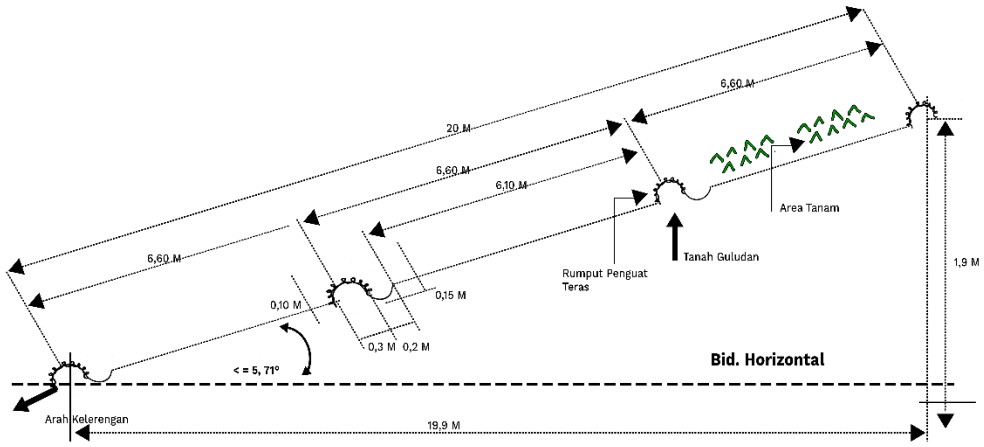

Figure 6. Credit Terrace.

Discussion

Based on the Terracing practicum, it can be seen that soil conservation can be done in one way, namely making terraces. Terracing is a concept used to place plants with a system that is made in stages. Terracing is done with the aim of increasing slope stability, making it easier to maintain, extending the water catchment area, shortening the length of the slope and minimizing the slope. This is in accordance with the statement of Mawardi (2011), which states that terracing is done to reduce the length of the slope and hold or minimize surface flow so that water can seep into the soil.

Based on the results obtained, the credit terrace. Credit terrace is a type of terrace with mounds and ditches made parallel to the contour. Credit terraces are best used on land with a slope of 3-10% with a crumbly soil structure and high permeability so that surface flow does not pass through the mounds. The soil depth of credit terraces is less than 40 cm. Credit terraces are not suitable for landslide-sensitive soils. One land that can be planted using credit terraces is peanut vegetated land. This is in accordance with the statement of Mujihah (2021), which states that credit terraces are best used on land with a slope between 3-10%.

CONCLUSIONS

Based on the Terraces practicum, it can be concluded that terraces are mechanical soil and water conservation structures made to shorten the length of the slope and or reduce the slope. The method of making terraces is by digging the upper slope and hoarding the lower slope, as a result the original soil horizon structure can be completely lost and there is a difference in layers between the upper middle and lower slopes. The purpose of terracing is to reduce the slope of land, thereby reducing the speed of surface flow and holding and accommodating it so that more water seeps into the soil through the infiltration process.

LITERATURE

Lanka, N. 2019. Income Analysis of Rice Farming with Terraced System in Pencong Village, Biringbulu District, Gowa Regency. *Thesis.* University of Muhammadiyah Makassar: Makassar.

Mawardi. 2011. The Role of Credit Terraces as Erosion Rate Control in Peanut Vegetated Land. *Technical Journal*. 6(3), 105-113.

Mawardi, & Setiawan, A. D. 2022. Slope Stability Analysis of Artificial Terraces with Elemental Phenite Method. *Technosia Journal*. 16(1), 39-50.

Mujihah, A. M. 2021. Innovative Mechanical Soil and Water Conservation Methods for Erosion Control in Minraleng Sub Das. *Thesis*. Hasanuddin University: Makassar.

Wardana, I. G. N. 2011. Effect of Changes in Groundwater Level and Terraces on Changes in Slope Stability. *Scientific Journal of Civil Engineering*. 15(1).

SWAT METHOD EROSION PREDICTION

Alya Hayu Ing Pambudiar[1)] and Asrianto[2)]
[1)] Practicum Practice of Soil and Water Conservation Engineering Study Program, Hasanuddin University
[2)] Soil and Water Conservation Engineering Practicum Assistant for Agricultural Engineering Study Program, Hasanuddin University

ABSTRACT

Erosion prediction can be done using hydrological models such as *the Soil and Water Assessment Tool* (SWAT). The goal is to be able to find out how to predict the erosion of a watershed using SWAT. The method used is to use *ArcGIS*, *Excel* and *Access* software to process erosion data. The result obtained is that discharge is one of the factors that affect the process of erosion, where discharge in high erosion can cause soil to become destructive, loss of soil fertility, sedimentation and other negative impacts on the environment. In conclusion, erosion is an event of movement or transportation of soil material from a place, namely the upper slope by natural media, in this case water. There are several methods of predicting erosion, one of which is using the SWAT method. SWAT erosion prediction methods can predict the effect of land management on water runoff, sediment and agricultural land in complex relationships to a watershed.

Keywords: watershed, sediment, climatology.

INTRODUCTION

Background

Rapid population growth and also unbalanced with land availability causes changes in land use. Changes in land use occur because new land is opened for agricultural, industrial, housing and road purposes. These changes can cause a reduction in the ability of the soil to absorb and also store water so that the amount of surface and the speed of erosion increases faster.

One of the phenomena that occurs in soil is erosion. Erosion is one of the phenomena that has a negative impact on the soil. The soil will lose nutrients and also increase sedimentation in the watershed. Erosion has various types depending on the characteristics possessed. Types of erosion such as groove erosion, splash erosion, surface erosion, landslides and others. Erosion itself is influenced by several factors such as rainfall that occurs in an area, the amount of vegetation around the land, land cover, the slope of existing slopes and is also influenced by human activities.

Erosion prediction can be done using hydrological models such as *the Soil and Water Assessment Tool* (SWAT). The *Soil Water Assessment Tool* (SWAT) model is a type of model used to predict the effect of land use on the flow of water, sediment and other chemicals that enter rivers or water bodies in a watershed by considering variations in soil type, land use, and management conditions of a watershed after a long period.

Based on the description above, the SWAT Model Erosion Prediction practicum was carried out to find out how to predict erosion in a watershed using the SWAT method and to understand the steps in predicting erosion in a watershed with the SWAT method using *software.*

Purpose and Uses

The purpose of conducting the SWAT Method Erosion Prediction practicum is to find out how to predict erosion in a watershed using the SWAT method.

The usefulness of the SWAT Method Erosion Prediction practicum is to understand the steps in predicting erosion in a watershed with the SWAT method using *software.*

LITERATURE REVIEW

Erosion

Erosion is the event of moving or transporting soil material from a place, namely the upper slope by natural media, in this case water, then deposited in the lower area as sedimentary material or deposits. Erosion is one of the causes of soil damage factors and causes a decrease in soil productivity. Erosion is the loss or erosion of soil from one place to another by media in the form of water or wind. Erosion leads to loss of fertile soil layer that is good for plant growth as well as reduced ability of soil to absorb and retain water. Erosion consists of two types, namely geological *erosion and* accelerated erosion. Geological erosion is the process by which formed soil and eroded soil are in a balanced state, and are well suited to support multiple plant growths. While accelerated erosion is erosion that occurs by human influence, namely the destruction of soil aggregates and accelerated the transfer of organic matter and mineral particles as a result of inappropriate tillage and loss of natural vegetation. Furthermore, it is said that erosion is a function of climate factors, namely rainfall, soil, topography, vegetation and humans (soil and water conservation measures) (Osok *et al*., 2018).

Land in a watershed (DAS) with high rainfall conditions, erosion-sensitive soil, topography in the form of long and steeper slopes, disturbed vegetation and the absence of soil and water conservation measures, will experience higher erosion compared to land that has lower rainfall, more resistant soil, flatter slopes, Vegetation is still good accompanied by soil and water conservation measures. Water and soil resources management and conservation comprehensively in an area, the right approach is through a watershed approach. One of the land resources, namely a watershed, tends to come under pressure along with rapid population growth. This will certainly affect the quality of a watershed (Osok *et al*., 2018).

Sedimentation

Sedimentation is a natural process in which solid particles or dissolved material settle and accumulate at the bottom of water or soil layers. This process occurs when the speed of water flow or wind decreases or when the particles lose their carrying capacity and fall to the bottom. Sedimentation is a natural process in which solid particles or dissolved material settle and accumulate at the bottom of water or soil layers. This process occurs when the speed of water flow or wind decreases or when the particles lose their carrying capacity and fall to the bottom. In addition, the sedimentation process also plays a role in precipitating materials dissolved in water, such as salt or other minerals. When water evaporates or the temperature changes, these dissolved materials precipitate and form a precipitate. Sedimentation can also affect aquatic ecosystems and the life in them. When sediments are carried into the waters, they can cause turbidity of the water and block sunlight from entering the bottom of the waters. This can have a negative impact on photosynthetic organisms. Sedimentation has a directly proportional relationship with discharge (Marhendi, 2018).

Sediments can be divided into two types, namely suspended *load* sediment and bed *load*. Drifting sediment is sediment consisting of fine grains that always float in rivers. Basic sediment is sediment in the form of grains and the movement of particles in the river water flow by rolling, sliding and jumping above the river surface (Julia, 2017).

Debit

Discharge is a term generally used to describe the amount or flow rate of a fluid, such as water, in a system. Discharge refers to the amount of fluid volume that passes through a point in a given period of time. Discharge can be measured in various units, such as liters per second, cubic meters per hour or gallons per minute. For example, in the context of rivers, discharge refers to the amount of water flowing through a river in a given time. River discharge can vary significantly depending on factors such as rainfall, surface *drainage* and watershed topography. Discharge can also refer to the flow rate of fluid within a plumbing system, irrigation canal, water supply system or other installation. An understanding of discharge is essential in planning and managing water resources, *drainage systems* and other water-related infrastructure (Nurmila *et al*., 2018).

Discharge (*discharge*) or the amount of river flow is the volume of flow flowing through a cross section per unit time and is expressed in units of m3 / second. While flow is the movement of water in the river channel. So discharge measurement is the process of measuring and calculating flow speed, depth and width as well as wet cross-sectional area for discharge calculation and water table height measurement. The calculation of water flow velocity can be done directly using the speed measurement method also using the formula (Tombokan *et al*., 2022).

Flow discharge is the amount of water flowing in units of volume per time. Discharge is a unit of water that comes out of a watershed (DAS). Flow discharge is the flow rate of water (in the form of water volume) that passes through a cross-section of the river per unit time ebit of the flow is influenced by the hydrological cycle, one of which is rain. The discharge in the dry season is large, the flow water will shrink drastically. While in the rainy season the flow discharge will be heavier and also influenced by the level of rain intensity that occurs. Low intensity flow discharge is small and at high rain intensity flow discharge will be even greater. The size of the flow discharge affects sedimentation in the upper reaches of the river (Fitriyani, 2022).

Erosion Model Measurement Methods

The erosion model method is a mathematical or physical approach used to model and predict the rate of soil erosion in a region. The purpose of using this method is to understand the erosion process, identify the factors that influence erosion and develop effective management strategies. Each method of erosion modeling has certain advantages and disadvantages depending on the specific goals and conditions of the region under study. It is important to choose the method that best suits the needs and availability of existing data. In addition, validation and calibration of models with field data is an important step in optimizing erosion model performance. Erosion prediction is very useful for determining how to prevent erosion or soil management systems in general, so that soil damage by erosion can be reduced as little as possible. Erosion prediction is a tool to determine the amount of erosion that will occur in a land use with certain management and to make decisions in soil conservation planning in a land area (Apriani *et al*., 2021).

One model that is quite developed is SWAT modeling. SWAT modeling can predict the effect of land management on water runoff, sediment and agricultural land in a complex relationship to a watershed including soil type, land use and periodic management of land conditions. SWAT uses the MUSLE formula for erosion and sedimentation analysis. The use of SWAT models can identify, assess, evaluate the level of problems of a watershed and as a tool to choose management actions in controlling these problems. So it is hoped that with the use of the SWAT model, several scenarios can be developed to determine the conditions for planning, management and control of the best watershed (Rahmad *et al*., 2017).

The Soil and Water Assessment Tool (SWAT) is a distributed model connected to a Geographic Information System (GIS). SWAT is a physics-based hydrological model for *continuous events* designed to predict the impact of land management on water, sediment and agricultural chemical resources on a large scale, namely complex watersheds with varying soil types, land uses and management conditions over long periods of time. The SWAT model initially divides the watershed into several sub-watersheds which then each sub-watershed will be divided back into several units of land. HRU (*Hydrologic Response Unit*) based on land use, soil type and slope class. Model input data for each HRU Sub Watershed is grouped into several categories, namely climate, hydrological response unit (HRU), inundation or wet area, underground water and main channels that drain the sub watershed. HRU is a group of land in a sub-watershed that has a unique combination of cover crops, soil and management. The data required in this model is daily data. Climate parameters used in SWAT are daily rain, maximum and minimum air temperature, solar radiation, wind speed and humidity. *SWAT output* is summarized in *files* consisting of *HRU, SUB and RCH* files.*The hru file* contains *output* of each HRU. While SUB contains *the output of each sub watershed and RCH is the output* of each main river in each sub watershed to be used (Sariyani, 2020).

PRACTICUM METHODOLOGY

Time and Place

The SWAT Motode Erosion Prediction Practicum will be held on Saturday, May 13, 2023, at 13.00 WITA until it is completed. Located in the Soil and Water Engineering Laboratory, Agricultural Engineering Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar.

Tool

The tool used in the SWAT Motode Erosion Prediction practicum is a laptop.

Material

The material used in the SWAT Motode Erosion Prediction practicum is climatological data.

Practicum Procedure

The SWAT Motode Erosion Prediction practicum procedure is as follows:

1. Open ArcGIS software.
2. Create a New SWAT Project.
3. Open automatic watershed deliniation.
4. Open the open file in the watershed delineation and load it from disk then press ok.
5. Open the properties on the watershed delineation and select the meter on the unit.
6. Select calculating flow diraction and accumilation and change the area to 500 Ha.
7. Select creat stream and outlets and specify an outlet on the map.

8. Choose whole watersheds outlets.
9. Choose delineate watersheds.
10. Select subbasin parameters.
11. Select Add reservoir.
12. Choose HRU analysis and choose land use and soil data.
13. Enter the grid data in the land use grid and select the value in the choose grid filed, then select ok.
14. Calcify the data by double-clicking on the land use classification table column and selecting crop, then selecting the land cover according to the data classification.
15. Choose edit SWAT input and choose Database.
16. Select user soil under user soil edit.
17. Enter soil type data using soil types 03, 05 and 06 by selecting add new and filling in based on soil characteristics table and SWAT code then select save edits.
18. Open soil data and enter grid data in soil grid then choose value in choose grid field and select ok.
19. Select UserSoil in the soil database options and populate the name table in the SWAT soil classification table to classify the data.
20. Select slope in land use/soils/slope definition and choose multiple slope.
21. Enter the number of slope cases 5 and fill the current slop 1 through 4 in succession 8, 15, 25 and 45, then reclassify and overlay.
22. Select HRU definition in HRU analysis.
23. Enter the data in the HRU definition and select create HRUs.
24. Open excel data wgen 5 station and enter data from excel into Microsoft access.
25. Open Microsoft Access and then paste the excel data wgen 5 station.
26. Reopening the ArcGIS software then enters rainfall data, temperature data, relative humidty data in the weather situation feature.
27. Enter SWAT data input tables in the write SWAT tables feature.
28. Change the day, date and year in the SWAT Simulation feature then select the daily and SWAT run features.
29. Displays the language of the program with run SWAT.
30. Take SWAT output data, sedimentation data and erosion data then enter the data in excel.
31. Create erosion and discharge simulation charts in excel.

RESULTS AND DISCUSSION

Result

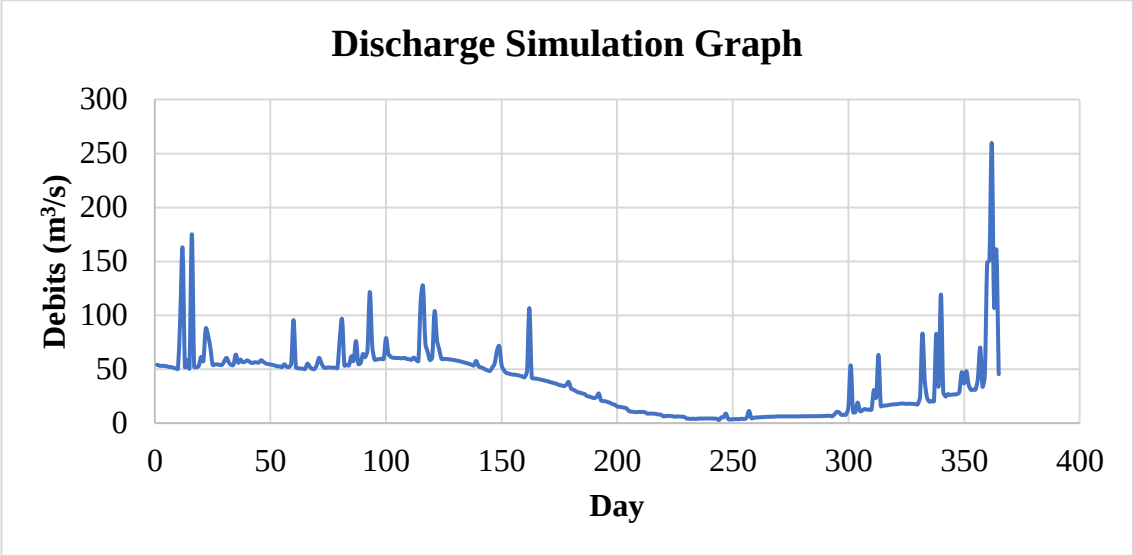

Figure 7. Discharge Simulation Graph Using SWAT Model in 2011.

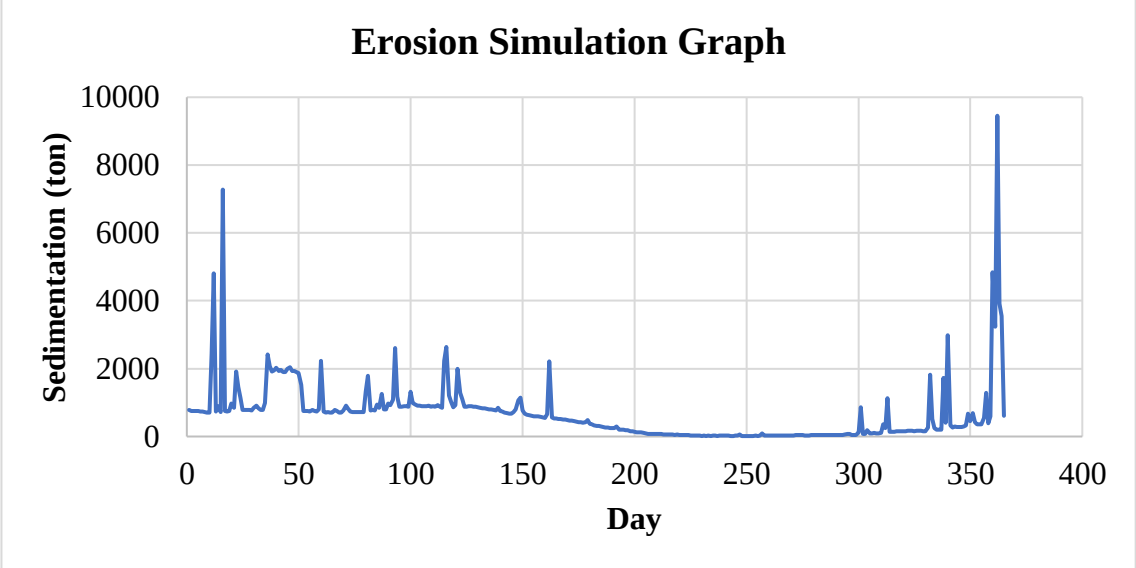

Figure 8. Erosion Simulation Graph Using SWAT Model in 2011.

Discussion

Based on the first graph, it can be seen that discharge is one of the factors that affect the process of erosion, where discharge in high erosion can cause soil to be destructive, loss of soil fertility, sedimentation and other negative impacts on the environment. Discharge management in erosion is very important in soil and water conservation, where erosion control includes planting strong vegetation, regulating appropriate land use, construction of protection structures such as terracing, dikes or other forms of protection that can reduce water flow and divert erosion energy in order to minimize the negative impact of erosion. On the graph, there are increases and decreases during the time used and the discharge increases on the last day of data collection. This is in accordance with a statement from Fitriyani (2022), which states that the size of the flow affects sedimentation in the upper reaches of the river.

Based on the second graph, it can be seen that sedimentation is one of the factors that affect the process of erosion. The graph in the picture above shows a simulation or process of sedimentation caused by erosion. Sedimentation is an event resulting from erosion, where soil or sand is carried by water, wind or gravitational forces which then experience deposition to the bottom surface. The shape of the sedimentation chart is almost the same as the discharge chart because the two are interconnected, where the greater the discharge, the more sedimentation produced. This is in accordance with Marhendi's statement (2018), that sedimentation has a directly proportional relationship with discharge.

CONCLUSION

Based on the SWAT Method Erosion Prediction practicum that has been carried out, it can be concluded that erosion is an event of movement or transportation of soil material from a place, namely the upper slope by natural media, in this case water, then deposited in the lower area as sediment material or deposits. There are several methods of predicting erosion, one of which is using the SWAT method. SWAT erosion prediction method can predict the effect of land management on water runoff, sediment and agricultural land in complex relationships in a watershed including soil type, land use and periodic management of land conditions.

REFERENCES

Apriani, N., Arsyad, U., &; Mappangaja, B. (2021). Erosion Prediction Based on *Universal Soil Loss Equation* (USLE) Method for Land Use Direction in Lawo River Basin. *Journal of Forests and Societies*, 49-63.

Fitriyani, N. P. V. (2022). Analysis of Water Discharge in Watersheds (DAS). *Journal of Engineering Sciences*, 2(2).

Julia, H. (2017). Significance of *Check* Dam Construction Scenario in Holding Sedimentation Rate in Sempor Reservoir. *Agrium*: *Journal of Agricultural Sciences*, 21(1), 78-88.

Marhendi, T. (2018). Prediction of Sedimentation Increase by Sediment Transport Method (Case Study of Sedimentation in Mrica Reservoir). *Techno (Journal of the Faculty of Engineering, University of Muhammadiyah Purwokerto*), 19(2), 87-94.

Nurmila, N., Munir, A., &; Suhardi, S. (2018). *Web-Based Computer Assisted Design* for Building Dimensions of Irrigation Canals. *Journal of Agritechno*, 155-162.

Osok, R. M., Talakua, S. M., &; Gaspersz, E. J. (2018). Analysis of Soil Erosion Factors and Erosion Hazard Level with the RUSLE Method in Wai Batu Merah Watershed, Ambon City, Maluku Province. *Journal of Agricultural Cultivation*, 14(2), 89-96.

Rahmad, R., Nurman, A., &; Wirda, M. A. (2017). Integration of SWAT and GIS Models in an Effort to Reduce the Erosion Rate of DAD Deli, North Sumatra. *Indonesian Geography Magazine*, 31(1), 46-55.

Sariyani, R. (2020). Prediction of Erosion and Sedimentation Rate Using SWAT (*Soil and Water Assessment Tool*) Method in Jenelata River Sub Basin. *Thesis*. Hasanuddin University.

Tombokan, F., &; Takaendengan, T. (2022). *Plagiarism Checker*: Identification and Measurement of Sario River Flow Discharge. *Journal of Applied Civil Engineering* (JTST), 3(3), 146-155.