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Biblometric Analysis of Landslide Slope Stability With Geotextile Reinforement Using Vosviewer

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Keywords

Landslides, slope stability, geotextile systems, prediction of landslide management

ABSTRACT

The aim of using the bibliometric method is to help improve understanding and mapping of research problems in the article on slope stability with geotextile reinforcement using VosViewer in landslide prevention, making it easier for the author to carry out research. In this research, the methodology used is research into various kinds of journal literature sources that exist today. Using biblometrics, this study investigates the relationship between geotextile reinforcement and landslide slope stability. 1000 studies with interrelated topics were created by collecting various studies from 2000 to 2023 using Crossref. Publish or Perish sources were used to run this research network, which was then processed in Vosviewer and saved in Research Information System (RIS) format. The results of the analysis show that slope angle is the most frequently used word and is associated with 63 studies. The results of research conclusion data on the topic of slope stability with geotextile reinforcement continue to increase, with the highest number in 2023 (110 studies).Keyword: Landslides, slope stability, geotextile systems, prediction of landslide management.

INTRODUCTION

A geological phenomenon involving the downward movement of slope material due to the influence of gravity and certain environmental factors. This can be triggered by high rainfall which causes an increase in air levels in the soil layer, thus potentially damaging land shifts, destroying infrastructure and posing a serious threat to human life. In Indonesia, a country located in a very active natural disaster zone, landslides are one of the most frequently occurring natural disasters (Zulfa, Widyasamratri, & Kautsary, 2022). Hilly land and high rainfall due to the tropical climate are some of the main factors that often trigger landslides in Indonesia. Not only that, the lack of awareness of the importance of reducing risks through mitigation measures has resulted in significant losses, both emotional and material, due to landslides. The problems associated with landslides are varied and often have serious consequences.

Landslide disasters in an area will have a negative impact on the natural and human environment, including damage to physical infrastructure, cessation of hydrological and ecosystem cycles, loss of life, and economic and social consequences. In densely populated mountainous areas, landslides triggered by rainfall can cause heavy casualties and material

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losses. These landslides will increase if the population living on or near the hillsides continues to increase. Because individual and property risks are two and three times greater than those experienced by OECD (Organization for Economic Co-operation and Development) member countries, respectively, disasters such as landslides would be a significant challenge if they occurred in developing countries (Boccard, 2021).

Slope stability analysis has a key role in reducing the risk of landslides and environmental protection. By understanding the factors that influence stability, plan and design effective slope reinforcement to prevent soil shifting. In the context of risk mitigation, slope stability analysis also helps in assessing the level of risk associated with landslides and enables timely planning of preventive measures and emergency reactions. By understanding the level of risk, efforts can be focused on areas that are most vulnerable or require immediate action. Apart from that, slope stability analysis is also needed in construction planning. Before building any infrastructure or structures on a slope, a stability analysis must be conducted to ensure that the structure will not threaten the stability of the slope (Juliantina, Sutejo, Dewi, Adhityia, & Rustam, 2018).

Bibliometric analysis plays an important role in revealing the complexity of research and science in the field of landslide slope strengthening planning. In order to address the risks and consequences associated with landslides, prevention and mitigation are essential. This includes an in-depth understanding of geology and geotechniques in landslide-prone areas, development of strengthening technologies, and effective emergency planning and management. One solution that has been proven to be effective in overcoming slope stability problems and reducing the risk of landslides is to strengthen the slopes using geotextiles. Geotextiles are synthetic materials that have been proven to have special mechanical and hydraulic properties (Tanasă, Nechifor, Ignat, & Teacă, 2022). These properties enable its use in a variety of civil engineering applications, including slope strengthening. This material functions as a binding element that compacts the soil layer, controls surface erosion, and increases the soil's bearing capacity. The use of geotextiles helps even out the distribution of pressure on the ground, thereby reducing the risk of landslides. Thus, geotextiles become a key element in efforts to increase slope stability. In our research, we will use bibliometric analysis to conduct quantitative research. Bibliometrics allows us to systematically analyze academic publications, citations and research trends, providing a comprehensive picture of the state of knowledge in slope stability planning.

In this article, the bibliometric method used is called VOSviewer. VOSviewer is bibliometric software that takes selected literature data as input and generates visual knowledge maps based on that data (Demiroz & Haase, 2020). The results of the biblometric method are used to understand the development of contributions in the field of science and identify future research directions. In the biblometric method you can use the Vosviewer software application to analyze scientific literature data, identify current research, and visualize citation data in graphs so that easy to understand. The aim of using the bibliometric method is to help improve understanding and mapping of research problems in the article on slope stability with geotextile reinforcement using VosViewer in landslide prevention, making it easier for the author to carry out research.

Literature Review

Landslide

Landslides are movements of soil structures and rock mixtures that move down lower areas around areas that are prone to landslides (Saputra, Ardhana, Adnyana, & Wayan, 2016). Indonesia has diverse geological and geographical conditions. Landslide events can also occur as a result of a combination of both internal and driving factors (Veder, 2012; Záruba et al.,

2002). Internal factors (geology and geomorphology) and driving factors (rainfall, groundwater and earthquakes) are the main causes of landslides (Terzaghi, 2013). Slope slope, sliding surface below the ground surface, presence of groundwater above the water-saturated layer, cumulative rainfall, rock geology, and land use factors are some of the causes of landslides (Susanti, Miardini, & Harjadi, 2017). These diverse conditions mean that hilly and sloping areas are often used as residences and even for other multi-storey buildings. Many soil and slope conditions are unstable, giving the potential for landslides to occur. Erosion along with ground movement which causes the rotation of soil and rock layers in an area is called a landslide disaster (Yassar et al., 2020). Therefore, there must be strengthening of the slope conditions as a way to overcome the landslide problems that arise (Rus, 2014).

If there is an imbalance on a slope, which causes a mechanical process to move part of the slope following the force of gravity, a landslide will occur. The slope will become balanced or stable again (Andri & Heru, 2016). While vulnerability and capacity are based on social, economic and environmental conditions, the risk of landslides itself is influenced by landslide susceptibility, which involves physical aspects of area conditions (Amri et al., 2016). There are two types of danger in this case: latent or active danger. Latent dangers come from natural conditions (geology, hydrometeorology and biology), while active dangers come from human actions (damaging the environment and technology).

A sloping ground surface that forms a certain angle to the horizontal plane is called a slope. Slopes can occur naturally or be formed by humans for a specific purpose. If the surface forms a slope then the components of the soil mass above the sliding surface tend to move downwards. due to gravity. If the gravity component that occurs is large enough, it can cause landslides on the slope. This condition can be prevented if the driving force does not exceed the resistance force originating from the shear strength of the soil along the landslide plane (Riogilang, Pontororing, & Mekel, 2014).

The next step that must be taken is to increase public awareness of the potential and danger of landslides in their area, as well as preparedness for potential landslides. This can start with observing environmental and climatic conditions, including observing the physical condition of the land and rainfall. Public awareness, especially increased vigilance during the high intensity rainy season, is very necessary. Apart from that, there is also a need to increase awareness to immediately close ground cracks in areas that are vulnerable to landslides (Raja, Hendarmawan, & Sunardi, 2017).

Slope Stability

If slope stress increases, including pore water pressure, the slope will become unstable, which in turn causes slope failure. The gravity component tends to move the soil downwards on non-horizontal ground surfaces. If the gravity component is so large that the resistance to shear that can be exerted by the soil in the landslide plane is exceeded, then slope failure will occur. For this reason, it is necessary to carry out a slope stability analysis. This is one of the components that must be considered on soil slopes to determine whether the slope condition is still in a safe condition, which means the slope is not prone to landslides, or whether the slope condition is less safe, which means the slope is prone to landslides if disturbed by internal or external forces. Research objectives this is to investigate how water seepage affects slope failure (Muntohar, 2006).

Stability analysis on a sloping ground surface is called slope stability analysis. Slope stability analysis is not easy, because there are many factors that greatly influence the calculation results. These factors include, for example, layered soil conditions, anisotropic soil conditions, water seepage in the soil and so on. The causes of slope landslides are divided into internal influences and external influences. External influences, namely influences that cause

an increase in shear force without any change in the shear strength of the soil (Hardiyatmo, 2016).

For example, human actions can cause cliff slopes to become sharper or deepen soil excavation and river erosion. Internal impacts are landslides that occur without an earthquake or change in external conditions. Natural slope failure can occur from the following things: 1). Added load on the slope: Additional load on the slope can come from new buildings, water entering the soil pores, and dynamic loads from vegetation blown by the wind. 2). Excavation or cutting of soil at the foot of the slope. 3). Excavation that sharpens the slope. 4). Rapid changes in the position of the water level. 5). Increase in lateral water pressure. 6). Earthquakes or excessive vibrations. 7). Decrease in shear resistance of slope-forming soil due to increased water content, increased pore pressure, seepage pressure due to standing water in the soil, soil on slopes containing clay. easy to expand, shrink and so on. Therefore, there is a need for landslide prevention planning (Pangemanan, Turangan, & Sompie, 2014).

To prevent subsequent landslides on slopes and to overcome slopes that have already collapsed, construction is needed that has the function of preventing landslides. In this case, the stability of the slope on the road body will be analyzed and the planning for strengthening the retaining walls used to increase slope stability. Processing contour data to produce slope slope information can be done manually or with the help of a computer. To support the analysis and planning of strengthening, soil parameters are required by direct soil investigation in the field by taking random samples according to height differences (Putra, Ardana, & Aryati, 2010).

One application of knowledge regarding the shear strength of soil/rock is for slope stability analysis. Shear failure in soil or rock occurs due to the relative motion between the grains. By using a slope reinforcement system, the collapsing force will be resisted by the shear and tensile capabilities of the reinforcement material (Latif, Rifa'i, & Suryolelono, 2016). Therefore, its strength depends on the forces acting between the grains. Thus it can be said that shear strength consists of:

*The part that is cohesive depends on the type of soil/rock and the grain bonds.

*The part that is frictional, which is proportional to the effective stress acting on the sliding plane (Hidayah & Gratia, 2007).

Geotextile system

Geotextiles are sheet materials made from polymeric textile materials. Geotextiles are formed from non-woven or woven materials that are water permeable and are used in contact with soil, rock or other materials in civil engineering applications (Hardiyatmo, 2016). Geotextiles are a type of geosynthetic or artificial product made from polymer materials which functions to improve soil performance. In the process of making geotextiles, textile elements such as fibers or multiple fiber strands are combined to create a sheet textile structure. The method used to combine filaments or ribbons into a sheet structure determines the classification of geotextiles. Woven and non-woven, as well as knitted, are the most common types of geotextiles in geotechnical material applications in civil engineering (Kenneth, 2015).

This geotextile has been widely used in various ways, both as a supporting structure and as the main structure. Several developed countries such as America, Australia and European countries already have geotextile factories which can be applied in various building structures. When designing civil construction using geotextiles, the function of the geotextile that will be applied must be determined first, after that select the appropriate type of material. The functions of geotextiles include: 1). Separator or separator 1separation), 2). Filtration, 3). Drainage, 4). Reinforcement, 5). Stabilization, 6). Protection, 7). Combination of these functions (Ndale, 2019).

In civil engineering, geotextiles are used for a variety of purposes, including

strengthening soil, stopping soil movement, and controlling water pressure. By using geotextiles, slope reinforcement construction becomes cheaper and technically more feasible than conventional construction methods (Kim, Hu, Lee, Kotwal, & Dickey, 2016). Geotextiles are a type of geosynthetic that is widely used in the field of civil engineering to solve geotechnical problems. Some examples of work in the field of civil engineering that are related to land are highway construction work, drainage work, earth embankment work, work on strengthening retaining walls. The problem often faced in this work is that the condition of the subgrade is soft with a load-bearing capacity. The low one.

Geotextiles that have the ability to withstand tension can provide reinforcement in the form of reinforcement. This material can be placed under embankments built on soft soil, can be used to build retaining walls, and can also be used to strengthen road pavement materials and the underlying soil (Hardiyatmo, 2008). Geotextiles must have high permeability to function as a filter. To avoid water pressure (lifting force), which can reduce the stability of the structure, geotextiles must pass water. If geotextiles are used as filters, water must be able to flow through them to the gravel or rock, pipes, or other drainage system. In general, the transverse permeability of geotextiles is sufficient for good soil drainage. One exception is when geotextiles are used beneath structures that control erosion (Ndale, 2019).

Development of landslide management prediction search.

The existence of a prediction, also known as a statement of an event that will come in the future, is necessary in designing a system or work that aims to solve a problem in the future. The prediction process involves assessing, reviewing, and quantifying the possibilities of what might happen in the future. The accuracy of a prediction can be assessed based on the probability it produces (Azam & Fardani, 2022).

When considering a condition that occurs in the field, it is important to use predictions. Of course, a strong prediction must be linked to the latest data. From this data, further processing and analysis will be carried out until it becomes a hypothesis that produces various possibilities. Predictions can be wrong if the results of the analysis are found to be inconsistent with real events that occur in the future or change due to something that greatly influences the possibility of future changes (Suriadi, 2012).

In civil engineering, everything related to forecasting must be taken into account. The calculations carried out must also contain realistic data so that the planning and construction process runs smoothly. With predictions based on theory, construction will certainly be successful and safe, thereby providing benefits for many people. Apart from Therefore, accurate predictions are also linked to the budget value used to avoid losses and wasteful economic costs. To manage a project, of course project management needs to be carried out. Project management means managing, organizing, and scheduling resources to achieve project goals. Every project must go through various stages to achieve its goals (Santoso & Proyek, 2009).

In connection with the research topic regarding the analysis of landslide slope stability in the next few years, predictions are very necessary to review and produce conclusions. In this prediction, of course you must have landslide data to be processed and researched. Landslide data as a rationale for drawing conclusions regarding the condition of slope stability in the coming year. This will be an aspect of consideration in the planning process for slope stability in the event of landslides.

METHODS

In this research, the methodology used is research into various kinds of journal literature sources that exist today. Journals which are of course based on the topic being researched regarding civil engineering. Bibliometric analysis used in this research is used to filter and group landslide research. This research stage uses Publish or Perish8 software with scientific work sources from the Google Scholar database. The types of publications used are journals, proceedings and theses. The keywords used are "landslide" and "slope" (Gaviria-Marin, Merigo, & Popa, 2018). Bibliometric analysis aims to provide an overview of the suitability of existing research, as well as research that is currently developing with a limited year range from 2000 to 2023.

The type of research carried out is a quantitative research method. This research consists of three stages: (1). collection of research data, (2). visualization of the bibliography obtained during the first stage, and (3). analysis of research results. The research results show that blibiometric analysis can be used to analyze scientific research on landslide research by making classifications based on the keywords used. The increase in the number of landslide events in recent years is closely related to the increase in information and the amount of landslide research in the fields of engineering and science. As part of developing research related to landslides, exposure of keywords and co-citations related to articles can help determine the development of topics that will be researched next (Muchlian & Honesti, 2023). Key words used include landslides, slope slope, slope stability, geotextile systems, and prediction.

To obtain research mapping results, this research used Vosviewer. This was chosen because Vosviewer is one of the most recommended mapping and visualization media applications for various types of research. The mapping results produced using Vosviewer can be visualized by describing the relationship between research topics, years of research conducted, and density between studies. In addition, this research requires the Publish or Perish application, which is used to collect data from various studies using selected keywords. previously. This application collects information such as research title, researcher name, year of research, and research source. Next, this data will be processed using Vosviewer, which makes the two applications very close and necessary.

RESULTS

Publish or Perish

From the results of network analysis of metadata retrieval in the Publish or Perish software application Version 8.9 via Crossref with a period of 2000-2023.

Tabel 1 Citation Metrics Results

Publication Years	2000-2023
Citation Years	23(2000-2023)
Papers	1000
Citations	3817
Cites/Year	165.96
Cites/Paper	3.82
Cites/Author	1709.43
Papers/Author	433.26
Authors/Paper	2.22
h-index	28
g-index	52

hI,norm	18
hI,annual	0,78
hA-index	9

Based on table 1 above, the results of the research. Pulling metadata with a time span of 2000 produced 1000 papers. With a total of 3817 citations, the results of pulling the data source produced two types of storage files. The RIS file type will be analyzed in the Vosviewer software application Version 1.6.19. Pada The CSV file type will be analyzed again using Ms. Excel and produce a chart on the development of the research year in the 2000-2023 time period.

Relevance of Research Keyword

In this bibliometric research, the database chosen is Crossref. because it is flexible in its outreach and easy to access. The search for studies using the Crossref database focuses on research discussion topics, namely by using the keywords landslides, slope stability, geotextile systems and predictions of their handling. reach. The data collected has been arranged in the Publish or Perish application with a total of 1000 studies related to the research topic of slope analysis on landslides. The visualization results of research keywords can be seen in Figure 1 below.

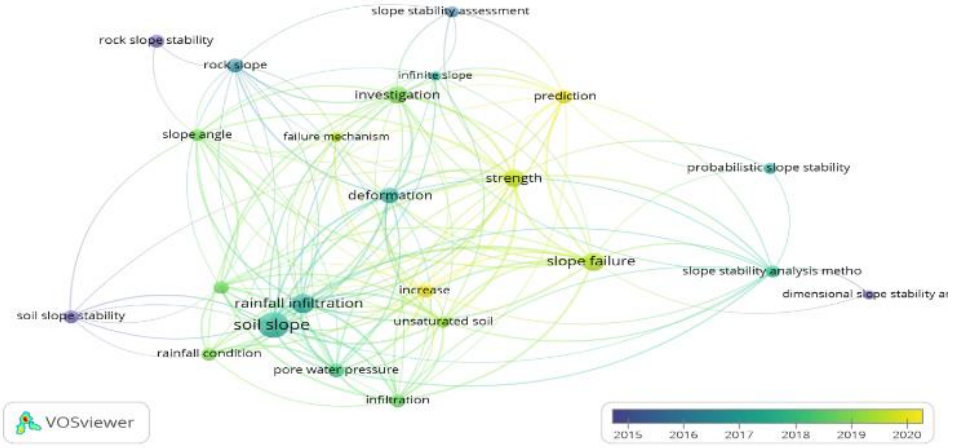

Figure 1 Research Keyword Network Linkages

From the visualization results in Figure 1 above, it shows that the keyword slope stability is the biggest keyword compared to other keywords. Followed by the keyword landslide data, and prediction, it is a keyword that has a large network with the others. In this research topic, we discuss stability analysis. slopes on landslides with geotextile reinforcement in the next few years

Research Publication Per Year

This research on analysis of slope stability in landslides with geotextile reinforcement takes the year range that has been set in the Publish or Perish application. The year period in the network of research journals from all over the world is taken from 2000 to 2023 with the aim of getting references and literature sources. Data from The results of the entire research journal network are calculated cumulatively to make it easy to display visualization results that can be understood. The results of this search using Publish or Perish data were processed using the Vosviewer application with the results in Figure 2.

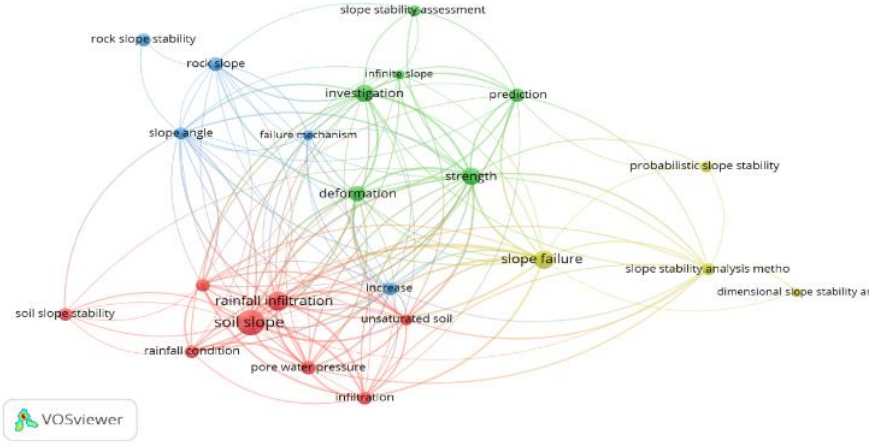

Figure 2 Overall average publications per year

In 1000 studies that have been carried out from 2000 to 2023. The cumulative data produced can be seen in the graphic image below. This research shows a decrease and increase in the last 23 years. The facts show that there was a decrease that was not too significant in the early years between From 2001 to 2007 there was an increase in the period of 8 years. A significant increase occurred in the last 9 years from 2015 to 2023 and up to 2023 the highest was 110 studies covered. With the ups and downs of this research graph it is not very significant, making the graph continue increases because the cumulative average tends to be stable and continues to increase. The increase in the cumulative number of publications on the topic of slope stability is certainly increasing from year to year, which can be seen from the data visualized in the graph below.

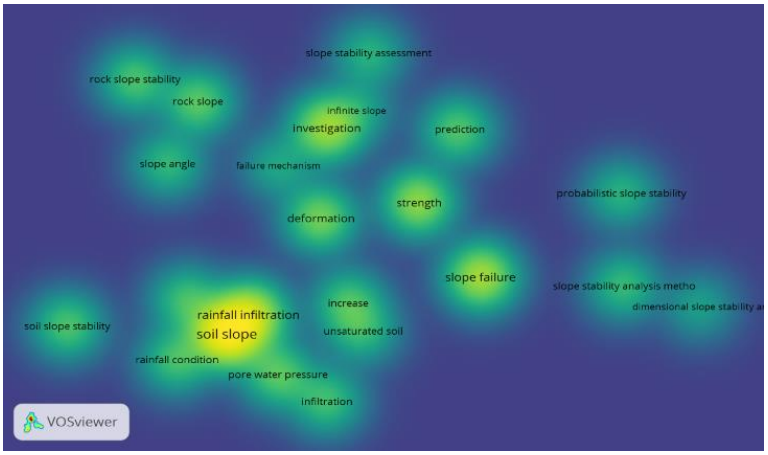

Figure 3 Cumulative research data from various years

Significant Keyword Research

From the results of the analysis produced using the Vosviewer application, there are significant research keywords. In research on the topic of slope stability in landslides in the next few years, the keywords are: landslide, slope stability, rainfall, stability, and prediction. These keywords are what collect the research. Related articles can be used as a literature source or reference by the author. The results of the research visualization network from the Vosviewer application by displaying the significance between research based on these keywords can be seen in (Figure 4) below.

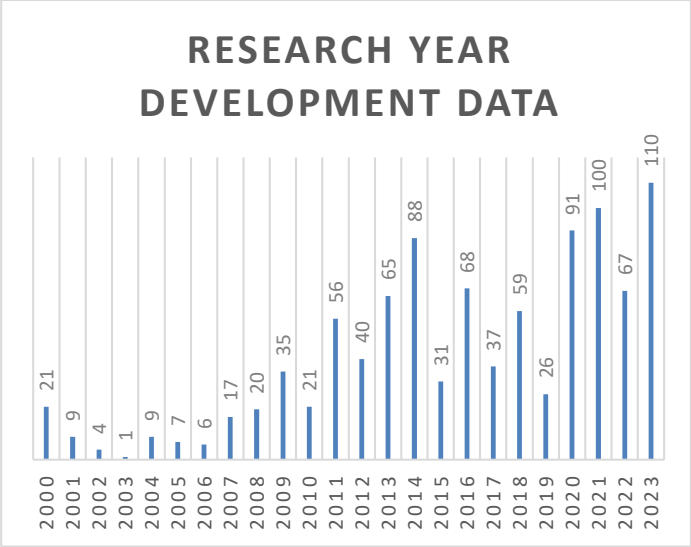

Figure 4 Significant keyword research.

Relevan And Occurrence

Based on the results of data analysis and processing using VosViewer software version 1.6.19 and Ms.Excel. These results are related to keywords collected with Vosviewer. This keyword returns the relevant Events and values found in figure 5 and figure 6 below. The results of the analysis show that slope angle is the most frequently used keyword and is associated with 63 studies

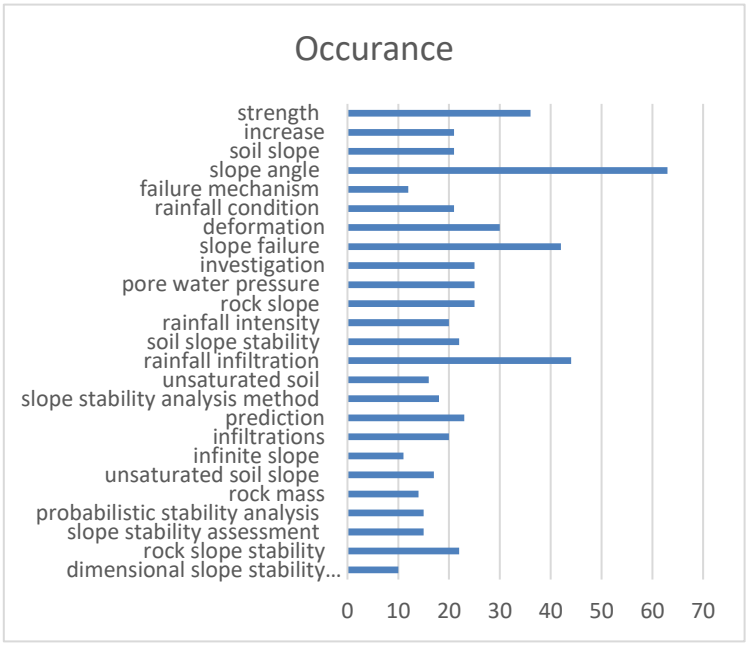

Figure 5 Occurance keyword

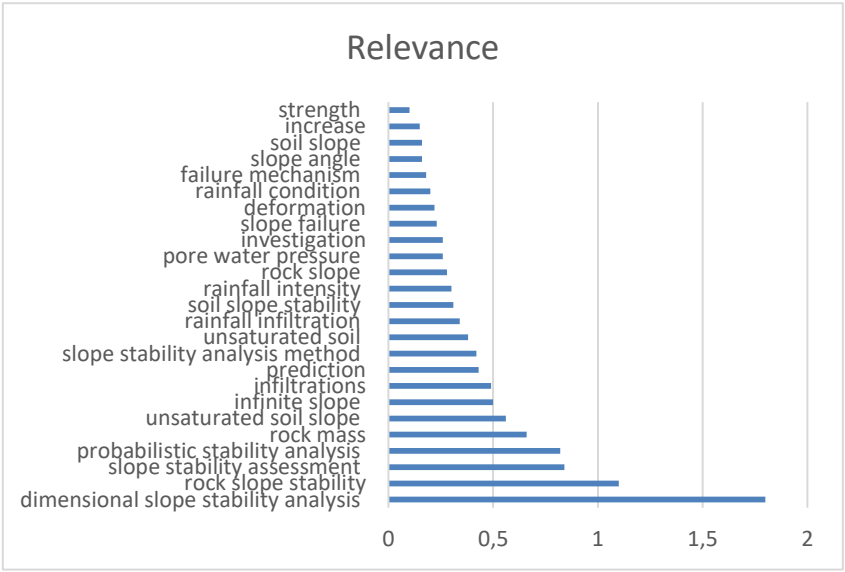

Figure 6 Relevance keyword

Country of Origin of the Research Case study

The diversity of research that was captured reflects research that occurs from anywhere. This diversity shows the distribution according to research topics from various parts of the world so that it can describe ongoing research developments. In the process of processing this data, country classification is used to determine specifically which type of research is most widely discussed. The following is a classification of research case studies based on country of origin which can be seen as follows (Table 2).

Tabel 2 Number of Studies From Various Countries

Research Topic	Amount
American	60
Belgia,England,Israel,Brunei Darussalam,Africa,Spanyol,Germany	1
Philipines,Hongkong,Singapore,Asia Selatan,California	2
Inggris,Korea,Australian,Norwegia	4
London,Mexico	5
Alaska	7
Italy,China	8
Canada	12
Japan	14
Belgia,England,Israel,Brunei Darussalam,Africa,Spanyol,Germany	15

This is explained by data from 60 studies in America. Apart from that, there are Belgium, England, Israel, Brunei Darussalam, Africa, Spain, Germany (1 study), the Philippines, Hong Kong, Singapore, South Asia; California (2 studies).);England, Korea, Australia, Norway (4 studies); London & Mexico (5 studies); Alaska (7 studies); Italy, China (8 studies); Canada (12 studies); Japan (14 studies); and Belgium, England, Israel, Brunei Darussalam, Africa, Spain, Germany (15 studies) which discuss the topic related. There are other countries that discuss similar topics but the numbers are not significant. This concludes that research developments from various countries in the world are experiencing an increasing trend and distribution will continue to grow over time.

Relevance of Research Keyword

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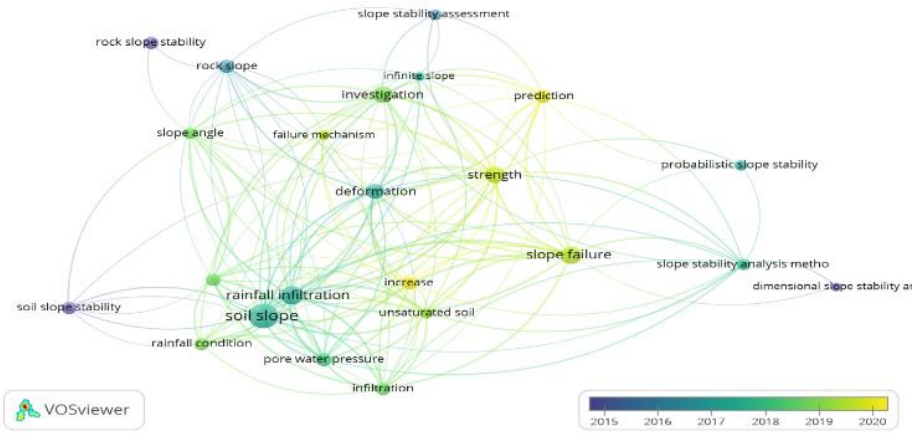

Figure 7 Research Keyword Network Linkages

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Research Publication Per Year

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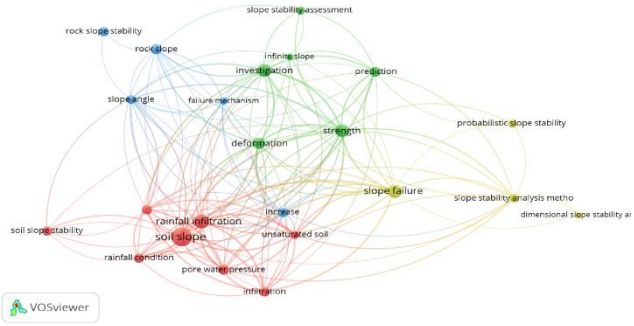

Figure 8 Overall average publications per year.

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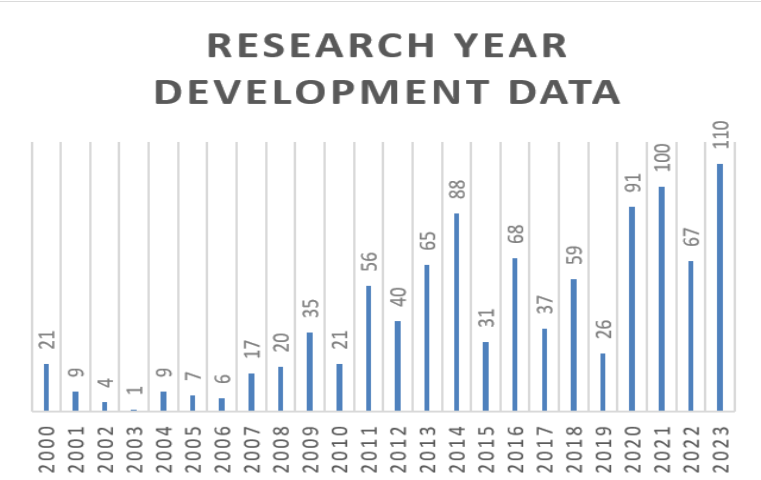

Figure 9 Cumulative research data from various years

Significant Keyword Research

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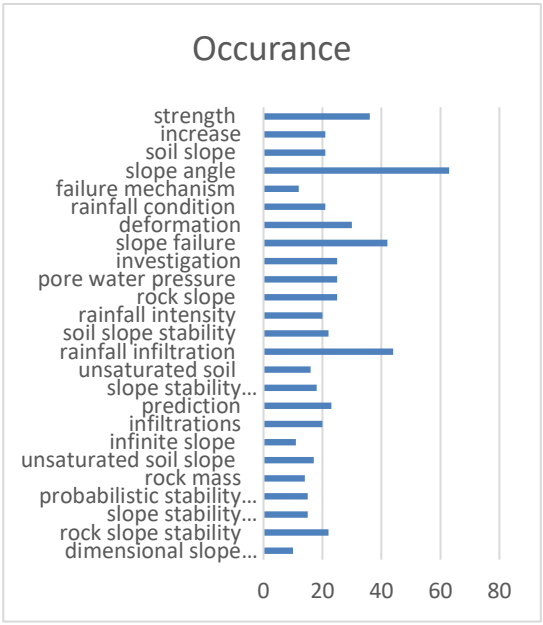

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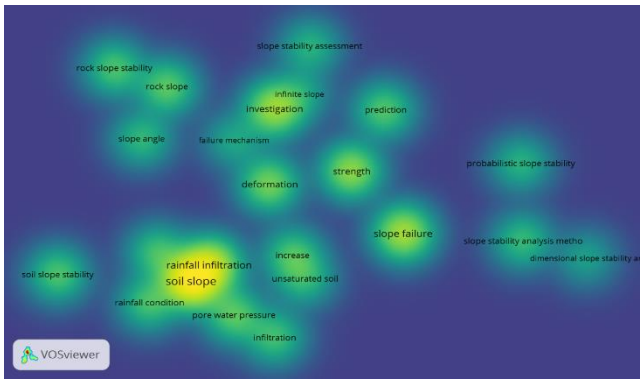

Figure 10 Occurance keyword

Relevan And Occurrence

Based on the results of data analysis and processing using VosViewer software version 1.6.19 and Ms.Excel. These results are related to keywords collected with Vosviewer. This keyword returns the relevant Events and values found in figure 5 and figure 6 below. The results of the analysis show that slope angle is the most frequently used keyword and is associated with 63 studies.

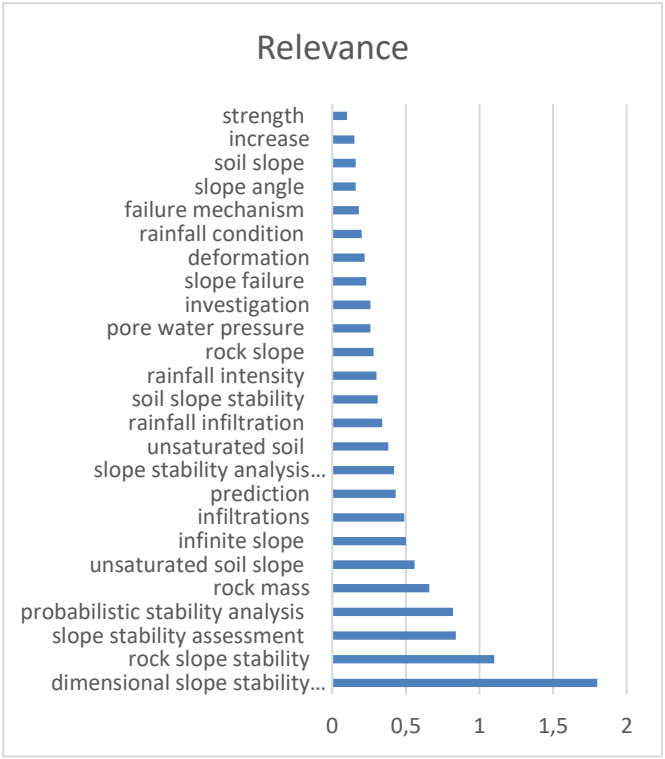

Figure 11 Relevance keyword

Country of Origin of the Research Case study

The diversity of research that was captured reflects research that occurs from anywhere. This diversity shows the distribution according to research topics from various parts of the world so that it can describe ongoing research developments. In the process of processing this data, country classification is used to determine specifically which type of research is most widely discussed. The following is a classification of research case studies based on country of origin

which can be seen as follows (Table 2).

Tabel 2 Number of Studies From Various Countries.

Research Topic	Amount
American	60
Belgia,England,Israel,Brunei Darussalam,Africa,Spanyol,Germany	1
Philipines,Hongkong,Singapore,Asia Selatan,California	2
Inggris,Korea,Australian,Norwegia	4
London,Mexico	5
Alaska	7
Italy,China	8
Canada	12
Japan	14
Belgia,England,Israel,Brunei Darussalam,Africa,Spanyol,Germany	15

This is explained by data from 60 studies in America. Apart from that, there are Belgium, England, Israel, Brunei Darussalam, Africa, Spain, Germany (1 study), the Philippines, Hong Kong, Singapore, South Asia; California (2 studies).);England, Korea, Australia, Norway (4 studies); London & Mexico (5 studies); Alaska (7 studies); Italy, China (8 studies); Canada (12 studies); Japan (14 studies); and Belgium, England, Israel, Brunei Darussalam, Africa, Spain, Germany (15 studies) which discuss the topic related. There are other countries that discuss similar topics but the numbers are not significant. This concludes that research developments from various countries in the world are experiencing an increasing trend and distribution will continue to grow over time.

CONCLUSION

The research uses biblometric analysis to evaluate the stability of landslide slopes with geotextile reinforcement. By using various keywords related to the subject, the analysis can be used to identify similar research trends. With the help of the Publish or Perish application which is used to review 1000s of studies formatted in the Information System Research (RIS) from 2000 to 2023. After going through the analysis process using Vosviewer, this research found that the keywords "Landslide Slope Stability" and "Geotextiles" were the most popular. In addition, the results of the development of the research years were obtained, with a total of 110 studies which will be conducted in 2023. There are 60 studies spread across the United States and followed by Belgium, England, Israel, Brunei Darussalam, Africa, Spain, Germany (1 study), the Philippines, Hong Kong, Singapore, South Asia; California (2 studies); UK, Korea, Australia, Norway (4 studies); London & Mexico (5 studies); Alaska (7 studies); Italy, China (8 studies); Canada (12 studies); Japan (14 studies); and Belgium, England, Israel, Brunei Darussalam, Africa. The main conclusions of the research will continue to change from year to year and the coverage of various countries in the world will continue to develop from time to time.

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