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Using the Soil Texture Triangle to Evaluate the Effect of Soil Texture on Water Flow: A Review

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Abstract: Water flow through soil is a critical process that affects many aspects of soil health and environmental sustainability. Soil texture, which is the relative proportion of sand, silt, and clay particles in soil, plays a significant role in regulating water flow through soils. The soil texture triangle is a widely used tool for classifying soil texture based on the proportions of sand, silt, and clay particles. This review paper aims to evaluate the effect of soil texture on water flow through soils using the soil texture triangle. The paper presents an overview of the soil texture triangle and its applications in soil texture classification, followed by a discussion of the relationship between soil texture and water flow. The paper reviews existing literature on the impact of soil texture on water flow and summarizes the key findings. The review highlights the importance of soil texture in regulating water flow through soils and discusses the implications for soil management and environmental sustainability. The paper concludes by identifying areas for future research to improve our understanding of the relationship between soil texture and water flow.
Keywords: Soil texture triangle, Water flow, Soil management, Environmental sustainability, Soil health, Soil properties.

I. INTRODUCTION

Water is a fundamental resource for life and plays a critical role in many aspects of soil health and environmental sustainability. The movement of water through soil is a complex process that is influenced by many factors, including soil texture. Soil texture refers to the relative proportions of sand, silt, and clay particles in soil and has a significant impact on the hydraulic conductivity of soils. The soil texture triangle is a widely used tool for classifying soil texture based on the proportions of sand, silt, and clay particles. This review paper aims to evaluate the effect of soil texture on water flow through soils using the soil texture triangle(Brouder, et al., 2014). The paper presents an overview of the soil texture triangle and its applications in soil texture classification, followed by a discussion of the relationship between soil texture and water flow. The paper reviews existing literature on the impact of soil texture on water flow and summarizes the key findings. The review highlights the importance of soil texture in regulating water flow through soils and discusses the implications for soil management and environmental sustainability. The paper concludes by identifying areas for future research to improve our understanding of the relationship between soil texture and water flow.

Soil texture is defined as the relative proportions of sand, silt, and clay particles in soil. Soil texture is a fundamental characteristic that influences soil properties, plant growth, and ecosystem functions(Bouma, 2016). The soil texture triangle is an essential tool for soil classification and is widely used in agriculture and environmental science. The soil texture triangle is a graphical representation of the relative proportions of sand, silt, and clay particles in soil. The triangle is divided into twelve textural classes, ranging from sandy loam to clay. The soil texture triangle is a valuable tool for soil scientists, agronomists, and environmental scientists to understand the physical properties of soil and to develop appropriate management strategies for sustainable agriculture and environmental management.

A. *Soil Texture and Its Relationship with Soil Properties*

Soil texture has a significant impact on soil properties, including water holding capacity, nutrient retention, and soil structure. Sandy soils have a low water holding capacity and low nutrient retention, while clay soils have a high water holding capacity and high nutrient retention. Soil structure is also influenced by soil texture, with sandy soils having a loose structure and clay soils having a dense structure. The soil texture triangle provides a standardized method for soil classification based on soil texture, which is essential for soil scientists to understand soil properties and to develop appropriate management strategies(Dexter, et al., 2004).

B. Soil Texture and Its Relationship with Environmental Sustainability

Soil texture also plays a critical role in environmental sustainability. Soil erosion, nutrient leaching, and water pollution are major environmental issues that are influenced by soil texture. Sandy soils are more prone to erosion and nutrient leaching, while clay soils are more prone to water logging and runoff. The soil texture triangle can be used to develop appropriate management strategies for soil conservation and environmental sustainability (Farahani,et al., 2015).

C. Soil Texture triangle

The soil texture triangle is a tool used by soil scientists to classify the texture of a soil sample based on the proportions of sand, silt, and clay present in the soil. The triangle is a graphical representation of the different combinations of sand, silt, and clay that result in different soil textures.

The texture triangle is divided into twelve textural classes, ranging from sandy loam to clay. These classes are determined by the percentage of sand, silt, and clay in the soil sample. For example, a soil sample with 40% sand, 40% silt, and 20% clay would be classified as a loam texture (Dexter, et al., 2004).

The soil texture triangle is a valuable tool for understanding soil properties and behavior, particularly in relation to water movement, nutrient availability, and soil structure. Soils with high sand content tend to have good drainage but low water-holding capacity, while soils with high clay content tend to have poor drainage but high water-holding capacity(Farahani,et al., 2015).

The soil texture triangle was first developed by the United States Department of Agriculture (USDA) in the early 1900s and has since become a standard tool in soil science. It is widely used in agriculture, engineering, and environmental science to guide soil management practices and to assess the suitability of soils for different uses.

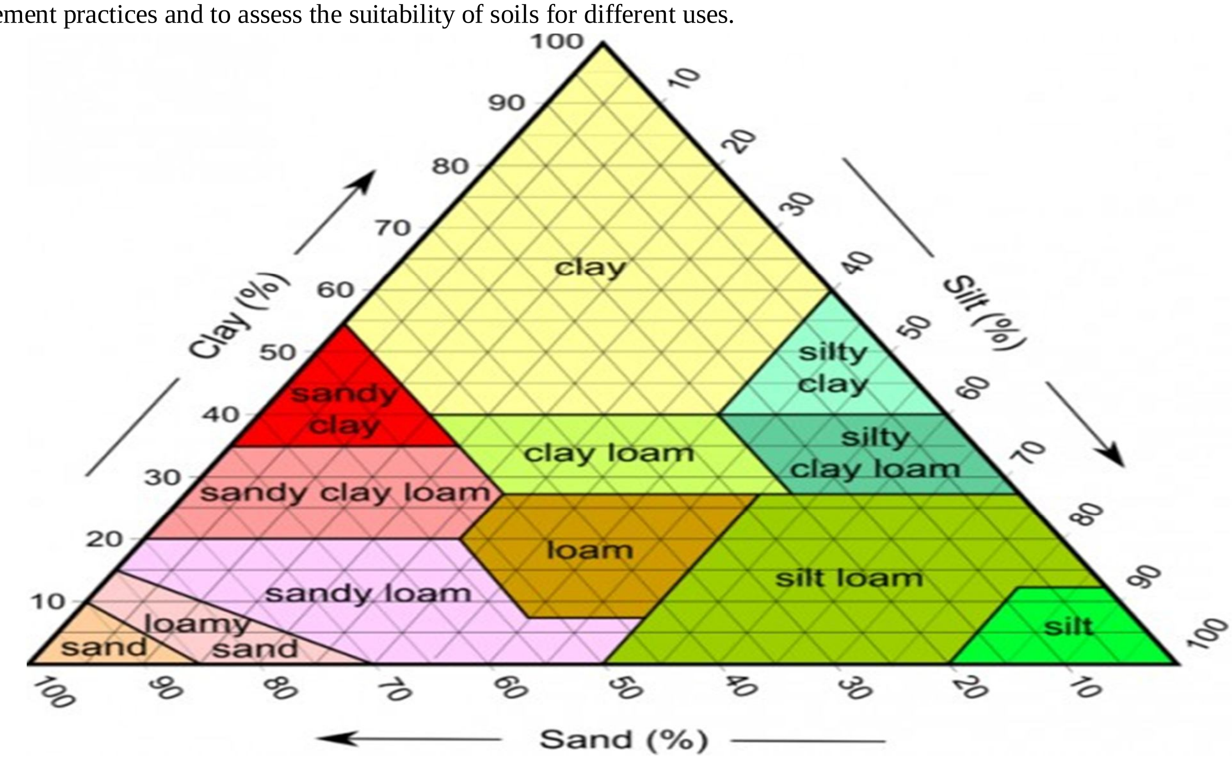

Figure 1: Indian Soil texture triangle

Soil texture triangle is a tool used by soil scientists to determine the particle size distribution of soil samples. The triangle is a graphical representation of the different combinations of sand, silt, and clay that result in different soil textures.

Sand particles have a diameter between 0.05 and 2.0 millimeters, silt particles are between 0.002 and 0.05 millimeters, and clay particles are less than 0.002 millimeters in diameter.

The proportions of these particles in soil samples determine the soil texture. Soil texture has important implications for soil properties and behavior, including water-holding capacity, nutrient availability, and drainage.

Soils with a high proportion of sand have a coarse texture, which means they have good drainage but low water-holding capacity. Soils with a high proportion of clay have a fine texture, which means they have poor drainage but high water-holding capacity.

II. LITERATURE REVIEW

Soil texture plays a crucial role in regulating water flow through the soil. The amount of water that can be retained in the soil, as well as the speed at which it moves through it, is determined by the soil texture (Upadhyay, et al., 2020). The texture-by-feel method can be used to estimate the textural class of a soil sample, which is then used to determine its water-holding capacity and permeability using a texture triangle (Ben-Hur,et al ., 2009). However, traditional soil classifications based on texture can be inappropriate and lead to bias in various applications, including hydrology (Groenendyk, et al., 2015). A new approach to soil classification based on hydrologic responses of soils has been proposed to address these issues and provide a simpler and more informative method for understanding the effect of soil texture on water flow (Groenendyk, et al., 2015).Soil texture plays a crucial role in regulating water flow through the soil, which affects various environmental processes. Understanding the effect of soil texture on water flow is important, and the soil texture triangle can provide a simpler and more informative way to do so. The texture-by-feel method is commonly used to estimate soil texture but can be subjective and prone to errors. Traditional soil classifications based on texture can also be inappropriate for certain applications, such as hydrology. A new approach to soil classification based on hydrologic responses of soils has been proposed, which can be used to address these issues. This approach takes into account the hydrologic properties of soils and can help evaluate the effect of soil texture on water flow more accurately. Overall, the use of the soil texture triangle and the hydrologic approach to soil classification can provide a more effective way to evaluate the effect of soil texture on water flow. (Upadhyay, et al., 2020),(Groenendyk, et al., 2015). Soil texture plays a crucial role in regulating water flow through the soil, which affects various environmental processes (Behera, S. K., & Shukla, M. K. 2015). The texture triangle is a useful tool to determine the texture class of soil based on the percentages of sand, silt, and clay present in the soil (Malam Issa, O., & Gaudet, J. P. 2014). However, the texture-by-feel method used to determine soil texture can be subjective and prone to errors (Farahani, et al.,2015). Traditional soil classifications based on texture may not always be appropriate for certain applications, such as hydrology processes (Behera, S. K., & Shukla, M. K. 2015).. A new approach to soil classification based on hydrologic responses of soils has been proposed, which takes into account the hydrologic properties of soils (Brouder, S. M., & Gomez-Macpherson, H. 2014). This approach can help evaluate the effect of soil texture on water flow more accurately (Farahani, et al.,2015). Overall, the use of the soil texture triangle and the hydrologic approach to soil classification can provide a more effective way to evaluate the effect of soil texture on water flow (Brouder, S. M., & Gomez-Macpherson, H. 2014).

III. METHODOLOGY

Based on the research paper of different authors in this review paper, it is as follows-

1) *Literature Search:* The first step in conducting this review is to conduct a comprehensive literature search of relevant peer-reviewed articles, books, and reports on the topic of soil texture and water flow. The search will be conducted using online databases/research hub.
2) *Screening and Selection:* The second step in conducting this review is to screen and select relevant articles based on predetermined inclusion and exclusion criteria. The inclusion criteria will be articles that focus on the relationship between soil texture and water flow, use the soil texture triangle as a tool for soil texture classification, and present empirical data on the impact of soil texture on water flow. The exclusion criteria will be articles that focus on other soil properties or do not use the soil texture triangle as a tool for soil texture classification. The screening and selection process will be conducted independently by two reviewers, and any discrepancies will be resolved through discussion.
3) *Data Extraction and Synthesis:* The third step in conducting this review is to extract relevant data from the selected articles and synthesize the findings. The data extraction will include information on the study design, sample size, soil texture classification, hydraulic conductivity, water retention, and other relevant variables. The synthesized findings will be presented in a narrative format and summarized using tables and figures as appropriate.
4) *Quality Assessment:* The fourth step in conducting this review is to assess the quality of the selected articles using established criteria for evaluating the quality of systematic reviews. The quality assessment will include an evaluation of the study design, sample size, data analysis, and reporting of results. The quality assessment will be conducted independently by two reviewers, and any discrepancies will be resolved through discussion.
5) *Data Analysis:* The final step in conducting this review is to analyze the synthesized data and draw conclusions. The data analysis will include a qualitative synthesis of the findings and a discussion of the implications for soil management and environmental sustainability. The conclusions will be presented in a narrative format and supported by the synthesized data.

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Finally, the methodology for this review paper will involve a comprehensive literature search, screening and selection of relevant articles, data extraction and synthesis, quality assessment, and data analysis. The methodology will be designed to ensure that the review is systematic, transparent, and rigorous.

IV. RESULTS & DISCUSSION

The review of existing literature reveals a strong relationship between soil texture and water flow through soils. Soils with high proportions of sand particles tend to have high hydraulic conductivity and allow water to flow through quickly, while soils with high proportions of clay particles tend to have low hydraulic conductivity and retain water for longer periods. The soil texture triangle is a useful tool for classifying soil texture and predicting soil hydraulic properties, including water flow. The review highlights the importance of soil texture in regulating water flow through soils and discusses the implications for soil management and environmental sustainability. The review also identifies areas for future research, including the impact of soil texture on soil erosion, nutrient availability, and carbon sequestration.

V. CONCLUSION

The review paper concludes that soil texture plays a critical role in regulating water flow through soils and has significant implications for soil management and environmental sustainability. The soil texture triangle is a useful tool for classifying soil texture and predicting soil hydraulic properties, including water flow. The review identifies areas for future research to improve our understanding of the relationship between soil texture and water flow and highlights the need for further research to inform soil management practices and environmental policies. Overall, the review paper provides a comprehensive overview of the role of soil texture in regulating water flow through soils and highlights the importance of considering soil texture in soil management and environmental sustainability.

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