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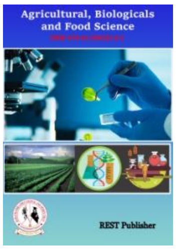

Evaluation of Soil Management Practices for Agriculture using TOPSIS Method

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Abstract. *Agricultural soil science is a subfield of soil science that focuses on the production of food and fiber in relation to soil conditions. It encompasses research in the realm of edaphic conditions, making it an integral part of agricultural departments. Historically, it was considered a distinct branch of soil science, known as edaphology. However, by 2006, it had merged with the broader field of soil science, particularly pedology, in both professional and popular contexts. Agricultural soil science delves into the chemical, physical, and biological aspects of soils as they pertain to agriculture. Soils exhibit variations in their chemical and physical properties due to factors such as climate, weather patterns, and microbial activities, leading to different soil types. Agricultural soil science follows a comprehensive approach that not only investigates the characteristics of soil but also considers the broader ecosystem and its sustainable management. This field scrutinizes soil chemistry, physics, biology, and mineral composition concerning agricultural applications, with a focus on enhancing crop productivity and dietary quality. Agricultural soil scientists address various concerns related to soil sustainability, such as soil erosion, compaction, fertility depletion, and contamination. They conduct research in areas like irrigation, drainage, tillage practices, soil classification, plant nutrition, and soil fertility. While maximizing crop and animal production is a fundamental goal, it is essential to be mindful of potential negative consequences, such as the impact of monoculture on crop diseases and the long-term effects of chemical fertilizers and pesticides on human health. To address these challenges, farmer-scientists employ an interdisciplinary approach, drawing from fields such as physics, chemistry, biology, meteorology, and geography to develop sustainable solutions. Techniques like TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) are used for multi-criteria decision analysis. In TOPSIS, the positive ideal solution (PIS) is determined by selecting the alternative with the shortest geometric distance from the ideal solution. This method assumes that an increase in criteria values is preferable. Normalization of parameters is often required in scaling problems, ensuring that criteria with varying dimensions are properly considered. Alternatives are evaluated based on characteristics such as clay content, sand content, silt content, peat content, chalk content, and loaminess. These criteria are then applied to evaluate preferences for elements like arsenic (As), cadmium (Cd), copper (Cu), and mercury (Hg). The results of the evaluation indicate that peaty soil ranks the highest, while silty soil receives the lowest ranking.*

Keywords: *Sandy, Soil organic matter, Soil organic carbon and TOPSIS method*

1. INTRODUCTION

Deforestation has led to significant consequences, including the constant use of land for non-permanent agricultural purposes, resulting in soil erosion, reduced productivity, and degraded water quality in ecosystems worldwide. These changes have also had a profound impact on the biodiversity of these biological systems. However, there has been limited research on the relationships between microbial diversity, soil and plant quality, and environmental sustainability. The dynamics of soil microbial communities are primarily influenced by environmental conditions, but there is a lack of comprehensive research on the properties of microorganisms and their activities in various ecosystems. Most studies have been limited in their scope and capacity, and they often describe specific cases rather than providing a broader understanding. One crucial aspect of addressing these issues is carbon sequestration in agricultural soils, as outlined in Section 3.4 of the Kyoto Protocol. However, there remain key challenges in identifying and measuring the accountability of carbon sequestration in soils. These challenges have significant political implications that need to be addressed. To tackle these challenges and promote sustainable practices, there is a need for technological advancements and economic opportunities related to carbon accounting in agricultural soils. This can help improve the management of carbon in European agricultural soils from 2008 to 2012, offering potential business opportunities that differ from the conventional practices. The reduction of net CO2 emissions in agricultural soils, often referred to as carbon sequestration, plays a significant role in mitigating climate change. In agricultural systems, a substantial amount of biomass is produced, including food, fodder, and unused plant material that can be used for fuel. These plant materials disrupt the cycling of carbon between the atmosphere and agricultural land, resulting in significant total CO2 fluxes, amounting to multiple petagrams (Pg) per year. However, the net difference in the carbon balance between what plants add to the soil as photosynthetically-stabilized CO2 and what is released as exposed CO2 is relatively small. The overall net carbon balance of the environment is determined by this difference, making agricultural soils either a source of CO2 emissions or a carbon sink, depending on the specific conditions and practices in place. This balance is crucial in understanding the environmental impact of agricultural activities on CO2 levels.

Agricultural soils have the potential to sequester a significant amount of carbon, and their carbon stocks are often underestimated. It is estimated that in the next 50-100 years, the global capacity for carbon sequestration in soils could reach 20-30 petagrams (Pg) of carbon. To enhance this carbon sequestration ability, it is essential to implement soil management practices that increase the input of organic matter into the soil and reduce the decomposition rates of soil organic matter. The effectiveness of these practices varies regionally and depends on both environmental and socioeconomic factors. In temperate regions, key strategies for increasing soil carbon include crop rotation with perennial fodder (including nitrogen-fixing species), retaining crop residues, and minimizing tillage or even adopting no-till practices. In North America and Europe, the conversion of marginal arable land into perennial plant cover, along with measures to protect fragile soils and landscapes, offers opportunities to enhance carbon sequestration and reduce agricultural surpluses. These strategies not only contribute to carbon sequestration but also have environmental and economic benefits that can vary depending on the specific region and conditions. While these chapters are well-referenced and informative, they may contain a lot of technical details that could be overwhelming for the average reader. Subsequently, the following three chapters focus on administrative issues. These chapters thoroughly explore topics such as pest control, erosion effects on site management, and the movement and persistence of herbicides in the soil. In a separate chapter, the book reviews the current understanding of silicon (Si) availability in agricultural soils, highlighting knowledge gaps. Silicon is considered essential for plant growth and can provide benefits to crops like rice and Si-accumulating plants such as sugarcane. These crops tend to thrive in weathered, dry soils, where the concentration of soluble Si is lower. The chapter discusses how various stressors, both biotic (such as plant pathogens and insect pests) and abiotic (like water deficits, excess salts, and metal toxicity), impact plant tolerance and, consequently, yield. Overall, the book provides a comprehensive overview of various aspects of agricultural soil science, from physical and chemical properties to administrative and environmental considerations, as well as the role of silicon in plant growth and stress tolerance.

Soil organic matter (SOM) is a complex mixture of organic materials that plays a crucial role in influencing various soil properties and nutrient cycling. It is affected by factors such as land use, soil type, climate, and plant types and quantities. High or low concentrations of SOM in soil can have significant consequences for soil physics, degradation, and nutrient cycling patterns, ultimately impacting agricultural productivity. The concern about SOM is not limited to England; it has global implications for the sustainability of agriculture. While we've focused our discussion on England in this context, similar concerns are equally valid in other parts of the world. The management and preservation of soil organic matter are essential for maintaining healthy soils and ensuring sustainable agricultural practices worldwide. Soil organic matter (SOM) is a complex mixture that is influenced by various factors such as soil properties, its impact on nutrient cycling, land use, soil type, climate, and plant influence. The concentration of SOM in the soil is high, and its decrease can lead to deterioration in physical properties and nutrient cycling, particularly in agriculture. This has significant implications for the sustainability of agriculture, not only in England, where our discussion is focused, but also in other regions worldwide. SOM plays a crucial role in soil behavior, with scientists emphasizing its importance at different concentrations in various types of soils. However, it's important to note that an essential limitation is seen when SOM levels drop below 2%. Soil organic carbon (SOC), which constitutes approximately 3.4% of SOM, is believed to be a critical factor, and a substantial decline in SOC content can lead to a decrease in soil quality. The influence of SOM and SOC on soil status is multifaceted, affecting heat transfer, water and gas movement, soil strength, and biological processes, all of which impact the compression process. Various methods for measuring these properties are described, but a comprehensive study comparing changes in different types of soils under applied mechanical stress, considering bulk density, void ratio, or porosity, is yet to be conducted.

The purpose of this thesis is to address this gap by presenting diverse compression curves for different types of soils, specifically in agricultural contexts, along with their corresponding properties and compression quantification methods.

Photosynthetic plants, whether found in terrestrial landscapes or aquatic environments, play a crucial role in the process of photosynthesis. Through the selection of plant species, efficient nutrient utilization, and the management of various soil and environmental factors, they have the capacity to enhance net primary productivity (NPP) and contribute to the overall carbon pool in the environment. In the latter half of the 20th century, a significant advancement in global agricultural production and the nutritional progress of terrestrial plants was achieved through effective management practices. However, in the realm of aquatic biology, the impact of marine fertilization on atmospheric CO2 sequestration remains a subject of debate and is an ongoing area of study. The effectiveness and advisability of such strategies are continuously being examined. Historically, the burning of soil has been a common practice in various regions, resulting in the release of high levels of carbon. This historical practice has been prevalent in grasslands, open woodlands, and in North American grasslands, including agricultural crop residues. For instance, reports from Australia and Germany, as well as findings from studies by Collins, have highlighted the historical significance of soil burning in these regions. In a study conducted in 1990, researchers examined the impact of various environmental factors, including drought, high temperatures, and strong winds, on agricultural areas in North America. They focused on five selected American soils and assessed the charcoal content in grasslands using physical separation, high-energy photography, and the stability of fire ignition. Collins (1990) also employed solid-state 13C nuclear magnetic resonance (NMR) spectroscopy to analyze the soil.

The findings indicated that, due to a combination of these factors, the indigenous people of the area often modified these five lands over time. Specifically, they introduced charcoal, measuring 53 meters in length, to attract wild game and to manage grassland fires. The human-made fires caused by this charcoal addition led to a significant increase in soil total organic carbon (TOC) activity, sometimes reaching up to 35%. As a result, there was historical evidence of disturbance in the grasslands, which was observed through scanning electron microscopy. The introduction of charcoal may have influenced the morphology of the local plant life, possibly leading to blockage and breakdown. Consequently, it is expected that there was an ongoing impact from these frequent interventions in the area's ecosystem. These particles, originating from Australian and German soils, share similar morphological characteristics. Their effects on combustion are of significant importance, and they exhibit high resistance to microbial decay within the soil. The study focuses on the role of this material in the carbon cycle within the soil [11]. In the study of biogeochemical processes related to soil carbon in croplands, various aspects of soil carbon and nitrogen dynamics are examined, taking into account plant growth, subsampling, and practical agricultural procedures such as land preparation, irrigation, tillage, crop rotation, and the use of composting amendments. Additionally, the study introduces a new model that includes short-term (1-9 years) degradation tests, analysis of seasonal soil CO2 respiration patterns, and long-term (100 years) assessments of soil carbon storage. This model has been validated against field results and explores how different agricultural practices impact soil organic carbon (SOC) flows [12]. The research investigates the effects of different agricultural practices on soil organic carbon (SOC) flows using common soils in America and considering various climate conditions.

2. MATERIALS & METHODS

Clay: Clays consist of clay minerals, which are hydrous aluminum phyllosilicates, with an example being kaolin, characterized by the chemical formula Al2Si2O5(OH)4. They represent a type of fine natural soil. When clay particles are surrounded by water molecules, they exhibit a film-like structure, making them wet and plastic. However, upon drying or firing, they become stiff, brittle, and non-plastic. Pure clay minerals are typically white or pale in color, but natural clays vary in color due to impurities, with small amounts of iron oxide giving rise to red or brown hues. Clay has been used for various purposes throughout history. Prehistoric humans discovered its useful properties and used it for making pottery. Early pottery fragments date back to ancient times, and clay is also employed in processes like papermaking, cement manufacturing, and chemical distillation, serving as a fundamental component in many modern industries. A significant portion of the world's population, approximately two-thirds, lives or works in buildings constructed from clay, particularly in the form of fired bricks. Clay plays a vital role in the load-bearing structure of these buildings, making it an essential material for construction.

Sandy: Sandy soil is well-suited for growing vegetables because of its excellent drainage and ability to heat up quickly. However, unlike clay soils, sandy soil doesn't retain nutrients well, which means that gardeners need to continually add supplementary elements throughout the growing season. For example, compost, grass clippings, or other organic materials can be added to improve sandy soil quality. Globally, there are vast areas of sandy soil, approximately covering 900 million hectares, particularly in dry and semi-arid regions. Many of these sandy soils are used for cultivation, although their fertility is often low. The soil's organic content relies on the amount of carbon present (SOC). In this context, a review was conducted using pedon databases, literature data, and three comprehensive case studies from around the world to assess SOC levels in sandy soils. Five major databases were selected, focusing on pedons in which at least 850 grams of sand per kg were present in the top 30 cm of soil. Sandy soils are found in various climates and soil types, predominantly in alfisols, entisols, inceptisols, spodosols, and ultisols.

Silty: Soil can exhibit various characteristics, and its moisture level can influence its texture and composition. When the soil is moist, it may feel slippery or grainy, and it usually lacks rocks. If over 80 percent of the soil is composed of sediment, it can be classified as sediment. Over time, alluvial deposits can become compacted, pressing the grains together and forming rock-like structures, such as siltstone rocks. Sediment is often shaped by the erosive forces of water, ice, or other agents, as it accumulates. In sugarcane cultivation, a traditional method involves planting sugarcane in paired rows at a spacing of 30 to 90 cm apart and irrigating in the autumn to maximize sugar yields. This method results in a higher sugar cane yield compared to other approaches, with an irrigation level of 40%. It's worth noting that 10% of the irrigation water is stored in sandy soils, and 24% is stored in clay and silty clay soils. In regions like Pakistan and other developing countries, the demand for surface water sources is increasing due to population growth. As these surface water sources become scarcer, it's essential to apply scientific knowledge to bridge the gap between sugarcane cultivation and water use. A determined effort is required to find sustainable solutions in sugarcane farming.

Peaty: Peat is a type of soil that is primarily composed of partially decomposed organic matter. It consists mainly of plant-derived materials and is typically found in the uppermost layer of the soil. Peat exhibits distinct characteristics, including high water retention, oxygen deficiency, high acidity, and nutrient deficiencies, as it accumulates over time. In lowland humid tropical regions, peat predominantly originates from the stable decomposition of organic matter from rainforest trees, such as leaves, branches, trunks, and roots. In other geographic areas, it can form in water-saturated conditions from various types of plants. For instance, the Restionaceae family in New Zealand is known to contribute to peat formation, while in tropical coastal regions, peat can be found on the edges of mangroves. These diverse sources contribute to the formation of peat.
Peat continues to be a subject of study, and new varieties and sources of peat may still be discovered.

Chalky and Loamy: Soil erosion by water is a growing problem, especially in soils such as sand, silt, and calcareous soils, particularly in arable lands where the organic matter content is less than 2%. When it rains, these soils are prone to splashing, causing the soil to become compacted, and heavy rains can make the water run off immediately rather than soaking into the soil. This can also lead to issues like soil panning. On sloping fields, especially in larger fields, erosion is more severe, as cultivation lines, crop rows, and tramlines tend to align with the slope direction. This results in more compression from vehicle wheels in the same direction. During wet weather or heavy rainstorms, deep grooves up to a meter deep and ditches up to 150 tons of soil per hectare can be washed away, leading to significant soil loss. Sometimes, crops can be carried from upper slopes and deposited at the lower end of a field due to soil erosion. To address this issue, some farmers use tractors with compaction tines fitted behind the wheels, which can help reduce the risk of erosion. Additionally, practices like spraying and other erosion control measures can be employed to minimize corrosion damage and soil loss.

Arsenic (As): Arsenic (As) is a toxic metal that is often found in agricultural soils, albeit at varying concentrations across different geographic regions. High concentrations of arsenic in soil can pose significant health risks when it enters cells during exposure, as it may have harmful effects on human tissues. On average, the mean total concentration of arsenic in soil is approximately 5 mg/kg. Several human activities contribute to the presence of arsenic in soil, including pesticide use, mining and mineral processing operations, coal-fired power plants, and waste disposal activities. For instance, the disposal of waste, particularly from industrial sources, can introduce arsenic into the soil. Another historical source of soil arsenic is tanneries, where animal skins were used to produce leather. These sites may have higher levels of arsenic in the soil due to the historical use of arsenic-based chemicals in leather processing.

Cadmium (Cd): Cadmium (Cd) is a significant environmental pollutant due to its extensive industrial use, and it has become a major concern in both soil and water. Cadmium pollution is a more recent problem that has emerged over time. The presence of cadmium in the environment can have detrimental effects on plant growth, including germination and overall yields. It damages various physiological functions of plants, including their interactions with water, essential mineral absorption, and photosynthesis. Exposure to cadmium can directly affect plants by impacting enzymes and other metabolites, leading to the production of stressful reactive oxygen species. This can result in metabolic changes in plants. In recent years, there has been an increasing interest in the potential of certain plants to accumulate or confirm the presence of cadmium-contaminating compounds. This interest has grown as researchers explore the biological aspects of cadmium contamination in plants.

Copper (Cu): Copper, with the chemical symbol Cu (derived from the Latin word "cuprum") and atomic number 29, is a chemical element known for its exceptional heat and electrical conductivity. It is a soft, flexible, and malleable metal. When freshly exposed, pure copper has a pinkish-orange color. Due to its excellent heat conductivity and electrical conductivity, copper is widely used in various applications. It is employed as a building material, in jewelry making (often alloyed with silver), for marine hardware, and in coin production. Copper is also used in cupronic acid and strain gauges, and it plays a role in thermocouples for temperature measurement.

Copper is unique among metals because it occurs in nature in a usable metal form, known as native copper. It has a long history of human use, dating back to around 8000 BC. Over thousands of years, humans have developed various applications for copper. The first smelting of copper from ores occurred around 5000 BC, marking a significant advancement. The first metal casting into specific shapes took place around 4000 BC, and copper was intentionally mixed with another metal, tin, to create bronze, making it the first known alloy, around 3500 BC.

TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution): The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is a method used for identifying the best solution among a set of alternatives based on multiple criteria. It involves simultaneously reducing the distance from an ideal solution and increasing the distance from a nadir point defined in terms of the solutions. The significance of TOPSIS lies in its ability to combine comparative weights of criteria. This technique has been applied in various fields, and its effectiveness has been reviewed using different weighing schemes and distance measurements. It requires limited subjective input from decision-makers, making it attractive for decision-making processes. TOPSIS has been widely used in different applications, such as selecting manufacturing processes, financial investment decisions, and assessing company efficiency based on financial ratios. In comparison to other methods, TOPSIS is known for its flexibility and ability to handle ambiguous data. It is a valuable tool for solving decision-making problems, especially in situations where there is uncertainty and ambiguity in the evaluation process. The method has been continuously evolving and adapted to various scenarios to improve its applicability and effectiveness. In some cases, an alternative approach to TOPSIS, called a-TOPSIS, is used to handle specific data types. Additionally, researchers have proposed modified versions of TOPSIS, like e-TOPSIS and u-TOPSIS, to enhance its performance and address specific requirements. TOPSIS has strengths and weaknesses, as do other decision-making methods. For instance, it focuses on finding the ideal solution by minimizing the distance from it while maximizing the distance from the negative ideal solution. However, it may have limitations related to weight assignment and judgment balance. Despite these limitations, TOPSIS remains a valuable decision-making tool, particularly when dealing with complex, multi-criteria problems. Researchers continue to develop and adapt TOPSIS to make it more effective and applicable in a variety of decision-making scenarios.

3. RESULT AND DISCUSSION

TABLE 1. agricultural soils

	arsenic (As)	**cadmium (Cd)**	**copper (Cu)**	**mercury (Hg)**
clay	81.08	79.53	23.15	22.05
sandy	96.12	94.97	33.69	27.30
silty	64.08	92.58	35.18	23.10
peaty	93.17	98.28	24.60	26.59
chalky and loamy	83.33	86.41	27.96	28.89

The table presents concentrations of various heavy metals, including arsenic (As), cadmium (Cd), copper (Cu), and mercury (Hg), in different types of agricultural soils. In clay soils, the values for these metals are 81.08, 79.53, 23.15, and 22.05, respectively. Sandy soils exhibit higher concentrations, with values of 96.12 for As, 94.97 for Cd, 33.69 for Cu, and 27.30 for Hg. Silty soils have varying levels, with 64.08 for As, 92.58 for Cd, 35.18 for Cu, and 23.10 for Hg. Peaty soils show concentrations of 93.17 for As, 98.28 for Cd, 24.60 for Cu, and 26.59 for Hg. Chalky and loamy soils exhibit values of 83.33 for As, 86.41 for Cd, 27.96 for Cu, and 28.89 for Hg. These values represent the content of these heavy metals in each soil type, which is essential information for understanding soil quality and potential environmental impact in agricultural settings.

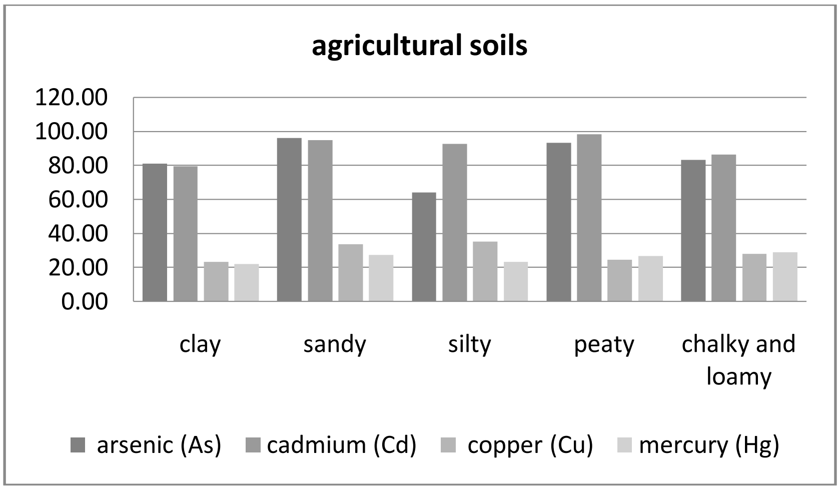

FIGURE 1. agricultural soils

Figure 1 Shows the arsenic (As)it is seen that sandy is showing the highest value for silty is showing the lowest value.the cadmium (Cd)it is seen that peaty is showing the highest value for clay is showing the lowest value. the copper (Cu) it is seen that silty is showing the highest value for clay is showing the lowest value. the mercury (Hg) it is seen that chalky and loamy is showing the highest value for clay is showing the lowest value.

TABLE 3. Normalized Data

arsenic (As)	**cadmium (Cd)**	**copper (Cu)**	**mercury (Hg)**
0.4301	0.4218	0.3532	0.3834
0.5098	0.5037	0.5140	0.4747
0.3399	0.4911	0.5368	0.4017
0.4942	0.5213	0.3753	0.4624
0.4420	0.4583	0.4266	0.5024

Table 3 displays normalized data for the concentrations of various heavy metals, including arsenic (As), cadmium (Cd), copper (Cu), and mercury (Hg). These values have been scaled to fall within the range of 0 to 1, making them more comparable and suitable for further analysis. In this normalized dataset, the values for As range from 0.3399 to 0.5098, for Cd from 0.4218 to 0.5213, for Cu from 0.3532 to 0.5368, and for Hg from 0.3834 to 0.5024. The normalization process allows for a standardized assessment of these heavy metal concentrations across different soils or samples, making it easier to evaluate and compare their environmental impact or suitability for various purposes.

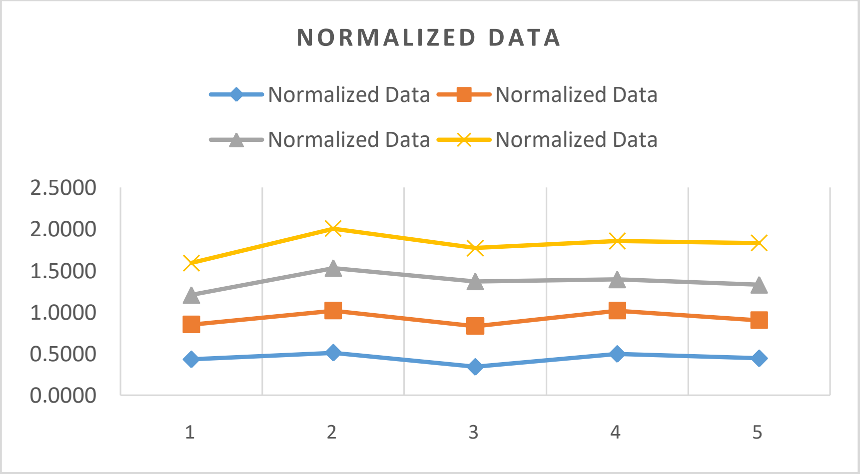

FIGURE 2. Normalized Data

TABLE 4. Weight

0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 4 provides the weightings for the different criteria or attributes, and in this case, all criteria are assigned the same weight value of 0.25. These weights are used in the analysis or evaluation of the data to indicate the relative importance of each criterion. By assigning equal weights, it suggests that each criterion is considered equally important in the decision-making process or analysis, ensuring a balanced approach when considering the various factors involved.

TABLE 5. Weighted normalized decision matrix

0.107516	0.10546	0.088305	0.095862
0.127459	0.125934	0.128509	0.118686
0.084973	0.122765	0.134193	0.100427
0.123548	0.130324	0.093836	0.1156
0.110499	0.114583	0.106652	0.125599

Table 5 displays the weighted normalized decision matrix, which combines the normalized data with the assigned weight values. The values in this table represent the result of multiplying the normalized data from Table 3 with the corresponding weight values from Table 4. This process helps assess the significance of each criterion while considering their relative importance. The weighted normalized decision matrix is a crucial step in decision-making processes, as it provides a structured approach for evaluating different alternatives or options based on multiple criteria and their respective importance in the overall analysis. The values in this table reflect the weighted contributions of each criterion to the decision-making process, allowing for a more comprehensive assessment of the alternatives.

TABLE 6. Positive Matrix

0.127459	0.130324	0.088305	0.095862
0.127459	0.130324	0.088305	0.095862
0.127459	0.130324	0.088305	0.095862
0.127459	0.130324	0.088305	0.095862
0.127459	0.130324	0.088305	0.095862

Table 6 presents the positive matrix, which appears to contain consistent values across all its entries. This matrix may be a result of a specific calculation or data transformation process, but without additional context, it is challenging to provide a precise interpretation. The identical values in each row and column suggest that the elements within the matrix have the same numerical values. The positive matrix may serve a particular purpose or represent a specific condition in a given analysis, but the provided information does not offer further details on its origin or intended use.

TABLE 7. Negative matrix

0.084973	0.10546	0.134193	0.125599
0.084973	0.10546	0.134193	0.125599
0.084973	0.10546	0.134193	0.125599
0.084973	0.10546	0.134193	0.125599
0.084973	0.10546	0.134193	0.125599

Table 7 displays the negative matrix, which, similar to Table 6, contains values that appear to be consistent across all its entries. The values in the negative matrix may also be a result of a specific calculation or data transformation process. In this case, the values are distinct from those in Table 6, suggesting that the negative matrix serves a different purpose or represents different aspects of the data. The identical values within each row and column indicate that the elements in the negative matrix have the same numerical values. While the provided information does not offer further context or details regarding the origin or intended use of the negative matrix, it may be employed in specific analyses or decision-making processes to assess criteria or alternatives.

TABLE 8. Si Positive & Si Negative & Ci

	SI Plus	Si Negative	Ci
clay	0.031874	0.059145	0.649812
sandy	0.046439	0.048004	0.508283
silty	0.063157	0.030546	0.325992
peaty	0.020868	0.061926	0.747955
chalky and loamy	0.041908	0.038643	0.479733

Table 8 Si Positive (SI Plus): This column represents a measure of the positive aspects or characteristics of each soil type. It ranges from 0.020868 to 0.063157 and provides insights into the strengths or advantages of each soil type in relation to the criteria being considered. Si Negative (Si Negative): This column represents a measure of the negative aspects or weaknesses of each soil type. It ranges from 0.030546 to 0.061926 and indicates the limitations or disadvantages of each soil type concerning the criteria under assessment. The Ci column likely represents a combined or overall evaluation score for each soil type, considering both the positive and negative aspects. The values in this column range from 0.325992 to 0.747955, with higher values indicating a more favorable evaluation based on the criteria being examined.

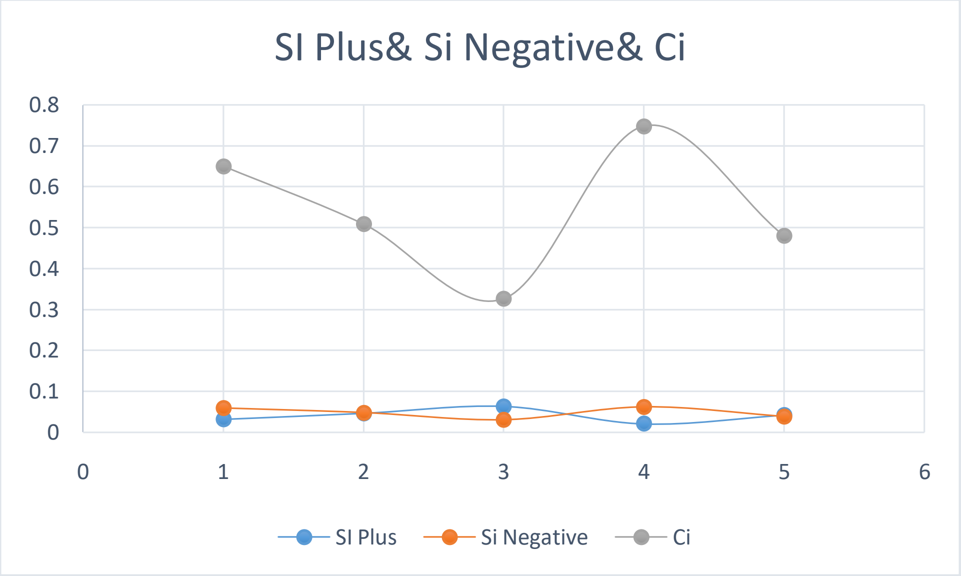

FIGURE 3. Si Positive & Si Negative & Ci

Figure 3 Si Positive & Si Negative & Ci shows the graphical representation.

TABLE 9. Rank

	Rank
clay	2
sandy	3
silty	5
peaty	1
chalky and loamy	4

The Table 9 provided ranking assigns a position to each soil type based on a specific set of criteria or evaluation process. These rankings allow us to gauge the relative performance and suitability of each soil type. At the top of the list, we find "Peaty" soil, holding the highest rank (Rank 1). This suggests that "Peaty" soil excels in meeting the criteria or requirements outlined in the assessment, making it the most favorable choice among the options considered. Following closely behind is "Clay" soil, securing the second rank (Rank 2), indicating its strong performance. "Sandy" soil holds the third rank (Rank 3), signifying its suitability but falling slightly behind the top two. "Chalky and Loamy" soil follows with the fourth rank (Rank 4), showing its respectable performance. Lastly, "Silty" soil is ranked the lowest (Rank 5) in this assessment, implying it may have characteristics or aspects that are less aligned with the specific evaluation criteria. These rankings provide valuable insights for decision-making processes, helping to identify the most promising soil types based on the given set of criteria.

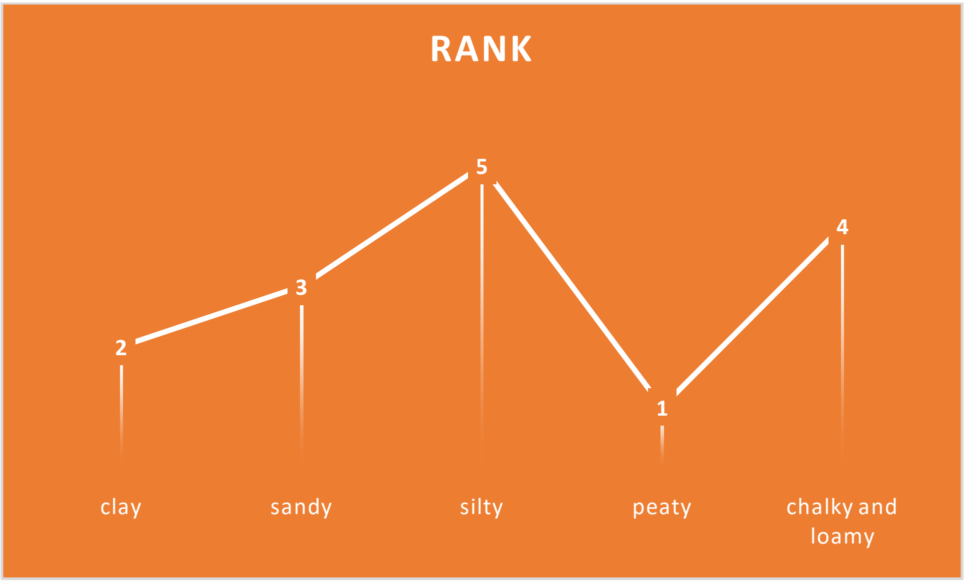

FIGURE 4. Rank

Figure 4 shows that Final rank shows that clayis in Second place, sandy in Third place, silty in the Fifth place, peaty in First place, chalky and loamy in Fourth place.

4. CONCLUSION

In conclusion, the provided data and tables offer a comprehensive evaluation of different soil types based on a range of criteria and attributes. The analysis involved the assessment of heavy metal concentrations, the normalization of data, weighting of criteria, and the calculation of positive and negative aspects for each soil type. These evaluations culminated in a ranking of the soil types, providing a clear indication of their relative performance according to the specific criteria used. "Peaty" soil emerged as the top-ranked choice, signifying its high suitability for the given criteria. "Clay" soil followed closely behind, earning the second rank. "Sandy" soil secured the third rank, indicating its respectable performance, while "Chalky and Loamy" soil was ranked fourth. "Silty" soil received the fifth and lowest rank in this assessment. These rankings serve as valuable information for decision-making processes in agriculture, environmental management, or other applications where soil quality is a crucial consideration. It's essential to note that the specific criteria used for this assessment were not provided, and the suitability of each soil type may vary depending on the context and objectives of the evaluation. Overall, this data and ranking offer a foundation for informed decision-making when choosing the most suitable soil type for a particular purpose or project, taking into account the specific criteria and attributes deemed most important in the given context.

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