Short Communication

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Urban Soil Health Check and Strategies for Monitoring and Improvement

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ABSTRACT

Urban soil health is crucial for sustaining healthy ecosystems, supporting urban agriculture, and enhancing overall environmental quality in densely populated areas. This article provides an overview of the importance of urban soil health monitoring and strategies for its improvement. Firstly, it highlights the diverse array of contaminants that urban soils may harbour due to industrial activities, vehicular emissions, and improper waste disposal. These contaminants can pose risks to human health and ecosystem functioning if left unaddressed. Secondly, the article discusses the importance of implementing effective monitoring protocols to assess soil health indicators such as nutrient levels, pH, and organic matter content, and contaminant concentrations. By utilizing soil testing kits, remote sensing technologies, and citizen science initiatives, urban residents and policymakers can gain valuable insights into the health status of urban soils. Finally, the abstract explores strategies for improving urban soil health, including soil remediation techniques such as phytoremediation, composting, and bio char application. Additionally, it emphasizes the importance of adopting sustainable land management practices, such as green infrastructure development, urban forestry, and community gardens, to enhance soil health and promote urban resilience. Overall, this abstract underscores the importance of proactive soil health management in urban areas and highlights the diverse strategies available for monitoring and improving urban soil quality.

Keywords: *monitoring, urban, ecosystems, green, land management*

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Introduction

Indicating that urban ecosystems are a relatively recent natural occurrence, there is evidence that the oldest archeological settlements date back to between 8,000 and 10,000 years ago. This suggests that urban ecosystems evolved relatively recently. The first mega-city to have a population of more than one million people was Rome, which flourished in the first century BC [1]. Rome was the first mega-city to have a capital city. At the beginning of the twenty-first century, the number of cities with more than one million citizens had rapidly increased to more than four hundred. In the year 1900, there were only sixteen cities that had more than one million residents. The most artificial kind of ecosystem is an urban ecosystem since it is driven by humans and other anthropogenic forces [2]. This makes urban ecosystems the most artificial type of ecosystem when compared to agricultural and natural systems. Although urbanization is the trend that is producing the most rapid change in land use, the quality and functions of urban soil have been disregarded. This is despite the fact that urbanization brings about the fastest change. All throughout the course of history, substantial soil surveys and conventional soil classifications have failed to take into consideration the origins of urban soil [3]. A concept known as "sustainable cities" is based on the idea that urban soil should be able to provide functions and support services that are necessary for both people and the environment. Nevertheless, urban soils are confronted with a conundrum in which they are of immense value in terms of the issues they provide in terms of property and development, but they are almost largely ignored in terms of the functions and ecosystem services that they may supply [4]. Both the health of the environment and the well-being of people are significantly impacted by the soil, which is a fundamental component of ecosystems and plays a significant role in both of these areas. A number of environmental dangers, including erosion, a reduction in fertility and biodiversity, sealing, pollution, and compaction, are among the elements that have the potential to have an impact on it. Applied soil science and ecology focuses a substantial emphasis on the monitoring and assessment of soil quality at a number of scales and for a variety of land uses [5]. This is because soil quality is associated with a wide range of environmental factors.

Throughout the course of human history, the quality of the soil has been linked to the fertility characteristics of the soil. These qualities include the amounts of organic matter and nutrients present in the soil, as well as the acidity and texture of the soil [6]. In spite of this, widespread industrialization and urbanization have resulted in an increase in the anthropogenic stressors that are imposed on soil. These strains include the contamination of the soil with chemical compounds and biological contaminants. The threat that contaminated soils offer to human health has brought to light the need of keeping sanitary and hygienic soil quality [7]. This hazard has brought to light the necessity of maintaining a soil quality that is both sanitary and hygienic.

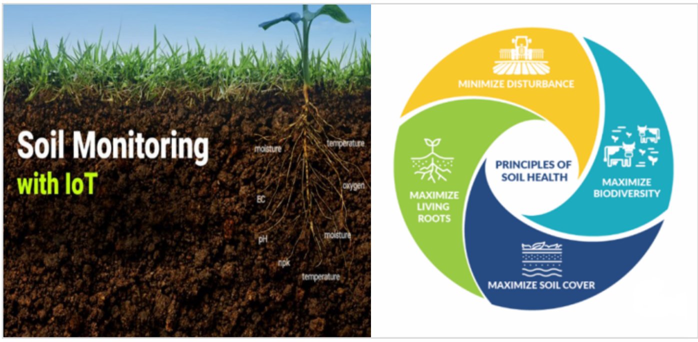
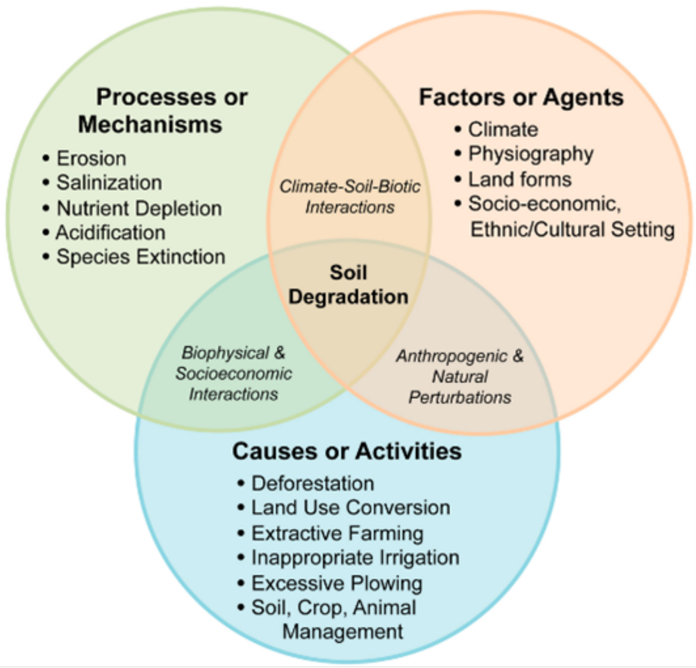


Fig 1: IOT soil monitoring profile and zones; Source from Google Scholar: Open access

Because of global environmental problems such as climate change, desertification, soil degradation, and the loss of biodiversity, the traditional perspective on soil quality has shifted to concentrate on the role that soil plays in global biogeochemical processes and the provision of services such as carbon sequestration or genetic storage. This shift in perspective has occurred as a result of the fact that these problems have become more prevalent. In modern times, the functions of the soil are more important than the specific qualities of the soil itself in determining the quality of the soil [8]. In the 1970s, the idea of "soil function" was first developed with the purpose of bringing attention to the function that soil performs in the spheres of the environment and the biosphere. Both the United States of America and the European Union, in addition to Russia (the country that once included the Soviet Union), have developed two distinct approaches to the definition of soil functions [9]. The phrase "soil function" is used in Russia to refer to the role that soil and soil processes play in ecosystems, as well as the variables that contribute to the preservation and development of these ecosystems. On the other hand, the research community in the United States and the European Union are largely in agreement that the most popular notion of soil function is one that is more human-oriented and practical. This idea views soil function as an effect of soil processes on the environment and human welfare [10]. It is also important to note that the goals of the application of soil functions differ from one nation to another as well as from one research institution to another. This is in contrast to the situation in Russia and other post-Soviet nations, where soil functions are used for the goal of protecting nature and producing the Red Book of Russian soils. In these countries, people employ soil functions to safeguard nature. For the purposes of property valuation and land-use planning, soil functions are considered to be of utmost importance in Russia [11]. The notion is difficult to put into practice since there is a considerable dearth of understanding about the techniques and parameters that may be utilized to quantify soil functions. This makes it harder to put the idea into practice. The findings of soil functions monitoring and assessment, in the majority of instances, only take into account a limited number of specific functions, rather than offering an evaluation of soil functioning that is comprehensive in nature. While natural and agricultural areas continue to get the majority of emphasis in major reviews, urban ecosystems continue to receive a relatively small amount of attention [12].



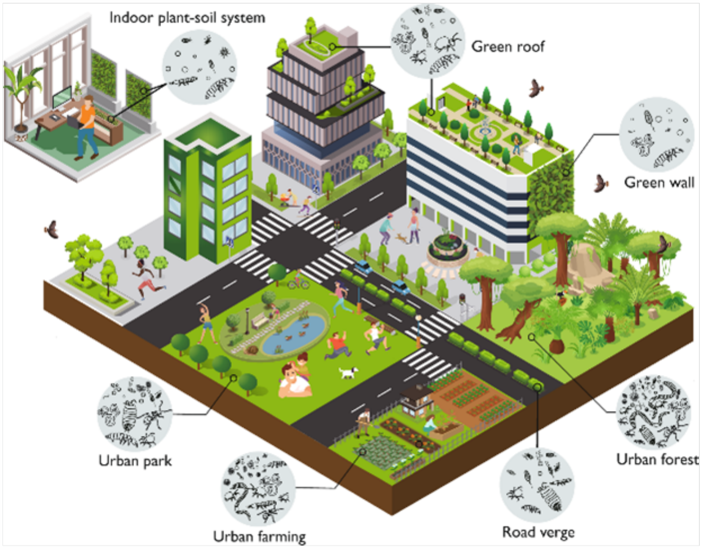


Fig 2 Erosion processing and urbanization Source from Google Scholar: Open access

Classification of urban soils

Historically, it has been believed that urban soils are prone to considerable human disturbances, such as sealing, over compaction, pollution, and salinization. These changes have been attributed to human activities. This direct human influence on urban soils, on the other hand, is further exacerbated by indirect effects of the urban environment, which change the variables that contribute to the formation of soil and the functioning of soil [13]. On the other hand, this direct human effect on urban soils is increased by the urban environment. The processes that are involved in urbanization result in changes that are irreversible to the natural and agricultural landscapes that were there in the past. These changes lead to the establishment of various ecosystems that differ from one another in terms of the movement of matter and energy, the biodiversity of the flora, and the composition of the soil [14].

In contrast to the microclimates of natural settings and suburban areas, the urban microclimate is characterized by a number of distinguishing characteristics. There is a reduction in both the overall amount of solar energy and the amount of time that the sun shines when there is smoke and dustiness present in the air in metropolitan areas. In addition, there is an increased likelihood of fogs and cloudiness being present [15]. An increase in the amount of precipitation that falls on an annual basis is one of the characteristics of the urban climate. Additionally, the average air temperature in densely populated areas is likely to be higher, and the spring and autumn frosts are shorter [16].

It is essential to keep in mind that urban vegetation consists of both native and other species that have been introduced. These species are more adapted to the conditions that are found in urban areas, and they have the capacity to spread to substantial extents in communities that have a variety of bioclimatic conditions. The weather is less likely to have an effect on urban lawns, which are more likely to be regulated by urban management [17]. Up to forty percent of urban areas that are not walled off may be occupied by urban grass. "Intrazonal" traits of urban landscapes are intensified as a result of this, which leads to the biotic homogeneity of metropolitan regions that are located within diverse temperature zones [18]. This is a consequence of the environment.

In urban contexts, relief and parent materials are two additional elements that contribute to the creation of soil that is prone to change that cannot be reversed. As a result of the bulk of the natural hollows and gullies being filled in and hills being flattened, urban relief is mostly artificial. This is done in order to provide the basis for the construction of structures, the creation of landscapes, and the development of architectural styles [19]. At the end of the day, the urban soils become momentarily saturated as a consequence of these modifications, which cause surface runoff to shift and have an influence on the water balance of the soil. Not only do natural and technological sediments, cultural layers, and even buried horizons of natural soils contribute to the formation of urban soils, but the parent materials that contribute to the formation of urban soils are also included [20].

Dust is another substantial component that has an impact on the parent materials of urban soils and contributes to the vertical expansion of the sediment layers. Dust deposition is a significant component that has an influence on the parent materials. A tendency that occurs throughout the process of soil formation is known as the "synlithogenic" tendency [21]. This tendency is characterized by the vertical growth of soil layers. The accumulation of dust and the presence of vegetation are two elements that contribute to the formation of this tendency. On the other hand, the formation of synlithogenic soil is not very prevalent in natural soils. This is because the bulk of the processes that create soil are often oriented downward in the profile (with the exception of alluvial and volcanic soils). Synlithogenic soil formation is a distinctive feature of soils found in metropolitan areas 22. The creation of urban soil is characterized by a variety of traits that are unique to urban environments. These characteristics include the vertical growth of topsoil layers and a predominantly "synlithogenic" soil formation process; short time periods for soil formation, which results in primitive stages of pedogenesis; specific chemical characteristics brought about by dust deposition and anthropogenic disturbances; altered physical characteristics, such as high bulk density and stoniness; and a particular biological community, both in terms of total biomass and biodiversity [23].

Both regional and global categorization schemes accept that there is a significant difference between urban and non-urban soils. This distinction is based on the fact that urban soil is created and the features of urban soil are what distinguish urban soil from non-urban soil. Anthrosols, which are formed by agricultural activity, and Technosols, which are formed at primary soil formation stages with a geomembrane or technical hard material and contain significant artifacts, are the two reference groups that are distinguished by the World Reference Base (WRB) for soil resource. Anthrosols are formed by agricultural activity, while Technosols occur during primary soil formation stages. The formation of anthrosols is a result of agricultural activities [24]. In the context of urban soils, the reference category known as technosols comprises the vast majority of soils. For the purpose of establishing a connection between urban soil and Technosols, it is also acceptable to use the term "Technic" to characterize urban soil if the proportion of artifacts that are present in the soil is less than twenty percent. The "Pretic" criteria has been included into the most current edition of the WRB [25], which allows for the evaluation of urban soils. The soils in question were formed on top of older cultural layers, and thus have a higher concentration of phosphorus and carbon, in addition to a restricted number of solid inclusions. Young age, synlithogenic aspects of soil formation, and specific characteristics such as neutral or slightly alkaline pH, high bulk density, enhanced pollutants, abundant anthropogenic inclusion, and artifacts are the primary focuses of the technique that is used in WRB for the purpose of identifying urban soils. This technique is used for the purpose of determining whether or not a soil exhibits these characteristics. Artefacts are among the other characteristics that are taken into account. When it comes to urban soil, there are three different sorts of diagnostic horizons that are used, and they are referred to as urbic horizons, rehabilitation horizons, and technogenic horizons, respectively [26]. Due to the fact that regional classifications may be more detailed than WRB, urban soils may be categorized into a wide number of various kinds and sub-types as a result of this [27].

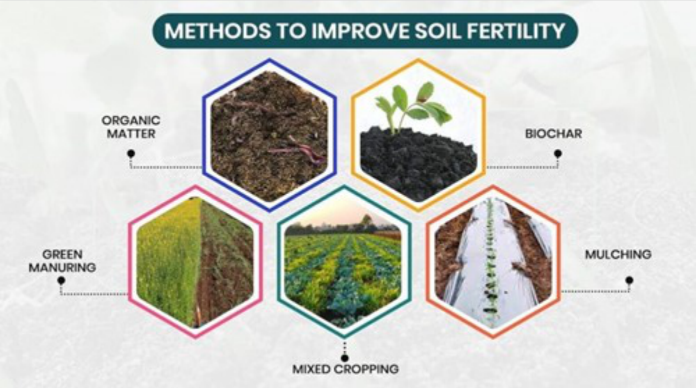


Fig 3: Methods to Improve Soil Fertility: Source from Google Scholar: Open access.

Soil management of urban areas

The USDA-NRCS has identified five guiding principles that may be used to improve the soil health of agricultural land. These concepts are included in the list. One of the initial ideas is called "soil armor," and it refers to the practice of keeping a layer of living plants, agricultural wastes, compost, or synthetic sheeting on top of the soil [28]. All of these things are made easier by this, including the control of soil erosion, the avoidance of weed development, the reduction of soil temperature swings, the decrease of soil compaction, and the creation of better habitats for species that live in the soil. The second principle, which is known as the notion of limiting soil disturbance [29], is based on the idea that the quantity of mechanical, chemical, and biological disturbances that are brought into the soil should be reduced. The third principle is plant diversity, which refers to the practice of producing a range of crops on agricultural land in order to decrease the development of diseases and pests and to preserve a well-functioning soil food web [30]. The fourth principle is that continuous live plant and root systems are responsible for enhancing soil biodiversity, microbial activity, and the capacity to manage soil erosion. These systems are also responsible for the ability to control soil erosion. These are all instances of livestock integration, which is the sixth item covered in this idea. Some examples of livestock integration include agricultural residue, animal grazing in cover crops, and weed management. The National Agricultural and Agricultural Research Service (USDA-NRCS) of the United States Department of Agriculture has been committed to the development and implementation of effective soil management strategies since the 1940s. The goal of these strategies is to preserve soil and improve soil ecosystem services, particularly agricultural production [31]. In the context of modern agriculture, the implementation of soil management practices is of utmost importance in order to either enhance crop yield or limit the adverse impacts on the environment. The use of land in an appropriate manner, cropping systems, conservation tillage, the application of organic residue, agronomic fertilization, and engineering soil conservation structures are some of the strategies that are included in this category [32]. These strategies are a direct translation of the five essential principles of soil health, and it has been shown that they are effective in preserving and increasing the health of the soil. Agricultural methods that are not adequate may lead to significant losses of healthy topsoil in water and wind, which in turn leads to a decrease in land productivity and a degradation in the quality of the environment [33].

A key source of soil health degradation is rapid soil erosion, which is the basic cause of soil health deterioration. This is also the primary source of soil health degradation. Proper land use is vital in the maintenance of soil health because human activities are impacted by the capabilities of the soil. This is because the soil is necessary for human activities. There are eight unique categories that are used to classify natural soils. These categories are determined by geography and the characteristics of the soil. Terracing, artificial drainage, and irrigation are some of the necessary management practices that should be implemented in order to overcome the limitations that are connected with the use of Class III–V soils for crop production. Therefore, it is essential to execute these management practices. The use of these regions for range, forestry, animal habitat, or recreational purposes is common since they are not suitable for agricultural purposes such as farming. Agricultural production is not possible on areas classified as Class VI-VIII [34]. Clay and clay loam are examples of heavy-textured soils that are not suitable for the placement of septic tanks. This is due to the fact that these kinds of soils are more likely to experience soil erosion losses and degradation. Among the methods of crop production that are considered to be acceptable is the practice of crop rotation, which involves the cultivation of two or more unique crops in alternating fashion on the same land throughout different seasons. As a consequence of the fact that different types of crops serve as hosts for a wide range of pests and soil microorganisms, this leads to the reduction of the number of pests and illnesses discovered in agricultural soils [35]. It is possible that altering the kind of crops that are cultivated in a particular region might help break the cycle of sickness, which in turn would assist in the management of illnesses and pests that are carried via the soil. Increasing crop yields is one of the many benefits of crop rotation, which also improves soil structure, resilience to erosion, biodiversity, carbon sequestration, and overall soil health. A major improvement in the health of agricultural soil may be achieved by the practice of crop rotation over an extended period of time, especially with regard to leguminous plants [36]. In order to maintain the soil's health, one of the most efficient methods is to plant a cover crop on agricultural land that is presently in a fallow state. The term "cover crop" refers to a kind of living ground cover that is planted either before or after a main crop and is often removed before the development of the crop that comes after it. They have been used in agricultural agriculture for a considerable amount of time, spanning many centuries. Orchards, greenhouses, high tunnel nurseries, and agricultural fields are common places to find them throughout the winter months [37]. They are also often seen on the strips that appear between the rows of trees. There are a few types of grasses, legumes, and broadleaf plants that are considered to be cover crops. There is a significant relationship between their existence and the avoidance of soil erosion, the maintenance of soil microbial diversity, and the enhancement of soil health. Different agricultural techniques and procedures have been developed in order to reduce the costs that are associated with growing cover crops and terminating them. These techniques and methods have been developed in order to reduce the expenditures. In order to properly cultivate cover crops, it is necessary to give careful consideration to a number of critical criteria, including the formulation of the seed, the seeding rate, as well as the planting and termination dates [38].

Through the addition of organic matter (OM) to the soil, the suppression of weeds and pests, the reduction of compaction, the improvement of soil structure, the enhancement of water infiltration, the promotion of nutrient retention and cycling, and the provision of emergency forage, cover crops bolster crop rotation and contribute to the health of the soil. Cover crops are a practical implementation of soil health principles 1, 3, 4, and maybe 5 (if animal grazing is included in the equation to be considered). The USDA-NRCS was the organization that came up with these concepts [39].

It has been shown that living cover crops are beneficial in reducing the amount of soil erosion losses and increasing the structure and function of living microbial communities, as stated by the conclusions of a comprehensive review that was carried out by Sharma et al. (2018). Oats were used as a cover crop in a winter wheat-fallow cropping system, which resulted in a reduction of more than 41 percent in the quantity of inorganic nitrogen in the soil. On the other hand, the amount of total nitrogen, total organic carbon, and biomass residues in the soil were all increased [40].

Fig 4: Materials and wastes: Source from Google Scholar: Open access

"Conservation tillage" is a planting technique or reduced tillage that, after planting, covers at least thirty percent of the soil surface with crop residues in order to minimize the quantity of water that is lost to erosion. This is done in order to prevent the loss of water. There are a few different types of tilling operations that fall under this category. Some examples are strip till, ridge till, stubble mulch till, reduced till, and no-till. Conservation tillage, which significantly reduces the amount of mechanical disturbance that farming soil is subjected to, is one of the most essential phases in the process of reaching the USDA-NRCS soil health principle 2 [41]. The quantity of soil erosion losses and greenhouse gas emissions are decreased, the organic content in the soil is conserved, and the structure of the soil is enhanced. All of these benefits are achieved via erosion control. There are further benefits, such as a reduction in the costs associated with tillage, subsurface soil compaction, improved water infiltration, and an increase in the amount of water that is conserved in the soil. Conservation tillage techniques, and notably no-till systems, have a variety of limitations as compared to conventional tillage systems [42]. These drawbacks are particularly noticeable in no-till systems. Among them are the chance of delays in spring planting due to soil that is either too wet or too cold, higher expenditures for weed and pest management, increased risks of nutrient runoff, limited root growth and development, and the possibility of increased costs for weed and pest control expenses. Strip tillage, on the other hand, has been shown to have the potential to enhance the stability of soil aggregates, in addition to the quantity of active organic carbon, mineralizable nitrogen, and microbial activity in vegetable plots [43].

In a rice-wheat cropping system in Pakistan, conservation tilling was shown to positively impact soil health, as demonstrated by the findings of a research study. This enhancement was seen in a variety of areas, such as the ability to store water, the pH, the total nitrogen, the accessible potassium, and the amounts of organic matter (OM). On the other hand, it is probable that the evaluation tools that are now available are not capable of providing an accurate assessment of the efficacy of conservation tillage [44]. The organic matter (OM) that is present in the soil is the most significant factor that impacts the overall health of the soil, with humic compounds being the most prevalent component. There are a number of elements that have an effect on the composition and content of organic matter. These include the local climate, the texture of the soil, the mineralogy, the use of the land, and the management. Tillage and artificial drainage both contribute to the decomposition of organic matter (OM) in the soil by increasing the amount of oxygen that is introduced into the soil with each of these practices. To the contrary, organic amendment is a technique that involves the addition of additional organic residues to the soil in order to increase the amount of organic matter (OM) that is present in the soil [45]. Increasing the amount of organic matter in soil and improving its biological properties can be accomplished through the application of organic residues or soil amendments. These include plant debris, animal manures, biosolids and composts, food processing rejects, agro-industrial wastes, and biochar. They are an effective method for achieving these goals. The findings of a field research that was carried out in Ireland indicated that soil amendments that included a substrate made of wasted mushrooms and a compost that was subjected to forced aeration produced barley grain yields that were much higher than those produced by the control and equal inorganic NPK fertilization treatments. The pace of amendment was shown to be linked with these yields [46].

There are significant amounts of plant nutrients that can be found in organic amendments such as wasted mushroom substrate, poultry litter, bio solids, and solid animal manures. The bulk density and acidity of the soil decrease, while the levels of organic carbon, total nitrogen, and accessible phosphorus rise. Organic amendments can be found in a variety of forms. When it comes to efficiently improving the health of the soil, it is feasible to apply these amendments to the land in a way that is both continuous and repeating, and at rates that are appropriate [47]. It is vital that scientific land application programs be organized with careful attention paid to the quality of organic amendments, the application rate, the timing, and the method in order to minimize the impact on the environment. This is because the environment is the primary target of these programs. Surface broadcasting is the most common way of treatment for solid organic pollutants, which is subsequently followed by immediate soil absorption. However, there are other methods of treatment that are also used. When it comes to slurry organic wastes, on the other hand, subsurface soil injection is the method of choice [48]. The land is utilized for the production of crops from spring through fall in an integrated system that incorporates crop-range-livestock production. The plant leftovers that are generated are left on the field for livestock animals to graze throughout the winter months. This system is referred to as a crop-range-livestock system. The rangeland is used for the purpose of raising livestock animals throughout the seasons of the year when crops are being planted [49].

One of the possible benefits of incorporating cattle grazing into the conventional cropping system is that it has the potential to enhance the health of the soil, reduce the quantity of chemical fertilizer and pesticide that is needed, and raise the efficiency with which farmers utilize their resources. On the other hand, excessive grazing may lead to problems such as the deterioration of soil health, the compaction of soil, the breakdown of aggregates, and the infiltration of water [50].

Overgrazing may lead to the degradation of soil, particularly when it includes larger animals like cattle. This is especially true when the animals in question are cattle. The practice of grazing animals in a pattern that rotates is one possible method for avoiding this from happening. In order to do this, a pasture is subdivided into smaller paddocks, and only a portion of those paddocks is grazed at any one time, while the other paddocks are left ungrazed. Through the use of this technique, the restoration of fodder is made feasible [51]. On the other hand, the benefits of rotational grazing can be lessened if the timeline is rigorous and does not take into consideration the speed of plant growth. It is feasible to minimize soil erosion, enhance water quality, and boost animal production by implementing a rotational grazing program that is properly managed. These goals may be accomplished via the execution of the program. If it is managed correctly, a rotational grazing program has the potential to improve both the quality of the water and the productivity of the animals within the program [52].

Soil web

It is a complex community of organisms that interact with one another to have a significant impact on activities that take place both above ground and below ground. This community is known as the food web of the soil. Soil-dwelling organisms, which play major roles in the function of soil, provide the foundation for vital activities such as the construction of soil structure, decomposition and nutrient cycling, bioremediation, and the promotion of plant health and diversity. These activities are crucial for the function of soil. The organic matter that is present in the soil is the principal source of energy and nutrients that are used by an assortment of organisms, including plants and other living things [53]. There are bigger organisms, such as small arthropods, that play a part in the process of decomposing plant matter and other organic waste. These organisms help promote the breakdown of these organic wastes. Common insects and other species that are associated to them play an active role in the process of decomposition that occurs within agricultural systems. This, in turn, helps to maintain populations of arthropods that are useful to the environment, such as predatory pests. Nematodes and mites may be found living in the pores of the soil, and decreasing the amount of soil disturbance helps to conserve the soil as a home for beneficial soil organisms. This is accomplished by conserving the pores and channels that are already present in the soil, which allows these microscopic species to continue to thrive [54]. A few examples of the many transformations that nitrogen (N) may undergo in the soil as a consequence of microbial activity include mineralization, nitrification, and nitrogen fixation. These are only a few of the many possibilities. Both free-living organisms and root-symbiotic organisms are capable of undertaking the process of nitrogen fixing. There is a process known as symbiotic nitrogen fixation, which occurs when bacteria that are found inside the nodules of the roots of plants that belong to the legume family fix more nitrogen. This process occurs when the plants are cultivated in soil that has low levels of NH_4^+ and NO_3^- [55].

Organic matter in the soil is also responsible for providing a significant portion of the cation exchange capacity (CEC) that the soil already has. By retaining positively charged nutrients in the soil, this ability serves to reduce the loss of these nutrients owing to leaching, which is a process that occurs when nutrients are lost. One of the few ways that the carbon exchange capacity (CEC) of the soil may be improved is by increasing the quantity of organic matter that is present in the soil [56].

One of the variables that has an effect on a wide variety of aspects of nutrient cycling and soil biology is the pH of the soil. The pH of the soil is a measurement of the activity of hydrogen ions in the soil solution. However, there are a few exceptions to this rule, and the majority of crops thrive best in soil with a pH that falls anywhere between 6 and 7. Because the pH of the soil is responsible for controlling the availability of a number of micronutrients, the availability of iron, manganese, and zinc rises as the pH of the soil becomes more acidic. This is because the pH of the soil contains a number of micronutrients. Plants often have specific micronutrient needs, which would explain why they prefer a pH that is higher than the average range of 6–7 [57]. It is common for crops to have these requirements. The pH of the soil has an influence on the organisms that dwell in the soil. In contrast to fungi, which flourish in soils with a broad range of pH values, earthworms and bacteria prefer a soil pH that is rather near to this neutral value.

Conclusion

In conclusion, it is vital to place a priority on the cleanliness of urban soils in order to cultivate cities that are both robust and sustainable. Keeping an eye on and working to enhance the condition of the soil is becoming an increasingly important need as urbanization continues to spread around the globe. Cities have the ability to alleviate the negative impacts of pollution, assist activities pertaining to urban agriculture, and improve the general quality of life for their citizens if they adopt targeted soil improvement methods and apply efficient monitoring systems. Furthermore, investments in green infrastructure and community-based initiatives have the potential to not only enhance the health of the soil but also to foster social cohesion and environmental stewardship. However, in order to solve the complex difficulties that are connected with urban soil management, it is necessary for people, scientists, community groups, and legislators to work together. By cooperating with one another, cities have the ability to produce healthier environments, improve food security, and construct urban landscapes that are more dynamic and sustainable for both the present generation and the generations to come.

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