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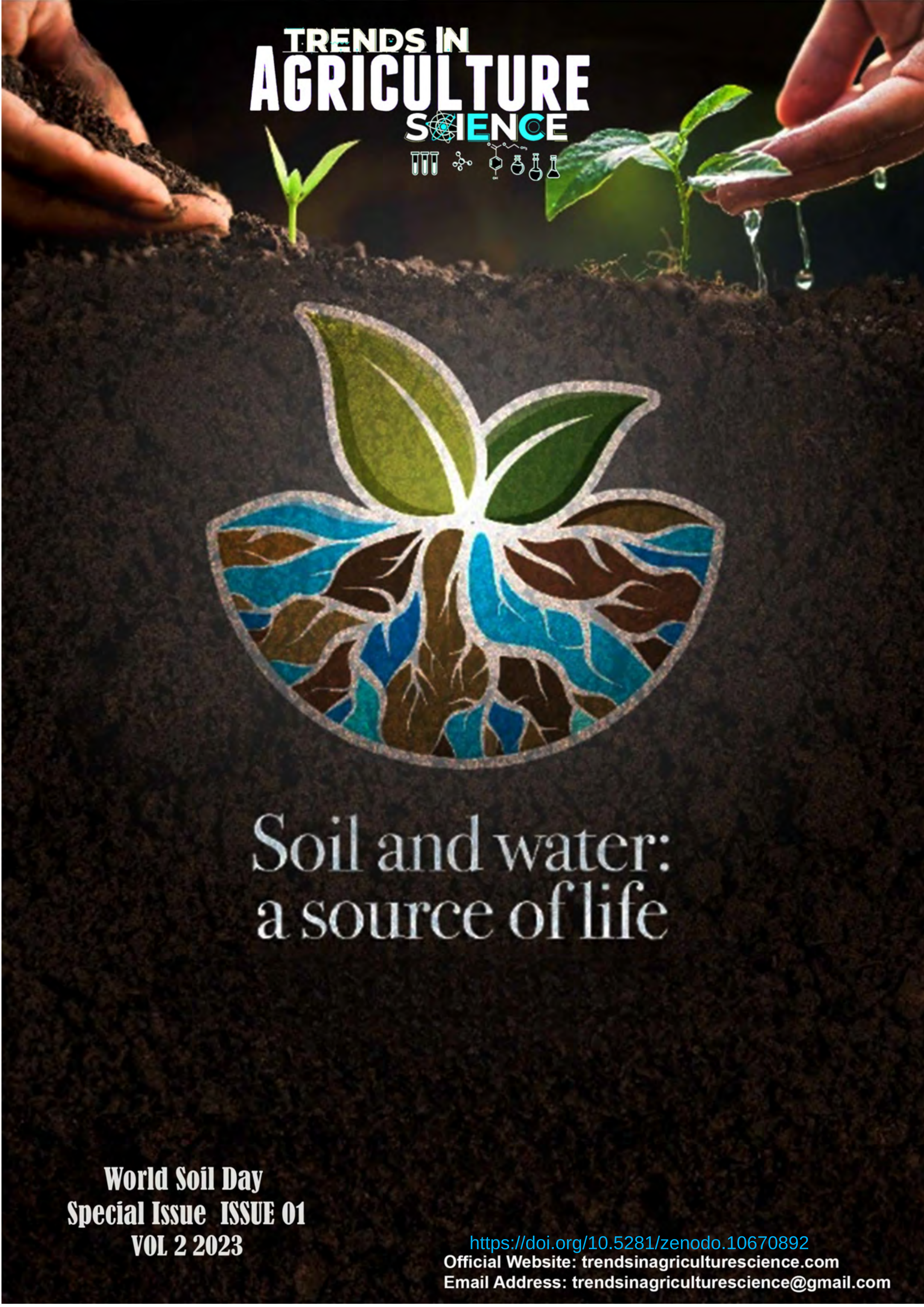

Soil and water: a source of life

World Soil Day
Special Issue ISSUE 01
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Editor In Chief
Dr V Kasthuri Thilagam

Soil and Water: A source of life

Greetings to all on the occasion of World Soil Day 2023

I believe the theme of WSD 2023 to be very pertinent to the present climate change scenario where soil and water resources are degrading faster. But these natural resources are constantly under pressure to feed and shelter the exploding population. Soil erosion is the principal degradation process and one of the most serious threats to soil and water quality. In India, about 146.8 Mha areas are under degradation due to erosion, salinity, acidity, and a combination of other factors. Apart from being the cause of soil degradation, erosion also results in water pollution by transporting the excess nutrients and chemicals from agricultural lands to the water resources. This also causes enrichment of nutrients in the waterbody and results in Eutrophication and water pollution issues. Further, the eroded soils are deposited in the waterbodies and reduces the storage capacity. The intricate connection between soil and water should have been understand by the people. Adoption of suitable and sustainable soil and water conservation practices is the eternal base for restoring soil health and water quality. Soil is no more an inert medium to physically support plant but a living entity has "health" that nourishes billions of lives in it. Soil system always responds to the way it has been treated and managed. Healthy soil and water are the basis for a healthy generation. They are the vital natural resources that bestowed the basic needs of not only humankind but also the lifeforms of the earth. Maintaining healthy soil can yield healthy food and clean water to not only humanity but to all the life forms of the earth.

Healthy Soil! Healthy Water!! Healthy people!!!

Dr A Vennila
Principal Scientist (Soil Science)
ICAR - Sugarcane Breeding Institute
Coimbatore- 641 007, Tamil Nadu

Soil: a live natural resource that supports life on earth

Soil is a unique natural resource that needs to be alive to support life. People have different views about soil. Most people view soil as an inert system, except the farmers. People exploit the soil resources to meet their greed, accelerating soil degradation. Although farmers knew that the soil is a live system, the social conditions such as pressure to produce more, lack of awareness and environment friendly technologies to solve the crop production issues, and easy access to synthetic inputs make them overlook the fact of live soil and indulge in irrational treatment of soil leaving the system to deteriorate over the time. The theme of World Soil Day 2023 is “Soil and water, a source of life” is selected in the appropriate time when the impact of thoughtless activities of humans and climate change on these two natural resources are very much evident around the world. These two resources are interlinked when it comes to agriculture. The soil supplies all the essential nutrients to the plants except carbon and oxygen which are supplied by air and hydrogen by water. Most of the plant nutrients are absorbed through mass-flow along with water, however for other modes of nutrient absorption also water is essential to make the nutrient available. Within the plant also, nutrient mobility is essentially regulated through water. Soil is a habitat for organisms that take part in nutrient cycles and produce many life-saving medicines, thus playing a vital role as a reservoir of biodiversity. Anchorage provided by the soil makes the plants withstand the climatic vagaries. Apart from providing nutrients and anchorage, soil plays a significant role as a purifier through filtration and detoxification processes. As per Food and Agriculture Organization, 95% of the food originates directly or indirectly from soil and water. In recent years, soil and water resources are threatened by population pressure, urbanization and industrialization, resulting in pollution, erosion and loss of biodiversity. Rational use of these two resources is urgently needed at this junction. Hence, it is a time to call for an integrated approach to preserve these two natural resources for future generations and sustain the ecosystem.

In this World Soil Day 2023, it’s our prime duty to understand and spread the message “Soil and water as live resources need ethical treatment from each of us”.

Healthy soil means a w(h)ealthy planet.

Dr. Praveenkumar B. Naikodi
Ass Prof Soil Science,
Department of Natural Resources Management.
College of Horticulture, Bidar.58540
University of Horticultural Sciences, Bagalkot

Message on World Soil Day

Two fundamental natural resources from which over 95 per cent of our food originates are soil and water. As the basis for the food chain and life cycle of countless creatures on the earth, soil is being put under tremendous pressure to cater to the needs of the ever-growing human population. Unfortunately, we are losing the soil both in qualitative and quantitative terms, majorly due to anthropogenic and natural activities both at global and national levels at a rapid pace. Many research findings have indicated that climate change, global warming, and natural calamities directly or indirectly relate to soil and land status. To address the issue, science-based conservation efforts and strategies for sustainable enhancement of productivity at macro and micro levels are being made by various institutions, organizations and farmers. Research findings, technologies, and success stories of broader applicability in saving soil, land and water for their productive management are being exchanged through several platforms and levels. Ultimately, a farmer, an institution, and the students must thoroughly understand the capabilities and limitations of soil and land to adopt suitable scientific management strategies. Issues of the status of soil testing, nutrient management based on soil test results, and the source and rate of fertilizer on soil and land degradation are to be addressed at the grassroots and international levels. Looking at the vital role of soil users at different levels, celebrating World Soil Day and similar events have become of greater importance, wherein conserving soil and enhancing its productive capabilities can be sensitized. Very importantly, students of different age groups who have never been exposed to such realities can be motivated to join hands in such a vibrant cause. Any policy or strategy can be effective and successful only when the end user is participating with a complete understanding of nature, its properties, the importance of soil and their role in saving the soil. There is a need to conduct events or activities like World Soil Day regularly to bring institutions and individuals mainstream to achieve the common goal of saving soil and its productivity in a sustainable manner.

Dr. Shaikh Nasrul Islam
Managing Editor

As we commemorate World Soil Day 2023, I am compelled to reflect on the paramount importance of soil and water as indispensable resources that sustain life on our planet. This year's theme, "Soil and Water: A Source of Life," resonates profoundly in light of the escalating challenges posed by human activities and climate change, which are increasingly evident in the degradation of these essential natural resources.

Soil, often overlooked as an inert system by many, is, in fact, a vibrant and living entity that forms the foundation of our existence. While farmers recognize the vitality of soil, societal pressures and a dearth of environmentally conscious technologies often lead to its exploitation and degradation. It is imperative that we, as stewards of the land, foster a deeper understanding of soil's intrinsic value and adopt sustainable practices to ensure its preservation for future generations.

The intricate relationship between soil and water underscores the interconnectedness of these resources, particularly in the realm of agriculture. Soil serves as a reservoir of essential nutrients for plant growth, while water acts as a vital medium for nutrient absorption and mobility. Moreover, soil serves as a habitat for diverse organisms, plays a crucial role in filtration and detoxification processes, and is a primary source of food production, with 95% of our food originating directly or indirectly from soil and water.

Despite their indisputable significance, soil and water resources are under increasing threat from population growth, urbanization, and industrialization, leading to pollution, erosion, and biodiversity loss. Now, more than ever, we must advocate for the rational and sustainable utilization of these precious resources, employing an integrated approach to safeguard them for future generations and sustain the delicate balance of our ecosystem.

On this World Soil Day, let us pledge to champion the ethical treatment of soil and water as living resources deserving of our utmost care and respect. By nurturing healthy soil, we nurture a healthy planet—one that thrives with abundance and vitality.

Warm regards,

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WORLD SOIL DAY
DECEMBER 05

WINNERS

OF WRITING COMPETITION

1. **The vital connection between soil, water and economic growth by** Harini. M and Gobikaa. G. M

2. **Wetland Ecosystem: Sustaining Life Through soil and water Interaction** by Shruthika SN

3. **Flow with water and grow with the soil** by Manish Mahalik.D

4. **Influence of climate change on soil fertility** by S.Surya Prakash

5. **Exploring the Crucial Role of Mangroves: Mitigating Soil Erosion and Enhancing Water Purification in Coastal Ecosystems** by Bhadarka Mayur Ramdebhai

Dr V Kasthuri Thilagam Ph.D
Editor In Chief

Dr Nasrul I. Shaikh
Managing Editor

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WORLD SOIL DAY
DECEMBER 05

CONSOLATION AWARDS

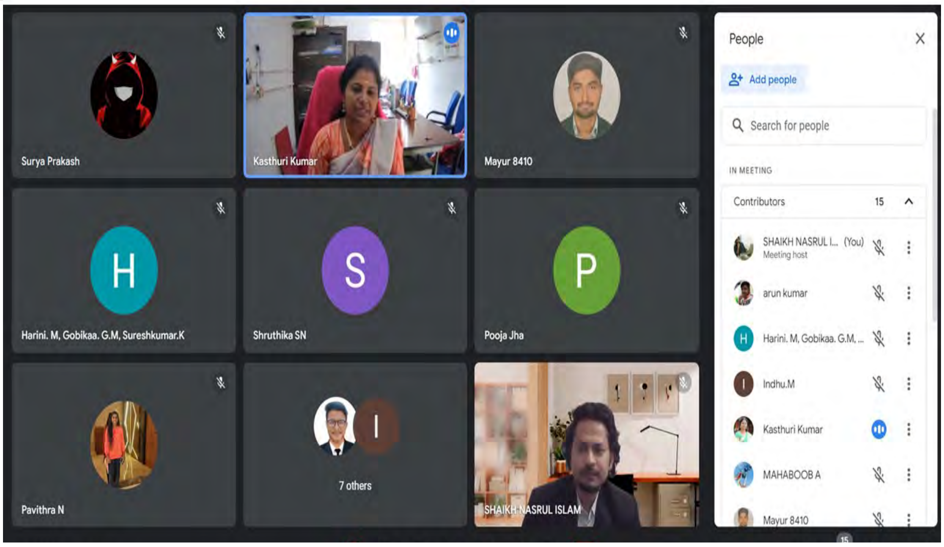
OF WRITING COMPETITION

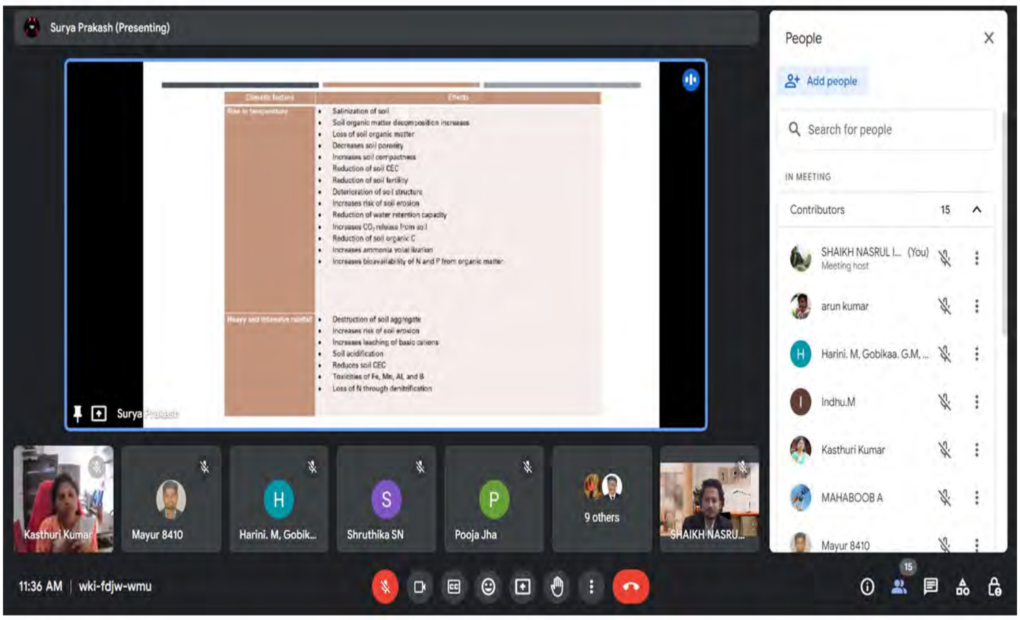
1. Soil and water, the source of life by Pavithra. N
2. Miracle of water in soil and its benefits in real life by Kaaviya AV
3. Soil and Water : a Source of Life by Pooja kumari

Dr V Kasthuri Thilagam Ph.D
Editor In Chief

Dr Nasrul I. Shaikh
Managing Editor

AWARD CEREMONY





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Farmers awareness campaign on Soil and Water: A Source of Life

Vennila, A., Kasthuri Thilagam V. and Palaniswami, C.
ICAR-Sugarcane breeding Institute, Coimbatore - 641007

Introduction

ICAR- Sugarcane Breeding Institute, Coimbatore Celebrated World Soil Day on 05th December 2023 at Annur, Coimbatore District collaboration with Bannari Amman Sugars Ltd., Sathymangalam. Dr.V Kasthuri Thilagam, Senior Scientist welcomed the farmers and briefed the history and importance of celebrating World Soil Day, and explained the theme of World Soil Day 2023, Soil and Water: a source of life. International Union of Soil Science in its 17th World Congress of Soil Science held at Bangok, Thailand in 2002 under the leadership of Kingdom of Thailand proposed for an international day to celebrate soil to create awareness on the importance of soils and promote sustainable management of soil resources. Subsequently in 2013, the FAO endorsed the proposal and requested the United Nations to adopt in its General Assembly. Accordingly, in 2013, UN General Assembly designated 05 December 2014 as the first official World Soil Day. 5th December is the birthday of Thailand King late King Bhumibol Adulyadej, who has contributed immensely to soil science and also supported the proposal of celebrating Word Soil Day. After its official designation, the world soil day is being celebrated all over the world with a theme in each year. The theme of World soil day 2023 is chosen to create awareness on the interlink between soil and water contributing for sustaining life on earth. Soil and water support for about 95% of food production in the world. One of the important roles of soil is to provide essential nutrients to the plants and animals. Soil water plays an essential role in nutrient uptake by plants. Most of the nutrients are absorbed through mass-flow along with water. Apart from this service, soil purifies the water and provides anchorage to roots. Soil though its carbon sequestration takes part in climate change mitigation. Hence, we have our primary responsibility of protecting soil and water from deterioration.

Healthy soil and quality water

On the occasion Dr A. Vennila Principal Scientist delivered lecture on “Healthy soil and quality water for sustainable sugarcane production” and also stressed the importance of soil and water testing. Soil and water are the two natural resources undergoing accelerated deterioration due

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to population pressure, uncontrolled greedy human activities, etc. The soil physical, chemical and biological constraints affecting sugarcane productivity and the management measures to be adopted by the farmers were deliberated upon. The subsurface soil compaction and hardpan management using chisel ploughing and enrichment of soil with organic matter was suggested. The role of integrated nutrient and water management in conservation soil and water resources were also highlighted. Improving soil organic carbon status in sugarcane soils by intercropping with legumes and trash mulching was emphasized to promote resource use efficiency as well as sustainability of these two natural resources. The farmers were advised to test the soil and water at least once in three years to know the existing status of quality and management requirement. Representative sample collection is the crucial part of soil and water testing to obtain appropriate analytical results. Sugarcane being a nutrient and water demanding crop, needs suitable soil and water management to sustain the productivity. Site-specific soil and water management should be adopted by the sugarcane farmers to continue sugarcane cultivation in a profitable manner.

Improved management practices and organic agroinputs for sugarcane cultivation

Dr S. Mohan, AGM (Cane Development), Bannari Amman Sugars Ltd., delivered lecture on Improved management practices for sugarcane cultivation, he also emphasized the role of organic inputs in enhancing soil health and sugarcane yield.

Subsidy schemes available for the sugarcane farmers

Subsidy schemes available for the sugarcane farmers from the sugar factory and the government for the adoption of improved sugarcane cultivation practices and organic agroinputs was explained by Mr K. Gokul, Steer Manager (Cane) from Bannari Amman Sugars Ltd., Sathyamangalam.

Distribution of soil health cards and extension material

During the occasion, Soil Health Cards prepared by ICR-SBI distributed to the farmers with nutrient status of the soil tested and fertiliser recommendations for achieving 125 tha^{-1} sugarcane yield. The brochure on "Collection of soil and water samples" was also distributed to the farmers who participated in the world soil day programme. On the occasion two videos prepared by ICAR on "Compost preparation" and "Balance fertilization" was showed and explained to the farmers. Farmers also interacted with scientists regarding integrated nutrient management and soil health maintenance and factory managers on availing subsidies and inputs.

Demonstration of soil and water sampling

The detailed procedure for the collection of representative soil and water samples for sugarcane cultivation was demonstrated to the farmers. The depth of soil sampling should be 30 cm for sugarcane and should be collected soil from 5-10 spots covering the field in a zig - zag pattern by making a 'V' shaped pit in each spot using spade/kurpi and an inch-thick slice of soil from top

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to bottom of exposed face of the 'V' shaped cut should be collected. Proper adoption of quartering method of reducing sample size and packing and labelling was also demonstrated. Water sampling directly from the open well as well as from pump outlet were also demonstrated to the farmers and also the importance of submitting water samples immediately to the nearest analytical laboratory was also explained.

The programme ended with the formal vote of thanks by Mr C. Eswaramoorthy, Manager (Cane), Bannari Amman Sugars Ltd., Sathyamangalam.






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ICAR - Sugarcane Breeding Institute


World Soil Day

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World Soil Day Celebrations at Kumaraguru Institute of Agriculture (Kia), Erode District

Dr.S.Hemalatha, Associate Professor (SS&AC)
Dr.V.Dhinesh, Asst. Professor ((SS&AC)
Dr.R.Abishek, Asst.Professor (SS&AC)
Ms.V.Sowndharya, I B.Sc.(Hons.) Agriculture
Ms.Dhivyadharshini, , I B.Sc.(Hons.) Agricultur
Kumaraguru Institute of Agriculture, Erode

Introduction

In a joint effort to raise awareness about the vital role of soil and water in sustaining life, Kumaraguru Institute of Agriculture (KIA) and Sakthi Sugars Limited Appakudal came together to celebrate World Soil Day at Kallipatti village. The theme for this year's celebration was "Soil and Water: Source of Life," emphasizing the interconnectedness of these two essential elements for the well-being of our planet. Mr. K. Prakash, Correspondent, KIA presided over the function.

Key Highlights of the Event:

Awareness Speech on Protecting Water: Dr. B.J. Pandian, the Principal of Kumaraguru Institute of Agriculture, delivered a compelling speech on the importance of protecting water resources. He highlighted the critical role water plays in agriculture, ecosystems, and daily life. Dr. Pandian stressed the need for sustainable water management practices to ensure a secure and abundant water supply for future generations.

Protecting Soil: A Lecture by Mr. P. Ashok Kumar: Mr. P. Ashok Kumar, General Manager (Cane) at Sakthi Sugars Limited, shared his insights on the protection of soil. Drawing a powerful analogy, he likened soil to a mother, emphasizing the nurturing and life-giving qualities it possesses. He discussed the impact of soil erosion, chemical contamination, and the importance of adopting responsible agricultural practices to preserve the fertility of the land.

Bioslurry Application on Soil: An Overview by Dr. B. Sudhagar: Dr. B. Sudhagar, Professor (Research) at KIA, provided an informative overview of bioslurry application on soil. He explained the benefits of using bioslurry as a natural fertilizer, promoting sustainable farming practices. Dr. Sudhagar also highlighted the subsidies available to encourage the installation of bioslurry units at the household level, aiming to make eco-friendly agricultural solutions more accessible.

Fig. 1 Dr. B.J. Pandian, Principal KIA addressing the gathering

Creative Contributions by KIA Students: Adding a touch of creativity to the event, first-year students of Kumaraguru Institute of Agriculture crafted attractive cake models representing the importance of soil and water conservation. These visually striking displays served as a powerful medium to convey the significance of nurturing our environment for a healthier and sustainable future.

Fig. 2 Cake models done by students

Mr. A. Balasubramanaian, Executive Officer, KIA offered felicitations. Dr. S. Hemalatha, Associate Professor (SS&AC) and Staff Advisor welcomed the gathering and Mr. K. Gobalakrishnan, Asst. Professor (FOR) proposed vote of thanks. More than 75 farmers, Agricultural Officer, Assistant Director of Horticulture, Asst. Agricultural Officers from T.N. Palayam Block, Govt. of Tamil Nadu , Cane officers from Sakthi Sugars Limited participated in the event.

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Conclusion

The World Soil Day celebration at Kallipatti village, organized jointly by Kumaraguru Institute of Agriculture and Sakthi Sugars Limited, successfully conveyed the urgency of protecting our precious soil and water resources. Through informative speeches, engaging lectures, and visually appealing displays, the event left a lasting impact on the community, inspiring individuals to take an active role in safeguarding the source of life on Earth. As we continue to face environmental challenges, such collaborative efforts contribute to building a collective consciousness for sustainable and responsible living.

The programme was organized by Soil Science unit and NSS unit of KIA

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The Magic Beneath Our Feet: Soil and Water's Incredible Contributions to Life

[1]S. Santhosh kumar, [2]M. Viknesh kumar [3] Er. K. Sureshkumar

[1&2] UG Scholar, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

[3] Assistant Professor, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638

Abstract

This article emphasizes the profound interconnectedness of soil and water with life, advocating for their conservation and responsible management to ensure a sustainable and resilient future for our planet. The guardianship role of soil and water is explored showcasing its significance in agriculture, climate mitigation through carbon sequestration, water purification, and pharmaceutical potential. Similarly, water acts as a guardian, regulating climate through oceanic processes, serving as reproductive and migration pathways for aquatic species, and maintaining the hydrological cycle

Introduction

When we think about the wonders of the natural world, our attention is often drawn to majestic landscapes, soaring mountains, and sparkling oceans. However, there is an entire universe of marvels lying just beneath our feet—soil and water. The intricate relationship between these two elements is crucial for sustaining life on Earth. In this article, we will delve into the hidden wonders of soil and water, uncovering their profound impact on the world around us.

Soil: Pillar of Ecosystems

Soil is far more than just dirt beneath our feet. It is a complex mix of minerals, organic matter, water, air, and microorganisms. Soil serves as a vital foundation for an array of ecosystems, from forests to grasslands, and from wetlands to deserts. The health and diversity of life above ground are intricately connected to the health and diversity of the soil beneath. Microorganisms regulates the overall functioning of ecosystems.

Water: The Essence of Life

Water is the essence of life. It has unique properties to support life in extraordinary ways. Water provides a medium for chemical reactions to occur, allows cells to transport nutrients and wastes, and helps maintain temperature stability. The water cycle is a continuous process through

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which water circulates on Earth. Water and climate are closely intertwined. It is the engine that drives ecosystems, regulating temperature, distributing precipitation, and shaping the landscape.

Soil and Water's Role in Sustaining Biodiversity

Different life forms ranging from minute nematodes to highly evolved organisms and microscopic phytoplankton to majestic marine mammals depends on soil and water for their survival and sustainable living. Additionally, water bodies like rivers and wetlands contribute to biodiversity by hosting unique ecosystems and providing breeding grounds for many species.

Everything we eat in one way or another, comes from the soil. The **interdependence of soil and water** in maintaining biodiversity highlights the importance of conservation efforts to preserve these vital components of our environment.

Soil: Guardians of Biosphere

- **Agriculture and Food Production:**

  Soil serves as the primary medium for plant growth, supporting agriculture and ensuring food production. The nutrients present in soil are essential for the development of crops, which, in turn, sustain human populations. Soil has cultural significance and provides the foundation for agriculture, which sustains human societies

- **Climate mitigation through carbon sequestration**

  Soil plays a vital role in carbon sequestration by capturing and storing carbon from the atmosphere. This helps to mitigate climate change by reducing the concentration of greenhouse gases, contributing to the overall health of the biosphere.

- **Water Purification and water retention:**

  Soil acts as a natural filter by removing impurities and contaminants from water during percolation. This process helps purify water, maintaining the quality of water sources that support aquatic life. Healthy soil has the capacity to retain water, preventing runoff and facilitating gradual water release. This regulation helps maintain soil moisture levels, supporting plants during dry periods and reducing the risk of water scarcity.

- **Pharmaceutical Potential:**

  Many pharmaceuticals and medicinal compounds are derived from plants that grow in soil. Soil biodiversity contributes to the synthesis of various secondary metabolites with potential therapeutic properties, making soil a valuable resource for medicine.

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Water: Guardians of Biosphere

- **Climate Regulation:**

  Oceans play a pivotal role in regulating the Earth's climate. They absorb and store heat, influencing weather patterns and helping to maintain a stable climate. Ocean currents also distribute heat around the globe.

- **Reproductive and Migration Pathways:**

  Reproduction: Many aquatic species depend on water bodies for reproduction. Oceans, rivers, and lakes serve as spawning grounds for numerous species, ensuring the continuation of their life cycles. Migration Routes: Water bodies often act as migration routes for various species, especially birds and fish. These migratory journeys are essential for breeding, feeding, and maintaining population diversity.

- **Hydrological Cycle:**

  The water cycle, involving processes like evaporation, condensation, and precipitation, connects various components of the biosphere. It ensures a continuous flow of water, linking terrestrial, aquatic, and atmospheric systems.

Duties of every individual to protect our Guardians – Soil and Water.

  - **Efficient Resource Management:** Advocate for sustainable practices in industries and choose products that promote water and soil conservation
  - **Government Collaboration:** Adhere to regulations and support government programs focused on water and soil conservation.
  - **Water Conservation:** Practice mindful water use, fix leaks, and employ water-efficient appliances at home.
  - **Smart Irrigation:** Adopt efficient irrigation systems in agriculture and landscaping to avoid overwatering.
  - **Soil Erosion Prevention:** Implement cover cropping and contour ploughing to prevent soil erosion.
  - **Sustainable Agriculture:** Adopt practices like crop rotation and agroforestry to maintain soil fertility.

- **Waste Reduction:** Properly dispose of household chemicals to prevent water contamination, and recycle organic waste through composting for improved soil quality.
- **Reforestation:** Engage in tree planting initiatives to prevent soil erosion and enhance water retention.
- **Education and Advocacy:** Promote awareness and support policies for sustainable water and soil management.

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"Let's unite and heal the damage that we have caused to our Guardian"

Conclusion

Soil and water, the overlooked heroes of the natural world, are indispensable for life on Earth. Soil provides a fertile cradle for biodiversity, sustains agricultural productivity, and contributes to climate regulation. Meanwhile, water is the essence of life, supports diverse ecosystems, and influences climate patterns. Understanding and appreciating the profound interdependencies between soil, water, and life is critical for shaping a sustainable and resilient future. Let us, as custodians of this planet, embrace the profound interconnectedness of soil and water, ensuring that their magic endures, and life continues to flourish.

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Interconnected Dynamics: Exploring the Relationship between Soil, Water and also its Sustainable Resource Conservation

[1] Kaviyasree B, [2] Er. K. Sureshkumar

[1] UG Scholar, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

[2] Assistant Professor, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

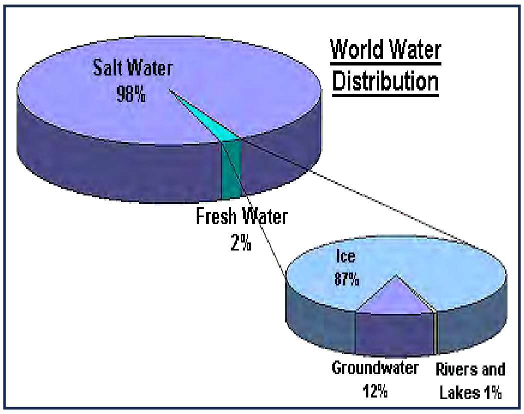
Abstract

Various connections exist between soil and water. Plants' access to water is influenced by soil moisture levels, and the fertility and health of the soil are affected by the quality of water that permeates it. Both soil and water quality can be significantly influenced by agricultural practices, deforestation, and urbanization, resulting in problems like erosion, sedimentation, and pollution. Efforts to conserve aim at preserving soil and water resources through sustainable practices, encompassing erosion control, afforestation, and responsible water management.

Key Words: Soil and water, significance, degradation, conservation practices.

Introduction:

The precious link between soil and water is vital for our survival. All terrestrial ecosystems rely fundamentally on soil and water, and over 95% of our food originates from these two resources. Soil, an integral part of our Earth, holds immense importance for sustaining life, serving as a crucial source for wildlife, plants, and humans.



Abundant supplies of water cycle through the globe, covering approximately 71% of the Earth's surface. However, only about **2%** of

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the total water constitutes **fresh water**, with a very small proportion effectively available for human use. In fact, the availability of fresh water varies both spatially and temporally.

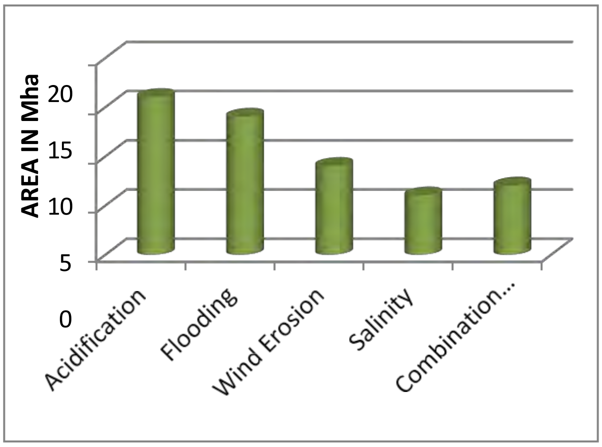
Importance Of Soil and Water in India:

About 2.45% of the world's surface area is accounted for by India, which possesses 4% of the world's water resources and sustains approximately 16% of the global population. Annually, the country receives about 4,000 cubic km of water through precipitation. From surface water and replenishable groundwater, the available amount is 1,869 cubic km, of which only 60% can be effectively utilized. Soil, functioning as our life support system, plays a crucial role in anchoring roots, retaining water, and storing nutrients. It serves as a habitat for earthworms, termites, and numerous micro-organisms that contribute to nitrogen fixation and the decomposition of organic matter. Beyond providing a foundation for construction, soil has the capacity to store substantial amounts of organic carbon, making it the largest terrestrial reservoir of carbon. Water, essential for life, is indispensable for drinking, sanitation, agricultural irrigation, livestock maintenance, industrial processes, and the sustenance of ecosystems that support all living organisms. Clean and fresh water is a requisite for these purposes, playing a role in both the dissolution and formation of Earth's materials.

Degradation of Soil and Water:

Soil degradation in India is estimated to be occurring on 147 million hectares of land which includes

- 94 Mha from water erosion,
- 16 Mha from acidification,
- 14 Mha from flooding,
- 9 Mha from wind erosion,
- 6 Mha from salinity, and
- 7Mha from a combination of factors.



Soil degradation stems from a combination of natural and human-induced factors. Natural causes encompass events like earthquakes, tsunamis, droughts, avalanches, landslides, volcanic eruptions, floods, tornadoes, and wildfires. Human-induced causes include activities such as road

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erosion, house construction, steep slope cultivation, tourism development, and animal trampling.

In India, water security confronts numerous issues and challenges that pose threats to the country's sustainability and development. These challenges involve over-extraction of groundwater, water pollution, inadequate distribution, insufficient water management practices, the impact of climate change, and conflicts over water resources. Additionally, challenges in water resources include the uneven distribution of rainfall, escalating demand for water, urbanization leading to water-related problems, issues with urban sewage, overexploitation of groundwater, ineffective cultivation practices, and water pollution.

Soil And Water Conservation Practice

The conservation of soil and water resources plays a crucial role in ensuring the sustainability of agriculture and the environment. Various soil conservation practices are employed to mitigate erosion and maintain soil health. Contour plowing, where the land is plowed along contour lines, reduces water runoff and minimizes soil erosion. Terracing, involving the construction of steps on steep slopes, helps control water flow and prevent erosion. Cover cropping, the strategic planting of crops during non-growing periods, provides ground cover, protecting the soil. Windbreaks, formed by planting rows of trees or shrubs along field edges, act as barriers, slowing down the wind and reducing erosion. Additionally, strip cropping involves alternating strips of different crops, particularly those with robust root systems, to prevent soil erosion and enhance overall stability.

In terms of water conservation, implementing government policies and regulations at local, regional, and national levels is essential for ensuring responsible water use. Central Government has formulated **National Water Policy 2012** which contains provisions for rainwater harvesting like incentivizing revival of traditional water harvesting structures by states, encouraging rainwater harvesting to increase availability of utilizable water in urban and industrial areas. Rainwater harvesting, achieved through methods like rain barrels or more complex harvesting systems, allows for the collection of rainwater for later use. Drip irrigation systems, designed for gardens and landscaping, deliver water directly to the base of plants, minimizing evaporation and runoff, and promoting efficient water utilization. These practices collectively contribute to the preservation and sustainable management of vital soil and water resources. Therefore, this year World Soil Day serves as a call to action, reminding us that the health of the soil and water is in our hands, and by safeguarding it, we are safeguarding the foundation of life itself.

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TRENDS IN AGRICULTURE SCIENCE

Special Issue

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Soil and water - A Source of Life

Dr. Biswajit Lenka*

Assistant Professor, Department of Genetics and Plant Breeding, Faculty of Agricultural Sciences, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha- 751029

Abstract

The soil-water nexus is a critical interdependence, influencing agricultural productivity and environmental sustainability. Soil health directly impacts water retention and quality, shaping hydrological cycles. Conversely, water availability influences soil moisture, nutrient transport, and microbial activity. This intricate relationship is pivotal for ecosystems and human well-being, as it determines crop yields, groundwater recharge, and watershed resilience. Understanding and managing this nexus is crucial for sustainable land use, effective water resource management, and mitigating the impacts of climate change on agriculture and ecosystems. Integrating soil and water conservation practices is essential for fostering resilient and productive landscapes.

Keywords: soil-water nexus, hydrological cycles, climate change, ecosystems, resilient.

Introduction

The intricate relationship between soil and water is fundamental to the sustenance of life on Earth. These two interconnected elements form the cornerstone of ecosystems, providing the necessary foundation for the growth and survival of countless organisms, including humans. This article examines the vital functions that soil and water perform as essential life-giving elements.

Soil: The Bassinet of Life

In order to sustain plant life, soil acts as a complex and dynamic medium by supplying vital nutrients. Soil is made up of minerals, organic matter, water, and air. These elements work together to create an environment in which plants may anchor their roots and draw in the nutrients required for growth (Lal *et al.,* 2017). A wide variety of fungi, insects, and microorganisms can be found in the soil, which is brimming with life. Because these species aid in the cycling of nutrients, break down organic matter, and preserve the general equilibrium of the soil ecosystem, biodiversity is essential to the health of ecosystems. Soil plays a pivotal role in regulating the Earth's carbon cycle. It acts as a reservoir for organic carbon, helping to mitigate climate change by sequestering carbon

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dioxide from the atmosphere. Sustainable soil management practices are essential for maintaining this critical function (Moghadam *et al.,* 2023).

Water: The Panacea of Life

Water is an essential element of life and a universal solvent. All living things, from microscopic microbes to enormous trees and everything in between, need on it to survive. Water is necessary for the biochemical reactions that support life, such as photosynthesis and cellular respiration (Abiye, 2022). From freshwater lakes to oceans, aquatic habitats support a staggering variety of species. The availability and quality of water directly impact the health of these ecosystems, influencing the distribution and abundance of aquatic species. Water is essential for crop cultivation in agriculture, which is the backbone of human civilization. In order to maintain agricultural practices and provide food security in the face of an expanding global population, effective water management is crucial.

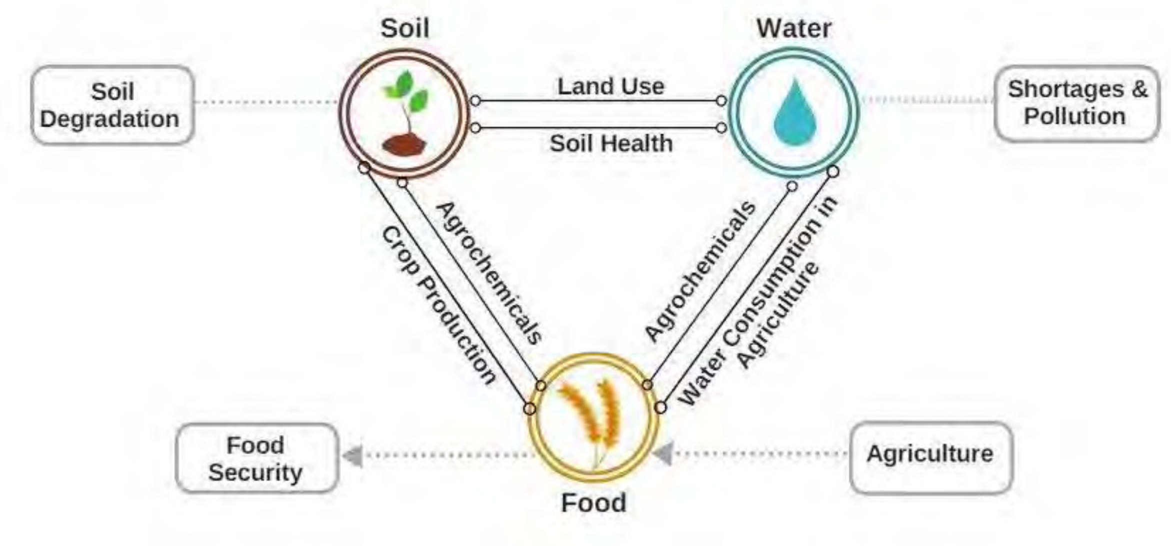

Figure 1. The soil-water nexus relationship

The Interconnected Web: Soil-Water Nexus

The hydrological cycle illustrates the complex dance that takes place between soil and water. Rainfall reaches the soil, recharging its reserves and preserving bodies of water on the surface. This cycle guarantees that water will always be available for use by different ecosystems and human activities (Koriem *et al.,* 2002). The health of soil and water is intricately linked. Agricultural runoff, industrial discharges, and improper waste disposal can degrade water quality, affecting both aquatic ecosystems and the quality of soil (Wu *et al.,* 2023). Sustainable land and water management practices are essential for preserving this delicate balance.

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Conclusion

In summary, soil and water are vital resources that are also complex parts of the fragile ecosystem that supports life on Earth. Understanding how soil and water are interdependent is essential to creating sustainable practices that protect these priceless resources for present and future generations. It is our duty as stewards of the earth to give conservation and wise management of soil and water first priority in order to guarantee a healthy and peaceful coexistence for all living things.

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Special Issue

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Understanding Soil and Water as a Source of Life

Shivani Sahani

Student of B.Sc Ag. (Hons), Kumaun university Nainital

Introduction

Soil and water are essential components of our environment, playing a vital role in sustaining life on Earth. The soil serves as the foundation for vegetation growth and various ecosystems, providing a habitat for countless organisms.

Furthermore, soil acts as a key factor in maintaining healthy forests and water circulation. Without soil, plants wouldn't have a medium to anchor their roots and obtain nutrients. Water, on the other hand, is the material that makes life happen on Earth. It is the base of life, forming a complex circular flow system that involves ocean's surface waters, arctic ice, soils, and plants. The interaction between soil and water is crucial for the survival of ecosystems, as it supports the growth and development of plants and animals. Additionally, water is a source of life in itself, as plants and animals also need water to survive. Therefore, the maintenance of soil and water quality and quantity is of utmost importance for environmental sustainability. Understanding the interplay between soil and water is crucial for comprehending their role as a source of life.

In particular, soil erosion poses a significant threat to both soil and water resources. It leads to a loss of fertile soil, decreased crop productivity, and reduced water storage capacity. As a result, it directly and indirectly contributes to water pollution. It is crucial to address and mitigate soil erosion to ensure the sustainability of both soil and water resources It is also important to consider the role of microorganisms in maintaining soil health and water quality. These microorganisms play vital roles in various biogeochemical cycles and contribute to the overall health and functioning of ecosystems. By understanding the interconnectedness of soil and water, we can work towards sustainable practices that preserve and protect these valuable resources The disruption of complex ecosystem processes by creating an imbalance in soil and water microflora jeqpardizes planetary health and pushes ecosystems beyond critical environmental thresholds

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Understanding the Importance of Soil and Water Conservation in Agriculture

Soil and water conservation plays a crucial role in agriculture. It helps to ensure the sustainable use of soil and water resources, which are fundamental for the success and longevity of agricultural practices. Soil and water conservation in agriculture helps to prevent or minimize soil erosion, which is a major concern in farming. It also helps in maintaining soil fertility and preventing water depletion. This is achieved through various practices such as terracing, contour plowing, crop rotation, cover cropping, and the use of conservation tillage techniques. These practices help to reduce soil erosion by preventing water runoff, enhancing water infiltration, and promoting the retention of nutrients and organic matter in the soil. Additionally, soil and water conservation in agriculture helps to preserve and improve the quality of water resources. By implementing measures to prevent sediment runoff and the contamination of water sources with agricultural chemicals, soil and water conservation ensures that water resources remain clean and usable for.

The Interplay Between Soil and Water

Different Types of Soil and Water

Gravitational Water	Capillary Water	Hygroscopic Water
Free water moving through soil by the force of gravity	Water held in the micropores of the soil.	Forms as a very thin film surrounding soil particles
Largely found in the macropores of soil	Water that composes the il solution.	Is bound tightly to the soil by adhesion properties
Very little gravitational water is available to plants as it drains rapidly down the water table	Is held in the soil because the surface tension properties (cohesion and adhesion) of the soil micropores are stronger than the force of gravity	Is generally not available to the plant
	Is the main water available to plants as it is trapped in the soil solution right next to the roots if the plant	

Conclusion

- Soil provides the nutrients and water that plants need to grow, and healthy soil can support a diverse range of crops.
- Water helps in cell enlargement due to turgor pressure and cell division which ultimately increase the growth of plant.

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Earth's Liquid Ballet: Unveiling the enchanting Choreography of Soil-Water Unions

[1]Tharun. D, [2]Atheshwar. R, [3] Er. K. Sureshkumar

[1&2] UG Scholar, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

[3] Assistant Professor, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

Abstract

This article delves into the connection between soil and water as the essential sources of life on our planet. The complex interaction between these two elements serves as the foundation for ecosystems influencing biodiversity, agriculture and human nourishment. The exploration starts by explaining the physical and chemical processes that govern the dynamic nature of interactions between soil and water. Special attention is given to the role of soil as a reservoir for water affecting groundwater recharge and supporting a wide variety of life forms. Additionally, it discusses how climate change impacts both soil dynamics and water conditions underscoring the importance of embracing practices that can adapt to these changes.

INTRODUCTION

Embark on a journey into the heart of Earth's vitality and discover the silent choreography of survival: soil and water, the unsung heroes sustaining life. In this exploration, We unravel their intricate dance, shaping ecosystems, nourishing crops, fostering existence and nurturing humanity. As humanity grapples with challenges such as population growth and environmental degradation, understanding and preserving this equilibrium, between soil and water becomes crucial. Understanding the connection between soil and water as vital sources of life is crucial, for promoting worldwide environmental responsibility and safeguarding the welfare of present and future generations.

Soil - "Earth's Symphony: The Hidden harmony Beneath Our Feet"

Soil, a dynamic pedosphere, is a complex blend of mineral particles, organic matter, water and air. Shaped by biotic and abiotic factors, it hosts a vibrant microbial community engaging in nutrient cycling. As a critical edaphic component, soil

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influences plant growth ecosystem dynamics and carbon sequestration, playing a pivotal role in terrestrial ecology.

Water - "Aqueous Alchemy: The biochemical essence of H_2O in Nature" Water, a ubiquitous and vital molecule, comprises two hydrogen atoms bonded to an oxygen atom. Its unique properties, such as polarity and hydrogen bonding, drive its role as a universal solvent. Essential for life, water participates in

biochemical reactions, regulates temperature and sustains ecosystems through its dynamic hydrological cycles.

Soil and Water - interactions

The composition of water flowing through and out of soils and rocks **reflects the composition of the material** that it has passed through. The chemical processes involved are mainly relatively rapid **cation exchange** reactions with **soil colloidal materials** and slow acid hydrolysis reactions which decompose primary minerals.

Together, water and soil are essential for the development of plants and microbial flora, all of these components being in a strong and continuous interaction. Watrer and soil quality significantly govern plant growth and development, particularly agricultural crops.

The interactions between soil and water play a crucial role in supporting various ecosystems and providing several benefits like nutrient transport,erosion control,groundwater recharge,temperature regulation,biodiversity support,filtration and purification,carbon storage,crop productivity,flood prevention,recreation and aesthetics.

Understanding the impact of adverse factors that affecting soil and water interactions and its management:

Land use practices - Agricultural practices such as Tillage, overgrazing, Monoculture, improper agriculture practices can degrade soil quality and reduce water retention.

Urbanization - Impervious surfaces like roads and buildings reduce water infiltration, increasing surface runoff and contributing to flooding. **Eg:** Cities like Chennai, Mumbai, Bangalore, Kolkata are experiencing many water consequences and having polluted soils due to rapid urbanization**.**

Deforestation - removing trees and vegetation disrupts the water cycle,leading to increase the runoff and decreases ground water recharge. **Eg:** In western Ghats, where rapid urbanization expansion has led to substantial clearing of forests that affects the natural soil-water interactions.

Pollution - Contamination of soil and water by pollutants such as chemicals or heavy metals can disrupt natural interactions and harm ecosystems.

Soil erosion - Erosion removes the top fertile layer of soil, reducing its ability to retain water and nutrients. **Eg:** In the state of Rajasthan, soil erosion is a pressing issue in India, improper land management practices have led to increased soil erosion in regions like Aravalli range.

Over-irrigation - excessive irrigation can lead to water logging and salinity,negatively impacting soil structure and fertility.

Climate change - Altered precipitation patterns and temperature variations affect water availability and soil health. **Eg:** The changing precipitation patterns in regions like the Himalayas that causes erratic rainfall events causing soil erosion and reduced water retention capacity (Uttarakhand).

Mining activities - Mining operations can introduce contaminants into soil and water, disrupting their natural interactions.

Invasive species - Invasive plants can alter soil structure and nutrient cycling impacting water absorption and availability. **Eg: Water hyacinth, Purple loosestrife, Zebra mussles.**

Land contour changes - Modifying the natural contour of the land,such as through levelling or grading can affect water drainage and soil stability.

Management: Conservation tillage, cover cropping, agroforestry, buffer strips, precision agriculture, terracing, water harvesting, nutrient management, waste management, Identifying and removal of invasive species, provide awareness among the people about the importance of soil and water.

For reducing the Mining effect of mining operations,in coal mining regions like Jharia in India, controlled blasting methods are employed to mitigate the impact on soil and water. These practices aim to limit the release of harmful elements and prevent the contamination of groundwater, ultimately contributing to sustainable mining practices.

Symbiotic Soils: Nurturing life Through Watery Threads:

Nutrient transport - Soil acts as a medium for nutrient storage and transport and water in the soil dissolves essential nutrients making them available to plants. It is vital for plant growth and helps herbivores and organisms higher up the food chain.

Plant growth and productivity - Plants are the products that are produced by the soil-water interactions that provides food and habitat for numerous organisms from insect to larger animals.

Hydration for animals - Animals directly or indirectly depend on the water content in soil for survival. **Microbial activity** - Soils are medium for microbial activity and water provides a essential environment for their activities.

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Aquatic ecosystems - The life of aquatic organisms depends on the quality and quantity of water influenced by surrounding soil conditions. The soil-water interactions also influence the groundwater recharge.

Conclusion

Within the gentle embrace of the soil, water intricately intertwines the threads of existence. A sees, nestled in the moist earth, awakens to growth. With raindrops tenderly caressing the soil a rhythmic ballet commences a choreography of hydration and sustenance. Roots, akin to eager tendrils, extent, drawing in vitalizing water and unlocking concealed nutrients. Microbial communities stir, alchemizing organic matter into essential nourishment, enhancing the soil's vigor. This nuanced interplay orchestrates a flourishing ecosystem, where blossoming plants, coming insects and the heartbeat of life resonate through the interconnected tapestry of soil and water. In this close partnership, the synergy of soil-water interactions sculpts a lively symphony, nurturing a resilient world beneath our feet.

"Harmony Below, Vitality Above; Sustaining Life Through Earth's Heartbeat"

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Special Issue

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The Vital Connection Between Soil, Water, and Economic Growth

[1]Harini. M, [2]Gobikaa. G. M, [3] Er. K. Sureshkumar

.[1&2] UG Scholar, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

[3] Assistant Professor, J.K.K. Munirajah College of Agricultural Science, T. N. Palayam, Gobi, Erode 638 506.

Abstract

Our earth's life lean on soil and water for hale and hearty life. The way how we satisfy the ravenous of soil and water, in the same way it fulfills our needs in return. The proper management of soil and water is inevitable because it also plays a main role in improving the economic growth of our country.

Introduction:

The theme of the year 2023 "soil and water-a source of life" focus attention on the analogy of these important resources and need for integrated management practices to make certain food safe future and address global challenges such as climate change and nutrient deficiency.

Soil and Water- Great connector of life:

Soil dispenses plants a foothold for their roots and tie up the essential nutrients for the plant growth ". A healthy soil leads healthy life".In return plants provides us a healthy life.

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Various texture of soil is

- ✓ Sand: 2-5mm
- ✓ Silt: 0.05-0.002mm
- ✓ Clay: <0.002mm

As in the same way water plays a senior role not only in humans life but also in plants and animals life, Without water existence of earth is impracticable.

Current status of soil and water:

- ✓ Our Indian soils classically have low amount of Nitrogen and Phosphorous but Potassium is high. From this 55% of our soil is insufficient in Nitrogen, 42% in phosphorous and 44% in organic carbon.
- ✓ About 71% of earth surface is covered by water. only 3% of earth's water is fresh water. Only 1.2% of water is at hand for drinking.
- ✓ India ranks 133rd in the world for amount of water available per person per year .

Partners of plants:

- ✓ Ideal soil temperature for plant growth 18-24°C and optimum pH 5.5-7.
- ✓ Earthworms helps in humus production.
- ✓ **Base period-** Time period between 1st watering of crop during sowing to last watering before harvesting. **Unit- Days.**
- ✓ **Delta-**Total quantity of water required for any crop during its base period.
- ✓ **Duty-**No.of. hectare of land that can be irrigated for the full growth of crop by supplying 1 cumec water continuously during entire base period.
- ✓ **Field water use efficiency-** Ratio of crop yield to the total amount of water used in the field.
- ✓ Capillary water is the only form of water available for plants.
- ✓ Hygroscopic and gravitational water are unavailable to plants.

Tracking of soil fertility with EOSDA:

- ✓ **EOSDA-EOS D**ata **A**nalytics is a global provider of AI-Powered satellite imagery analytics.
- ✓ This crop monitoring platform plays a vital role in soil fertility.
- ✓ It permits growers to use GIS and remote sensing in the approach of executing precision farming in soil fertility.
- ✓ It aids in using the resources.
- ✓ This is a one-stop solution that unites various types of data (Crop health ,weather conditions, rotation of crops).

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Complications and Control measures:

Problems	Management
✓ Soil erosion	Construction of contour and graded bund, bench terracing, growing vegetative covers, soil resistance and permitting crops.
✓ Nutrient issues	Applying compost and organic manure. Avoiding blank recommendation.
✓ Problematic soils	Liming, Leaching , Scraping, Gypsum application. Supplying good quality irrigation water.
✓ Water erosion	Restoring bank vegetation.
✓ Flood	Constructing dams , reservoirs, watershed management.
✓ Groundwater depletion	Construction of farm ponds, percolation ponds, watershed management.

Conclusion:

Our planet's persistence depends on the crucial link between soil and water. Your mind and body is like a plant it needs soil and water as a good soul in our life.

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The Foundation of Life

Aswini Rithika B
SRM College Of Agricultural Sciences

Introduction

The purpose of wrote this is to know the importance of soil and water, especially the upcoming generation must know and conserve the soil and water 💦, because it's very difficult to create it. At the same time it doesn't matter what ingredient in our plate is or where it's come from, all roads lead to Agriculture only. So for that Agriculture soil and water 💦 is fundamental part. I hope that after those who are all read this, it will create slight awareness among the natural entities- soil and water 💦. We have to conserve our long lasting natural assets.

Soil and water 💦 correlation:

Soil and water 💦 is well interrelated, because the soil captures and store water 💦 making it available for absorption by crops and thus minimizing surface evaporation and maximize water 💦 use efficiency and productivity. When water passes through soil it is cleaned via physical, chemical and biological processes Soil contains various types of important microorganisms that helps transform and decompose certain chemical and other things such as contaminants from soil thus helping filter them out of the water 💦. In reality the soil is very complex and dynamic. Always the typical Soil consist of approximately 25 percent of water 💦. It indicates the best optimal value.

Soil Supply of nutrients:

We have to conserve the soil and make the soil pollution free. It is Our responsibility. Soil lays foundation of many lives in the earth 🌏. It is a pioneer for agriculture through this only we achieved a Good yield. Avoid dumping of non biodegradable waste such as plastics, e waste into the soil, because always inaugural changes come from ourselves first. Avoid excessive application of chemical fertilizers, pesticides in the soil. It is adversely affecting the soil fertility. These kinds of anthropogenic activities lead to soil pollution. There are many ecofriendly methods are available to conserve the soil such as,

- Rotation
- Cover crops
- Mulching etc.
- Water - heart of Agriculture:

Without water life couldn't have sustained on this planet. Earth is abundant with water as 71% of its covers the surface. Water is known as heart of Agriculture to grow crops and produce food. Water is an essential part of life. We have a limited amount of freshWater that available in liquid form. It plays a major role in Determination of plant growth and development.

Methods of water conservation:

- Expanding water reservoir
- Take shower instead of using pipeline
- Construction of farm ponds
- Drip irrigation
- Irrigation scheduling etc

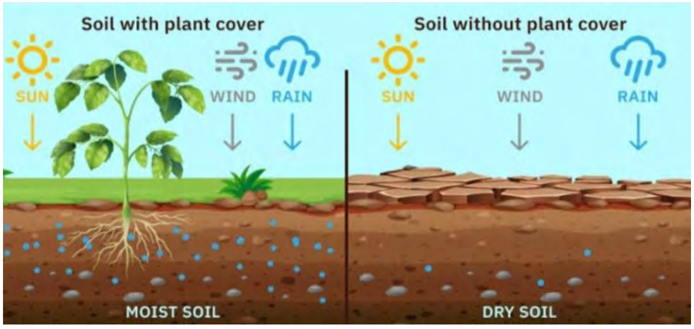
Benefits of soil Conservation:

- Reducing soil erosion
- Increase water infiltration
- Improve soil fertility
- Increase Crop yield etc

Benefits of water conservation:

- Conserve water leads to saving energy
- Reduces water purchase cost
- It solves the problem of water scarcity

Saving water is useful for upcoming generations.



If we fail to follow mean it will severely affect our Livelihood, and it leads to face the consequences because the Availability of freshWater is very scarce in current situation. Moreover one of the sad fact was for the development of

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one inch Of soil it takes hundreds of years anyhow we have to accept this Truth, and follow the eco friendly way to conserve the soil and water 💦 in a proper manner.

Inference

I hope everyone those who read this will definitely understood the importance of soil and water 💦, know the reality and comes to analyze the current situation. It is our responsibility to save the environment from hazardous things.create awareness among the society. Keep our surroundings clean. Wherever the place, whatever the situation it's our duty!!

Our motto:

Soil And Water 💦 - Source Of Life.

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Soil and Water: Essential Sources of Life and Their Impact on Climate Change

Khatera Qane
Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India

Abstract

Soil and water, pivotal components of Earth's biosphere, intricately shape ecosystems, influence biodiversity, and impact global changes. Climate change, marked by shifts in air temperature, precipitation, and rainfall patterns, directly alters the soil environment, with region-specific variations requiring precise meteorological and soil data assessments. These resources are fundamental, serving as ecosystem cornerstones and storing the largest terrestrial carbon reserves. Sustainable Soil Management (SSM) techniques offer opportunities for climate change adaptation and mitigation, alongside Sustainable Land Management (SLM) strategies that boost productivity, curb greenhouse gas emissions, and promote carbon sequestration. Identifying suitable areas for SLM, backed by effective policies and financial mechanisms, is vital for widespread adoption. Water, a finite life-sustaining resource, faces challenges due to climate change, impacting its availability and quality. More frequent and intense droughts, coupled with rising temperatures, challenge agricultural production by elevating crop water demands. Efficient water management strategies are crucial for sustainable freshwater use, especially amid a growing global population. Climate change intricately interlinks soil processes, properties, and hydrological cycles, thereby impacting the availability of soil and water resources. Temperature and precipitation variations significantly affect soil functionality, necessitating adaptive measures. Water resources management plays a role in offsetting climate change effects on stream flow and water availability up to a certain limit. Understanding the intricate relationship between soil, water, and climate change is pivotal for formulating effective strategies to mitigate adverse effects. This abstract emphasizes the crucial roles of soil and water as life essentials while highlighting their substantial influence on climate change. Advocating sustainable management practices is key to securing a resilient and sustainable future for our planet.

Introduction

Soil is crucial for sustaining life, providing nutrients for plants, regulating water flow, maintaining environmental balance, and influencing climate change. Soil and water are interconnected; healthy soil acts as a natural filter, purifying and storing water. Rain-fed agriculture heavily relies on effective soil moisture management practices for crop production. Soil and water are utilized in agriculture, industry, and wildlife conservation. Proper soil management is vital for

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maintaining fertility, reducing pollution, and promoting water circulation to ensure high-quality food production and biodiversity. To preserve life on Earth, preventing soil erosion, halting illegal mining/construction, improving soil-water management, raising awareness about soil protection, enhancing agricultural practices, introducing soil conservation programs, and promoting biodiversity are crucial measures. These actions aim to conserve soil and water resources for future generations and mitigate environmental degradation. In the past year, severe floods and droughts have become prevalent across all continents, coinciding with the global population surpassing 8 billion and projected to exceed 10 billion this century, posing significant challenges. In 2022, the United Nations Climate Change Conference (COP27) specifically addressed the pressing necessity to cap the global temperature increase at 1.5°C above preindustrial levels. This conference established a framework for "loss and damage" funding aimed at assisting vulnerable nations impacted by climate-related disasters. It acknowledged that the degradation of soil, water, and biodiversity resources falls within this scope of loss and damage. With the mounting pressure from population growth and escalating climate-related difficulties, the threats to natural resources, global food, and water security, as well as ecosystems, have heightened, Steiner *et al*. (2023). The Soil and Water Conservation Society (SWCS) has long emphasized the dangers posed by climate change to our natural resources and the communities and ecosystems reliant on them. Their research underscores increased threats to conserving soil and water in agricultural lands, underscoring the crucial need for improved comprehension and tools to effectively apply conservation methods in the face of amplified precipitation and concentrated flow patterns across terrains (SWCS 2003). Climate change, despite its gradual nature, significantly impacts soil processes, especially those related to fertility, through shifts in moisture, elevated temperatures, and increased CO_2 levels. These alterations are anticipated to variably affect crucial soil properties essential for restoring fertility and productivity, primarily driven by rising temperatures and CO_2 levels (Pareek, 2017). Climate profoundly impacts soil formation and characteristics, influencing their evolution, utilization, and management. Variables such as temperature, precipitation, atmospheric composition (e.g., carbon dioxide, nitrogen, and sulfur compounds), and moisture and temperature patterns drive alterations in soil structure, stability, nutrient availability, erosion, organic carbon content, and soil biota traits. These climatic elements directly impact soil development by affecting biomass and weathering conditions, regulating energy consumption for soil formation, water balances, and interactions between organic matter and minerals. Changes in external factors, such as temperature and precipitation, result in shifts in internal factors related to energy, hydrology, and soil biology. Consequently, climate change might escalate mineral weathering, potentially simplifying the mineral structure and reducing soil fertility functions, potentially requiring increased reliance on

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mineral fertilizers (Brevik, 2013). Climate change affects water resources by influencing the quantity, variability, timing, form, and intensity of precipitation, Daba *et al.* (2018).

Fig 1: Soi and water a source of life

Fig 2: Climate change

Conclusion

The interdependence of soil, water, and climate change necessitates urgent action to mitigate adverse effects. Climate variability impacts soil fertility, structure, and water availability, challenging global sustainability. Addressing these challenges demands collaborative efforts. Implementing Sustainable Soil Management (SSM) and Sustainable Land Management (SLM) practices, backed by effective policies and financial mechanisms, is crucial. Water scarcity and extreme weather events further intensify with rising global temperatures, threatening agriculture and biodiversity. Mitigating climate change's impact on soil and water requires a multifaceted approach raising awareness, conserving resources, and improving management practices. Understanding these complexities is pivotal for crafting resilient strategies toward a sustainable future.This conclusion encapsulates the need for immediate action, emphasizing the importance of sustainable management practices in mitigating the effects of climate change on soil and water resources.

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Soil and water are the source of life

Dr. Dibyajyoti Talukdar
College of Veterinary Sciences & A.H., Central Agricultural University, Aizawl, Mizoram-796015, India

Abstract

Soil and water both are vital elements for human life. Soil is said to be Earth's living skin: thin and flimsy but also playing an incomparable task in guarding the health of humans and the global biosphere. It has been reported that 95 per cent of our food originates from soil and water. Soil water, an essential element for the absorption of nutrients by plants, holds our ecosystems together. Thirty per cent of the world's soils are now despoiled. Soil erosion poses a major threat. "Regenerative agriculture" practices are a vital step to minimize soil degradation. By changing the ways we farm, soils can be protected from spoil while sullied soils can be restored by planting a diverse range of plants and vegetation. Nowadays the requirement for food increases as global populations grow, there are efforts should be made to produce huge quantities of food with less quantity of water, by using advanced irrigation technologies, agricultural water management, crop types, and water monitoring.

Soil is vital for both people and the earth. Soil is considered an imperative source of food and drugs; it filters and purifies our water, prevents flooding and plays a vital role in the battle against climate change. It controls the atmosphere and plays a critical role in driving the carbon and nitrogen cycles. It's also crucial to diving climate change as it captures and stores vast quantities of carbon. Soil is also one of the most biodiverse territories on Earth. Although occasionally dismissed as "dirt" or "slush" soil is frequently described by scientists as the Earth's living skin thin and flimsy but also plays an incomparable part in protecting human health and the universal biosphere.

As per the FAO report, a total of 30 per cent of the world's soils are now despoiled. At the same time, the European Commission estimates that between 60 and 70 per cent of its soils are unhealthy. It has been recorded that multiple human-made pitfalls to soil health, which include deforestation, urbanization, agricultural strengthening, soil compaction, acidification, salinization, pollution, landslides, wildfires and soil erosion. As per the FAO report, soil erosion poses major trouble to global food security and could negotiate the well-being of at least 3.2 billion people

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worldwide. A centimetre of healthy soil, means we are presently losing soil 50 to 100 times quicker than it is capable of restoring (FAO and ITPS, 2015).

In the current situation, agriculture is considered the largest intimidation to healthy soils. As the Industrial Revolution proceeds, an estimated 135 billion tonnes of soil has been lost from cropland. Deforestation to produce further pastoralist land, mono-cropping, overgrazing, tillage, use of heavy machinery and overuse of fertilizers and pesticides are the main factors responsible for soil degradation (FAO, 2014).

In the present situation, it is most important to diminish soil degradation by switching to "regenerative agriculture" practices. These include regular change of crop, sustainable grazing and mixed-use agricultural farming methods such as agroforestry, which may include planting of trees alongside crops. If we change our mindset then we will be able to protect the healthy soils from damage as well as degraded soils can be restored by growing a varied variety of vegetation. It is also imperative to make a consciousness camp regarding the importance of soil and how it is at risk –is necessary in bringing soil health into the wider environmental debate.

Water is a natural resource which is potentially valuable for humans, as a supply of drinking water and irrigation. On Earth, salt water is estimated at 97% and only 3% is fresh water. Out of which two-thirds are frozen in glaciers and polar ice caps (UIA, 2021). The residual unfrozen fresh water is available as groundwater and above the ground i.e. in the air in a small quantity.

It has been observed that around 8% of universal water is used for domestic work i.e. drinking water, bathing, cooking, lavatory flushing, cleaning, laundry and farming. Peter Gleick estimated that the basic domestic water requirement is around 50 litres per person per day, excluding water for vegetation and floriculture (UN, 2006). Drinking water is water that's of sufficiently high quality so that it can be consumed or used without the threat of immediate or long-term detriment. It is generally called drinkable water. Over 844 million people still demanded an introductory drinking water service in 2017. Of those, 159 million people worldwide drink water directly from natural sources (UIA, 2021).

As per a recent report, the groundwater level has tremendously decreased and occurred most significantly in Asia, South America and North America, even though it is still unclear how much natural renewal balances, and whether ecosystems are in danger (UN, 2006). Water pollution and climate change are the main threats to drinking water scarcity.

It is projected that 70% of worldwide water is used for irrigation, with 15–35% of irrigation withdrawals being untenable. It was estimated that approximately 2,000 – 3,000 litres of water are required for the production of sufficient food for one person to ensure daily dietary requirements. This is a considerable quantum when compared to that needed for drinking, which is between two

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and five litres. To produce food for the now over 7 billion people who inhabit the earth moment requires water that would fill a conduit ten metres deep, 100 metres wide and 2100 kilometres long (CA, 2007; UIA, 2021).

In some areas of the world, irrigation is necessary to grow any crop, in other areas, it permits more profitable crops to be grown or enhances crop yield. Different irrigation techniques involve different trade-offs between crop yield, water consumption and capital cost of outfits and structures. Irrigation techniques similar to crinkle and outflow sprinkler irrigation are generally less precious but are also generally less effective, because much of the water evaporates, runs off or drains below the root zone. Other irrigation styles considered to be more effective include drip or teardrop irrigation, swell irrigation and some types of sprinkler systems where the sprinklers are operated near ground position. These types of systems, while more precious, generally offer lesser implicit to minimize runoff, drainage and evaporation. Any system that's inaptly managed can be extravagant; all styles have the eventuality for high edge under suitable conditions, applicable irrigation timing and operation. Some issues that are frequently rightly considered are the salinization of groundwater and adulterant accumulation leading to water quality declines.

As global populations grow, and as demand for food increases, useful efforts should be made to learn how to produce healthy and sufficient food with small quantity of water, through advancements in irrigation styles and technologies, agricultural water operation, crop types, and water monitoring. Brackish marketable fisheries may also be considered as agricultural uses of water, but have generally been assigned a lower precedence than irrigation.

Conclusion: "Regenerative agriculture" practices are the vital step to minimize soil declination which includes regular crop change, sustainable grazing and mixed-use farming techniques i.e. agroforestry. If we can change our mindset then we will be able to protect the healthy soils and water from damage as well as degraded soils can be restored by growing a varied variety of vegetation. People should learn how to produce healthy and sufficient food with a small quantity of water, by using modern irrigation technologies.

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Impact of Biochar Application on Soil and Water Management

S. Divya, S. Sivagnanam and S. Ponmalini

School of Agriculture, Bharath institute of higher education and research Selaiyur, Tambaram

Abstract

Due to the increase in global population, food deficit and rising climate change. We need to find sustainable solutions to improve soil fertility, plant growth, and crop yield. Biochar is the ultimate solution for soil and water management. We reviewed biochar in improving the physiochemical and biological properties of soil. This article shows an overview of how biochar application in soil and water can improve the soil structure, soil fertility status, water holding capacity, bulk density of the soil, and reduce heavy metal contamination toxicity.

Keywords: Biochar, soil fertility, soil structure, water holding capacity, bulk density, toxicity.

Introduction

Soil degradation has increased nowadays due to the modern agriculture practice. However, these contain various pharmaceutical ingredients such as lead, zinc, cadmium, etc. which result leads to soil acidification, soil alkalinity, depletion of soil organic matter, etc., These chemical inputs release ammonium and methane which increases global warming and serious water pollution. Biochar is a promising source of soil fertility. Biochar is the product of pyrolysis. It contains a porous carbonaceous structure and an array of functional groups (Lehmann J, 2009). The carbon content is increased with the pyrolysis temperature from 300 to 800 °C while the content of the nitrogen and hydrogen is decreased. Biochar with soils could improve soil structure, increase porosity, decrease bulk density, and enhance aggregation and water retention (Baiamonte *et al*., 2015). It is important to understand the mechanism of change in soil fertility after the application of biochar. In this article we discussed the change in soil properties includes physiochemical and biological properties after the application of biochar.

Biochar as fertilizer

Biochar contains organic matter and inorganic salts such as humic-like, fluvic-like substances and NPK in available form which serves as fertilizer. (Lin *et al*, 2012) suggested that biochar produced from Acacia saligna at 380°C and sawdust at 450°C contained humic (humic-like and fluvic-like materials) of 17.7 and 16.2 %, respectively. Biochar made from *Lantana camara* at 300°C contained available P (0.64 mg kg^{-1}), K (711 mg kg^{-1}), Na (1145 mg kg^{-1}), Ca (5880 mg kg^{-1}) and Mg (1010 mg kg^{-1}) (Masto *et al*, 2013).

Impact of biochar on physical properties of soil

Biochar possibly increases the porosity of the soil, water storage capacity and decreases the bulk density (Chen *et al*, 2007; Abel *et al*, 2013). (Peake *et al,* 2014) preferred that biochar application could increase the available water holding capacity by over 22 %. Decrease bulk density from 1.47 to 1.44 mg m^{-3}, and increase porosity from 0.43 to 0.44 m^3 m^{-3} (Nelissen *et al*, 2015). Finally, the practice of biochar improved the physical properties of soil such as bulk density, water holding capacity, and aggregation ability, which satisfy the soil fertility.

Impact of biochar on the chemical properties of soil

Application of biochar to the soil improves the chemical properties of soil including the increase in pH, Organic carbon content, Cation exchange capacity (CEC) and Nitrogen fertilizer use efficiency (NUE) (Agegnehu, G., A. K. Srivastava, and M. I. Bird. 2017). (Novak *et al,* 2009) reported that the application of biochar in acidic coastal soil increases soil pH, soil organic matter, manganese and calcium and decreases sulfur and zinc. Table 1 summarizes the changes in soil chemical properties as a result of different levels of biochar application at 0, 10, 15 and 20 t ha^{-1} (Uzoma *et al,* 2011).

Table 1: Effect of biochar application in different rates

Sr. No.	Chemical properties	Biochar(0 t ha^{-1})	Biochar(10 t ha^{-1})	Biochar(15 t ha^{-1})	Biochar(20 t ha^{-1})
1.	pH	6.40	7.10	7.34	8.00
2.	Carbon (g ⁄kg)	1.22	5.56	6.54	7.64
3.	Nitrogen (g ⁄kg)	0.45	1.46	1.50	1.52
4.	C:N	2.75	3.82	4.36	5.02
5.	Phosphorous (g ⁄kg)	0.12	0.15	0.18	0.16
6.	Potassium (cmol(+)⁄kg)	0.12	0.14	0.15	0.17
7.	Calcium (cmol(+)⁄kg)	0.38	0.49	0.56	0.63
8.	Magnesium (cmol(+)⁄kg)	0.24	0.38	0.44	0.51
9.	CEC (cmol(+)⁄kg)	0.75	0.92	1.14	1.27

source: (Uzoma *et al,* 2011)

Impact of Biological Properties on Soil with Biochar Application

The form of biochar provides an asylum for small beneficial organisms such as symbiotic mycorrhizal fungi penetrate and increase the enzymatic activity of soil. Symbiont (e.g., Rhizobium) in biochar treatment gets activated, which in turn increases the nodulation and nitrogenase activity. Also, free-living Azotobacter *sp* and Azospirillum colonize and multiply in biochar treated soil due to surplus habitat and required oxygen supply (Gabhane *et al*, 2020)

Environmental implementation of biochar

1. **Biochar in remediation of metal, metalloids and pollutants**: Biochar obtained through pyrolysis at the high temperature of (550°C–750°C) which is useful for phytoremediation of metal such as zinc, lead, and cadmium. As Biochar contains alkaline pH it helps to raise soil

pH and stabilize metals and potentially reducing the bioavailability and leachability of heavy metals and organic pollutants in soils through high adsorption and different physicochemical reactions (Zhang *et al*., 2013)

2. **Biochar in reducing water pollution:** Biochar application can manage water pollution and treatment of contaminated wastewater. (Hao *et al.,* 2021) reported that the application of coconut shell biochar can reduce the contamination of lead in water through the porous structure of biochar
3. **Biochar in carbon sequestration and climate change alleviation:** Biochar is highly stable when applied to the soil which reduces climate change through carbon sequestration. Application of biochar at the rate of 2% – 5% has been reported to increase carbon sequestration significantly by 46%–58% from rice and beet fields (Lai *et al*., 2013). Biochar obtained from apple wood residues and re-applied in apple orchards promoted the soil organic carbon sequestration, which increased by 316.52%–354.78% in a two-year study in the Loess Plateau of China (Han *et al*., 2022).
4. **Biochar is a rectification for emerging hazardous wastes such as organic pollutants and microplastics:** Due to immersive use of plastic globally increases the contamination of soil and aquatic environment. A further approach to the separation and removal of microplastics from aquatic systems is catalytic removal by utilizing the magnetic biochar activating oxidation processes (Ye *et al*., 2020). A relevant approach for microplastic removal from aqueous solutions has been suggested to use the magnesium and zinc-modified magnetic biochar by utilization of magnetic and thermal degradation approaches (Wang *et al.,* 2021)

Conclusion

The application of biochar is likely to enhance soil fertility, plant growth, and crop yield. The specific properties of biochar, including its surface area, well-developed pore structure, and concentrations of exchangeable cations and nutrient elements, are influenced by factors such as the type of feedstock used and pyrolyzing temperature. These physiochemical characteristics contribute to increased soil fertility and promote the growth of beneficial microorganisms in the soil following biochar application. This review provides a structured overview of the significance of biochar application in soil, water and wastewater treatment to mitigate contamination in natural ecosystems.

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Soil And Water – A Source Of Life

***R Shreemathi**

Veterinary College and Research Institute, Namakkal

Abstract

Soil and Water are in symbiotic relationship that supports the ecosystem and sustains biodiversity. Soil serves nutrients for the growth of plants, while the water transport nutrients to plants. Soil and Water provides a habitat for many organisms and thus contribute to nutrient cycling and overall health of the ecosystem. Due to anthropogenic activities and natural causes the soil and water gets heavily polluted and leads to loss of biodiversity and ecosystem balance. In order to prevent the pollution and conservation of resources, the government has implemented various schemes and programme for the benefit of life. Technology plays a crucial role in conservation, offering innovative solutions. Soil and Water, the silent architects of life, by fostering awareness, implementing innovative technologies, and advocating for policies that prioritize conservation, we can safeguard these precious resources for the current and future generations.

Introduction

The symbiotic relationship between soil and water is foundational to the existence and vitality of life on Earth. This synergy supports ecosystem, sustains biodiversity, and nourishes humanity. The intricate interplay involves soil serving as a cradle for the growth of plant life, fostering growth through its nutrient-rich composition. Meanwhile, water, the elixir of life, acts as a conduit, transporting essential nutrients to plants and sustaining diverse forms of life. Together, they form the bedrock of ecosystems, fostering biodiversity and supporting the delicate balance of the nature world.

A Journey With Soil And Water

Healthy soil and water provides a habitat for a diverse range of organisms, including bacteria, fungi, and insects. These organisms contribute to nutrient cycling and the overall health of ecosystem. The diversity of life in these ecosystems contribute to ecological balance and resilience. Soil provides the foundation for agriculture and water through irrigation, is a critical input for agricultural practices, ensuring the productivity of the soil and the production of food. Oceans and other water bodies influence climatic patterns, while soil plays a role in carbon storage. Together, they contribute to the regulation of global climatic conditions. Although the soil and water forms

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the basis of life, it gets heavily polluted for the past two decades mainly by anthropogenic and natural causes. Soil gets polluted by industrial activities which includes factories and manufacturing processes release various pollutants into the soil, which including heavy metals, solvents, and chemicals. Excessive use of fertilizers, improper disposal of solid and hazardous waste and accidental spill of chemicals and oils can lead to localized soil pollution. Water gets polluted by discharging the chemical pollutants directly into the water bodies, untreated sewage and animal waste can contaminate water, leading to water borne diseases. Accidental spills from oil tankers, industrial activities, or runoff from roads can introduce hydrocarbons into water, harming aquatic life and ecosystems. These soil and water pollution may affect the life by impaired soil fertility, crop contamination, erosion and soil degradation, coral reef damage, impact on food chain and leads to human health risks, habitat destruction, loss of biodiversity etc. Quality of human health merely depends soil quality. Therefore, soils around highly polluted areas having high population density play an important role on human health, as their food requirement are met from the agricultural activities surrounding the area. The Central Pollution Control Board (CPCB) identified critically polluted industrial areas based on its Comprehensive Environmental Pollution Index (CEPI) rating. 43 critically polluted zones were reported in the 16 states which have CEPI more than 70. Among the 43 sites, 21 sites exists in only 4 states namely Gujarat, Uttar Pradesh, Maharashtra and Tamil Nadu. In order to control the pollution and to conserve the soil and water resources, the Central and State Government implemented various schemes and programme which includes National Rural Drinking Water Programme (NRDWP), National River Conservation Programme (NRCP), Dam Rehailitation and Improvement Programme, World Bank Assisted TN Sustainable Urban Development Program (TNSUDP), Estt. Of common effluent water treatment plant, Monitoring water quality through Global Environmental Monitoring System (GEMS) and Monitoring of Indian National Aquatic Resources (MINARS), TNUDP-Project III (Underground Sewage Scheme), Integrated Solid Waste Management (MAWS), National Mission for Sustainable Agriculture (NMSA), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Integrated Watershed Management (IWMP),National Watershed Development Project for Rainfed Areas (NWDPRA), Jal Shakthi Abhiyan (JSA), National Water Mission (NWM), Atal Bhujal Yojana (ABHY), Namami Gange Programme, Kudimaramathu Scheme, Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management (IAMWARM) etc. Technology plays a crucial role in conservation, offering innovative solutions to address erosion, degradation, optimize water usage and other soil and water related problems. Use of Soil Moisture Sensors, Groundwater Monitoring Sensors, Desalination Technologies, IoT devices, GPS, GIS technology etc. Phytoremediation is a cost-effective and environmental restoration technology, uses certain plants and associated soil-

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microbes to reduce the concentrations or toxic effects of contaminants in the environment. Bioremediation of ocean oil spills by Pseudomonas putida also called as oil guzzlers/superbugs " A living solution for oil spills" is a gram negative, rod shaped, saprophytic bacterium which was patented by Anand Mohan Chakrabarty – The superbug superhero, for the ability of the bacterium to biodegrade oil.

Earth's Elixir: Soil and Water – Sustaining the Symphony of Life

Soil and Water, the silent architects of life, nurture the roots of existence and weave the threads of sustenance for all living beings. In conclusion, soil and water stand as the foundational elements of life, intricately connected in a symbiotic dance that sustains the rich tapestry of existence. The synergy between soil and water extends beyond mere biological processes, shaping landscapes, influencing climate patterns, and serving as the canvas upon which life's story unfolds. As stewards of the Earth, recognizing the profound importance of these resources is paramount. Sustainable land management practices, responsible water use, and a collective commitment to conservation are essential to ensuring the continued well-being of our plant. In the fact of environmental challenges and human impact, it is imperative to embrace a holistic approach to soil and water stewardship. By fostering awareness, implementing innovative technologies, and advocating for policies that prioritize conservation, we can safeguard these precious resource for the current and future generations. Soil and Water, as the silent architects of life, beckon us to treat lightly, to cherish the interconnectedness of all living things, and to nurture the very source from which life spring forth.

"Nature is the inheritance we pass to our children. Let us be diligent in its preservation, ensuring a legacy of beauty, biodiversity, and balance."

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Effects of Microplastic Pollution on Soil and Water Environment

S. Ponmalini, S. Sivagnanam, S. Divya, S.Surya Prakash, M.Indhu bala
School of Agriculture, Bharath Institute of Higher Education and Research,
Selaiyur, Tambaram, Chennai – 600 073

Abstract

Microplastics are minuscule plastic particles measuring less than five millimeters in size. They can either be intentionally manufactured at this small scale, such as microbeads found in personal care products, or they may result from the degradation of larger plastic items over time. Microplastics manifest in various forms, including fibers, fragments, films, pellets, and spheres. The contamination of microplastics poses a concern to human health and is consequently prevalent in the environment. These particles are identified in ocean bodies as fragments, fibers, and pellets, with dimensions typically less than 5mm (Osman.A.I, et al., 2023). When intentionally produced in small sizes, they are referred to as 'microbeads,' commonly utilized in cosmetics and beauty products. The primary issue arises in water bodies due to the ingestion of these microplastics by marine life, subsequently entering the human body through the interconnected food chain.

Key words: Microplastics, microbeads, fibre and food chain.

Introduction

According to the National Geography (2021) survey the ocean has 5.25 trillion pieces of microplastic residues. The centre has reported that 2,69,000 tons of microplastics float on the surface (June 1st , 2021). The size of the particles are less than 5mm. It is easily enter into the ecosystem. The word 'microplastic' is coined by four scientists (Thompson *et al,* 2004). Thompson et *al.* (2004) conducted a groundbreaking study on ocean pollution, leading to the identification of a previously unrecognized form of contamination known as microplastic pollution. Following this discovery, the issue garnered international attention, prompting researchers and scientists to investigate this emerging source of pollution. Figure 1. Shows the life cycle of microplastics (Ahmed I. *et al*., 2023). Microplastics are pervasive in the hydrosphere, resulting from the ingestion of these minuscule particles by zooplankton, small fishes, and larger fishes, ultimately reaching human beings through the food chain. Extensive traces of microplastics have been identified in human bodies, including in feces, saliva, blood, placenta, etc. (Osman.A.I, *et al.,* 2023), attributed to the ubiquitous use of plastics in everyday life. Notably, infants exhibit a higher rate of plastic pingestion, primarily due to the use of teethers, toys, feeding bottles, and other items. This article aims to explore the sources of plastics, the impact of plastics on the environment, and the associated toxicity levels of these materials.

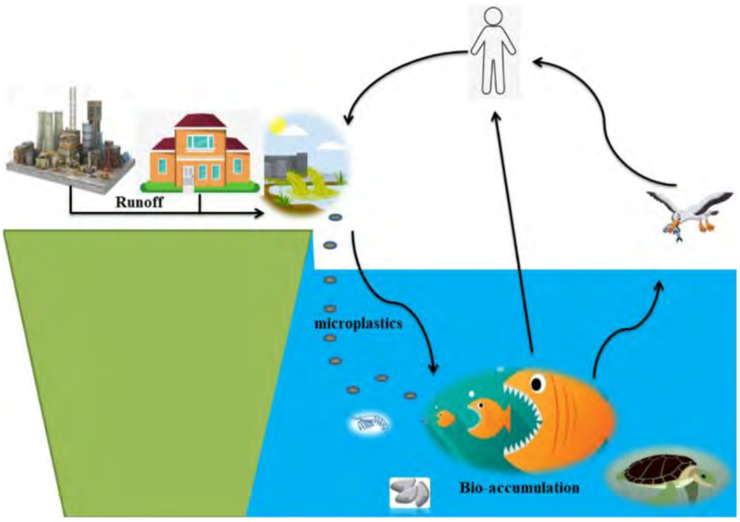

Figure 1. Life cycle of microplastics on environment (Ahmed I. *et al*., 2023).

Sources of the plastics

Microplastics can be categorised as primary and secondary microplastics. Primary microplastics are deliberately manufactured by the industries and added to the commercial market selling products like cosmetics, personal care products, pharmaceuticals, detergents, insecticides etc, Secondary microplastics are not purposefully contaminating, they form due to the breakdown and weathering of wind, waves and other environmental agents. The larger materials like car tyres, polythene bags, toothbrushes, water bottles etc., are broken down into minute particles and contaminate the water and land resources (Wang *et al* 2023 and Osman. A. I, 2023). Recently, there is a huge increase in the pollution of land and water based microplastics, approximately they contribute about 80-90% (Duis and Coor, 2016) of land pollution. This includes the plastic bags, personal care products, textiles, cosmetics, incinerator producing ash, construction materials etc,. Ocean based pollution contributes about 10-20% (Li, 2018 and Karbalaei *et al.* 2019) microplastics discharge into water, they mainly include plastic litters, fishing gears and rods, marine vessels etc,.

Effect of plastic toxicity on the environment

Microplastics are abundant in the global environment. As a typical arising pollutant, it's risky health hazards are widely concerning. These plastics produces harmful hazards to the living organisms and it is affected by many factors including the physical and chemical properties of the sources. A current report from world health organisation (2019) raised an immense concern about the nano and microplastic ingestion by the human. The response to the swallowed particles depends

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on the different individual's immune system response, metabolism and the individual's susceptibility. It is expressed as bronchial reaction (asthma like),chronic pneumonia chronic bronchitis(Prata.J.C, 2018). The most widely occurring health issues are cancer, immunotoxicity, intestinal diseases, pulmonary diseases, cardiovascular diseases (Environmental chemistry letters, Osman.A.I. *et al,* 2023).

Limitations of microplastic

There is a sufficient proof to show that microplastics come in different shapes, sizes, densities, structures or even show difference in the chemical composition and properties (Auta *et al.* 2017). Bui *et al*., (2020) has reported, from last 7 decades of plastic production has raised from 1.5 million tonnes to nearly 359.0 million tonnes in global level and it is likely to reach 500.0.

Table 1. Limitations of microplastic control strategies (Osman A I, *et al*., 2023).

Control strategy	Limitations
Reducing plastic and microplastic usage and production	Reducing plastic and microplastic usage and production It may not be feasible in some industries or for some products, could be expensive to implement, requires a shift in consumer behaviour, and may not address existing plastic waste.
Behavioural changes towards plastic and microplastic products	Public fear of change, lack of trust in alternative products It may take a long time to be achieved, requires a shift in consumer behaviour, may not be feasible for everyone, and may not address existing plastic waste.
Using biodegradable plastics	High production cost and low efficacy of bioplastics compared to conventional plastics. Not all biodegradable plastics are biodegradable, and they may not fully address the issue of plastic waste.
Recycling and reuse of plastic waste	The unsuitability of recycling and reusing certain plastic wastes, such as medical wastes, particularly during the coronavirus disease-19 pandemic the process can be expensive and energy-intensive

Conclusion

In this current world, people using plastics are very inevitable. Plastics has become a routine product to use in this environment. Microplastics can be avoided only through the reduction of plastics and more usage of eco-friendly products and also avoiding the sewage discharge in the coastal bodies is the main source of eliminating plastics. People should need proper awareness about the microplastics hazards. In this connection, government implementing a new act in ipc section for the plastic reduction may be an eye-opening remedy in this need of the hour.

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Special Issue

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Soil And Water – A Source of Life

Brindha sree.M

Kumaraguru Institute of Agriculture, Erode

Abstract

As we know how important soil and water Is. Both soil and water are important resources for our healthy living. Both are endless resources which is over exploiting now-a-days. According to the recent study by FAO,in earth soil has been already degraded 33% and if it continues it will reach about 90% by 2050.Humans are the major reason behind it. Three fourth of our planet are surrounded by soil and water. Major importance of water is it plays crucial role in hydrological cycle. Soil water and plant are interlinked to one another. Major impact on soil is soil degradation and soil salinization and water is eutrophication. Both plays huge role. Therefore, it is necessary to take essential steps in both conservation and management activities.

Keywords: Soil and water, importance of soil and water, impact of human activities on soil and water, soil and water conservation.

Introduction

One of the most essential component for life is soil and water which is backbone for agriculture ecosystem.Of which has formed, when earth originates.Soil is formed by weathering and water by hydrological cycle vapourization,condensation and by precipitation.Another form of water is groundwater.About 95% of soil and water depletion is because of population growth which has increased to 8.1 billion recently.FAO says 33% soil has already degraded and it will reach 90% by 2050.Only 0.3% is usable form of water remaining are in form of vapor,glaciers etc..,Without water life doesn’t exist.

Soil health,soil quality and available water are linked to one another.Major manmade activity is pesticide application.Which in turn reduces the soil quality and affects the plant health.Despite,it is a natural resources,it’s our duty to conserve it.Replenishment of soil has to be done for a healthy future and standard of living.And also balancing ecosystem is essential which is a global problem.As soil produces 95% of humanities food supply.

Importance of soil and water

Both soil and water are important in resilient agri food ecosystem.75% body weight and body muscles are made of water in theoretical perspective.It is a backbone for agricultural

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productivity.Soil is the primary resource and provide mechanical support for plant growth.As soil and water quality increases,health of living organism also benefited.Soil is made of major soil nutrients and is enriched with microorganisms.One of the important organism is earthworm which produce 'wormcast' rekoned about 25tonnes/ha/year.About 80% crops are grown on land,only it contributes about 60% global food production.Study in 1996 shows that Fungi produces a substance called 'Glomalin' which enrich the soil health.And also it stores the atmospheric carbon and act as a carbonsink..

Water is essential not only for survival (regulating body temperature) and also for physiological process that functions the plant. Helps in better development of the ecofriendly environment.

Impact of human activities on soil and water

Major problem of soil degradation is due to ploughing.Which leads to soil compaction and decreases the pore size and water holding capacity of soil so that root cannot penetrate easily.Release of harmful poisonous chemicals from industries and diverting it into the water bodies affect the normal life.Uncontrolled application of chemicals and fertilizers causes eutrophication in water ecosystem.Soil salanizaton and sodification decreases the productivity over time period.s per research,one litre of waste water pollutes at about eight litres of pure water.Chemically contaminated waters are toxic to all organisms that survives.Another important thing is around 75 billion soil is lost by erosion.

Conservation and management

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It is necessary to conserve soil and water for an economically sustainable future.As both are sensitive resources it can be managed in biological aspects.Zero tillage is practiced instead of soil manipulation by machines.Green and animal manure are also added to enrich the soil fertility status.Mulching is also done to prevent the soil from erosion.There are some department and organisations that provide a key support in management of soil and water.Awareness on soil conservation programmes are given to peoples.

Conclusion

Stabilized growth of our world depends on soil and water-primary source of life.Climate change also plays an critical role in scarce resources depletion.Decrease in improper farming activities,increases the structure of soil.Severe management has to be taken for the reclammation of already degraded soil.Watershed development in heavy rainfall area is a key step in water conservation.As an overview,for a sound and disease free future it is necessary to take step by us.

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Special Issue

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Soil And Water – A Source of Life

Mahaboob A

III year of BSc (Hons.,) Agriculture, Agricultural College and Research Institute, Kudumiyanmalai, Pudukkottai-622104.

Abstract

This article explores the intrinsic relationship between soil and water as the vital sources underpinning life on earth. Expanding on their interdependence, the piece explores how healthy soil acts as a nurturer, supporting diverse ecosystems and serving as a natural filter of water. Simultaneously, water, recognized as the elixir of life, sustains terrestrial and aquatic life forms. The article emphasizes the critical need for sustainable practices to counter the challenges posed by deforestation, agricultural practices, and pollution, underscoring the urgency of preserving the delicate balance between soil and water for the well-being of our planet and its inhabitants.

Keywords: Soil, water, interdependence, ecosystems, sustainability, pollution, terrestrial life, aquatic life. nutrient cycling.

Introduction

Both soil and water are the two sides of a coin which plays a significant role in making our living possible, both goes hand in hand. Though many soilless crop production techniques have been identified, 95% of our food comes from soil. We can't even imagine a life without soil and water. As the process of soil genesis takes vast time, it's very important to conserve soil from degradation. The unique link between soil and water is very precious for life and it plays a crucial role in maintaining the biota of our planet.

SOIL- The cradle of life

Beneath our feet lies a complex matrix of minerals, organic matter, and microorganisms. This miracle blend is not just the ground we walk on; it is a living entity that plays a vital role in supporting life. Soil offers the stability of plants and acts a repository for essential nutrients. The intricate web of roots interwoven within the soil facilitates nutrient uptake, promoting the growth of diverse vegetation.

Moreover, soil serves as a habitat for an array of organisms, from microscopic bacteria to earthworms and insects. The biodiversity within the soil contributes to its fertility, aiding in the natural processes of decomposition and nutrient cycling. In essence, soil is the cradle of life, a foundation upon which terrestrial ecosystems thrive.

WATER- The Elixir of life

In tandem with soil, water emerges as the lifeblood that sustains ecosystems across the globe. Although the majority of earth is covered by water, it is the freshwater ecosystems- rivers, lakes, and aquifers- that play a pivotal role in supporting terrestrial life. Water acts as a universal solvent, facilitating biochemical reactions, transporting nutrients and providing a habitat for aquatic organisms.

Interconnected harmony

The relationship between soil and water is intricately woven, with each influencing the other's health and functionality. Soil quality directly impacts water quality, as contaminants or excess nutrients can leach into water sources. Conversely, water availability affects soil moisture, influencing plant growth and overall ecosystem health.

Soil and water degradation

According to a report published by United Nations in 2022 estimates that up to 40% of all soils worldwide are moderately or severely degraded and it is expected to be raised to 90% by 2050 if deforestation, overgrazing, intensive agriculture, urbanization, and other harmful practices persist. So, it becomes significant to conserve soil. Only about 3% of Earth's water is freshwater and this percentage may decrease if the level of water pollution goes on increasing.

Causes of soil and water degradation

In this modern world and with growing technologies, there are various causes of soil degradation which includes, Deforestation, Intensive farming practices. Forest fires, Overgrazing, Industrial pollution, Extraction of minerals and ores, Soil erosion, Drought, long-term climate change, Urbanization and so on.

Similarly, water is also being polluted by, industrial effluents, sewage water, fuel spillage, pesticide residues, household waste, thermal pollution and so on. It's our duty to reduce

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the water pollution and conserve the water from being polluted. As we all in need of fresh water for drinking purpose and for other necessities, we should find ways to treat the waste water and to reduce the waste water discharge in fresh water resources.

Soil and water conservation

We can reduce dumping the waste materials by adopting the technologies like sanitary fillings, incineration, pyrolysis. Solid wastes can be minimised by adopting the **4 R strategy** which includes, Reduce, Reuse, Recycle, Recovery.

Sustainable land management practices, afforestation efforts, and responsible water usage are crucial for preserving soil water resources. Conservation measures, including erosion control, watershed management, and sustainable agriculture, are imperative to safeguard these lifelines for future generations.

Conclusion

Recognizing the intrinsic connection between soil and water is vital for preserving the delicate balance that sustains life on earth. Sustainable practices in agriculture, forestry, and water management are essential to ensure the health and vitality of these fundamental resources. By understanding and respecting the intrinsic relationship between soil and water, we can work towards creating a harmonious coexistence that supports life in all its forms.

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Special Issue

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Seaweed: Nature's Dual Role as Soil Conditioner and Water Purifier

Pinak Bamaniya[1]*, D. T. Vaghela[2], Ishita Bambhaniya[3], Mayur Bhadarka[1], Milan Ram[1]

[1*] PG Schloar, Dept. of Aquatic Environment Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India

[2]Associate Professor, Dept. of Aquatic Environment Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India

[3]PG Schloar, Dept. of Aquaculture, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India

Abstract

Modern agriculture faces challenges due to chemical-based soil practices, climate shifts, and urbanization, necessitating eco-friendly soil management solutions. This article delves into seaweed's burgeoning role as a versatile agent in agriculture and environmental conservation. Seaweed, rich in nutrients, acts as a potent soil enhancer, positively impacting soil structure, moisture retention, and nutrient availability. Its application correlates with enhanced plant growth, root development, and resilience to drought stress. Moreover, beyond agricultural benefits, seaweed demonstrates promise as a pollutant absorber, aiding soil remediation and indoor environment improvement.Furthermore, seaweed contributes significantly to water purification, fostering mineral-rich alkaline water and organic water-soluble fertilizers, augmenting crop quality and yields. Innovative methods for seaweed extract production highlight its practicality in sustainable agriculture and water treatment.

Keywords: - seaweed, soil, water, soil enhancement, environmental remediation

Introduction

Soil management is crucial for growing high-quality crops, and it can be achieved through intensive inputs of fertilizers, irrigation, and integrated soil management. Chemical-based fertilization practices have led to environmental degradation and health hazards, posing a major challenge for eco-friendly soil fertilization. Climate change, loss of biodiversity, and urbanization further complicate the challenges faced by farmers. To address these issues, new innovations in fertilizer options and an integrated approach to soil management are needed. Seaweeds, also known as macro algae, have emerged as promising candidates in soil management practices and "green" agriculture. Seaweeds not only promote plant growth but also improve the physical, chemical, and biological properties of soil, enhancing soil health and moisture-holding capacity. (Kaur, 2020)

Seaweed as a soil conditioner

Research has explored seaweed's potential as a soil enhancer, demonstrating its capacity to enhance soil structure, boost moisture levels, and elevate the function of beneficial soil enzymes. Seaweed is also valued for its rich nutritional content, as outlined in Table 1, which compares the dietary and nutrient profiles of different commercially available seaweed species. Moreover, seaweed extracts have shown the ability to heighten the accessibility of vital nutrients like nitrogen, phosphorus, and potassium in the soil. Furthermore, applying seaweed has been linked to fostering root growth and altering root structure, resulting in better water efficiency and resilience to drought in plants (Chen et al., 2023). Its use as a fertilizer has been associated with increased soil urease activity and ammonium nitrogen levels, along with augmented leaf proline and water content in plants, ultimately enhancing drought resistance (Zhang et al., 2023). Overall, seaweed exhibits promise in bolstering soil health, improving plant growth, and fortifying crop resilience to drought, offering potential benefits for sustainable agriculture.

In addition to its agricultural benefits, seaweed possesses the capacity to absorb environmental pollutants. Seaweed-based fertilizers serve the dual purpose of nourishing plants while assisting in pollutant removal from the soil. These fertilizers contain natural seaweed elements abundant in nutrient substances and exhibiting high biological activity. The compounds from seaweed in these fertilizers are easily assimilated by plants, fostering growth and increasing yields. Moreover, water-absorbent materials derived from seaweed can enhance soil water retention, while seaweed coatings are effective in reducing indoor noise by absorbing sound waves. Overall, seaweed holds promise as an effective tool for both pollutant absorption and the improvement of soil and indoor environments.

Table 1. Nutrient and Mineral composition of some edible seaweeds

Species	Protein	Ash	Dietary fiber	Carbohydrate	Lipid	Na	K	P	Ca	Mg	Fe	Zn	Mn	Cu	I
	(mg.100 g−1 DW).					(% dry weight)									
Chlorophyta (Green seaweed)															
Caulerpa lentillifera	10–13	24–37	33	38–59	0.86–1.11	8917	970 – 1142	1030	780 – 1874	630 – 1028	9.3 – 21.4	2.6 – 3.5	7.9	0.11 – 2.2	-
C. racemosa	17.8–18.4	7–19	64.9	33–41	9.8	2574	318	29.71	1852	384 – 1610	30 – 81	1 – 7	4.91	0.6 - 0.8	-
Codium fragile	8–11	21–39	5.1	39–67	0.5–1.5	-	-	-	-	-	-	-	-	-	-
Ulva compressa	21–27	18.6	33–45	48.2	0.3	-	-	-	-	-	-	-	-	-	-
U. lactuca	10–25	12.9	29–38	36–43	0.6–1.6	-	-	-	-	-	-	-	-	-	-
Phaeophyceae (Brown seaweed)															
F. vesiculosus	3–14	14–30	45–59	46.8	1.9	2450 - 5469	2500 - 4322	315	725 – 938	670 – 994	4 – 11	3.71	5.50	<0.5	14.5
Laminaria digitata	8–15	37.59	37.3	48	1.0	3818	11579	-	1005	659	3.29	1.77	<0.5	<0.5	-

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Saccharina japonica	7.5	26.63	10–36	51.9	1.0	2532 - 3260	4350 - 5951	150 – 300	225 - 910	550 – 757	1.19 – 43	0.89 – 1.63	0.13 – 0.65	0.25 – 0.4	130 – 690
Sargassum fusiforme	11.6	19.77	17–62	30.6	1.4	-	-	-	1860	687	88.6	1.35	-	-	-
Undaria pinnatifida	12–23	26–39	16–46	45–51	1.5–4.5	4880 - 6494	5691 - 6810	235 - 450	680 - 1380	405 - 680	1.54 - 30	0.944	0.332	0.185	22-30
Rhodophyta (Red seaweed)															
Chondrus crispus	11–21	21.08	10–34	55–68	1.0–3.0	1200 – 4270	1530-3184	135	420 – 1120	600 – 732	4 – 17	7.14	1.32	<0.5	24.5
Palmaria palmata	8–35	15–30	28.57	46–56	0.7–3	1595	7310	235	560	610	50	2.86	1.14	0.376	55
Porphyra tenera	33–47	20.5	12–35	44.3	0.7	3627	3500	-	390	565	10.3	2.21	2.72	<0.5	-
P. umbilicalis	29–39	12	29–35	43	0.3	940	2030	235	330	370	23		‘	-	17.3
P. yezoensis	31–44	7.8	48.6	44.4	2.1	570	2400	-	440	650	13	10	2	1.47	-

Source – (Pereira, 2016)

Figure 1. Some seaweed found along Veraval (Gujarat) coast

Seaweed as water purifier

Seaweed holds versatile uses in water purification processes. It's utilized in creating mineral filters for water purification, transforming water into mineral-rich alkaline water (Bang, 2019). Moreover, seaweed contributes to the development of water-soluble fertilizers, enhancing soil fertility and balance, resulting in improved yields and quality of crops like vegetables and fruits (Cao & Kuang, 2015). A specialized water extractor for edible seaweed streamlines the water extraction process, enhancing production efficiency and reducing labor intensity (Yao, 2015). Additionally, seaweed-based organic water-soluble fertilizers supply essential elements for crop growth, fostering rapid development, maintaining nutritional equilibrium, boosting stress resistance, mitigating chemical harm, and fortifying crop roots (Zhang & Li, 2018). Lastly, equipment for water purification in photovoltaic power stations, designed to automatically eliminate algae waste using seaweed, enhances operational efficiency and water quality (Zhou, 2018).

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Method for making seaweed extract

Material	Procedure
1. Seaweeds (ex. *Cladophora rupestris,* and *Ulva lactuca*)	1. Wash collected seaweeds thoroughly to remove impurities (epiphytes, sand, dust particles). Repeat 3-4 times.
2. Distilled water	2. Dry washed seaweeds in a shady area for 3-4 days to reduce water content.
3. Cheese cloth / filter paper	3. Soak dried seaweeds in distilled water and boil for 30 minutes.
	4. Store dried seaweeds in powdered form for future use.
	5. Filter the boiled content using fresh cheesecloth/filter paper.
	6. Collect filtrate (seaweed extract) and store it in airtight containers.
	7. Use the obtained extract as a 100 percent concentration, dilute based on usage.

Source – (Thanigaivel et al , 2023)

Conclusion

In conclusion, In the realm of sustainable agriculture, seaweed emerges as a dual-purpose solution—serving as both a soil conditioner and a water purifier. Its proven ability to augment soil health, foster robust plant growth, and bolster crop resilience against drought showcases its potential in cultivating more sustainable farming practices. Furthermore, its unique capacity to aid in pollutant removal from the soil and improve water quality underlines its broader environmental significance. Seaweed, with its multifaceted benefits, offers a promising avenue for nurturing healthier soils, enhancing crop productivity, and contributing to more eco-friendly agricultural methodologies.

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Paper mill effluent is an alternate water and nutrient source in agriculture

Dhanushkodi ,V., Balamurugan, R and Baskar, M

Department of Soil Science and Agricultural Chemistry Anbil Dharmalingam Agricultural College and Research Institute
Tiruchirappalli -620 027, Tamil Nadu, India

Abstract

Water is a valuable and indispensable natural resource and is an essential base for all life on earth. The paper industry is one of the top water consumers and top producers of wastewater in the world. The release of these effluents into water bodies changes the natural quality of water and other hazardous substances. However, treated wastewater includes a sizable amount of nutrients that may be helpful for plant growth. Furthermore, it has been viewed as a potential water resource and contains a rich source of plant nutrients. Hence, this effluent can be used as alternate sources for irrigation water and conventional inorganic fertilizers.

Introduction

The paper industry is one of the top water consumers and top producers of wastewater in the world. In India, approximately 700 paper mills (Kumar *et al.*, 2017) are functioning and generate 8.5 million tonnes of paper/year. Typically, one tonne of paper require 273-450 m^3 of water, which consequently, generates 300 m^3 of waste water (Hazarika *et al.*, 2007). The release of these effluents into water bodies changes the natural quality of water by increasing the pH, BOD, COD, lignin, total suspended particles, colour, heavy metal ions and other hazardous substances. However, treated wastewater includes a sizable amount of nutrients that may be helpful for plant growth. Moreover, treated paper mill effluent is a rich source of plant nutrients and used as an alternate source for irrigation water and conventional inorganic fertilizers. It has properties similar to fertilizer, improves nutrients uptake and promotes the growth and yield of crops.

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Hence, the use of wastewater in agriculture is gaining importance rapidly. Properties of the paper mill effluent Wastewater originating from the paper industry, specifically from pulping, bleaching and washing operations, is frequently identified by a set of distinctive features. The treated effluent discharged from paper mills typically exhibits reduced contamination levels and in most cases, it complies with the standards set forth by the World Health Organization (WHO). The raw pulp and paper mill effluent typically exhibited a dark brown tint. The paper mill effluent have potential to improve agriculture due to the presence of various chemical properties (Fig.1).

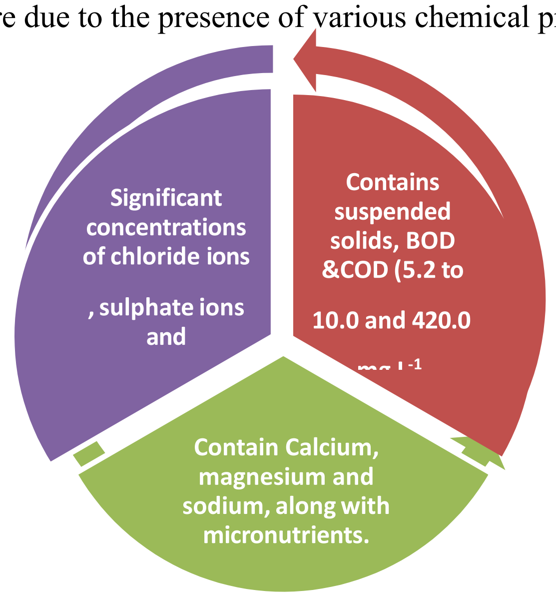

Figure 1. Compounds present in the treated paper mill effluent

Role of paper mill effluent in soil fertility status

The application of paperboard effluent on soil had several positive effects. Treated wastewater is now recognized as a potential water resource in agriculture. It contains a substantial amount of nutrients that are beneficial for plant growth. The application of treated paper mill effluent has a capacity to improving the permeability, infiltration and total porosity on soil. The levels of exchangeable basic cations, including calcium (Ca), magnesium (Mg), sodium (Na) and potassium (K) improve soils nutrient sources (Gomathy *et al*., 2021). Continuous irrigation with effluent from the paper industry can lead to higher levels of organic matter in the soil. Paper board mill effluent helps in raising the

otal nitrogen, phosphorus and potassium contents in the soil. Soil nutrient enrichment and enzyme activity by paper mill effluent irrigation also have ability to increase the abundance of bacteria, fungi and actinomycetes.

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Paper mill effluent as a water and nutrient for crops

The paper mill effluent has various impacts on the growth and yield of different crops. As industrialization has increased at a stimulating rate the effective usage of industrial waste in agriculture supports as a new source and alternative for irrigation water and fertilizers. paper mill effluent had a positive impact on crop growth which lads to an increase in biomass and yield (Rashid *et al*. (2021).

The further application of treated paperboard mill effluent irrigation in combination with the application of solid waste viz., bio-manure, vermicompost, farmyard manure and fly ash could increase the growth, yield and quality of crops.

Conclusion

The use of treated paper mill effluent at diluted concentrations and particularly when combined with organic manures, can be a sustainable approach for crop production without any adverse effects on either soil or yield or quality. Moreover, the paper mill effluent helps in improve soil nutrients.

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Special Issue
Vol.3 Special Issue 01 Dec 2024, Page: 66-68

Soil and water - A source of life

Hemalatha MK
Department of Soil Science and Agricultural Chemistry Anbil Dharmalingam Agricultural College and Research Institute
Tiruchirappalli -620 027, Tamil Nadu, India

Abstract

Soil and water from the bed rock of life on earth, nurturing ecosystem and sustaining all living organisms. Our planet's survival depends on the precious like between soil and water. Their independence creates a delicate balance crucial for biodiversity, agriculture and human survival. Over 95% of our food originates from these two fundamental resources. The health of the soil and the quality and availability of water are interconnected.

Soil

Foundation of life soil is more than just dirt; it's a complex ecosystem teeming with microscopic organisms, minerals, organic matter and air. This living matrix support plant growth, provides nutrient and regulates water flow. It's ability to retain water and nutrients influences crop productivity and sustain forests, grasslands and wetlands. Soil serves as the life line for agriculture, providing the necessary nutrients and support for plant growth. It's ability to retain water, regulate temperature, and store carbon contributes significantly to the productivity of ecosystem and global carbon cycle.

However, the health of our soil is under threat. Erosion, pollution, overuse of chemical fertilizers, and deforestation are jeopardizing it's delicate balance. Degraded soil leads to decreased agricultural productivity, compromised water quality and diminished biodiversity, posing significant challenges for global food security and environmental stability.

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Water

Elixir of life Water, often called the elixir of life, vital for all forms of existence. It circulates through the environment in a continuous cycle, sustaining life by hydrating metabolic processes, and shaping landscapes. Freshwater source from river to aquifers, support agriculture, industry, and human consumption. Water, the quintessential element, is the very essence of life itself. Covering around 71% of earth surface, this transparent and tasteless compound is a fundamental building block of our planet's ecosystem, supporting life in myriad forms. Crucially, water is indispensable for human existence. It's vital component of bodily functions, enabling physiological processes, maintaining hydration and facilitating nutrient transport.

However, this precious resource faces multifaceted challenges. Water scarcity, pollution, climate change induced droughts and inefficient water management practices threaten it's availability and quality

Interconnectedness and Challenges

The relationship between soil and water is intricate. Healthy soil absorbs and filters water, reducing erosion and preventing pollutants from entering water bodies. Conversrly, water shapes the landscape, carrying sediments that affect soil fertility and quality. However, this balance faces threats from deforestation, pollution, overuse and climate change, leading to soil degradation, water scarcity and loss of biodiversity. Water scarcity leads to the loss of soil biodiversity, while leaching and eutrophication from agriculture practices lead to the loss of biodiversity in water bodies. Poor irrigation and drainage practices are some of the main drivers of soil salinization. Rising sea levels contribute to land loss, increasing the risk of soil salinization and sodification, which can negatively impact agricultural productivity.

Conversation and Sustainability

Preserving soil and water resources is essential for the planet's health. Conservation practices like crop rotation, Agroforestry, terracing and watershed management help maintain soil fertility, prevent erosion and safeguard water quality. Sustainable water management, efficient irrigation, and reducing pollution are crucial for ensuring a continuous supply of clean water for future generation.

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Sustainable soil practices must be put in place to improve water availability for agriculture. Only then, we can begin to improve the livelihood and health of people and ecosystem.

- Prevent soil erosion
- Stop illegal mining and construction
- Improve soil and water management
- Improve soil protect awareness
- Improve the agricultural system
- Adapt soil conservation prprograme
- Promote biodiversity
- Educate and motivate

In essence, soil and water are the lifeblood of our planet. By understanding their significance and adopting sustainable practices, we can ensure their preservation, safeguarding life in all its forms.

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Soil and water are important source of life and essential in agriculture.

ROJA A
AC&RI Kudumiyanmalai, Pudukkottai – 622104

Abstract

A source of life is anything that is necessary to survive. The important source of life is soil and water. Our planet survival depends on the precious link between soil and water because of 95% of our food originates from these two fundamental resources. "World soil day" is held on 5th December 2014, as first official world soil day, which was recommended by International Union of Soil Sciences (IUSS in 2022).Food and agriculture organization (FAO) has supported the formal establishment of WSD as a global awareness raising platforms. Water is called the medium of life.75% of water on the earth surface is too salty found in oceans, 3% only a fresh water. Water is a need not just a want. The film "A World without water" is an eye-opener. It shows how rich survives and poor tend to die because of dirty water, lack of supply and accessibility. Soil and Water Conservation Society (SWCs) is the premier international organization who practice and advance the art and science of natural resource conservation. Soil and water are vital for nutrient absorption by plants, binds our ecosystem together i.e. without soil and water, plants died. Without plants, animals are died and entire ecosystem gets destroyed without the soil and water. It plays a major role in agriculture and food production.

Key words: Agriculture, Conservation, Resources, Soil, Water.

Introduction

The three most important non-living resources for us is the air we breathe, the water we drink, and land we live on. Without these resources we can't exist. The UN general assembly choose the Dec 5th as World soil Day in 2014. The theme of world soil day 2023 is "Soil and water, a source of life". It focuses on raising awareness about importance of soil and water for sustainable and resilient agriculture food systems. According to FAO, of the earth's soil, 33% are already degraded and over 90% could become degraded by 2050. The health of the soil and the quality and availability of water are interconnected. It can take upto1000 years to produce just 2 cm of soil. The ICAR-Indian Institute of Soil and Water Conservation (ICAR-IISWC) was established on 1st April, 1974 with headquarters on Dehradun by combining soil and water conservation research. It caters to the need of natural resource management in different regions with mandate principle to conserve soil

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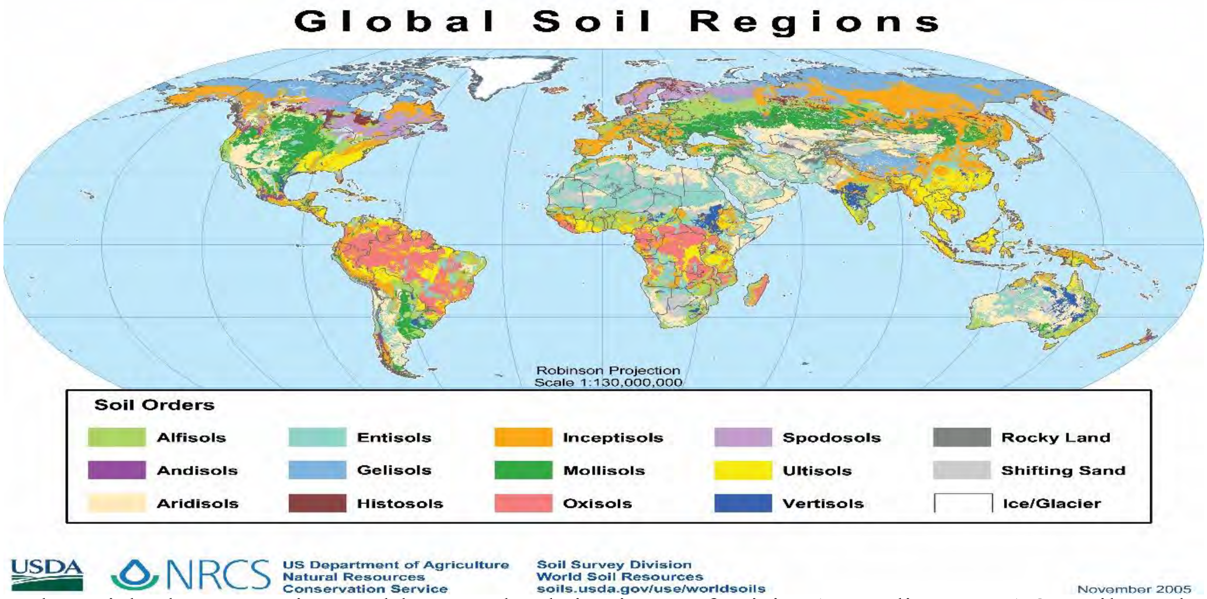
and water in arable and non-arable production systems and promote agriculture production. Climate change is affecting soil erosion most directly through changes in extreme precipitation, according to resent research.

Influence of soil on crop yield and food security

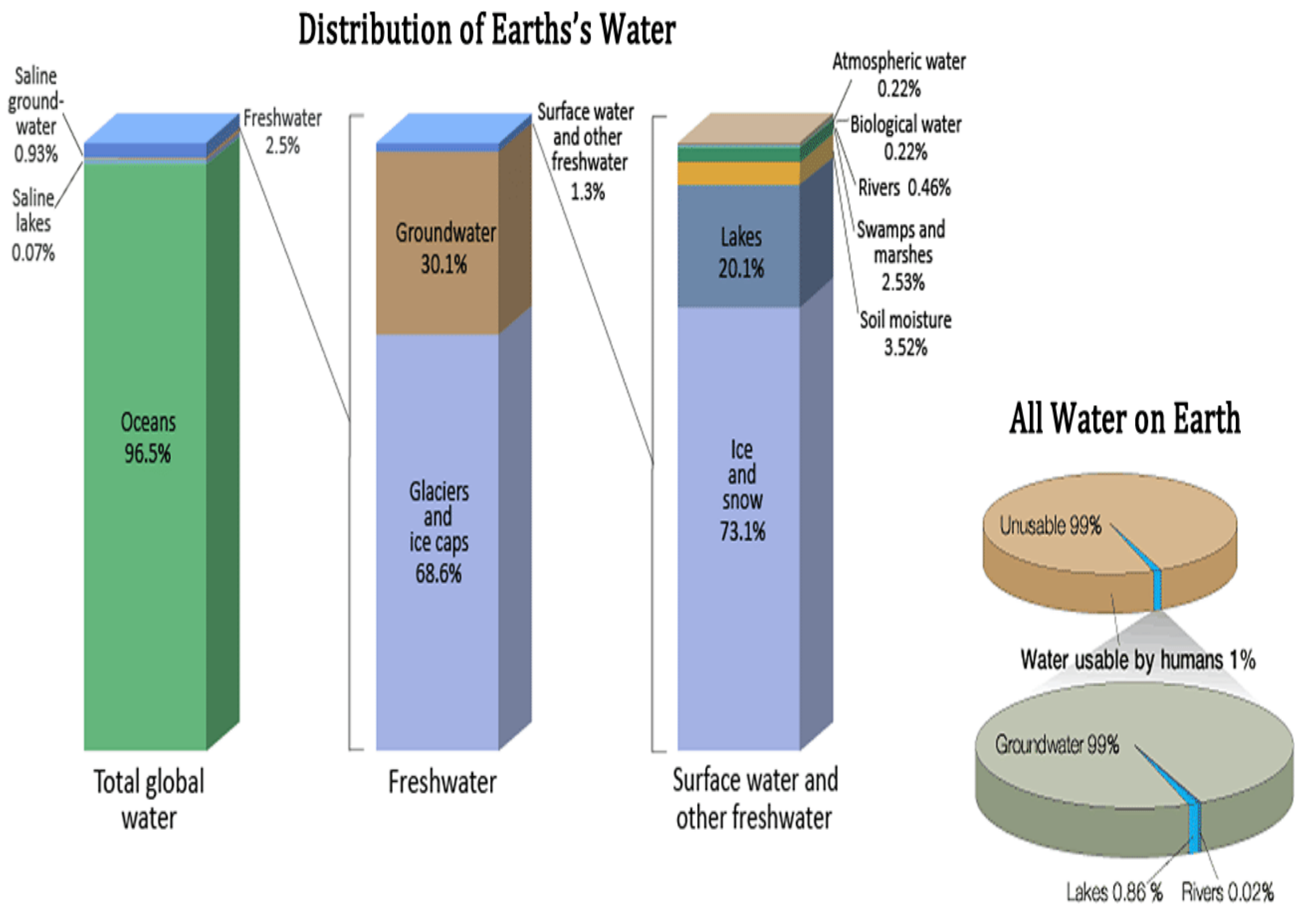
Soils that have well developed structure, sufficient organic matter and other physical and chemical properties conducive to promote the crop growth leads to strong yields and are thus important for food security. Soil degradation which includes soil erosion and loss of soil structure and nutrient content decrease the crop production and threatens the food security. Food security is the availability, accessibility and affordability of food to all people at all times. Soil quality is directly linked to food quality and quantity. TN has implemented the popular One Nation One Ration Card scheme from 1st October, 2020, enable the migrant workers and their families to access the public distribution system benefits from any fair prices shops across the country. United States Agency for International Development (USAID) is an advancing global food security by helping families and individuals meet their need for a reliable source of quality food and sufficient resources to produce or purchase it, which supports global stability and prosperity. The enactment of the Global Food Security Act of 2016 and Global Food Security Reauthorization Act of 2018 solidified the U.S. Government continued bipartisan commitment to reducing hunger, malnutrition and poverty around the world. As part of this effort, approach of USAID to fighting hunger and strengthening food security by leading the America feed the future initiative to strengthen agriculture collaboration with multiple U.S. agencies and departments and providing emergency food assistance



so malnourished can survive and bounce back in times of crisis. According to FAO, soil produce 95% of food we eat, ability to grow plants would be impossible without healthy soils.

The Role of Water in Agricultural Development

Water has unique characteristics that determine both its allocation and use as a resource by agriculture. In developing countries, irrigated agriculture plays a vital role towards poverty alleviation. Agriculture is the largest users of water in all regions of the world except Europe and North America (FAO, 2002). In 2000, agriculture account for 70% of water withdrawals and 90% of water consumption worldwide. For domestic uses people use approximately 30-300 L of water per person per day. Due to population growth, urbanization and climatic change, competition for water resources is expected to increase, with a particular impact on agriculture. Agriculture is expected to face increasing water risks in the future. Researchers say that a key component to understanding the water in agriculture is the water footprint of food, which contains of three components; green, blue and grey water footprints. Green water refers to rainwater consumed, Blue water is the volume of surface and ground water used for irrigation and grey water is the volume of fresh water needed to assimilate the pollutants generated in the crop.



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Conclusion

It is our responsibility to conserve and manage the resources, soil and water for future generations. We have to conserve it preserve soil erosion, stop illegal mining and construction, improve soil and water management, improve soil protection awareness, improve agricultural system, promote biodiversity, educate and motivate to prevent these two (soil and water) interconnected resources by creating awareness about the importance of water and soil; our source of life. Unfortunately, both soil and water are under threat from a variety of human activities, including erosion, overuse, deforestation, and pollution. Protecting these resources is critical for ensuring that we can continue to sustainably produce food, fiber, and fuel, as well as maintain healthy ecosystems and promote public health. We can work together to protect soil and water resources for future generations.

Acknowledgement

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Soil And Water: A Source of Life

Pooja kumari
ICAR- IARI jharkhand

Abstract

Discover the dynamic duo of life—soil and water! This article dives into their incredible roles, from powering bountiful farms to shaping vibrant ecosystems. Get ready for a journey through conservation tips, a look at pollution challenges, and a call to cherish these life sources. Join us in understanding why soil and water are not just resources but the heartbeat of our planet, urging us all to be eco-champions for a healthier world!"

Introduction

Soil and water are the fundamental elements that sustain life on our planet. With their indispensable roles in agriculture, ecosystems, and even human survival, it is undeniable that soil and water are truly the source of life.

At its most basic level, soil provides the necessary foundation for all plants to flourish. The richness and composition of the soil directly impact the quality and quantity of crops. It acts as a reservoir for vital nutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth and development.

Water, on the other hand, is the elixir of life. It is the driving force behind all forms of life on Earth. From single-celled organisms to complex multicellular beings, water is essential for their survival. It plays a crucial role in biological processes, allowing for the transport of nutrients, elimination of waste, and regulation of body temperature. Animals, including humans, depend on water to maintain hydration, while aquatic organisms rely on it as their habitat.

Conserving soil and water is crucial for maintaining a healthy environment and sustaining agricultural productivity. Implementing sustainable practices not only protects our natural resources but also contributes to long-term ecological balance. Here are some practical tips for

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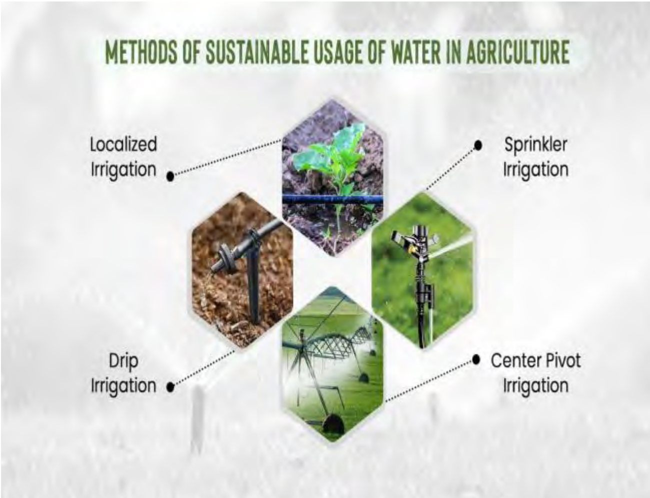
soil and water conservation. As Mulching for moisture retention, Rainwater harvesting system, efficient irrigation method, composting for soil health, native plant selection, terracing to prevent erosion, no till farming practice, optimal irrigation timing, cover crops for soil protection, regular soil testing. By incorporating these conservation tips into our daily practices, we can contribute to the preservation of soil and water resources. Sustainable agriculture and landscaping not only benefit the environment but also create a resilient and productive ecosystem for future generations.

Pollution poses a significant threat to our environment, with soil and water being particularly vulnerable. This article explores the challenges posed by pollution in these vital resources and proposes actionable



solutions for mitigation. As Pollution challenges are industrial runoff, chemical agriculture, improve waste disposal, urbanization impact, deforestation and erosion.

Addressing soil and water pollution requires a multifaceted approach. Firstly, promoting sustainable agricultural practices, such as organic farming and precision agriculture, can minimize chemical runoff. Additionally, enforcing strict industrial waste regulations and promoting eco-friendly technologies can reduce contaminants entering water bodies. Implementing efficient waste management systems, promoting afforestation, and investing in water treatment facilities are crucial steps in combating pollution. Public awareness and community involvement are also vital for long-term success in preserving our soil and water resources. Exploring the profound significance of soil and water unveils their role as the lifeblood of our planet.

Beyond mere resources, they are the heartbeat sustaining ecosystems and human

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existence. Joining this journey of understanding compels us to become eco-champions, advocating for practices that preserve these vital elements. By championing a healthier world, we safeguard not only our environment but also the very essence of life.

Conclusion

The journey through the intricate dynamics of soil and water reveals their irreplaceable significance as the heartbeat of life on Earth. As we navigate the challenges of pollution impacting these essential resources, the call to action becomes clear. Embracing sustainable practices, conserving resources, and fostering a global commitment to environmental responsibility are paramount. In doing so, we not only protect the delicate balance of ecosystems but also secure the foundation of agriculture and the well- being of humanity. "Soil and Water: A Source of Life" is a reminder of our shared responsibility to cherish, protect, and sustain these life-enabling elements for a thriving and resilient future.

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Antimicrobial resistance through water: Development and mitigation

Jhanak Chaveriya[1,2], Ajit Pratap Singh[1], Kush Shrivastava[1]*, Tripti Jain[1], Bikash Ranjan Prusty[1], Sanjay Shukla[1]

[1]Animal Biotechnology Centre, Nanaji Deshmukh Veterinary Science University, Jabalpur, M.P., India

[2]Department of Biological Science, RDVV, Jabalpur, M.P., India

Abstract

Antimicrobials and antibiotics are employed in aquaculture, agriculture, the livestock business, human infections, and animal diseases as preventive and therapeutic measures. Even in modest quantities, antimicrobial disinfectants, and metals found in wastewater can act as a selection pressure for antibiotic resistance. Antimicrobial residues are transferred to many habitats by excretions, inappropriate drug disposal, wastewater from the antibiotic production unit, and the use of antibiotics in plant production. In this article, we discuss the development of antimicrobial resistance through water, its effect, challenges, and how it mitigates.

Key words: Antimicrobial resistance, Drinking water, antimicrobial residue

Introduction

In the past century, the use of antimicrobials has improved healthcare services and increased life expectancy. They are essential for treating infectious infections in humans, animals, and plants. Antimicrobials comprise antivirals, antibiotics, antiparasitic, and antifungals. However, when viruses, fungi, parasites, and bacteria stop responding to antimicrobial medicine, it means that they have become resistant, and it's termed antimicrobial resistance (AMR). Drug resistance increases the risk of disease transmission, acute illness, disability, and death by making antibiotics and other antimicrobial medications ineffective and making it challenging or impossible to treat infections.

Antibiotic resistance evolves from four genetic reactors. The primary reactor includes more than 500 different bacterial species that make up the human and animal microbiota, the secondary reactor comprises hospitals, farms, or crowded places where susceptible people have the chance to mix and become exposed to bacterial exchange. The wastewater and any biological residues that came from the secondary reactor, such as sewage treatment plants, or compost toilets, are referred to as the tertiary reactor. The soil and surface or groundwater environments serve as quaternary reactors, where the bacterial species from the earlier reactors interact and balance out with the surrounding environmental organisms. All four genetic reactors involve water as a critical component, but the final ones significantly do (Baquero *et al.*, 2008).

AMR is a natural process; however, its severity and transmission are accelerated by human, animal, and plant pathogenic microbes that are continually discharged with wastewater into the aquatic environment, including treated drinking water. Antibiotics reach the environment through human and animal discharge, industrial antibiotics production units, and disposal of unused antimicrobial medicines. AMR spreads because of the selection pressure created by the antibiotic's presence in the environment. Bacterial and viral infections are difficult to treat, but as antimicrobial drugs are less or not effective, due to AMR, will cause chronic or fatal infections that may impact globally greater medical costs and mortality numbers. It was estimated that Bacterial AMR caused 4.95 million fatalities worldwide in 2019 alongside causing 1.27 million deaths directly related to drug resistance and if preventive measures are not widely implemented, this figure will rise to 10 million cases annually by 2050 making antimicrobial resistance a major threat to public healthcare (Murray *et al*., 2022).

Antibiotic resistance in river water

River water plays a crucial role in biological functions, it’s very important for both humans and animals. River waters are repositories for AR, they are also thought to be a crucial route for the spread of antimicrobial resistance components, and antimicrobial-resistant residues have been found in almost most of the rivers on earth, including river Ganga, and the concentrations of AMR’s are rapidly increasing.

Because there is a direct correlation between the quality of irrigation water utilized and the presence of antimicrobial-resistant bacteria in food, irrigation water may be one of the sources of microbial contamination in the preharvest environment, the irrigation water used may be from the nearby rivers or this irrigation water may flow to river water. The presence of AMRs in bacteria in food is a major concern for the health sector, it may lead to incurable and fatal diseases.

Antibiotic resistance in drinking water

Clean drinking water is crucial for survival in humans, if not available it can cause outbreaks of disease in a large population. Drinking water distribution systems are made up of a vast network of pipelines that transport potable water from drinking water treatment facilities to end users and

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reservoirs need to have long-term water storage capabilities. These water treatment systems may contain a large biofilm area, which can separate and release AMR bacteria or genes and contaminate drinking water.

Thus, there is a serious risk to public health from the growth of biofilms in drinking water distribution systems and from inadequate water treatment methods that can't treat AMRs. Accordingly, polluted drinking water has been linked to epidemic outbreaks in the past and is a major risk to human and animal populations.

Antibiotic resistance in soil–water environments

AMR contaminants are released into the water from industries, and this water goes into the soil, binding the AMRs to soil particles. Due to the binding to the soil, biodegradation of the antimicrobial particles takes time and they remain in the environment for a very long time. These drugs pollute the soil affecting its pH and important parameters.

The dissemination of antibiotic resistance among bacterial pathogens is influenced by genome plasticity that includes utilizing horizontal gene transfer. Horizontal gene transfer includes processes like conjugation, transformation, and transduction, gene transfer agents, and membrane vesicle fusion they can adapt to their surroundings and thrive in antibiotic-contaminated environments. It's the primary cause of newly emerging strains of bacteria with resistance.

Transformation is the process by which free DNA from a foreign, competent bacterium is taken up and integrated into the receiving bacterium following the lysis and death of the host bacterium. Plasmids can be transferred from a donor cell to a recipient cell during conjugation when bacteria come into contact with one another's cells. Following bacterial lysis, bacteriophages can incorporate DNA fragments into their host bacteria's genome, this process that bacteriophages mediate is called transduction.

Selection pressure, mutation, and gene transfer all contribute to the development of AMR in microorganisms. Random bits of DNA are liberated by bacterial lysis and are carried by gene transfer agents, which safeguard DNA from external factors. The occurrence, amplification, and dispersion of AMR in the environment are determined by selection pressure.

Antimicrobial-resistant genes

Antibiotic resistance is a naturally occurring process, in this the innate capacity of bacteria to withstand the effects of antibiotics and other substances that can stop them from growing or killing them. Many of the pathogenic organisms contain antimicrobial-resistance genes (ARG), which may

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be inserted into plasmids, integrons, or transposons and they may be able to span among water microbial communities. Resistance genes use resistance mechanisms such as resistance mutations, efflux pumps, and antibiotic inactivation strategies. Antimicrobial resistance may result from a multitude of distinct genes. Understanding resistance epidemiology, confirming non-susceptible phenotypes, and identifying resistant strains—particularly when genes express poorly in vitro—all depend on the identification of these genes.

Identification and analysis of antimicrobial-resistant genes has been done using PCR, metagenomics, functional metagenomics, databases, and software. Also in several cases, it is necessary to do sequencing of PCR products, which can make the process a little time-consuming.

New techniques are continuously being developed, opening up novel possibilities for the investigation of ARGs in the microbial population. A high-throughput technique that can resolve an ARG's host without culturing is needed. One of them is epicPCR, which links two genes, originating from one cell to an amplicon. Another tool is an inverse PCR along with long-read sequencing, which is useful for the determination of the genetic environment of ARGs.

Control of Antimicrobial Resistance

Strategies aimed at the proper removal of antibiotics should be part of the mitigation of antibiotic resistance spreading in the environment. These strategies include novel approaches to water remediation, such as the use of biomaterials, nanoparticles, and microalgae to adsorb and degrade contaminants such as AMRs and ARGs.

Noval strategies for the control of AMR include many different techniques. One of them is by using nanotechnology, to fight antimicrobial resistance. By using different engineered nanomaterials such as nanoparticles, nanotubes, and biogenic nanoparticles, antimicrobials can be removed. Utilizing biogenic nanomaterials is more eco-friendly, safer and economically feasible, than using non-biogenic nanomaterials, which may be made with hazardous chemicals that can harm the environment.

Another strategy is based on Microalgae, it's an eco-friendly and cost-effective process that is used for water remediation. The three primary processes that microalgae use to eliminate antibiotics are bioadsorption, bioaccumulation, and biodegradation. An intermediary stage between bioadsorption and biodegradation is bioaccumulation. Since biodegradation is an irreversible process that can produce fewer hazardous byproducts, it is the most effective mechanism for removing antibiotics out of the three processes in treating contaminated water.

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The utilization of microalgae-bacterial consortiums for water remediation is another strategy for treating water. About 54% of sulfamethoxazole was removed from wastewater treatment plant effluents by a microalgae-bacterial consortium, with *Chorella sorokiniana* being the most prevalent microalgae species. This was mostly accomplished through bacterial biodegradation (da Silva Rodrigues *et al*., 2020). This consortium takes advantage of the symbiotic relationship between microalgae and bacteria in which microalgae detects and takes up vitamins and becomes an oxygen source for bacteria. The microalgae-bacterial consortium is a potentially effective method for getting rid of antimicrobials from drinking water treatment plants and wastewater treatment facilities.

Considering this, and in spite of the data demonstrating the benefits of the microalgae-bacteria consortium, its application needs to be investigated further to comprehend the mechanism. Also, novel techniques are needed for more effective removal of antimicrobial-resistant contaminants in the water. If not, this contamination can cause outbreaks of epidemic in the general population of human and veterinary animals.

Conclusion

To prevent and treat human illnesses as well as animal diseases, antimicrobials, and antibiotics are used in aquaculture, agriculture, the livestock industry, and other fields. The ongoing overuse, abuse, and unchecked environmental contamination caused by antimicrobials worldwide is making the AMR problem into a global health emergency. Antimicrobials and other resistance cofactors have the ability to accelerate the formation of ARGs in the chromosomes or mobile genetic elements of naturally occurring bacteria found in water bodies. These pollutants can affect the whole food chain through drinking water and can also cause soil pollution. Drug resistance causes antibiotics and other antimicrobial treatments ineffective and makes treating infections difficult or impossible, hence increasing the risk of disease transmission, severe sickness, disability, and death.

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Hydrogel Application in Agriculture

M. Indhu bala, S. Sivagnanam, S. Surya Prakash, S. Ponmalini
School of Agriculture, Bharat Institute of Higher Education and Research,
Selaiyur, Tambaram, Chennai-600 073

Abstract

Water, a crucial natural resource, is experiencing a decline due to ongoing global climate change, leading to water scarcity. Depletion of irrigation water resources poses a significant challenge in agriculture, impacting food safety and security. Effective water management is essential for optimal irrigation water utilization in regions facing water scarcity. Hydrogel, a valuable resource, aids in managing irrigation water effectively by retaining water and fertilizer, gradually releasing them to crops. This article emphasizes the importance of hydrogel application in agriculture, particularly in arid and semiarid regions.

Key words: Hydrogel, fertilize and irrigation

Introduction

The impending water scarcity issues projected for the year 2025 demand urgent solutions (Shabir Ahmad Bhat, 2022). The Central Water Commission notes a constant increase in the demand for water, while the availability of pure water is expected to decline rapidly. Currently, 80% of potable drinking water in India is consumed in agricultural practices. The application of hydrogel can mitigate water evaporation and serve as a slow-release fertilizer, addressing these concerns. Hydrogel, also known as "root watering crystal," "water retention granules," or "raindrop," consists of 3-dimensional water-absorbing polymers that are biodegradable and non-toxic (Farag G. Ghazy, 2023). There is two types of hydrogel polymers, linear (polyacrylamide) and cross-linked polymers, offer different functionalities. Linear polymers dissolve in water, reducing irrigation-induced erosion, while cross-linked polymers, forming a gel when mixed with water, help retain moisture.

Effect on water use efficiency

Water use efficiency, the relationship between total seasonal water used and production, improves with hydrogel application. Hydrogel increases plant water content, acting as a water reservoir. The hydrophilic organic polymeric products in hydrogel enhance water-holding capacity in sandy soil, aiding in efficient germination, plant development and nutrient intake (Bhaskar Narjary et al., 2013).

Soil Amendments:

Hydrogel serves as a soil conditioner by absorbing excess soil water and providing it to plants over an extended period, reducing water loss and moisture stress on crops.

Reduction of draught stress: Hydrogel usage in agriculture becomes essential to counter crop yield losses in adverse climatic conditions caused by water depletion, which leads to drought stress. Hydrogel helps maintain plant morphology and overall health.

Enhancement of fertilizer availability

Hydrogels, when used with fertilizers, increase the availability of nitrogen and potassium ions. The slow release of chemicals from the polymers nourishes soil fertility over time.

Table 1. Hydrogel application of soil types (vikaspedia, 2020).

Type of Soil	Suggested dosage of Hydrogel
Arid & Semi-arid Regions	4-6g/kg soil
All water stress level	2.25-3g/kg soil
Sandy soils – Delay Permanent wilting	0.2-0.4g/kg OR 0.8% of soil whichever is more
Loamy soil – 50 % Reduce in water use	2-4g/ plant pit
Relative water content and leaf water use efficiency	0.5-2.0g/pot
Reduce drought stress	0.2-0.4% of soil
Prohibition of Drought Stress	225-300kg/ha of cultivated area
Decrease in water stress	3% by weight

IMPORTANCE OF HYDROGEL

Hydrogels play a vital role in enhancing soil characteristics, improving water storage, decreasing irrigation frequency, reducing fertilizer leaching and combating soil compaction, water runoff, erosion and plant water stress. They enhance soil permeability, infiltration rates, and water use efficiecy and fertilizer use efficiency.

Methods of hydrogel application in agriculture

Hydrogels act as soil conditioners, preventing crust formation on the soil surface and improving soil structure at various depths. The application rate and depth depend on soil texture, with recommendations ranging from 2.5 kg/ha at 15-20 cm depth for clayey soil to 5.0 kg/ha at 10 cm depth for sandy soils (Shabir Ahmad Bhat, 2022).

Benefits of hydrogels

Hydrogels serve as water reservoirs, storing up to 1500 times their weight in water and releasing it gradually based on plant needs. They support quick seed germination, increase yield capacity, resist freezing in colder conditions, and operate independently of temperature fluctuations. Hydrogels reduce irrigation frequency, labour, production costs, and osmotic pressure. They resist leaching and runoff of water and nutrients during drought conditions, enabling plants to withstand prolonged periods without water and decreasing overuse of soil nutrients.

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Conclusion

In regions facing water scarcity, especially in dry and drought-prone areas, hydrogels prove indispensable for effective agriculture. These biodegradable hydrogels aid in retaining water, acting as slow-release fertilizers, maintaining soil moisture levels, ensuring nutrient availability, and protecting plants. Their environmentally sustainable nature and ability to boost production make them a valuable resource. Therefore, it is concluded that biodegradable hydrogels are beneficial in arid and semiarid zones for efficient agricultural practices.

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Special Issue
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Soil Entomology - Source Of Life

Keerthana. A, Kodimalar. S, Madhushini. S, Keerthana. S
Kumaraguru Institute of agriculture, Erode

Abstract

Insects are source of life of humans either directly or indirectly. Many of them are beneficial, some of them are harmful and remaining is neither beneficial nor harmful. They are important as they play major role in cycling nutrients, pollinators, soil fertility enhancer, etc… Those insects which involve in soil ecology acts as ecosystem engineer, ecosystem assistants and connects above\below ground surfaces. The most beneficial activity by them is being natural enemies (predators). Even though we are not protecting them, harming of beneficial insects should be avoided.

Introduction

Insects have adapted to every environment on Earth. They play key role in the functioning of every terrestrial ecosystem activity. They are used as food and medicine, acts as predators and decomposers, helps in nutrient recycling and plant community composition (herbivores, pollinators, biocontrol). Insects have a profound impact on human activities and vice versa. Insects are source of life of humans either directly or indirectly. Even though some may cause harm, majorly they are beneficial to human kind. Using insects as a source of life is in the hands of humans. Now let's see how insects act as source of life.

Soil Insects

Any insects which, during its growing\feeding stages, live either on\beneath the soil surface may be considered as soil insects. Many of them are not harmful, they are beneficial or neither beneficial nor harmful. They live both persistently below the soil surface or non-persistent forms which may not be present in same field for more than one/two years.

Importance of soil insects

Insects are important because of their diversity, ecological role, and influence on agriculture, human health, and natural resources. They create the biological foundation for all terrestrial

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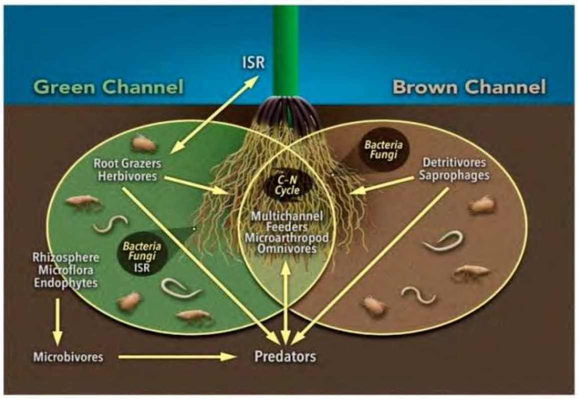
ecosystems. They cycle nutrients, pollinate plants, disperse seeds, maintain soil structure and fertility, control population of other organisms, and provide a major food source for other taxa.

Soil Insect Ecology

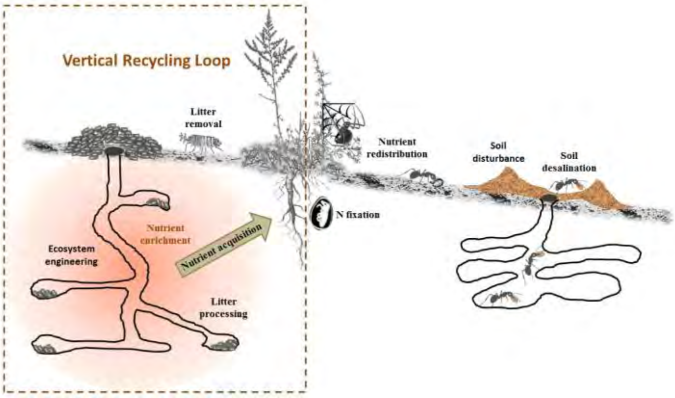
Insect ecology is the scientific study of insects as individual or as a community and their interaction with the surrounding environment. These interactions some times are beneficial. They are,

- Ecosystem engineers
- Ecosystem assistants
- The above/below ground connection



Ecosystem engineers- they make major alterations to environment especially in soil ecosystem by movement, burrowing activity of insects mixes soil layers and spreads microorganisms. The major soil ecosystem engineers are

- Dung beetles- soil aeration
- Ants- increases water filtration, soil aeration and pH by nesting building
- Termites- produces methane and increases aeration and fertility



Ecosystem assistants- they help in ecological processes which are beneficial for humans. Those processes are

- Nutrient cycling- increases surface are\accessibility for fungi and microbes (bio available form)
- Pollination- 90% of pollination by insects

Above/below ground connection- the root feeders from above ground is fed by predators/parasites present below the ground and vice versa. The soil insect also helps in pollination by moving above the ground and pollinate.

Soil insects for natural pest control

These are some major pest in crops and their natural enemies who control their population and helps in ecosystem balance.

Table 1: Pests and their natural enemies

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Pest	Natural enemies
Aphids	Parasitic wasp
Beetles	Assassin bug
Earwigs, cricket	Tachinid flies
Insect eggs	Soldier beetles
Mealy bugs	Wasps
Sawflies	Assassin bugs

Conclusion

All the above explained activities of insects are just only 50%. Insects have the largest population among living organisms. Their uses and values are vast which is impossible to cover under one topic. But the most important soil benefits which help human kinds are explained. Even though we are not protecting them harming of beneficial insects should be avoided. **Reference**

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Soil Entomology - Source Of Life

Madhushini V S Keerthana A, Keerthana S, Kodimalar S
Kumaraguru Institute of agriculture, Erode

Abstract

In the intricate life on Earth, soil microbes make a key role in the ecosystem. It includes nitrogen cycle, decomposition of organic matter, bioremediation, etc… Soil microbes are essential for the ecological balance on earth.

Introduction

In the complex life on Earth, beneath our feet lots of miracle will happens by soil microbes. The soil microbial population is uncountable. It plays a major role in soil that is interlinked to human's life. Soil microbes are beneficial and harmful to environment which includes bacteria, fungi, algae, actinomycetes, protozoan and so on.

Source of life

Soil microbes contribute in nutrient cycle, decomposition of organic matter, maintaining soil fertility, symbiotic relationship, bioremediation, nitrogen fixation, etc… All these process are essential for human life. If anyone of the process is affected, it will directly effect on day to day life of human. Soil microbes and human life can't be separable.

Soil ecology

In terrestrial ecosystem soil has the greatest diversity. Nearly soil contains $50x10^9$ tons of dry weight of microbes on Earth. Soil is the favorable habitat for microbes. It is responsible for soil food web. Most of the microbes get their food from producers (plant, moss, photosynthetic bacteria and algae) and some of the microbes get energy from nitrogen, sulphur, iron compound that are called chemoautotroph. The microbial population is very important to maintain balanced ecosystem.

Nature of microbial processes	Example of microorganisms involved
Anaerobic decomposition	*Clostridium,* Methane bacteria
Aerobic decomposition	*Trichoderma, Armillaria*
Nitrification	Nitrosomonas, Nitrobacteria
Nitrogen immobilization	Bacteria, fungi
Nitrogen mineralization	*Pseudomonas, Bacillus*

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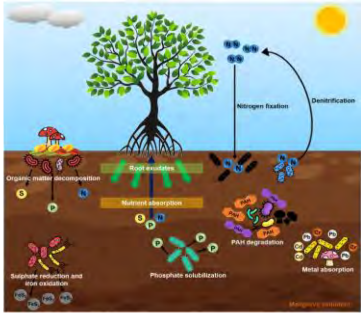
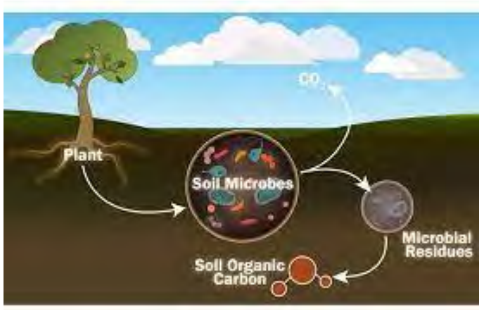
Nitrogen fixation



Nitrogen is the key element for plants. It is abundantly present in atmosphere but cannot be used directly by plants. So, nitrogen fixing bacteria present in soil which convert atmospheric nitrogen to available form of nitrogen to plants. Some of the nitrogen fixing bacteria such as *Nitrosomonas*, nitrobacteria, azotobacter and rhizobium which are naturally present in soil. These bacteria play a important role in nitrification, denitrification, assimilation, etc…

Soil organic matter



Soil organic matter is an essential factor for soil aggregation, water holding capacity, maintains soil structure, erosion control and improves soil aeration. It was produced by decomposition of biological residues present in soil which was carried out by microbes (decomposers). Soil organic matter is an indicator for soil health. If the organic matter increases in soil, it will consider as good soil for agriculture.

Bioremediation

Bioremediation refers to the use of living organisms to remove pollutants from soil and water. It is an ecofriendly approach to clean the environment. *Pseudomonas, Bacillus* is some of the bacteria used to clean the oil spills.

Conclusion

Soil microbes serve as the unsung heroes of life on Earth and play a crucial role in ecosystem. These soil microbes preserve the soil health for wellbeing of our planet and all inhabitants on Earth.

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Soil Microorganisms and Water Quality

S. Bavananthitha[1], B.P. Harshitha[1], B. Bharani[1], S.N. Shruthika[1], V. Karthika[2], N. Arunkumar[3].

[1]Third Year B.Sc (Hons.) Agriculture, Kumaraguru Institute Of Agriculture, Erode – 638315.
[2] Assistant Professor, Department Of Crop Management, Kumaraguru Institute Of Agriculture, Erode -638315
[3]Assistant Professor, Department Of Crop Management, Kumaraguru Institute Of Agriculture, Erode -638315

Abstract

Soil microorganisms play an important role in enhancing and maintaining water quality through various mechanisms. Nutrient cycling is a repeated process in which nutrients get absorbed, transferred, released and reabsorbed into the environment. Nitrogen (N) and Phosphorous (P) cycles play a major role in improving water quality by reducing pollution process and maintaining equilibrium. Also through geochemical bioremediation processes microorganisms remove pollutants particularly heavy metals from the environment and water bodies.

Key Words: Nutrient cycling, pollutants, Nitrogen and Phosphorous cycles, Heavy metals, Remediation.

Introduction:

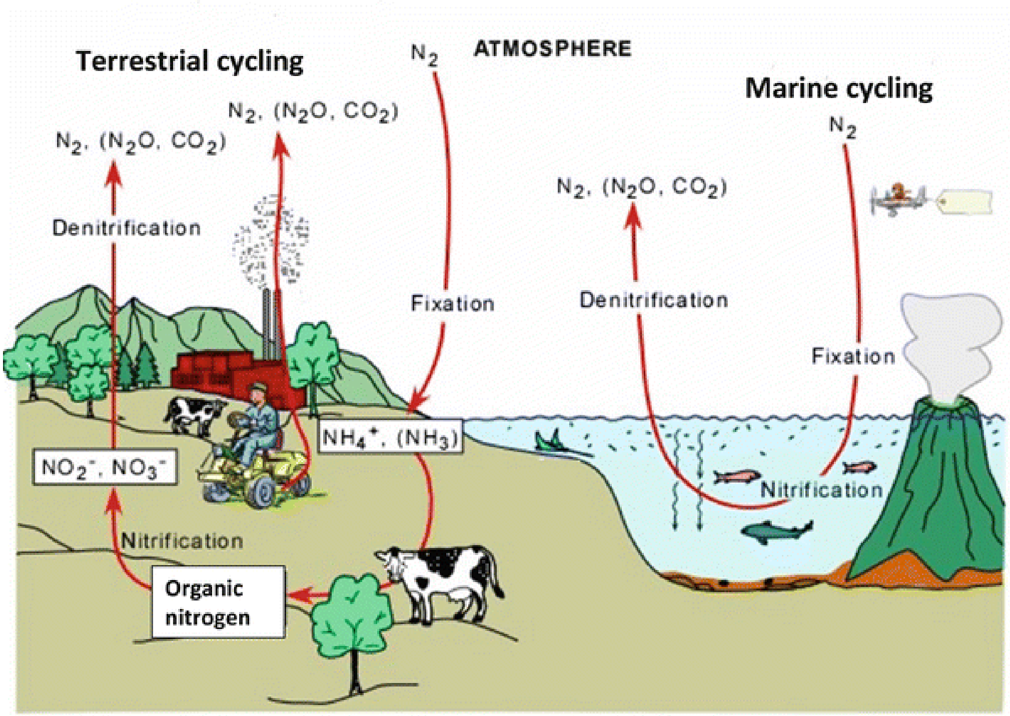
Water is the most valuable resource on the earth hence known as the elixir of life. About two third of earth surface is covered with water. However, only less than 0.3% is accessible for human consumption. Furthermore, this water gets polluted through various natural and unnatural activities. Hence, there is an urgent need to prevent these pollutions and to treat the polluted water bodies accordingly. Soil microorganisms play a crucial role in enhancing the water quality through various mechanisms like Nutrient cycling, Pollution remediation, Filtration and detoxification.

Nutrient cycling:

Nutrient cycling facilitates the breakdown of organic matter, recycling nutrients like Nitrogen (N) and Phosphorous (P). This process prevents nutrients run off into water bodies, reducing Eutrophication and maintaining water quality (Shiomi 2015).

Nitrogen cycle:

The organic matter from plants and animals undergo microbial decay and organic nitrogen is released as ammonium in turn utilised by crop plants. The nitrogen cycle starts with fixation of N_2 which higher plants use for growth. When the plants and animals die, the organic form of nitrogen in its tissue is converted into inorganic nitrogen by the activities of soil microorganisms. This takes place in two distinct microbiological steps. The first step is Ammonification, the process of mineralisation in which proteins, nucleic acid and other organic components are degraded by micro organisms with the liberation of ammonia by proteolysis and deamination. The soil microorganisms responsible for this ammonification process are *Pseudomonas , Bacillus, Proteus, Clostridium, Histolyticum, Micrococcus, Alternaria, Penicillium etc.,.* The second step is Nitrification, biological oxidation of ammonia salt to nitrites and subsequent oxidation of nitrites to nitrates is called Nitrification. Nitrifying microorganisms includes *Nitrosomonas, Nitrococcus, Nitrobacteria, Nitrospira, Nitrospina, Aspergillus, Penicillium, and Cephalosporium.* Denitrification is the final step that is the conversion of nitrates and nitrites into molecular nitrogen.



Nitrogen cycle (Bertrand *et al.,* 2015)

Phosphorous cycle:

The inorganic phosphorus in the plants and animals are in the form of nucleic acids, phospholipids etc. Phosphorus cycle starts with the solubilisation of inorganic P. Insoluble inorganic compounds of phosphorus are largely unavailable to plants, but microorganisms can bring the PO_4 into solution and make it available to plants. Phosphorus solubilizing micro organisms are *Pseudomonas striata, Micrococcus, Bacillus sp, Fusarium, and Aspergillus sp* . These Phosphorus

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solubilizing micro organisms convert insoluble phosphate into soluble form through the process of acidification, chelation, and exchange reaction. The organic form of phosphorus in the remains of the vegetation and in soil organic matter is made available to succeeding generations of plants by the action of bacteria, fungi, and actinomycetes (Mineralisation).

Pollution Remediation:

Micro organisms can degrade or metabolize the pollutants present in the soil through these geochemical cycles preventing their migration into ground water or surface water, thereby improving water quality (Abo-Alkasem *et al*., 2023). Other microbial mechanisms reported for Pollution eradication are metal chelation and sequestration that increase their heavy metal tolerance and biotransformation into less toxic form reported in *Allescheriella, Pleurotus, Phlebia* and *Stachybotrys* and actinobacteria such as *Amycolatopsis, Corynebacterium, Streptomyces* and *Rhodococcus* have the potential to remediate heavy metals such as Hg (II), Co (II), Cd (II), Zn (II), Cr (VI) and Ni (II).

Conclusion:

A report from WHO says that in 2022, about 1.7 billion people world wide drank the contaminated water. Even if it is an elixir contamination could turn water into a poison causing serious threats to the live hood of the global population. By adopting various mitigation techniques combined with microbial remediation is the need of the hour to eliminate water pollution in our ecosystems.

Reference:

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Soil Microorganisms and Water Quality

S. Bavananthitha[1], B.P. Harshitha[1], B. Bharani[1], S.N. Shruthika[1], V. Karthika[2], N. Arunkumar[3].

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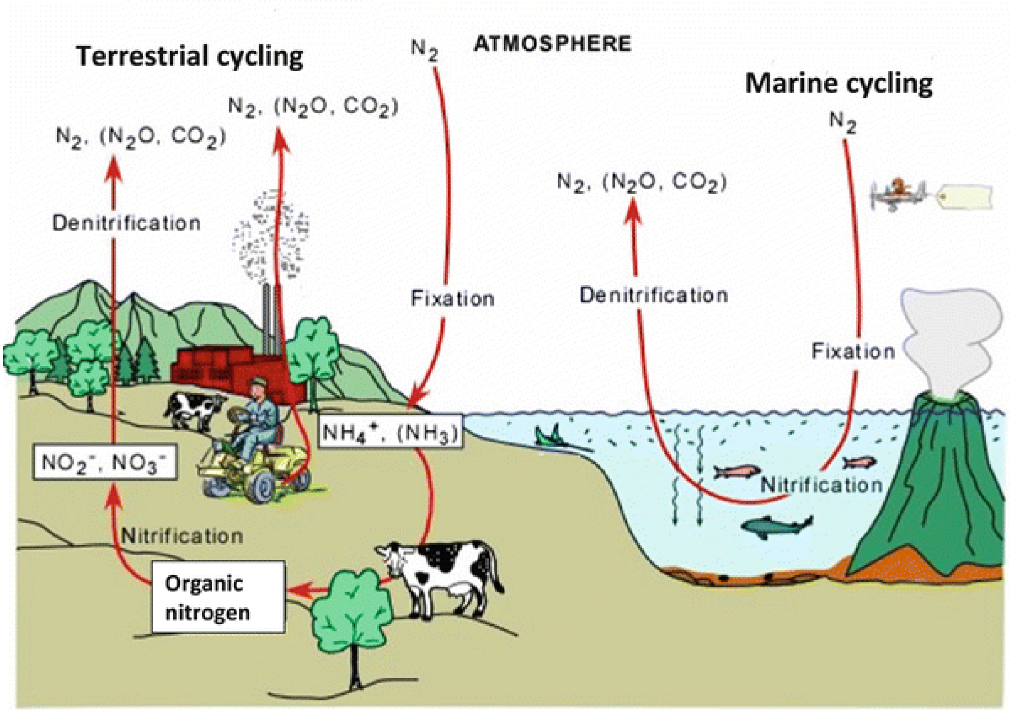

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Special Issue

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Wetland Ecosystem: Sustaining Life through Water and Soil Interaction

S.N. Shruthika[1], S. Bavananthitha[1], B.P. Harshitha[1], B. Bharani[1], V. Karthika[2], N. Arunkumar[3].

[1]Third Year B.Sc (Hons.) Agriculture, Kumaraguru Institute of Agriculture, Erode – 638315.

[2]Assistant Professor, Department of Crop Management, Kumaraguru Institute Of Agriculture, Erode -638315

[3]Assistant Professor, Department Of Crop Management, Kumaraguru Institute Of Agriculture, Erode -638315

Abstract

Soil microorganisms play an important role in enhancing and maintaining water quality through The term "wetland" refers to a combination of aquatic and terrestrial environments. They play an important role in preserving and sustaining the ecosystem's biodiversity. Wetlands provide organisms with long-term life by interacting with water and soil. Through soil microbial interactions at the wetlands, the biodiversity of various microorganisms is boosted, and soil fertility is increased.

Keywords: Ecosystem, Wetland, Soil, Interaction.

Introduction:

Wetlands are essential ecosystems that function as biological super systems, balancing the environment via complex interactions between soil and water. Marshes, swamps, and bogs are examples of these distinctive ecosystems (Mobilian and Craft, 2021). They offer a wide range of ecological functions that support the health of the world as a whole. By removing sediments and contaminants from water bodies, wetlands serve as nature's water purification system, improving the quality of the water. Additionally, they lessen the effects of extreme weather events by collecting and storing extra water after heavy rains, acting as a natural buffer against flooding.

Importance of wetlands:

1. **Biodiversity hotspots:** These ecosystems are teeming with life, supporting a rich biodiversity that includes diverse plant and animal species. Wetlands provide critical breeding grounds for numerous aquatic and bird species, fostering a delicate balance within the ecosystem.

2. **Carbon Sequestration:** Wetlands are excellent at sequestering carbon and hence play an important role in climate change mitigation. Wetland water logging slows organic matter decomposition, resulting in carbon buildup in the soil, which acts as a long-term carbon sink.
3. **3. The Role of wetlands in Sustaining Life:** The hydrological cycle is maintained between green water i.e., transpiration, evaporation loss of water and blue water i.e., through rain water. The various types of wetlands, such as coastal wetlands, salt marshes, tidal fresh water, mangrove swamps, fresh water swamps, marshes, and peat lands, have an impact on a wide range of life. They keep climate change at bay and make living more sustainable.

Challenges and conservation efforts:

Wetlands face numerous threats, including habitat loss, pollution, and climate change. Conservation initiatives such as restoration projects, strict regulations, and community involvement are essential in safeguarding these ecosystems for future generations (Perillo., *et al* 2018).

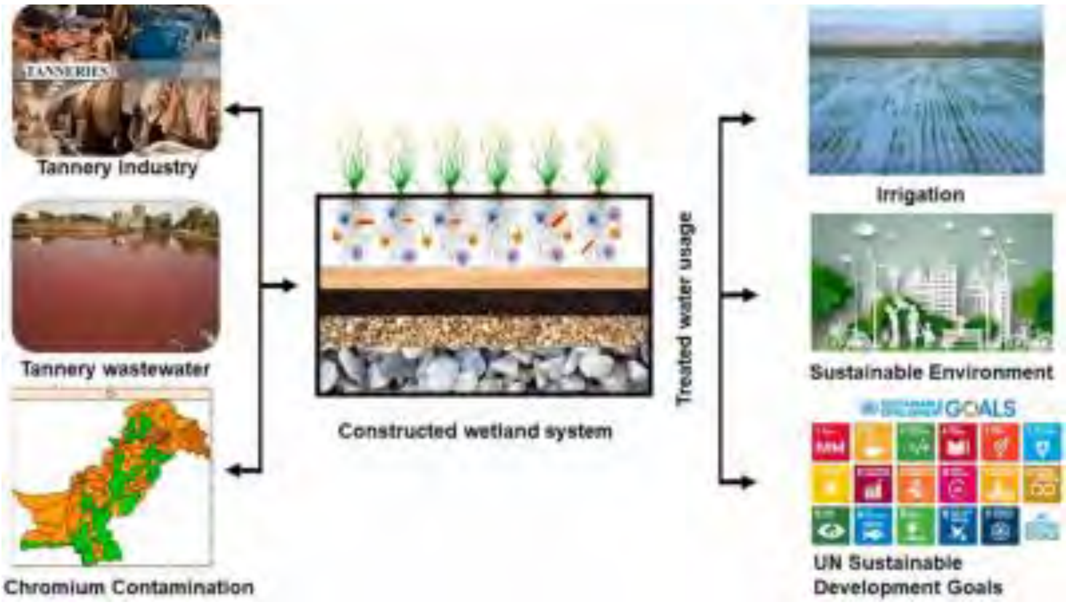

Figure1. Constructed wetlands as a sustainable technology for wastewater treatment (Younas *et al*., 2022)

i) **Sustainable Practices:** To ensure the preservation of wetland ecosystems, adopting sustainable practices is imperative. Responsible land use planning, avoiding excessive draining or filling of wetlands, and promoting conservation efforts are crucial steps toward maintaining the delicate equilibrium of these habitats.

ii) **Artificial Wetlands:** Artificial wetlands, also known as constructed wetlands, are engineered systems created to emulate the ecological processes and functions of natural wetlands. These systems are designed to treat wastewater, manage stormwater, enhance water quality, and provide habitat for diverse flora and fauna. Artificial wetlands are versatile and sustainable solutions for water treatment and management, leveraging natural processes to enhance environmental quality. Their applications extend across various sectors, contributing to both ecological conservation and human well-being.

iii) Educating the Public: It is critical to raise public knowledge about the importance of wetlands. Wetland ecosystem services can be highlighted in public education efforts, as can the role that individuals can play in their conservation, developing a sense of responsibility for these essential natural areas.

Conclusion:

Wetland ecosystems exemplify the intricate dance between water and soil, offering a myriad of benefits to both the environment and human communities. Recognizing the importance of these ecosystems and implementing sustainable practices is key to ensuring their longevity and the well-being of our planet.

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Special Issue

TRENDS IN AGRICULTURE SCIENCE

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Flow With Water & Grow With The Soil

Manish Mahalik. D, Nithiya Prakash. R. R, Bharathi. P
UG Scholars, Department of Agricultural Engineering, Nandha Engineering College
Teaching Associate, Department of Agricultural Engineering, Nandha Engineering College, Erode -638052

Abstract

Soil and water plays a crucial role in daily life. Soil consists of 45% minerals, 5% organic material 25% air and 25% water. Through this 61% of the soil is polluted. Soil acts as a medium for plant growth supporting agriculture which produces our food and water. In this world 90% of the land is occupied by water. Out of this 40% of water is polluted. Water is not only essential for hydration, sanitation but also for various activities. Both are not just a resource, but also origin of all the living organisms in the earth and plays a vital role in sustaining life and ecosystem. Without them no life form could exist soil and water are connected as a human body and soul to flourish the earth with the more green things and it helps too make the human life better and best in universe.

Introduction

Soil upholds plant development, furnishing us with food. Soil is a combination of natural matter, gases, fluids and endless organic entities, filled as a mechanism for plant development that directs water stream and goes about as a channel for contaminations. Some scientific research distinguish dirt from soil. plays a role in cooking, cleaning, agriculture, horticulture and in modern cycles. Water an essential asset exists in different structures like fluid, strong (ice), and gas (fume). It spins through the air, land and in ocean in a constant interaction known as the water cycle. Water is major for all living creatures, supporting biological systems, agribusiness and human exercises. Soil and Water performs pivotal parts in our regular routines. Understanding the connections among soil and water is critical to overseeing normal assets in these days, advancing manageable horticulture and guaranteeing water quality for both natural and human prosperity.

The Untold Story of Great Comrades of Nature (Soil & Water) Role of Soil And Water

A medium to establish development and supports different environments. Water, an essential part forever, exists in various structures on the planet, including sea, streams, lakes and groundwater. The collaboration among soil and water is indispensable for farming, as water goes about as a supply

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for soil, a fundamental for plant development. Understanding this relationship is critical to feasible land use and water management. Soil and water assume significant parts in different ventures.

Utilization of Soil And Water

Soil is utilized in farming for developing harvests. Water is fundamental for the vast majority modern cycles, including producing, power age, and cooling frameworks. Moreover both soil and water are significant in development exercises, going about as unrefined substances and supporting framework improvement. Proficient administration of soil and water assets is fundamental for supporting these businesses and guaranteeing ecological maintainability.

Causes of Man Towards Soil And Water

People can adversely influence soil and water through exercises, for example, deforestation, rural practices that lead to soil disintegration and water contamination, garbage removal, and over-extraction of groundwater. These activities can bring about loss of biodiversity, corruption of soil quality, and pollution of water sources, presenting dangers to environments and human wellbeing. Clearing land for farming and deforestation can prompt soil disintegration, knowing its fruitfulness and causing sedimentation in water bodies.

Effects of Soil And Water

Release of poisons from ventures into water bodies can defile water, influencing amphibian biological systems and presenting dangers to human wellbeing. Metropolitan improvement can increment impenetrable surfaces, prompting water spill over and diminished invasion, which influences groundwater re-energize and can add to flooding. Extraction of minerals from the dirt can upset environments, debase soil quality, result in the arrival of unsafe substances into water bodies. Removal of waste, including compounds and plastics, can prompt soil and water contamination, influencing the climate and natural life. Exorbitant withdrawal of groundwater for

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farming can prompt spring consumption, influencing water accessibility and quality. Changes in environment examples can modify precipitation and temperature, influencing both soil dampness levels and water accessibility, prompting shifts in biological systems.

Conclusion

We need to note down the practices and methods that is to be implemented to reduce the impact caused by human activities. Some of them are sustainable practice, Industrial regulation, Afforestation, conservation, Water management, Policy development, etc. By this we can conclude that "Soil is the heart & Water is the blood of all lifeforms."

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Skin of Earth And Droplets of Life- The Integrity of Soil And Water

S.Kanishka[1], V. Karthika[2], N. Arunkumar[3].

[1]Third Year B.Sc (Hons.) Agriculture, Kumaraguru Institute of Agriculture, Erode – 638315.

[2]Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315

[3] Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315

Abstract

There is an enthralling collaboration between soil and water, the dynamic couple that gives our world life. This essay investigates how soil nurtures microscopic wonders and gives stability for life, whereas water, the elixir of life, generates habitats, controls temperatures, and dances through the hydrological cycle. Understanding how soil and water are interconnected is critical for emphasizing the importance of mindful conservation for a harmonious and sustainable future.

Key words: Soil, Water, Interactions, sustainable

Introduction

Two silent protagonists take centre stage in nature's symphony, defining the story of life as we know it. Imagine soil as the canvas and water as the brush, creating a work of beauty that maintains every breath, every flower, and every heartbeat of our world. "Soil and water: the invisible threads stitching ecosystems together, weaving the story of life in every drop and particle."As a result, soil and water play critical roles in sustaining life on ecosystems.

The Fertility of Soil

Soil, also known as the "skin of the Earth," is more than just a substrate; it is a flourishing ecosystem in and of itself. Soil, which is high in organic matter, minerals, and microbes, provides a favorable environment for plant growth. Soil also acts as a habitat for a variety of creatures, resulting in a vibrant and linked ecosystem. Therefore, it is said, "Dirt is where life begins - nurture the soil, nurture the future."

The Fluidity of Water

Water, the "life-giving blood of our planet," is constantly in action, sculpting the environment as it flows. Oceans, rivers, lakes, and underground aquifers form a complex network

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that supports life. Water, in addition to fulfilling the thirst of living organisms, plays an important function in controlling global temperatures due to its heat-absorbing potential. That's why we often say **"Droplets of life, the essence of our existence: Conserve water, preserve our future."**

Interconnectedness of Soil and Water

"In the dance of soil and water, every drop narrates the story of life." These two basic resources provide more than 95 percent of our nourishment. The interconnectedness of soil and water is critical for many reasons, including nutrient recycling and plant growth, water filtration and purity, groundwater recharge, erosion control and landscape stability, biodiversity and habitat support, agricultural productivity and habitat support, climate regulation, microbial ecology and soil health, carbon sequestration, flood mitigation and water regulation, cultural and recreational value, and so on. This dynamic partnership creates the cornerstone of a sustainable environment, exemplifying the profound interdependence of soil and water in a delicate dance that affects the balance and resilience of the entire ecosystem.

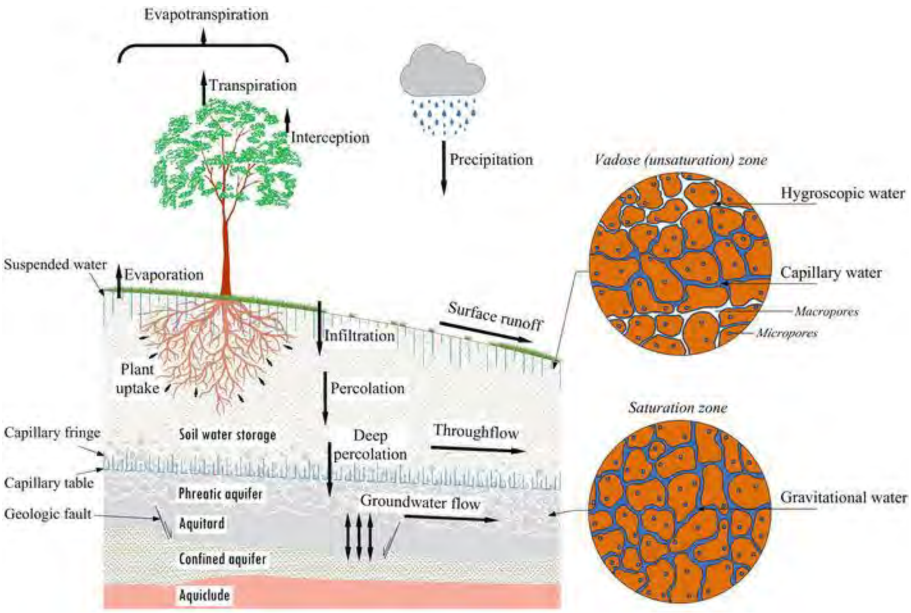

Figure 1. The essential role of soil in providing humanity support for life (Kučera *et al*., 2020)

Need of an Hour-Conservation

An estimated 135 billion tonnes of soil have been lost since the Green Revolution. According to FAO, if current soil degradation rates continue, the world's topsoil might be completely destroyed over the next 60 years. "Conservation is a state of harmony between men and land." Leopold, Aldo. Conservation has become our obligation in a world teetering on the brink of environmental disaster. We harmonise with the Earth by preserving the delicate balance of soil and water, ensuring a legacy of life for future generations.

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Management of Soil

The integrated management of soil and water resources is critical to their health and quality. "Fertility of the soil is the future of civilization-Albert Howard."We require sustainable soil management approaches such as limited tillage, crop rotation, sustainable grazing, organic addition and cover cropping, and mixed agricultural methods such as agro forestry, which entails planting trees alongside crops. Sustainable soil management strategies increase agricultural water availability, regulate water retention, and contribute to long-term agricultural practices. Water scarcity, efficient water use, and soil salinisation are all essential components of sustainable resource management. It is true that **"the nation that destroys its soil destroys itself-Franklin D. Roosevelt."** Improper soil and water management has far-reaching implications, influencing soil erosion, biodiversity, soil fertility and water quality.

Conclusion

As we come to the end of our trip into the essence of soil and water as the beating hearts of life, we find ourselves on the shores of environmental stewardship. Recognizing their inherent connection, we bear a responsibility to preserve, defend, and appreciate the delicate dance that nourishes our planet. Let our footsteps be echoed by our commitment to preserving the vitality of land and water, ensuring that the beautiful symphony of life continues for future generations.

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Influence of Climate Change on Soil Fertility

S. Surya Prakash, S. Sivagnanam, S. Ponmalini, S. Divya, M.Indhubala
School of Agriculture, Bharath Institute of Higher Education and Research,
Selaiyur, Tambaram, Chennai – 600 073

Abstract

The profound consequences of climate change are increasingly evident across the globe, with far-reaching implications for various ecological systems. This article delves into the intricate relationship between climate change and soil fertility, exploring the multifaceted ways in which rising temperatures, altered precipitation patterns, and extreme weather events are shaping the very foundation of our agricultural landscapes. Spanning three comprehensive pages, this article synthesizes current research findings to unravel the intricate mechanisms through which climate change influences soil fertility.

Introduction

Climate change, driven by human activities and natural processes, is a global phenomenon that has far-reaching consequences for the Earth's ecosystems. One critical aspect of our environment that is significantly affected by these changes is soil fertility. The predicted global climate change involving increase in temperature and atmospheric carbon dioxide (CO_2) levels, changes in rainfall pattern, and atmospheric nitrogen deposition influences various Soil physical, chemical, and biological properties and properties are important for restoring soil fertility and productivity. Climate change has potential impacts on soil health including supply of organic matter from biomass, soil temperature regime, soil hydrology, and salinity. Considering all these affairs, the consequences of climate change on soils have been reviewed. As temperatures rise, precipitation

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patterns shift and extreme weather events become more frequent, the intricate balance that sustains soil health is disrupted. This article explores the profound influence of climate change on soil fertility and the potential repercussions for agriculture, ecosystems and global food security.

Temperature Changes

Climate change has an impact on the soil, a vital element in agricultural ecosystem. Higher air temperatures cause higher soil temperatures, which generally increases solutions chemical reaction rate and diffusion controlled reactions (Buol *et al*., 1990). One of the primary impacts of climate change is the rise in global temperatures. Increased temperatures alter microbial activity and nutrient cycling in the soil. Microorganisms, essential for breaking down organic matter and making nutrients available to plants are sensitive to temperature changes. Warmer temperatures can accelerate the decomposition of organic matter, potentially leading to a faster release of nutrients, but also risking the loss of vital soil organic carbon. Lal, R. (2004)

Altered Precipitation Patterns:

Changes in precipitation patterns, including more intense rainfall events and prolonged droughts, are becoming more common due to climate change. These alterations can significantly impact soil moisture levels, affecting the availability of nutrients to plants. Excessive rainfall may lead to nutrient leaching, washing away essential minerals from the soil, while drought conditions can reduce nutrient uptake by plants, hindering their growth and productivity (Lobell, D. B., & Field, C. B. 2007)

Climate change effects on soil quality

Climatic factors	Effects
Rise in temperature	• Salinization of soil • Soil organic matter decomposition increases • Loss of soil organic matter • Decreases soil porosity • Increases soil compactness • Reduction of soil CEC • Reduction of soil fertility • Deterioration of soil structure • Increases risk of soil erosion • Reduction of water retention capacity • Increases CO_2 release from soil • Reduction of soil organic C • Increases ammonia volatilization

	• Increases bioavailability of N and P from organic matter
Heavy and intensive rainfall	• Destruction of soil aggregate • Increases risk of soil erosion • Increases leaching of basic cations • Soil acidification • Reduces soil CEC • Toxicities of Fe, Mn, Al, and B • Loss of N through denitrification
Decreased rainfall	• Increases salt content • Soil moisture deficit • Decreases diffusion and mass flow of water-soluble nutrients • Possibility of occurring drought • Loss of nutrient from rooting zone through erosion • Reduces nutrient acquisition capacity of root system • Reduces N-fixation in legumes

Carbon Sequestration and Soil Organic Matter

Soil acts as a crucial carbon sink, sequestering large amounts of carbon in the form of organic matter. However, climate change can impact this delicate balance. Warmer temperatures and changing precipitation patterns can accelerate the decomposition of organic matter, releasing carbon dioxide into the atmosphere. This not only contributes to climate change but also reduces the soil's ability to store carbon, compromising its fertility and resilience reported by Lal (2004)

Shifts in Plant and Microbial Communities

Climate change can influence the distribution and composition of plant and microbial communities in the soil. Certain crops may become more or less suitable for specific regions, affecting agricultural practices. Changes in microbial communities can impact nutrient cycling and

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the availability of essential elements for plant growth. Davidson and Janssens (2006) and Marschner *et al.,* (2011)

Conclusion

The influence of climate change on soil fertility is a complex and multifaceted challenge that requires urgent attention. The global temperatures continue to rise and weather patterns become more unpredictable, the consequences for soil health are becoming increasingly apparent. Sustainable agricultural practices, responsible land management, and international cooperation are essential in mitigating the impacts of climate change on soil fertility. Addressing this issue is not only crucial for maintaining global food security but also for preserving the health and resilience of our planet's ecosystems

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Soil-Plant-Water Interactions in Arid Environments: Focus on the challenges and solutions related interactions in arid regions

B. Bharani[1], S.N. Shruthika[1], S. Bavananthitha[1], B.P. Harshitha[1], V. Karthika[2], N. Arunkumar[3]
[1]Third Year B.Sc (Hons.) Agriculture, Kumaraguru Institute of Agriculture, Erode – 638315.
[2]Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315
[3]Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315

Abstract

The delicate interplay of soil, plants, and water is especially important in dry environments, where water scarcity, fluctuating rainfall, and poor soil structure, texture, and porosity are all issues. Water absorption from soil is quite difficult in certain places due to low groundwater levels. However, productivity in these avid regions is critical since it accounts for around 10% of total food production. As a result, various alternative solutions, such as drip irrigation, rainfall collection structures, producing drought-tolerant and resistant plants, and so on, emerge as critical components in lessening the impact of water scarcity, aiming for a roughly 80% solution to the problems in dry regions. Furthermore, many technological innovations, such as precision agriculture, are developing sustainable solutions to overcome water scarcity challenges in the face of a changing climate.
Keywords: water scarcity, rainfall fluctuation, climatic change, desertification, drip irrigation, rain water harvesting, and sustainable water use.

Introduction

Normally, soil-plant-water interactions play a critical role in supporting plants in arid environments. Plants grown in this region will encounter issues such as water shortages, high soil temperature, low relative humidity, low organic carbon content, poor soil structure, and a lack of rain fall, all of which will contribute to desertification, biodiversity loss, food insecurity, and other difficulties.

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Challenges

Low soil organic carbon content	Abiotic stress	Poor soil structure and texture
Poor soil porosity	Climate variation	High temperature and low humidity
Decrease in groundwater level	Scarcity of water	Scarcity of rainfall

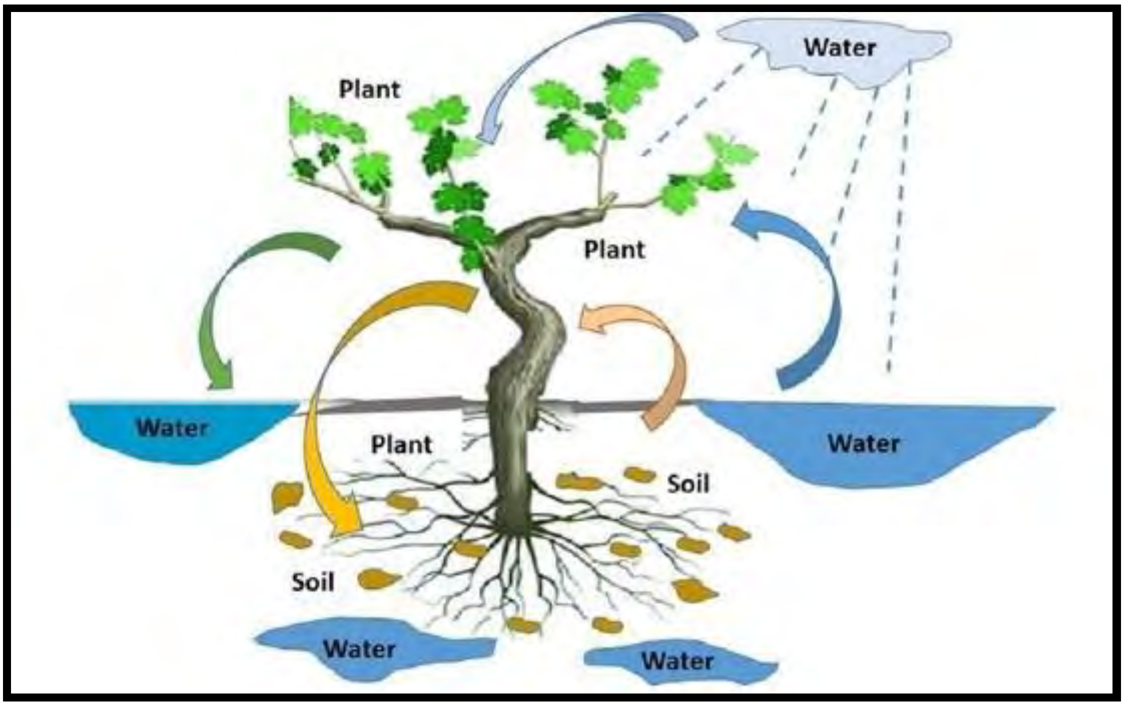

Figure 1. Water, Soil, and Plants Interactions in a Threatened Environment

(Gavrilescu *et al*., 2021**)**

Solutions for sustainable water use:-

A multimodal approach combining technological, agricultural, and community-based solutions is required to achieve sustainable water use in acidic regions. Construction of rainwater collecting studies, as well as micro catchment, will aid in the collection and utilisation of runoff water. Similarly, agronomical practices such as mulching and cover cropping reduce leaching and evaporation rates, which primarily seduce soil temperature and increase groundwater recharge. Otherwise, there are a few efficient irrigation techniques available, such as drip irrigation, which delivers water directly to the root zone with minimal water loss while simultaneously increasing water use efficiency (Ayangbenro and Babalola, 2021).

Sensors in precision agriculture help to monitor a cop's water needs and provide optimal irrigation. However, the most cost-effective and simple application of matter is the selection of drought-resistant crops with deep roots to absorb subsurface water. Finally, we can raise awareness about water scarcity and teach people about aquifer recharge, wastewater treatment, and other alternatives for sustainable water usage.

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Microbes: Soil And Water Ecoprotectors

Harshitha, B.P. [1], B. Bharani[1], S.N. Shruthika[1], S. Bavananthitha[1], V. Karthika[2], N. Arunkumar[3].
[1]Third Year B.Sc (Hons.) Agriculture, Kumaraguru Institute of Agriculture, Erode – 638315.
[2]Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315
[3]Assistant Professor, Department of Crop Management, Kumaraguru Institute of Agriculture, Erode -638315

Abstract

By functioning as natural guardians of soil and water quality, microorganisms play a critical role in maintaining the ecological balance of terrestrial and aquatic ecosystems. This article examines microbes' diverse contributions as ecoprotectors, emphasising their potential to improve soil fertility, destroy contaminants, and maintain water quality. The complex interactions of microorganisms with their environment are investigated, offering light on the methods by which they reduce environmental stresses and enhance ecosystem resilience. This article digs into the microbial techniques that maintain our planet's important resources, from soil-dwelling bacteria and fungus that aid in nutrient cycle to aquatic microorganisms that participate in water purification Processes.
Keywords: Microorganism, nutrient cycle, pollution control, mechanisms of remediation

Introduction:

Microbes emerge as important players in nature's complicated network, orchestrating the delicate symphony of ecosystems. This article delves into the mysterious world of microorganisms, revealing their roles as master conductors of nutrient cycles and their astonishing ability to resist pollution. We discover the brilliant principles behind environmental rehabilitation as we delve into the microbial realm, where these microscopic champions use their particular biochemical prowess to transform adversity into ecological harmony. The microbial tapestry weaves a tale of resilience and adaptability from the depths of soil to huge expanses of water, portraying these little organisms as unsung heroes in the big drama of Earth's ecological health.

Microbes As Nutrient Cyclers:

- **Nitrogen cycle:** Some bacteria are vital in turning atmospheric nitrogen into plant-available forms for plants. Bacteria like *Rhizobium* and *Azotobacter* contribute to the nitrogen cycle.

Some microorganisms, such as *Bacillus, Enterobacter, Micrococcus*, and *Pseudomonas*, aid in denitrification. They convert nitrate back to nitrogen gas, limiting the buildup of potentially hazardous nitrogen compounds that would otherwise disrupt the ecosystem.

- **Phosphorous cycle:** *Bacillus* and *Pseudomonas* bacteria participate in this cycle. Phosphate salts dissolved in water are assimilated by aquatic plants. Animals obtain phosphorus via consuming plants or herbivorous animals. Microbes aid in the breakdown of plants and animals after they die. As a result, the cycle is repeated.
- **Iron reduction:** Iron is a micronutrient that is necessary for life. Bacteria such as *Shegella* and *Geobacter* play critical roles in making iron available to plants by converting it from insoluble to soluble forms.
- **Sulphur cycle**: Sulphur cycling microbes such as *Desulfovibrio*, *Thiobacillus* helps in reducing sulphate to hydrogen sulfide and vice versa.

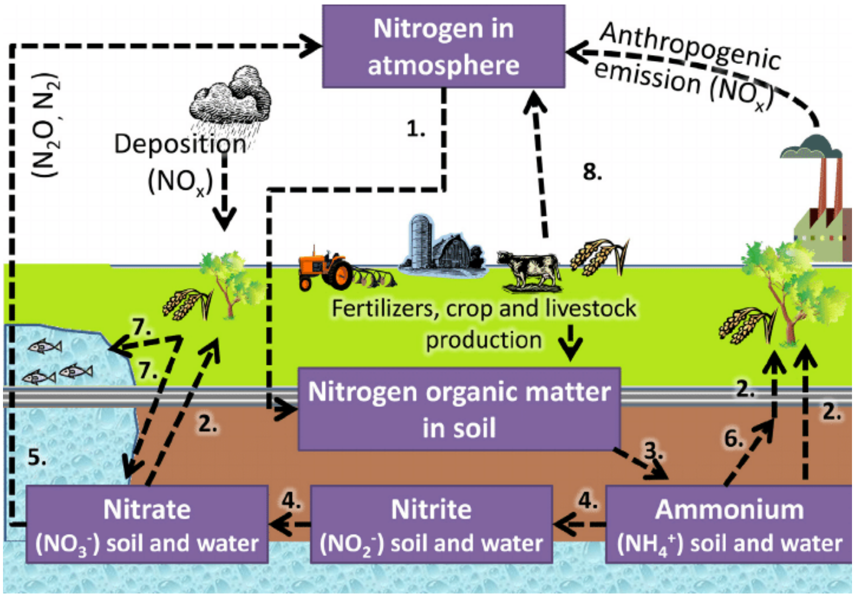

Figure 1. Nitrogen cycle (Bednarek *et al*., 2014)

Water Filters in Nature:

Soil microorganisms promote biodiversity in addition to their involvement in nitrogen cycle. They support a vast diversity of aquatic species by generating nutrient-rich environments, contributing to the delicate fabric of the water ecosystem. When rainfall seeps into the soil, the various layers act as natural filters. As water percolates, soil particles and organic matter capture pollutants, sediments, and toxins. Plants serve two functions in water filtering. The process of transpiration releases purified water vapour as water is pulled through the roots. Furthermore, plant roots absorb and filter certain contaminants. Submerged and floating plants serve as effective water

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filters in aquatic settings. Riparian zones along water bodies help to avoid soil erosion, reduce pollution, and keep water clear.

Microbes Against Pollution:

Soil microbes operate as nature's defenders in polluted water ecosystems by breaking down pollutants in the biogeochemical cycle. Microbes that degrade hydrocarbons thrive in maritime conditions, where they serve an important role in breaking down oil spills. *Alcanivorax barkumensis* is a marine bacterium that can digest hydrocarbons from oil spills (Bookstaver *et al*., 2015). It thrives in oil-contaminated areas, helping to restore polluted marine ecosystems naturally. The function of *Desulfovibrio desulfurians* in heavy metal bioremediation is well established. It immobilises hazardous metals including mercury and chromium, reducing their environmental impact. *Mycobacterium vaccae* contributes to the degradation of industrial chemicals. It contains enzymes that breakdown a variety of contaminants.

Mechanisms Of Remediation:

These microbial mediated geochemical cycles directly and indirectly play a major role in different pollution remediation process. They are as follows

- **Bioaugmentation:** It is the process of adding microbes to polluted area to make the microbes feed on pollutants. For example, *Burkholderia* sp. known to degrade nitrophenolics compounds.
- **Biostimulation:** It is the process of adding nutrients to the polluted area to stimulate the activity of microbes which are naturally present in that area and to enhance remediation. Example: *Bacillus*sp., *Rhodococcus* sp. are used for heavy metal bioremediation.
- **Bioleaching:** It is the process where microorganisms are employed to extract metals**.** For example: *Acidithiobacillus ferrooxidans, Acidithiobacillus thiooxidans* are used in copper bioleaching. They thrive in acidic condition and utilize iron and sulfur compounds.
- **Biosorption:** It is a process of removing heavy metals from aqueous solution. Example: *Streptomyces* sp.
- **Bioaccumulation:** It is a gradual accumulation of pollutants in living organisms where the rate of uptake exceeds the rate of metabolism by microbes. For example: plankton absorbs methyl mercury from water.
- **Precipitation:** it is influenced by microbes, in which toxic pollutants are converted to precipitates or crystals. For example: *Bacillus subtilis.*

Conclusion:

Finally, the investigation of microbes as soil and water ecoprotectors reveals the significant impact of these microorganisms on the health and sustainability of our planet. Microbes are hardy

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and important companions in nature's complicated web, from their responsibilities as master conductors of nutrient cycles to their amazing capacity to battle pollution. The amazing mechanisms discovered on this expedition demonstrate not just the intricacy of microbial methods in environmental restoration, but also the promise for novel solutions to severe ecological concerns.

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Exploring the Crucial Role of Mangroves: Mitigating Soil Erosion and Enhancing Water Purification in Coastal Ecosystems

Mayur Bhadarka[1]*, Pinak Bamaniya[1], Mohit Bamaniya[3], Neha Kharadi[3], Hardik Sikotariya[2]

[1]PG scholar, Department of Aquatic Environment Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India.

[2]PG scholar, Department of Fisheries Resource Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India.

[3]PG scholar, Department of Fish Processing Technology, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat (362265), India.

Abstract

Mangroves, as robust coastal forests, flourish in challenging saline environments, offering crucial contributions to coastal regions. They are instrumental in controlling coastal water productivity and providing essential support for fisheries. Notably, these ecosystems possess unique capabilities to counter coastal erosion while aiding in water purification. Their resilience, however, is under threat from various sources, including the impacts of climate change and human activities. These factors pose significant challenges to the sustainability and health of mangrove habitats worldwide. Preserving these invaluable coastal ecosystems is critical amidst these escalating threats to ensure their continued benefits for the environment and communities.

Keywords: Mangroves, Soil erosion, Coastal barriers, Water purification, Conservation.

Introduction

Coastal erosion is a natural process dislodging particles like rocks, sand, and mud from shorelines via various agents like waves and tidal surges. This movement can permanently shift land between regions. Erosion severity on beaches depends on wave strength, influenced by tides and water density. Coastal erosion impacts coastal residents and marine life in estuaries, bays, and shallow ocean areas. In mangrove ecosystems, loose mud is highly susceptible to erosion. The presence of vegetation, especially mangroves and associated species, regulates erosion levels in islands and coastal regions (Mitra, 2020).

Mangroves, resilient coastal forests growing at the intersection of land and sea, thrive in salty conditions. Their ability to endure salt and brackish waters is a common trait. Their structure and function are influenced by climate and site factors like temperature, water availability, minerals, nutrients, and light. Mangroves affect coastal water productivity by controlling nutrients and suspended sediments, although their role as both suppliers and repositories of nutrients creates some uncertainty in their impact on coastal processes. These forests rank among the most productive ecosystems globally and serve as a resource for timber, thatch, fuel, and tanning materials. They significantly contribute to nearshore fisheries, supporting various communities, and are crucial breeding grounds for large-scale fisheries like commercial shrimp fishing. Some species also hold importance for food and medicine. Unique in their morphology, anatomy, physiology, and seed development, mangroves possess distinctive features in seedling growth, adaptations, and succession mechanisms. They offer numerous benefits to humans, including fisheries, forest products, pollution control, carbon storage, and protection against natural disasters such as tsunamis and cyclones. Economically and ecologically valuable, mangroves play a pivotal role in sustaining the health, food security, and safety of coastal communities worldwide, fostering rich biodiversity (Kathiresan & Bingham, 2001).

Fig 1: - mangrove vegetation along kotda (Gujarat)

Role of Mangrove in Preventing Soil Erosion

Coastal erosion occurs naturally and involves the movement of rock, sand, and mud particles from shorelines due to erosion forces. This process can permanently shift land from one area to another. Global warming accelerates erosion in coastal and estuarine regions, caused by increased summer glacier flows and intensified tidal actions. Mangrove vegetation reduces tidal speed by creating more resistance. The dense roots of mangroves play a vital role in binding soil and slowing water currents, which encourages sediment buildup and reduces erosion. Mangrove root systems contribute to the creation of a peat foundation under mangrove islands. Over time, layers of organic deposits form, several meters thick, providing significant resistance to erosion and offsetting the effects of sinking and rising sea levels. Mangroves also reduce the strength of wind and waves, thereby lessening their erosive impact on sediments and structures like dikes and sea walls. Mangroves are believed to stabilize coastlines by managing erosion and promoting sediment deposition. To combat coastal erosion, authorities often plant mangroves intentionally. For instance, Gujarat in West India has engaged in extensive mangrove planting, effectively controlling coastal erosion (Mitra, 2020, Spalding et al., 2014).

Intertidal mudflat with mangrove vegetation

(No or Less erosion occurs)

Intertidal mudflat without any mangrove vegetation (highly erosion occurs)

Fig 2: - mangrove vegetation in Sundarban region (Source :- (Mitra, 2020)

Mangroves Role in Water Purification

Mangroves showcase unique adaptability in their ecology, seen through viviparity, specialized root systems, and their ability to filter salt. The diverse organisms beneath them aid in water purification, reducing occurrences of red tides. They improve water quality by absorbing nutrients that might otherwise trigger harmful algal blooms offshore. This cleansing role is crucial for sustaining clear, healthy water, benefiting coral reefs and seagrass beds. Mangroves not only resist water pollution but also reduce levels of suspended solids, nutrients, and contaminants. Their sediments, rich in sulphide within an oxygen-lacking environment, effectively bind metals, absorbing heavy metals from the water. Looking specifically at the mangrove species Rhizophora stylosa, its root system filters seawater, allowing it to thrive in saline conditions. The plant actively regulates salt levels in its roots through filtration mechanisms, maintaining specific threshold values (Kim et al., 2016).

Mangroves Threat

Climate change affects mangroves through factors like sea level changes, intensified storms, altered precipitation, temperature shifts, CO_2 level variations, ocean circulation changes, interconnected ecosystem health, and human responses to these impacts. Arid mangroves face risks due to excessive nutrients causing biomass buildup in leaves (Gilman et al., 2008). Below, potential threats to the mangrove ecosystem will be outlined.

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Conservation management

One advantage of managing mangrove ecosystems is their potential for restoration through natural regrowth or artificial replanting with seedlings. Mangrove conservation is built on key foundations: large-scale planting efforts, protective strategies, improved management capabilities, establishing new habitats, education initiatives, community engagement, involvement of industries, research-based management, eco-tourism, and ongoing monitoring to guarantee plantation effectiveness. (Field, 1999)

Conclusion

In conclusion, mangroves serve a vital function in mitigating coastal erosion through their ability to decrease tidal speed, anchor soil, and moderate water flow. Their role in purifying water by absorbing nutrients and mitigating pollution is also noteworthy. Nevertheless, mangroves face threats from climate change, emphasizing the importance of conservation efforts to safeguard and regenerate these crucial ecosystems.

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Problematic Soils And Their Reclamations

Jasmeet Kaur Hundal
Punjab Agricultural University, Ludhiana, Punjab
.

Introduction

Problematic soils are those that possess particular qualities or attributes that render them unsuitable or less productive for use in farming (1). The process of reclamation involves getting these soils back to a condition where they can sustain the growth of healthy plants. Problematic soils can be classified as contaminated, saline, acidic, alkaline, wet, compacted, eroded, or eroding (2). A particular reclamation technique, such as leaching, liming, acidifying, draining, tilling, mulching, or remediation, is needed for each kind of problematic soil. Improved soil fertility, higher agricultural yields, better soil quality, less soil erosion, and the preservation of soil resources are some advantages of soil reclamation (Fig1).

Reclamation Techniques

An overabundance of soluble salts in saline soils can induce osmotic stress in plants, which restricts their ability to absorb water and nutrients. In order to remove surplus salt from the soil, drip irrigation is one of the appropriate irrigation techniques used in the reclamation of saline soils. Furthermore, choosing crop cultivars that can withstand salt helps increase resilience under these demanding circumstances.

High levels of acidity in soils can negatively impact nutrient availability and impede plant growth. Acidic soils can be restored by liming them with substances like dolomite or agricultural lime, which will increase pH and enhance nutrient availability(3). Sustaining ideal soil conditions requires routine monitoring.

Because alkaline soils contain higher pH values, there may be nutrient imbalances and less availability of key components for plant growth. Acidifying additions, such as elemental sulphur, are used to lower pH levels in alkaline soil reclamation (4). To enhance the fertility and structure of the soil, organic matter can also be introduced.

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Because wet soils are so saturated with water, they can become anaerobic and prevent roots from growing and respiring. Waterlogged soils can be restored by installing drainage systems, such as ditches, wells, or pipelines, to remove the excess water. Increasing the porosity and texture of the soil can also aid in improving aeration and water infiltration.

Because compacted soils are hard and dense, they may hinder root penetration and the flow of air and water. Tilling the soil is necessary to loosen it and break up any clods in order to restore compacted soils. Moreover, adding organic matter might aid in enhancing the porosity and structure of the soil.

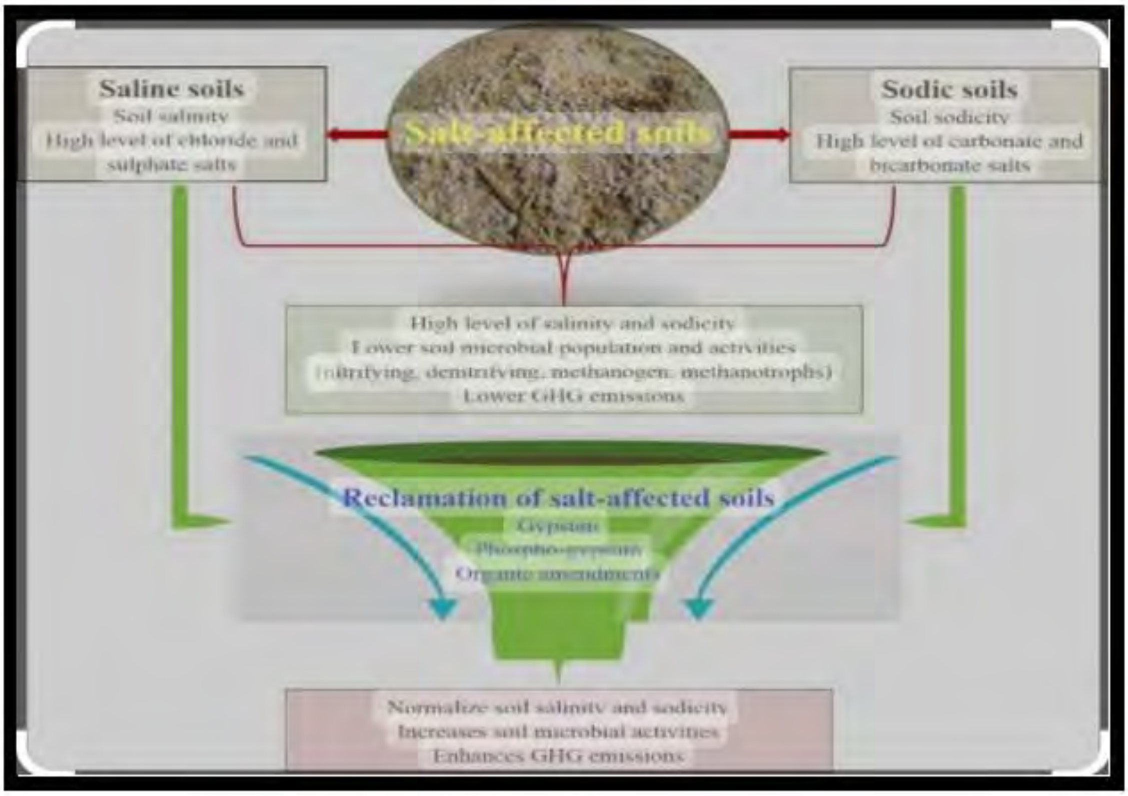

Fig1: Salt affected soils and their reclamation.

Eroded soils are those that have lost topsoil as a result of wind or water erosion, which can lower the fertility and productivity of the soil. Mulching the soil with organic or inorganic materials helps restore degraded soils by preventing additional erosion and preserving moisture. Stabilising the soil and preventing soil erosion can also be achieved by planting grasses or cover crops.

Soils that have been contaminated by metals, chemicals, or diseases can be dangerous for human, animal, or plant health. Remedial methods, including soil cleaning, phytoremediation, and bioremediation, are used to eliminate or decompose contaminants from polluted soils.

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Conclusions

Reclamation of salt affected soils improve the soil texture, increase fertility and help to attain higher productivity.

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Special Issue
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Soil and water-a source of life

Jasmeet Kaur Hundal
Punjab Agricultural University, Ludhiana, Punjab
.

Abstract

Soil and water are the integral element of agriculture. Soil provides the essential nutrients and support for plant growth, while water is crucial for hydration and nutrient transport. For successful agriculture, well-drained soil, adequate water supply and proper irrigation is necessary. The most productive soil in India, the alluvial soil accounts for 45% of land and is degrading steadily. A single gram of soil may contain millions of individuals and several thousand species of bacteria.

Soil -the plumule: water-the conjugator

Soil and water are the fundamental renewable element of our environment that serves as the very foundation of life on earth. In contrary, if soil is the canvas of nature then water is the essence of nature where the science of life takes primordium. The soil plumule serves as a habitat for infinite organism from microscopic bacteria to complex plant roots. This intricate web of life, within the soil contributes to nutrients cycle, organic matter decomposition and the overall health of terrestrial ecosystem. Soil act as a reservoir for water, playing a vital role in the water cycle. Adequate water availability is paramount for survival of plants, animals and ultimately humans. Water makes up 60-75% of human body weight. A loss of just 4% of total body weight leads to dehydration and a loss of 15% can be fatal. Likewise, a person could survive a month without food but wouldn't survive 3 days without water. This crucial dependence on water broadly governs all life forms. Soil and water are incarnation in a mutually dependent relationship. The quality and health of the soil impact the

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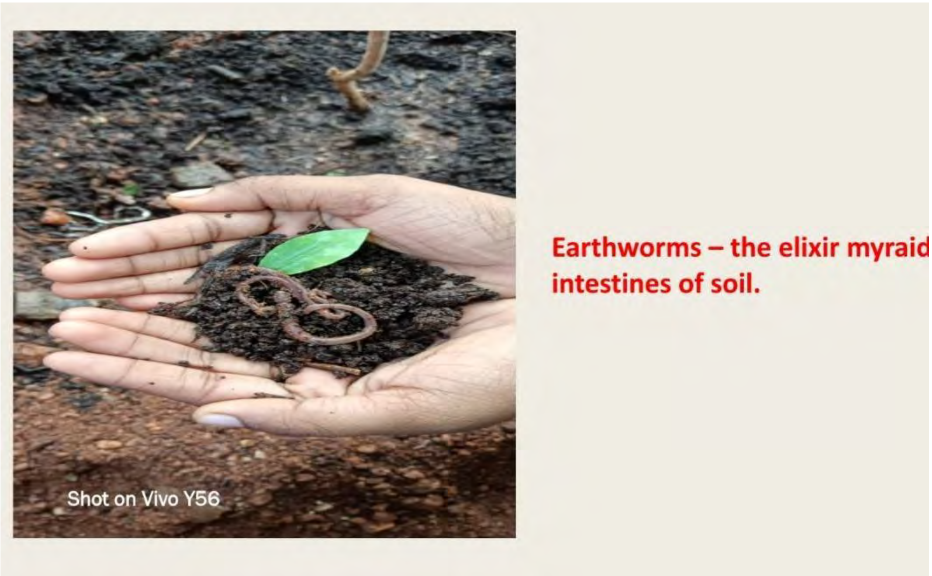
water resources by affecting factors like groundwater recharge, infiltration, runoff. conversely, the availability and quality of water alter the soil composition, nutrient cycling, erosion. Sustainable management of both the resources is crucial for the health of ecosystem and agricultural productivity. Survival hinges between the delicate interplay of soil and water.

Myriad and elixir of life

Soil, the myriad ecosystem teeming with microscopic life forms provides a crucial foundation for plant growth and biodiversity. As roots delve into the soil, they extract essential nutrients, fostering the growth of crops that form the basis of our food supply. The delicate balance of soil and water is under constant threat due to human activities, deforestation, industrialization, global warming, ozone layer depletion, improper agricultural practices can lead to soil erosion, loss of fertility and water pollution. Climatic changes exacerbate these challenges causing shift in precipitation pattern and impacting both soil and water availability.



Plummeting the greens

Remember, collective action is the key. By practicing sustainable land management practices, afforestation, and promotion of responsible water use and encouraging others to do the same can contribute to the embodiment - *soil and water, the source of life*.

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Internet: https://vaagdhara.org

Photo: Shot in college premises

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Special Issue

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Soilwater- A Source Of Life

Pavithra. N

V. O. C Agricultural college and research Institute, killikulam, Tirunelveli- 628252.

Introduction

Soil can process and hold certain amounts of water which is known as soil water. Soil water is the water that is present in the pores of soil. Water enters the soil through large pores (Macropores) and gets stored in the small pores which are the micropores. The maximum amount of water that a given soil can retain is called field capacity. The main sources of soil water are groundwater and precipitation. Groundwater is the water that rises against gravity from the ground water table up the soil profile and precipitation is the water that infiltrates and percolates from the top- into the subsoil. The zone between the ground surface and the water – table is called the soil water zone. Healthy soil is a living sponge that can absorb huge amounts of water in periods of heavy rainfall. One cubic meter of healthy soil can retain over 250 litres of water.

Uses Of Soil Water

Soil water contains nutrients that move into the plant roots when plants take in water. Soil water which contains dissolved organic and inorganic substances is called Soil Solution. It transports dissolved nutrients to the plants roots for absorption. Soil water is also important for photosynthesis. Soil is a home to more than 25% of our planet’s biodiversity. The organisms in soil like bacteria, fungi and insects utilize soil water and enhance soil fertility. Dryland farming systems rely on the soil to store and release water to meet crop demand. Soil water is also important for climate modeling and numerical weather prediction. It is also useful in irrigation management to know the depth of water required to fill a layer of soil to field capacity. Soil water regulates soil temperature. It helps in chemical and biological activities of soil.

Depletion Of Soil Water

The soil water deficit of a crop is determined by the difference between rainfall and rates of plant evapotranspiration from leaf surfaces.

Causes Of Soil Water Depletion

The soil water or soil moisture can be lost by evaporation from the soil surface as well as transpiration from the plant’s leaves. Over use of soil water for irrigation and other purposes and

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soil water contamination can be the major causes that makes the soil water unfit for utilization. The amount of water a soil can hold depends on its water holding capacity. When soil is at field capacity, further addition of water can cause erosion because the excess water cannot be stored in the soil profile. Sometimes a soil's pore spaces are reduced through human or natural processes which is called "Compaction" of soil. This causes the soil particle to become very close to each other and the pore space is minimized. So the water will not be able to penetrate into the soil. The fertilizers and pesticides that we use in agricultural lands and the volatile organic compounds (VOC's) when spilt on the land can also get absorbed by the soil and can contaminate soil water which makes the soil water unfit for proper use.

Effects Of Soil Water Depletion

When the soil moisture in the specified root zone is depleted to predetermined level which is different for the different crops which is to be replenished by irrigation. Reduction in soil water level causes reduced stomatal conductance, growth, root proliferation, photosynthetic pigments, protein contents, and impaired photosynthetic pigments, and alter hormone distribution and increased activities of antioxidant enzyme to cope unfavorably with osmotic changes. The contamination of soil water can result in poor water quality, loss of water supply, degraded surface water systems. As the pollution of soil water is increasing day by day one fifth of the world's population do not have safe drinking water. In Europe and America 35% of the population has fresh and clean drinking water in their homes but in Africa and Asia only less than 10% of the people have clean drinking water which is from wells and tanks.

Conservation Of Soil Water

Soil water management's ultimate aim is to improve the efficiency with which rainfall is converted into crop and pasture yield. There are many process to conserve soil water.

1. **Conservation Tillage-** Reducing tillage helps to maintain healthy soil organic levels which helps to maintain the soil's capacity to hold and retain water.
2. **Deep Tillage**- Even though it is only suitable for certain types of soils, deep tillage increases porosity and permeability of soil which increases the soil water absorption and retention capacity.
3. **Crop Rotation**- Growing different crops for different seasons can improve soil structure and soil fertility which improves the water holding capacity.
4. **Use Of Green Manure-** Growing of plant materials with the sole purpose of adding to the soil for improved organic matter and nutrients. This improves soil quality then also improves water retention capacity of the soil.

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5. **Contour Ploughing**-by ploughing the soil along the contour instead of up and downward slopes, the velocity of runoff is reduced which creates even barriers and more water is retained in the soils.
6. Some of the other soil water conservation methods would include rainwater harvesting to minimize runoff and collect water for use on site.

Conclusion

Soil water provides suitable habitat for plants. Rivers play a major role in carrying water in the earth's system. Some of the rainwater soaks deep into the ground to feed the wells underground and streams. Life can be survived only because water is constantly being recycled which is done by soil, by purifying and filtering rainwater and making it suitable for utilization. Soil and water are shared resources. So the soil water should be conserved for better sustaining of plant and animal life on this planet.

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Soil and Water is a Source of Life – Innovative Technology for Managing Emerging Contaminants for a Sustainable Future.

Raghupathi Matheyarasu., Yaswanth Rajaram*

Department of Environmental Science, Palar Agricultural College, Vellore, TN.635805.
*Adhiyamaan College of Agriculture and Research, Tamil Nadu, 635105.

Abstract

Soul **of I**nfinite **L**ife is meant by Soil. Good soil and clean water are essential for human health and well-being. Soils serve as a home to billions of microorganisms, insects, and plants that use them as root anchors. Soil participates either directly or indirectly in biogeochemical cycles by moving energy from one trophic level to another tropical level through the usage of bio agents such as primary producers, consumers, and decomposers. The majority of the living biota is dependent upon both the characteristics of the soil and water. The importance of soil and water to the Biodiversity of Earth is widely acknowledged, and without it, human survival would be extremely challenging.

Introduction

Increasing global population directly put pressure on soil and water for feed the over 8 billion people across the globe. On the other hand global arable land are is start shrinking and losing the productivity since 2000 it was about 37.5% and it is only 36.8%. Globally Scientist urged to working on alternatives and remedial measures to towards meeting the food demand of people by using limited land and water resources and that's even getting polluted by various means and measures. Soil Health and water quality is getting affected by numerous anthropogenic impacts and natural effects such as Soil pollution, water contamination, wastewater discharge, waste dumping and xenobiotic (human-made) chemicals. The contaminants listed below are some that are becoming more and more of a Global issue.

Contaminants of emerging concern (CECs):

Pharmacies and personal care products (PPCPs) are among the pollutants of emerging concern (CECs) that are being detected at ever lower amounts in surface water. This gives rise to worries over these compounds' potential impact on aquatic life.

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Microplastics:

Microplastics are now recognized as a worldwide pollutant of concern. Microplastics, which have a life span of up to 450 years, can linger in the environment for centuries before breaking down into smaller particles known as micro- and nanoparticles, which can then enter the ecosystem and destroy marine life.

Perfluorinated compounds (PFCs):

Thousands of different chemicals are combined with fluorine to form perfluorinated compounds (PFCs), a class of synthetic molecules. The two most well-known PFCs are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). Because of their chemical composition, PFCs offer unique properties like oil and water repellency and thermal stability.

Polybrominated Biphenyls (PBBs):

Chemicals known as polybrominated biphenyls (PBBs) were added to polymers in a wide range of consumer goods, including computer monitors televisions, fabrics, and plastic to make them more difficult to burn. PBBs were able to escape plastic and enter the environment because they were incorporated into polymers instead of being attached to them. The following are cutting-edge strategies that can minimize the effects of contaminants that are becoming increasingly concerning and provide opportunities for a sustainable future.

Climate Smart Agriculture (CSA):

Climate-smart agriculture, also known as CSA, is a comprehensive management strategy for landscapes, including fisheries, forests, livestock, and crops, that tackles the interconnected issues of nutrition and global warming. Its three main objectives are to decrease or eliminate greenhouse gas emissions wherever feasible, adapt to climate change and build resilience to it, and raise agricultural incomes and output in a sustainable way.

Nutrient Budgeting:

A nutrient budget serves as an efficient management tool for calculating the quantity of nutrients that are brought into and removed from a system. Having a balanced nutrient budget for a sustainable agricultural system helps save unnecessary production costs and significantly reduces the risk of pollution from excess nutrients.

All of the nutrients added to a farm as well as those taken from the land are included in a nutrient budget. Budgets for nutrients provide information about how crop inputs and outputs are balanced.

Sustainable Development Goals (SDGs):

The UN Sustainable Development Goals, also known as the SDGs, provide a novel framework for global governance. The Sustainable Development targets (SDGs) hold considerable promise for promoting sustainable soil management. They have facilitated the formulation of targets that consider various national and local approaches and priorities, along with cultural specifics, and aim to foster greater regional engagement.

IoT / AI in Agriculture:

To be more useful to small farmers in emerging economies like India, drones' artificial intelligence (AI) has to be improved. Modern drones are more suited for observing common crops grown in vast monoculture fields, like maize. Since drone monitoring programs have trouble identifying regions with a greater variety of crops, lesser-known foods, and grains that grow uniformly everywhere, they are no longer as useful for monitoring agricultural development and welfare.

Conclusion:

Given the world's changing environment and growing population, farmers will need to embrace new technologies in order to deal with new challenges. With access, farmers can increase yields, save costs and time, and respond with amazing precision and accuracy. Adopting cutting-edge technologies is an efficient strategy to construct a sustainable future without harming the environment by promoting the idea that soil and water are sources of life and that they can meet the growing demands for food and water.

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Soil Miracle of Water in Soil and its Benefits in Real Life

Kaaviya AV
Amrita school of Agricultural Sciences, Arasampalyam, Coimbatore.

Abstract

This article explores the fascinating interactions between soil and water, revealing the amazing impacts that this dynamic relationship has on our day-to-day lives. The study extends into real-world applications, showing how this water-in-soil miracle translates into concrete advantages for people and communities. The complex relationship between water and soil produces abundant harvests in a variety of agricultural and home gardening endeavors, supporting sustainable practices and food security. Furthermore, as we work to untangle this partnership's mysteries, we reveal its capacity to protect the environment, highlighting its function in reducing soil erosion and maintaining essential ecosystems. Realizing the power of water in soil enhances our knowledge of natural processes and gives us the ability to make decisions that will benefit a healthier, greener world. This opens doors to real-world uses and fosters a greater understanding of the wonders that lurk beneath the surface of the places we see daily.

Introduction

There is no life on this earth without soil. Soil is the building block of several life sources on this planet. We could hear that the fertility and organic content of the soil are decreasing day by day due to human activities. A lot of steps are taken to protect the soil because it plays a huge role in the cultivation of crops for consumption. Nature's gift should be nurtured so that we can get maximum benefits out of it. Numerous ecological services that are needed by humans are offered by soils. These consist of regulating services, which include flood mitigation, nutrient and pollutant filtering, carbon storage, and greenhouse gas regulation, waste recycling and detoxification, control of pests and disease populations, and recreation, aesthetics, heritage values, and cultural identity; provisioning services, which are the supply of food, wood, fiber, raw materials, and physical support for infrastructure. (Dominati et al., 2014).

Water plays a critical role in sustaining life on Earth and supporting various ecosystems. Water is essential for sustaining plant life, keeping soil fertile, and protecting the general health of terrestrial ecosystems. It affects a wide range of interrelated processes that support the sustainability

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of our environment, going beyond just keeping us hydrated. The availability of agricultural systems and hydric resources is threatened by global climate change. Precipitation cycles, extreme event frequency and intensity, soil moisture, evapotranspiration fluxes, and surface runoff are expected to change. (Sillmann et al., 2008), (Zhang et al., 2017). A drop of water can give crop yield if properly invested. Studies are conducted to save the gift of nature and use it sustainably for future generations too.

Benefits

Life is sustained by the wonderful synergy between water and soil, which produces innumerable advantages for us in our daily lives as they dance together harmoniously beneath the surface. This complex relationship which is sometimes disregarded uncovers several practical benefits that affect many facets of our lives and extend beyond the idea of simple hydration. As the water enters the soil it becomes the life giver of plants. It enriches and nourishes the plant by producing more yield. Soil is a home for many microorganisms to survive as it gives life and increases our biodiversity. By keeping the soil healthy we can mitigate climate resilience and keep soil healthier. As the water penetrates the ground it increases the water table and recharges the soil. This process makes soil sustainable with more organic carbon. As the water binds with the soil, it holds the particles and prevents soil erosion. Humus also can be retained. The temperature of the soil environment is controlled by the water in the soil, which serves as a natural thermostat. This protects against the negative effects of heat or cold on plant life in addition to offering a suitable home for soil organisms and plant roots. It also helps minimize temperature extremes. The ability of ecosystems and agricultural landscapes to withstand drought conditions is improved by well-hydrated soil. The soil's ability to hold water makes sure that plants have a buffer during dry spells, which helps them survive and keeps essential ecosystem processes going. Practically, soil health and water resources are rapidly decreasing due to human activities and enhanced technology with unskilled labours.

Conclusion

The foundation of global food security is the wonder of water in soil. Crops are nourished by the symbiotic interaction between soil and water, which increases their development and yield.

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This not only takes care of the pressing issue of feeding a growing population, but it also emphasizes how important sustainable land management techniques are to the future of our farming industry.

The importance of water in soil is reflected in ecosystem resilience, even outside of agricultural areas. A sufficient amount of water in the soil ecosystems promotes biodiversity, sequesters carbon, and maintains the general stability of natural environments. Realizing this marvel leads to a change in conservation strategies that place a higher priority on soil health, recognizing the complex web of life that thrives beneath our feet. Another aspect of the wonder of water in soil that has an immediate effect on human cultures is the replenishment of groundwater resources. Water recharges aquifers as it seeps into the soil, guaranteeing a steady supply of freshwater for people all over the planet. This emphasizes the necessity of competent water management plans that strike a balance between meeting human demands and protecting vital natural resources. The binding effect of water on soil particles helps to minimize soil erosion, which is a significant benefit with wide-ranging effects. Maintaining rich topsoil protects agricultural output while reducing the negative environmental effects of soil erosion. It emphasizes how crucial it is to implement policies that put soil protection and sustainable land use first in order to safeguard the basis of our agricultural systems. It is clear that the phenomena of water in soil is more than just a scientific curiosity when we consider its many advantages and wonders. It also serves as a basis for making well-informed decisions. Understanding these complex processes encourages a closer relationship with nature and motivates people to take responsible care of the land. The interconnection of ecosystems, agriculture, and human societies is woven into the fabric of our life by the marvel of water in soil. It calls on us to cherish and safeguard our soils, adopt sustainable practices, and acknowledge the fragile balance that keeps life on Earth possible. Recognition is the key to a future in which the wonder under our feet will continue to provide for, uphold, and inspire future generations.

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Soil water- A Source of Life

Sushmitha. A
Amrita School of agricultural sciences

Introduction

Soil can process and hold certain amounts of water which is known as soil water. Soil water is the water that is present in the pores of soil. Water enters the soil through large pores (Macropores) and gets stored in the small pores which are the micropores. The maximum amount of water that a given soil can retain is called field capacity. The main sources of soil water are groundwater and precipitation. Groundwater is the water that rises against gravity from the ground water table up the soil profile and precipitation is the water that infiltrates and percolates from the top- into the subsoil. The zone between the ground surface and the water – table is called the soil water zone. Healthy soil is a living sponge that can absorb huge amounts of water in periods of heavy rainfall. One cubic meter of healthy soil can retain over 250 litres of water.

Uses of Soil Water

Soil water contains nutrients that move into the plant roots when plants take in water. Soil water which contains dissolved organic and inorganic substances is called Soil Solution. It transports dissolved nutrients to the plants roots for absorption. Soil water is also important for photosynthesis. Soil is a home to more than 25% of our planet's biodiversity. The organisms in soil like bacteria, fungi and insects utilize soil water and enhance soil fertility. Dryland farming systems rely on the soil to store and release water to meet crop demand. Soil water is also important for climate modeling and numerical weather prediction. It is also useful in irrigation management to know the depth of water required to fill a layer of soil to field capacity. Soil water regulates soil temperature. It helps in chemical and biological activities of soil.

Depletion of Soil Water

The soil water deficit of a crop is determined by the difference between rainfall and rates of plant evapotranspiration from leaf surfaces.

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Causes of Soil Water Depletion

The soil water or soil moisture can be lost by evaporation from the soil surface as well as transpiration from the plant's leaves. Over use of soil water for irrigation and other purposes and soil water contamination can be the major causes that makes the soil water unfit for utilization. The amount of water a soil can hold depends on its water holding capacity. When soil is at field capacity, further addition of water can cause erosion because the excess water cannot be stored in the soil profile. Sometimes a soil's pore spaces are reduced through human or natural processes which is called "Compaction" of soil. This causes the soil particle to become very close to each other and the pore space is minimized. So the water will not be able to penetrate into the soil. The fertilizers and pesticides that we use in agricultural lands and the volatile organic compounds (VOC's) when spilt on the land can also get absorbed by the soil and can contaminate soil water which makes the soil water unfit for proper use.

Effects of Soil Water Depletion

When the soil moisture in the specified root zone is depleted to predetermined level which is different for the different crops which is to be replenished by irrigation. Reduction in soil water level causes reduced stomatal conductance, growth, root proliferation, photosynthetic pigments, protein contents, and impaired photosynthetic pigments, and alter hormone distribution and increased activities of antioxidant enzyme to cope unfavorably with osmotic changes. The contamination of soil water can result in poor water quality, loss of water supply, degraded surface water systems. As the pollution of soil water is increasing day by day one fifth of the world's population do not have safe drinking water. In Europe and America 35% of the population has fresh and clean drinking water in their homes but in Africa and Asia only less than 10% of the people have clean drinking water which is from wells and tanks.

Conservation of Soil Water

Soil water management's ultimate aim is to improve the efficiency with which rainfall is converted into crop and pasture yield. There are many processes to conserve soil water.

1. **CONSERVATION TILLAGE-** Reducing tillage helps to maintain healthy soil organic levels which helps to maintain the soil's capacity to hold and retain water.
2. **DEEP TILLAGE**- Even though it is only suitable for certain types of soils, deep tillage increases porosity and permeability of soil which increases the soil water absorption and retention capacity.
3. **CROP ROTATION**- Growing different crops for different seasons can improve soil structure and soil fertility which improves the water holding capacity.
4. **USE OF GREEN MANURE-** Growing of plant materials with the sole purpose of adding to the soil for improved organic matter and nutrients. This improves soil quality then also improves water retention capacity of the soil.

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5. **CONTOUR PLOUGHING**-by ploughing the soil along the contour instead of up and downward slopes, the velocity of runoff is reduced which creates even barriers and more water is retained in the soils.

Some of the other soil water conservation methods would include rainwater harvesting to minimize runoff and collect water for use on site.

Conclusion

Soil water provides suitable habitat for plants. Rivers play a major role in carrying water in the earth's system. Some of the rainwater soaks deep into the ground to feed the wells underground and streams. Life can be survived only because water is constantly being recycled which is done by soil, by purifying and filtering rainwater and making it suitable for utilization. Soil and water are shared resources. So, the soil water should be conserved for better sustaining of plant and animal life on this planet.

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Bioengineering The Future: Role Of Biotechnology in Feeding the World

Anto Rashwin A. and Joel Sanjeeth I.

Undergraduate student, Agricultural College and Research Institute, Vazhavachanur,
Tamil Nadu Agricultural University

Abstract

This article explores the transformative journey of biotechnology within agriculture, highlighting its significant role in meeting growing food demands. From the Green to the Gene Revolution, it examines how biotechnological tools have enabled the modification of genetic makeup, resulting in resilient crop varieties, amplified yields, and sustainable practices. However, amid these advancements, the piece emphasizes the critical need for scrutiny. Concerns spread large over the safety of genetically modified (GM) crops on human health, environmental stability, and socio-economic factors. Striking a balance between progress and caution, the article calls for comprehensive evaluations and robust regulations to address these multiple concerns. Furthermore, it highlights emerging methodologies like cisagenesis and genome editing as promising alternatives, providing a glimpse into the future of agriculture. This critical review of biotechnology concludes with a call for transparency, and innovation to navigate the evolving landscape of biotech-driven farming.

Keywords: Biotechnology, food security, genetic modification, sustainable farming, GMOs

Introduction

Crop improvement plays a crucial role in ensuring global food security. It involves enhancing crop characteristics to meet the increasing demands for food production due to population growth and environmental challenges. Biotechnology, utilizing scientific techniques, is so important in this endeavour. It involves the alteration and enhancement of characteristics in plants, animals, and microorganisms, which hold economic importance in various sectors such as

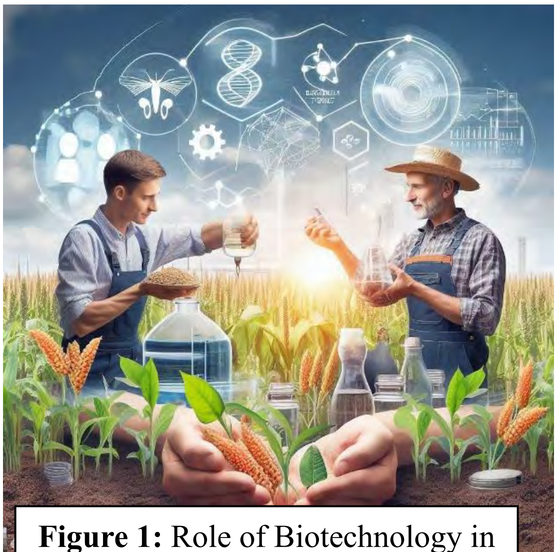

Figure 1: Role of Biotechnology in crop improvement

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food processing, agriculture, forestry, environmental protection, and the medical field.

In agriculture, biotechnology is employed for modifying and improving crops and livestock. This aligns with the concept of an "Evergreen Revolution," aiming to continuously enhance agricultural productivity. The advent of biotechnology has expanded our understanding of Mendelian genetics and the physiological constraints of crop yield potential.

Historical Perspective

1. **Gregor Mendel & "Experiments on plant hybridization":** Mendel's work laid the foundation for understanding trait inheritance.
2. **Gene Modification in Crops:** The selection of novel crop types began around 10,000 years ago through chance or random gene modification.
3. **Green Revolution:** This era in the 1960s witnessed increased productivity of rice, maize, and wheat, a crucial breakthrough in agricultural history.
4. **Molecular Structure of DNA & Genetic Code Discovery**: The understanding of DNA's molecular structure and its role in inheritance in the 1960s was a significant turning point.
5. **Transfer of Genetic Material & GMO Development**: The discovery of the genetic code facilitated the transfer of genetic material, leading to the development of GMOs.
6. **Modern Biotechnology & Genetic Manipulation:** This led to the rise of modern biotechnology, enabling genetic manipulation in agriculture, horticulture, environmental protection, medicine, forensic science, and various other fields.

Recent Trends in Agriculture Relevant to Biotechnology

Genetic modification involves the alteration of an organism's genetic makeup using biotechnological. These tools enable scientists to modify specific genes within plants, animals, or microorganisms, enhancing desirable traits such as increased yield, resistance to pests or diseases, or improved nutritional content.

Biotechnological tools utilize scientific techniques to precisely alter and enhance genetic characteristics, revolutionizing agriculture, medicine, and various other fields.

Genetic Modification Through Transgenesis

Transgenesis, a cornerstone of genetic engineering, relies on recombinant DNA (rDNA) technology to manipulate genetic material. Through precise cutting and joining of DNA, hybrid genetic combinations are crafted and introduced into new organisms. This process yields Genetically Modified Organisms (GMOs), engineered with heritable genetic traits.

Herbicide Resistance in Agriculture

Glyphosate-tolerant transgenic crops, pocess the EPSPS gene from the CP4 strain of *Agrobacterium tumefaciens* (GUO et al., 2020). This genetic modification confers resistance to glyphosate, a key component of herbicides like Roundup. Commercially, glyphosate-resistant crops

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primarily utilize genes pat and bar sourced from *Streptomyces spp*., ensuring tolerance to specific herbicides like glufosinate.

Insect-Resistant Transgenic Crops

Insect-resistant transgenic crops, fortified with cry genes sourced from *Bacillus thuringiensis* (Bt), provide robust defences against a spectrum of pests including Lepidopterans, Coleopterans, and Dipterans. These genes offer selective resistance while being non-toxic to mammals (AL-Harbi et al., 2019). Commercial successes include cotton varieties engineered with the cry gene, showcasing remarkable resilience against insect pests **Fig.2**. Among crops, Maize, Cotton, and Potato lead in the adoption of multiple insect-resistant events.

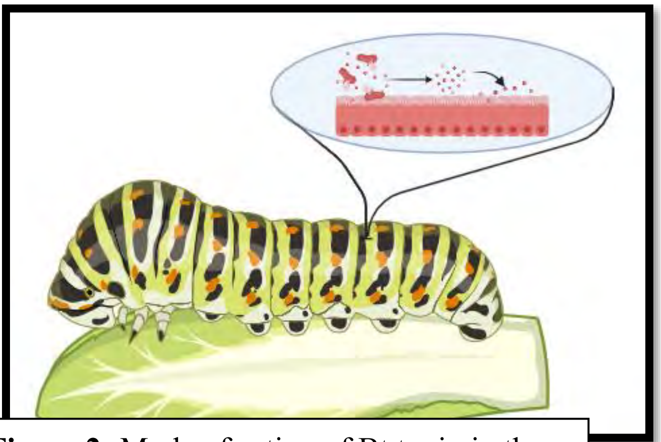

Figure 2: Mode of action of Bt toxin in the caterpillar's peritrophic membrane

Abiotic Stresses and Molecular Adaptation

As climate shifts, abiotic stresses exert profound impacts on crops. At the molecular level, plants adapt by modulating gene expression to counter these stresses. The adaptation traits are intricate, involving multiple genes to create favourable conditions for growth. In the agricultural domain, specific events addressing abiotic stress tolerance have been commercialized, primarily in Maize, Sugarcane, and Soybean.

Transgenic Biofortification

Transgenesis has revolutionized the enhancement of nutritional qualities in crops. A notable milestone is the approval of GR2E, popularly known as Golden Rice, fortified with genes 'crt1' and 'psy1,' offering a carotenoid-rich source. Furthermore, the introduction of the antisense fae1 gene into *Brassica napus* and *Brassica juncea* resulted in reduced erucic acid levels (Wang et al., 2022).

Tissue Culture

Tissue culture, a technique involving the cultivation of cells, tissues, or organs in a sterile nutrient medium, has revolutionized agricultural practices. This method allows the manipulation and extension of cells, anthers, and other tissues, creating new organisms and fostering genetic variability. In agriculture, tissue culture has enabled the propagation of disease-resistant, high-yielding clones. Moreover, it aids in conserving endangered germplasms and preserving seeds that are difficult to germinate or store for prolonged periods.

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Embryo Rescue Techniques

Embryo rescue, crucial in inter-specific or inter-generic crosses, overcomes hurdles like pre- or post-fertilization incompatibility barriers, salvaging embryos for cultivation. This technique involves rescuing these embryos and nurturing them into whole plants, a pivotal step for transferring desirable genes from wild relatives into cultivated species.

Somatic Hybridization: Uniting Genetic Diversity for Novel Organisms"

Somatic hybridization merges cells from diverse cultivars, species, or genera, manipulating genomes through protoplast fusion. This technique can generate new germplasm and entire organisms. Overcoming barriers between different species or genera, somatic hybridization merges protoplasts, as seen in the fusion of Potato and Tomato, birthing innovative organisms like Pomato (Solanopersicon) (Mamata et al., 2021).

Omics

'Omics' technologies represent a suite of bioinformatics tools comprising genomics, proteomics, transcriptomics, genome sequencing, and metabolomics. Genomics aids in unravelling gene structures, functions, and evolution, deciphering DNA contributions to traits in organisms. Proteomics delves into tissue proteins, decoding gene expressions and specific protein functions.

Challenges And Ethical Considerations

Ethical considerations surrounding the adoption of GMOs and other technologies are discussed below,

1. **Unintended Ecological Impacts of Transgenic Crops:** Transgenic crops engineered for disease or pest resistance inadvertently affect non-target organisms. Adoption of glyphosate-resistant crops in the USA and Mexico led to reduced monarch butterfly populations. Monarch larvae feeding on genetically modified Bt maize-dusted milkweed showed higher mortality compared to lab conditions.
2. **Safety Concerns Surrounding Transgenic Foods:** Transgenic foods raise apprehensions about human health and the environment. Risks include allergenicity, toxicity, and potential horizontal gene transfer, leading to increased allergen levels or the introduction of new allergens. To ensure consumer safety, testing of transgenic food is essential.
3. **Challenges of Resistance in Transgenic Crop Cultivation:** The widespread use of insect-resistant and herbicide-tolerant crops intensifies selection pressure, fostering resistance in targeted insect populations. This scenario encourages the evolution of new insect biotypes resistant to transgenic technology and the emergence of superweeds impervious to herbicides. Instances like field-evolved resistance in *Spodoptera frugiperda* in Brazil to cry1F corn and cry1Ac soybean.

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Conclusion

The evolution from the Green to the Gene Revolution enables genetic modification using biotechnology, meeting rising food demands with resilient, high-yielding crops. This approach ensures sustainability, reduces costs, and uplifts farmers' livelihoods. Yet, concerns arise about the safety of GM crops on health, the environment, and socio-economic aspects. It urges transparent assessments and robust regulations. Alternative methods like cisagenesis and genome editing offer hope for improved crops, emphasizing the need for cautious advancement in agricultural biotechnology.

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Soil and Water a source of life

Dr. Rohitash Kumar
Ph.D. Scholar, Department of Veterinary and A.H. Extension Education
PGIVER, Jaipur

Introduction

We see our land, water, and human resources as living assets to be guided by prudent arrangements for future days, rather than as static and sterile belongings. **(Franklin D. Roosevelt)** On December 5th, the entire world celebrates **World Soil Day** each year. The event this year has **"Soil and Water are the Source of Life"** as its subject. Today is a significant day for us to recognize the value of soil for ourselves and to share that value with others. Since soil plays a significant role in our planet's ecosystem, protecting it is vital to mankind.

Significance of soil: Soil is an integral part of our earth that is extremely important for life. For humans, plants, and wildlife alike, soil is an essential source of life. It plays a significant part in water flow, environmental balance, and climatic change. It also includes a range of nutrients that are necessary for plant development and the maintenance of the natural order. Numerous issues pertaining to soil have emerged in recent times for diverse causes. The quality of soil is deteriorating as a result of improper farming practices, unethical use, and population expansion. By overusing this priceless natural resource, humans are not only decreasing soil fertility but also contributing to environmental issues like drought, excessive rainfall, and climate change. The media in which plants develop and get vital nutrients is soil and water. As a natural filter, healthy soil is essential for cleaning and storing water that enters the soil. 60 percent of the world's food supply comes from 80 percent of crops cultivated on land under rain-fed agricultural systems. Effective methods for managing soil moisture are crucial to these systems.

Since soils maintain life on Earth and boost ecosystem resilience, integrated soil and water management techniques provide vital ecosystem services. By removing carbon from the atmosphere, healthy soils serve as carbon sinks, aiding in the prevention and adaptation of climate change.

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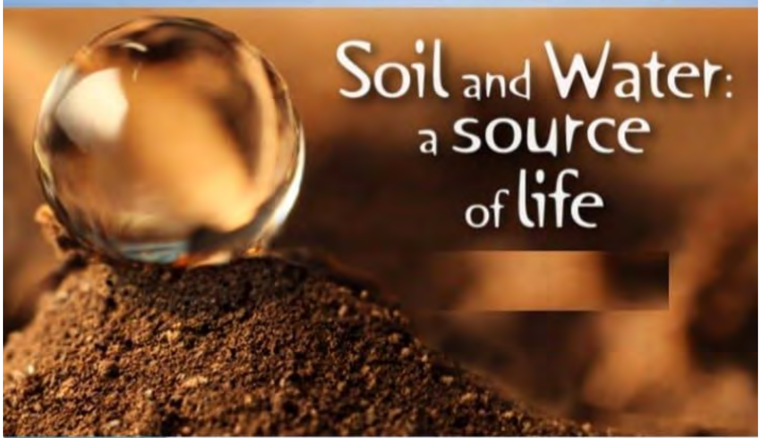
Uses of Soil and Water: Agriculture, manufacturing, and wildlife preservation all utilize soil. Water circulation, pollutant reduction, and soil fertility are all aided by proper soil use. To ensure that the soil continues to yield the highest quality goods and maintain the diversity of food sources, it must be carefully managed and safeguarded.



Actions to preserve life on earth: Water and soil are essential resources that are necessary for human health, the ecology, and the production of food. Given their critical importance, it is our duty to protect and manage soil and water resources for coming generations.

- **Prevent soil erosion:** The soil's capacity to hold, release, and filter water is hampered by soil erosion. Raises the possibility of landslides, floods, and dust or sand storms.

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- **Stop illegal mining and construction:** The loss of biodiversity is a result of the alteration in land use brought about by mineral mines, quarries, and numerous construction projects. That's why we need to end this.
- **Improve soil and water management:** Enhancing soil and water management makes the nation more resilient to extreme weather events including floods, sand/dust storms, and droughts.
- **Improve soil protection awareness:** Raising awareness of the value of soil is vital. Information on how unsystematic land use degrades soil and how to preserve it has to be disseminated.
- **Improve the agricultural system:** Both soil and water may be saved by decreasing the use of inappropriate agricultural practices and implementing acceptable soil and water conservation strategies.
- **Adapt soil conservation programmes:** Different soil conservation techniques, including mounding in fields and planting trees, should be introduced and implemented by governments and public organizations/communities.
- **Promote biodiversity:** It is important to take action to protect biodiversity by developing forests, conserving and growing different plant species, and safeguarding wildlife.
- **Educate and motivate:** People should be made aware of soil and water conservation through the organization of educational programs and motivating workshops.

Sustainable soil management practices not only improve soil fertility but also enhance crop resilience to climate change, reduce the need for synthetic inputs, and contribute to long-term food security. By investing in soil health, we invest in the well-being of present and future generations.

Expectations of the community:

- Encourage the implementation of employment guarantee programs and other demand mechanisms for village-level water and soil conservation structures, working with local public representatives and Gram Panchayats.
- Encourage the growth of regional crops and plant lots of trees. It is recommended to outlaw the use of chemical pesticides and fertilizers and to promote the use of organic alternatives.
- As we celebrate World Soil Day 2023, let us recognize the invaluable role that soil plays in sustaining life on Earth. It is our collective responsibility to prioritize sustainable soil and water management practices, promote conservation efforts, and address the challenges posed by climate change. By nurturing and protecting our soils and water, we are safeguarding the foundation of life and building a sustainable future for generations to come.

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