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FROM THE PRESIDENT'S DESK

The Soil Affects Our Health More Than We Think

Balanced diet is normally considered first in maintaining the good health. Next important items for healthy life are a good sleep, daily exercise and other necessary life styles based on age. Health-conscious persons also keep an eye on the number of steps moved, monitor heart rate and track the calories consumed and used. But we hardly think about the role of our soil and its role on our health. Soil quality affects the main critical factors responsible for our health i.e. quality of our food, water flowing in rivers and air.

Healthy soils, rich in organic matter and beneficial microbes, produce fruits, vegetables, or grains with higher levels of vitamins, minerals, and antioxidants. Soil with more available nutrients—such as nitrogen that promotes plant health and selenium that benefits human health—yields more nutritious food (LinkedIn newsletter, Wellness To-Go). In addition, basic micronutrients in soil, like iron, zinc and iodine directly impact our health. Moreover, minerals and microorganisms present in soil help to filter out pollutants such as heavy metals, organic waste, harmful bacteria and viruses, from air and water as they move through soil layers. In contrast, depleted soil poses a risk to both the environment and our health.

When soil experiences 'dysbiosis' or an imbalance of the organisms in it, the plant growing in it senses stress. This stress, in turn, affects the plant's overall health. As a result, the food made from it, is different, meaning it's less nutritious (Jeffrey Bland, nutritional biochemist, functional medicine doctor, and author of The Disease Delusion: Conquering the Causes of Chronic Illness for a Healthier, Longer, and Happier Life). When we eat this food, it might not provide the required amounts of nutrients to our bodies needed to stay healthy.

A study published in the Journal of American College of Nutrition that analyzed nutritional data of 43 fruits and vegetables from 1950 and 1999 found significant

decline in protein, vitamins B_2 and C, iron, calcium, and phosphorus over the years. More recently, a 2024 review published in Food Journal, notes that many fruits and veggies like apples, oranges, bananas, tomatoes, and potatoes have lost their nutritional density by 25-50% or more over the last 50 to 70 years. This is primarily due to soil degradation, aggressive farming practices and genetic factors.

Ethno-botanical Practices in North East Indian Farming

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With 255,083 km^2 of hills, valleys, and plateaus, the North Eastern Region (NER) of India is extremely different from the rest of the nation in terms of ethnicity and culture. North East India's agricultural environment is fundamentally shaped by traditional farming techniques as paddy-cum-fish farming, jalkund, bamboo drip irrigation, and shifting agriculture (jhum). In order to preserve soil fertility and manage weeds, shifting cultivation entails changing the use of the land. Using bamboo pipes, bamboo drip irrigation is a novel way to effectively manage water resources. Farmers can store rainwater for irrigation by using a water-saving method called jalkund. Rice farming and fish breeding are combined in paddy-cum-fish farming to increase production and biodiversity. These agricultural methods, which uphold ecological balance and promote local lives, are indicative of the creative and sustainable agricultural ways prevalent in the region. The region's great and distinctive biodiversity is a result of topographical and environmental factors.

Shifting (Jhum) Cultivation

One of the oldest agricultural practices is shifting cultivation, commonly referred to as slash-and-burn, swidden, or rotational bush fallow agriculture. It is said to have started around 8,000 B.C. during the Neolithic era. This practice is primarily seen in the hilly and mountainous regions of Southeast Asia, Latin America, and Central Africa. It is a farming method where a forest patch is removed entirely, the debris is allowed to dry, then burned, and the land is used for cultivation for a year or two. Following the cropping season, the land is left fallow for a specific number of years, ranging from three to ten or more years, during which time the vegetation naturally regenerates. The cycle is repeated when the fallow period ends and enough forest growth have been achieved. The same area is then cleared for farming once more. This

(Freshly cleared and burned shifting cultivation patch in Nagaland)

agricultural technique is notable for its lack of tillage, use of archaic instruments like hoes and dribbling sticks, reliance on human labour, lack of irrigation and manuring, and short-term land use followed by a protracted fallow period. Jhum agriculture, which is based on alder, is well-known in Nagaland. The nitrogen-fixing *Alnus nepalensis* trees in this system are pollarded to a height of 1-2 meters above the ground and kept in the Jhum plots. The field is torched to release the clipped branches and leaves, and the soil is then ready for planting. Job's tear, maize, potatoes, tomatoes, chillies, cabbage, cauliflower, squash, cucumbers, ginger, French beans, soybeans, and peas are the principal crops and vegetables cultivated.

Paddy-cum-fish cultivation

The indigenous Apatani tribe of Arunachal Pradesh practices paddy-cum-fish cultivation, also referred to locally as 'Aji-ngyii.' The method entails raising fish and indigenous millet (*Eleusine coracana*) on the same land as wet-rice farming. Millet is planted along the bunds encircling the rice fields, while paddy is produced on the field itself.

(Paddy-cum-fish cultivation)

The edible herb *Houttuynia cordata*, which grows naturally on the bottom sides of bunds, is kept in place and serves as a soil binder to fortify the bunds even more.

Other North Eastern states also cultivate paddy-cum-fish, primarily in the Manipur valley region. Trenches known as 'Kom' were excavated in this technique, either on one side or all the way around the boundary of the paddy field. Their width varied from 4 to 5 meters, depending on the size of the field. This Kom is filled with water, where paddy is left in the middle and fish aquaculture is practised. Since the ancent time, practically every household is engaged in this practice, which gives a high economic value and is highly productive.

Bamboo drip irrigation

In the Jaintia Hills district of Meghalaya, indigenous inhabitants use an inventive irrigation technique called the bamboo drip irrigation system. They live in the War Jaintia areas. It is estimated that this irrigation system is 200 years old. As building ground irrigation canals is challenging due to the area's steep and undulating geography, this technique has evolved to make up this gap. In this technique, water from springs and streams that are located higher up is used and directed into fields until it reaches the base of the plant, where it evaporates into droplets. Using bamboo has two benefits: it uses cheap, natural materials that are readily available and minimizes leaks while enhancing crop production with less water. Leaching is decreased when water is applied locally, minimizing the loss of nutrients and fertilizers. Soil infiltration capacity is raised and weed development and soil erosion are efficiently controlled.

(Bamboo drip irrigation in 'War' Jaintia area of Meghalaya)

Jalkund

To store rainwater in the upper terrace conditions, a straightforward and inexpensive rainwater harvesting structure known as Jalkund has been created. During crucial phases of crop growth, Jalkund can supply life-saving irrigation, improving crop output and resilience to dry times. Farmers, through Jalkund, can diversify their revenue streams by raising fish using the rainwater that has been stored there. To provide a sufficient supply of water for their animals' needs, farmers might use the collected rainwater for their livestock operations and animal husbandry. The harvested rainwater can also be used domestically, helping farmers and their households in fulfilling their water needs.

(Jalkund)

The traditional agricultural practices of indigenous communities of North East India focus on biodiversity and natural resource management. Shifting cultivation is important for maintaining agro-biodiversity, soil fertility, erosion control, and ecosystem services, provided the jhum cycle is of appropriate period. Paddy-cum-fish cultivation showcases advanced integrated farming, utilizing limited water resources and constructing intricate irrigation systems. Bamboo-drip irrigation is another example of skilled farmers using locally available bamboo resources. Jalkund promotes rainwater harvesting for farmers, enhancing productivity, water availability, and sustainable livelihoods in hilly regions, addressing water scarcity challenges and enhancing resilience. Transitioning from traditional agriculture to commercial farming could lead to the loss of ecological knowledge, agro-biodiversity, genetic diversity, and ecosystem services. Urgent efforts are needed to promote the sustainable use and management of traditional farming systems, integrating traditional knowledge with scientific knowledge through a multi-stakeholder approach. Scientific research is crucial for gaining a functional understanding of indigenous knowledge, including identification, collection, and assessment.

Hydroseeding: An Effective Solution for Erosion Control

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Soil erosion is a worldwide problem that washes away fertile soil layer. To stabilize and protect the soils from erosion, a very effective method is covering the bare soil by vegetative cover which protects the soil from direct impact while the roots bind the soil. Numerous techniques are being employed for erosion control out of which hydroseeding is one of the efficient methods of ground revegetation to stabilize bare soil surface to prevent soil erosion by soil stabilization and slope protection. Hydroseeding is a technique which involves the application of a complex mixture of seeds, fertilizers, adhesives, mulch, and water on soils, through a suitable hydroseeding machine. It is a widely

used technique for controlling erosion and promoting vegetation growth on bare or disturbed soil surfaces. The resulting mixture, often referred to as a 'Hydroseed slurry' forms a protective layer that helps in preventing erosion, supports plant growth, and eventually establishes a stable and sustainable vegetative cover.

The materials required for hydroseeding are as follows:

i. **Seeds:** Includes grass seed (blue grass, fescue, rye grasses, Bermuda, Bahia, centipede, native grasses etc), wild flowers, erosion control seeds (crown vetch, birdsfoot trefoil).

ii. **Fertilizers:** Includes granular, water soluble and liquid fertilizers with high phosphorus starter fertilizers.

iii. **Mulches:** Protects seed, maintains moisture to promote fast germination, help to hold seeds and soil in place. Pourable mulches (paper, wood), straw based mulches, erosion control mulches.

iv. **Adhesives (tackifiers)**: Acts as glue to combine water, seeds and fertilizers. Guar, derived from seeds of cluster bean plants, Plantago, Anioniv Polyacrylamide (PAM) that retains large amount of water, Hydrotac that holds seed to surface of soil by allowing air, water to pass through it into ground.

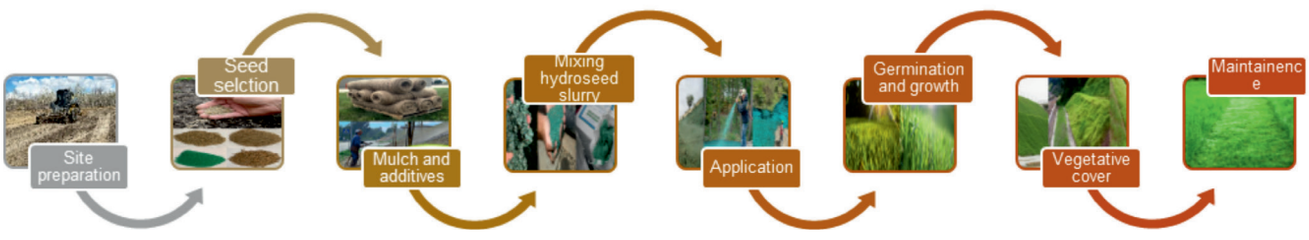
v. **Hydroseeding machine**: Jet agitated hydroseeders, Mechanical (Paddle) agitated hydroseeders, Brine sprayers and Brine makers, straw blowers, watering units

Hydroseeding is an important and popular treatment to stabilize steep slopes. A hydroseed binder can decrease sediment production by providing cover on bare soil, reducing raindrop impact erosion, reducing runoff during precipitation events by increasing infiltration into the soil and increasing soil water-holding capacity by decreasing soil evaporation. This approach is one of the techniques of ground re-vegetation used to stabilize bare soil surface to control landslide hazard. The cellulose mulch mixed with tackifier acts as a binder. The cellulose mulch, combined with the seeds, germinator, fertilizer, are mixed with water in the hydroseeder, forming a homogeneous slurry and uniformly sprayed on the soil. The fertilizer-mixed cellulose fiber mulch and the seed act as an absorbent mat and hold a large water capacity that helps seed germination and forms a stable blanket cover on the surface before the seed germination period. It is a widely used and fastest method of landslide or soil erosion control. Some seeds germinate within two days, which enables the topsoil of the embankment to be already 100% stabilized right before the development of the vegetation ground cover. Watering is required less as soon as the ground cover grass seed has been established. The mulch serves as water retention and absorbing mat, and reduces the development of the unwanted weeds. The end product of hydroseeding requires a very minimal maintenance policy as soon as the permanent ground cover is purely developed. Hydroseeding can achieve dense grass cover in the short term by stabilizing the soil, thus controlling erosion. Grass rapidly develops a fine, extensive root system that stabilizes soil particles.Numerous long grass roots growing almost vertically downwards is able to penetrate and mitigate the soil erosion. The application of hydroseeding process can be considered for both temporary and permanent erosion control. Hydroseeding is effective with mild and moderate slopes. Based on the slope, the seed material has to be selected.

Advantages of hydroseeding:

It is a cost effective, comparatively less laborious, provides better vegetation quality, control erosion efficiently, and offers ideal micro-environment for seed germination and

Process of hydroseeding



high-water retention. It is also an eco-friendly way for soil stabilization.

Conditions to be considered for hydroseeding:

Soil conditions, site topography, season and climate, vegetation types, maintenance requirements, sensitive adjacent areas, water availability and plans for permanent vegetation.

Applications:

Construction sites, slopes and embankments, post wildfire rehabilitation, highway and roadside stabilization, landfill caps and reclamation.

Conclusion

Hydroseeding is a versatile and effective solution for erosion control, offering numerous advantages over traditional methods. Its cost-effectiveness, rapid application, and ability to enhance germination rates make it a popular choice for a wide range of applications. However, successful hydroseeding requires careful planning, site preparation, and maintenance to address potential challenges. As the demand for sustainable and efficient erosion control methods continues to grow, hydroseeding stands out as a reliable technique for mitigating erosion and promoting sustainable land management.

Carbon Farming: A Climate Solution towards Sustainable Agriculture

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Novel approaches to cropping systems and soil management are being developed to cope with the abundance of CO_2 in the environment while improving water use efficiency and soil quality at the same time. Satisfying human needs and protecting environmental resources simultaneously is the key to effective planning strategies. In light of escalating environmental concerns and the pressing need for climate resilient agricultural practices, carbon farming has emerged as a crucial mechanism within the agriculture sector globally. Carbon farming represents a strategic approach aimed at maximising carbon sequestration and employing agricultural practices designed to enhance the absorption of carbon dioxide (CO_2) from the atmosphere while facilitating its retention in both plant biomass and soil organic matter.

Significance of carbon farming

Carbon farming is significant for several reasons, particularly in the context of addressing climate change and promoting sustainable land management. Here are some key aspects of its importance:

Climate change mitigation

Carbon sequestration: Carbon farming practices capture and store atmospheric carbon dioxide (CO_2) in soils and vegetation, helping to offset greenhouse gas emissions. This is crucial for mitigating the impacts of climate change.By improving soil health and adopting practices like reduced tillage, cover cropping, and agroforestry, carbon farming can reduce the emission of other greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O).

Soil health enhancement: By nurturing healthy soil, carbon farming bolsters water retention, diminishes erosion, and boosts nutrient availability, resulting in amplified crop yields and agricultural productivity. Organic waste can be converting into compost that can be used as a soil amendment to improve soil structure, fertility and carbon content.

Biodiversity enrichment

Habitat creation: Carbon farming fosters biodiversity by fostering intricate ecosystems in agricultural settings. Agroforestry and other carbon farming practices can create habitats for various plant and animal species, promoting biodiversity.

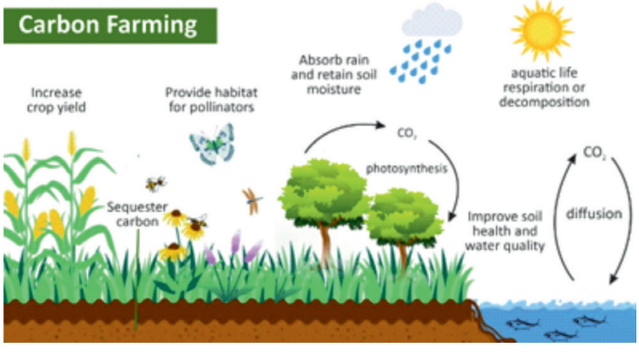
Ecosystem services: Healthier soils and diversified landscapes contribute to ecosystem services such as pollination, water filtration, and pest regulation. Carbon farming fosters biodiversity by attracting beneficial insects and pollinators that fortify crop health and lessen dependence on pesticides.

Economic opportunities

Implementation of carbon farming practices opens avenues for farmers to tap into carbon credit markets, alongside potentially augmented yields from enriched soil, thus diversifying income streams and bolstering financial resilience.

Public and policy support

Carbon farming aligns with international climate goals, such as those outlined in the Paris Agreement, by contributing to national and global efforts to reduce greenhouse gas emissions. Many state governments and organizations are creating policies and incentives to encourage carbon farming, which can help drive broader adoption and support for sustainable practices.



Techniques involved in carbon farming

Carbon farming involves various techniques that focus on enhancing the ability of soils and vegetation to capture and store carbon dioxide (CO_2) from the atmosphere. Here are some key techniques used in carbon farming:

Forest management

Healthy forests absorb and hold carbon dioxide emissions produced from other sources and are an important source of greenhouse gas (GHG) sequestration. Carbon offsets can be created through a variety of strategies including, avoiding deforestation and permanent land conservation, reforestation and replanting activities, and improved forest management.

Agro-forestry not only sequesters carbon but also provides additional sources of income for farmers whereas deforestation contributes to 15-20% of the rise in greenhouse gas levels globally. Activities to address this include managing forests by thinning them out, selectively harvesting trees, encouraging regrowth, planting new trees, and using fertilizers to help forests grow in a productive and sustainable way.

Grasslands conservation

Native grasses and other vegetation provide a natural source of greenhouse gas (GHG) absorption and sequestration. Carbon offsets from this category focus on maintaining native plant life through permanent land conservation and avoiding conversion for commercial development or intensive agriculture.

Conservation agriculture techniques

Cover cropping: Cover cropping is an agricultural practice where crops are planted primarily to cover and protect the soil rather than for direct harvest, grown during periods when the main crops are not being cultivated, such as during the off-season or between harvests. Cover cropping improves soil organic matter, enhances soil structure, reduces erosion, and increases carbon sequestration.

Reduced tillage/Conservation tillage: Reduced tillage refers to minimizing or eliminating soil disturbance through reduced or no-tillage methods. It promotes maintenance of soil organic carbon, improves soil structure and water retention, and reduces erosion and greenhouse gas emissions.

Crop rotation: Crop rotation is a key practice in carbon farming due to its benefits in improving soil health, enhancing carbon sequestration, managing nutrients, controlling pests, and increasing resilience. By integrating diverse crops into farming systems, crop rotation supports sustainable agriculture and contributes to climate change mitigation.

Rotational grazing

It entails periodically relocating livestock to new pasture, this practice allows previously grazed areas to rejuvenate, minimizing erosion and fostering robust re-growth. The flourishing vegetation, in return, absorbs carbon dioxide from the atmosphere and sequesters it in the soil through photosynthesis.

Wetland restoration

Wetlands are highly effective at capturing and storing carbon in their soils. Restoration of wetlands often involves reintroducing water into areas previously drained, which helps to reduce carbon dioxide (CO_2) emissions from the soil by preventing oxidation of stored carbon.

Potential opportunities for carbon farming in India

India, with its diverse agro-climatic zones and extensive agricultural landscape, has significant potential for carbon farming. Here are several opportunities for carbon farming in India:

Economic opportunity

India's extensive agricultural base presents significant economic opportunities through the adoption of carbon farming practices with an estimated potential of $63 billion from approximately 170 million hectares of arable land.

Carbon credit systems

Implementation of carbon credit systems can offer additional income streams to Indian farmers by recognising their contributions to environmental services. Agricultural soils in India have the potential to sequester 3-8 billion tonnes of CO_2 equivalent annually over 20-30 years, thus providing opportunities for farmers to participate in carbon trading markets.

Regional suitability

Different regions of India offer varying degrees of suitability for carbon farming initiatives. The fertile plains of the Indo-Gangetic region and the expansive Deccan Plateau are particularly favourable for implementing carbon farming practices.

India's legal framework

The Government of India passed an amendment in 2022 to the Energy Conservation Act 2001, which lays the foundation for the Indian Carbon Market. Following this, the Council on Energy, Environment and Water (CEEW) conducted an industry stakeholder discussion to understand their concerns and perspectives.

Challenges associated to carbon farming

Soil composition: Soils with poor structure or low organic matter may have limited capacity for carbon storage and may require amendments or management practices to enhance fertility and carbon sequestration potential.

Geographic location: Geographic factors like elevation, slope, and proximity to water bodies also impact land use options and agricultural productivity. For example, high-altitude regions may have limited crop options due to colder temperatures, while coastal areas may face challenges related to saltwater intrusion and soil salinity.

Varieties of crops: The selection of crop varieties suitable for specific soil types, climates, and growing seasons is critical for optimising agricultural productivity and carbon sequestration potential, varieties that are well-adapted to local conditions and resilient to pests, diseases, and extreme weather events can enhance crop yields and contribute to soil health and carbon storage.

Water scarcity: Adequate water is essential for plant growth and photosynthesis, which are fundamental processes for carbon sequestration. Arid regions face challenges in carbon farming due to inadequate water availability, which impedes plant growth and reduces the capacity for carbon sequestration.

Conclusion

Carbon farming is a specialized aspect of sustainable agriculture focused on sequestering carbon and mitigating climate change. It involves techniques that enhance soil health, improve resource efficiency, and support ecosystem services, all of which align with the goals of sustainable agriculture. By integrating carbon farming practices, farmers can contribute to climate change mitigation while promoting long-term environmental and economic sustainability.

Environment Day Observed By Meghalaya Chapter of SCSI

'World Environment Day' was observed by Meghalaya Chapter of Soil Conservation Society of India at College of Agriculture (CoA), Kyrdemkulai on 5th June, 2024 by organizing series of lectures and plantation drive. At the outset, dean of the college, Dr. Ram Singh welcomed the members of SCSI and appreciated the Meghalaya Chapter for selecting the CoA, Kyrdemkulai for celebrating this important day by planting more than 200 saplings in the college campus. He informed that during the process of developing new experimental farm at the campus, they are compelled to clear the forest area, and this initiative of plantation by the Meghalaya Chapter of SCSI will cover the damage caused to nature. He said that the series of lectures will create awareness among the students for protecting the planted saplings. He promised that each planted saplings shall be assigned to a specific student against roll number, who has to take care of that during his/her stay at the campus.

Dr. Sanjay Swami, Professor (Soils) & Chairman of the SCSI-Meghalaya Chapter, while addressing the students informed that the UN General Assembly designated 5th June as World Environment Day in 1972 to spread awareness among the people and encourage them to take some actions to protect the environment. The first celebration, under the slogan "Only One Earth" took place in 1973. Since its inception, this day is celebrated every year on 5th June. The occasion provides an opportunity to broaden the "basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in preserving and enhancing the environment." Every year, the campaign is raised around a theme in order to draw

attention towards pressing environmental issues. This year marks the occasion of 51st anniversary of World Environment Day, which focus on "Land Restoration, Desertification & Drought Resilience" based on ecosystem restoration under the slogan 'Our land, Our future. We are #Generation Restoration. He informed the house that today, the Prime Minister of India Sh. Narendra Modi is going to launch 'Ek Ped Maa Ke Naam' campaign by planting a *Peepal* tree at Buddha Jayanti Park in Delhi with the urge to protect Mother Nature by making sustainable lifestyle choices and contributing in making our planet better. He shared that our country is leading the way in sustainability and environmental conservation with Mission LiFE (Lifestyle for Environment), an India-led global mass movement promoting eco-friendly practices and sustainable lifestyles. India is the first country to include LiFE in its Nationally Determined Contributions (NDCs), reflecting its commitment to combating climate change through behavioral change rooted in traditional, sustainable living. The concept of LiFE was introduced by the Prime Minister of India at the 2021 United Nations Climate Change Conference (COP26) in Glasgow by calling for a global effort to adopt sustainable lifestyle practices, and since then, India has been mobilizing people to embrace LiFE. He further elaborated that Mission Lifestyle for environment recognizes that Indian culture and living traditions are inherently sustainable. The importance of conserving our precious natural resources and living in harmony with nature are emphasized in our ancient scriptures. The need of the hour is to tap into that ancient wisdom and spread the message to as many people as possible. Mission LiFE seeks to channel the efforts of individuals and communities into a global mass movement of positive behavioural change.

Speaking on the occasion, Dr. N. Janaki Singh, Associate Professor (Soils) and Secretary of the Meghalaya Chapter discussed about various issues of land, environment degradation and urged the student to follow simple and easy to adopt actions from their home or school to restore it. He emphasized that climate change is one of the main drivers of land degradation, with erosion of topsoil reducing the land's carbon sink ability and water storage function.

Dr. Lala I P Ray, Professor (Soil and Water Conservation) and Treasurer of the Meghalaya Chapter highlighted that currently up to 40 percent of the world's land is degraded, impacting around 3.2 billion people globally due to desertification. Moreover, projections suggest that by 2050, over three-quarters of the world's population will be affected by drought. Human-induced environmental damage is escalating, with serious consequences such as climate change, ecosystem loss, and land desertification. It is our duty as the current generation to protect the environment and restore land and nature to their natural state. Continuing the series of lectures, other active members of the Meghalaya Chapter, Ms. Pritisha Patgiri, Mr. Deepak and Ms. Ventina Yumnam elaborated about the various issues of land restoration, desertification and drought resilience, and appealed the students to scale-up and speed-up the actions to tackle these crisis with available science and solutions.

A plantation drive was also initiated by the members of SCSI-Meghalaya Chapter in the College of Agriculture, Kyrdemkulai campus. Around 200 fruit and ornamental plant sapling were planted in the college campus. Members also took pledge to save the natural resources and reconnect themselves with nature. The Dean, College of Agriculture, Kyrdemkulai congratulated the SCSI-Meghalaya Chapter team for organizing such a wonderful programme involving students, teachers and non-teaching staff. A formal vote of thanks was proposed by Ms. Anchita Borah, a member of SCSI, Meghalaya Chapter.

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