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SOIL AND WATER CONSERVATION *Today*

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IN THIS ISSUE

International Decade of Soils 2015-2024

FROM THE PRESIDENT'S DESK

According to the United Nations, over 2 billion people live in countries experiencing high water stress. India alone has 88 million people who lack excess to save water, placing the nation at the centre of the global problem 80% of Indians fresh water use in agriculture, making it a critical resource of the livelihoods of farmers and the countries' food security. Farmers relay heavily on ground water then wells, tube wells. The crisis created by large scale ground water extraction needs concerted and skilled up water management efforts rural India.

Even 74 years after independence, over 60% Indian do not have piped drinking water. The country is the largest extractor of ground water, it extract about 24 billion cubic meter of ground water to cater to 85% of its drinking water needs on the other hand, the quality of water resource is handling fit for drinking. According NITI Aayog nearly 70% of the fresh water resource contaminated and 600 million citizens are under stress.

There is global water crisis due to population growth, nature of economy growth, the climate crisis, land use change, in efficient of water use and weak planning and enforcement. The crisis shows how India has disregarded its strong tradition of water harvesting and has not been able to cope with changing demand. In 2019 Prime Minister of India launched the JAL JEEVAN mission a truly ambitious and liable scheme which has already shown much progress so as to provide dirking water to all rural household by 2022, the same year, the Jal Shakti Abhiyan was launched who campaign for water conservation and security. Both are interlink without recharging ground water there will be no piped water for safe and consent water supply the government must promote community based water conservation, allow the citizens to harvest rainwater and stop destroying wetland and contempt area.

Dr. Suraj Bhan
President SCSI

MANAGING SOIL ACIDITY FOR OPTIMIZING CROP PRODUCTION

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Soil acidity is a major problem in North Eastern Region of India. Acidic soils create production problems by limiting the availability of some essential plant nutrients and increasing the soil solution's toxic elements, such as aluminum and manganese, the major cause of poor crop performance and failure in acidic soils. Below soil pH 5.5, aluminum may be concentrated enough to limit or stop root development. As a result, plants cannot absorb water and nutrients, are stunted, and exhibit nutrient deficiency symptoms, especially for phosphorus. Toxic levels of manganese interfere with normal growth processes in the aerial plant parts which stunt the plant, discolor it and cause poor yields.

What causes soil acidity?

Farmers generally ask this question to the soil specialists. There are four major reasons for soils to become acidic: high rainfall and leaching, acidic parent material, organic matter decay, and harvest of high-yielding crops. Wet climates have a greater potential for acidic soils. In time, excessive rainfall leaches the soil profile's basic elements *viz.*, calcium, magnesium, sodium, and potassium that prevent soil acidity. Soils that develop from weathered granite are likely to be more acidic than those developed from shale or limestone. Organic matter decay produces hydrogen ions (H^+), which are responsible for acidity. Like that from rainfall, acidic soil development from decaying organic matter is insignificant in the short term. Harvest of high-yielding crops plays the most significant role in increasing soil acidity. During growth, crops absorb basic elements such as calcium, magnesium, and potassium to satisfy their nutritional requirements. As crop yields increase, more of these lime like nutrients are removed from the field. Compared to the leaf and stem portions of the plant, grain contains minute amounts of these basic nutrients. Therefore, harvesting high-yielding forages crops affects soil acidity more than harvesting grain crops.

Nitrogen fertilizer has been blamed for the increase in soil acidity problems throughout the region. Yes, when ammoniacal fertilizer materials are applied to the soil, acidity is produced, but the form of nitrogen removed by the crop is similar to that found in fertilizer. In reality, nitrogen fertilizer increases soil acidity by increasing crop yields, thereby increasing the amount of basic elements being removed.

How soil acidity can be managed?

Soil acidity can be corrected easily by liming the soil, or adding basic materials to neutralize the acid present. The most commonly used liming material is agricultural limestone, the most economical and relatively easy to manage source. The limestone is not very water-soluble, making it easy to handle.

How much lime is needed?

Although harvested crops remove plentiful lime like elements each year, the soil pH does not change much from year to year, meaning the soil is buffered, or resistant to change. The most important source of buffering in an acidic soil is the exchange of the lime like elements mostly calcium attached to the surface of soil particles. As the crop removes these elements from the soil solution, attached elements move from the soil particles to replenish the solution. In time, reserve elements are depleted enough to cause acidity. When you apply lime, consider the size of the reservoir or buffering capacity. Typically, clay soils have a larger reservoir than sandy ones, which means that they require more lime to achieve a favorable pH. Pay attention to the buffer index or pH on the soil test because it is an indirect estimate of the soil reservoir's size. Because the lab test involves adding basic material to soils with a pH less than 6.5 and then re-measuring pH, the buffer pH is larger when the reservoir is small (Table 1). If the buffer pH is 6.8, then it will take 1.2 tons of effective calcium carbonate equivalent (ECCE) of lime to raise the pH to 6.8 and 0.7 ton to increase it to 6.4.

The correct pH depends on the crop being produced. Grasses tend to tolerate acidic soils better than legumes,

Table 1. Tons of ECCE* lime needed to raise soil pH to 6.8 or 6.4

Buffer index	Lime required pH 6.8	Lime required pH 6.4
>7.1	none	none
7.1	0.5	none
7.0	0.7	none
6.9	1.0	none
6.8	**1.2**	**0.7**
6.7	1.4	1.2
6.6	1.9	1.7
6.5	2.5	2.2
6.4	3.1	2.7
6.3	3.7	3.2
6.2	4.2	3.7

*Effective calcium carbonate equivalent.

so liming to pH 5.5 may control acidity without limiting production. Legumes, however, need more calcium and perform best between pH 6.5 and 7.5: pH 6.0 to 7.0 is best for nutrient availability. In acid soils, acid tolerant crops should be grown. Choice of crops may be done according to soil pH like highly acid tolerant crops: rice, potato, sweet potato, oat, castor, tea, coffee, etc., moderately acid tolerant crops: maize, barley, wheat, turnip, brinjal, cow pea, mung beans, pigeon peas, pea nuts, etc. and slightly acid tolerant crops: tomato, carrot, red clover, etc.

Lime requirements are expressed in terms of ECCE, which is established on the basis of two components: the purity of the lime, determined chemically by the calcium carbonate content in the lime material, and the fineness of the lime material, determined by how much it is ground. The more calcium carbonate and the finer the material size, the higher the ECCE. Because the ECCE of lime is not always 100 percent, the amount of material required to provide that percentage must be calculated:

ECCE lime required x 100 = Lime required ECCE %

What lime does in the soil?

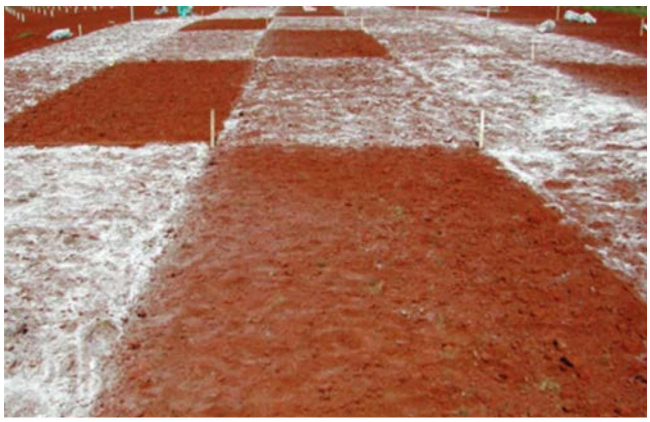
- Lime makes phosphorus more available.
- Lime increases the availability of nitrogen, as increase in nitrification and nitrogen-fixation.
- Organic matter decomposition increases.
- Lime makes potassium more efficient on plant nutrition.
- Beneficial soil bacteria are encouraged.
- Harmful aluminium and manganese and iron are rendered insoluble and harmless when a soil is well supplied with lime.
- Calcium and magnesium become available.
- Flocculating power of soil increases.
- Improves the physical condition of the soil
- Checks soil erosion.
- Fertilizer effectiveness increases.
- Plant diseases favoured by acid soil decrease.

How long it will take for lime to work?

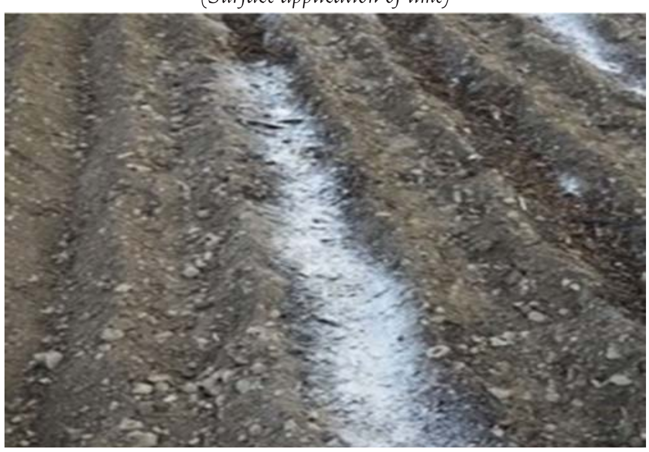
It takes water to activate the lime reaction, so lime works slowly in dry soil. Even with adequate soil moisture, it may take a year or more for a measurable change in pH. Since neutralization involves a reaction between soil and lime particles, mixing lime with soil increases the efficiency of acidity neutralization.

Method of applying lime:

The most efficient way to use lime is to apply small amounts every year or alternate, but this liming programme increase the cost of application. Lime can be applied at any stage in the cropping system, but normally it is applied one or two months before the sowing of crop. It is desirable that newly spread lime be well-mixed with the whole plough layer. However, the lime rates based on exchangeable aluminium cannot become popular in the hilly region of North East India, because here inputs are carried manually to the distant fields. This problem can be overcome by furrow application of small doses of lime every year as furrow require less amount to achieve optimum productivity. Furrow application of lime (80 mesh size) @ 250–400 kg/ha every year to maize and soybean is economical than a relatively higher dose based on exchangeable Al. When excessively large amounts of lime are applied to sandy soils low in humus, injury to plant growth sometimes occurs due to boron, iron, manganese, copper, zinc etc. Over liming injury may be reduced by application of large amount of compost, farm yard manure, phosphorus, boron etc.



(Surface application of lime)



(Furrow application of lime)

Maintaining a favorable pH is extremely important in a soil fertility management plan. Routine soil testing reveals soil pH levels and provides liming recommendations.

Meghalaya Chapter Celebrated World Soil Day

The Meghalaya Chapter of Soil Conservation Society of India in collaboration with the School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Barapani celebrated 'World Soil Day' on 5th December, 2021 at Mowphrow village of Ri-Bhoi district wherein more than 50 farmers along with headmen and secretary of various nearby villages participated.

Dr. Sanjay Swami, Professor (Soils) & Chairman of the SCSI-Meghalaya Chapter, while welcoming the farmers and dignitaries informed that that World Soil Day (WSD) is observed annually on 5th December as a means to focus attention on the importance of healthy soil and advocating for the sustainable management of soil resources. Every year, focus is given on a specific soil problem assigning specific theme. This year's theme is "Halt soil salinization, boost soil productivity." He highlighted that nearly 147 million ha of land in our country is subjected to soil degradation, including 94 million ha from water erosion, 23 million ha from salinity/alkalinity/acidification, 14 million ha from water-logging/flooding, 9 million ha from wind erosion and 7 million ha from a combination of factors due to different forces. Government of India has fixed a target of restoring 26 million ha of degraded lands, including salt-affected soils, by the year 2030 to ensure food security for the people. Around 6.74 million ha area in the country is salt-affected. Estimates suggest that every year nearly 10% additional area is getting salinized, and by 2050, around 50% of the arable land would be salt-affected. He added that India would require around 311 million tons of food grains (cereals and pulses) during 2030 to feed around 1.43 billion people, and the requirement expectedly would further increase to 350 million tons by 2050 when India's population would be around 1.8 billion. To achieve food security in the country, the attempts need to focus on both area expansion under agriculture as well as rise in crop productivity. The possibility of area expansion under agriculture, therefore, exists in restoring the degraded lands.

He further added that we are lucky enough that the North Eastern Region in general and Meghalaya in particular are not facing the problem of soil salinization but at the same time we have to focus on managing soil acidity problem for improving crop productivity. He further stressed that the significance of celebrating the 'World Soil Day' lies in our re-affirmation to preserve the soils and to create healthy soils for a healthier and more sustainable life of humanity. He urged the gathering to lend a hand to save soils and make everyday 'Soil Day.'

Speaking on the occasion, Dr. A.K. Singh, Senior Agronomist said that soil salinization, in addition to reducing net cultivable area, has serious implications for agricultural productivity and quality, the choice of cultivable crops, biodiversity, water quality, supply of water for critical human needs and industry, the longevity of infrastructure and the livelihood security of the people. There may be two approaches to tackle problem of soil salinity. One, to reclaim salt-affected soils; two, to manage salt-affected soils as they exist, i.e., without reclamation, using alternate suitable agricultural options such as cultivation of salt tolerant crops, saline aquaculture etc. The choice depends on the feasibility of reclamation and the cost effectiveness. The bio-remediation approach, which involves plant-microbial interaction, has received increased attention worldwide for enhancing productivity of salt-affected soils. A low-cost microbial bio-formulation "CSR-BIO," a consortium of *Bacillus pumilus*, *Bacillus thuringenesis*, and *Trichoderma harzianum*, is rapidly becoming popular with the farmers in many states.

The day was observed by organizing series of activities like on farm demonstration on scientific method of collecting good soil samples for testing, free distribution of vegetable seeds and small farm implements, distribution of soil health cards and farmers-scientists interaction.

Mr. Parlad Toor, prominent local leader appreciated the efforts of the SCSI-Meghalaya Chapter team for organizing such a wonderful event and helping the farmers. The programme ended with vote of thanks proposed by the Secretary of Meghalaya Chapter, Dr. N.J. Singh.

Farmers participating in the World Soil Day celebration

Free distribution of vegetable seeds and farm implements to the farmers

Integration of space technology for advanced surveying, mapping and site suitability analysis for rainwater harvesting in rain fed agro-ecosystems of South Bihar.

Binod Kumar Vimal and Anshuman Kohli
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Rainfall is the main source of water recharge in various ponds, lakes, rivers, wells and runoff farming systems locally known as *Ahar-Pyne* in south Bihar. It is generally observed that the status of water in ponds and lakes as seen in the rainy and winter season gradually declines, in the summer season eventually leading to a dried up state. Besides, the size of most of the water bodies is shrinking and at some places are completely encroached upon in places ike Gaya, Nawada, Jamui and Banka districts of Bihar. Scientific techniques are needed for management, revival and rejuvenation of village ponds and other natural water bodies like lakes, *Ahar- Pynes* and rivers etc. These techniques are further needed for a complete evaluation of stored water resources, for planning the future requirement. This evaluation would include estimation of annual groundwater recharge from rainfall and other sources, delineation of water bodies and identification of potential sites for artificial recharge.

Watershed is defined as any surface area from which runoff resulting from rainfall is collected and drained through a common outlet. This helps to account for the sources of water storage, conserving soil and water, reduce the peaks of flood in the downstream area and sustainable production. A watershed may also be also treated as a source of water catchment for the area of interest. Accurate delineation of a catchment plays an extremely important role to assess the water storage potential. The delineated boundaries form the nucleus around which the management efforts such as river flows and their direction, pore points, nearby availability of ponds, cropping sequences etc. are analyzed and appropriate conclusions drawn. With an objective of identification and characterization of existing water bodies and tracing out the suitable sites for water recharge in existing water bodies for regular supply of the water in village ponds, remote sensing and GIS have emerged as cutting edge technologies for advanced surveying and mapping of these resources. These technologies provide ways for rapid collection of field data and prompt data processing using satellite images and geospatial softwares.

A traditional flood water harvesting catchment area of cultivated land which stores the water for a long duration of time for agricultural and domestic livestock use in various districts of South Bihar is known as *ahar-pyne* in local parlance. Similarly, Koull, Moun and Ox-bows are the water storage structures found in lower Gangetic plains. These days, during the summer season, an extreme decline of water level in *Ahar- Pynes* has been observed. This is accentuated by the shallow depth and open surface of water bodies. Remote sensing and Geographic Information System has been used to delineate the *Ahar- Pyne* structures near the villages of Rajgir hills for their assessment as a suitable site for water storage (Fig.1 & 3). Satellite images from Landsat ETM+ showed the water bodies near the foot hills on the agricultural lands. (Figure 2).

Figure 1: The traditional ahar-pyne structures existing in Jethian village of Rajgir.

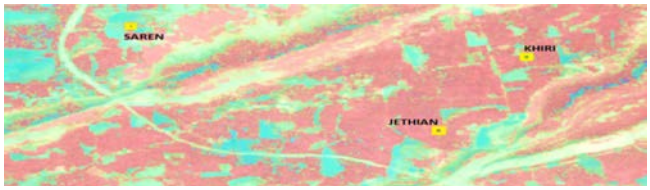

Figure 2: Satellite view of the water bodies existing in the vicinity of agricultural lands in Rajgir, Bihar

SRTM Elevation data can be used to understand the direction of slope and flow of streams. SRTM data has been used to delineate the elevation /slope gradient of study areas. In the villages around Rajgir, maximum elevation was observed in the South but low land elevation was found in North-North East. (Figure 3). These further suggest that the flow direction of the streams is North to North East, further indicating that the maximum probability of the existence of *ahar-pynes* is in the low land slopes of northern side.

Figure 4: Another field photograph of ahar-pynes

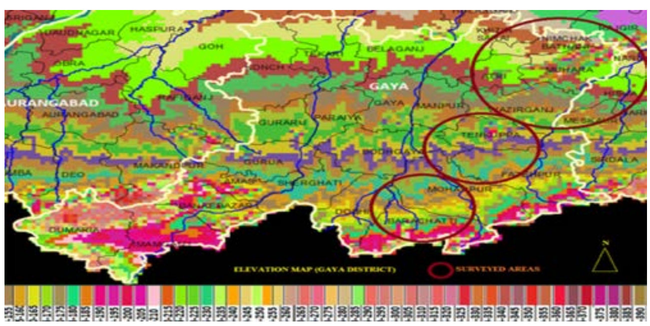

Figure 5: Demarcation of watersheds at different altitudes in Rajgir area of Bihar.

Geotextile in Managing Soil Erosion

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Geotextiles are permeable textiles used in the conjunction with soil, foundation, rock, earth or any geotechnical engineering related material. The principle applications of geotextiles include drainage, separation, filtration, slope reinforcement, vegetation management and erosion control. They are biodegradable in nature, thus maintain sustainability. It helps in controlling surface erosion and sub-surface drainage. It also helps in enhancing vegetative cover by increasing seed germination ratio and accelerating seed emergence.

The worldwide consumption of geotextile is around more than 1 billion square metres per annum out of which India consumption is minimal i.e. around 1 million square metres per annum. Although erosion control geotextiles only contribute between 9-11 percent of total geotextile use. Growth rates for such products have been estimated at around 8.5 percent per annum.

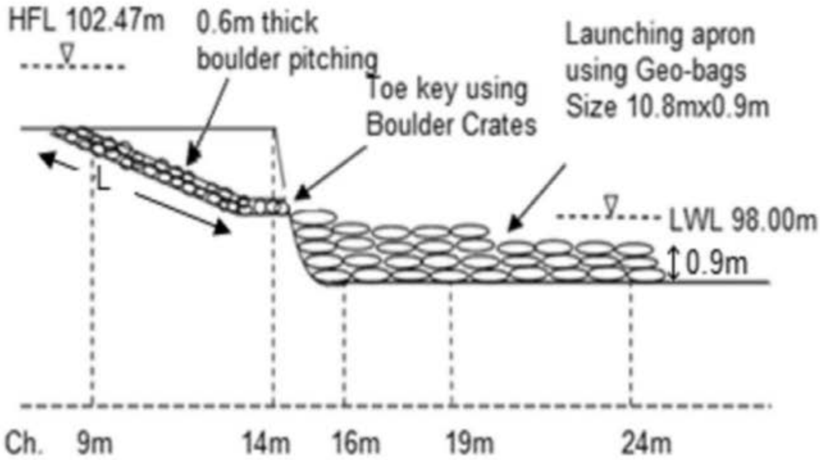
There are mainly two types of geotextiles used in agriculture, one is natural forms of geotextiles such as jute, flax, coconut (coir), cotton, hemp are used and the other one is composite or synthetic materials for geotextiles. Erosion control geotextile products can be classified into four groups: Geomats, Geocells, Biomats and Bionets. Geomats are three dimensional structures, usually comprising mats of randomly distributed filaments, or a 10-20 mm thick core of fibres or filaments, contained between two lightweight grids. Geocells are three dimensional, honeycomb structures manufactured by a single extrusion process from high-density polyethylene or by glueing together strips of non-woven geotextiles. Biomats are usually made of natural fibres, held together between two layers of lightweight mesh which can be made from synthetic or natural materials. Bionets are woven meshes formed from yarns spun from natural fibres such as jute or coir.

In India, around 42 million ha nearly 12.6 percent of land cover is prone to landslide hazard. Out of this, 0.18 million sq. km falls in North East Himalaya, including Darjeeling and Sikkim Himalaya. And the main cause for this is surface erosion in which it first loosened the soil then detached it and finally transported it to nearby places. Therefore different forms of geotextiles were used for controlling the erosion on slopes. These materials are permeable in nature to allow the flow of fluids through it or in it, and a geo membrane is designed to restrict the fluid flow. It protects soil surfaces from the tractive forces of moving water or wind and rainfall erosion. Later they degrade to form organic mulch and help in quick establishment of vegetation. And this degradation will depend on types of fibers used which will degrade at different rates e.g. coir geotextiles degrade in 2-3 years while jute degrades in 1-2 year. For example use of geogrids installed on steep slopes prevent in washing soil particles from surface. This allow the water to pass through but resist the fine soil migration. After vegetation, which provides erosion control of slope, becomes grown, the geogrid will decompose after several years. The role of geo-textiles in soil conservation will grow in the future since the probability of extreme meteorological events leading to severe soil erosion may increase.

North Eastern Region comprises of eight states, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura which occupies around 5.6 percent of total geographical area of the country, is prone to heavy rain fall. Due to high rainfall and undulating condition, the hills slopes lead to frequent landslides thereby damaging roads and causing serious erosion problems. In spite of high rainfall, this region faces serious water crisis as the rain water cannot be retained and stored. The use of this materials in water conservation will help in storing the rain water and shall address the water scarcity in the region. The use of Geotextiles in slope and hill protection shall prevent the landslides which are common in North Eastern Region. The application of geotextile on slope land increases moisture availability in the soil and enhances infiltration. Since the slopes were stabilized with the application of geotextiles, sediment deposits on the terraces due to erosion were minimized and hence cultivation is possible both on the slopes and the terraces. As the poor and marginal farmers occupy the highland region, this method provides an economically viable option for income generation and food security along with slope stabilization.

Even though heavy rainfall is prone in North East India, there is scarcity of water as it cannot be retained and the use of geotextiles in water reservoirs aids in storage of rain water for better efficiency and also assists in slope protection due to landslides. A scheme has been launched in 2014 for promoting use of Geotextiles in North East Region as this area have high seismic activity and landslides. A case study was conducted on geotextiles at Jia Bharali river bank, Assam. As a measure launching apron (constructed from geotextile bags) was installed up to lower water level and boulder pitching above lower water level. The diversion of river flow pattern was observed due to protection work and the sandbar extends almost to the width of launching apron. Due to launching apron the velocity of river flow gets reduced near bank and silt deposition starts. As the silt deposit increases main stream flow direction is deflected and siltation area widens. So this measure is able to control the erosion.

As use of geotextiles is negligible in NE India, use of coir geotextile fabrics is effective control for erosion, landslides. The coir board was popularizing Coir Bhoovastra as a soil



erosion control. In North East India the protection measures taken by coir board for soil erosion control are protecting of hill slopes Nirjuli in Arunachal Pradesh, protection of hill slopes of Gangtok in Sikkim. In agriculture, mainly three types of geotextiles materials were used jute fibre which is an effective means of imparting cohesion to re-moulded and compacted soil. Due to the inclusion of fiber, impact resistance of soil can be considerably improved, bamboo strips used for long time both as strips and mats but bamboo deteriorates quickly in wet conditions and is also prone to fungus and insect attacks and the last is coir fibers which are suitable for various applications such as, soil stabilization, erosion control, slope protection, landscaping and reinforcement. Coir fibers rot due to the ecological natural cycle. Apart from this, coir fibers are highly water absorbent. Coir has the greatest tearing strength and retains this property in wet conditions, which is cost effective.

In spite of having so many materials, geotextile are getting popular day by day in erosion and sediment control. When selecting a geotextile, a designer must take into account not only the mechanical and hydraulic properties of the geotextile at the point of manufacture, but the proven longevity of the properties in the site environment, both prior to installation and for the duration of the design. The use of geotextiles manufactured from the bi-products of other manufacturing processes must be undertaken with extreme caution as the long term performance can never be fully known.

SOIL CONSERVATION SOCIETY OF INDIA

NAVSARI AGRICULTURAL UNIVERSITY

31st National Conference

on

Innovative approaches for management of costal ecosystem and climate resilience

October13–15, 2022

Organized by

Soil Conservation Society of India (SCSI), India

In collaboration with

Navsari Agricultural University, Navsari, Gujarat, India

THEMES OF THE CONFERENCE

1. Conservation, management and reclamation of natural resources
   - o Organic and natural farming for sustainable ecosystem
   - o Soil ecology and management
   - o Bio engineering for soil and water conservation
2. Technological interventions for sustainable agriculture
   - a. Precision agriculture for sustainable natural resource utilization

b. Geospatial technologies in agriculture and watershed management

c. Nano technologies for sustainable agriculture

d. Molecular biology and biotechnological interventions for climate smart agriculture

e. Uses of modelling in sustainable agriculture

f. Information technology for sustainable agriculture

3. Socio economic impacts of climate change

a. Supply chain management under variable climatic conditions

b. Environmental quality incentive program

c. Agricultural Best Management Practices

4. Coastal ecosystem and aquaculture

5. Biodiversity and land use system (Horticulture / Agroforestry) for nutritional and environmental security

The aim of this conference is to gather professionals working in the field of Agriculture, Soil Science, Soil &Water Conservation Engineering, Forestry, Horticulture, and allied agricultural sciences.UG/PG Students, Research Scholars, Faculties and Scientists from academic institutions and R&D and Non-government organizationsto participate and present theirfindings.

CALL FOR PAPERS

The Conference will have Key-note speaker and lead paper presentations of eminent personalities in each of the thematic areas followed by selected presentations by the scientists in oral and poster sessions. Abstracts are invited on any of the above-mentioned themes. The abstracts should not exceed 500 words. A minimum of five key words should be given below the abstract in italics. The abstract and full paper should be prepared in M.S. Word, Times New Roman, 12 font size and single space leaving 1″ margin on the left and right sides. The accepted papers and mode of presentation will be intimated to the authors based on the decision of the review committee. The abstracts / full papers by email (ncscsi2022@gmail.com) should reach to the convener / organizingsecretary on or before the deadline given below. Registration form and further details are available at the website www.nau.in

IMPORTANT DATES

Last date for receipt of abstract: August 20, 2022

Intimation of acceptance of abstract: August 31, 2022

Submission of full-length paper: September 30, 2022

Last date for registration without late fee: October 05, 2022

Last Date for Accommodation Request: October 05, 2022

*Selected full length papers will be published as Book / E-Book by reputed National /International Publisher.

CONFERENCE VENUE

Conference will be held at ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India. Navsari is wellconnected by air, rail and road. The Surat Airport (STV), Surat Railway station and Navsari Railway station are respectively 40 Km, 45 Km and 2 Km from the venue.

All the correspondence related to the conference may be addressed to:

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