ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

Climate Change Pushed Indus Valley Migrants West to East: Study

The researchers from Indian Institute of Technology, Kharagpur (IITKGP), concluded this from the study of two previously unknown post-Harappan, Iron Age sites in the western part of the Great Rann of Kutch (GRK) and the lower fringes of the Thar desert.

"Our findings suggest that such human migration was far more expansive than thought before. We believe that the gradual southward shift of Intertropical Convergence Zone (ITCZ) over the last seven thousand years forced people to migrate for greener pastures," Anindya Sarkar, lead author of the study, said.

Trees, water are our lifeline; save them.....

Every year we celebrate 'World Environment Day', 'World Forest Day', 'World Water Day' to raise awareness about the importance of these natural components provided free to the mankind. But will celebrating and talking big, conserve our forests and raise the water table?

Water is the most valuable resource and every component of the ecosystem needs it to survive. But we are so unaware of the continuous loss of water due to the different water-intensive activities we enjoy. As the economist would say that we have widened the 'supply and demand' gap which is taking a toll on the quality and quantity of water.

Our attention is turning to trees..... Why?? Trees play a big role in water conservation – they absorb water and release it into the atmosphere. Reports say that one tree can store 100 gallons or more of water after 1-2 inches of rainfall, although this may vary with the type and size of tree. The intercepted water is slowly released to the soil below, quenching the water requirement of the trees and crops. The water stored in the tree roots is eventually released in the atmosphere; the average tree breathes out 250-400 or more gallons of water in one day.

Question arises – are we taking care of these survivors of life?? Answer would be a big NO. We are wasting water instead of conserving it and ruthlessly cutting trees instead of improving the tree cover.

Trees provide cool and peaceful atmosphere, so people should grow more and more trees and save water!!

Trees share water to keep this dying stump alive

In a rainforest in the Waitakere Ranges on New Zealand's North Island, there is a kauri tree stump (*Agathis australis*). Researchers were surprised to see it was alive despite missing both branches and leaves. They found that the water flow in the stump increased as water flowed from the surrounding trees, meaning the stump was taking water from the trees around it. This suggests, the scientists say, that the tree stump had formed connecting pieces, called grafts, with the roots of nearby trees to share water and other nutrients.

Kelly Mayes Science July 25, 2019

LETTERS

Thank you so much for sending the new issue of **EnviroNews**, which offers valuable and interesting information. I am especially grateful for including a comprehensive review on our new arrival, "**Nanomaterials and Plant Potential**".

Prof. Muhammad Iqbal, PhD, FNASc, Jamia Hamdard University, Department of Botany, New Delhi. (iqbalg5@yahoo.co.in)

Thank you very much for sharing the ISEB-Newsletter 'EnviroNews' for July 2019. I will surely share the suitable updates if it is at my side. Have a nice evening ahead.

Mr. Rama Kant Dubey, Institute of Environment & Sustainable Development, BHU, Varanasi, UP, India, (ramakant.dubey04@bhu.ac.in; dubeyramakant@hotmail.com)

NEWS FLASH

Prof. Rana D.P. Singh, Former Joint Director & Head, Div. of Plant Breeding, Sugarcane Research Station, Gorakhpur (U.P.) and Life Member of International Society of Environmental Botanists, has been conferred with Performance Excellent Award by GISR Foundation during International Academic & Research Excellence Awards ceremony organized on 08 June, 2019 at Hotel Park Ascent, Noida (U.P.) and Eminent Scientist Award-2019 by Dr. Ram Avatar Shiksha Samiti during Scientist Award Ceremony organized on 12 July, 2019 at Lucknow University, Lucknow (U.P.). The prestigious awards were presented to Dr. Singh for his outstanding research and remarkable role in the field of Genetics & Plant Breeding.

Dr. P.K. Trivedi, a Life member and Executive Councillor of International Society of Environmental Botanists has been awarded the prestigious Fellowship of Indian National Science Academy (INSA), New Delhi.

Dr. U.N. Rai, Ex. Senior Principal Scientist, CSIR-NBRI, fellow and life member of ISEB, Lucknow delivered an invited lecture entitled "Emerging Green Technologies for Combating Enviromental Pollution and their Usefulness in Sustainability Education" in an International Conference on Sustainability Education during 9-10 September, 2019 at India Habitat Center, New Delhi organized by UNESCO and Mobius Foundation, New Delhi.

Dr. Vivek Pandey, Senior Principal Scientist and Head, Plant Ecology & Climate Change Science Division, CSIR-NBRI and Joint Secretary, ISEB attended 33rd IUBS General Assembly & IUBS Centenary Celebration held at The Norwegian Academy of Science and Letters and at The Science Library of University of Oslo, Blindern, Oslo, Norway from 30th July 2019 to 2nd August 2019. Dr. Vivek Pandey presented a new project "Environmental Education and Climate change adaptation: Science of Pollution Tolerant and Climate Resilient Plants" for funding under the IUBS Scientific Programmes Triennium 2019-2022. In his presentation, Dr. Pandey stressed the importance of climate change education and awareness. It helps people understand and address the negative impact of climate change and air pollution. Education and awareness-raising enable informed decision-making. This proposed project aims to produce simple educational tools for worldwide environmental education at undergraduate level students/teachers that would lead to screening / selection of tolerant plants at local level for climate change adaptation and air pollution mitigation. The project proposal is under consideration for funding after some amendments.

WELCOME NEW LIFE MEMBERS

Dr. Sudhir Shukla, Senior Principal Scientist, Cytogenetics & Plant Breeding Division, CSIR-NBRI, Lucknow (s.shukla31@rediffmail.com).

Emerging Green Technologies for Combating Environmental Pollution and their Usefulness in Sustainability Education

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Green technologies are eco–friendly technologies and no risk is involved in their application, they use renewable things, conserve natural resources and the environment, thus help in sustainable development. There are no side-effects while cleaning/ ameliorating pollutants from environmental components (water, air & soil) and are environment conscious and can change radical thinking. Application of green technology provides a multiple achievements by reducing disaster vulnerability, risk and impacts, and tackling climate change by reducing GHG emissions, changing waste generation pattern and safeguarding environment, economic growth and development. Low carbon and ecologically sound developmental strategies will help relive the impacts of disaster and climate change. Emerging Green Technologies are: environmental green clean technologies (phytoremediation, rhizofiltration, constructed wetlands, bioremediation); green energy (wind, water, solar, bio-fuels, wastewater); green buildings (environment conscious for water, energy and wastes); green chemistry (safe, environment-benign substances, energy efficient process, waste disposal); green purchasing (green products, organic clothing, green chemicals, low volatile compounds) and green nanotechnology for enhancing environmental sustainability of process.

Green Clean is the direct use of living green plants for *in situ*, or in place, risks reduction by removal of pollutants from soil, sludge, sediments and ground water through contaminant removal, degradation, or containment to render them harmless. It is emerging as the new eco-ally that can cut the cost of cleanup, non – intrusive and restore much larger sites than has been possible with traditional remediation methods. Is an aesthetically-pleasing, passive, solar energy driven clean up technique. It improves contaminated site aesthetics and potential for ecosystem restoration. Sub-sets of green clean (phytoremediation) technology are; phytoextraction, rhizofiltration, phytostabilization , phytodegradation and phytovolatilization. Rhizofiltration refers to the approach of using hydroponically cultivated plant roots to remediate contaminated groundwater, surface water and wastewater through absorption, concentration, precipitation and filtering contaminants through a mass of roots to remove toxic substances or excess nutrients. Besides, engineered bed reed system (horizontal flow system and down flow system) and constructed wetlands in which role of rhizospheric microbes mediated bioremediation is important.

Phytoremediation of toxic metal contaminated industrial wastes like; tannery effluent, sludge and fly-ash etc *vis a vis* utilization of treated phytomass by composting is an important advance step to enhance the success of the technology. Bio-gas plant is the best way to digest or compost treated plants and other organic material. The fertilizer which comes from a bio-gas plant contains three times more nitrogen. Bio-compost is natural and organic fertilizer, thus better establishment and growth of plants. Biogas, a promising substitute for natural gas, is the collective term for the mixture of methane and carbon dioxide produced by the biological breakdown of organic matter in the absence of oxygen. It consists of about 60% methane, a non-toxic and effective fuel gas and 40% is mainly inert carbon dioxide with traces of hydrogen, hydrogen sulphide, etc. Biogas can replace the wood as an energy source to save standing forest cover. This shadow price of afforestation/deforestation will minimize resource depletion. In addition, biogas could potentially help reduce global warming by less emission of nitrous dioxide and methane, which warms atmosphere three hundred and ten times and twenty-one times more than carbon dioxide, respectively.

Constructed wetlands for wastewater treatment have been proven to be effective, low-cost and

sustainable alternative for conventional wastewater treatment technologies. Different types of wastewater can be treated with constructed wetlands as: domestic wastewater, storm water runoff from parking lots or farmland, wastewater from livestock operations, wastewater from mining and oil operations and landfill leachate. For the most common current use, treating domestic wastewater, the wetland is usually used in conjunction with a pretreatment process such as a standard septic tank. Different types of constructed wetlands are developed and applied at treatment sites epending upon demographic, topographic factors and the nature of waste to be treated. Surface flow constructed wetlands characterized by the horizontal flow of wastewater across the roots of the plants while subsurface flow constructed wetlands in which the flow of wastewater occurs between the roots of the plants and there is no water surfacing (kept below gravel). As a result the system is more efficient, doesn't attract mosquitoes and is less odorous and less sensitive to winter conditions. For large applications, they are often used in combination with vertical flow constructed wetlands and third vertical flow constructed wetlands, which are similar to subsurface flow constructed wetlands but the flow of water is vertical instead of horizontal and the water goes through a mixture of media, it requires less space than surface flow but is dependent on an external energy source. Intake of oxygen into the water is better (thus bacteria activity increased), and pumping is pulsed to reduce obstructions within the intakes. Basic understanding of environmental factor and their interactions is important for the design and construction of a wetland. The wetland needs to be designed according to nature of contaminant, absorption, sedimentation and chemical process, etc. In addition design principles need to address based on hydraulic load rate, residence time, plant density and inlet concentration. CSIR-NBRI has developed a horizontal flow constructed wetland at Shantikunj, Haridwar for onsite treatment of untreated drained wasters emerging from domestic sources, which may be helpful in treatment of wastewater before discharged in Ganga to conserve the river ecosystem. The results of the research on plant- based management of Ganga water pollution have immense applied value. Monitoring results of operation of wetland revealed a significant improvement in sewage water quality as reflected by a marked reduction in BOD (90%), TSS (65%), TDS (78%), NO_3–N (84%), P (76%) and NH_4–N (86%) and concomitant increase in dissolved oxygen content after 36 h retention time under established condition. Further, constructed wetland also resulted in the reduction of metal contents which was 35, 87, 49, 39, 95, 55, 85 and 92% for Cr, Mn, Co, Ni, Cu, Zn, As and Pb, respectively. Such pollution loaded plants could be harvested from the wetland from time to time and could be digested in a bio-composter for production of biogas and organic manure, thus facilitating the green economy. Sustainable development is a confluence of four constituent parts; environmental, economic, socio-political and cultural sustainability. Drivers of changes for sustainable development are technology, financial mechanisms, policy, legal enforcement and the systems in which communication and education are crucial. The goal of sustainability education is to develop a world population that is aware and concerned about the total environmental, economical and social issue its associated problems, and which has the knowledge, attitudes, skills, motivation, and commitment to work individually and collectively towards sustainable development and for prevention of global issues; climate change, greenhouse effects and biodiversity loss by facilitating use of green technologies. To protect children living in polluted regions, environmental education represents a relevant means of prevention. It is need for the hour to propose the sustainability education where teaching and learning to be designed in a participatory, learner-centered way. Need for sustainability education is to acquire the skills for identifying and solving environmental problems by using green technologies and lastly, the participation to encourage citizens to be actively involved at all levels in working toward for resolution of environmental problems for sustainable development.

Various global issues as climate change, global warming, bio-resource degradation, biodiversity loss, sustainable development must be included in their curriculum. Sustainability education goals are to produce confident and independent students, create equality, healthy social relations, priority for self-activity, thinking about other development i.e., permanent type of development and people should do their basic development and peace for human security.

Rich Biodiversity boosts ecosystem productivity - Every species, small or big, has its niche in ecology.

Sacred Forests in the Central Western Ghats as a Unique Ecosystems for Lichen Conservation

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The Western Ghats biodiversity hotspot are bestowed with complex geography, wide variations in rainfall, altitudinal decrease in temperature and large scale anthropogenic factors which have resulted in many unique ecosystems having different vegetation types. These ecosystems spread over six different federal states of India are well known for their rich diversity of flora and fauna. The part of Western Ghats passing through the state of Karnataka and encompassing the districts of Uttara Kannada, Shivamogga, Chikmagalur, Hassan, Kodagu and parts of Dakshina Kannada constitute the central Western Ghats. Abound with many protected areas (including national parks, wildlife sanctuaries, biosphere reserves), perennial rivers, hills of varying altitude, vegetation ranging from climax evergreen to deciduous forests and shola grasslands, and plantations (coffee, cardamom, coconut, cashew, arecanut). The central Western Ghats of Karnataka are home to very rare and critically endangered species viz., *Semecarpus kathalekanensis* Dasappa & Swam. (an evergreen tree only found in Kathalekan climax forest), *Syzygium travancoricum* Gamble and *Madhuca bourdillonii* (Gamble) Raizada (thought to be extinct but rediscovered in Uttara Kannada district) and Lion Tailed Macaque (the only second home in Gerusoppa Ghat of Uttara Kannada district apart from Silent Valley National Park).

However, despite the uniqueness and richness of this region in terms of species diversity, the forest ecosystems of the central Western Ghats are constantly battling against the increasing anthropogenic factors such as unsustainable natural resources exploitation, expansion of roadways and railways, illegal logging and hunting, large scale land conversion for agricultural purposes, diversion and exploitation of freshwater streams, etc. Nonetheless, there are some forest fragments scattered across the region which have been conserved and protected since many decades by the local communities for worships. Most of these forests are believed to be associated with some form of God, Goddess or Deity due to which they are called as "Sacred Groves" or "Sacred Forests". All the flora and fauna thriving in such sacred forests are believed to be under the protection of the reigning deity, and any destructive or disturbing activity in that forest is strongly considered as a taboo. The sacred groves are often islets of fragile forests mostly relating to the climax forest of the region in the otherwise disturbed landscapes in present day India. They have been documented from different parts of India with the major concentration being in the Himalayas and the Western Ghats along with some records from central and western India. These groves not only provide a marvel for nature lovers and enthusiasts, but also play a significant role in conservation of our forests, soil and water resources as well.

The presence of different tribal communities along with a vast variety of socio-cultural and religious practices has led to the development of a sustainable relationship of the human communities with the sacred forests throughout the central Western Ghats. These sacred forests can range from one hectare to several hundred hectares in size and are generally known as '*kans*' or '*devrakadus*' in this region. In the past couple of years, there has been a significant surge in sacred forest studies throughout the Western Ghats biodiversity hotspot. However, most of these studies have mainly focused on the flowering plants as compared to the cryptogams. Among the cryptogams, lichens comprise of the most diverse group of organisms demonstrating a successful symbiotic association between the photobiont (algae or cyanobacteria) and the mycobiont (fungi). They have been able to establish themselves in various habitats right from the tropics to the temperate region. With more than 19,000 species in the world, lichens dominate about 8% of the earth's land surface. India, being a biodiversity rich country, is also home to more than 2700 lichen species which are widely distributed in eight different lichen-geographic regions – Western Himalaya, Eastern Himalaya, Western Ghats, Eastern Ghats & Deccan Plateau, Andaman & Nicobar Islands, Central India, Gangetic Plain and Western Dry Region. The Western Ghats Biodiversity Hotspot is home to about 1200 lichen species among which the crustose lichens find their dominance followed by foliose and fruticose growth forms.

During our lichenonological studies in the central Western Ghats of Karnataka state, especially in the Uttara Kannada and Shivamogga districts, we have come across many small and big sacred groves having varied sets of socio-religious beliefs and practices which continue to harbour a rich diversity of lichens. Some of the noteworthy sacred forests are Hosagundakan, Kulundekan, Kurnimakkikan and Yelakundlikan in Shivamogga district, and Kathalekan,

Karikan, Heravalikan and Mattigarkan in Uttara Kannada district. Among these, Kathalekanis an erstwhile sacred forest, which is still in its pristine condition having climax evergreen forests along with a unique *Myristica* swampy ecosystem. On the other hand, Kulundekan and Kurnimakkikan were also once rich evergreen sacred forests which are now in severely degraded condition, owing mainly to large scale conversion of these forests for coffee and areca nut plantations along with other anthropogenic factors. The remaining *kans* still possess a temple with local deity where worshippers come from nearby areas to pay their respects and hence, the locals refrain from harming the biodiversity in these forests.

Together all these sacred forests harbour more than 120 species of lichens with the majority belonging to crustose growth forms followed by foliose and only a few fruticose species. The highest lichen diversity has been recorded from Hosagundakan in Shivamogga district, which is a unique forest worth mentioning. Hosagundakan is located little away from the state highway connecting Shivamogga to Sagara town comprises of an under construction temple with a small pond surrounded by majestic semi-evergreen forest intermixed with moist deciduous trees. According to available information and local folklore, Hosagunda was once an acclaimed centre of spiritual settlements with many temples built by the then rulers of this land which gradually fell into ruins after the rulers got extinct and people left this area eventually. However, the strong beliefs in the Gods of this land protected this forest as a sacred grove and today there is a rejuvenated interest and belief leading to rebuilding of desiccated temples on this land. Today this sacred forest is home to more than 60 different lichen species with a special mention of *Pyxine endochrysina* Nyl. This foliose lichen species belonging to Caliciaceae family is known only from Manipur state in India and has not been thereafter collected since 1892. The current collection from Hosagundakan comes as the only report of this species after a gap of 126 years.

The sacred forests provide an important and unique microhabitat and ecological niche not only for abundant lichen growth but also for novel lichen species. The evidence of this can be obtained from the many new lichen records that have emerged in our studies as well as many other studies too. One such example is that of the crustose lichen species *Zwackhia robusta* (Vain.) Ertz (≡*Opegrapha robusta* Vain.), which was reported as a new record for India. The species was found growing in the shady and moist habitats of Kathalekan sacred forest on the bark of IUCN Red Listed swamp tree *Gymnacranthera canarica* (Bedd. ex King) Warb. Apart from this, two lichen species, *Bacidia subannexa* (Nyl.) Zahlbr. and *Enterographa pallidella* (Nyl.) Redinger were also recorded from Kathalekan sacred forest as new records for the Western Ghats biodiversity hotspot and Karnataka state respectively.

With the constant developmental activities going on across the country, the central Western Ghats are facing challenges every day to sustain their forests and associated biodiversity. This region has been exploited many years for large scale commercial crops cultivation such as coffee, cardamom, areca nut, etc. which have emerged as major livelihood resources for the local and tribal communities. In a district like Uttara Kannada, despite these plantations, the forests are relatively less disturbed making it a suitable habitat for different flora and fauna. In contrast to this, the sacred forests in Shivamogga district are comparatively in degraded stage mainly due to large scale opening up of forest patches for various plantations. A classic example of this was observed in Kulunde and Kurnimakkikan which were once an important sacred forest providing habitat for evergreen and endemic tree species such as *Dipterocarpus indicus* Bedd. and *Vateria indica* L. However, parts of these sacred forests were opened up for plantations which slowly spread in a large area resulting in severe fragmentation of forests and reduction in native biodiversity. Despite this, about 40 different species of lichens were recorded from these sacred groves. The lichens in these sacred forests had a good representation of foliose growth forms, mainly members of the families, Parmeliaceae and Physciaceae as compared to the other sacred groves. These lichens were found colonizing on twigs, branches and trunks of trees in areas having canopy openings receiving good amount of light and wind.

Such studies further fortify the need to enhance our knowledge on the biodiversity composition of sacred forests as many of them still lie understudied. Today many sacred forests which were once the indicator of evergreen ecosystems of the Western Ghats have now merged with a mosaic of secondary forests. The lichenological explorations carried out in the central Western Ghats have revealed the presence of several endemic and novel lichen species harbouring in the sacred forests. More studies in this direction will enable us to have a better understanding of the lichen biota of these unique ecosystems as well as determine their current conditions using lichens as bioindicators. The sacred grove related culture is a celebration of biodiversity, and such forests need to be identified and conserved urgently for the sake of ecology and for upholding the spirit of conservation.

Efforts through such studies are also being made to bring out the potentially sacred forests having rich and unique biodiversity for declaring them as 'Heritage sites' using the provisions of Biodiversity Act 2002. Apart from that, through our studies, we have always tried to rope in different stakeholders such as forest department officials, students at various levels in different colleges and schools, local communities, etc. towards awareness creation and conservation of lichens in this region. Any such steps towards protection of the remnants of the primaeval evergreen forests of especially South Indian Western Ghats are likely also to ensure better conservation of lichens exclusive to such forests, many of which are yet to be inventoried.

Study on the Relation among Agriculture and Forests

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Agriculture is the main source of livelihood for a majority of the region's rural population. In the last 10 years, the per capita land availability in the region has reduced by 18.4 per cent and now remains a meagre 0.16 ha. The reduction is attributed to the rapid increase in population and consequent fragmentation of the land. Similarly, per capita cereal availability has also reduced by 9.4 per cent in the last 10 years. The present per capita cereal availability is only 0.16 kg, thus making it very important to ensure food security in the region at any cost. Agricultural productivity in the region is not adequate to produce sufficiently for the increasing population. The average agricultural yield at present is 2.1 tonnes/ha (excluding Maldives) after an increase of 8.1 per cent in the last 10 years. The increase is attributed to increased use of fertilisers (69 kg/ha, which is a 40 per cent increase in the last 10 years in the region, excluding Maldives) and inclusion of more area from forests into the agriculture sector. This situation has, in its turn, taken its toll by depleting and threatening the remaining biodiversity of the region.

Forests play a vital role in the economy of developing countries. A large segment of South Asia's population depends on forests for its housing, fuelwood and fodder needs. The demand for forest products and services is increasing with the growth in population and economy, even as the forest cover in the region deteriorates. A disproportionate withdrawal of forest produce as compared to a forest's carrying capacity leads to this deterioration. Between 1990 and 1995, five countries in the region have experienced a reduction in their forest cover; the exception has been India where forest cover has increased by 36,000 ha. This increase can be attributed to an increase in commercial plantation and wasteland reclamation activities.

Plantations: In order to cater to the increasing demand for fuelwood, fodder and timber, the area under commercial plantations has increased in five countries of the region (Bangladesh, Bhutan, India, Nepal and Pakistan) between 1990 and 1995. Forestry has been accepted as a farming practice, but has not spread in the region at the desired pace because the rotation cycle of forestry plantations takes time to give returns. It, therefore, has become limited to the bigger farmers. slow-growing indigenous tree species have not been preferred in the commercial plantations, resulting in the introduction of fast-growing exotic tree species, which in turn has changed the composition of the local vegetation to some extent. Plantation forestry has resulted in large-scale monocultures of teak, sal, eucalyptus, Mexican pine, etc. The yield and income data collected from different countries have influenced the developing countries to adopt these species. This has been complemented by the indiscriminate plantation of eucalyptus, even on very dry sites where other species can perform better.

Shifting cultivation: Commonly practised by the hill tribes of India, Nepal, Pakistan and Sri Lanka, shifting cultivation is considered to be a major cause of deforestation. It is difficult to estimate the exact extent of shifting cultivation in the region due to the dispersed and unorganised nature of the activity, however it is estimated that it is practised over an area of 63.57 million hectares by about 22.7 million people in Bangladesh, India and Sri Lanka (State of Environment in Asia and Pacific, 1990). In India alone, shifting cultivation is reported to be practised on 4.37 million hectares, and in Bangladesh about 8,00,000 people depend on shifting cultivation in the northern and eastern hills, where land degradation rates are quite high (SAARC, 1992). According to the Forest Survey of India, an important cause of habitat destruction in the eastern Himalayan states of Sikkim and Arunachal Pradesh is slash-and-burn/shifting cultivation practised in nearly 70 per cent of the land area, which has resulted in the loss of nearly 57 per cent of forests in the area. However, it is not the practice itself

that is faulty; the growing population pressure has led to a shortening of the fallow cycle, thus not allowing sufficient time for forest resources to regenerate, which has resulted in this practice becoming unsustainable.

Livestock grazing: Forest grazing is also a major factor in the deforestation process. In the region's drier parts, forest grazing is traditional and endemic to agricultural lifestyles. This problem is acute in large parts of India, which suffers from a lack of adequate grazing lands and a mammoth livestock population. Forests, therefore, are the only places where livestock can find any vegetation. Occupying a little over 2.4 per cent of the global land area and 16 per cent of the human population, India accounts for nearly 20 per cent of the world's livestock population. The nation's 12 million hectares of permanent pastures are grossly inadequate for the needs of its 1,896 million heads of cattle. This large livestock population has put tremendous pressure on land, particularly the grasslands. Not only are rangelands damaged by grazing practices, but forests also suffer livestock pressure as branches are cut for fodder or entire stands are levelled to make way for pastures. In Nepal, lopping is a prevalent practice, with nearly 40 per cent of the buffalo feed and 25 per cent of cattle feed is made of logs and leaves, thus putting tremendous pressure on the forests. Besides overgrazing by livestock, conversion to croplands is also a major threat to natural grassland ecosystems and results in decreasing vegetation and exposes the soil to water and wind erosion. In addition, livestock trampling compacts the soil, reducing its capacity to retain moisture. This is estimated to affect 280 million hectares in the region (33 per cent of the total degraded land).

Propagation of monocultures: Being a primarily agrarian region, agriculture practised over several thousands of years has led to the building up of a complex gene pool of thousands of crop plants adapted to local conditions. The traditional practice of planting several different varieties of crops in different seasons in an area, was intended to minimise risks from crop failure. However, the past years have witnessed the introduction of monocultures of fast and high-yield crop varieties and livestock to increase productivity. Introduction of monocultures has resulted in genetic erosion of domesticated species of plants, animals and fishes. Thousands of varieties of rice, millets, oilseeds, vegetables and legumes have been lost and several breeds of domesticated animals and birds are threatened. It is estimated that for the past 50 years, Indian farmers were growing nearly 30,000 varieties of rice. However, Maheshwari (1986) predicts that this is expected to reduce to 50 varieties and according to an estimate by Ryan (1992), India is expected to produce 75 per cent of its rice from just 10 varieties. This is expected to drastically reduce the genetic diversity of staple food crops, posing serious consequences not only for the future plant breeding programmes, but also for meeting the food requirements of the burgeoning population.

Fuelwood and fodder extraction: In India, nearly 90 per cent of cooking fuel is biomass based (fuelwood, cowdung and crop waste). The average annual requirement of cooking fuel in the country is 130 million tonnes, and more than 80 percent of the fuelwood is collected from the countryside. Increased fuelwood needs have been resulting inincreased deforestation to the extent that some sacred groves, which were left untouched for several years, have been damaged or cut down (Gadgil & Vartak 1975, 1976). In Nepal, nearly 90 per cent of all the energy consumed is still in the form of traditional fuel (WRI, UNEP, UNDP, WB, 1995). Biomass fuel comprises 73 per cent of the total energy consumed in Bangladesh.

These subsistence threats have, over the years, led to deforestation and loss of prime habitats of biodiversity. Loss of tree cover has led to erosion, landslides, silting of rivers and dams and floods downstream, resulting in economic losses. This has put to threat the existence of several species. Introduction of fast-growing monocultures has resulted in genetic erosion and loss of germplasm for evolution.

Tourism: Increased tourism continues to be a source of pressure on coastal resources. In fact, coastal tourism is recognised as the most rapidly growing sector of tourism world-wide. Sri Lanka's coastal resources are expected to come under increasing threat from this economic sector. It poses a serious threat of environmental degradation, particularly through construction of hotels, beach clubs and marinas which involves infilling and dredging. Pressure from tourism has led to degradation of forests, changes in density and composition of species, and a loss of rare plants. In Sikkim (north-east India), a biodivesity hotspot, unplanned domestic tourism is adversely affecting the biodiversity of the region. Tourists invade ecologically fragile areas such as alpine grasslands, trample and uproot plants, leaving a trail of destruction behind them. Hotels and lodges in the state consume about 40 kg/day of oak, mahua and rhododendron bushes for firewood. In several areas in Sikkim, felling of fir trees for construction of hotels and lodges has resulted in accelerated erosion. The growth of trek tourism has resulted in the use of animals like yak, which consume nearly 30 kg of fodder - which puts further strain on the forests.

Group of biologists tries to bury the idea that plants are conscious

The gardening gloves are off. Frustrated by more than a decade of research which claims to reveal intentions, feelings and even consciousness in plants, more traditionally minded botanists have finally snapped. Plants, they protest, are emphatically not conscious. The latest salvo in the plant consciousness wars has been fired by US, British and German biologists who argue that practitioners of "plant neurobiology" have become carried away with the admittedly impressive abilities of plants to sense and react to their environments. While plants may curl their leaves in response to touch, grow faster when competitors are near and spring traps when prey wanders into them, the vexed biologists argue that is no reason to believe they choose their actions, learn along the way or occasionally get hurt in the process, as some plant neurobiologists assert.

Bothered by claims that plants have "brain-like command centres" in their root tips, and possess the equivalent of animal nervous systems, the critics counter there is no proof of sentient vegetation or structures within plants that would grant them what the neuroscientist Antonio Damasio has called "the feeling of what happens". Writing in the journal Trends in Plant Science, where plant neurobiology made its debut in 2006, Lincoln Taiz, a botanist at the University of California, Santa Cruz, and seven like-minded researchers state: "There is no evidence that plants require, and thus have evolved, energy-expensive mental faculties, such as consciousness, feelings, and intentionality, to survive or to reproduce." Taiz told the Guardian: "Our criticism of the plant neurobiologists is they have failed to consider the importance of brain organisation, complexity and specialisation for the phenomenon of consciousness."

The broadside drew a robust response from the University of Sydney's Monica Gagliano, who conducts research on the cognitive abilities of plants, including perception, learning, memory and consciousness. She said the criticisms failed to take account of all the evidence and focused only on work that supported the authors' viewpoint. "For me, the process of generating knowledge through rigorous science is about understanding the evidence base behind a claim," she said. "Where is their experimental data? Or are we expected to just accept their claim at face value?" Taiz draws on work by the US researchers Todd Feinberg and Jon Mallatt, who explore the origins of consciousness by comparing simple and more complex brains in animals. They conclude that while animals ranging from insects and crabs to cats and monkeys have sufficient brains to be conscious, other organisms fail the test. Those organisms include plants, Taiz argues.

The debate is shaping up to be the biggest botanical bunfight since the Romantic era when plant biologists argued for more than a century about sex in plants. As the purists argued nothing so obscene would be happening in flower beds, extremists on the sex side envisioned plants not only having sex but being full of lust and passion. Taiz believes the rise of plant neurobiology is driven by the environmental crisis that poses an ever-increasing threat to life on Earth. "They want to raise people's consciousness about plants as living organisms and reach them on an emotional level. I'm very sympathetic to the motivations, but it is clouding their objectivity. They have to be prepared for the fact that plants may not have consciousness," he said. "It's bad science. It takes the whole scientific enterprise and reduces its credibility." But Gagliano is having none of it. "If we think we already know how things are and fail to continuously question our own assumptions, but construct our claims on a system of beliefs we are dearly attached to, then we are in deep trouble and miss the opportunity for true scientific discovery to occur. "Miserably, this opinion piece seems yet another missed opportunity, one that makes strikingly no headway towards a better scientific understanding of what consciousness is." Where the debate leaves Prince Charles, who not only talks to his geraniums but positively instructs them, is unclear. "Far be it from me to criticise Prince Charles, or anyone else for that matter, for talking to their plants," Taiz said. "I would indeed be concerned, however, if they ever talked back."

Ian Sample
(Source–The Gurdian, Jul 3, 2019)

Could climate change make Siberia more habitable?

Large parts of Asian Russia could become habitable by the late 21st century due to climate change, new research has found. Scientists used current and predicted climate scenarios to examine the climate comfort of Asian Russia and work out the potential for human settlement throughout the 21st century. A study team from the Krasnoyarsk Federal Research Center, Russia, and the National Institute of Aerospace, USA, used current and predicted climate scenarios to examine the climate comfort of Asian Russia and work out the potential for human settlement throughout the 21st century. They published their results in *Environmental Research Letters*. At 13 million square kilometers Asian Russia -- east of the Urals towards the Pacific -- accounts for 77 per cent of Russia's land area. Its population, however, accounts for just 27 per cent of the country's people and is concentrated along the forest-steppe in the south, with its comfortable climate and fertile soil. "Previous human migrations have been associated with climate change. As

civilizations developed technology that enabled them to adapt, humans became less reliant on the environment, particularly in terms of climate," said the study's lead author Dr Elena Parfenova, from the Krasnoyarsk Federal Research Center.

"We wanted to learn if future changes in climate may lead to the less-hospitable parts of Asian Russia becoming more habitable for humans." For their analysis, the team used a combination of 20 general circulation models (Coupled Model Intercomparison Project Phase 5) and two CO_2 Representative Concentration Pathway scenarios -- RCP 2.6 representing mild climate change and RCP 8.5 representing more extreme changes. They applied the collective means of January and July temperatures and annual precipitation of the two scenarios to Asian Russia to find their respective effects on three climate indices that are important for human livelihood and well-being: Ecological Landscape Potential (ELP), winter severity, and permafrost coverage. Dr Parfenova said: "We found increases in temperature of 3.4°C (RCP 2.6) to 9.1°C (RCP 8.5) in mid-winter; increases of 1.9°C (RCP 2.6) to 5.7°C (RCP 8.5) in mid-summer; and increases in precipitation of 60 mm (RCP 2.6) to 140 mm (RCP 8.5). "Our simulations showed that under RCP8.5, by the 2080s Asian Russia would have a milder climate, with less permafrost coverage, decreasing from the contemporary 65 per cent to 40 per cent of the area by the 2080s."

The researchers also found that even under the RCP 2.6 scenario, the ELP for human sustainability would improve in more than 15 per cent of the area, which could allow for a five-fold increase in the in the capacity of the territory to sustain and become attractive to human populations. Dr Parfenova concluded: "Asian Russia is currently extremely cold. In a future warmer climate, food security in terms of crop distribution and production capability is likely to become more favorable for people to support settlements. "However, suitable land development depends on the authorities' social, political and economic policies. Lands with developed infrastructure and high agricultural potential would obviously be populated first. "Vast tracts of Siberia and the Far East have poorly developed infrastructure. The speed these developments happen depends on investments in infrastructure and agriculture, which in turn depends on the decisions that should be made soon."

Simon Davies
(Source-ScienceDaily, Jun 6, 2019)

Biodegradable plastics: testing can help inform most appropriate end-of-life options, but also reveals environmental concerns

Scientists have tested the behaviour of biodegradable plastics in managed composting and anaerobic conditions, as well as under simulated environmental conditions, such as in seawater or soil. This study found that blending different types of biodegradable plastics may open up new opportunities in relation to their end-of-life treatment —notably the potential to make one of the world's best-selling biodegradable plastics, polyactic acid (PLA), home-compostable by blending it with another polymer (polycaprolactone —PCL). However, the researchers were also concerned that most materials tested could still cause plastic pollution as they failed to biodegrade sufficiently —and, in some cases, not at all, in particular, in soil and the marine environment.

Biodegradable plastics are often promoted as an environmentally friendly alternative to conventional plastics. However, most of the time it is not clear how efficiently they degrade —either under managed conditions, such as composting facilities —or in the natural environment. This lack of clarity is compounded by the fact that biodegradable plastics are often blended, to create a stronger or more flexible material. This study found all mixtures of plastics tested reached the biodegradation standard under industrial composting conditions. The results of this EU-financed study suggest that biodegradable plastics can generate biogas as they biodegrade which, in the context of an anaerobic digestion plant, can serve to produce electricity. However, their post-consumer management needs careful consideration, as does the design of products made from these materials. The researchers investigated the fate of six different types of biodegradable plastics used, for example, in packaging and medical applications: polylactic acid (PLA), polyhydroxybutyrate (PHB), polyhydroxyoctanoate (PHO), poly(butylene succinate) (PBS),thermoplastic starch (TPS) and polycaprolactone (PCL). They also tested nine different blends of these materials, which were mixed in different ratios to achieve certain characteristics such as flexibility or increased strength. Samples of these materials were studied in the lab under various simulated conditions. Three of the lab conditions mimicked managed end-of-life options: industrial composting, home composting and anaerobic (airless) digestion. Another four simulated environmental conditions: soil, seawater, freshwater and anaerobic sludge.

The scientists explored whether the materials met international standards for biodegradation set by the ISO and ASTM, under these lab conditions. For instance, plastics must biodegrade within one year at a temperature of 28°C to meet the home composting standards of the International Organization for Standardization (ISO) 14855. TPS and PHB were the only bioplastics to degrade according to the standards across all seven of the tested environments. The least degradable materials were PBS and PHO, which only biodegraded in the industrial composting environment. These results are of concern, as they suggest that, if improperly managed at

end-of-life, biodegradable plastics still contribute to plastic pollution. They are likely to degrade even more slowly in the real world, where temperatures are cooler, than for test conditions (e.g. 25 °C for soil tests and 30 °C for marine tests). More generally, the researchers recognize that the temperatures used in international tests applied in this study are higher than temperatures in the unmanaged environments that tests mimic —an aspect to be carefully considered when shaping plastic waste policies and plastic product design. However, there were also positive results. Surprisingly, PLA met the ISO criteria for home composting when it was blended with PCL at a 80/20 ratio. After 259 days at a temperature of 28°C, the PLA-PCL blend was shown to be as degradable as cellulose (plant fibre), which the study used as a comparison. On its own, PLA is not home-compostable as it needs temperatures of over 50°C to biodegrade. It is important to note that, while the clear majority of biodegradable plastics appear to degrade under anaerobic digestion conditions, their degradation time is three to six times longer than the retention time in industrial anaerobic digestion plants.

Furthermore, when bioplastics break down under anaerobic conditions, as found in landfill, they release CO2 and methane and contribute to climate change, suggesting it is imperative that biodegradable plastic are managed and directed to the appropriate organic stream in collection, the researchers note. They argue, however, that under controlled anaerobic conditions, the emissions could be harnessed as a form of renewable energy. Methane can be used as biogas, which can be used to produce electricity. Plastics in this study could potentially produce 265–600 litres (L)of methane per kilogram(kg) of bioplastics, compared with 200–529 L/kg for food waste. The researchers comment that biodegradable plastics should not be perceived as an undesirable contaminant in waste streams. It is more important for waste management to adapt to evolving compositions of waste, they suggest. A better understanding of the behaviour of biodegradable plastics and their blends could also help inform product design; for example, plastic that biodegrades well in seawater could be prioritised for marine products, which have a higher chance of being unintentionally released into the sea. In this study, only PHB and TPS biodegraded in seawater, under laboratory conditions with a temperature of 30 °C ± 1.

(Source- Science for Environmental Policy, May 30 2019)

Adding 1 billion hectares of forest could help check global warming

Global temperatures could rise 1.5° C above industrial levels by as early as 2030 if current trends continue, but trees could help stem this climate crisis. A new analysis finds that adding nearly 1 billion additional hectares of forest could remove two-thirds of the roughly 300 gigatons of carbon humans have added to the atmosphere since the 1800s.

"Forests represent one of our biggest natural allies against climate change," says Laura Duncanson, a carbon storage researcher at the University of Maryland in College Park and NASA who was not involved in the research. Still, she cautions, "this is an admittedly simplified analysis of the carbon restored forests might capture, and we shouldn't take it as gospel."

The latest report from the United Nations's Intergovernmental Panel on Climate Change recommended adding 1 billion hectares of forests to help limit global warming to 1.5° C by 2050. Ecologists Jean-Francois Bastin and Tom Crowther of the Swiss Federal Institute of Technology in Zurich and their co-authors wanted to figure out whether today's Earth could support that many extra trees, and where they might all go. They analyzed nearly 80,000 satellite photographs for current forest coverage. The team then categorized the planet according to 10 soil and climate characteristics. This identified areas that were more or less suitable for different types of forest. After subtracting existing forests and areas dominated by agriculture or cities, they calculated how much of the planet could sprout trees. Earth could naturally support 0.9 billion hectares of additional forest—an area the size of the United States—without impinging on existing urban or agricultural lands, the researchers report today in *Science*. Those added trees could sequester 205 gigatons of carbon in the coming decades, roughly five times the amount emitted globally in 2018.

"This work captures the magnitude of what forests can do for us," says ecologist Greg Asner of Arizona State University in Tempe, who was not involved in the research. "They need to play a role if humanity is going to achieve our climate mitigation goals." Adding forests wouldn't just sequester carbon. Forests provide a host of added benefits including enhanced biodiversity, improved water quality, and reduced erosion. Estimates of how much forest restoration on this scale would cost vary, but based on prices of about $0.30 a tree, Crowther says it could be roughly $300 billion. Exactly how much carbon future forests could store may not be crystal clear, but Duncanson says NASA has new instruments in space—like the Global Ecosystem Dynamics Investigation (GEDI) aboard the International Space Station—that will use lasers to create high-resolution 3D maps of Earth's forests from canopy to floor. These data will add much-needed precision to existing estimates of aboveground carbon storage. "With GEDI we can take this paper as a stepping stone and inform it with much more accurate carbon estimates," Duncanson says. "There have always been large uncertainties on large-scale carbon totals, but we have richer data coming soon."

Alex Fox
(Source – Science, Jul 4, 2019)

CONFERENCES

7th International Conference on Pollution Control & Sustainable Environment 2020
02-03 March, 2020; Rome, Italy
E-mail: pollutioncontrol@experts conferences.org
Website: https://pollution.environmental conferences.org/

WSED - World Sustainable Energy Days 2020
0 4 - 06 March, 2020; Wels, Austria
Email: office@esv.or.at
Website: http://www.wsed.at

2nd International Conference on Water Resources in Arid Areas 2020
16 - 19 March, 2020; Muscat, Oman
Email: mingjie@squ.edu.om
Website: http://conferences.squ.edu.om/icwriaar/

11th International Conference on Sustainable Development and Planning2020
6 - 8 May 2020; A Coruña, Spain
Contact: Stephanie Everest
Wessex Institute, Ashurst Lodge,
Ashurst, Southampton, SO40 7AA
E-mail: severest@wessex.ac.uk

2nd International Conference on Urban Agriculture and City Sustainability 2020
12 - 14 May 2020; Valencia, Spain
Contact: Irene Moreno Millan
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Ashurst, Southampton, SO40 7AA
E-mail: imoreno@wessex.ac.uk
Website: https://www.wessex.ac.uk/conferences/2020/urban-agriculture-2020

15th International Conference on Monitoring, Modelling and Management of Water Pollution2020
13 - 15 May 2020; Valencia, Spain
Contact: Irene Moreno Millan
Wessex Institute, Ashurst Lodge,
Ashurst, Southampton, SO40 7AA
E-mail: imoreno@wessex.ac.uk

World Environmental & Water Resources Congress 2020
17 - 21 May, 2020; Henderson, NV, United States
Website: https://www.asce.org/templates/conferences-events-event-detail.aspx?id=2825

28th International Conference on Modeling, Monitoring and Management of Air Pollution2020
8 – 10 June 2020; Seville, Spain
Contact: Irene Moreno Millan
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E-mail: imoreno@wessex.ac.uk
https://www.wessex.ac.uk/conferences/2020/air-pollution-2020

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Springer 2019
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