

Green technologies for sustainable ecosystem*

At a time when the world is grappling with serious issues such as environmental degradation and depleting natural resources, there is an urgent need to innovate and adopt new green technologies. To address these burning issues, St Joseph's College, Bengaluru conducted an international seminar with an aim to provide an interdisciplinary forum on global sustainable development and allow stakeholders to share their experiences and research findings in the areas of sustainable ecosystems and green technologies.

There were seven themes which were deliberated and delegates from 10 countries presented papers. In Theme 1, 'Biofuels and alternate sources of energy', Y. B. Ramakrishna (Working Group for Biofuels, Government of India) in his inaugural address stressed the need for self-sufficiency in biofuels in India, and gave a detailed plan on how to achieve the same without affecting the area under agricultural production by utilizing 460 lakh wastelands, where agriculture is not possible. The guest of honour Hoysall N. Chanakya (IISc, Bengaluru) spoke about the availability of sustainable technologies in areas like solar energy, biowaste conversion at home and community level, and the need for popularizing these technologies by NGOs and the environment ministry. In the field of solar energy, development of quasi-solid state dye-sensitized solar cells using electroconductive fabrics improves the stability of the system and prevents solvent leakages and evaporation losses. However, caustic chemicals such as sodium hydroxide and hydrofluoric acid used for manufacturing solar cells need to be disposed carefully. Electromechanical systems which produce electricity can be incorporated in apartments, whereby human energy can be harvested. Children and adults are involved in peddling and handle movements, which not only produces electricity, but also provides health benefits.

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Young researchers proposed their ideas and research work on sustainable utilization of agro wastes by solid substrate fermentation (SSF) using soil microbes for the production of bioactive metabolites like enzymes, natural antioxidants, vitamins and pigments. Paddy straw, one of the main agro wastes can be employed for large-scale production of industrially important amylase enzyme. Living electrodes – the harmful algal blooms can be heated at 700–1000°C in argon gas in order to convert them to hard carbon that can be used in high-capacity low-cost electrodes for sodium-ion batteries as an alternative for lithium-ion batteries. Biofuel-enhanced biomass and lipid accumulation in local microalgae like *Chlorella* for production of biofuels using low-cost substrates like cow waste and goat waste were acknowledged.

Under theme 2, 'lifestyle changes and food habits', Anthony Joseph gave a different version of sustainability by rejecting the present model of lifestyle and calling upon everyone to lead a frugal life with minimum needs. He advised the youth to stop further exploitation in the name of modern living and lead simple lives making as less demands as possible on the planet. Use of biodegradable wrappers to enhance the shelf-life of foods using polyhydroxybutyrate films from tulsi leaves which contain natural food preservatives was discussed. Development of zero-energy food storage device (Kokuna) using nylon 6, aluminium foil and cerium oxide nanoparticles, which can enhance the shelf-life of food by preserving it at 22°C, was discussed. Health and quality of life using functional food for diabetics like millet-based ready-to-prepare mixes using white finger millet, flax seeds, ragi, bajra and soya bean, which not only have high nutrient value, but also lower the blood glucose and cholesterol levels, was discussed. Suitable method for extraction of lovastatin from wild mushroom which is a potent inhibitor of biosynthesis of cholesterol was presented. Use of underutilized foods like green leafy tops of beetroot, carrot and radish for nutritional enhancement of pasta, and dehydration of tamarind greens, amla and onions

using solar driers and their use as food additives were discussed.

Under theme 3, eco-friendly design and building materials used were discussed in detail. Eco-friendly design methodology can reduce energy consumption by minimizing energy inputs for heating, cooling and light by incorporating energy-efficient appliances. Eco-friendly construction not only helps create a better outdoor environment, but also helps build a healthier indoor environment. Green buildings eliminate these problems through good ventilation design, breathable walls, and the use of natural, non-toxic products and materials. The research on eco-friendly materials and methods was discussed at length. Manufacture of red bricks using agro materials like sugarcane bagasse and rice husk reduces the heavy dependence on clay present in the topsoil.

Theme 4 was on climate smart agriculture and vertical farming. C. Aswath (ICAR-IIHR, Bengaluru) in his presentation deliberated in detail about multi-storeyed vertical farms established in Japan, Singapore, Taiwan, China, Korea and USA. Some vertical farms have been constructed by adding onto existing buildings, while few are green-field edifices. However, this practice is yet to gain momentum in India. Perhaps the time is ripe for the country to gear up and introduce this space-saving practice, especially in the urban and periurban clusters in order to meet the nutritional needs of a burgeoning population. Most of the delegates considered that vertical farm systems can be structured to control, if not eliminate, carbon emissions using organic inputs and biopesticides. In vertical farming, even the recycled water of the urban waste can be utilized effectively. Climate changes affect food security by altering food availability, food accessibility, food utilization and food system stability. Studies on the influence of climatic factors on plant-herbivore interaction that enables greater insight into how plants and insects interact in the future, with implications for sustainable pest control and future crop security were discussed.

A method to automate farms allows farmers to apply the right amount of

water at the right time, by analysing soil moisture and measuring soil salinity. This system of monitoring and controlling irrigation not only increases plant yield, but also helps decrease water and power consumption, thus preventing global warming.

Detailed deliberations was made under theme 5 on 'Waste management'. Novel techniques for waste management system like segregation, collection, treatment and disposal of waste, recovery, reuse and recycling of waste, advanced thermal treatment (ATT) and incineration with energy recovery that reduces global warming were discussed. Utilization of planted gravel system for phytoremediation of sewage in villages and townships which produce sewage on a small scale, is a sustainable option to use potable water. To improve legislative measures for sustainable development of wetlands integrated novel and clean methods for recycle and reuse of garden waste, plant debris, plastic waste, electric waste and glass wastes were discussed.

Under theme 6, sustainable urban management was discussed at length. Implementation of sustainable streetscape design for water management and flood control in cities like Chennai was discussed. Green urbanization is an attempt to shape more sustainable places, communities and lifestyles to consume less of the world's resources. Several features of green urbanism like renewable energy source, carbon neutrality, distribution, eco-efficiency, biophilic source, and sustainable transport were discussed. Green urbanization is the need of the hour, and there was a discussion on converting metro cities into green cities. Green solutions for improving in-

door air quality by growing plants which absorbs benzene from air-conditioners and volatile organic compounds that are hazardous to health were also discussed.

Theme 7 dealt with reduction and elimination of pollutants and toxins. In his keynote address, Hong Ming Wong (Hong Kong University) explained the presence of mercury, lead and cadmium in fish, which is a major part of his country's diet, due to industrial contamination. He discussed in detail the removal of pollutants at source contamination and eliminating them before contaminated water reaches the sea. Strategic approaches for the conservation and management of lakes in Bengaluru, and the need for watershed management in a participatory approach by institutes, organizations and individuals were the main topics discussed. Novel technologies for bioremediation of pollutants like arsenic from soil and water by microbial transformation of arsenic residues using thermophilic bacteria, yeast and fungi and also utilization of prokaryotic microbes as biosensors to detect arsenic pollutants in environment were discussed. Bio-adsorbents from agricultural waste like rice husk, spent grain, sugar cane and fruit waste reduce the concentration of heavy metals to a low level. Use of *Commelina benghalensis* as a low-cost green absorbent for removal of hexavalent chromium from aquatic environment was acknowledged. Use of agro waste like lignocellulosic waste to improve laccase production in bacteria, which is used for effluent detoxification and decolorization of textile dye; degradation of pesticides by bacteria and fungi isolated from coffee plantation soil; use of

Aeromonas punctata in the degradation of reactive black 5 dye; cypermethrin degradation by *Serratia nematodiphila*, were discussed. Isolation and characterization of plastic-degrading bacteria from the soil, and microbial control of toxin producing cyanobacterium in hyper-tropic lake using algicidal bacteria and cyanophages were also discussed. Bioremediation using *Pseudomonas*, a potential bacteria for treatment of diesel contamination, oil clean-up by indigenous microbes like fungi, *Brevi bacterium*, actinomycetes, bacterial remediation of hydrocarbons, antibiotics and cyanotoxins using *B. cereus* and *E. lugwiddii* were discussed.

The use of nanotechnology for photocatalytic degradation of industrial dye effluents with silver-doped zinc oxide and amine functionalized magnet nano adsorbent for platinum removal from acidic aqueous solution were discussed. Usage of biodegradable polymer produced by renewable resources against synthetic polymer in different industries like medical (surgical structures, drug delivery systems), agriculture (agriculture mulches and controlled release of agriculture chemicals), and food (edible coating, food packaging and active packaging systems) for better waste disposal was also discussed in brief.

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MEETING REPORT

Genome editing technologies*

The XV Genetics Congress Trust is a not-for-profit organization established to promote the science of genetics with emphasis on genetics education for public

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good. As a part of its activity, the Trust organized a one-day meeting on genome editing technologies. The meeting was chaired by M. S. Swaminathan and participants included Soumya Swaminathan (Department of Health Research/Indian Council of Medical Research) and T. Mohapatra (Department of Agricultural Research and Education/Indian Council of Agricultural Research), V. L. Chopra,

and about 20 leading scientists and science administrators from different government laboratories, research institutions and universities. Also present were representatives from Department of Biotechnology (DBT) and Review Committee on Genetic Manipulation (RCGM). The objectives of the meeting were: (i) to review the latest developments on genome editing technologies, including