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ECO NEWS

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Photo courtesy: M. Kumaravelu

C.P.R. ENVIRONMENTAL EDUCATION CENTRE
The C.P. Ramaswami Aiyar Foundation
1, Eldams Road, Alwarpet, Chennai 600 018, Tamilnadu, India.
Phone : 91-44-24337023 / 24346526 Fax 91-44-24320756
Email : cpreec@gmail.com
Websites : www.econewscpreec.com / www.cpreec.org / www.cpreecenvis.nic.in
A Centre of Excellence of the Ministry of Environment, Forests & Climate Change, Govt. of India.

C.P.R. ENVIRONMENTAL EDUCATION CENTRE

Established in 1989

- ✯ **1980** - The C.P. Ramaswami Aiyar Foundation starts nature education for teachers and students.
- ✯ **1989** - C.P.R. Environmental Education Centre (CPREEC) established jointly by the Ministry of Environment and Forests and the C.P. Ramaswami Aiyar Foundation as a Centre of Excellence of the Ministry of Environment and Forests. Government of India.

Our Mission

- ✯ To increase knowledge, awareness and interest among the public about the environment in all its aspects
- ✯ To develop resource materials for environmental education and awareness raising
- ✯ To conduct training programmes for a wide cross-section of people
- ✯ To take up environmental projects for demonstration and research

Our Activities

- ✯ Training and awareness raising
- ✯ Awareness to and through action
- ✯ Awareness programmes in ecologically fragile areas
- ✯ Conservation of the ecological heritage
- ✯ Research and surveys
- ✯ Generation of resource materials
- ✯ Exhibitions
- ✯ Courses, seminars and symposia

Facilities

- ✯ Environmental Laboratory
- ✯ Library
- ✯ Computer Division
- ✯ Publications Division

Geographical Spread

CPREEC's activities extend to

- ✯ Andaman & Nicobar Islands
- ✯ Andhra Pradesh
- ✯ Goa
- ✯ Karnataka
- ✯ Kerala
- ✯ Maharashtra
- ✯ Orissa
- ✯ Tamilnadu
- ✯ Puducherry

NGO Network

CPREEC has an extensive network of about 600 NGOs. All educational programmes are carried out in partnership with select NGOs, Universities, Colleges and Schools.

Publications

- ✯ Activity and information books and pamphlets for children
- ✯ Environmental training guides and kits for teachers
- ✯ Researched Publications
- ✯ Colourful and informative posters
- ✯ *ECONEWS* - A quarterly magazine
- ✯ *Indian Journal of Environmental Education*, a peer-reviewed journal

Exhibitions

CPREEC designs three new exhibitions every year and has a bank of mobile exhibitions that travel all over India.

Environmental Education

- ✯ Green Schools of India (GSI)
- ✯ Training programmes for Teachers
- ✯ Training programmes for School and College Students
- ✯ Environmental Law Education

Special Projects

- ✯ National Green Corps (NGC)
- ✯ Biomedical Waste
- ✯ Biodiversity Conservation

Research and Surveys

- ✯ Sustainable Technologies
- ✯ Surveys of Natural Resources
- ✯ Socio-Economic Surveys
- ✯ Lab to Field Technology Transfer

Contents

Artificial Food Colours and Ingredients

Dr. P. Sudhakar

Colours were added to food to make food more attractive and to create a market. Natural colours obtained from vegetables and minerals were used by the Egyptians as early as 1500 BCE for colouring candies. Few laws were there to restrict or ban the use of colours in food for centuries. In 1396 a French Act was introduced against the colouring of butter; in 1531 German Law permitted anyone using saffron as colour to be burnt; In 1574 French Law made adding colours illegal for pastries. Till the middle of the nineteenth century colours used in cosmetics, textiles, drugs and foods were of natural origin from plants, animals and minerals.

The beginning of the Industrial Revolution made way for artificial food colouring. People from different areas moved to work in the industries that were newly set up. These workers were depending on the food prepared and sold by others. Artificial food colouring and adulteration began to flourish as there was more competition among food producers and traders. Heavy metals and other inorganic chemical compounds were used. For example, to colour cheese and confectionery, Red Lead (Pb_3O_4) and vermilion (HgS) were used. Used tea leaves were recolured by adding cupric hydrogen arsenite ($CuHAsO_3$) and resold.

The first synthetic colour mauvine was accidently discovered by Sir William Henry Perkin in the year 1856 while trying to form an anti malaria drug. After this a range of colours like magenta, fuchsia, violet, blue and green followed. The new artificial dyes were cheaper and were a more stable method of colouring food, used indiscriminately without looking into the safety for life. Several countries brought their own regulations and legislations on using artificial dyes. For example, German Food Regulation released in1882 set the elimination of dangerous minerals such as arsenic, copper, chromium, lead, mercury and zinc which are frequently used as colouring agents. The Pure Food and Drug Act 1906 of the USA reduced the list of permitted colours from 700 to just 7. Colours are classified into two categories, namely certified colours that are synthetically produced and colours that are exempt from certification which includes pigments derived from natural sources.

Types of Artificial Food Ingredients

The following table lists the types of common food ingredients, why they are used, what for they are used and some examples of the names that can be found on product labels. Some of these additives are used for more than one purpose.

Types of Ingredients	What they do	Examplesof uses	Names Foundon Product Labels
Color Additives	Offset color loss due to exposure to light, air, temper--ature extremes, moisture and storage conditions; correct natural variations in color; enhance colors that occur naturally; provide color to colorless and "fun" foods	Many processed foods, (candies, snack foods, margarine, cheese, soft drinks, jams/ jellies, gelatins, pudding and pie fillings)	FD&C Blue Nos. 1 and 2, FD&C Green No. 3, FD&C Red Nos. 3 and 40, FD&C Yellow No. 5 (tartrazine) and No. 6, Orange B, Citrus Red No. 2
Flavors and Spices	Add specific flavors (natural and synthetic)	Pudding and pie fillings, gelatin dessert mixes, cake mixes, salad dressings, candies, soft drinks, ice cream, barbeque sauce	Artificial flavor and spices
Nutrients	Replace vitamins and minerals lost in processing (enrichment), add nutrients that may be lacking in the diet (fortification)	Flour, breads, cereals, rice, macaroni, margarine, salt, milk, fruit beverages, energy bars, instant breakfast drinks	Thiamine hydrochloride, riboflavin (Vitamin B_2), niacin, niacinamide, folate or folic acid, beta carotene, potassium iodide, iron or ferrous sulfate, alpha tocopherols, ascorbic acid, Vitamin D, amino acids (L-tryptophan, L-lysine, L-leucine, L-methionine)
Humectants	Retain moisture	Shredded coconut, soft candies, confectionaries	Glycerin, sorbitol
Firming Agents	Maintain crispness and firmness	Processed fruits and vegetables	Calcium chloride, calcium lactate

Types of Ingredients	What they do	Examplesof uses	Names Foundon Product Labels
Enzyme Preparations	Modify proteins, polysaccharides and fats	Cheese, dairy products, meat	Enzymes, lactase, papain, rennet, chymosin
Gases	Serve as propellant, aerate, or create carbonation	Oil cooking spray, whipped cream, carbonated beverages	Carbon dioxide, nitrous oxide

* **Source:** http://www.foodinsight.org/Food_Ingredients_Colors, retrieved on 31 May 2016

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4. http://www.fda.gov/ForIndustry/ColorAdditives/ColorCertification/ColorCertificationReports/default.htm
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Bird Sancturies of Tamilnadu

Dr. T. Sundaramoorthy

The State of Tamil Nadu is very rich in biodiversity. The richness of biodiversity is due to the occurrence of different ecoregions. The total geographical area of Tamil Nadu is 1,30,058 sq.km., out of which 22,877 sq.km., is forest area. An area of 6,708 sq.km(29.32%) of forest land has been declared as national parks, sanctuaries and conservation reserves. This includes 14 sanctuaries, 5 national parks, 15 bird sanctuaries and one conservation reserve. All these protected areas maintain a rich biodiversity. So far 5828 plants and 1059 animal species were recorded from Tamil Nadu by various agencies. Of the 1059 animal species 454 are birds. Out of 454 bird species 32 comes under red listed species and 17 species are endemic to Tamil Nadu state. The richness of birds is due to the presence of 15 bird sanctuaries in different parts of Tamil Nadu. The total area of the 15 bird sanctuaries is 17,666 ha. These 15 bird sanctuaries are located in 9 districts of Tamil Nadu. In this article the salient features of the 15 bird sanctuaries are elaborated.

Vedanthangal Birds Sanctuary

One of India's oldest sanctuaries, it was officially notified only in the year 1996,

although long-conserved by traditional customs of the resident villagers there, dating back to 1798. The water enriched by bird droppings results in increased yield. This a rather small place, with a total area of the wetland being only 30 ha, where the water body i.e., the main tank is managed by Public Works Department (PWD) of Tamil Nadu Government. An array of birds including residents ones like cormorants, coots, moore-hens, jacanas, water-hens, egrets, herons, storks, ibis and pelicans and migratory ones like ducks species such as garganerey teals, shovallers and pintails. Majority of bird diversity here is found during the winter months, between November and February. On an average, around 40000 birds would visit per season.

Pulicat Lake Bird Sanctuary

Pulicat lake, situated in the Coromandal Coast abutting the Bay of Bengal, is a natural brakish water lagoon spanning a large area of about 15367 ha. This area long-known for its water-bird diversity was officially declared as a sanctuary in 1980. Part of the sanctuary borders the Nellore district of Andhra Pradesh, along its northern boundary, while the majority of its lies in the Thiruvallur district of Tamil Nadu. Rivers Arni and the Buckingham canal passes through the sanctuary. A part of the region is closed off as it belongs to the Sriharikota island aeronautics centre. Major bird species of this region include flamingoes, pelicans, ducks, marine forms like sea gulls and terns, and many waterside birds like curlews, stilts, plovers, sand pipers, lapwings, redshank, egrets, herons, bitterns and even raptors like kites, osprey, white-bellied sea eagle etc. Winter visitors are numerous and around November to February is the best time to visit.

Karikili Bird Sanctuary

This small sanctuary is ecologically similar to Vedanthangal and thus has the same bird fauna. Situated about 86 km from Chennai in Madurantakam Taluk of Kanchipuram District. Spread over 61.21 ha, this region comprises of two rain fed tanks managed by the PWD Dept. Most of the bird species occurring in Vedanthangal, are also visitors to this sanctuary.

Karaivetti Bird Santuary

This rather compact reserve, sprawling to about 454 ha, the sanctuary is home to nearly 90 species of water birds. This sanctuary was started in 1999 and the wetland bodies are maninatned by PWD personnel. A total of 188 species of birds have been so far documented in the sanctuary. This sanctuary is located in Ariyalur district of Tamil Nadu. Noteworthy water birds species visiting the sanctuary are barheaded geese, white stork and white necked stork, Grey Pelican, Ibis, spoonbills etc. Over 15 species of ducks and twenty species of Waders have been recorded in the sanctuary. Birds arrive here in November and stay on till May, far beyond the winter season, although the maximum is in the month of January. Over 50000 birds have been recorded within the sanctuary during peak season. Important land birds of the sanctuary such as Rosy Pastor, Sand Grouse, Stone Curlew and raptors such as the Peregrine Falcon, Osprey, Marsh Harrier, Tawny Eagle, etc. could be regularly sighted here.

Udhayamarthandapuram Bird Sanctuary

Udhayamarthandapuram Bird Sanctuary was declared in 1998. This is situated in

Thiruvarur District and has a very small area of just 45 ha. The Sanctuary is home to variety of migratory water birds like Coot, Grey Heron, White Ibis, Open bill Storks, Night Heron and Purple Heron. Birds arrive to the sanctuary from September and remain till nearly March, and peaks during November-December. During these times upto 10000 birds could be seen congregating in the park.

Vaduvoor Bird Sanctuary

Located in Thiruvarur district, Vaduvoor Bird Sanctuary is rather close to Thanjavur city, located 25 kms from the sanctuary. It spans about 128 ha. Created in July 1999, the Sanctuary attracts more than 50 species of water birds like coots, cormorants, geese, moorehens, pintails, teals, ibis, spoonbills, storks, pelicans, bitterns and herons etc. The large irrigation tank there receives water from the distant Mettur dam's Stanley Reservoir. Peak winter months, around November-December is the best time to visit.

Chitrangudi Bird Sanctuary

Chitrangudi bird sanctuary with a small area of 48 ha was declared as a sanctuary in 1989. Community tank embankments abound within the sanctuary and these are maintained by PWD staff. Vast heronries with multiple species of egrets, herons, storks and bitterns abound in the sanctuary and offer vivid arenas for ornithological studies. Much of the wintering migrant birds flock to the sanctuary during October-February.

Koonthankulam-Kadangulkam Bird Sanctuary

Koonthankulam-Kadangulkam bird sanctuary situated in Tirunelveli district, is very unique in that is actively protected and managed by the Koonthakulam village community. As was the case with Vedanthangal, local people participation in active wildlife conservation makes it unique. This is the largest breeding water bird reserve in south India and attracts over a lakh birds every year. It is located 35 kms away from Tirunelveli, covering an extent of 129 ha and was declared as a protected area in 1994. Many large water birds like the Painted stork, Pelicans and even Flamingos have been nesting every year around the Koonthankulam village.

Vellode Bird Sanctuary

Vellode Bird Sanctuary situated in Erode District is a moderately-sized reserve with an area of 77 ha. With a large water body with nearly perennial water source, this sanctuary attracts several species of waders, ducks, geese, stilts, avocets and other shore-line birds. The good fish population in such permanent water bodies means a good hunting ground for the birds. Even raptors like kites, falcons, eagles and many species of owls have been recorded in the sanctuary.

Melselvanur-Keelselvanur Bird Sanctuary

Located near the town of Sayalkudi in the Ramanathapuram district, the Mela-Keela Selvanoor Bird Sanctuary is a fine spot for wetland birds. Declared in the year 1998, the sanctuary has a rather large area of nearly 593 ha, making it the largest bird sanctuary in Tamil Nadu. Special mention has to be made of the numerous migrant birds such as storks, pelicans, ibis, spoonbills, godwits, avocets, plovers, stilts and several more species of waders of both deep waters and shallow pools. Many of these bird species breed here in mass heronries

atop several artificially planted trees, mainly for this express purpose.

Kanjirankulam Bird Sanctuary

Declared in 1989, this bird sanctuary situated in Ramanathapuram district, has a total area of 104 ha is divided into 66 ha situated in Keela Kanjirankulam and 37 more ha. in Mela Kanjirankulam. As with other similar sanctuaries this area has several artificial community tanks and embankments to provide nesting and breeding ground for birds. Annually during October – February, scores of migrant and resident water birds throng to the lake. The wetland is deep but yet also houses smaller waders. The bird sanctuaries houses over 170 species of birds, including breeding populations of Painted stork, White Ibis, Black ibis, Little egret, Large egret, Grey Heron.

Vettangudi Bird Sanctuary

Situated in Sivagangai district, Vettangudi bird sanctuary, this small, 38 ha sanctuary hosts an array of wetland birds such as egrets, herons, cormorants, teals, coots, moorehens, jacanas, water hens, shellducks, shovellers and pintails. Larger local and winter migratory birds such as open-bill storks, painted storks, grey herons, night herons, white ibis are to be seen as nesting colonies frequently in this sanctuary. PWD-managed artificial tanks maintain most of the water here. Peak winter months (November-December) is the ideal time of visit.

Theerthangal Bird Sanctuary

A rather small sanctuary with just 29 ha, this sanctuary, also from the Ramanathapuram district adds further on the already long list of bird sanctuaries there. Birds such as egrets, cormorants, coots, moorehens, waterhens, herons, pelicans, storks and other birds such as kingfishers and raptors including kites are recorded in the sanctuary.

Sakkarakottai Tank Bird Sanctuary

This recently declared bird sanctuary was opened up only in 2012. Located in Ramanathapuram district, this sanctuary adorns the existing ones and adds on to the scores of the sanctuaries there. With an area of 230 ha, this one is also fairly large with a water tank. Large colonies of heronries consisting of various species of egrets, herons, ibises, spoonbills and plovers are to be seen, mainly during the winter months (November-January). As with other bird sanctuaries in the vicinity, PWD-managed water bodies are to be seen in this reserve.

Oussudu Lake Bird Sanctuary

Oussudu lake (also called as the Oustheri lake) bird sanctuary is situated in Villupuram district. Having an area 332 ha, this is the newest bird sanctuary in the state that was declared only in 2015. Due to its close proximity to Vedanthangal and Karikili sanctuaries, this one is ecologically similar to them and has more or less the same bird species as them. Water tanks maintained by PWD staff are also to be seen in this sanctuary.

Conclusion

Among the about 450 species of birds, an easy 40% of them amounting to nearly 200 species are wetland birds. More

importantly, it is these large and squat wetland birds that are persecuted and hunted by people, compared to small and tree-dwelling obscure forest birds. Large-scale awareness programmes targeting and even involving the local people, especially school children about the conservation importance of the wetland birds should be initiated and furthered in these sanctuaries.

Source: Anonymous. 2008. Wild Biodiversity of Tamil Nadu. Tamil Nadu Forest Dept. 88 pp.

Vultures

M. Kumaravelu

In sanctuaries and reserve forests, avian species like kites, vultures and owls have become vulnerable. Recent studies show that the vultures and kites are on the verge of extinction. As per the IUCN report among the nine species of vultures found in India, White backed vulture (*Gyps bengalensis*), Indian vulture (*Gyps indicus*) and Red headed vulture (*Sarcogyps calvs*) are notified as critically endangered.

In the Nilgiri Biosphere Reserve, the Mudumalai Tiger Reserve (MTR), Bandipur Tiger Reserve (BTR), Sathyamangalam Tiger Reserve (STR) and Wayanad Wildlife Sanctuary are the major habitation for vultures. Long billed vulture or Indian vulture, White backed vulture and scavenger vulture (*Neophron percnopterus*) are found in the above mentioned reserves. The most supportive vegetation for vulture has found in the reserves are tropical dry thorn forest, dry and moist deciduous forests, semi evergreen forest and bamboo and riparian forest (Champion & Seth 1968).

Vulture are commonly sighted around the carcass of large mammals where the above said forest types are intact. The nesting behaviour of vultures is also mostly upon the *Terminalia arjuna, Dalbergia lanceolaria*, etc.

Various reasons have been identified by the researchers for declining the vulture population in India. Decline of vultures began by late 1990s. It is identified that 95 percent of vulture population were affected due to external factors and got killed and these factors made the vulture species endangered. Disappearance of habitat, nesting trees, human activities with the vulture habitat, increase of feral dogs and cattle population that carry rabies are known to be the reasons impacting the vulture survival ability.

Besides, vultures feeding on the carcass of cattle that had been administered with veterinary analegesic diclofenac were found to have died often developing nephrological disorders. Realizing the harmful effect of the veterinary diclofenac, the Government of India has banned to use. However, the illegal and stealthy use of veterinary diclofenac has played havoc with the vulture population over the years.

Moreover, some virulent virus is also said to be a reason for the decline in the

vulture population and other birds. A detailed research is needed on this virus which is said to be fatal to the vulture and other birds. Andrew Cunningham of the Zoological Society of London also revealed a few other reasons for the declining vulture population, such as pesticide poisoning, industrial pollution, etc.

It is estimated that there are 500 million head of cattle in India, particularly along the villages located at the fringes of forests. Most of the dead cattle carcasses pose a threat to vultures and other scavenging birds if the dead animal had been treated previously with the veterinary diclofenac.

Cultural and Social linkage of vultures

The Hindu community worships all birds in general, as birds are believed to be the vehicles of some deities. The Parsis in India depend on vultures for disposal of dead bodies.

Ecological role: Innumerable insects are seen in the natural environment. Many have an amazing character of multiplication of their number. A Canadian entomologist has estimated that a single pair of Colorado Beetles or Potato Bugs increases in a season to sixty million. This is harmful to grasses and cereals. Similarly the Caterpillars are major destroyers that eat twice their own weight in a day. Scientists strongly believe that the birds have effective checks upon insect numbers.

Owls, hawks and other birds of prey generally have the capacity to control and check rats, mice and destructive pests that damage crops and carry the diseases fatal to man. In addition, the birds are effective in pollination and cross fertilization. Simultaneously, this helps largely in increasing the yield of cash crops like silk cotton, sugar cane, coffee, etc. On the other hand a bird contributes widely to the production of fertile seeds and healthy generation of many wild tree species. The seed passing through a bird's intestine produces seedlings with vigour that are stronger and grow well.

To understand the role of birds in the food chain and the environment, awareness should be created. To popularize the importance of bird watching among villagers on the fringes of forests, students and youth, effective programmes should be established to make them love the birds and to conserve them for their ecological role.

Further, strict laws must be enacted and enforced to protect the birds and their habitat. Vigil, watch and action should be taken on the illegal sale and use of toxic drugs like diclofenac. The tree species that feed birds and facilitate nesting are to be protected and planted in urban and rural areas to help the avian wonders to live in peace and co-exist with human kind.

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Sustainability Education

U. Thirunavukkarasu

Sustainability Education is more than environmental education; it includes both natural and built environment and encompasses social, economical and environmental spheres. It inquires in a holistic way about ways in which the quality of life is ensured for the future through practices, strategies and skills. In a broader way, it draws its basic principle from the 'Our Common Future"- widely known as Brundtland Report.

Sustainability Education brings the thought process to the fore with teaching and learning practices as a tool to achieve required change. It entails envisioning sustainable futures, reflective thinking, critical analysis of thought process and learning by experience in an inter connected way to hone the skills and behavior in establishing sustainability. Sustain--ability education establishes system thinking and in perceiving a bigger integrated social, economical and environmental picture.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

- Brundtland Commisssion

"Education for Sustainable Development (ESD) is about enabling us to constructively and creatively address present and future global challenges and create more sustainable and resilient societies"

-UNESCO

"Our vision is a world in which our work and lifestyles contribute to the wellbeing of all life on Earth. We believe that through education, human lifestyles can be achieved that support ecological integrity, economic and social justice, sustainable livelihoods and respect for life".

-The Ahmedabad Declaration 2007,
United Nations Conference on
Environmental Education

Education for Sustainable Development

Sustainability Education differs from Education for Sustainable Development by not stressing too much on the economic aspect and does not contain development paradigm as a parallel theme. Sustainability Education promotes systemic thinking and prepares young ones with necessary skills for achieving sustainability

Sustainability Education in Schools

School as a miniature society, is a potential ground to breed systemic sustainability thinking and build sustainability skills. The existing formal school curriculum can be used effectively to integrate principles and practice of sustainability. It also provides ample opportunity to brush up the principles of democratic relationships, learning

through cooperation, issue based critical analysis and skill building by hands on experience.

Sustainability Education in Schools – WIPRO Earthian

The WIPRO's sustainability outreach programme – Earthian, promotes sustainability education in the schools of India by working with them in the thematic areas of Water and Biodiversity. The participating schools are invited to form project groups of 2-5 students guided by a teacher. The project groups have to work on the thematic areas of Water or Biodiversity and submit a project report. The project submissions received from the participating schools will be evaluated by a competent jury to adjudge most creative, innovative and novel project submissions for national awards.

CPR.Environmental Education Centre, Chennai is partnering with WIPRO in organizing and promoting sustainability education in the schools of south India. Tamilnadu, Andhra Pradesh, Telangana, Odisha, Karnataka, Kerala, Pondichery, Goa and the union territory of Andaman and Nicobar Islands are reached through the sustainability education programmes.

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Sacred groves in the hot plains of Tamil Nadu

M. Amirthalingam

In the Hot Plains

It appears that the ancient deities of Tamil Nadu are the present deities worshipped in villages under different names, most found in intimate association with at least a small grove of plants. These are the sacred groves, dedicated to local deities and/or ancestral spirits. Thousands of these groves have been documented as storehouses of remarkable biodiversity, repositories of unique and rare plants and home to myriad birds, reptiles and other animal species. Sacred groves probably represent the single most important ecological tradition of ancient Indian culture.

Each grove is dedicated to the local folk deities and spirits (vanadevatai) and has a legend associated with either the deity or the grove. The commonly found deities are Aiyanar (the guardian deity), Sastha, Muniyappa, Karuppuswami, Veeran (Kaaval Teivam or p rotective deity), Andavar (a powerful wish-fulfilling deity)

and goddesses Selliyamman, Kali, Ellaikali, Ellaipidari, Sapta Kannis, Pechiyamman, Rakkachiyamman and Nagadevadhai (fertility and good health). Among these, Aiyanar is the most worshipped deity. He is worshipped every Friday and also offered special pooja on special occasions.

The sacred groves are apparently distributed around almost all the villages, and about 1270 such groves dedicated to various male and female deities have been identified. Of these, 343 are dedicated to 308 male deities and the rest to 184 female deities and 5 herostones.

For biodiversity conservation: Sacred groves protect several valuable plant and animal species that may have vanished elsewhere in the surrounding environment, often including wild crop relatives and endemic and endangered species. In 1986, Meher-Homji first reported a grove in Puthupet near Pondicherry, a lush grove spread over 20 hectares that is a relic of a forest, housing 104 plant species belonging to 44 families; it is also a refuge of rare species like a cucurbit *Stychnos lentiecellata*, the insectivorous plant *Drosera burmanii* and a rare bone-setting plant *Ormocarpum cochinchinensis*. The sacred groves in the Kanchipuram district protect rare species like *Amorphophallus sylvaticus*, *Kedrostis foetidissima* and an enormous banyan tree, while those in other parts of Tamilnadu are home to many other vanishing and uncommon species of flora and fauna. Kanyakumari district harbour many of the rare endemic plants of the Western Ghats and they are Sacred groves in the Kanyakumari district harbour rare endemic plants of the Western Ghats such as *Antiaris toxicaria*, *Diospyros malabarica*, *Diospyros ebenum*, *Feronia elephantum*, *Butea frondosa*, *Garcinia cambogia*, *Sterculia foetida*, *Gnetum ula* and *Cycas circinalis*. Sacred groves in remote areas do not usually shelter major mammalian wildlife species. However, sacred groves that form part of a continuous stretch of reserved forest, as in the hills, are home to several wild species. Apart from primates and minor mammals, sacred groves also have numerous bird, butterfly and bat species. For example, the groves are home for myriads of birds and animals by providing food and shelter for them, Peacock in Kandanur and Snakes in Anthills of sacred groves. However, there are as yet no detailed accounts or inventories of biodiversity in the sacred groves.

Taboos, rituals and beliefs: The taboos, rituals and beliefs associated with the groves, supported by mystic folklore, have been the prime motivating factors for preserving them in pristine condition. People believe that any damage to the sacred grove, harm to the fauna residing in it or felling of any tree may invite the fury of the local deity, causing diseases and failure of agricultural crops. Even taking a dry twig is forbidden in some. Therefore, many people will not even take dead wood out of sacred groves.

Folklore plays an important role in conservation of sacred groves. Not only tribal people, the rural people also preserved the sacred groves by their traditional customs, rituals, ceremonies and folk-beliefs. Several stories depict various facets of life and culture of the people. The annual festival is celebrated in all the groves of all districts accompanied by community offerings of pongal and animal sacrifice. As against the animal sacrifice, Aiyanar who lives in a temple is happy with the offering of a coconut and pongal. In all districts, offering pongal to the associated deity is either by individuals or by the community. Sacrifice of fowl, goat and sheep is offered to all the deities except Aiyanar. Pig is sacrificed to

Karuppuswami in certain groves. In certain sacred groves, people fulfill their vows by tonsuring (shaving the head to make a ceremonial offering of hair to the god) or offerings of terracotta horses of various sizes are lined up in front of the deity within the sacred grove in the hope of a good harvest. During the festival, the villagers organise a form street theatre called *terukoothu* at night.

Management of sacred groves: In the Western and Eastern Ghats, most of the groves are preserved by local communities or tribes, managed either by an individual family or trustees or community or a village head. The management decisions are taken collectively at a gathering of the entire village during the annual festivals in the sacred grove. The majority of them are maintained by the village communities under hereditary trustees.

Present threats to sacred groves: Our ancestors were well aware of the role played by sacred groves in the maintenance of the nutrient and water table. Today, the fundamental concept of sacred groves is the traditional belief systems which were mere superstitions. Very few people of the older generations may be familiar with the rituals and taboos related to sacred groves.

Recent observations show that traditional rituals are still performed in accordance with the customary beliefs in the larger groves, but in smaller groves the traditional rituals are no longer performed or followed. Due to modernization, urbanization and people's changing aspirations, the traditional values appear to be disappearing. As a result, the violation of cultural norms and taboos no longer carries heavy consequences, and the sacred groves are becoming degraded.

Human activities such as dead wood collection, biomass gathering, lopping of tender branches and green leaves for goats, creation of footpaths, cattle grazing, mining of sand and clay, brick-making and collection of wild fruits, vegetables and collection of plant parts for medicine are affecting the ecology of many of our sacred groves. In addition, invasion of exotic weeds become a serious problem in the ecology of some sacred groves; the domination of alien species such as *Eupatorium odoratum*, *Lantana camara* and *Prosopis juliflora* often threatens and depletes the local species. Conflicts among the sacred grove managers have also resulted in the loss of biodiversity in certain sacred grove.

Local people have conserved sacred groves out of religious sentiment. Humans and nature have co-existed without disturbing the environment in the past. Such traditional practices have to be strengthened with appropriate scientific inputs for conservation.

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Eco-friendly refrigerants - An efficient alternative to halogenated refrigerants

T. R. Gowthama

The Montreal protocol has highlighted the rising trend in per capita consumption of ozone depleting substances like chlorofluorocarbon (CFC) and all other hydro chlorofluorocarbon (HCFC) in the developing countries. Consequently, the developing countries were asked to trim down their usage of CFCs by 2010 and HCFCs by 2040.

The Kyoto protocol of United Nations Framework Convention on Climate Change (UNFCCC) in 1997 affirmed that hydroflourocarbon (HFC) refrigerants are among the six targeted green house gases and an important factor for global warming.

HFC contribute to ozone layer depletion and global warming ultimately resulting in adverse climatic changes being noticed recently. Hence, it is necessary to look for the alternative refrigerants not only to fulfill the international protocols (Montreal and Kyoto) but also to save our own nation from growing environmental problems.

Refrigerant is a liquefied solution that absorbs heat from the room and releases it into the atmosphere. It undergoes a series of phase changes during the process of cooling. While in the absorption process it becomes gas and during the compression process it becomes liquid. The ideal refrigerant is the one that is non-corrosive, non-flammable, and non-toxic in nature and also possesses favourable thermo dynamic properties. CFC, with its convincing properties, has gained popularity during the 20th century and has been accepted as a refrigerant.

R-11 and R-12 (Freon), a CFC compound, was the most widely used refrigerant. Later on the CFCs were replaced by HCFCs and that is when R-22 (Chlorodifluoromethane) came into the picture. Even though it is better than CFC, yet it is harmful to the environment due to the presence of chlorine. R-22 has both ozone depletion potential and global warming potential. Despite its potential harm to the environment, R22 is widely accepted as a refrigerant and is still available in the Indian market with almost all the brands.

Replacing chlorine, manufacturers came up with an alternative set of refrigerants known as hydroflourocarbon (HFC). R-134a, R-404A and R-410A are some of the HFCs available in the market to be used as refrigerants. R-134a is called Tetrafluoroethane and the other two R-404A & R-410A are an azeotrophic mixture of HFC refrigerants. They are non-toxic, non-flammable, energy efficient and have absolutely zero contribution towards ozone layer depletion but have the potential for global warming. The usage of these refrigerants in the Indian market is on the rise. The products capable of handling R-22 cannot go with these HFCs. Therefore, manufacturers developed the product exclusively to employ HFC refrigerants.

Refrigerants		ODP	GWP (Time Horizons of 100 years)
HCFC	R-22	0.055	1700
HFC	R-134A	0	1300
	R-404 (R125/143a/134a)	0	3800
	R-410A (R32/125)	0	2000
Natural Refrigerant	Ammonia (R-717)	0	Less than 1
	Propane (R-290)	0	20
	Isobutene (R-600a)	0	20

Source: Environmental effects of refrigerants, UNEP 2002

There are certain natural refrigerants as well apart from CFCs, HCFCs and HFCs, such as R-717 (Ammonia), R-290 (Propane) and R-600a (Isobutene). These natural refrigerants are halogen-free and are high in energy efficiency. They also have zero contribution towards ozone layer depletion as well as global warming but are highly flammable, which is not considered safe. Considering its eco-friendly nature, these natural refrigerants can serve as an effective alternative to the conventional hydrocarbon-based refrigerants, provided some significant measures are carried out on its safety aspects.

As of now, HFC based refrigerants are preferable considering its zero ozone depleting potential and safety. A better refrigerant which is both eco-friendly as well as safe is possible only with technological advancement and standards.

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Nanotechnological process that are inherently carried out by animals

N. Sudha

Introduction

Nanotechnology is the study of nanoparticle, the research for the design, synthesis and manipulation of the structure of particles with dimensions lesser than 100nm. A branch of nanotechnology is nanobiotechnology. Nanobiotechnology merges biological principles with chemical and physical procedures to generate nano-sized particles with specific functions.

The animal kingdom comprises many impressive forms. On nano level also the evolution process has been carried, producing nanostructures - that help animals in their motility process such as climb, slither, camouflage etc.

Compound eye of an insect's has individual facets around 50 to 10,000, each with its own set of optical organization.

Wings of butterflies with nanostructures

The shines with soft colours in a butterfly's wings are produced with nanostructures. Butterfly's wings are produced not with pigments like the melanin; melanin is the primary determinant of our skin colour.

Light is scattered by nanostructures in different directions. That scattering can also make the wing scales iridescent.

When the chitin nanostructures are hit with heat, they tend to expand changing their shape and therefore display their colours.

Parallel nanofibers - Penguin blue colour

Penguins produce a blue colour with parallel nanofibers wrapped up together, made of beta-keratin and 180-nanometer -wide. Similar fibers had been previously found in some bird's blue skin, where they are made of collagen.

Microfibrils -Snakes- Slippery

Snakes such as the ball python movement are actually a complex interaction of muscle movement but seem to effortlessly move. Micro fibrils are not more than 400 nanometers wide and micro fibrils cover the scales on a snake's belly. Towards the tail end of the snake they all point in the same direction and their ends are raised about 200 nanometers above the skin, allowing for a smooth glide forward but cease backward motion.

Nanogrooves - Solar powered bug

When the sun's heat is at zenith, most wasps slow down and are most active in the morning. *Hornets* are the largest of the eusocial wasps. In the hornet's abdomen, exoskeletons are made up of the layers of cuticle and are carved with grooves, about 160 nanometers high. The

groove helps to trap the lights that strike the hornet and bounces it around within the cuticle.

The yellow section, has about 50 nanometers high protrusions that absorbs light, the researchers showed that the xanthopterin pigment that gives it yellow color, xanthopterin can be used to convert light into electricity. The insect carries out same mechanism; this makes them busiest when it is sunniest, when oriental hornets are hit with UV light they wake up faster.

Crystal proteins of nanometers wide - Spiders with tough silk

Spider's webs without falling to pieces can withstand sudden strong rush of wind and catch hurtling insects that move at high speed. The silks get their toughness from thin crystal proteins that are only nanometers wide, which are arranged together. The layers are joined together by hydrogen bonds on the atomic level. Under pressure those bonds turns out to be an advantage, allowing the silk to flex and stretch.

Conclusion

Nanoparticle synthesis and the study of their size and properties are of prime importance in the advancement of recent research. It is found that the properties of nano particle are determined by their size, shape and chemical surroundings.

The above examples provide evidence that there is the existence of inherent nanotechnology methods within them. Thus nanotechnology concepts are not new but available inherently within living organisms from the time of evolution. Biological systems such as animals are already equipped with advanced technologies. Above all, animals are beautiful and technologically sound creatures which should not be subjected to any cruelty such as factory farming, research studies or animal entertainment purpose.

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Tackling Urban Drought through use of Treated water for Housing Constructions

B. Tirumala

Water is essential for life and plays a major role in creating earth's climate. By modifying land use, the proportion of the different pathways, evaporation, percolation and run off change. A change in evaporation from a region has impacts upon climate. Changes in percolation change ground water availability, both for humans and natural springs and streams [(2)]. Climate change has resulted in drastic seasonal fluctuations leading to erratic rainfalls and prolonged droughts in India.

India has 7,935 cities and towns according to the 2011 Census, 70 per cent of the urban population lives in 468 Class I Urban Agglomerations (UAs) that is with a population of 100 thousand and above. The number of Class I UAs increased from 384 in 2001 to 468 in 2011. Furthermore, there are 53 million-plus UAs which comprise 43 per cent of India's urban population.[(3)]

This alarming growth of population has further strained the already shrinking natural resources such as land, water and energy in these urban areas. With increase in population the need for a decent shelter for all economic classes has lead to massive growth in real estate sector. There is an increasing trend towards construction of buildings for residential as well as non residential purposes in urban areas and making the open areas as pucca for parking etc. This trend has decreased drastically the infiltration of rain water into the sub soil and recharging of ground water has diminished due to over development which has depleted the aquifers. Surface water is inadequate to meet our demand and we have to depend on ground water.[(2)]

With traditional small scale Indian storage practices, from temple tanks to elaborate stepwells fallen into despair, the country faces a water storage crunch. Shortage of water for industrial and domestic use and even for drinking purpose is a cause of concern throughout India. Unless preventive measures are taken on a large scale, the problem will become more acute with dangerous consequences. Only a handful of city and state governments have lately begun to mandate rainwater harvesting to slowly recharge ground water.[(4)]

The National Water Policy of Government of India recognizes the need of planning the economic activities like agriculture, industries and urban development in conformity with availability of this life-sustaining resource and has recommended water-zoning [(1)]. From the point of view of urban development, building industry is known to be a major consumer of water resource, which in many cases, is the ground water extracted through bore-wells.

Building construction is a highly resource intensive process, concerning use of materials, land, energy and water. Since

buildings are required to fulfill our primary need for shelter, consumption of these resources is simply unavoidable. However, with shrinking stock of natural resources and degrading eco-system services, the consumption process has to be wise, judicious and non-wasteful.[5]

Since water is everybody's business and any water disaster will affect population cutting across socio-economic classes, water mapping in building industry is not only significant to understand the dynamics of water resource consumption in one of the key sectors of urbanization, but also to select and decide on the most appropriate strategy to monitor and optimize this quantity for global sustainability and water management issues.[2]

"It has been established that construction activity requires about 1 kilolitre of water per square metre. Going by that standard, one lakh square feet of construction will consume more than 9,000 million litres of water."

"This is a quantity that can cater to the water requirement of 50 households for an entire year.[6]

Currently, water used for construction is arranged from private sources using water tankers, which draw surface water, water from shallow wells or also ponds during scarcity periods. As the demand for water grows, more water is extracted and transported sometimes over great distances which can require a lot of energy. If the local source of water is ground water, the level of ground water becomes lower as more water is removed and this increases the energy required to pump the water to the surface.[7]

Recently, the National Green Tribunal in Bengaluru has ordered that while granting environmental clearances (EC) to construction sites, the use of water required for construction and operation should be taken into consideration separately and at the same time use of treated water should be mandated for big housing projects.[6]

India has shifted the thrust of the policies from water development to sustainable water development. A vital element of this shift in strategy is the increasing importance of water harvesting and artificial recharge of ground water [2]. But this is not enough to reduce the water stress until and unless strict rules are made and implemented for reckless use of ground water for purposes like Construction of buildings where treated water can be used without any undesirable effects.

There is a greater need for propagating and promoting the use of treated water for construction purposes so that the groundwater is not exploited and can be saved for other purposes including saving the lives of millions of people who don't have access to drinking water.

A mass awareness campaigns just like Polio campaign wherein all forms of media were used to drive the message of protecting children from polio through vaccination must be carried out. Since the general public is unaware about treated water and its usage, a proper methodology must be developed to create awareness. Information technology tools can play a major role in disseminating the information regarding treated water.

Both centre and state governments with the help of experts must develop policies concerning the criteria for setting up of water treatment plants in every city and development of buffer zones which act as natural sieves and help in cutting down the pollutants entering into the water from construction run-off.

Water resource management in building construction and operation, however, has still a long way to go, especially because the amount of water used per unit area of construction largely remains undocumented[5]. Urban governing bodies must be given more powers to come up suitable solution and deal with the reckless use of groundwater by the builders and by individual householders. A systematic approach will definitely lead to awareness and promote the sense of conservation and judicious use of very valuable groundwater.

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Indoor Pollution

M. Lakshmi Sree

We have all come across the term pollution of air, noise, water, etc. The air pollution is high at traffic intersections due to emissions from vehicles. The flames and fumes from road side eateries and small food joints also add to the air pollution. In industrial areas, fumes from factories add to the air pollution.

Have we ever thought about indoor pollution? Indoor pollution is the degradation of air in our living rooms filled with harmful chemicals and other materials. It is estimated that indoor pollution is worse than outdoor pollution by ten times as closed areas enable pollutants to multiply than in open spaces.

According to a study by Indian Council for Medical Research, the World Health Organization (WHO) has prescribed 20 micro grams in cubic meter (ug/m3) of air for particulate matter as a norm for indoor air pollution. In India, the average indoor air pollution is 375ug/m3 and the prime contributor for this is the burning of solid fuels. It is estimated that about a million people die in India every year due to indoor pollution, highest in the world.

During 2015-16, our Chennai, which has an average air quality index of around 150, has been among the 'moderate' cities in terms of air pollution. Indoor air pollution in urban areas especially metros have increased manifold in the recent years. This can be attributed to increase in high raised buildings without proper ventilation. As people tend to shut their windows for dust and remain in air conditioned rooms, the level of pollutants get multiplied. Cross ventilation is needed in houses to prevent indoor pollution. Many Chennaites face respiratory problems, asthma, bronchitis, sore throat, etc. due to indoor pollution. The quality of indoor air in Chennai has deteriorated due to the fungal content in air during the recent floods.

People should give more thought to indoor pollution. Due to increase in population, proper and spacious housing is not possible and has always remained a distant dream. In order to have easy access to work place and educational institutions, many high rise buildings have come into the heart of the city. Outside pollution will also add fuel to the existing indoor pollution. In order to prevent excess dust, vehicular emissions, one might not open the windows and welcome fresh air. People should give more importance to proper ventilation in houses, especially in the kitchen, which will be helpful in preventing indoor pollution.

We are also reading in the dailies that people are prepared to spend more money on installing 'air purifiers'. The sale of air

purifiers for cars, bedrooms, living rooms and larger areas such as boardrooms has increased uniformly with orders coming in from corporates and residents in the last one year or so.

Alternatively, people can keep a tulsi plant in their balconies, which will prevent indoor pollution to a considerable degree.

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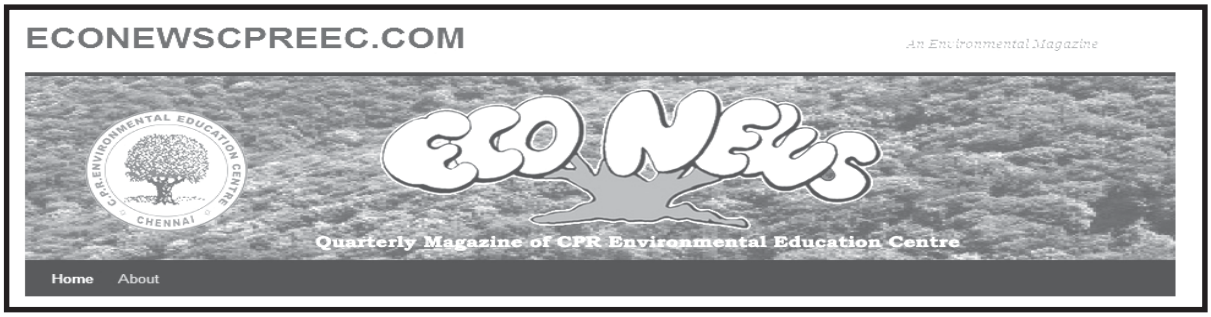

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