VIGYAN PRASAR

DREAM 2047

MAY 2022 / Vol. 25 / No. 5 / ₹ 20

Brown-headed Barbet

CONSERVATION OF MIGRATORY BIRDS FOR WETLAND AND FOREST

CROWN SHYNESS: A PROCESS OF PHYSICAL DISTANCING AMONG PLANTS

PLASMA AND SPACE

WHY BIRDS MATTER

INSIGHTS ON CONSERVATION ASPECT AND CHALLENGES

VIGYAN PRASAR

स्वतंत्रता का अमृत महोत्सव

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Published by Dr Nakul Parashar on behalf of Vigyan Prasar, A-50, Institutional Area, Sector-62, Noida-201 309, U.P. India.

Cover Design & Illustrations By: BIPRO KUMAR SEN

NAKUL PARASHAR

No complacency, please!

SUMMERTIME!

Besides vacation, it's time to get into the science groove. Vigyan Prasar has organised a fortnight of hands-on activities every year for the school children. However, the past two years have been an exception; what about this year? Clouds seem to be gathering to put the world under the weather once again. The new variant of SARS-CoV-2 has struck the CJK (China-Japan-Korea). It has started to knock on the doors of the subcontinent. What to do? A booster dose sans complacency and following COVID-19 protocols seriously to avoid more lockdowns. Remember, this variant is highly contagious. As always, prevention stands to be better than cure. With temperatures soaring, it is more important that all care is taken.

Yes, summers have set in early this year. However, the silver lining is that our met department has predicted a normal southwest monsoon this year. Every year, the southwest monsoons have been predicted through neural networks, where a nonlinear method is deployed to correlate with predictors from previous monsoons. After that, based on these computations, the rainfall pattern is reconstructed to predict the arrival and percentage of rainfall. We've now come a long way in monsoon prediction.

The southwest monsoon provides respite from the heat and dispels the dryness of the soil. These monsoons have far-reaching consequences on the national economy. From time immemorial, our farmers have much awaited the southwest monsoon. Paddy crop, which is sown in most parts of the country, requires much water. Rain-fed rivers get their annual due and everything around gets green. How nice it is to think about rain when it is too hot around! So, the news about the normal monsoon ahead is a big respite. Fingers crossed!

Indeed, for all of this to happen, we need a healthy ecosystem – the air we breathe, the food that we eat. We need a wide range of animals, plants, and microorganisms to maintain the balance required to support life. This is biodiversity. To enhance understanding of biodiversity issues, the UN adopted May 22 every year as the International Day for Biological Diversity. For the public, it would be nice if we could visit a zoo, a nature park, or a science museum on the Biodiversity Day. This year's theme for Biodiversity day is Building a shared future for all life.

Well, here's an update from our end too. In our effort to enhance our foray into Indian languages, Punjabi is the new addition. *Jigyasa* would be the new popular science monthly in Punjabi. In cooperation with the Punjab Council of Science & Technology, Chandigarh, we shall rapidly bring out books and films and thus organise seminars and workshops for the Punjabi-speaking populace. A similar effort with assistance from the Central University of Jammu has been inked for SCoPE-in-Dogri. We continue to expand and take up all those languages that we had missed in our first phase– Malayalam and Odia. We would endeavour to rope them in before the end of September. Yet again, fingers crossed.

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KANCHAN PURI AND RITESH JOSHI

WHY BIRDS MATTER: INSIGHTS ON CONSERVATION ASPECT AND CHALLENGES

We share this planet with millions of other species including plants, microbes and animals. Birds play a vital role in the functioning of the ecosystems in a way that directly impacts human health. Bird's migration is one of the nature's greatest wonders. It is fascinating to know their amazing journey across the continents.

We share this planet with millions of other species including plants, microbes and animals. Birds play a vital role in the functioning of the ecosystems in a way that directly impacts human health. Bird's migration is one of the nature's greatest wonders. It is fascinating to know their amazing journey across the continents. Migratory birds fly thousands of kilometres to find the best habitats for feeding and breeding. A migratory route will have nesting sites and breeding site depending on, availability of preferred food and suitable habitat. There are many different migration patterns and literatures reveal that the health of the ecosystems is linked with bird's migration. Birds act as pest control agents by devouring insects and other organisms that harm the environment and crops. Locust attack is one such disaster that was due to the absence of birds. Migratory birds help in dispersal of seeds, leading to maintenance of biodiversity along their routes. Ducks transport fish eggs in their guts to new water bodies. The droppings of birds are rich in nitrogen and act as organic fertilizers. Migratory birds form both prey and predator bases in ecosystems and can, therefore, have an ecological impact. Prevalence of migratory birds helps analyse the state of environment in an area.

India is home to several migratory birds including Amur falcons, bar-headed Geese, black-necked cranes etc. The black-headed, brown-headed and slender-billed gulls arrive mostly from Europe and Central Asia. From Siberian Cranes to Greater Flamingo many beautiful birds migrate to India every year during the winters and summers for food, breeding, and nesting. The Indian sub-continent is part of the major bird flyway network, i.e., the Central Asian Flyway (CAF) that covers areas between the Arctic and Indian Oceans. This flyway comprises several important migration routes of birds, most of which extend from the northernmost breeding grounds in Russia (Siberia) to the southernmost non-breeding (wintering) grounds in West and South Asia, the Maldives and the British Indian Ocean Territory. Including India, there are 30 countries of North, Central, and South Asia and Trans-Caucasus under the Central Asian Flyway that covers at least 279 populations of 182 migratory water bird species, including 29 globally threatened species. The birds on their annual migration cross the borders of several countries.

World Migratory Bird Day is celebrated on the second Saturday of May and October every year highlighting the need for the conservation of migratory birds and their habitats. It raises awareness on the threats faced by migratory birds and their ecological importance. This day marks global relationship with birds and to protect them in a post-pandemic world. This year (**14 May 2022**) the theme is *"Focus on Light Pollution"*.

Migratory birds as global ambassadors of nature connect different places across the planet and also re-connect people to nature. During the pandemic, we have been listening to and watching birds like never before. Clearly, the pandemic has been an unprecedented challenge for humankind. Birdlife International report states that there has been a continuing deterioration in the status of the world's birds over the last 25 years. Species in the Pacific and ocean-going seabirds have declined the fastest.

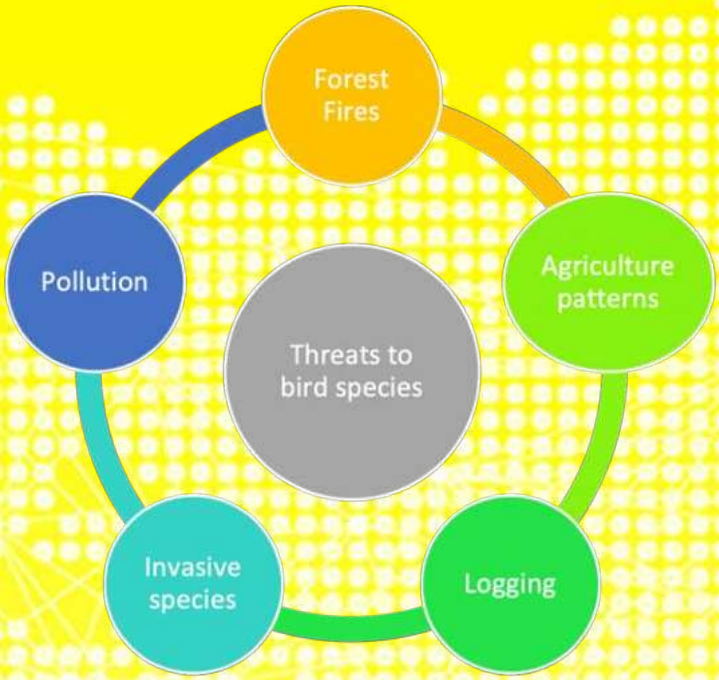
THEMES IN THE PAST YEARS:

YEAR	THEMES
2006	Migratory birds need our support now
2007	Migratory birds in a changing climate
2008	Migratory Birds–Ambassadors for Biodiversity
2009	Barriers to migration
2010	Save migratory birds in crisis-every species counts
2011	Land Use Changes from a Bird's-Eye View
2012	Migratory birds and people
2013	Networking for migratory birds
2014	Destination Flyways: Migratory Birds and Tourism
2015	Energy–make it bird-friendly
2016	Stop the illegal killing, taking and trade of Migratory Birds!
2017	Their Future is our Future
2018	Unifying our voices for bird conservation
2019	Protect Birds: Be the Solution to Plastic Pollution
2020	Birds Connect Our World
2021	Sing, Fly, Soar–Like a Bird

CHALLENGES AND THREATS

In several parts of the world where birds travel through or are resident, their eggs are poached and hunted down. Loss of water bodies and wild habitats are also the major concerns. Further, increasing illumination at night adversely affects migration by confusing the birds. Degradation of the environment and increased pollutant levels jeopardise the life cycle and migration of birds. Heavy pollution of water bodies and presence of large amounts of pesticides leads to improper hatching. Available records and studies conducted by various researchers have indicated that rapid human population growth and development across the region has dramatically increased pressure on inter-tidal and freshwater wetlands, grasslands, and other habitats, which has resulted in their degradation and loss, their pollution, and harvest of waterbirds. These pressures have resulted in the decline

and local extinctions of waterbird populations. Management and conservation of waterbird populations requires up-to-date information on populations and their trends. Actions to promote collection of data and their analysis at the flyway and national level will provide the basis for improving the knowledge base.



CONSERVATION ASPECTS

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) is an environmental treaty, which provides a global platform for the conservation of migratory animals and sustainable use of their habitats. The treaty unites the regions through which migratory animals pass and lays the legal foundation for coordinated conservation measures throughout their range. The 13th Conference of Parties (COP) of the CMS was held in Gandhinagar in 2020. India now holds the COP Presidency till 2023 with a focus on collaborative approach to tackle biodiversity issues. The Government of India is Signatory to the Convention on Conservation of Migratory Wild Animals since 1983. India has signed non-legally binding MOU with CMS on the conservation and management of Siberian Cranes (1998), Marine Turtles (2007), Dugongs (2008), and Raptors (2016).

The Action Plan builds on and complements actions that are being undertaken by national governments and various international conventions including CMS, AEWA, Ramsar, Convention on Biological Diversity, development agencies including UNEP, UNDP, World Bank, Asian Development Bank, international NGOs including BirdLife International, IUCN, and WWF to promote regional and national cooperation and conservation action.

The National Wildlife Action Plan, duly supported by the Indian Wildlife (Protection) Act, 1972 provides legal framework relating to migratory waterbirds and wetlands. In addition, various other legislations such as Environmental Protection Act, Indian Forest Act, Pollution Control Act, and Coastal Zone Regulatory Act are some of the additional legislations supporting wetland and migratory waterfowl habitats managements.

Long-term monitoring programmes to assess the migration trends in birds and educating public on the importance of bird migrations can be of paramount importance. Seeking local support for nesting/conservation of migratory birds can be another tool to conserve the migratory birds. In Nagaland a community project to protect migratory Amur falcons from hunting in the northeast has remained successful. Such initiatives need to be promoted for survival of these beautiful birds and continual of nature's wonder.

SIBERIAN CRANES

The Siberian Crane is an endangered member of the crane family, designated as "Critically Endangered" under the IUCN Red list Category. It can be spotted mainly at the Keoladeo Ghana National Park or the Bharatpur National Park during the winter season.

These cranes are omnivorous and breed in the arctic tundra of Russia and Siberia.

GREATER FLAMINGO

The migratory bird is mostly found during the winter season in parts of Nal Sarovar Bird Sanctuary, Khijadiya

Bird Sanctuary, Flamingo City and in the Thol Bird Sanctuary of Gujarat.

It is listed as 'least concern' as per the IUCN Red List of Threatened Species.

AMUR FALCON

During the winter season, Amur falcons are found around Doyang Lake in Nagaland. They are small raptors that breed in Siberia and migrate to Southern Africa.

It is listed as 'least concern' as per the IUCN Red List.

RUDDY SHELDUCK

The Ruddy Shelduck, 'least concern' on the IUCN Red List, a common winter visitor in India where it arrives by October and departs by April.

It is found in large numbers in lakes and reservoirs. It breeds at high altitude wetlands in the mountains of central Asia and in winters around lakes, rivers, and other water bodies of south Asia.

DEMOISELLE CRANE

Demoiselle Cranes are the smallest species of crane family and lives in different environmental conditions, including desert areas of Rajasthan.

These birds from colder regions of Eurasia fly to India. They are primarily grassland birds but are usually found within a few hundred meters of rivers, shallow lakes, depressions, or other natural wetlands.

BAR-HEADED GOOSE

Bar-headed Goose is the highest flying bird in the world that migrates to India every winter season.

During its annual migration, this species travels directly over the Himalayas on its route between its nesting grounds in India. It is listed as 'least concern' as per the IUCN Red List of Threatened Species.


Painted Stork


Purple moorhen

Kanchan Puri is Senior Research Officer, Development Monitoring and Evaluation Office, NITI Aayog and Dr Ritesh Joshi is Scientist E, Ministry of Environment, Forest and Climate Change, Indira Paryavaran Bhawan, New Delhi.

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SANJIT KUMAR SAHA AND RINKI MUKHERJEE SAHA

Conservation of Migratory Birds for Wetland and Forest

Negative externalities impact migratory birds adversely. Light pollution, for example, affects their winter migration from breeding ground to wintering ground and vice-versa during their return migration. Light pollution causes disorientation for them when they fly at night, leading to collisions with buildings, interfering with their internal clocks, or with their ability to undertake long-distance migrations. As per the Convention on the Conservation of Migratory Species (CMS) and Agreement on the Conservation of African-Eurasian Migratory Water-birds (AEWA) of the UNEP, artificial light is increasing globally by at least 2 per cent per year and it is known to adversely affect many bird species. The solution is compassionate conservation with the principle of co-existence by dimming the building lights during migration phases in spring and autumn. This will assure sustainable energy consumption and management of natural resource. Light Pollution #WMBD2022 is the theme of UN-backed global World Migratory Bird Day Campaign, for 14 May 2022 to address the impacts of light pollution on migratory birds with the official slogan of "Dim the Lights for Birds at Night".

Migratory birds enjoying the refuge and submerged foods at the Rasikbeel Wetland after weed eradication.

Positive externality of income generation for the local farmers and fishermen surrounding Rasikbeel Wetland by removal of water hyacinth.

Rasikbeel Wetland

With the unique representation of sub-Himalayan geography, Rasikbeel Wetland complex of Coochbehar, the largest inland wetland in West Bengal, is an important wintering ground for more than 50 species of migratory birds between November and February every year. Profuse natural regeneration of Water Hyacinth (*Eichornia crassipes*), the exotic aquatic weed, has been acting as a limiting factor to provide refuge and food for the migratory water birds for last few years. Field research has shown that production of paddy seedlings by the fringe population around the edges of the shallow water depth of the Rasikbeel Wetland is adding run-off chemical pesticide to the wetland and helping in natural regeneration of this harmful weed and other exotic aquatic weeds. With prohibiting the unsustainable practice of paddy seedbed preparation by

A group of near-threatened Ferruginous Pochard at the Rasikbeel Wetland.

Flock of Red Crested Pochards in their winter migration at Gajoldoba.

locals and then cleaning the wetland of the exotic obnoxious Water Hyacinths by involving them have helped in regaining the health of the water body. The Water Hyacinth has been used as a raw material for producing vermicompost. The free water surface is now providing wild paddy, grasses, reeds, water lilies, phyto-planktons etc. for the migratory ducks. It also increased fish production. Guts of migratory birds carrying fish-seeds may be another reason for the increased fish production. The positive externality goes to the local farmers and fishermen as earning from the wages and selling of fish in the local markets. Bird migration therefore has assured hidden positive externalities for the wetland and forest conservation benefitting our Mother Earth and the humankind.

Apart from the success story of Rasikbeel Wetland, we can observe the assured positive externality in the livelihood of locals with the winter migration of Red Crested Pochards at Gajoldoba Wetland of West Bengal.

For last few years the Gajoldoba Wetland in the Jalpaiguri District of West Bengal has become a common and regular wintering habitat of many migratory birds. Red-crested Pochards are one of the main attractions for the visitors who flock the region every year for bird watching. The scientific name of this bird is *Netta rufina*. '*Netta*' is a Greek word, meaning Duck and '*Rufina*' is a Latin word, meaning 'Rufous, Ruddy or Golden-red'. They belong to the order '*Anseriformes*' and family '*Anatidae*', i.e., the duck family. The male birds have the unmistakable 'rusty orange' broad round head, prominent red bill, black breast, and white wings. Female birds however have their distinctive 'dirty buff' plumage with white cheek. By reviewing available literature, we have found an interesting and unique breeding behaviour specific to the Red-crested Pochard. The female birds lay eggs on their own nest but give warmth to the eggs of other nests.

The breeding ground of this bird is lowland marshes and lakes of the southern Europe and Central Asian countries. After completing their breeding cycle they come in their wintering grounds of Indian subcontinent through the migratory route of Central Asian Flyway (CAF) via staging sites for temporary halt. In the Indian subcontinent they mostly prefer aquatic habitats of the inland wetlands, primarily for refuge and food. They feed on different submerged hydrophytes of the wetland ecosystem by diving and upending. Their presence also indicates a healthy ecosystem for the wetland. Their presence also helps in recognizing a wetland important from the 'Ornithological' perspective.

Gajoldoba wetland of West Bengal with the potential habitat of migratory birds is being converted to an ecotourism hotspot. This also helps in revenue generation and supporting livelihood for the locals and for their income generation. The place got its official name, 'Pakhi Bitan' primarily after the winter migration of Red-crested Pochard and other migratory birds. The wetland can also be developed as a model for sustainable management.

However, immediate actions must be taken to stop unauthorised trespassing of over-enthusiast visitors who have been seen chasing the birds on hired boats for taking photographs. They hire the boats of the local fishermen and intrude into the natural habitat of the birds, violating the ethics of photography of wild birds and animals. This kind of unethical and unregulated practices will compel the migratory birds in shifting their wintering ground. Local people and boatmen should also be sensitised in this aspect so that they refuse and restrict the actions of the tourists and protect the wetland as their responsibility. We should not forget that India is the signatory and flag bearer of the Convention of the Conservation of Migratory Species (CMS) among the countries of the Central Asian Flyway (CAF). It is our duty to restore and rejuvenate all the wetlands of local and national importance with the objective of protection, conservation, and sustainable management of the habitats of the migratory birds

Photographs: Sanjit Kumar Saha

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KAUSHIK ROY

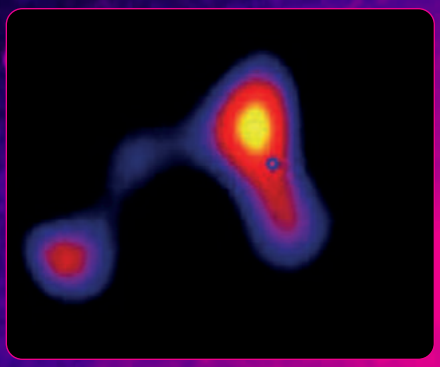
Plasma and Space

Recent research on plasma has attracted much attention because of its applications in different areas of space and astrophysics. Space plasma is a rapidly growing area of plasma science research. Our knowledge about space atmosphere can be attributed to the remarkable progress in space technology and also to the improvement of plasma science research. The joint work of astrophysicists and geophysicists with the help of data obtained from the space experiments, have found a very significant plasma linkage between Sun and Earth.

Plasma is considered as the fourth state of matter. As the temperature rises, the state of matter changes from solid to liquid, and then gas. With further increase in temperature, some or all of the atoms of neutral gas get ionised. The gas becomes fully or partially ionised, which is known as the plasma state. The word "plasma" is of Greek origin meaning "mouldable substance". In 1879, Sir William Crookes first identified it as "radiant matter". After that, in 1897, Sir J.J. Thomson identified the nature of matter. American physicists Lewi Tonks and Irving Langmuir in 1929 used the term plasma to describe the inner region of a glowing ionised gas produced by means of electricity discharged in a tube.

Plasma is a quasi-neutral gas of charged and neutral particles which exhibit collective behaviour. As these charges move around, they generate local concentrations of positive or negative charges, which give rise to electric fields. Motions of charges also generate electric currents and hence magnetic fields that affect the motion of other charged particles far away. Collision-less' plasma, in which the long-range electromagnetic forces are so much larger than the forces due to the ordinary local collisions that the latter can be neglected altogether.

Nearly 99% of visible matter in the universe is in a state of plasma. We are lucky that 1% of the matter on Earth happens to be something other than plasma. However, plasma still exists within the channels of lightning in the ionosphere, in the auroras and in Earth's magnetosphere. In the solar system, plasma is seen in the solar wind, in the planet's magnetosphere and the comets, while plasma forms gigantic plasma toroids around Jupiter and Saturn. The Sun itself and its corona and the rest of the stars are enormous plasma balls. Again, a good part of the nebulas within the galaxies is comprised of plasma.



The star Tau Ceti has a very large Dusty Plasma or Dust Disk surrounding it. It is said to be formed by asteroid dust as there is very little else in science that can explain the amount of dust found around this star. (http://www.everythingselectric.com/forum/index.php?topic=73.0).

Dusty Plasmas

Dust and plasmas exist together in the universe which results in the formation of dusty plasma. It is a particular form of plasma that owes its origin to fully or partially ionised gases. It consists of ions, electrons, and micron-sized extremely massive (compared to ions and electrons) charged dust grains. It is normal electron-ion plasma with an additional charge component of macro particles.

Dusty plasmas are found in space environment like asteroid zones, planetary rings, cometary tails, lower part of Earth's ionosphere and magnetosphere, and interstellar medium. In dusty plasma, dust grains can weigh a billion times more than the ions and attain several thousand electron charges. The dust grains are charged due to a variety of physical processes including the collection of the background plasma electrons and ions by dust grains, photoelectron emission, secondary electron emission and thermionic emission, etc. The electrons originate from the grains when charged negatively due to the irradiation of ultraviolet radiation. The dust-grain charging appears as a new physical process in dusty plasma, which differentiates between the dusty plasma and the usual multi-component electron-ion plasma containing two ion species.

Negatively charged dust grains in plasma are produced only when the dust is charged by collecting plasma through electrons and ions, and this process is the most significant charging process. However, there are other significant charging methods through which dust grains become positively charged.

Quantum Plasma

Plasma can be considered as quantum plasma when the quantum nature of its particles considerably affects its macroscopic properties. Quantum plasma consists of electrons, ions, positrons, and holes. The theory of quantum plasma was developed with the help of renowned mathematical models, namely (i) Schrodinger-Poisson model, (ii) Winger-Poisson model, and (iii) Quantum hydrodynamics model.

Research in quantum plasma now includes its applications in various fields of laboratory plasma and astrophysics. These include the fabrication of semiconductor devices, quantum dots and quantum wires, quantum wells,

Planetary ring (https://www.wallpaperflare.com/search?wallpaper=planetary+rings)

carbon nanotubes and quantum diodes, ultracold plasmas, microplasmas, biophotonics, and intense-laser solid-density plasma experiments, etc. Quantum plasma is even important in the studies of super-dense astrophysical bodies such as white dwarfs, neutron stars, etc. The presence of dense quantum plasma can be seen in nature like in the interior of the planets like Saturn, Jupiter, etc., on the surface as well as core of brown and white dwarfs, and neutron stars, etc.

Traditional plasma physics has mainly emphasised on regimes characterised by high temperatures and low densities for which quantum mechanical effects have virtually no impact. Recent technological advances in semiconductors, however, have made it possible to envisage practical applications of plasma physics where the quantum nature of particles plays a significant role. Quantum effect can no longer be ignored at room temperature and standard metallic densities, as electron gas comprises a perfect arena to study the dynamical properties of quantum plasma. But quantum aspect should be considered while observing some astrophysical objects under extreme conditions of temperature and density, such as white dwarf stars, neutron stars, where the density is some tens of magnitudes larger than that of ordinary solids.

Quantum plasma differs extensively from classical plasma in that in quantum plasma the density is very high and temperature is generally low. On the other hand, traditional plasmas have high temperature and low density.

Magnetized plasmas

Magnetised plasma can be defined as one in which the magnetic field is strong enough to control the movement of the charged particles. Magnetised plasmas are anisotropic, meaning that their properties in the direction parallel to the magnetic field are dissimilar from that perpendicular to it. On the other hand, the electric fields in plasmas are generally small, as the conductivity is high and the electric field moves in a magnetic field but is not affected by the Debye shielding.

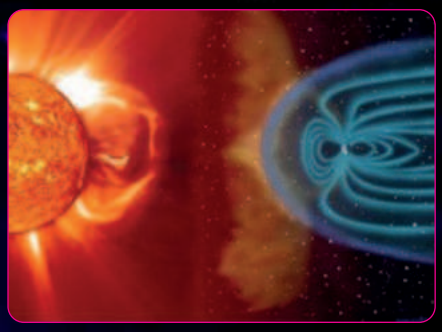
The northern and southern lights that can be frequently seen at night close to the Arctic and Antarctic circles are due to the magnetosphere of our planet that contains spectacular aurora borealis and aurora australis. The electrons from the magnetosphere when accelerated along the Earth's magnetic field into the upper atmosphere collide with atmospheric particles at altitudes between 100 and 200 km. This collision results in the formation of aurora.

Non-Maxwellian distribution in plasmas

Space plasmas are collision-less and the particles associated with it are characterised by non-Maxwellian behaviour. The study of Space plasma has undoubtedly specified the presence of ions and electrons which are far away from their thermodynamic equilibrium. In general, the plasma is found to have electrons with a non-Maxwellian high-energy distribution in space plasma environment like magnetosphere, astrophysical plasmas and the solar wind.

Nonthermal Distribution

Space plasma research has revealed the presence of ion and electron populations that are not in thermodynamic equilibrium in space environment. Different researches confirm the existence of energetic electrons in a variety of astrophysical plasma environments like Earth's bow-shock and fore-shock, the upper Martian ionosphere and the vicinity of the Moon.



The solar wind pushing on Earth's magnetic field. NASA (https://skyandtelescope.org/astronomy-resources/solar-wind/).

The measurements of their distribution functions also show them to be extremely nonthermal. In the different regions of the magnetosphere, energetic electron distributions are also observed. The Vela satellite had noted that nonthermal ions exist in the Earth's bow-shock region. The Phobos 2 satellite also noted the loss of energetic ions from the upper ionosphere of Mars. Furthermore, the Nozomi satellite indicated the occurrence of very huge velocity protons close to the Earth in the vicinity of the Moon.

Kappa Distribution

The generalised Lorentzian distribution is a non-Maxwellian distribution which is popularly known as kappa distribution. Kappa distributions were used to describe various space plasma populations in the heliosphere, from solar wind and the planetary magnetosphere to the inner heliosheath and beyond.

q-non-extensive distribution

Non-extensive statistics, or Tsallis statics, is a new statistical approach, that has been proposed to study the cases where Maxwell distribution may be insufficient. This was first acknowledged by A. Renyi in 1955 and later recommended by C. Tsallis in 1988.

In space science there are numerous applications of plasma and research of plasma science will help in enriching space science and technology.

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NAVNEET KAUSHIK

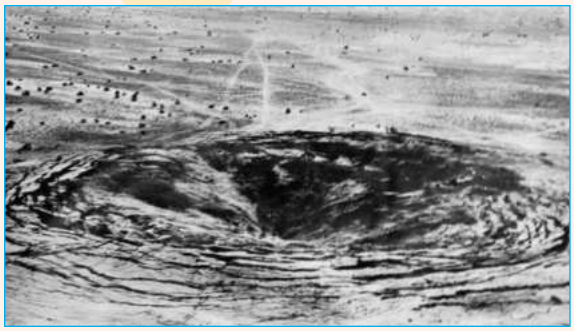
NATIONAL TECHNOLOGY DAY: Its Significance

"When Nuclear Energy has been successfully applied for power production in say a couple of decades from now, India will not have to look abroad for its experts but will find them ready at hand".

Dr Homi Jehangir Bhabha, Father of Indian Nuclear Programme

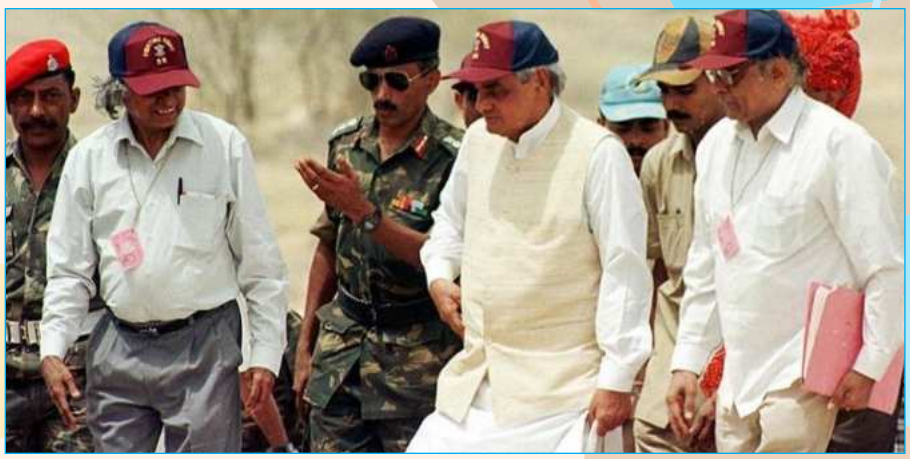
These enlightening words from Dr Bhabha laid the foundation of India's first nuclear programme. After India became independent, the former Indian Prime Minister Jawaharlal Nehru authorised the development of a nuclear programme headed by Dr Bhabha. In 1954 Homi J. Bhabha steered the nuclear programme in the direction of weapons design and production, and established the Atomic Energy Establishment, Trombay (now BARC: Bhabha Atomic Research Centre) for multidisciplinary research programme essential for the ambitious nuclear programme of India.

Pokhran-I (Operation Smiling Buddha)



The test site, Pokhran I

Soon after Indo-Pak war of 1971, the then Prime Minister Smt. Indira Gandhi authorised BARC to manufacture a nuclear device and prepare it for a test. On 18 May 1974 the device was detonated. Codenamed 'Operation Smiling Buddha' this was India's first successful nuclear bomb test. The bomb was detonated at the Pokhran Test Range, Rajasthan by the Indian Army under the supervision of several key Indian generals.



'Atal Bihari Vajpayee with R Chidambaram and APJ Abdul Kalam at Pokhran II site'

Pokhran-II (Operation Shakti)

It was in 1998, that India had a prideful accomplishment of successfully conducting Nuclear Missile Test at Indian Army's Pokhran range. The tests were initiated on 11 May 1998, under the assigned code name Operation Shakti, with the detonation of one fusion and two fission bombs. Thereafter, on 13 May 1998, two additional fission devices were detonated.

The prolific team involved in the operation consisted of 'Missile Man of India' Dr A.P.J. Abdul Kalam, then Scientific Adviser to the Prime Minister and Head of the DRDO; Dr R. Chidambaram, then Chairman of the Atomic Energy Commission and the Department of Atomic energy; Dr K. Santhanam, then Director, Test Site Preparations, DRDO; Dr G.R. Dikshitulu, Senior Research Scientist B.S.O.I. Group, Nuclear Materials Acquisition, Atomic Minerals Directorate for Exploration and Research; Dr Anil Kakodkar; and other scientists.

India was declared a full Nuclear Country, thereafter, and since then, 11 May is being observed as the National Technology Day. The Day aims at commemorating the achievements of scientists, researchers, engineers, and all others involved in the field of science and technology. The day has two more historical perspectives: on 11 May, 1998 the first indigenous aircraft "Hansa-3" was test flown at Bangalore and India also performed successful test firing of the Trishul missile.

To celebrate this special day, the Technology Development Board (TDB), a statutory body of the Department of Science and Technology, Government of India by the virtue of its mandate, honours technological innovations that have helped in the national growth under the aegis of National Awards from the year 1999. For this, TDB organises an event every year on 11 May, where the President of India as the chief guest confers these awards to scientists, technologists, and entrepreneurs for their contributions in the field of science and technology.

THEME- "PRAGATI- Promoting Avenues for Growth through Technological Innovations."

Every year a theme for the event is being selected by the Board and for the year 2022, the theme is "PRAGATI-

'The Former President of India' Dr. APJ Abdul Kalam at National Technology Day Function, 2011.

Promoting Avenues for Growth through Technological Innovations."

For modern India to become Aatmanirbhar Bharat, science, technology and innovation are expected to play a pivotal role in shaping the future economy and environmental sustainability of the country. It is therefore imperative that the promotion of knowledge system, development of indigenous technologies, and adapting imported technologies for domestic application are given a significant thrust. The new and innovative technologies will provide greater opportunities and challenge the Research and Development (R&D) institutions, academia, and industry to synergize, collaborate, and cooperate for the vision of national growth. It envisages strengthening of different S&T ecosystems by fostering and improving the participation of grassroot level entrepreneurship for identifying critical S&T sectors and developing their indigenous technology-based growth models. In addition to this, equal opportunities have also been provided for women candidates, youths from rural remote areas, marginalised communities, and differently-abled individuals, irrespective of their socio-economic backgrounds.

Currently, India is the world's third most appealing investment destination for technology transactions. In the field of scientific research it has been ranked among the top five countries in the world and also among the top five nations in the field of space exploration. Also, the country is aiming to position itself as a global leader in terms of export, industrialization, and technical development. Therefore, to achieve this, the country has launched Science, Technology, and Innovation Policy 2020, with the primary objective of being decentralised, evidence-based, bottom-up approach that is expert-driven and inclusive. It intends to integrate the concept of "dynamic policy" with a strong governance framework which includes periodic review, policy evaluation, feedback, and adaptation, as well as timely exit strategy for various policy instruments. This strategy will bridge an inherent gap between empirical policy and award categories for future national technology innovations.

National Awards 2022

Every year, for furtherance of its mandate, TDB seeks applications for National awards for commercialization of technologies under three categories, i.e., National Awards, MSME awards, and Start-up awards. These awards are conferred to various industries for successful commercialization of innovative indigenous technologies and also provide a platform for recognising Indian technology providers, who work to bring innovation to the market and help in contributing to the vision of Aatmanirbhar Bharat.

The description related to the three categories of awards are-

I. National Award for the Successful Commercialization of Indigenous Technology: This award will be given to an industrial concern which has successfully developed and commercialised an indigenous technology. In case, the technology developer, provider, and commercialiser are from different categories, each one would be eligible for cash award of ₹25 lakh and a trophy.

II. *National Award for MSME:* The award is given to MSMEs which have successfully commercialised a product based on indigenous technology. Cash award of ₹15 lakh and a trophy are presented to the recipient.

III. National Award for Technology Start-Ups: The award is given to a technology start-up for promising new technology with potential for commercialization. It has a cash award of ₹15 lakh and a trophy.

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SURYA KANT SHARMA

LIGHT HOUSE OF INDIAN SCIENCE:

The National Calendar

As we celebrate Aazadi ka Amrit Mahotsav to celebrate and commemorate 75 years of India's independence and the glorious history of its people, culture, and achievements, it is also the time to celebrate India's scientific achievements. It is also important to put effort in kindling scientific temperament among masses.

Many are unaware of the fact that the 'Indian National Calendar' was adopted constitutionally by the Indian Parliament in 1957. This is based on the Saka Era, with Chaitra as its first month and a normal year of 365 days. However, it has remained unnoticed in the people's psyche, regrettably.

Organisations like Vijnana Bharati in association with Ministry of Culture, Department of Science and Technology, Council of Scientific and Industrial Research,

Ministry of Earth Sciences, IUCAA, IIA, Vigyan Prasar, Vikram University Ujjain, IIT Indore, Rashtriya Dindarshika Prachar Manch, etc. have collaborated to celebrate this development at National level.

A two-day conference and exhibition on the National Calendar of India was scheduled for 2-3 Vaisakh 1944 (22-23 April 2022) at Ujjain and Dongla (a place on the tropic of Cancer). This was a remarkable opportunity to inculcate scientific temperament among masses at different populace pockets across the nation. The organising committee and the partner agencies utilised this event to promote and popularise the National Calendar, its utility and usage through a conference. Six curtain-raiser events were planned on 01 Caitra (22 March) at CSIR-NPL, New Delhi; 08 Caitra 08 (29 March) at Indian Institute of Astrophysics, Bengaluru; 15 Chaitra (05 April) at IICB, Kolkata; 16 Caitra (06 April) at IIT Guwahati; 21 Caitra (11 April) at University of Mumbai, Mumbai and 22 Caitra (12 April) at Central University of Jammu, Jammu.

The opening remarks at the 2-3 Vaisakh Conference were delivered by Shri Jayant Sahasrabudhe, National Organising Secretary, Vijnana Bharati. Dr Dinesh Gupta, Vice President, Rashtriya Dindarshika Prasar Manch released the National Calendar of India. Shri Govind Mohan, Secretary, Ministry of Culture; Dr Srivari Chandrasekhar, Secretary, Department of Science and Technology; Dr R. Ravichandran, Secretary, Ministry of Earth Sciences;

Curtain Raiser at Mumbai University

Dr Arvind C. Ranade addressing the gathering during the curtain raiser program at IIT Guwahati

Curtain Raiser at IIT Guwahati

Dr V K Jain, Director, UM-DAE Centre for Excellence in Basic Sciences addressing the gathering during the curtain raiser program at Mumbai University

Dr Shekhar C. Mande, Director General, CSIR and Secretary, DSIR; Prof. Anil D. Sahasrabudhe, Chairman, All India Council for Technical Education (AICTE) also graced the occasion.

Owing to the COVID-19 pandemic the curtain raiser programmes were conducted in hybrid mode. Online registrations for participation for the event at Ujjain was through the website http://bharatcalendar.in. An Expo was also organised in which several lectures, panel discussion, and observation sessions were organised.

CSIR-National Institute of Science Communication and Policy Research (CSIR-NISCAIR) published some valuable publications like History of Calendar and Collected Works of Dr Meghnad Saha. Participatory Scientific Organisations, especially Vijnana Bharati, and CSIR must be credited for their stewardship.

The Gregorian Calendar (named after Pope Gregory XIII) which is widely used across the is not very scientific. For example, no logic has been followed regarding the nomenclature of the months; number of days in a month have been decided arbitrarily; beginning of a year has no connection or relation with any astronomical incident; etc. Moreover, October, November, and December used to be 8th, 9th, and 10th months and then were made the 10th, 11th, and 12th months. None of the month begins with any astronomical event either.

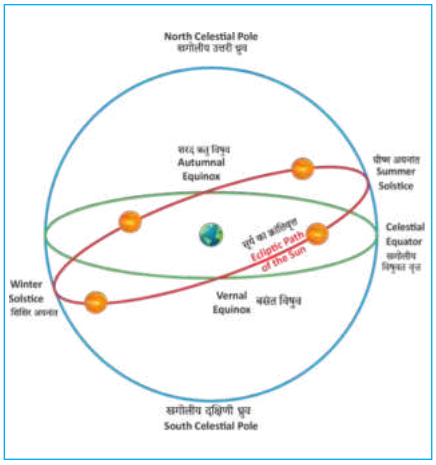
After independence the first prime Minister of India Shri Jawaharlal Nehru and other esteemed intellectuals contemplated to having a National Calendar. In 1952, a committee under CSIR was constituted and Dr Meghnad Saha was nominated to be its chairman. The committee was entrusted with the responsibility of developing the national calendar in synchronisation with the rich cultural and scientific history of the country. The committee consisted of eminent experts like Prof. A.C. Banerjee(EX-Chancellor of University of Allahabad); Dr K.L. Daftari; Shri J.S. Karandikar (Ex-Editor of Kesari); Prof. R.V. Vaidya (Ujjain Vikram University), Pandit Gorakh Prasad and Prof. N.C. Lahiri. The term of reference or objectives of the committee were

1. Deciding on the beginning of the Year, its duration, and period
2. Deciding on the duration of months;
3. Nomenclature of solar month;
4. Deciding on the beginning of the day;
5. Locating the central place in the country to calculate time;
6. Deciding on date and Constellation *vis* a *vis* festival to have synchronisation;

The Committee studied nearly 30 calendars and Panchangas prevailing in the country.

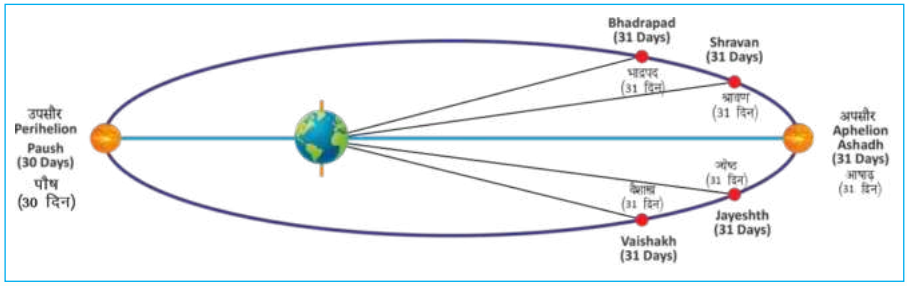
Scientific basis for the National Calendar

The celestial equator and the ecliptic cross at two cardinal points: ***vernal equinox*** and ***autumnal equinox*** (equal length of day and night with Sun's Declination zero). On the ecliptic, towards the North, the **summer solstice** (Dakshinayan) is the highest declination point of the Sun (23.5°N), and similarly, the **winter solstice** (Uttarayan) is the lowest declination point of the Sun (23.5°S) towards the South. These four points are of astronomical importance. The National Calendar starts from the day following **vernal equinox** as date **Saur Caitra 01** (22 March). The day next to Summer Solstice is **Saur Aashadh 01** (22 June). The day following autumnal equinox is **Saur Ashwin 01** (23 September) and the day after winter solstice is **Saur Paush 01** (22 December).



According to Kepler's Second Law, the Sun covers equal area in equal time intervals. One of the direct inferences is the Sun moves slower when near farthest distance (aphelion) and moves faster near the closest distance from the Earth (perihelion). From Fig. 2 it is clear that months from the vernal equinox to autumnal equinox need to have longer length, while the months from the autumnal equinox to vernal equinox need to have a shorter length to comply with the Kepler's Second Law. The same was suggested by the Calendar Reform Committee and proposed to have the length of months from Caitra to Bhadrapada should be 31 days while the days in months from Ashwin to Phalgun should be 30. The month of Caitra is 30 days in ordinary year and 31 days in a leap year.

The months in the National Calendar are named according to the Indian knowledge system. Nakshatra is a division of monthly path of the Moon divided into 27 equal parts and named after the bright stars called yogatārā. In Indian system, the month's name is derived the Full Moon near the yogatārā of a particular *nakshatra* which the Moon transits.



It is evident that the Indian National Calendar is based on a firm scientific foundation and the most scientific and accurate calendar in the world.

(With technical inputs from Dr Arvind C. Ranade, Scientist F, Vigyan Prasar)

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DHRUBAJYOTI CHATTOPADHYAY

CROWN SHYNESS: A Process of Physical Distancing Among Plants

For the last few years the term physical distancing or social distancing has gained considerable usage, thanks to the pandemic! It is advised to stay at least 6 feet (roughly about 2 arms' length) away from other persons both in indoor and outdoor spaces to slow the spread of the COVID-19 virus. You will be amazed to know that the plant world has been following the norms for ages! In forests, when you look up you will see a network of imaginary cracks formed by gaps between the outermost edges of certain tree branches. It looks like a precisely engineered jigsaw puzzle, each branch growing just perfectly so that it almost—but not quite—touches the neighbouring tree. It is really interesting to see how some trees maintain distance from others. This beautiful phenomenon is known as crown shyness or canopy shyness. Scientists still don't fully understand why few species of trees so often refuse to touch each other.

The phenomenon of crown shyness is known to us for a long time. In 1920s descriptions of crown shyness have appeared in some of the scientific literatures. But, the first scientific research on this topic started only in 1982. Eminent Biologist Francis "Jack" Putz one day strayed into a knot of black mangrove trees while conducting a fieldwork with his team members on March 1982. As he gazed skyward, he observed when the wind stirred the tops of the mangroves above him, it caused the limbs of neighbouring trees to claw at each other and snap off some of their outermost leaves and branches. Putz also noticed that this reciprocal pruning had left tracks of empty space running through the canopy. Putz concluded that trees need personal space and from then he started to work for unravelling the causes of this behaviour. Since then this phenomenon draw attention of the scientists and they are still working on it.

Species showing Crown shyness

Crown Shyness has been documented in forests around the world. From the mangroves of Costa Rica to the towering Borneo camphor trees of Malaysia, gaps can be seen in the canopies. There's a special structure for a forest called a cathedral forest, where the forest has lost its understory (underlying layer of vegetation) and the big, giant canopy trees kind of over-arch, and those are the most favourable places for crown shyness. However, there are plenty of forests where crown shyness is not found. The interesting thing is the younger the forest the rare it is, whereas in old forest there is maximum probability of crown shyness.

Some of tree species that usually display crown shyness are Black Mangrove, Eucalyptus, Camphor, Sitka Spruce, Japanese Larch, etc.

Probable causes of crown shyness

Trees might be tall and strong, but few of those are still a bit sheepish. There are a few hypotheses for their growth patterns that cause crown shyness.

a. Relation of Wind and Abrasion

Australian forester M.R. Jacobs, who studied the crown shyness patterns in eucalyptus in 1955, believed that the growing tips of the tree were sensitive to abrasion, resulting in canopy gaps. We know about Pruning in plants and often do it in our garden. In this process we artificially remove certain parts of trees and plants, such as branches, leaves and buds. It affects the lateral growth of the

trees. In nature it can happen due to winds. Blowing wind causes flexible branches of trees to move randomly which hit their adjacent trees. It gives rise to unnecessary pruning. So, pruning with the help of winds may lead to damage of important parts of the tree like foliage, which plays a vital role for performing photosynthesis. As a result, trees limit growth at these locations to avoid further damage. This reflects that for preventing unnecessary abrasion with neighbouring trees, trees may show crown shyness.

This theory makes sense, given that crown shyness is exhibited between trees of different and same species, and sometimes even between branches of the same tree. When researchers were able to prevent wind-induced collisions between trees, they filled in the canopy.

b. The Relation of the Blue-Green Pigment 'Phytochrome'

There is another theory for timid tree branches based on their ability to sense nearby plants. We know that Phytochrome is one type of photoreceptor in trees and plants which helps to detect light. They are sensitive to far-red and red region of the visible spectrum. Based on light sensitivity we may classify them as type I (activated by far-red light) and type II (activated by red light). Neighbouring plant detection is thought to be a function of several unique photoreceptors. Few plants are able to sense the proximity of any neighbour by sensing backscattered far-red (FR) light with the help of phytochrome photoreceptors. Phytochrome is responsible for expansion of lateral branches. When they receive the light directly from the Sun, both kinds of lights are received. But when the light falls indirectly on the leaves, much of the red light is already absorbed making greater far-red light reach the shaded leaves. The leaves can thus sense that the light coming on the top branches is not direct sunlight. This forces the branches and leaves to stop growing and avoid obstruction. Physical distancing on both ends ensures that neighbouring trees do not cover their crowns and minimize harmful competition for resources.

This theory could also explain why some trees do not exhibit crown shyness when interacting with trees of their own species. Studies have shown that some plants that sense nearby relatives will position their leaves to avoid casting shade on their kin, even at the cost of shading themselves. On the other hand, in dense forest the natural resources, especially sunlight, is limited. Hence this behaviour also helps other species to survive.

c. The Camphor Connection

Camphor ($C_{10}H_{16}O$) is a solid compound. Eucalypt and Dryobalanops are two most popular tree species, which show crown shyness. It is interesting to note that both of these plants have camphor. The essential oil extracted from their leaves have some amount of camphor. Studies are going on to find the role of camphor for crown shyness.

A recent study has suggested that 'Arabidopsis' shows different leaf placement strategies when they are grown amongst kin and unrelated conspecifics, shading dissimilar avoiding kin. This response was shown to be contingent on the proper functioning of multiple photosensory modalities. However, a strong link between photoreceptors and a crown asymmetry is yet to be proven experimentally.

d. Competition and Adaptation

Some species have gradually adapted to take advantage of crown shyness. They choose to grow into shapes that complement the nearby trees, so that they don't have to compete for canopy room. Thus, it helps both the species to survive; it is one kind of mutual relationship.

Benefits of crown shyness

As the natural resources are limited, plants, like any other living beings, compete for nutrients, water, space, and light in order to survive. In forested areas with dense canopies there is intense competition between plants for light. If there is a gap in the canopy resulting from crown shyness it will allow trees to increase their exposure to light and optimize the process of photosynthesis. Scientists are still debating on the potential causes of crown shyness, but they have agreed with the positive side effects of crown shyness.

In dense forest it is very rare that sunlight could reach the soil. But for any soil to become fertile sunlight is required. It is also essential for the survival of microbes and decomposers. Crown shyness allows the light to reach the forest floor, which could benefit other plants and animals that may in turn be beneficial to the trees.

Additionally, by having branches that do not physically touch those of their neighbours, trees may be able to limit the spread of harmful insects. Sometimes diseases spread from one plant to other when those are in contact. Through crown shyness plants avoid the transmission of harmful diseases.

Crown shyness teaches us a lot. Contrary to the concept of survival of the fittest, recent ecological development indicates sustainable coexistence and collaboration rather than competition.

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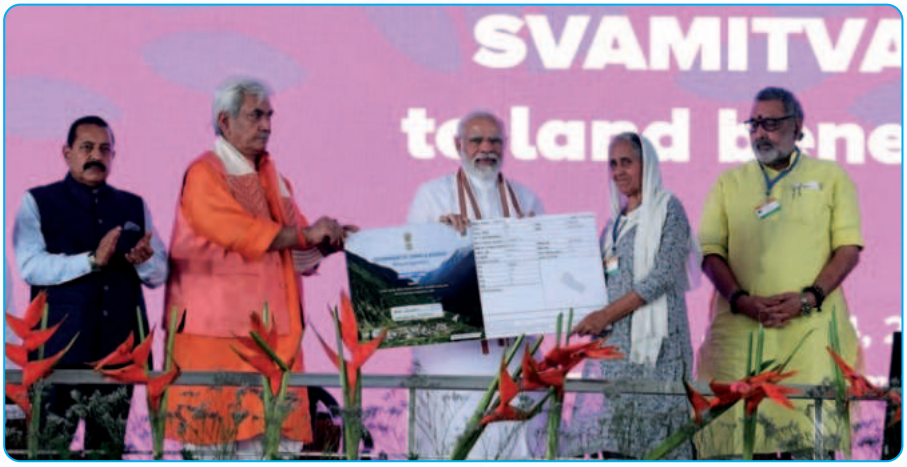
National Panchayati Raj Day 2022

If a village perishes, our nation perishes as well. Gandhiji envisioned democracy in every village. In order to revitalise rural development, Government of India established the Panchayati Raj system. To improve the grass-roots condition of rural India, the Ministry of Panchayati Raj started celebrating National Panchayati Raj Day every year on 24 April. Distribution of e-cards under the SWAMITVA Scheme was launched in 2010 on the Panchayati Raj Day. Every year the Ministry of Panchayati Raj awards the best panchayat based on their performance which is recommended by the State Governments and Union Territories administration. This year, the nation commemorated the 13th National Panchayati Raj Day in Palli panchayat of Samba district of Jammu Region. Hon'ble Prime Minister Shri Narendra Modi graced the event and inaugurated various scheme at Palli Panchayat. On this day 340 houses of Palli Panchayat was gifted with solar plant of 500 KW capacity. This technology is definitely going to help the household of Palli to have clean electricity making it the country's first carbon-neutral panchayat under the "Gram Urja Swaraj" programme of Government of India. Addressing the Gram Sabha across the country Hon'ble Prime Minister urged the nation to create awareness about malnutrition and anaemia among people. He inaugurated the Banihal Qazigund Road Tunnel. Apart from this he laid the foundation stone of three road packages of Delhi-Amritsar-Katra Expressway and also inaugurated rattle hydroelectric project on Chenab river in Kishtwar District. He also launched Amrit Sarovar–an initiative aimed at developing and rejuvenating 75 water bodies in each district of the country and also dedicated 108 Aushadhi Kendras to people of Jammu & Kashmir to avail quality medicines at affordable prices.



Hon'ble Prime Minister handing over property cards to beneficiaries at Palli under SVAMITVA Scheme

Union Ministry of Science & Technology in Jammu giving final touches to Technology Exhibition

The celebration was focussed on localised sustainable development goal which are a) Poverty and enhanced livelihood village; b) Healthy village; c) Child-friendly village; d) Water sufficient village; e) Clean and green village; f) Self-sufficient infrastructure in village; g) Socially secure village; h) Village with good governance; and i) Engendered development in village. The programme was organised under the aegis of the Ministry of Panchayati Raj in association with many other ministries. The event was marked with a three-day exhibition which was held under these localized sustainable development goals. Entrusted by Department of Science & Technology; Vigyan Prasar took the responsibility of organising this three-day exhibition. Council of Scientific and Industrial Research (CSIR), Department of Biotechnology (DBT), Department of Space, Department of Atomic Energy, and Ministry of Earth Sciences also showcased their technologies with the help of posters, films, etc. Several important instruments were also displayed at the exhibition.

Some latest innovations were on display that in future will enable farmers and Sarpanches to improve agricultural practices and in turn their income. Solar Dome Dryer and Domestic Egg Incubator for hatching poultry eggs, Robotic instruments called AGROBOT, Geo-spatial tool, weather forecast app for rural development and farmers, Lavender cultivation known as purple revolution, aroma mission, Floriculture mission; Biotechnology innovations to increase apple production for farmers' income, technologies such as use of drones for pesticide spraying and waste treatment, and increasing shelf life of fruits through nuclear radiation were exhibited during the exhibition.

The emphasis of this event was to display science and technology in an integrated manner with the theme of Rural Development and Panchayati Raj. Such exhibitions prove that how important it is to develop our village for sustainable growth of the nation.

Dr Gaurav Jain, Mansee Upadhyay,
Dr Avilekh, and Dr K B Bhushan.