



# S&T Newsletter

## FROM THE DG'S DESK

GREETINGS from the NAM S&T Centre!!



The impact of COVID-19 Pandemic has been so much that the whole world is struggling to attain a new equilibrium and the NAM S&T Centre is also trying its best to pursue the S&T activities and deliver the best with an excellent support from our Focal Points and Industry Network Members.

It gives me an immense pleasure to inform you that the Centre is continuing to organize Virtual Events on various S&T issues by inviting participation of our stakeholders from NAM and other developing countries. I am happy to share that the Centre organised an International Roundtable on "*Policy Development in Lightning Hazard Mitigating Strategies in Countries with High Ground Flash Density*" in partnership with the Centre of Excellence on High Voltage Engineering (CEHVE), University of the Witwatersrand, Johannesburg, South Africa; South African Institute of Electrical Engineers (SAIEE), Lightning Chapter; and the Department of Science and Innovation (DSI), Pretoria, South Africa during 11-12 May, 2021 in Virtual Mode. The event was a great success and more than 160 scientists and professionals from 25 countries participated in the event.

During the last quarter, the Centre has also published a book entitled "*Air Pollution and Public Health – Challenges, Interventions and Sustainable Solutions*" edited by Dr. Nour Shafik El-Gendy from Egypt and Dr. Vartika Mathur from India.

Keeping in view the ongoing restrictions on international travel and unsure of the COVID-19 crisis, the Centre has announced the organisation of two scientific events through online platforms – an International Workshop on "*Energy Security and Energy Access: Health Implications of Poor Energy Quality in Developing Countries*" during 26-27 July, 2021 in partnership with the CSIR-Indian Institute of Petroleum (IIP), Dehradun, India; and another International Workshop on "*Smart Agriculture for Developing Nations: Broader Perspectives and Special Challenges for Island States*" in partnership with the Ministry of Education, Tertiary Education, Science and Technology, Phoenix, Republic of Mauritius during 11-12 August, 2021. Interested Scientists and professionals with relevant background may send their request to the Centre.

A number of scientific programmes on a range of topics have been also planned by the Centre for the near future and we look forward to receive nominations for participation from our Member Countries and the global scientific community.

I would like to take this opportunity to thank you all for being a part of our success story and the long and eventful journey so far.

Stay Safe and Happy Reading!

*Amitava Bandopadhyay*  
**(Amitava Bandopadhyay)**  
 Director General



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 Centre for Science and Technology of the Non-Aligned  
 and Other Developing Countries (NAM S&T Centre)

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## Centre Organised

### INTERNATIONAL ROUNDTABLE ON POLICY DEVELOPMENT IN LIGHTNING HAZARD MITIGATING STRATEGIES IN COUNTRIES WITH HIGH GROUND FLASH DENSITY

**11-12 MAY, 2021**  
**(Virtual Mode)**

Safety and protection techniques used in lightning play an important role in preventing human, livestock and economic losses in countries with high ground flash density. Africa, South America, South and South East Asia can be rated as the regions with the highest lightning impacts in the world.

Awareness on lightning safety is insignificant as a matter of concern in most parts of the world. Interestingly, the correct knowledge about lightning safety and protection techniques is quite poor even among the electrical engineering community including electricians and installers and the commercial sector in the lightning protection business itself.

At the administrative level, issues on lightning safety have been totally overlooked in almost every safety guidelines in both government and non-governmental sectors. This is true for both the developing as well as developed countries. It is interesting to note that the '*Occupational Safety and Health Act*' published by many developing countries do not even mention about lightning safety, preparedness and its related issues.

The above scenario describe evidently the non-proactive perspectives of the state, professionals and academic bodies on lightning related risks. Lack of public awareness and insignificant educational programs on lightning emergency and preparedness is mainly attributed to negligence from state-level to recognize lightning and thunderstorms as a serious extreme natural event that disrupts public life and create significant economic losses as well as loss of human lives.

As the lightning related scientific community views, a feasible solution will be the incorporation of lightning safety strategies into national disaster mitigation frameworks, roadmaps, guidelines and national policy documents.

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In order to discuss various issues on the above subject, the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi; in partnership with the Center of Excellence on High Voltage Engineering (CEHVE), University of the Witwatersrand, Johannesburg; South African Institute of Electrical Engineers (SAIEE), Lightning Chapter; and the Department of Science and Innovation (DSI), South Africa organized a comprehensive two-days International Roundtable on **'Policy Development in Lightning Hazard Mitigating Strategies in Countries with High Ground Flash Density'** during **11-12 May, 2021**. The Roundtable was hosted by CEHVE, University of the Witwatersrand, Johannesburg, South Africa and organized in **Virtual-Mode**.

The **Inaugural Session** was facilitated and moderated by **Prof. Pat Naidoo**, Member, South African Institute of Electrical Engineers (SAIEE), Lightning Chapter.

A Welcome address was made to the audience by the Chairman, SAIEE-LC; **Dr. Andreas Beutel**. During his address, Dr. Beutel suggested that thunderstorms and lightning should be considered as 'dangerous weather emergency' and particular attention should be given to safety and preparedness guidelines, understanding basic physics of lightning, injury mechanisms, lightning detection and early warning systems.

Introductory remarks were then made by **Dr. Amitava Bandopadhyay**, Director General, NAM S&T Centre, New Delhi. In his address, Dr. Bandopadhyay expressed his gratitude to his long-time friend and collaborator, Prof. Chandima Gomes from CEHVE, University of Witwatersrand, Johannesburg, South Africa, for organizing and hosting this program. He also thanked the other key partners (SAIEE and DSI) and associated partners (ACLENNet, ZaCLIR and SALNet) of the program for their valuable intervention. He briefed about the significant contributions made by the NAM S&T Centre in capacity building and exchange of knowledge among its Member Countries on the subject of *'Lightning'* and other extreme natural events in partnership with various S&T institutions and agencies by organizing international workshops, roundtables and training programmes.

**Mr. Selby Modiba**, Deputy Director, Multilateral Cooperation, Department of Science and Innovation, South Africa, talked about the role of South Africa - "the lightning capital of the world" in improving lightning safety.

Following this, the organiser and host **Prof. Chandima Gomes**, Director, CEHVE, University of the Witwatersrand, South Africa, explained the purpose of organising the event.

The two days dynamic Roundtable was attended by about 160 participants from 25 countries including **Australia, Bangladesh, Colombia, Eswatini, France, India, Iran, Iraq, Kenya, Malaysia, Mauritius, Myanmar, Nepal, Nigeria, Pakistan, Palestine, Sri Lanka, Thailand, UAE, Uganda, United Kingdom, United States, Zambia, Zimbabwe** and the host country **South Africa**.

The program was graced by the honourable presence of the Chairman, South Asian Meteorological Association (SAMA); **Prof. Ajit Tyagi**, and Senior Member, **Prof. Someshwar Das**, who were invited as special guests.

**Technical Session 1** was moderated by Dr. Hugh Hunt (SAIEE-LC) & Mr. S. Gopakumar (TC81-India).

A presentation on **'Lightning Accidents and Prevention Strategies Adopted in Sri Lanka'** was given by **Mr. Nuwan Kumarasinghe**, Former Chief Electrical Engineer, Department of Meteorology, Sri Lanka. Mr. Kumarasinghe in his presentation summarized the different approaches adopted in Sri Lanka for lightning mitigation such as: (i) lightning research studies, (ii) policy/standard implementation like adoption of IEC 62305 & IEC 61643 lightning protection standards in 2014, TRCSL guidelines in 2010/2017, lightning policy development etc. (iii) awareness programmes for school children, government officials, farming community, technical personnel in various sectors, (iv) LPS consultancy services and LPS installation for government-sector institutes and some vulnerable villages in Sri Lanka.

Following this, **Dr. Ken Nixon**, Member, South African Institute of Electrical Engineers (SAIEE), Lightning Chapter, gave a talk on **'Thunderstorm Related Risks in South Africa - Lightning and Protection'**. Dr. Nixon in his presentation provided an overview on lightning physics, lightning safety guidelines (including general guidelines, protection guidelines, weather and monitoring guidelines), injury mechanisms, lightning detection (like early warning systems: handheld, fixed installation and post event detection and location systems), road to safety (like a lightning siren to immediately seek shelter, personal vigilance in case hear thunder, flash to bang lightning warning method / 30-30 rule for lightning safety, establishing a guideline or plan) and people & beliefs.

**Dr. Shriram Sharma**, Director, South Asian Lightning Network (SALNet), Nepal, provided an interesting presentation on **'National Heritage in Danger due to Lightning'**. Through a pictorial presentation, Dr. Sharma showcased some major reported damages to national heritage monuments, temples and churches caused by lightning strike.

With her inspirational journey and long experience in the field of lightning safety and education, **Prof. Mary Ann Cooper**, Director, ACLENNet, Uganda/United States, engaged the participants' interest with a talk on **'Lightning Mitigation Efforts Being Made in Africa - African Centres for Lightning and Electromagnetics Network'**. Prof.

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Cooper in her presentation underlined that ACLENet is strongly dedicated towards decreasing deaths, injuries and property damage from lightning across Africa. Training regional/district teacher-trainers in lightning science and safety will help dispel harmful traditional beliefs in witchcraft and curses and gather data on local injuries to improve injury database. Also, providing right professional education to engineers, architects, LP designers and installers working with the existing lightning protection systems will help make LPS available at reduced costs to Ugandan engineers and installers and with improved designs and installations.

Thereafter, **Ms. Foster Lubasi**, Director, ZaCLIR, Zambia, drew attention of participants with her lecture on '**Major Challenges in Mitigating Lightning Risk in Africa**' emphasizing that people in Africa perceive lightning as witchcraft/horrendous ghastly myth, disbelieving it as a scientific natural phenomenon. She said that although, the centres for lightning research are not yet fully established in most African countries, the formation of lightning centres in Zambia and Uganda is helping in bringing the discussions on lightning fatalities to the forefront.

A lecture on '**Global Lightning Density Distribution and Loss Statistics**' was given by **Mr. Ronald L. Holle**, Senior Scientist, VAISALA, USA. In his presentation, Mr. Holle underlined that the global lightning fatalities and threats to people are decreasing in developed countries but major factors contributing to increasing number of reports of lightning casualties in developing countries are: (i) involvement of larger population in labour-intensive agricultural work (ii) unavailability of lightning-safe buildings or vehicles (iii) poor lightning awareness, detection, warnings, and medical care, etc.

**E.E. Daniel Esteban Villamil Sierra**, Lightning safety researcher and promoter, Universidad Distrital Francisco José de Caldas-UDFJC, Colombia, delivered a presentation on '**Lightning Safety Module Developed in Colombia**'. E.E. Sierra in his study provided the lightning mortality data from the scientific studies made in Colombia and development of lightning safety module through: (i) creation of a lightning safety comic strip (ii) development of a lightning safety documentary for Colombian rural population (iii) implementation of lightning safety radio advertisements (iv) addition of lightning to the UNGRD Climate Change Mobile (app and risk awareness website) (v) inclusion of lightning risk in the UNGRD Knowledge Committee.

The day got concluded with **Q&A round and discussion** which was moderated by Prof. Pat Naidoo (SAIEE-LC).

**Technical Session 2** was moderated by Prof. Mary Ann Cooper (ACLENet) and Ms. Foster Lubasi (ZaCLIR).

A presentation on '**Electrical Safety - National and International Standards**' was given by **Mr. S. Gopakumar**, Managing Director, Cape Electric Pvt. Ltd., Chennai, and IEC 62305-TC 81 Mirror Committee, India. In his presentation, Mr. Gopakumar discussed at length about lightning safety standards. ISO, IEC and ITU are recognised as international standards of lightning safety whereas EN (EU nations), BS (UK), DIN (Germany), NF (France), ANSI (USA) are national standards of a nation / region influenced by the local/historic/cultural requirements. VDE (Germany), IET (UK), NFPA (USA), UL (USA), IEEE (USA) are associations for trade/ engineering development / private organisations. The standards made by these organisations e.g. NFPA 70 (National Electrical Code – USA), NESC (National electrical safety code – USA), BS7671 by IET (UK), DIN VDE 0100 (Germany) are recognised as national standards by the respective governments due to some historic reasons. Some national standards may contain biased information, hence shall be used very carefully. He stressed the use of standards made by ISO/IEC/ITU in under-developed and developing nations to ensure non-discriminatory and transparent business.

An expert in lightning protection, grounding and bonding, and the host of the program **Prof. Chandima Gomes**, Director, CEHVE, University of the Witwatersrand, South Africa, delivered a training lecture to the participants on '**Lightning Safety Measures for Small Structures in the Industrial Sector and Under-privileged Communities**.' His study in African continent revealed that a clear majority of lightning fatalities in the developing world are related to "indoor accidents", as in most under-privileged communities home is just a 'temporary hut'. Thus, the solution is either to provide lightning protection to these structures through structural protection system (external and internal protection system) or guide the people to a purpose-made lightning safe structures under the thunderstorm conditions.

**Dr. Senaka Basnayake**, Climate Resilience Director, Asian Disaster Preparedness Center (ADPC), Bangkok, Thailand, and an expert in disaster risk management and extreme weather events spoke on '**Regional Cooperation on Disaster Management Policy Development for Lightning Hazard**.' Dr. Basnayake discussed that the regional cooperation for lightning risk management is guided by global frameworks for disaster management, climate adaptation & sustainable development [Sendai Framework for Disaster Risk Reduction (SFDRR), Paris Agreement on Climate Change and Sustainable Development Goals] to develop a regional mechanism for lightning risk management. This is coordinated by regional and UN organizations like NAM S&T Centre, ADPC, RIMES, UN agencies etc. and National Disaster Management Organizations (NDMOs) and technically supported by National Meteorological and Hydrological Services (NMHSs), academia, research and development institutes/agencies.



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Following this, **Prof. Robert Jallang'o Akello**, Professor, The Technical University of Kenya spoke on the theme, '**Real Time Lightning Monitoring and its Applications for Curbing Lightning Accidents**'.

A presentation titled '**Government Actions against Non-Standard Lightning Protection Systems**' was delivered by **Prof. Zainal Kadir**, Professor, Advanced Lightning, Power & Energy Research Center (ALPER), UPM, Malaysia. Prof. Kadir with his expertise in high voltage engineering identified some key issues in lightning protection such as (i) unsound knowledge of lightning protection among the responsible parties [e.g. risk assessment standards (national/international)], (ii) unsafe selections by the opportunistic vendors [e.g. non-conventional systems, no justification on selection – specifications and location], (iii) rigorous and aggressive promotion of non-conventional systems [e.g. technology, simplicity, reward to promoter], and (iv) significant problems in the installation and maintenance of wiring systems [e.g. earthing, wiring system, supervision during installation] and provided with some concrete actions taken by the government against such non-standard lightning protection systems.

**Mr. Likezo Musobani**, Principal Early Warning and Preparedness Officer, Disaster Management and Mitigation Unit (DMMU), Zambia, took over the last session on '**Curbing Extreme Weather Related Losses in Zambia**.' He highlighted that the Zambian government through DMMU has recognised lightning as a serious natural hazard and has partnered with the Zambian Centre for Lightning Information and Research (ZaCLIR) to curb the lightning related losses in the country. DMMU further hopes to strengthen collaboration with ZaCLIR to effectively manage the hazard of lightning in the country by preparing a five year strategic plan as a road map to curb lightning related fatalities, injuries and damages in the country.

A Panel Discussion on **Developing National Frameworks for Curbing Lightning Related Losses** was held which was moderated by Prof. Chandima Gomes. The **Panel Members** included: Prof. Mary Ann Cooper (USA), Prof. Zainal Kadir (Malaysia), Dr. Senaka Basnayake (Thailand), Dr. Shriram Sharma (Nepal), Dr. Amitava Bandopadhyay (NAM S&T Centre), Mr. John Dlamini (South Africa) and Mr. S. Gopakumar (India). Questions were asked to Panel Members on basis of their expertise in the subject.

Prof. Cooper shared her experience in promoting lightning safety in Africa when she expressed that the North-American standards for lightning safety and protection cannot be imposed on other countries and in regions like Africa. A lightning safety module should be unique to a region considering various socio-economic factors such as literacy rate, urban-rural ratio, cultural and religious practices, level of exposure of the region, topology of the region etc.

Dr. Sharma advised countries which have not yet adopted/implemented lightning protection standards to do so at the earliest in their disaster mitigation framework. He also shared the experience of his native country Nepal for integration of lightning as a risk in disaster management policy. He indicated that Nepal and other countries like India, Bangladesh and Sri Lanka are facing similar challenges with implementation. Encouraging governments and policy-making bodies in these countries may help in execution.

During the discussion, Dr. Basnayake spoke about the scope of ADPC to support Asian countries in mitigating adverse effects due to natural atmospheric extreme events. He briefed that ADPC is dedicated towards working for disaster risk reduction in Asia and Pacific region. ADPC has developed mechanism to interact with the governments and closely works with the national disaster management organisations as members, as well as national meteorological and hydrological services and other sector organisations. For an efficient and effective early warning systems for disaster risk reduction, ADPC works at all levels - regional, national, sub-national, local and committee level.

Mr. Dlamini shared views of South Africa in promoting and ensuring implementation of lightning protection standards among the industrial sector and general public. He elucidated that without enforcement by governments and regulators, it is very difficult to implement lightning protection standards in a country. However, South Africa has done a lot in lightning protection research. South Africa is developing a lightning standard in addition to IEC 62305 in order to cover several aspects which have not been covered by IEC 62305 (e.g. protection of trash roofs and risk assessment of solar PV systems alone).

Afterwards, Dr. Bandopadhyay described at length the role of the NAM S&T Center in promoting national framework among its 47 Member Countries. He elaborated that the NAM S&T Centre facilitates dissemination of information in areas like disaster management and extreme natural events through organization of seminars, workshops, roundtables etc. to generate awareness on major issues for formulation of appropriate policies and guidelines. The Centre interacts with its Member Countries and other stakeholders to facilitate creation of reliable database on disaster mitigation and management and sharing of best practices. The Centre also sensitize Member Countries to form Task Forces for regional cooperation on disaster mitigation, publish books, monographs, state-of-the-art reports and disseminate knowledge through print and electronic media.

Mr. Gopakumar then provided his views on the role of industrialists, NGOs, and community to ensure implementation of good lightning protection systems in a country. He underlined that from government, scientific bodies, engineers and

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businessmen to final end users all have equal responsibility to implement good lightning protection systems in a country. However, in countries like India, Bangladesh, Sri Lanka, Nepal, the governments have a major role to play in implementation of disaster safety measures. Governments should collaborate with concerned agencies to frame regulations to ensure that people in villages are protected against lightning.

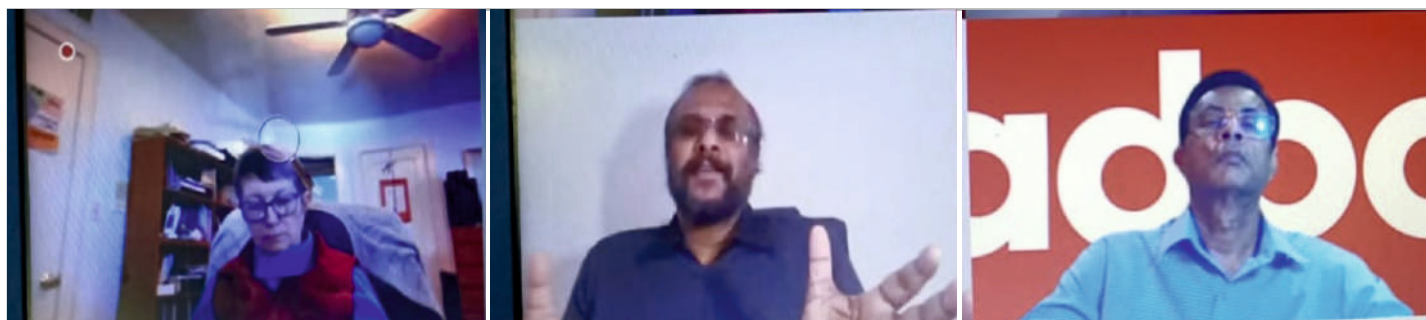
Prof. Kadir shared his success story of Malaysia in implementing national policy and national law/legislation on non-standard lightning protection systems. He highlighted that Malaysia follow hierarchical governance for implementation of non-standard lightning protection systems - from ministries, regulators, to agencies and researchers (such as Department of Standards, Ministry of Works, Ministry of Housing and Local Government, Energy Commissions and Research Centres). However, some countries do not have this kind of arrangement like Malaysia to govern the legislative innovators. Thus, this structural arrangement of Malaysia should be replicated in other countries.

Lastly, Prof. Someshwar Das, Convener, South Asian Meteorological Association (SAMA) shared his views that the Lightning Hazard Mitigating Strategies should include an early warning system for lightning strike potentials (lightning potential indices, flash rate densities and their probabilities). He mentioned that the Lightning Safety Policy and Framework group should also include Atmospheric Scientists and Meteorologists. He mentioned that the lightning safety hardware can only protect from the current occurrences of the lightnings, but the early warning systems can alert the people on the probabilities of the occurrences of lightning at any location and time as well as the intensity of the lightnings (low, moderate or severe) at hourly intervals, well in advance, which are very important for the lightning safety. He mentioned that the India Meteorological Department (IMD), the National Centre for Medium Range Weather Forecasting (NCMRWF) and the Indian Institute of Tropical Meteorology (IITM, Pune) are providing lightning forecasts on routine operational basis up to 72 hours lead time based on the complex Numerical Weather Prediction (NWP) Models at very high resolution. None of the countries in this region provide the lightning forecasts. The lightning forecast maps produced by India can cover the neighbouring countries and can be useful to the entire South Asian region. IMD/IITM have also developed an App called "Damini", which provides the current locations of lightnings and their nowcasting based on the ground lightning networks of India. The lightning warning system is based on the complex cloud models, which predicts the lightnings using the hydrometeor contents of the Cumulonimubs clouds and the updraft/ downdrafts within them. There is a need to compute the skill scores of these forecasts and improve them, which is gigantic challenge. The lightning flash rates observed from satellites and the ground detection networks have also to be assimilated in the NWP models for improving the forecasts. There is a need to emphasize on these aspects as well as capacity building of countries in this area.

In addition to the panel members, some of the participants made their observations. Mr. Hafiz Ali Raza, Institute of Agriculture Extension, Education and Rural Development, University of Agriculture, Faisalabad, Pakistan, resolved some myths and misconceptions about lightning strike like lightning never strikes twice at the same place or some metal objects attract lightning. It is important to understand the facts from fiction and therefore, Lightning Safety Awareness (LSA) Campaigns are essential to provide lightning protection and safety education to prevent injuries and deaths.

The **Concluding Remarks** were given by Dr. Amitava Bandopadhyay, Director General, NAM S&T Centre. He concluded that there is an urgent need to give "**Lightning**" its due attention as a serious natural disaster and a priority in national disaster management program. There is also an urgent necessity to develop national framework to curb lightning related losses and integration of lightning policy into the existing disaster management framework of the NAM and other developing countries. As a recommendation of the program, a template **Guideline Document** would be prepared for the '**Development of National Lightning Safety Policy and Framework**' for its circulation to the NAM Member Countries and other stakeholders of the program. In addition, with the contribution of all the key and associated partners of the program, it was recommended to prepare a "*Concise Three-year Action Plan*" (One page document) for taking forward the "Lightning Safety and Protection Program" in the developing countries.

A **Vote of Thanks** was given by **Dr. Hugh Hunt** from the University of the Witwatersrand, Johannesburg, South Africa.



## Special Features

### DEVELOPMENT AGENDA 2030: ON CONTRIBUTING TOWARDS ACHIEVING SDG - 14 IN PARTNERSHIP WITH NAM S&T CENTRE

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Oceans and seas are an integral part of the United Nations Development Agenda 2030. Sustainable Development Goal 14 (SDG14) is specifically meant to “conserve and sustainably use oceans, seas and marine resources for sustainable development”. Reaping benefits from the ocean's wealth while sustaining ocean health is at its core. Because of the ocean's regulatory role in Earth's climate and its social and economic functions, SDG #14 has direct bearing on the implementation of other SDGs (e.g., 1 No poverty, 2 Zero hunger, 3 Good health and well-being and 8 Decent work).

Goods and services provided by oceans and seas are estimated by the UNDP to have a GDP potential of about a trillion dollars; about 500 million jobs come from ocean sectors such as for example, fisheries and aquaculture, shipping, energy and mineral resources as well as tourism. This economic potential is under threat from climate change in many regions. Especially regions in Asia and Africa have been identified as some of the most vulnerable regions by the Intergovernmental Panel for Climate Change (IPCC). There, coastal seas on which lives of millions depend for food and income are already threatened by other environmental changes. These, and a lack of capacity to deal with them hinder nations to make the best use of ocean resources for development initiatives under what is commonly called “blue economy”.

Coastal seas and oceanic regions take up carbon dioxide from the Earth's atmosphere by a variety of physical and biogeochemical processes. These processes have ensured the removal to the ocean of about one third of carbon emitted to the atmosphere by human activities since the Industrial Revolution. They thus represent major carbon sinks that need to be conserved and restored. However, the enhanced uptake and the attendant changes (for example, in ocean chemistry and consequent ocean acidification), are affecting the quality of goods and services provided by oceans and seas.

Among challenges faced especially by developing nations today is the need to better understand the scientific underpinnings of processes that drive and sustain ocean and coastal ecosystems and their response to changes, both natural and human-induced. Changes are brought about by heat waves, sea level changes, acidification (global warming), pollution and eutrophication (introduction of nutrients, waste, chemicals, plastic), habitat destruction (deforestation, seabed mining), biodiversity changes and extinction (overfishing, warming). Superimposed on these are extreme events from seafloor and atmospheric perturbations (tsunamis, storm surges, cyclones). The impacts on ecosystems also affect the social and economic structures of societies, especially those that are dependent on resources from the sea.

Among targets set by the SDG 14 are, for example, prevention or reduction of pollution from land, restoration of damaged ecosystems, creation of protected areas, combating of ocean acidification. These require actions both global and local. Currently for many developing countries, taking actions towards achieving the targets will be a huge challenge because of lack of capacity and resources. Here, SDG 14 calls for an increase in scientific knowledge and development of research capacity.

For many developing coastal states, extended maritime jurisdiction brings with it a new set of challenges. Lack of adequate scientific and technical information from these extended areas interferes with informed policy and decision-making process. To benefit from resources available in these extended marine areas, countries need to explore them. This requires a diversification of coastal and marine research with multi- and interdisciplinary scientific activities as well as large scale data handling and management.

All these are challenges with impacts that are transboundary. There is the potential for conflicts over national sovereignty claims. They need to be resolved through a better understanding of the marine systems in question, through negotiations on access to them as well as by participation in international arrangements and formulation of national and international marine policies and jurisdiction. An example is that of the South China Sea, where a lack of scientific basis in the exploitation of renewable and non-renewable resources appears to be one of the main causes of conflicts in economy, society and maritime security. These conflicts become more and more serious as riparian nations having limited capacity become aware of the potential of marine resources to fuel their national



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development. The challenge in such situations will be to exploit marine natural resources scientifically and sustainably without compromising maritime security and territorial sovereignty of riparian countries. Capacity to develop tools for the assessment of ecosystem services and the analysis of benefits from diverse, developing marine economic sectors will allow designing international cooperation and guiding negotiations to sustainably exploit transboundary marine resources. The current intensification of the search and exploitation of renewable and non-renewable resources will only exacerbate these conflicts and challenges. Crucial in dealing with them is cooperation among riparian nations with the capability to address and respond to them.

Developing the needed capacity calls for simultaneous measures and interventions in diverse areas such as marine scientific research, development of adequate tools of assessment and analysis, technology development and application, ocean policy development and implementation (governance), regional and international science diplomacy. This is tantamount to developing ways to train a new breed of ocean professionals who can also: (i) appreciate the conflict potential of the involved issues, (ii) help build consensus in policy making at national, regional and global levels and (iii) can assist at regional and international negotiations.

### Contributions from NAM S&T Centre

Member states of the NAM S&T Centre have jurisdiction over approximately 60% of the world's coastline and their associated marine areas. Some of these marine regions are rich in living and non-living resources. Although there are member states with capabilities for advanced oceanographic research and exploration, many are only beginning to build capacity to take advantage of them for national development.

For more than a decade now, NAM S&T Centre has been contributing to ongoing international efforts to develop capacity and infrastructure for the sustainable use of the oceans and coasts. The current programs and instruments (Scientific Conferences, Training Workshops, Fellowships, Scientific Publications) of the NAM S&T Centre are on par with those being successfully employed by major international inter- and non-governmental organizations handling ocean affairs. Through our Institutions in Germany, Indonesia and Vietnam we were fortunate to have been participants of the ocean-related activities of the NAM S&T Centre.

In the aftermath of the Indian Ocean Tsunami, we partnered with NAM S&T Centre to bring together experts from member states and those from Europe within a Conference and Training Workshop on "Coastal Ecosystems: Hazards, Management and Rehabilitation". This was held at the General Soedirman University in Purwokerto in Indonesia.

Through cooperation with the NAM S&T Centre, we had unique opportunities to promote awareness in developing countries on the potential of ocean resources to contribute to national development and to point out the need to give the affairs of oceans and seas the policy and budgetary priorities they deserve. We could highlight the role of international cooperation in ocean research as a tool in what could be termed "science diplomacy" and the need for capacity development to enable participation in such cooperation.

NAM S&T Centre's Fellowship programs in cooperation with Institutions in Africa, Asia and Europe bring together young talents from NAM countries to work at internationally reputed scientific and technological institutions. While promoting the careers of young Fellows, these programs are of immense value to the host Institutions, who benefit by expanding their cooperative networks and extending their knowledge horizon. We have been fortunate to be part of the development and implementation of one such program in ocean-related topics. We thank the former Director General Professor Arun Kulshreshtha and his colleagues for their support and guidance for our jointly conducted activities mentioned above.

We are pleased to hear that NAM S&T Centre is planning to expand the scope of its current programs to include more ocean-related themes that are of interest to NAM nations. We like to bring up an idea which we had brought up earlier: establishing a "Training Centre for Sustainable Oceans" in one of the NAM S&T Centre member countries to conduct periodic international training programs and workshops in ocean-related themes. With its worldwide network with at least some members with excellent ocean research and exploration capabilities and its potential to make use of the best available training tools and technologies, NAM S&T Centre is uniquely placed to launch such an initiative. This could be part of its continuing contribution to United Nations Development Agenda 2030 and towards the United Nations Decade of Ocean Science for Sustainable Development (2021-2030), in particular.

We are grateful to the current Director General Dr. Amitava Bandopadhyay for inviting us to contribute to the 30th Anniversary Compendium and to share our thoughts on NAM S&T Centre's valuable contribution to capacity development in the marine sector and, especially to achieving SDG 14. We wish Dr. Bandopadhyay and his colleagues success in taking the Centre's activities and programs to new heights in the coming years.

*Reprinted from NAM S&T Centre Publication titled, "In Pursuit of Science, Technology & Innovation – Three Decades of NAM S&T Centre: A Compendium"*

## SCIENCE, TECHNOLOGY AND INNOVATION (STI) FOR ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS (SDGS) OF NEPAL

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### Background

The Centre for Science & Technology of the Non-aligned and other Developing Countries (NAM S&T Centre) was established in 1989 as an Inter-governmental Organization. The decision for its establishment was made after various Summits of the Heads of State or Government of the Non-aligned Movement (NAM) countries in order to promote South-South Cooperation in Science and Technology. Since its establishment, NAM S&T Centre has been conducting training, workshops, implementation of multilateral collaborative projects and fellowship programs and publication of books and reports on scientific topics through networking, sharing of knowledge and pooling of the resources. Among forty-seven member states of the NAM S&T Centre, Nepal has been the member from the beginning of its establishment. Nepal Academy of Science and Technology (NAST) was established as an apex body of Science and Technology in 1982 and strengthened by the Parliamentary Act in 1992 for the promotion and development of science and technology of Nepal. It has been working with NAM S&T Centre as a national focal point for Nepal since 1993. Since then NAST is actively participating in the NAM S&T Centre's activities and collaborating in various events. In the August of 2019, NAM S&T Centre is going to celebrate its 30th Anniversary and it is going to bring out a Commemorative Compendium on this occasion. In this context, this is an article that highlights the role of Science, Technology and Innovation (STI) for achieving the Sustainable Development Goals (SDGs) of Nepal.

### Introduction

Nepal is small but beautiful landlocked country in between two giant countries India in three directions (East, West and South) and China in the North. Naturally and culturally rich country Nepal is also famous globally as country of Mount Everest and Birthplace of Lord Buddha. It has become a Federal Democratic Republic Country since 2008 with seven provinces. Now it has seven provinces, seventy-seven districts and 753 local units (293 Municipalities and 460 Rural Municipalities). Nepal has adopted a new Constitution that protects the democratic and fundamental rights of its people. The country has been now emphasizing for the empowerment of the people and ensuring higher, sustainable and equitable growth. In the political and social fragile post-conflict situation, Nepal is trying its best to reduce existing poverty level, inequality and social exclusion.

Despite the long political instability and in the absence of elected representatives at local levels for longer time in the recent past, the progress made in achieving the Millennium Development Goals (MDGs) was satisfactory. Nepal is a least developed country (LDC) with characteristics of slow economic growth and low level of human development. The country has set the goal of graduating from LDC status to developing country by 2022 and achieve middle income Country Status by 2030.

The status of Science, Technology and Innovation (STI) is also a major indicator of the development of any country. Since the time of Gopal dynasty, which is regarded as the first dynasty of Nepal, it has been traced the development of science and technology in Nepal with knowledge of animal husbandry, agriculture farming, traditional medicine and use of bamboo in construction work. In 1951, 104 years' autocratic rule of Ranas was eliminated and democracy was established in the country which paved the path to modernization. The country started its planned development with the introduction of first Five Year Plan in 1956. It took about 30 years to recognize science and technology sector as a means of national development. Only in the sixth Five Year Development Plan (1980-1985), National Planning Commission explicitly included Science and Technology statement policy for the first time. After this, Science and technology has been continuously getting priority in each and every National development Plan of the government. An autonomous apex body, Nepal Academy of Science and Technology was established in 1982 AD (and strengthened with parliamentary act in 1992) to promote Science and Technology in Nepal. The first national Science and Technology Policy for Nepal was formulated by NAST in 1989. Second Science and Technology policy of Nepal was formulated in 2005 and recently Science, Technology and Innovation (STI) policy has been formulated by the Ministry of Education, Science and Technology. A separate Ministry of Science and Technology was established in 1996 for the development of science and technology in the country. After that, the Ministry of Science and Technology sometimes stood separately and sometimes merged with other ministries. However, the plans and programs for the development of STI have been executed centrally by the Ministry in Nepal. But unfortunately, total annual Research and Development expenditure in Nepal is approximately estimated as 0.35% of GDP only and is also less than 1% of the total budget.



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## Sustainable Development Goals of Nepal

Nepal has strong global commitment to achieve the Sustainable Development Goals (SDGs) by 2030. But for the less resourceful country like Nepal all the 17 SDGs and 169 targets need to be prioritized, localized and motivated for a bottom up path towards greater progress for achieving the goals. More than 230 indicators have been suggested to measure and track the progress globally, which have been localized. According to the preliminary estimation made by the National Planning Commission (NPC) in 2017, the annual investment required for the entire SDG period, 2016-2030, ranges from 42-54 percent of GDP. The average requirement estimated is about 16 billion US \$ per year or nearly 49 percent of GDP over the entire duration of the SDGs. To meet the huge investment for achieving SDGs the efforts of government of Nepal alone is not sufficient; therefore, partnership approach needs to be adopted. The NPC, an apex government planning body is the focal organization leading the activities for SDGs. The government has formed a SDG Steering Committee, which is chaired by the Prime Minister, who is also the Chairman of the National Planning Commission. The other members of the steering committee are Finance Minister, Foreign Minister, Chief Secretary of the Government of Nepal and the Secretary of NPC as the Member Secretary. This committee can invite members from academic institutions, private institutions, non-governmental organizations, civil societies, media and others. The committee provides policy directives, provides conducive policy environment and builds partnership for achieving SDGs. For coordination and implementation there is Coordination and Implementation Committee under the leadership of the NPC vice-chairperson. This committee guides the line ministries on mainstreaming the SDGs into national, provincial and local plans; arranging financial, human and technical resources. Nine SDG implementation and Monitoring Thematic Committees have also been formed under the leadership of the related NPC members for economic development, industrial development, urban development, social development, labor and employment, agriculture, climate change and environment, infrastructure development, energy development, and governance. These committees help to prepare SDG plans, policies and programs, budget implementation, and monitoring and evaluation.

Achieving SDGs belongs to the shared responsibility of all three tiers of government (national, provincial and local); private sector, cooperatives, civil society, Nepal's citizen, and development partners. For the least developed and young federal republic country like Nepal with limited resources, skills, and poor access to the appropriate technology, mainstreaming the agenda of SDGs into the sub-national levels is a major challenge. Thus, to achieve the above mentioned SDGs, additional efforts have to be made for implementation, adequate financing; mainstreaming science, technology and Innovation (STI); Capacity Development, integrating SDGs into provincial and local government plans and programs; and Partnership with all stakeholders (national and international).

## Science, Technology and Innovation (STI) in Nepal

Presently running but soon out going three years fourteenth National Development Plan is the first plan entrusted for implementation of the socio-economic principles related to federal system of governance as incorporated in the newly promulgated Constitution of Nepal in 2015. This Plan aims for building a prosperous Nepal moving ahead towards building a national economy that is self-reliant, prosperous, and aspiring towards socialism. Similarly, the incoming Fifteen Five Year National Plan approach paper will mainly focus on "Prosperous Nepal and Happy Nepali" targeted to achieve the average annual economic growth rate of 10.1% for five years. The use of science and technology is applicable to all strategies for the development of agriculture, tourism, small and medium industries, physical and social infrastructures as well as economic development of the country to achieve the national goal "Prosperous Nepal and Happy Nepali". To meet the demands of the people for improving quality of life needs consumption of resources. Resources are limited in the country. Responsible consumption and production resources are key for sustainable development. This needs efficient use of resources, which requires development and application of STI. The role of STI is therefore very pertinent for achieving sustainable development goals by using resources in more efficient, affordable and reliable way. Sustainable Development can be achieved through the development of STI that propagates cleaner and smarter technologies that provide energy efficient solutions and do minimal impact on the environment. It is also important for Nepal to have better coordination and cooperation with its development partners, inter- governmental organizations like NAM S&T Center and the international community for technology transfer to enable it to achieve the SDGs. SDG 2 has major target of ending hunger by 2030 and ensuring access of all people to safe, nutritious and sufficient food all year around, which needs application of STI to promote smart and modernized agricultural practices for increasing food productivity to feed people of Nepal. SDG 3 stresses on ensuring healthy lives and promoting wellbeing of people at all ages. Achieving this goal also requires development and modernization of medical sciences and technology. SDG 6 is about ensuring Clean Water and Sanitation for all, SDG 7 is about access of affordable, reliable and sustainable energy for all, SDG 9 is about Building resilient infrastructure, SDG 11 aims for developing Sustainable cities and resilient communities, and SDG 13 is about combating climate change. All these goals can be achieved if we have strong STI development in the country that utilizes resources available and provides output in more efficient and affordable ways to all. For example: smart technology for small scale agro-based entrepreneurs and producers can help to achieve SDG 2. Low carbon emission engineering helps to increase industrial outputs and decrease the pollution, which help to achieve SDG 12 and 13. Development of appropriate technology for mega hydro-projects, international airports, railways and water ways, housing and apartment contributes for achieving SDGs 1,7,8,9, and

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## 11. Developing electric vehicles and train transportation system helps to realize SDGs 11 and 13.

Although, there has been made some progresses in STI, many challenges still remain. After scanning the current situation, the problems and challenges identified in the STI sectors are: Absence of implementable STI policy in the changed context of the country (which government has recently drafted but not approved yet), insufficient budget for research and development (less than 1% of the total budget), less prioritized Science and Technology sector of the current Ministry of Education and form Ministry of Education, Science and Technology, lack of sufficient human resources ( only about 8% of the students are studying in science and technology field), brain drain, missing link between Academia and Industry, negligible public private partnership in STI sectors, poor awareness of the people on the importance of S&T, poor research and publication culture, lack of resources mapping and its sustainable use for the development, less acquisition of Intellectual Property Right by scientists, researchers and innovators. In addition to these problems and challenges, in one hand, the visible outputs of the concerned scientific and research institutions of the country to the society is not satisfactory while in other hand scientists and researchers are also not happy with their existing facilities. Development of STI sector of small country like Nepal also depends on international aid in science and technology sector and also technology & knowledge transfer and sharing from international community. For this, science diplomacy is very important, which is also not functioning with noticeable impacts in Nepal.

### Road Map for the Development of STI Sector

To overcome the previously mentioned problems and challenges ahead, roadmaps for development of STI sectors of Nepal for achieving the SDGs are as follows:

1. The development of political consensus for the implementation of STI policy as soon as possible and strong commitment for increasing the government budget for this sector for which start with 1% of GDP and gradually increase to 3% within a decade.
2. A fundamental requirement of Public Private Partnership (PPP) for development of S&T and R&D to enhance their relevance to society by developing partnership for linking university and research institutes with industry and business community. PPP arrangement is also useful for the establishment of Incubation Centers at universities.
3. Improvement of traditional and indigenous technology using knowledge of STI for the benefits of the society.
4. The value of STI must be raised in the society for the overall development with capacity development and education from school to university and promote the STI based entrepreneurship.
5. Special emphasis should be given on the role of women and youth in the involvement and development of STI.
6. S&T human resources in Nepal is not sufficient, so the focus should be given for producing middle level technical manpower through vocational education and specialized manpower with higher education. Enabling environment has to be made for reversing brain drain retaining the manpower produced in the country.
7. For effective operational capacity in STI, it is required to have adequate information technology like basic access of internet for all ensuring reliable information database system.
8. Intellectual Property Rights of scientists, researchers and innovators need to be improved with motivation and capacity development of scientists, researchers and practitioners.
9. For creating enabling environment for STI, it is necessary to have time relevant policy and act related with STI sector. For example, Biotechnology policy, Space Technology Policy, Cyber and IT Act and Nuclear Act, Nanotechnology Policy, etc. if comes into existence, will help for the development of STI sector in Nepal.
10. Establishment of an institutional and regulatory framework like National Science, Technology and Innovation Council to promote, coordinate, mobilize resources and manage STI.
11. STI should be streamlined towards achieving SDGs (2016-2030).
12. Development of STI to transform the country with the five major national priority areas (Agriculture development, Water resource management and hydropower development, Infrastructure development, Tourism development and Urban Development).
13. Establishment of National Research Centers in the field of Space Technology, Bio-technology, Cyber technology, Nano-technology and Nuclear Technology at different provinces as Centers of Excellence.
14. Sustainable use of available resources by mapping the available resources.

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15. Proper utilization of Science Diplomacy for promotion and development of STI in the country by bringing foreign aid and foreign direct investment to the country. By means of science diplomacy, not only capacity development and knowledge sharing but also development of physical infrastructures (Science City and Province Level Research Centers) related to STI could be made possible.
16. For successful implement of any plans, programs and policies to achieve desired goals, smart people equipped with modern scientific temperament is a must. Hence, special national awareness campaign for developing scientific temperament among people of all sectors needs to be launched.

## Conclusion

Science, Technology and Innovation's role is obvious for achieving SDGs. STI could support achieving SDG 1 of reducing poverty, SDG 2 of making zero hunger, SDG3 of providing better health services for all, SDG4 for better quality of education, SDG 5 to maintain gender equality, SDG 6 for water and sanitation, SDG 7 for scaling renewable energy technologies, SDG8 for decent work and economic growth, SDG9 for industry and industry, SDG 10 for reducing inequalities, Goal 11 for shaping urbanization and development to create safe, resilient an sustainable human settlement, SDG 12 for scaling up the adoption and dissemination of relevant technologies for sustainable consumption and production, SDG13 for combating climate change, SDG14 for life under water , SDG 15 for protecting terrestrial ecosystems, SDG 16 for peace, justice and strong institutions and SDG 17 for partnership for the goals. Outputs of STI such as digital devices, robotics, artificial intelligence and automation, biotechnology and nanotechnology all can make significant impacts on economy, society and environment. But at the same time careful decision has to be taken for application of STI in appropriate way as there could also be chances of further intensifying wealth inequalities between rich and poor and mass unemployment from artificial intelligence, the internet of things and other technologies due to the development of STI. In summary, it can be said that there are enormous potentials of STI for achieving SDGs of Nepal and STI will be central to the success of SDGs.

For this what we have to do is to take actions for development of STI creating appropriate roadmap. Science Diplomacy including partnership or association with the international science and technology related organizations needs to be utilized properly for promotion and development of STI in the country. In this context, association of NAST as an old and active member of NAM S&T has great value for the STI development of Nepal in terms of capacity of development and executing joint scientific projects. I wish NAST will continue to getting support and cooperation in the areas of mutual interest from NAM S&T centre and the cordial relation between NAST and NAM S&T Centre will be strengthened more and friendly relation will receive newer heights in the days to come. With best wishes, this article is dedicated to NAM S&T Centre on the occasion of celebrating its 30<sup>th</sup> Anniversary.

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## Science, Technology & Innovation News

### HEALTHCARE

#### China has Eliminated Malaria

The World Health Organization (WHO) today is certifying China as free of malaria, after a decade's long effort drove an estimated annual toll of 30 million cases in the 1940s, including 300,000 deaths, to zero in 2017. Along the way, China developed new surveillance techniques, medicines, and technologies to break the cycle of transmission between the *Anopheles* mosquitoes that spread malaria parasites and humans. China launched a program to identify new malaria drugs in the late 1960s. As part of that effort, pharmaceutical chemist Tu Youyou screened traditional Chinese medicine concoctions for compounds active against malaria, eventually isolating artemisinin from sweet wormwood (*Artemisia annua*). Artemisinin became the key compound in the front-line drugs now used against malaria and won Tu a Nobel Prize in Physiology or Medicine in 2015. In 2012, the country initiated a push to eliminate malaria with a "1-3-7" strategy, allowing local health facilities 1 day to report a malaria diagnosis, 3 days to investigate the case, and 7 days to implement countermeasures. In recent years, Chinese scientists have developed genetics-based approaches to track drug resistance and to distinguish indigenous cases from imported ones.

After maintaining zero indigenous cases for three consecutive years, China applied for WHO's malaria-free certification, which is being granted following a May inspection mission by the independent Malaria Elimination Certification Panel. The last three countries awarded the same status were El Salvador, in February, and Algeria and Argentina, both in 2019.

Source: [www.sciencemag.org](http://www.sciencemag.org); June 29, 2021

#### OMEGA 3 Rich Diet May Reduce Migraine Headaches

Eating a diet rich in omega 3 (n-3) fatty acids reduces the frequency of headaches compared with a diet with normal intake of omega 3 and omega 6 (n-6) fatty acids, finds a study published by *The BMJ* (June 30, 2021). These diets tend to be high in omega 6 fatty acids. These fatty acids are precursors to oxylipins — molecules involved in regulating pain and inflammation. Oxylipins derived from omega 3 fatty acids are associated with pain-reducing effects, while oxylipins derived from omega 6 fatty acids worsen pain and can provoke migraine. A team of US researchers wanted to find out whether diets rich in omega 3 fatty acids would increase levels of the pain-reducing 17-HDHA and reduce the frequency and severity of headaches. Their results are based on 182 patients at the University of North Carolina, USA with migraine headaches on 5-20 days per month who were randomly assigned to one of three diets for 16 weeks. However, headache frequency was statistically significantly decreased in both intervention groups. The high omega 3 diet was associated with a reduction of 1.3 headache hours per day and two headache days per month. The high omega 3 plus low omega 6 diet groups saw a reduction of 1.7 headache hours per day and four headache days per month, suggesting additional benefit from lowering dietary omega-6 fatty acid. "This study provides a biologically plausible demonstration that pain can be treated through targeted dietary alterations in humans. Collective findings suggest causal mechanisms linking n-3 and n-6 fatty acids to pain regulation, and open the door to new approaches for managing chronic pain in humans," they conclude.

Source: [www.scitechdaily.com](http://www.scitechdaily.com); June 30, 2021

#### SUPERBUG: Not a Threat Anymore

The team of researchers led by RMIT University in Melbourne, Australia developed a new superbug-destroying coating that could be used to prevent and treat potentially deadly bacterial and fungal infections. The material is one of the thinnest antimicrobial coatings developed to date and is effective against a broad range of drug-resistant bacteria and fungal cells, while leaving human cells unharmed. The material is based on an ultra-thin 2D material. Superbugs are the strains of bacteria, fungi, virus and parasites that are resistant to most of the antibiotics. Antibiotic resistance has become the global threat, causing at least 70,000 deaths per year and the death toll could rise to 10 million people a year by 2050, if we do not solve this out. Studies on black phosphorus (BP) have indicated it has some antibacterial and antifungal properties. BP breaks down in the presence of oxygen, which is normally a huge problem for electronics and something we had to overcome with painstaking precision engineering to develop our technologies, but the materials that degrade easily with oxygen can be ideal for killing microbes. As BP breaks down, it oxidizes the surface of bacterial and fungal cells. This process is known as cellular oxidation which ultimately works to rip them apart. Not only this but the BP also began to self-

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degrade in that time and was entirely disintegrated within 24 hours, an important feature that shows the material would not accumulate in the body. The researchers have now begun experimenting with different formulations to test the efficacy on a range of medically-relevant surfaces.

**Source: [www.sciencedaily.com](http://www.sciencedaily.com) ; April 14, 2021**

### **SARS-CoV-2 Eventually Becomes Just Another Seasonal Corona Virus?**

SARS-CoV-2 could become just a seasonal nuisance in the next decade, causing just coughs and sniffles like a common cold, suggests new research. Scientists at the University of Utah, USA, tried to predict the possible future of the novel corona virus using mathematical models that use learning from the current pandemic on changes in human immunity over time. The researchers developed a mathematical model to predict when SARS-CoV-2 may become avirulent based on the interplay between 3 factors: correlation of severity in consecutive infections, age-based susceptibility of a population, and decreased disease severity due to partial immunity. Each of the 3 elements can limit severe, infectious disease over time given the right circumstances, but when combined, they can rapidly bring down the frequency of more severe manifestation of disease over a broad range of conditions. According to the authors, vaccines may complicate this evaluation as they might mimic natural infection with respect to the type and duration of immunity. They added that existing genetic variation in SARS-CoV-2 and further mutation might also change the evolutionary path of the virus in ways that this model cannot predict. In the long-term, SARS-CoV-2 and the human immune system may evolve together in the context of a genetic arms race rendering the virus more virulent and humans more resistant. As we capture more reinfections over the next few years, these mathematical models will help test if COVID-19 severity is beginning to decrease as per the predictions of this model and predict the future of the disease. Further studies are needed to determine if individuals with a history of prior SARS-CoV-2 infection exhibit milder symptoms upon getting reinfected. These investigations should account for whether people are vaccinated, because that could also be associated with mild disease.

**Source: [www.news-medical.net](http://www.news-medical.net);; May 26, 2021**

## **RESEARCH & DEVELOPMENT**

### **Flying Car Completes First Inter-city Flight in Slovakia**

The hybrid car-aircraft, called AirCar and developed by Slovakia-based company Klein Vision, flew between the two international airports on Monday 28 June, 2021 completing its 142<sup>nd</sup> successful landing in Bratislava at 6:05am (GMT+2). The aircraft can transform itself into a sports car in under three minutes. It typically cut the travel time by a factor of two. "The automated transition from road vehicle into an air vehicle and vice versa, deploying/retracting wings and tail, is not only the result of pioneering enthusiasm, innovative spirit, and courage; it is an outcome of excellent engineering and professional knowledge." Klein Vision equipped the AirCar Prototype 1 with a 160HP BMW engine with a fixed-propeller and a ballistic parachute. Under the supervision of the Civil Aviation Authority, the AirCar has completed over 40 hours of test flights, including steep 45-degree turns and stability and maneuverability testing. AirCar Prototype 1 has flown at 8,200ft and reached a maximum cruising speed of 190km/hr (103kt). The firm will equip its pre-production model, the AirCar Prototype 2, with a 300HP engine and is set to receive the EASA CS-23 aircraft certification with an M1 road permit. With its variable pitch propeller, they expect Prototype 2 to have a cruise speed of 300km/hr (162kt) and a range of 1,000km (621 miles). "This flight starts a new era of dual-transportation vehicles. It opens a new category of transportation and returns the freedom originally attributed to cars back to the individual," said Klein after exiting the AirCar cockpit in Bratislava.

**Source: [www.theiet.org](http://www.theiet.org) ; June 30, 2021**

### **Buildings that Can Store Energy Like a Giant Battery**

Dr. Emma Zhang, formerly of Chalmers University of Technology, Sweden, joined Professor Luping Tan's research team a few years ago to look for the building materials of the future. Together they managed to develop the world's first cement-based battery concept. The concept first includes a cement-based mix with a small amount of short carbon fibers to increase conductivity and flexural strength. Then embedded in the mixture is a metal-coated carbon fiber mesh – iron for the anode and nickel for the cathode. Luping Tang and Emma Zhang's research resulted in a cement-based rechargeable battery with an average energy density of 7 W-hours per square meter. The energy density is still low compared to commercial batteries but this limitation can be overcome due to the enormous volume at which the battery can be constructed for use in buildings. "It can also

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be connected to solar panels to provide electricity and power monitoring systems on highways or bridges, where sensors powered by a concrete battery can detect cracks or corrosion,” suggests Emma Zhang.

**Source: [www.magzmagz.com](http://www.magzmagz.com); June 18, 2021**

## Research and Innovation Achievements to Tackle COVID-19

*The report “The COVID-19 Research and Innovation Achievements” prepared by WHO is a reflection of the collaborative nature of global research and a demonstration of the vast and extraordinary community behind each and every research action and study that is helping combat COVID-19. The document provides a summary of global research initiatives and identifies key R&D achievements and the gaps that still exist to tackle COVID-19.*

In March 2020, within a few weeks of the World Health Organization (WHO) declaring COVID-19 to be a public health emergency of international concern (PHEIC), a coordinated global research roadmap was published by WHO. It was a pivotal document and represented a transparent and globally agreed pathway through which all individuals and organizations involved in the research response could act, and be held to account. It identified and recorded:

- Eight immediate research actions needed in the emergency response to COVID-19
- Nine broader research priorities and actions with selected knowledge gaps for each area
- A timeline for implementation of research actions, as well as immediate, midterm and longer-term priorities

Fourteen months later, research on most of the knowledge gaps have been initiated and are progressing. New COVID-19 research challenges emerge everyday but scientific achievements have already provided answers to several of the knowledge gaps identified in the roadmap and priority research has been done with some achievements. Most notably, Research and Development (R&D) has delivered safe and efficacious COVID-19 vaccines at an unprecedented speed; this is a triumph for modern science although equitable access remains a challenge. Research and innovation work has also helped:

- Rapid diagnostics for use in community settings.
- The identification of optimal protective equipment (PPE) to protect health care staff and the public across the world.
- Evidence-based infection prevention and control (IPC) measures such as mask-wearing and social distancing in health care and community settings.
- Better understanding of likely animal host(s) for the virus. This will help in future efforts to prevent continued spill over to humans.
- Major clinical trials for the evaluation of candidate therapeutics, evaluating a dozen drugs, some of which have proven not to be effective in reducing mortality, and a handful of which have had positive results on cutting deaths.

**Source: [cdn.who.int](http://cdn.who.int); April 07, 2021**

## A New Water Technology: Could Clean Martian Soil

A team led by University of California Riverside engineers has developed a catalyst to remove a dangerous chemical from water on Earth that could also make Martian soil safer for agriculture and help produce oxygen for human Mars explorers. Perchlorate, a negative ion, occurs naturally in some soils on Earth, and is especially abundant in Martian soil. Perchlorate is a common water contaminant that causes certain thyroid disorders. Perchlorate bio-accumulates in plant tissues and a large amount of perchlorate found in Martian soil could make food grown there unsafe to eat, limiting the potential for human settlements on Mars. Perchlorate in Martian dust could also be hazardous to explorers. Current methods of removing perchlorate from water require either harsh conditions or a multistep enzymatic process to lower the oxidation state of the chlorine element into the harmless chloride ion. Doctoral student Changxu Ren and Jinyong Liu noted anaerobic microbes use molybdenum in their enzymes to reduce perchlorate and harvest energy in oxygen-starved environments. They found by simply mixing sodium molybdate, a bipyridine to bind the molybdenum, and a catalyst called palladium on carbon; they produced a powerful catalyst that quickly and efficiently broke down the perchlorate in water



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using hydrogen gas at room temperature with no combustion involved. “A convenient catalytic reduction system may help harvest oxygen gas from perchlorate washed from the Martian soil when the catalyst is coupled with other processes,” Liu said.

## NANO-TECHNOLOGY

### Synthesizing a New Class of Bio-Inspired, Light-Capturing Nano-materials

Researchers Developed a material that provides a highly efficient artificial light-harvesting system with potential applications in photo-voltaic and bio-imaging. Scientist Chun-Long Chen and his collaborators created a new material that reflects the structural and functional complexity of natural hybrid materials. This material combines the programmability of a protein-like synthetic molecule with the complexity of a silicate-based nano-cluster to create a new class of highly robust nano-crystals. They then programmed this 2D hybrid material to create a highly efficient artificial light-harvesting system. “The sun is the most important energy source we have,” said Chen. “We wanted to see if we could program our hybrid nano-crystals to harvest light energy—much like natural plants and photosynthetic bacteria can—while achieving a high robustness and processibility seen in synthetic systems.”

**Source:** [www.dailyadvent.com](http://www.dailyadvent.com); May 17, 2021

## ENVIRONMENT

### Polymer Eating Enzyme

Scientists have now invented a way to make compostable plastics break down more easily, with just heat and water, within a few weeks, solving a problem that has flummoxed the plastics industry and environmentalists. The process involves embedding polyester-eating enzymes in the plastic as it's made. These enzymes are protected by a simple polymer wrapping that prevents the enzyme from untangling and becoming useless. When exposed to heat and water, the enzyme shrugs off its polymer shroud and starts chomping the plastic polymer into its building blocks — in the case of PLA, reducing it to lactic acid, which can feed the soil microbes in compost. The polymer wrapping also degrades. The process eliminates micro plastics, a byproduct of many chemical degradation processes and a pollutant in its own right. Up to 98% of the plastic made using this technique degrades into small molecules.

**Source:** [www.scitechdaily.com](http://www.scitechdaily.com) ; April 22, 2021

### Humanity's Fast-food Habit is Filling the Ocean with Plastic

Takeaway food and beverage packaging is the main source of plastic litter accumulating along many coasts. Around 8 million metric tons of plastic waste ended up in the ocean in 2010. Using data from scientific surveys and community waste inventories, Carmen Morales-Caselles and Andrés Cózar, at the University of Cadiz in Puerto Real, Spain, and their colleagues classified more than 12 million items of litter found worldwide according to product type, material composition and probable origin. Takeaway items discarded shortly after use, including plastic bags, wrappers, food containers, bottles, cans and cutlery, accounted for the largest share — up to 88% — of waste accumulating along shorelines and in near-shore waters. Waste resulting from fishing activities, including synthetic ropes, strings and nets, is the dominant source of litter in the open ocean, the researchers found. Understanding the products that account for the biggest share of marine litter is crucial to reducing pollution, the authors say. Such knowledge is also needed to ensure responsible production and consumption patterns, they added.

**Source:** [www.nature.com](http://www.nature.com); June 10, 2021

## WASTE MANAGEMENT

### Wastewater Treatment by Using Microalgae Reactor

Research on treatment of wastewater using microalgae reactor has given positive results. The micro-algae *Cladophora* species collected from Nizwa region of Oman used for the treatment of domestic waste water through continuous process and batch process. In the continuous process, the data showed that, micro-algae can be used to treat domestic wastewater as the percentage reduction observed were the chemical oxygen demand (COD) of 87%, biological oxygen demand (BOD) of 52%, total organic carbon (TOC) of 99%, and turbidity of 93.1%. On the other hand, for the batch process, the optimum conditions at which the maximum

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removal of pollutant was determined to be was at residence time of 144 hours, algal dosage of 0.5 kg and an agitation period of 10 hours using response surface methodology (RSM). The higher the retention time, algae dosage and agitation time, the better is the removal of contaminants from domestic wastewater. The percentage removal at optimum conditions in batch process of COD, TDS, TOC, and turbidity were 93.25%, 23%, 88.2%, and 90.3%, respectively.

**Source: [www.inderscience.com](http://www.inderscience.com); April 26; 2021**

## Vermi-Biotechnology and Waste Management

Abundant use of chemical fertilizers disturbs the soil organism, soil texture and physico-chemical properties of soil and affects human health as well as the environment. The biological wastes cause environmental hazards and various adverse effects on human health and their domesticated animals, if their proper management and disposal practices are not available. Organic farming through vermi-biotechnology is a better option for the management of wastes by earthworms and the improvement of soil quality. It is one of the interesting aspects, since it contributes to a broad relationship among food, environmental quality and safety of human and animal health. Vermicompost of wastes is easily preparable, biodegradable, most effective, easily transportable, non-hazardous to animals, humans and the environment and eco-friendly, which is a boon for the farmers. So, we can say that the vermi-biotechnology is a suitable way for sustainable development and today there is need for the use of bio-fertilizers in crop fields.

**Source: [www.inderscience.com](http://www.inderscience.com); March 19, 2021**

## ASTROPHYSICS

### First Black Hole-Neutron Star Mergers Detected

A long time ago, in two galaxies about 900 million light-years away, two black holes each gobbled up their neutron star companions, triggering gravitational waves that finally hit Earth in January 2020. Discovered by an international team of astrophysicists including Northwestern University researchers, two events detected just 10 days apart mark the first-ever detection of a black hole merging with a neutron star.

The team of researchers observed the two new gravitational-wave events dubbed GW200105 and GW200115 on January 5, 2020, and January 15, 2020, during the second half of the LIGO and Virgo detectors third observing run, called O3b. Although multiple observatories carried out several follow-up observations, none observed light from either event, consistent with the measured masses and distances.

All three large detectors (both LIGO instruments and the Virgo instrument) detected GW200115, which resulted from the merger of a 6-solar mass black hole with a 1.5-solar mass neutron star, roughly 1 billion light-years from Earth. With observations of the three widely separated detectors on Earth, the direction to the waves' origin can be determined to a part of the sky equivalent to the area covered by 2,900 full moons.

Just 10 days earlier, LIGO detected a strong signal from GW200105, using just one detector while the other was temporarily offline. While Virgo also was observing, the signal was too quiet in its data for Virgo to help detect it. From the gravitational waves, the astronomers inferred that the signal was caused by a 9-solar mass black hole colliding with a 1.9-solar mass compact object, which they ultimately concluded was a neutron star. This merger happened at a distance of about 900 million light-years from Earth. Because the signal was strong in only one detector, the astronomers could not precisely determine the direction of the waves' origin. Because the two events are the first confident observations of gravitational waves from black holes merging with neutron stars, the researchers now can estimate how often such events happen in the universe. Although not all events are detectable, the researchers expect roughly one such merger per month happens within a distance of one billion light-years.

While it is unclear where these binary systems form, astronomers identified three likely cosmic origins: stellar binary systems, dense stellar environments including young star clusters, and the centers of galaxies.

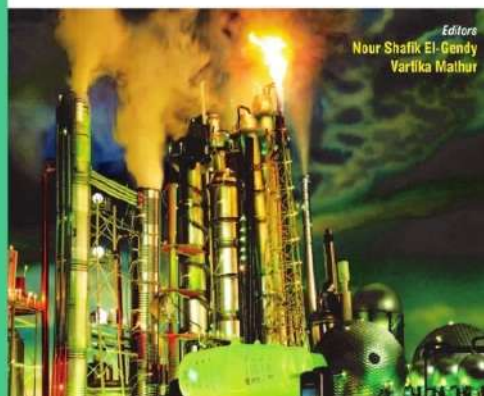
The team is currently preparing the detectors for a fourth observation run, to begin in summer 2022.

**Source: [www.sciencedaily.com](http://www.sciencedaily.com); June 29, 2021**

## New Publication

# Air Pollution and Public Health

Challenges, Interventions and Sustainable Solutions



Editors  
Nour Shafik El-Gendy  
Vartika Mathur

Centre for Science and Technology of the Non-Aligned and  
Other Developing Countries (NAM S&T Centre)

## AIR POLLUTION AND PUBLIC HEALTH CHALLENGES, INTERVENTIONS AND SUSTAINABLE SOLUTIONS

This book titled 'Air Pollution and Public Health: Challenges, Interventions and Sustainable Solutions' stems from the papers presented as well as a series of discussions and deliberations during the International Workshop on 'Air Pollution and Public Health: Challenges and Interventions' jointly organized by the NAM S&T Centre, New Delhi and Sri Venkateswara College, University of Delhi, India during February 5-7, 2020 in New Delhi, India. The book contains twenty scientific and research papers contributed by the participants of the workshop and other experts, from 15 countries.

The book covers a diverse set of topics of particular interest to the developing world such as the effects and challenges posed by rising air pollution, its concomitant impact on health and economic development and possible methods for interventions & solutions to arrest the seemingly unstoppable rise in air pollution. The book is divided into three sections for the benefit of the readers. Section 1 is titled 'Air Pollution - Effects and Mitigation' which includes papers addressing topics such as sources and effects of air pollution on human health and their environment, and provide novel and effective strategies and solutions to mitigate air pollution. Section 2 is titled 'Case Studies from Developing World' and contains country status reports and case studies based on examples from a few developing countries. The third and the final section of the book, 'Examples of Action Plans from Developing World', delves into several innovative, highly efficient, effective and replicable action plans implemented by the developing countries.

The book published by the NAM S&T Centre would serve as an invaluable source of information for scientists, doctors, medical and pharmaceutical professionals, technologists, researchers and academicians working in the

relevant fields in various countries, and provide them a shared vision and understanding on air pollution, plan and implement mitigation policies and programmes to curb the problems relating to air pollution as a burden to 'One Health'.

*Foreword: Prof. Randeep Guleria, Director, AIIMS (India)*

*Introduction: Dr. Amitava Bandopadhyay, DG, NAM S&T Centre (India)*

*Preface: Dr. Nour Shafik El-Gendy (Egypt) and Dr. Vartika Mathur (India)*

### SECTION I: Air Pollution—Effects and Mitigation

1. Fossil Fuels and Air Pollution, *James G. Speight (USA)*
2. Bio-valorization of Organic Waste Biomass into Different Valuable Products as Out-of-Box Approaches for Mitigation of Air Pollution, *Nour Sh. El-Gendy and Hussein N. Nassar (Egypt)*
3. Effect of Air Polycyclic Aromatic Hydrocarbons in Food Chain: Direct and Indirect Exposure, *Kavita Verma and Vartika Mathur (India)*
4. Reducing Carbon Dioxide Emissions through the Production of Synthetic Natural Gas, *Radwa A. El-Salamony (Egypt)*
5. Air Pollution Mitigation using Artificial Intelligence: A Review, *Lalita Josyula, Shounak Chakraborty, Akanshu Mahajan, Varun Bharti and Pradeep (India)*
6. Impact of Air Pollution on Public Health: Current and Future Challenges, *Surya Prakash Bhatt and Randeep Guleria (India)*
7. Effects of Rising Air Pollution on Public Health and Measures Adopted Globally to Improve Air Quality, *Keerti Mishra (India)*
8. Air Pollution Abatement Technologies: A Brief Introduction on Filters, Membranes and Coatings, *C.P. Leo (Malaysia)*

### SECTION II: Case Studies from Developing World

9. The Challenges and Intervention of Air Pollution to Health Issue in Cambodia, *Dina Heng (Cambodia)*
10. Carbon Footprint: Sector-Wise Emission Analysis of Urban Youth, *Pooja Gokhale Sinha (India)*
11. Environmental Impact of Coal-Fired Power Plant on Local Air Quality: Case Study of Southern Java, Indonesia, *Widyaning, Dindin Makhmuddin, Andri Fachrur Rozie, Diana Rahayuning Wulan and Sudaryati Cahyaningsih (Indonesia)*
12. Monitoring and Analysis of CO<sub>2</sub> and NO<sub>2</sub> Levels: A Case Study of the Capital City of Mauritius, *K. Boodhoo and M.R. Lollchund (Mauritius)*
13. Study of Urban Area Air Quality in Yangon, Myanmar, *Moe Myitzu (Myanmar)*



14. Case Study of Quantifying the Carbon Emission of the Crematoria to Identify Carbon Sinkable Tea Vegetation Requirement to Counterpoise the Carbon Foot Print of Crematoria, *Thammita A.S. Anuruddha, E.A.N.K. Edirisinghe, T.L. Wijerathne and N.S.K. Samarasinghe (Sri Lanka)*
15. The Impacts of Indoor Air Pollution on Human Health and the Challenges to Control it in Peri Urban Areas (Case Study of Mazyopa Compound-Lusaka District), *Clavel Mulenga (Zambia)*
16. Air Pollution Know Your Enemy - A Case Study of Harare, Zimbabwe, *Sikayi Gloria Winnie (Zimbabwe)*
17. Long Term Monitoring of Air Pollution from Quarries with Health Effects—Case of Palestine, *A. Rasem Hasan, Amjad I.A. Hussein, Asmaa Al-Asmar, Abdelhaleem Khader, Hanan A. Jafar and Tawfiq Saleh (Palestine)*

### SECTION III: Examples of Action Plans from Developing World

18. Actions to Mitigate Health Effect Caused by Air Pollution in Cuba, *Marisol Romeu Hernández (Cuba)*
19. Role of Universities in Air Pollution Control: An Action Plan Taken by Ferdowsi University of Mashhad, Iran, *Mohammad Kafi and Seyed Yaser Banihashemi (Iran)*
20. A Study on the Status of Air Pollution and its Impacts in Nepal, *Bimala Devi Devkota Paudel and Pawan Kumar Neupane (Nepal)*

### NEW DELHI RESOLUTION

New Delhi Resolution on *Air Pollution and Public Health: Challenges and Interventions*

## Centre Announces

### International Workshop on “Energy Security and Energy Access: Health Implications of Poor Energy Quality in Developing Countries”

CSIR-Indian Institute of Petroleum (IIP), Dehradun, India

26-27 July, 2021

(A VIRTUAL EVENT)

Two major concerns in developing countries are **Energy Security** and **Energy Access**. Energy security is the continuous availability of energy in varied forms and sufficient quantities, at an affordable price, to meet domestic, industrial, transport and military requirements. It entails the high prospects of current and future energy needs being met, irrespective of economic or political instability. Energy is an essential part of innovation, progress and life. It plays vital roles, directly as well as indirectly, in the survival of human beings, as well as to a country's economic development. For these reasons, energy access needs to be improved particularly in remote, backward and inaccessible regions, which can be achieved through proper infrastructure for the generation, transmission and supply of energy, as well as the human skills and expertise needed to maintain and improve the system.

Poor energy quality in developing nations has had serious implications on health and environment and it is high time we address these issues. In order to discuss various aspects of energy security, clean and affordable energy for all, and health hazards associated with poor energy quality, the **Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre)**, New Delhi, India jointly with the **CSIR-Indian Institute of Petroleum (IIP)**, Dehradun, India, will be organizing an International Workshop on 'Energy Security and Energy Access: Health Implications of Poor Energy Quality in Developing Countries' during **26-27 July, 2021**. The Workshop will be hosted by CSIR-Indian Institute of Petroleum, Dehradun and will be organised in Virtual-Mode.

Scientists & Researchers from conventional and renewable energy background, technology providers and start-ups, LCA professionals, energy technology consultants, project-planners, Government officials, policy makers and other stakeholders from industry and non-government organizations from various NAM and other developing countries and island nations who are engaged in R&D, generation, promotion and policy making on Energy Security, Energy Access, Affordable Clean Energy, and Climate Change and available supported technological solutions for minimizing environmental impact on human health, are invited to participate in this Virtual Workshop.

Experts and professionals from the developed countries are also welcome to participate as resource persons for delivering keynote lectures on relevant topics during the workshop.

The last date for submission of application is **16<sup>th</sup> July 2021**.

**For further details, please visit the NAM S&T Centre's Website ([www.namstct.org](http://www.namstct.org)) or write to [namstcentre@gmail.com](mailto:namstcentre@gmail.com)**

## TENTATIVE ACTIVITY CALENDAR OF THE NAM S&T CENTRE

Serial No.	Topic	Venue, Partner Institution and Country	Dates
1.	International Workshop on "Energy Security and Energy Access: Health Implications of Poor Energy Quality in Developing Countries"	<b>[Virtual Mode]</b> CSIR-Indian Institute of Petroleum, Dehradun, India	26-27 July 2021
2.	International Workshop on "Smart Agriculture for Developing Nations: Broader Perspectives and Special Challenges for Island States"	<b>[Virtual Mode]</b> Ministry of Education, Tertiary Education, Science and Technology, Mauritius	11-12 August 2021
3.	1 <sup>st</sup> Bureau Meeting of the 15 <sup>th</sup> Governing Council (GC) of the NAM S&T Centre	<b>(Virtual Mode)</b> Academy of Scientific Research and Technology (ASRT), Egypt	21 September 2021
4.	International Exposure Conference on "Application of Ocean Science and Technology for the Practice of Sustainable 'Blue Economy' in Developing Countries"	<b>[Virtual Mode]</b> Scientific Committee on Oceanic Research (SCOR) USA	8-9 November 2021
5.	International Workshop on "Technology Transfer and Commercialization"	<b>[Virtual Mode]</b> Ministry of Research and Technology / National Research and Innovation Agency, Indonesia	7-8 December 2021
6.	International Workshop on "STEM Education"	<b>[Virtual Mode]</b> Myanmar Engineering Council (MEC), Myanmar	2021/22
7.	International Workshop on "Gender Issues in Water Management in Developing Countries and Sustainable Development"	Scientific Committee on Problems of the Environment (SCOPE), Paris, France; JSS University, Mysore, India	February 22-24, 2022
8.	International Workshop on "Cyber Security"	Ministry of Technology, Sri Lanka	2022

## Centre Announces

### International Workshop on “Smart Agriculture for Developing Nations: Broader Perspectives and Special Challenges for Island States”

Mauritius, 11-12 August 2021

(A VIRTUAL EVENT)



'Smart Farming' is an emerging concept that refers to managing farms using technologies like **Internet of Things (IoT), Robotics, Drones and Artificial Intelligence (AI)** to increase the quantity and quality of products while optimizing the human labour required for production. The Internet of Things has provided not only a way to better measure and control growth factors like irrigation and fertilizer on a farm, it has also changed how we view agriculture entirely.

It is an emerging concept that refers to managing farms using modern Information and Communication Technologies (ICT) to increase the quantity and quality of products while optimizing the human labor required. Among the technologies available for present-day farmers are: **(i) Sensors:** soil, water, light, humidity, temperature management; **(ii) Software:** specialized software solutions that target specific farm types or use case agnostic IoT platforms; **(iii) Connectivity:** cellular, LoRa, etc.; **(iv) Location:** GPS, Satellite, etc.; **(v) Robotics:** Autonomous tractors, processing facilities, etc. and **(vi) Data analytics:** standalone analytics solutions, data pipelines for downstream solutions, etc. Armed with such tools, farmers can

monitor field conditions without even going to the field and make strategic decisions for the whole farm or for a single plant. The driving force of smart farming is IoT - connecting smart machines and sensors integrated on farms to make farming processes data-driven and data-enabled.

In order to discuss various issues on Smart Farming Technologies and related subjects, the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi, India jointly with the Ministry of Education, Tertiary Education, Science And Technology, Republic of Mauritius will be organizing an International Workshop on '**Smart Agriculture for Developing Nations: Broader Perspectives and Special Challenges for Island States**' during **August 11-12, 2021**. The Workshop will be hosted by the Ministry of Education, Tertiary Education, Science and Technology, Republic of Mauritius and will be organised in **Virtual-Mode**.

This Workshop aims to bring together the experts, professionals and the policy makers from the developing countries in the areas of agriculture, IoT, AI, and smart applications domain to develop synergy, exchange knowledge and ideas on smart agriculture and provide solutions with a broader perspective and special focus to island states.

For further details, please contact the NAM S&T Centre (**Email : [namstcentre@gmail.com](mailto:namstcentre@gmail.com)**) or visit our **website: [www.namstct.org](http://www.namstct.org)**.

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