I.S.S.N 0971-4200

NAM S&T Newsletter

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

VOL. 36, No. 2
JULY - SEPTEMBER 2026

FROM THE DG'S DESK

Greetings and best wishes to our Esteemed Readers!!



It gives me immense pleasure to present this quarterly issue of the NAM S&T Centre Newsletter, highlighting the Centre's ongoing initiatives to promote Science, Technology and Innovation (STI) for inclusive and sustainable development across its Member Countries and the wider Global South. The issue brings together key developments in scientific cooperation, research, capacity building and knowledge dissemination among its Members and other developing counties.

At the NAM S&T Centre, one of the primary objective is documenting, sharing and disseminating knowledge for the benefit of all stakeholders. With more than 100 edited scientific books and monographs published by the Centre on subjects of importance to the Global South, the Centre has contributed significantly in making scientific knowledge more accessible and fostering international cooperation. In this issue, we attempt to take a critical look at why documenting and disseminating scientific and technological knowledge is essential to empowering nations, bridging knowledge gaps and building a more sustainable future for all.

The Centre is going to organise its 17th Governing Council (GC) Meeting during 16-17 November 2026 that would be hosted by the Academy of Scientific Research and Technology (ASRT), Egypt in Cairo. The GC will review the progress and achievements of the Centre during the period after its last meeting held in Mauritius in July 2023, and give necessary advice and directions to the Centre. A summary of the achievements of the Centre that would be presented during the GC Meeting is given in this Newsletter for the information of our readers.

During the quarter, we have published a book, titled *"Technological Innovations for Sustainable Industrialization"*, which explores how technological advancements can promote resource efficiency and sustainable industrial practices while supporting industrial growth and addressing environmental and developmental issues. The book has been published by the leading International Publisher Springer Nature, Singapore.

The NAM S&T Centre is pleased to publish its fifteenth Fact File, titled *"Fatty Liver Problems in the Developing World: Implications of the Modern Diet"*, prepared to raise awareness and improve understanding of fatty liver problems, their risk factors and the impact of modern dietary patterns, particularly in the developing world.

The Centre continues to promote international collaboration and research capacity building of scientists from developing countries through its Fellowship Programmes. We have initiated a new fellowship scheme: "Joint NAM S&T Centre – UM, Malang, Indonesia Post-Doctoral Fellowship", and continued the "Joint NAM S&T Centre – JSS AHER, Mysuru, India Fellowship Programme" in 2026. These programmes provide young and mid-career researchers with opportunities to enhance their expertise and build partnerships across institutions and countries. We are pleased to present before the readers the names of researchers who have been awarded these two fellowships this year.

Looking ahead, we have planned to organise two International Workshops: *"Intelligent Energy Transitions and Futuristic Solutions for the Global South"*, to be held on 7-9 February 2027 in Kochi, Keralam, India; and *"Clean Water Resources and Sustainability of Life in Coastal Zones"*, to be held on 25-26 March 2027 in Shanghai, China. Both Workshops will provide opportunities for scientific dialogue and cooperation to address key sustainability challenges.

As part of our initiative to highlight scientific achievements by our Member Countries, two articles from Malaysia and Indonesia have been included highlighting their recent scientific contributions.

The NAM S&T Centre remains committed to promoting South-South cooperation, strengthening scientific and technological capabilities and fostering partnerships for equitable and sustainable development. I sincerely thank our Member Countries, Members of NAM S&T – Industry Network, partner institutions, researchers, contributors and readers for their continued support and cooperation.

Happy Reading!!

(Amitava Bandopadhyay)
Director General

Documenting and Disseminating Scientific & Technological Knowledge for a More Inclusive and Sustainable World

Scientific & Technological knowledge should be widely disseminated beyond academic and research institutions to ensure that its benefits reach all sections of society. Effective dissemination of S&T knowledge helps in evidence-based policymaking, accelerates sustainable development, and promotes social inclusion, especially in developing countries.

Publications on S&T do more than simply documenting research study or work; they preserve ideas, share knowledge and bring important issues to the attention of the wider world. They also provide structured channels for sharing new discoveries, technological advances and innovations, enabling researchers to communicate their findings, build on existing knowledge, validate scientific results, and promote further research and innovation.

In this context, for the NAM S&T Centre, documenting S&T knowledge on issues affecting developing countries goes beyond publishing books, articles, fact files and other materials. It is about making their realities more visible, so that their concerns receive attention, their challenges are understood, and their contributions become part of global S&T knowledge.

Many challenges faced by developing countries, including access to clean water and sanitation, health and well-being, clean and affordable energy, food security, climate change and sustainable development - deserve greater attention in global S&T discussions. When these issues are documented, they become part of a shared body of knowledge that others can learn from, question and build-upon. A solution developed in one country may also prove useful to another facing a similar situation.

The Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) plays an important role in this process by bringing S&T knowledge from developing countries to a wider audience. Established in New Delhi in 1989, as an intergovernmental organisation, the Centre promotes South-South cooperation in science, technology and innovation. The Centre encourages sharing of knowledge, experience and expertise among member countries on various S&T subjects, with a focus to address issues related to the social, economic and environmental dimensions of sustainability. Through its books, monographs, workshop proceedings, reports and directories, it provides a platform for researchers and institutions to document their work and highlight S&T issues of importance to the developing world. The Centre's workshops, training programmes, collaborative research initiatives and fellowships further encourage scientists and institutions to learn from one another, exchange ideas and build lasting partnerships.

At a deeper level, the Centre's work reflects a simple but important principle: every country deserves to have its experiences heard, its knowledge recognized and its challenges taken seriously. S&T progress should not be measured solely by a country's economic strength or global standing. The knowledge, research and innovations emerging from developing countries are equally valuable in advancing our collective understanding of the world and addressing shared global challenges.

The NAM S&T Centre is facilitating the wider exchange of S&T knowledge through documentation and dissemination, extending its reach beyond individual institutions and countries to benefit the scientific community at large. It encourages the exchange of ideas, supports informed decision-making and helps bring research closer to the needs of communities. In doing so, it contributes to a more balanced global S&T landscape in which developing countries are not merely recipients of knowledge but also active contributors to its creation and use.

Considering the above, in recent years the Centre has published books, monographs and other publications on a wide range of topics, with contributions from experts across various developing and developed countries. These publications cover areas such as lightning, dryland agriculture, extreme natural events, blue economy, science, technology and innovation diplomacy, smart agriculture, groundwater recharge and rainwater harvesting, water management, arsenic remediation, leather science and technology, severe storms, plastic pollution, food toxicity and safety, science, technology and innovation in achieving sustainable development goals, and sustainable industrialization. All these edited volumes have been published by Springer Nature, Singapore, a leading international academic publisher, and is available in both electronic and print versions. In addition, the Centre has published a number of books covering a diverse range of topics, including technological innovation and management, sustainability of leather sector, vaccines, drug development, antimicrobial resistance, science popularization, air pollution, food green cities, and generic drugs etc., through other reputed publishers.

Similarly, the Centre has documented S&T knowledge through Fact Files prepared in collaboration with academic and research institutions in its Member Countries. These Fact Files cover a wide range of scientific, technological, environmental and public health issues relevant to developing countries, including sustainable agriculture, birth defects, rare diseases, plastic pollution, lightning, heatwaves, non-communicable diseases, circular economy, marine pollution, change management in higher education, green polymers, life and livelihoods in the himalayas and fatty liver problems: implications of modern diet.

Documenting science and technology is both an act of recognition and a responsibility. It will make sure that the challenges we are facing today are not forgotten, the knowledge gained is available tomorrow, and the voices of developing countries have a meaningful place in shaping our shared future. Through its continued commitment to dissemination of S&T knowledge and information, and South-South cooperation, the NAM S&T Centre is helping to advance a vision of science and technology that is inclusive, collaborative and directed towards the common good.

The lofty goal of achieving "Sustainability" is a distant dream and, as noted American Poet Laureate Robert Frost wrote in his famous poem "Stopping by the Woods on a Snowy Evening":

The woods are lovely, dark and deep;

But I have promises to keep;

And miles to go before I sleep;

And miles to go before I sleep.

The poem reminds us that despite the challenges ahead, we must remain committed to documenting and disseminating S&T knowledge, recognising that achieving a more inclusive and sustainable world requires sustained collective effort.

New Publication

Technological Innovations for Sustainable Industrialization



Sustainable Industrialization stands as one of the most formidable challenges of the twenty-first century, lying at the intersection of technological advancements, environmental stewardship and social equity. As the world grapples with escalating pressures from climate change, resource depletion and social inequality, the urgency to adopt sustainable industrial practices has never been greater. By integrating cutting-edge research and innovation into infrastructure planning and industrial development, we can ensure that growth is not only sustainable but also inclusive and equitable. To address these issues, the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre) has brought out the publication titled "Technological Innovations for Sustainable Industrialization".

The edited book brings together contributions from scientists and experts from seven countries, viz., India, Iraq, Mauritius, Myanmar, Nigeria, South Africa and Zimbabwe. Through its 14 chapters, the book aims to provide a detailed overview and actionable insights into how innovations can reshape the future of infrastructure and industrialization across various sectors, ranging from nanotechnology and precision agriculture to infrastructure development and renewable energy integration. The insights presented in the book offer valuable perspectives for policymakers, researchers, industry leaders and entrepreneurs, providing a roadmap for harnessing technology in a way that fosters both economic development and environmental sustainability.

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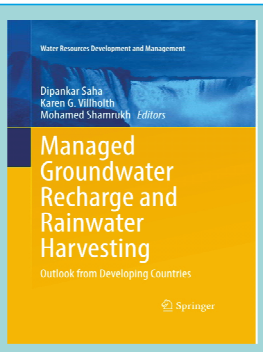
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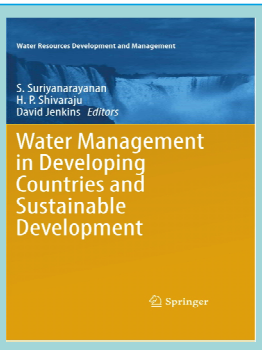
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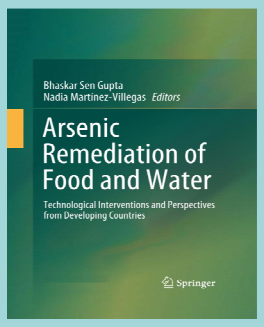
Managed Groundwater Recharge and Rainwater Harvesting

Editors:
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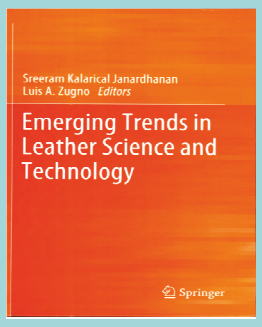
Water Management in Developing Countries and Sustainable Development

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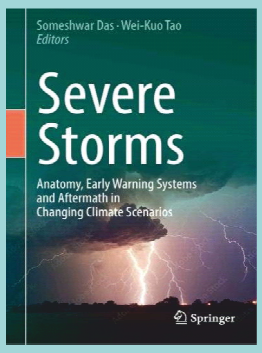
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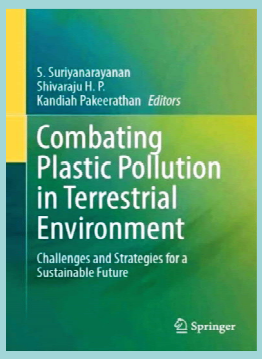
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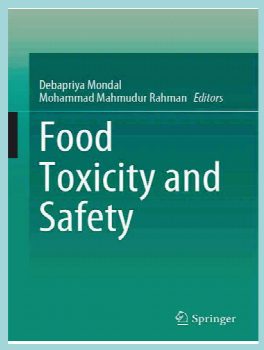
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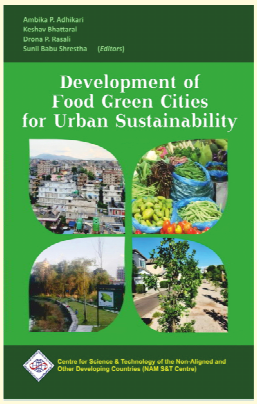
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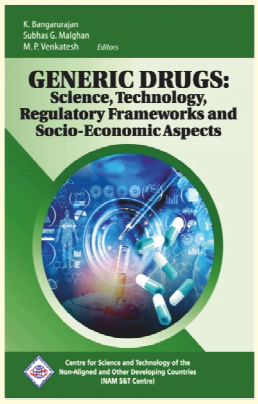
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Editors:
Xavier Poshiwa
Vennan M. Sibanda and
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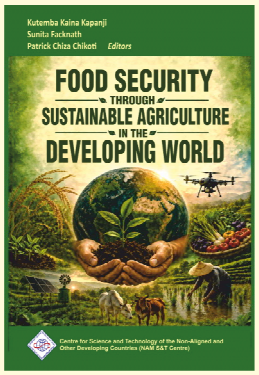
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FACT FILES

The NAM S&T Centre has undertaken a new initiative for the dissemination of S&T information and knowledge through series of concise information booklets - "Fact Files", covering emerging topics of relevance to the developing countries. The following twelve Fact Files have been brought out by the Centre since the 16th GC Meeting of the NAM S&T Centre, July 27-28, 2023:

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!

I am happy to present before you a new Fact File titled "**Rare Diseases: An Emerging Global Health Priority**".

A Rare Disease affects only a smaller percentage of the population, compared to other general diseases. Its prevalence is comparatively very low. As rare disease occurs infrequently in a population, there is no universal definition. The World Health Organization (WHO) defines a rare disease as an often debilitating lifelong disease or disorder condition with a prevalence of 1 or less, per 1000 population. It is estimated that there are about 7000 rare diseases. Most of the rare diseases – (about 80%) are genetic and hence affects a large number of children. Some rare diseases are not inherited such as – some rare cancers, auto-immune diseases, infectious tropical diseases, etc. Unfortunately, there are no treatments available for many rare diseases. Identification and treatment of rare diseases is a challenging task because of the general lack of awareness and very limited availability of scientific and medical infrastructure.

It is thus essential for medical community, healthcare practitioners, researchers, experts, professionals and other international stakeholders across NAM Member and other developing countries to work cohesively with WHO, health-system managers and policymakers in designing their national level policy and building capacity for treatment of rare diseases.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!

I am happy to present before you the fourth Fact File being published by the NAM S&T Centre titled "**Plastic Pollution**".

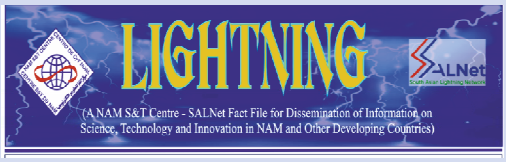
Plastic pollution is a widespread problem affecting both the land and marine environment. It threatens our life on earth, ocean health, health of marine species, food safety and quality, human health, coastal tourism and also contributes to climate change.

The main sources of plastic debris found in the oceans are land-based, coming from- single use plastics, personal care products, urban and stormwater runoff, littering, inadequate waste disposal, industrial activities, construction and illegal dumping. Ocean-based plastic pollution originates primarily from the fishing and marine activities.

Plastic pollution affects the habitats and natural ecosystem. Plastic debris ingested by marine species causes lacerations, infections, reduced ability to swim and internal injuries. Plastic also interferes with the body's endocrine system, causing developmental, reproductive, neurological and immune system disorders in humans. When plastic waste is incinerated, it releases carbon dioxide and methane into the atmosphere, thereby increasing green house gas emissions. Plastic waste also damages the aesthetic value of tourist destinations leading to decreased income from tourism.

We are thankful to Dr. Ranadhir Mukhopadhyay, Former Chief Scientist, CSIR-National Institute of Oceanography, Goa, India and Prof. Dr. S. Suriyanarayanan, Associate Dean (Research), JSS Science and Technology University, Mysuru, India for editing the Fact File. We also express our appreciation to Dr. Mahua Saha, Principal Scientist, CSIR-National Institute of Oceanography, Goa, India for her comments and inputs for editorial revisions.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

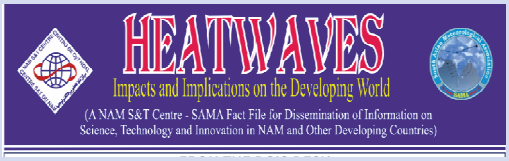
It is with great pleasure that I introduce you to another Fact File published by the NAM S&T Centre on the topic of "**Lightning**". This Fact File, jointly prepared by the South Asian Lightning Network (SALNet), Kathmandu, Nepal in collaboration with the NAM S&T Centre aims to shed light on the impact of lightning on human life, livestock, infrastructure and the environment.

Lightning strikes cause significant fatalities annually worldwide. Besides human casualties, lightning also triggers devastating forest fires, damages buildings & electrical/electronic systems and disrupts utilities, leading to substantial economic losses. To mitigate these risks, lightning protection systems are crucial. Real-time lightning detection technologies, contribute significantly to early warning systems, aiding sectors such as aviation, defense, utilities and public safety. Despite technological advancements, the impact of lightning remains particularly severe in developing countries, where agricultural workers and outdoor laborers are most vulnerable due to lack of protective infrastructure and awareness. In conclusion, while lightning is a natural phenomenon with complex scientific explanations, its societal impact underscores the need for continued research, robust mitigation strategies and global S&T collaboration to reduce casualties of human/livestock and economic losses worldwide.

We are thankful to Dr. Shriram Sharma, Professor, Amrit Campus, Tribhuvan University, Nepal and Chairman, South Asian Lightning Network (SALNet) for suggesting this important topic and contributing as the Scientific Editor for this Fact File. We also express our appreciation to Mr. Ronald Holle, National Lightning Safety Council, USA and Dr. Daile Zhang, University of North Dakota and National Lightning Safety Council, USA for their valuable contributions in preparing this Fact File. We also express our sincere gratitude to Prof. Mary Ann Cooper, Managing Director, African Centres for Lightning and Electromagnetics Network (ACLENet) for providing us the photographs of the tragic lightning incident that took place on June 28, 2011 in Uganda and for critically reviewing the contents of this Fact File.

I believe that this Fact File will provide valuable insights and foster greater understanding of the multifaceted challenges posed by "Lightning".

FROM THE DG'S DESK



Warmest Greetings to our Esteemed Readers!

I am pleased to present the latest Fact File titled "**Heatwaves**: Impacts and Implications on the Developing World" brought out by the NAM S&T Centre in collaboration with the South Asian Meteorological Association (SAMA), New Delhi.

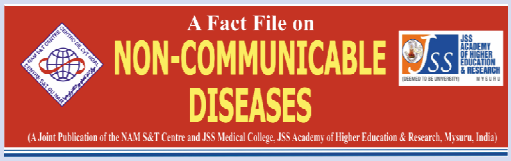
As climate change intensifies, heatwaves are becoming a pressing global issue, particularly impacting developing countries. This Fact File outlines the alarming rise in the frequency and intensity of heatwaves, highlighting their detrimental effects on health, agriculture, water resources and economic stability, especially for vulnerable populations.

Key findings indicate that extreme heat events can lead to increased mortality rates, reduced agricultural productivity and heightened water scarcity. The Fact File emphasizes the urgent need for tailored "Heat Action Plans" and effective early warning systems to mitigate these impacts. Urban areas, particularly in South Asia are especially vulnerable due to the "Urban Heat Island Effect", highlighting the necessity for localized strategies such as early warning systems and public awareness campaigns.

I would like to take this opportunity to extend my heartfelt thanks to the Editor AVM (Retd.) Prof. Ajit Tyagi and other contributors, including Dr. Poulomi Chakravarty, Prof. Someshwar Das, Dr. Swagata Payra and Dr. Mohan Kumar Das from the South Asian Meteorological Association (SAMA) for their valuable insights.

I hope our readers will find the information on such an important topic interesting and useful.

FROM THE DG'S DESK



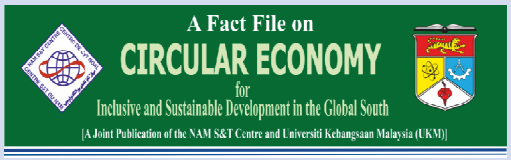
Warmest Greetings to all our Esteemed Readers!

Non-communicable Diseases (NCDs) are medical conditions that are not caused by infectious agents and cannot be transmitted from person to person. They are usually chronic and progress slowly over time. The four main types of NCDs that are directly linked to increased morbidity and mortality are: cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes. Common behavioural risk factors associated with NCDs are: tobacco use; harmful use of alcohol; unhealthy diet and physical inactivity which in turn contribute to metabolic changes that increase the risk of NCDs such as: high blood pressure (hypertension), overweight/obesity; high blood glucose levels (diabetes) and abnormal blood lipids (high cholesterol). An important way to control NCDs is to focus on reducing the risk factors associated with these diseases and monitoring their progress and trends.

Recognizing the paramount importance of this health issue, the NAM S&T Centre is pleased to publish this Fact File on "**Non-Communicable Diseases**" jointly with the JSS Medical College, JSS Academy of Higher Education & Research (JSS AHER), Mysuru, India. This document provides an overview of non-communicable diseases and their main types; percentage of total deaths due to NCDs in various regions; non-modifiable, modifiable and metabolic and environmental risk factors associated with NCDs and strategies that can be adopted for prevention and control of NCDs to reduce their impacts.

We are thankful to Prof. (Dr.) Basavanagowdappa Hathur, Vice Chancellor, JSS AHER, Mysuru and Prof. (Dr.) Praveen Kulkarni, Professor and Vice Principal, JSS Medical College, Mysuru for their significant contributions in bringing out this Fact File. We are also thankful to my colleagues Mr. Madhusudan Bandyopadhyay, Senior Adviser; Ms. Jasmeet Kaur Baweja, Senior Programme Officer and Mr. Pankaj Buttan, Data Processing Manager, NAM S&T Centre for their contributions in bringing out this important Fact File.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

It is with great pleasure for me to bring to you another Fact File published by the NAM S&T Centre on a very important topic of **"Circular Economy for Inclusive and Sustainable Development in the Global South"**. This Fact File, jointly prepared by the Universiti Kebangsaan Malaysia (UKM), Selangor, Malaysia and the NAM S&T Centre, aims to shed light on the increasing importance of Circular Economy principles in promoting sustainable development, particularly in the Global South.

Circular Economy (CE) offers a sustainable path forward by focusing on reducing waste, reusing materials and recycling products. Unlike the traditional linear economy, which follows a 'take-make-dispose' model, CE promotes resource efficiency and economic resilience by extending the lifecycle of materials. This approach helps address critical issues like resource scarcity, environmental degradation and socio-economic inequalities in developing regions. In regions like the European Union, the Circular Economy Action Plan (CEAP) helped in integrating sustainability into various sectors, driving innovation, creating jobs and improving GDP.

However, challenges such as policy gaps, limited technology and financial constraints hinder implementation of CE in the developing countries. By overcoming these challenges, the Global South can lead in circular practices, contributing to global sustainability efforts and a long-term environmental and economic resilience.

We are grateful to Dr. Umawathy Techanamurthy, Senior Lecturer, Department of Engineering Education, Faculty of Engineering and Built Environment, UKM, Selangor, Malaysia for suggesting this important subject and contributing as the author and Scientific Editor of this Fact File. We are also thankful to the UKM Management for their kind permission to publish this Fact File as a joint initiative between the NAM S&T Centre and UKM.

I believe that this Fact File will provide valuable insights and foster greater understanding of the importance of the application of Circular Economy principles in the Global South.

FROM THE DG'S DESK



Warmest Greetings to our Esteemed Readers!

I am pleased to present before you the latest Fact File titled "**Marine Pollution**" published by the NAM S&T Centre; in collaboration with the Centre for Sustainable Ocean Policy (CSOP), Universitas Indonesia; and the Non-Aligned Movement Centre for South-South Technical Cooperation (NAM CSSTC), Jakarta, Indonesia.

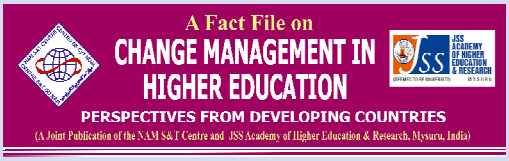
This Fact File is a concise document that provides an overview of Marine Pollution, which is one of the most serious environmental challenges of our time; and also gives an outline of the threat that extends beyond the degradation of marine ecosystems. The document delves into the degradation of vital ecosystems, threats to food security and public health, and the limitations of current international legal frameworks like MARPOL, UNCLOS and the London Protocol. Particularly noteworthy are the technological and legislative innovations featured in this Fact File, including AI-based pollution tracking systems, biodegradable solutions and pioneering initiatives like the Ocean Cleanup and ASEAN's regional action plans.

This Fact File is not only an informative document but also a reminder for action by governments, industries, scientists and citizens to reaffirm our shared responsibility toward a sustainable future where marine ecosystems can thrive in harmony with human development.

I would like to express my sincere gratitude to Dr. Arie Afriansyah, Chair, CSOP, and Professor of International Law, Faculty of Law, Universitas Indonesia, for his valuable contributions as the Chief Contributor and Scientific Editor. I also extend my heartfelt thanks to H.E. Ambassador Diar Nurbintoro, Director, NAM CSSTC; and Mr. Madhusudan Bandyopadhyay, Senior Advisor, NAM S&T Centre for their guidance and support as Editorial Advisers.

We are also hopeful that the Fact File will enhance our understanding and appreciation of the UN Sustainable Development Goal 14 (Life Below Water).

FROM THE DG'S DESK



Warmest Greetings to our Esteemed Readers!!

It is with great pleasure that I present another Fact File titled **"Change Management in Higher Education: Perspectives from Developing Countries"** brought out by the NAM S&T Centre. The document highlights the increasing importance of strategic, inclusive and adaptive change management in higher education institutions.

As countries face rapid technological advancements, evolving policy reforms, labour market dynamics and the impacts of globalisation, higher education systems must adapt to remain relevant, efficient and effective towards delivering excellence.

This Fact File provides a comprehensive overview of both planned and unplanned changes, showcasing diverse examples from across Africa, Asia and Latin America. From India's National Education Policy (NEP) - 2020 to South Africa's Decadal Plan for STI, and from Brazil's AI Strategy to Kenya's Emergency Digital Learning Response, the document captures a global mosaic of initiatives aimed at transforming higher education to meet the emerging challenges. It explores critical drivers of change such as digitalisation, policy shifts and international collaboration, while also addressing key challenges like limited resources and institutional resistance.

The document represents our contribution towards the achievement of the *"UN Sustainable Development Goal 4: Quality Education for All"*, underscoring the pivotal role of higher education in promoting equitable, inclusive and sustainable development.

We extend our sincere thanks to Dr. C. G. Betsurmath, Executive Secretary, JSS Mahavidyapeetha, Mysuru, India, for serving as the Lead Author and Scientific Editor of this Fact File. I am confident that this Fact File will be a valuable source of information and knowledge for policymakers, experts and other stakeholders interested in higher education systems in the Global South.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

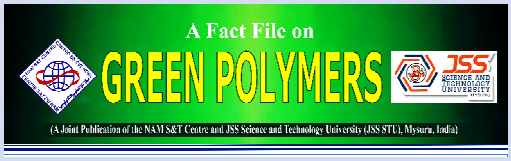
It gives me great pleasure to present this Fact File on **"Bone Diseases and Disorders in the Global South: Challenges and Prevention"**, a subject of growing public health concern. This Fact File highlights the prevalence, causes, prevention and management of common bone-related disorders such as osteoporosis, arthritis, rickets, osteomalacia and fractures, while also emphasizing the socio-economic challenges linked with bone health.

Bone health is fundamental to overall well-being, mobility and productivity. Unfortunately, factors such as aging populations, nutritional deficiencies, sedentary lifestyles, long-term use of certain medications (such as corticosteroids) and comorbid conditions have contributed to a rising emergence of bone diseases worldwide. The challenges are even more pronounced in developing countries, where limited awareness, delayed diagnosis and inadequate access to treatment hinder effective management of bone related problems. This not only leads to reduced quality of life but also imposes considerable social and economic costs.

Adequate nutrition, preventive care strategies, optimum lifestyle management and advanced treatments can play a vital role in improving bone health. By strengthening policy frameworks, improving awareness, enhancing early detection mechanisms and making treatments more affordable, countries in the Global South can address the burden of bone diseases more effectively and efficiently.

We extend our sincere gratitude to Dr. Khayati Moudgil, Assistant Professor, Faculty of Health Sciences, School of Pharmacy, JSS Academy of Higher Education and Research, Mauritius, Prof. Varsha Bangalee, Associate Professor (Pharmacy Practice), Discipline of Pharmaceutical Sciences, College of Health Sciences, University of KwaZulu-Natal, South Africa and Dr. Jhassu Varsha Naveena Mohadeb-Somar, Chairperson of the Dental Council of Mauritius for their valuable contributions in preparing this publication. We also record our appreciation for Dr. Praveen Mohadeb, Vice Chancellor & CEO, JSS Academy of Higher Education and Research, Mauritius for his kind support and permission to bring out this joint publication as a collaborative scientific activity between our two institutions. I am confident that this Fact File will serve as an important resource for policymakers, researchers, healthcare professionals and the wider public in deepening their understanding of bone diseases and related disorders.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

It is with great pleasure that I present the NAM S&T Centre's latest Fact File on **"Green Polymers"**. The document highlights the growing importance of environmentally sustainable materials such as green polymers in addressing global challenges such as plastic pollution, resource depletion and severe environmental degradation.

Green polymers derived from renewable biological sources and designed to be biodegradable and recyclable, offer a promising pathway towards sustainable development and responsible industrial practices. Green polymers are sustainable and eco-friendly materials which help in reducing reliance on fossil fuels, lowering carbon footprint, and reducing greenhouse gas emissions, and thus contribute greatly towards achieving the United Nations Sustainable Development Goals (SDGs). This Fact File briefly describes various issues on green polymers, including their classification, properties, synthesis and related technological advances; and highlights their various applications. The document also examines the role of green polymers in advancing a circular economy; reviews global market trends & challenges; and recommends measures to accelerate the adoption of green polymers in the society.

We would like to express our sincere appreciation to Dr. B.S. Madhukar, Associate Professor, JSS Science and Technology University (JSS STU), Mysuru, India for serving as the Principal Author and Scientific Editor of this Fact File. We also gratefully acknowledge the contributions of Dr. S. Suriyanarayanan, Associate Dean (Research), JSS STU and Mr. M. Bandyopadhyay, Senior Adviser, NAM S&T Centre for their guidance. We are thankful to Ms. Yashaswini V.L. from JSS STU and Ms. Abhirami Ramdas, Programme Officer, NAM S&T Centre in the preparation of this informative document.

I am confident that this Fact File will serve as a valuable source of information for those who are interested in environmentally sustainable materials, and the global efforts on the transition towards a Circular Economy.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

It gives me immense pleasure to present this edition of the NAM S&T Centre's Fact File titled **"Life and Livelihoods in the Himalayas: Perspectives from Nepal"**. This document highlights the evolving livelihood systems in the Himalayan region and examines how communities in Nepal have adapted to changing socio-economic, environmental and demographic conditions. It also highlights the unique mountain conditions that influence livelihood opportunities and challenges in the region.

Traditionally, livelihoods in Nepal's mountainous regions were rooted in crop-livestock agriculture, forest based activities and local trade systems. Over time, these livelihood strategies have diversified in response to migration, tourism development, market integration, infrastructural expansion and changing climatic conditions. This Fact File discusses the growing importance of sectors such as cultivation of high-value crops, livestock production, non-timber forest products, tourism, labour migration, community based tourism and niche agricultural products in strengthening local economies and rural livelihoods.

The Fact File further examines demographic transitions and emerging challenges affecting mountain communities, including labour shortages in agriculture, human-wildlife conflict, climate change impacts and increasing dependence on migration based income. At the same time, it reflects the resilience and adaptive capacities of Himalayan communities in sustaining their livelihoods under changing circumstances.

We express our sincere appreciation to Dr. Gobinda Basnet, Consultant, Nepal Academy of Science and Technology (NAST), Nepal for authoring this informative Fact File. We also gratefully acknowledge Dr. Rabindra Prasad Dhakal, Secretary, NAST for serving as the Scientific Editor. We further acknowledge Prof. Dilip Subba, Vice-Chancellor, NAST and Mr. M. Bandyopadhyay, Senior Adviser, NAM S&T Centre for their valuable guidance. We are thankful to Ms. Abhirami Ramdas, Programme Officer, NAM S&T Centre for her efforts in the preparation of this informative document.

I am confident that this Fact File will serve as a valuable resource for policymakers, researchers, academicians, development practitioners and students interested in mountain livelihoods and sustainable development. Although this Fact File primarily focuses on Nepal, we believe that many of the livelihood patterns, challenges and adaptive strategies discussed herein are also relevant and applicable to other Himalayan and hilly regions across the developing world.

FROM THE DG'S DESK



Warmest Greetings to all our Esteemed Readers!!

It gives me great pleasure to present this Fact File on "**Fatty Liver Problems in the Developing World: Implications of the Modern Diet**", a timely publication addressing one of the most pressing and rapidly emerging public health challenges in the Global South. Once considered a relatively uncommon condition, fatty liver disease has become increasingly prevalent due to modern dietary patterns, changing food habits, rapid urbanization, sedentary lifestyles, and the growing burden of obesity, diabetes and other metabolic disorders.

Often referred to as a "Silent Disease" because it may progress without noticeable symptoms, fatty liver disease can lead to serious complications, including liver fibrosis, cirrhosis and liver cancer, if left undiagnosed and untreated.

This Fact File provides an overview of the growing burden of the disease, explains its underlying causes and progression, examines the important role of the gut-liver connection and the microbiome in maintaining liver health, discusses the challenges associated with early detection and also highlights management and treatment strategies, with particular emphasis on lifestyle modification and appropriate clinical care.

I am confident that this publication will serve as a valuable resource for enhancing awareness, encouraging early detection and timely intervention, and supporting efforts to reduce the growing burden of fatty liver disease across the developing world.

We express our sincere gratitude to Dr. Khayati Moudgil, Asst. Professor, Faculty of Health Sciences, School of Pharmacy, JSS Academy of Higher Education and Research, Mauritius for her valuable contributions in preparing this Fact File. We also record our appreciation for Dr. Praveen Mohadeb, Vice Chancellor & CEO, JSS Academy of Higher Education and Research, Mauritius for his kind support and permission to bring out this joint publication as a collaborative scientific activity between our two institutions. We believe that this Fact File will serve as an important source of knowledge for researchers, policymakers, healthcare professionals and general public in obtaining some basic understanding of this very important and yet often overlooked "lifestyle disease".

SCIENTIFIC EVENTS ORGANISED BY THE NAM S&T CENTRE

During the period since the 16th GC Meeting, the Centre organised the following **19** International Workshops and Training Programmes:

1) **Cairo, Egypt:** International Training Programme on "Low Cost Technologies for Arsenic Removal from Groundwater" during 5-6 September 2023.
2) **Mauritius**: International Workshop on "Improving Efficiency and Effectiveness in Health Delivery Systems in Developing Countries: Research, Implementation and Policy Issues" during 21-23 November 2023.
3) **Mauritius**: International Workshop on "Impacts of Climate Change on Small Island Developing States (SIDS)" during 28-29 February 2024 [Virtual Mode].
4) **Lusaka, Zambia:** International Consultative Meeting on "Research & Development and Technology Transfer for Sustainable Agriculture and Food Security in Low-Income Countries" during 8-9 May 2024.
5) **Stellenbosch, South Africa:** International Conference on "Integrated Responses to the Intensification of Extreme Climate and Weather Events in Developing Economies" during 22-24 May 2024.
6) **Kuala Lumpur, Malaysia:** International Training Programme on "STI Policy: Roles of STI for Excellence in Commercialization in Emerging Economies" in Kuala Lumpur, Malaysia during 12-14 September 2024.
7) **Phoenix, Mauritius:** International Workshop on "Patenting for Economic Growth: Opportunities and Challenges" during 24-25 October2024 [in Virtual Mode].
8) **El-Ain El-Sokhna, Egypt:** International Workshop on "Food, Water, Energy Nexus & Sustainability" during 20-21 February 2025.
9) **Réduit, Mauritius:** International Workshop on "Role of Women in Science, Technology and Innovation in the Global South" during 17-18 April 2025.
10) **Kathmandu, Nepal:** International Conference on "Science and Technology Information Management System: Practices and Experiences" during 7-9 May 2025.
11) **Keralam, India:** International Workshop on "Energy Efficiency, Conservation and Transition for Achieving Net Zero and Sustainable Development Goals" during 9-10 September 2025.

12) **Malang, Indonesia:** International Training Workshop on "STI Policy: Artificial Intelligence for Climate Learning Futures" during 22-25 September 2025.

13) **Mysuru, Karnataka, India:** International Conference on 'Heat and Heatwave Trends and their Health Implications in the Global South' during 6-7 November 2025.

14) **Mauritius:** International Workshop on 'Clean Water and Sanitation in the Developing World: Perspectives, Best Practices and Future Challenges' during 20-21November 2025 [Virtual Mode].

15) **Chennai, India:** International Workshop on "Circular Economy in Leather and Leather Product Industries" during 29-30 January 2026.

16) **Flic en Flac, Mauritius:** International Workshop on "Promoting Blue Economy and Overcoming its Implementation Challenges" during 26-27 March 2026.

17) **Mysuru, Karnataka, India:** International Workshop on 'Generic Drugs: Science, Technology, Regulatory Issues and Societal Dimensions in the Developing World' during 23-24 April 2026.

18) **Moka, Mauritius**: International Conference on "Lifestyle Diseases in the Developing World: Perspectives, Current Status and Future Challenges" during 14-15 May 2026

19) **Cape Town, South Africa:** Foundations of Science Diplomacy: A Training Programme for Early and Mid-Career Researchers during 21-23 June 2026.

FELLOWSHIP SCHEMES

Ongoing:

In pursuance of its objectives to promote South-South and also North-South cooperation in Science and Technology, the Centre executed the following Fellowship schemes jointly with the Centres of Excellence in various countries for supporting young scientists and researchers in the developing countries for their capacity building in research and development:

(i) Joint NAM S&T Centre – ZMT Bremen (Germany) Fellowship

13 Scientists – from Bangladesh (1), India (1), Indonesia (3), Kenya (1), Malaysia (4) and Sri Lanka (3) have availed this Fellowship after the last GC meeting held in July 2023.

(ii) Joint NAM S&T Centre – JSS AHER, Mysuru, India Fellowship Programme

13 Scientists – from Egypt (3), Indonesia (1), Malaysia (2), Mauritius (3), Nepal (1) and Sri Lanka (3) have availed this Fellowship after the last GC meeting held in July 2023.

During 2026, 5 scientists were selected from Egypt, Indonesia, Kenya, Malaysia and South Africa

(iii) Joint NAM S&T Centre – ICCBS Fellowship

Only one scientist from Indonesia was selected.

New Fellowship Schemes Initiatives:

Since the last GC Meeting in July 2023, the Centre has been successful in negotiating two more Fellowships arrangement as listed below:

(i) Joint NAM S&T Centre - JSS STU, Mysuru, India Fellowship Programme

4 Scientists – from Egypt, Kenya, Mauritius and Myanmar have successfully completed their research projects since the Fellowship started in 2025.

(ii) Joint NAM S&T Centre – UM, Malang, Indonesia Post-Doctoral Fellowship

5 Scientists – from Egypt, India, Iraq, Myanmar and South Africa have been offered this Fellowship since it has been started in 2026.

NEW NAM S&T – INDUSTRY NETWORK MEMBERS

In order to facilitate direct participation of individual scientific agencies, academic and R&D institutions, Centres of Excellence, and industries in the developing countries, in the scientific activities of the Centre, the 8th Governing Council of the Centre in its Meeting held in November 1997 in Dhaka, Bangladesh approved the establishment of a **'NAM S&T – Industry Network'**.

Persistent efforts are being made by the NAM S&T Centre as well as through the Focal Points in its Member Countries to induct new scientific institutions and agencies as 'NAM S&T-Industry Network Members'. As a result of the Centre's efforts, **JSS University, Noida, Uttar Pradesh, India;** and **JSS Science and Technology University (JSS STU), Mysuru, India** have joined the NAM S&T – Industry Network during the period after the last GC Meeting in July 2023.

Special Feature-1

Malaysia's Vibrant Research, Development, Innovation, Commercialisation and Economy (RDICE) Ecosystem: Success Stories and Lessons Learnt

Science, technology, innovation and economy (STIE) remain the definitive engines of growth, shaping global development and delivering crucial solutions for clean energy, food security, healthcare and climate resilience. In Malaysia, strategic investments in research, talent, and innovation have driven the nation's rise to become one of Southeast Asia's leading upper- middle-income economies.

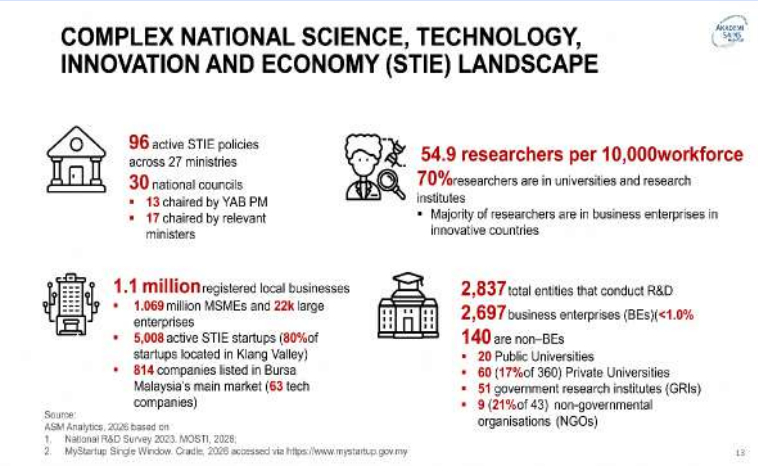
Over the years, Malaysia has developed an extensive STIE ecosystem, encompassing policy and governance structures, research institutions, and industry participation.

Governance and Research Capacity: Malaysia's STIE ecosystem is broad and institutionally diverse. It is supported by 96 STIE-related policies spanning 27 ministries and 30 national councils. The country has 54.9 researchers per 10,000 workers. About 70% work in universities and research institutes, whereas innovation-driven economies typically employ a larger share of researchers in industry.

Industry Participation: Malaysia has 2,837 R&D-performing organisations. However, fewer *than 1% of its 1.1 million registered businesses conduct R&D, indicating limited private-* sector participation in research and innovation. Over 96.2 % of Malaysian business enterprises are MSMEs that have limited capacity to carry out R&D, even though they contribute 39.7% of Malaysia's GDP, employ around 8.1 million people accounting for 48.7% of the national workforce (MSME performance Report, 2025, DOSM).

Focus on Experimental Development: The bulk of R&D expenditure in Malaysia is concentrated in experimental development, which is the pre-commercialisation stage in translating ideas into solutions, at 60.96% in 2022 (National R&D Survey 2023, 2025, MOSTI). This has been largely due to ASM's recommendation to shift the increase the percentage share to over 50% of R&D activities from basic research to experimental development, in line with trends in innovative countries (Science Outlook 2017, 2018, ASM).

Implications for the Ecosystem: Expanding research capacity alone will not close this gap. Malaysia also needs stronger pathways that enable businesses to engage directly with researchers, articulate technical and operational challenges, and identify, adopt, and scale relevant research outcomes.



Malaysia now ranks 34th among 139 economies in the 2025 Global Innovation Index, its highest position to date, and has climbed to 15th in the World Competitiveness Ranking in 2026. Aligned with the MADANI Economic Framework's target of breaking into the world's top 12 most competitive economies by 2033, strategic roadmaps such as the 10-10 MySTIE framework are already channelling resources into 30 national niche areas to drive long-term inclusive prosperity.

To accelerate this transformation, Malaysia aims to increase R&D expenditure beyond its current level of approximately 1.4% of GDP and mobilise RM3.4 trillion in STI-related investment by 2030. This ambition aligns with the National Science, Technology and Innovation Policy 2021–2030, which seeks to establish Malaysia as a high-technology, innovation-driven nation by 2030.

The National RDICE Action Plan 2025-2030 provides the strategic blueprint for delivering this vision, championing a mission-oriented approach to tackling national challenges through cross- sector collaboration. While the country has built a strong foundation in research infrastructure and STEM talent, persistent challenges remain in coordinating research priorities, sustaining investment, strengthening industry participation, and ensuring the RDICE ecosystem aligns with national priorities. Addressing these challenges requires an integrated ecosystem grounded in the quintuple helix model, bringing together government, academia, research institutes, industry and society to mobilise their respective expertise and capabilities.

At its core, RDICE is a chain. Research generates knowledge and discoveries. Development translates findings into practical applications. Innovation creates value through new ideas, technologies, products, and services. Commercialisation brings viable innovations to market, while the economy benefits through increased productivity, investment, employment, enterprise growth, and competitiveness.

But the chain is not strictly linear. Innovation can spark at any point, whether from fundamental research, technological adaptation, industry needs or user feedback. Nor should scientific achievement be measured solely by commercial returns. Research also delivers new knowledge, scientific talent, evidence-based policy, societal well-being and environmental sustainability. For academic and R&D institutions especially, value extends from fundamental discovery to applied solutions for national grand challenges.

Malaysia's progress in scientific and technological capabilities is best understood through the Academy of Sciences Malaysia's flagship report, *Science Outlook 2020: Unlocking the Future.*

The report assessed the country's STI ecosystem and its contributions to economic vibrancy, societal well-being, and environmental sustainability. It identified information technology (IT) services, electrical and electronics (E&E), telecommunications and courier services, food processing, automotive, chemicals, petroleum, and pharmaceuticals as pacesetter industries, reflecting their relatively high levels of innovation activity and knowledge content. Indeed, the country has already begun to see advances in the following sectors:

a) Semiconductors and Advanced Manufacturing

- Expansion of the semiconductor ecosystem, particularly in wafer fabrication support, testing, packaging, and related services.
- Increased research activity in advanced materials, battery and energy technologies, industrial engineering, and manufacturing-process optimisation, with more findings published internationally.

b) Digital Government and Applied AI

- Broader government adoption of online public services and stronger technology delivery across agencies.
- Advances in the use of artificial intelligence in healthcare, education, and public services.

c) Health, Biotechnology, and Energy

- Progress in medical and biotechnology applications, including diagnostics and public- health technologies.
- Energy-transition initiatives spanning smart-grid enablement and engineering for renewable-energy integration.

d) Deep-Tech Development and Commercialisation

- Continued development of prototypes in connectivity and the Internet of Things, cybersecurity, and applied computing, alongside clearer pathways to
- commercialisation.
- More deep-tech ventures—often linked to universities—advancing toward pilot programs and commercialisation in fintech infrastructure, cybersecurity, industrial IoT, and health technology.

While these reflect the country's innovative capability, they remain in pockets; they are not a system. Science creates value by expanding fundamental knowledge and generating applied knowledge to address societal and environmental challenges through evidence-based policymaking. Turning these strengths into sustained national capability requires tighter integration across the research, development, innovation, commercialisation and economy (RDICE) continuum. This integration depends not only on funding and the institutional mandates,

but also on clear routes for knowledge exchange, technology transfer and feedback from those expected to use the resulting solutions.

A key principle is **Return on Value** (ROV), which broadens how we understand and assess the outcomes of research, development and innovation. Rather than measuring success solely by financial returns or the number of technologies commercialised, ROV recognises the multiple forms of value that RDICE activities can generate. These include socioeconomic benefits, productivity improvements, stronger domestic technological capabilities, the creation and application of knowledge, and wider societal impact.

For academic and R&D institutions, this offers a more comprehensive perspective on recognising achievement. Fundamental research expands our understanding. Applied research shapes public policy and improves public services. Collaborative research strengthens talent and knowledge networks. Technology development sharpens industrial competitiveness or advances environmental sustainability.

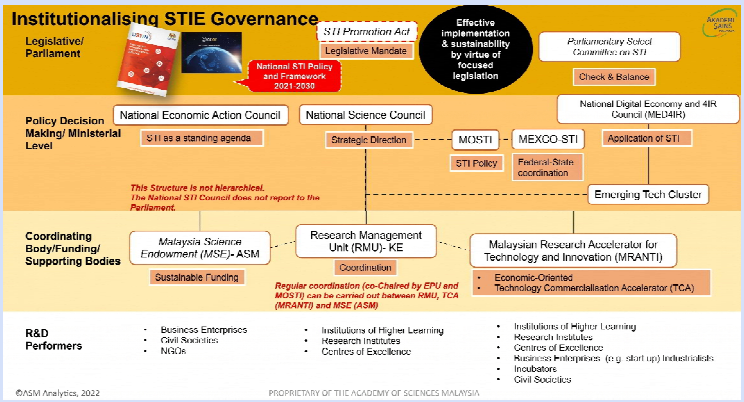
Some payoffs are immediate and measurable; others take years to materialise. Demonstrating a higher ROV also increases the potential to attract investment, generating positive spillovers that improve quality of life and reinforce a sustainable and virtuous STIE ecosystem. Applying an ROV perspective therefore means assessing outcomes against their intended purpose and national priorities, while recognising that not every valuable scientific contribution needs to produce an immediate commercial return.

Realising Malaysia's vision to become a high-technology, innovation-driven nation by 2030 through the RDICE Roadmap requires an enabling environment built around three foundational pillars: **governance, talent** and **funding**.

- Under the **governance pillar**, improved coordination across ministries, agencies and institutions will reduce fragmentation and align research priorities with national development objectives. Proposed institutional mechanisms include strengthening the Research Management Unit (RMU) and supporting its envisaged evolution into a Research Management Agency (RMA), to coordinate national RDICE planning and government research institutes. A Technology Commercialisation Accelerator (TCA), envisaged to be led by Malaysia Research Accelerator for Technology and Innovation (MRANTI), would help strengthen connections between research and industry, facilitate commercialisation and monitor outcomes.

Additionally, overlapping roles and duplicated research among intermediaries and research institutes across the RDICE ROV continuum must be realigned to optimise resources, with public agencies, research institutions and intermediaries embracing open innovation to ensure a continuous, cross-sector flow of knowledge that translates R&D into market-ready solutions.

Making this ecosystem work does not require creating new institutions for every function. The players already exist. Different ministries, agencies, institutions and intermediaries already contribute at different stages of RDICE. For instance, the Ministry of Higher Education (MoHE) supports fundamental research, while the Ministry of Science, Technology and Innovation (MOSTI) drives applied research and experimental development.



In this landscape, universities and research institutes act as technology providers generating potential solutions. Anchoring these solutions in open science platforms such as the Malaysia Open Science Platform (MOSP) ensures that research data is findable, accessible, interoperable and reusable. This enables industry, businesses, and state governments to engage effectively as technology seekers, bringing forward real-world market and development needs.

Open science and open innovation are complementary, yet distinct: open science supports access to and reuse of research outputs, whereas open innovation enables organisations to collaborate and draw on knowledge beyond their own boundaries.

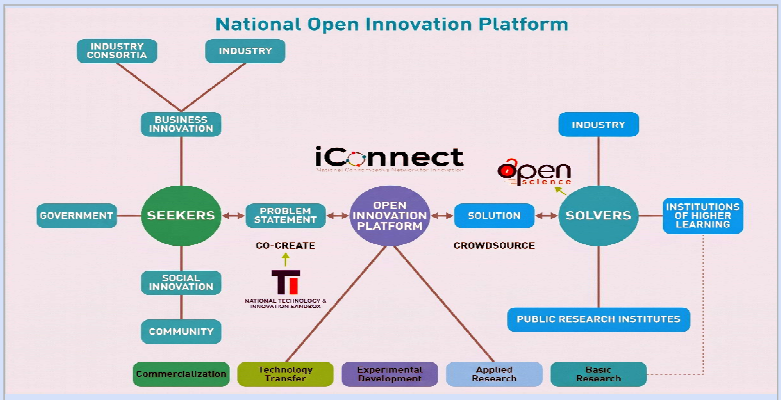
At the same time, mechanisms such as regulatory sandboxes can facilitate the testing and adoption of indigenous technology, while federal and state funding bodies, investors, and banks provide the financing required to advance solutions towards deployment and commercialisation.

Therefore, the priority is to connect these existing actors, funding mechanisms, and innovation activities through a more coordinated federal–state platform. This approach directly anchors research to tangible needs, helps viable solutions move more effectively towards market adoption, and enables states to participate in shaping and benefiting from Malaysia's innovation ecosystem. A coordinated platform can also help surface demand from smaller businesses and state-level actors who may lack the resources to identify suitable research partners or navigate existing support mechanisms. The implementation of the RDICE strategy is expected to further positively impact Malaysia's startup ecosystem.

- The **talent pillar** focuses on cultivating the human capital needed to sustain Malaysia's transformation into a high-technology, innovation-driven nation. While universities and public research institutes provide an important foundation for Malaysia's STI workforce, further efforts are needed to strengthen research career pathways, develop future-ready skills and improve alignment between education, research and industry needs. This includes enhancing STEM education by tailoring academic curricula and training modules to current and emerging market demands.

Additionally, customised incubators that nurture entrepreneurial and technopreneurial mindsets, are vital for fostering dynamic interactions and collaborations within the talent pool. Greater industry participation in talent development can help expand opportunities for researchers, engineers and technical professionals to apply their expertise across sectors.

By strengthening the relationship between education, research and industry, Malaysia can build a resilient talent pipeline capable of supporting technological advancement and industrial upgrading.



The envisaged National Open Innovation Platform would serve as a single gateway connecting solution seekers facing common pain points with solution providers across the innovation ecosystem, simplifying collaboration and helping seekers select the best solutions from a broader pool of expertise and technologies.

- Within the **funding pillar**, the focus is on diversifying funding sources, encouraging private- sector investment and improving coordination among research funding agencies. The proposed Malaysia Science Endowment (MSE), an alternative funding mechanism, would support more sustainable research financing. In parallel, a national handshake mechanism, supported by an integrated funding management database, is proposed to strengthen visibility and monitoring of research investments across ministries and agencies.

These measures aim to ensure funding continuity across the RDICE chain, enabling high- potential projects to progress from experimental development through technology demonstration to successful market deployment. Continuity is particularly important for promising ideas that require several stages of testing, validation and refinement before they are ready for wider adoption, and for cases where the benefits may emerge beyond the funding period.

To navigate this non-linear continuum and ensure that research effectively translates into systemic impact, robust evaluation tools

are essential. The **Innovation Readiness Level (IRL)** framework addresses this need by adopting a multidimensional approach comprising 11 parameters across four key segments to evaluate not only technology readiness but also organisational capability, market readiness, and the competitive landscape.

The ***Mission Readiness Level (MRL)*** is a key parameter in this framework. It assesses how well an innovation aligns with national grand challenges and mission-oriented objectives.

Beyond evaluating R&D projects in isolation, the IRL framework could support funding decisions by identifying high-potential projects with stronger Return on Values (ROV).

At the heart of this approach is a mission-oriented strategy that mobilises resources to address clearly defined national grand challenges. Rather than allowing research activities to develop independently across institutions and sectors, this approach encourages collaboration around shared objectives that require multidisciplinary expertise and coordinated resources.



Building on this direction, seven **National Mission-Oriented Initiatives (MOIs)** have been launched: ***food sovereignty and security***; ***the advanced semiconductor industry***; ***energy sovereignty and securit***y; ***value creation in the oil palm industry***; ***the well-being and empowerment of an ageing society***; ***digital healthcare***; and ***quantum technologies.***

These initiatives offer opportunities for universities, research institutes, government agencies and businesses to combine their capabilities, align research with national priorities and develop solutions with economic, societal and environmental significance. The approach is also intended to be scalable, ambitious, long-term and humanity-centric, enabling organisations to develop missions relevant to their respective sectors and priorities.

Ultimately, the RDICE Roadmap and Action Plan replaces fragmented efforts with a designed ecosystem. While the **MOIs** define the national grand challenges that demand urgent answers, RDICE provides the pathway to solve them.

By connecting stakeholders through coordinated governance, aligned funding mechanisms, and shared objectives, this framework ensures that collaboration across the continuum, from lab discovery to commercial scale, is not left to chance but is designed to translate research into viable, market-ready solutions and lasting societal impact. Progress should be assessed not only by commercialisation and economic performance, but also by the generation of knowledge, stronger technological capabilities, improved public outcomes, and contributions to environmental sustainability.

Delivering on the vision of a high-technology, innovation-driven nation by 2030, demands an unwavering commitment to scientific excellence, supported by agile governance, future-ready talent, and sustainable financing designed to deliver lasting value for the economy, society, and the planet.

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Acknowledgements:

This article has benefited from an overview of the RDICE scenario provided by **Academician Emeritus Professor Dato' Dr V G Kumar Das FASc,** Senior Fellow of the Academy of Sciences Malaysia, Malaysia.

Special Feature-2

Indonesia's New Agenda for Research-Driven Development

1. Introduction

Science, technology, and innovation (STI) are increasingly recognized as essential drivers of economic transformation, national competitiveness, and sustainable development. However, for developing countries, enhancing scientific capabilities is only one of the challenges that should be addressed in the context of broader difficulties. To contribute successfully, the STI strategy must translate scientific knowledge into technological development, industrialization, improved policymaking, and improved social welfare. It requires an integrative research and innovation system backed by coherent policies, institutional coordination, and investments in scientific and technological capabilities.

Indonesia faces the challenges of being a relatively large, resource-rich archipelago with diverse regional development features, while pursuing a vision of technological independence. Improving food and energy sovereignty, strengthening health care, accelerating industrialization, reducing environmental risks, and developing technologies are priorities that require a strong, integrated research system to address these linked issues. Prior empirical studies of the Indonesian STI policy have stressed the importance of policy coherence. Thus, Putera et al. (2022), while reviewing performance indicators across successive national STI policy frameworks, revealed inconsistent research and innovation indicators and goals that may affect policy continuity. The authors noted that performance measurement should be more integrated, covering capabilities in research, innovation diffusion, institutional partnerships, and research finance.

The latest empirical evidence supports this statement. For example, Yudhoyono et al. (2025) analyzed Indonesia's scientific development through scientometrics using SciVal. They found disparities in scientific performance and citation influence across strategic sectors, as well as the need to build a stronger connection between scientific research and the country's development. While Indonesia has increased scientific output, challenges remain in enhancing scientific influence, strengthening industrial research capabilities, and aligning scientific activities with the country's economic and social needs.

In response, the Government of Indonesia introduced the National Strategic Research Roadmap and Agenda, 2026 Edition, under Joint Decree No. 2/M/KB/2026 and No. 148/I/HK/2026, issued by the Minister of Higher Education, Science and Technology and BRIN. This framework links long-term research priorities through 2045 with a research and innovation agenda for 2026- 2029. It appears to aim to strengthen policy coherence and accelerate implementation of the link between research activities and development goals. Besides its domestic importance, it offers opportunities for scientific cooperation between developing countries.

2. The STI Landscape in Indonesia

Indonesia's STI landscape shows growing research capacity alongside persistent structural barriers. According to BRIN, Indikator Iptek, Riset, dan Inovasi Indonesia 2025 reports that national expenditure on research and development (R&D) amounted to IDR 50.27 trillion in 2024, or up 0.23% of gross domestic product (GDP). Higher education institutions accounted for 71.02% of R&D spending, businesses and industry 14.96%, government institutions 13.64%, and private non-profit organizations 0.39%. As shown, higher education plays a prominent role in national research activity. However, industry participation in research and new technology development also needs to increase.

Indonesia is also demonstrating impressive results in terms of scientific output. The number of international scientific publications indexed in Scopus increased. The number of publications rose from 62,137 in 2023 to 63,737 in 2024. But this increase in publication volume does not mean the country's technological competitiveness or economic impact has increased. According to the same BRIN report, the share of high-technology products manufactured and exported relative to imports fell from 39.63% in 2023 to 37.77% in 2024, indicating an ongoing challenge in increasing the country's capacity to produce high-technology products.

Selected indicators of Indonesia's STI landscape

Indicator	Reported figure	Reference year
National R&D expenditure	IDR 50.27 trillion (0.23% of GDP)	2024
Higher education share of R&D expenditure	71.02%	2024
Business and industry share of R&D expenditure	14.96%	2024
International scientific publications (Scopus)	63,737	2024
High-technology export-to-import ratio	37.77%	2024
Global Innovation Index ranking	55th	2025
STI professionals per million inhabitants, presidential-annex series	1,267	2025

Sources: BRIN (2025); Ministry of National Development Planning/Bappenas (2026). The expenditure estimates are provisional. The personnel estimate employs the same definition as in the presidential annex.

Further information on the relationship between research performance and the country's development needs comes from a scientometric assessment by Yudhoyono et al. (2025). Using the SciVal database with data from 2018-2022, sectoral disparities between scholarly productivity and economic impacts were identified. For example, manufacturing accounts for 19.86% of GDP in the authors' comparison, while it represents 7.80% of average publications, with a field-weighted citation impact (FWCI) of 0.57. Although overall statistical comparisons have not revealed significant differences in publication shares under national priority weightings, some disparities and weaknesses in citation influence have been detected. This means STI development needs not only increased scientific productivity but also scientific influence, strategic relevance, and connections with productive sectors.

The report has also reported attempts to translate scientific capabilities into applications. In the 2026 annex to the President's address, it mentions examples such as deploying ARSINUM Mobile technology to make floodwater drinkable during disaster response, the Sidenuk rice breed, which yields 1 tonne per hectare, and research on fluorine-18 radiopharmaceuticals for cancer imaging. All of these cases illustrate how research can contribute to public service provision, food production, and health care. At the same time, further investments, research intermediation, and collaboration are necessary to expand this practice.

3. A New National Research Policy Framework

Indonesia's national research policy framework consists of two interrelated documents. The first one is National Strategic Research Roadmap 2026-2045: Dynamic and Multistakeholders' Approach. This document establishes the long-term direction for research and technological transformation. The other document is the National Strategic Research and Innovation Agenda 2026-2029: Implementation Plan. This document specifies strategic priorities, research activities, annual goals, and implementation measures.

The roadmap outlines three development phases: 2026-2029, 2030-2035, and 2036-2045. The document's phased structure aims to ensure continuity of research priorities and technological capabilities over the long term. The Implementation Plan focuses on the first four years and provides a framework for coordinating research priorities, scientific capabilities, and measures. Overall, the two documents combine strategic policy formulation with research implementation.

A distinctive feature of the framework is its dynamic and multi-stakeholder nature. Based on discussions during the National Science, Technology and Industry Convention (KSTI) 2025, governmental agencies, universities, research organizations, industry, and other stakeholders participated in policy preparation. It is acknowledged that the research priorities should correspond to the changes in technologies, economic situation, needs of society, and constraints of the implementation.



Indonesia's National Strategic Research Roadmap and Agenda, 2026 Edition, comprising the National Strategic Research Roadmap 2026–2045 (Book 1) and the National Strategic Research and Innovation Agenda 2026–2029 (Book 2).

The other feature of the policy framework is a systems approach. Research priorities are considered from the perspective of scientific capabilities, the regulatory environment, financing requirements, institutional arrangements, and potential users. This approach aligns with Yudhoyono et al.'s (2025) emphasis on resource orchestration and open innovation, particularly in linking research organizations, industry, and government. In this way, the Roadmap should function not as a static planning document but as a dynamic framework that supports the development and implementation of evidence-based policies.

4. Strategic Research Priorities toward 2045

The National Strategic Research Roadmap 2026-2045 identifies eight priority fields of long-term transformation: food, health, energy, maritime development, defense, digitalization (including artificial intelligence and semiconductors), advanced manufacturing and materials, and downstream industrialization. This list reflects Indonesia's efforts to strengthen the country's technological capabilities and promote productivity and sustainable development.

Food-related research includes biotechnology, improving crop varieties, sustainable farming systems, and post-harvest and value-added technologies. Energy research focuses on renewable technologies, energy storage and diversification, and technologies to increase energy efficiency. Maritime development research aligns with Indonesia's geographical features, namely the sustainable development of its maritime resources, coastal development, and maritime connectivity. At the same time, strategic areas such as artificial intelligence, semiconductors, advanced materials, and manufacturing are prioritized to increase high-tech capabilities and industrial competitiveness.

A key point of the Roadmap is that technological advancement alone is not enough for innovation. Eight strategic research priorities are supported by six cross-cutting fields: education; economics and business; law and social affairs; disaster resilience; environment; and infrastructure. These fields address the research talent, financing, regulatory certainty, social acceptability, sustainability, and institutional capabilities necessary for innovation.

Cross-cutting fields matter because research should respond to development needs. Not only the scientific and technological capabilities but also the capabilities of governance, skilled human resources, adequate infrastructure, and social engagement are needed. In addition, the Roadmap accounts for regional aspects of research activity, recognizing the heterogeneity of provincial needs, local economic structures, and research and technological capabilities.

5. Translating the Roadmap into Action: The 2026-2029 Agenda

The National Strategic Research and Innovation Agenda for 2026-2029 transforms long-term priorities into the implementation framework. The document reveals eight implementation areas: food sovereignty; energy sovereignty; water resilience and sustainable environmental development; health sovereignty; strategic industrial development; social, community and cultural resilience; aerospace and space technology development; and nuclear science and technology development.

Although these operational areas are classified differently from the strategic fields, they provide additional ways to implement the country's research priorities. In this document, there are specified research directions, annual goals, and measures that are aimed at the enhancement of scientific capabilities and the development, validation, and utilization of research results.

Food sovereignty priorities include research in agricultural biotechnology, precision agriculture, food processing technologies, and sustainable production systems. Energy sovereignty deals with renewable energy, diversification, energy storage and technological

efficiency. Water and environmental research addresses resource resilience, clean technologies, and sustainable ecosystem management. Health sovereignty includes pharmaceuticals, diagnostics, biotechnology, and medical technologies. Other priorities include industrial development, social and cultural resilience, and aerospace and nuclear technologies across sectors.

An important characteristic of the implementation framework is its orientation toward the knowledge-to-impact pathway. Research should not be measured by publications, patents, or prototypes, but by the linkage between knowledge creation, technological development, validation, adoption, and broader benefits for the economy and society.

This is an important step towards research-driven development. But successful implementation will depend on sustaining financing, research infrastructure, industrial participation, regulatory and monitoring arrangements, and programmatic support. Research initiatives should also address user needs from the start to increase opportunities for technology adoption and implementation.

6. Opportunities for South–South Scientific and Technological Cooperation

Indonesia's strategic research agenda presents opportunities for international scientific cooperation, especially for developing countries facing the same development challenges. NAM S&T Center is a good platform to explore the possibilities for collaboration on research, knowledge exchange, capacity building, and technological partnership.

Food sovereignty and sustainable agriculture appear to be good domains for collaborative research. The participating countries can engage in common research on climate-resistant crops, sustainable farming, and post-harvest and processing technologies. In the field of energy and environmental research, further opportunities exist, including research on renewable energy, decentralized energy systems, clean water technologies, environmental monitoring, and adaptation to climate change.

Health-related research is also a field for joint activities. The collaborating countries can pursue research on tropical diseases, biotechnology, diagnostics, and pharmaceutical and medical technologies needed in developing countries. The establishment of joint research networks, researchers' exchange, and specific training can contribute to the development of national scientific capabilities and solve health problems together.

Besides research collaboration in particular disciplines, collaboration in the governance of research and innovation can also occur. Potential initiatives may include joint research projects, sharing the infrastructure for research, technology validation, development of the science parks, and exchange of experiences in research priority-setting, financing, and performance measurement.

The importance of international cooperation is highlighted in the findings of Yudhoyono et al. (2025), which revealed that cross-institutional partnerships, knowledge exchange, and international collaboration enhance scientific performance and innovation capabilities. But the cooperation should not only lead to joint publications but also to the development of scientific capabilities, technology absorption, and resolution of shared development problems.

Indonesia's experience suggests two areas for collaboration: research priorities and the exchange of experience in national research policy development and implementation. Effective collaboration will require clear objectives, equity of participation, adequate financing, knowledge sharing, and measurable outcomes. These are potential opportunities for cooperation.

7. Conclusion

The new framework for research-driven development in Indonesia, consisting of the National Strategic Research Roadmap 2026-2045 and the Research and Innovation Agenda 2026-2029, appears to aim at strengthening the link between scientific capabilities, technological development, and national development priorities. Recent indicators of Indonesia's STI and scientometric analysis show both achievements and existing challenges in research investment, scientific influence, industrial involvement and technology utilization.

Indonesia's research-driven development agenda aims beyond increasing scientific output. It aims at increasing the contribution of research and innovation to economic transformation, technological sovereignty, environmental sustainability, and social well-being. Achieving this aim will require collaboration, sustainable financing, implementation and evaluation.

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Special Feature-3

Building Better Bones: What You Need to Know About Osteoporosis and Fall Prevention

How Bone Health Changes Over Time

Bones are living organs that constantly break down and rebuild to keep the skeleton strong. Under a microscope, healthy bone looks like a fine lattice with thick, well-connected struts. During youth and early adulthood, the skeleton adds mass much faster than it sheds old mineral, reaching a peak in bone density around age thirty. After this window, the balance flips. The body gradually absorbs mineral faster than it lays down fresh bone matrix, causing the internal mesh to thin out and lose its structural support.

When this thinning accelerates, the condition is termed osteoporosis—literally "porous bone". The spaces inside the bone expand while the outer wall becomes brittle and fragile. Because this loss happens without stiffness, soreness, or early warnings, clinicians describe it as a silent condition. Most people only discover their skeleton has weakened after a low-impact accident—like slipping from standing height, bumping into heavy furniture, or coughing hard—ends in a sudden fracture. These fragility breaks most often strike the hip, wrist, and spine, where collapsed vertebrae can lead to stooped posture, height loss, and chronic back strain.

Major Risk Factors and Causes of Bone Loss

While everyone loses some bone density with age, several inherited and environmental factors speed up the process. People with a family background of hip fractures, or those with naturally petite frames, start with a smaller reserve of peak bone mass.

Hormones also directly regulate bone turnover. Estrogen protects bone by keeping breakdown cells in check, so when estrogen levels plunge after menopause, women often lose substantial bone mass within a decade. In men, declining testosterone causes a similar, though usually slower, drop in density. Systemic conditions like celiac disease, overactive thyroid disorders, and rheumatoid arthritis also interfere with normal mineral balance.

Everyday habits play a major role in overall bone resilience:

- Low mineral intake: A diet short on calcium forces the body to pull calcium from the skeleton to run heart rhythm, muscle contraction, and nerve signalling.
- Vitamin D shortfall: Without sufficient vitamin D, the digestive tract fails to absorb dietary calcium efficiently, starving the bone remodeling process.
- Physical inactivity: Bones adapt to load. Long periods of sitting tell the body it has no need for dense bone, accelerating mineral loss.
- Cigarettes and heavy drinking: Smoking directly harms bone-forming cells and raises lifetime fracture risk, while heavy alcohol use disrupts calcium uptake and dulls motor coordination.
- Specific medications: Long-term use of oral corticosteroids (like prednisone), certain anti-seizure drugs, and chronic acid reducers can thin bone over time.

Practical Ways to Maintain and Rebuild Bone Strength

Protecting bone mass requires a mix of targeted nutrition and regular physical loading. Daily meals should supply adequate calcium through foods like yogurt, hard cheeses, milk, calcium-set tofu, dark greens, and canned fish with soft bones. Because skin produces vitamin D from sun exposure, people who stay indoors or live with low sunlight often need regular supplementation to maintain protective blood levels.

Exercise provides the mechanical force needed to stimulate bone-building cells:

- Weight-bearing workouts: Activities where the skeleton supports body weight against gravity—such as brisk walking, stair climbing, and low-impact aerobics—help preserve density in the legs and hips.
- Resistance work: Lifting weights, using elastic bands, or doing bodyweight exercises like squats pulls on bone attachment points, encouraging the spine and arms to stay dense.
- Balance and posture drills: Practices like yoga and tai chi strengthen core stabilizers and sharpen spatial awareness, reducing the risk of stumbling.

Screening, Clinical Care, and Home Fall Prevention

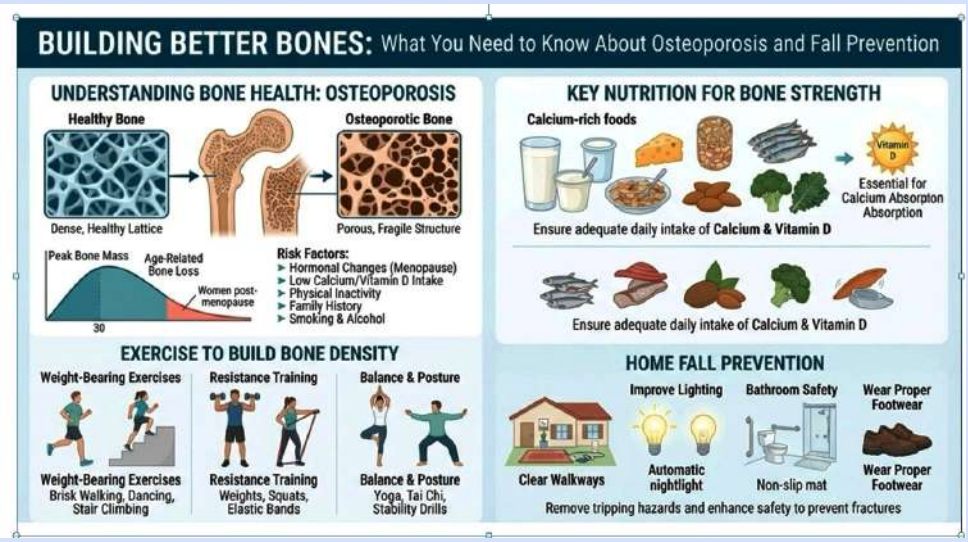
Catching bone loss early allows for targeted steps before a break occurs. The standard test is a dual-energy X-ray absorptiometry (DEXA) scan, which measures mineral density in the hip and lumbar spine with very low radiation. Comparing these readings against peak young-adult averages gives a T-score that indicates whether bones are healthy, osteopenic, or osteoporotic.

For patients with significant bone thinning, clinicians can prescribe targeted drug therapies alongside lifestyle changes. Antiresorptive drugs, including bisphosphonates, slow the rate of bone breakdown to stabilize the skeleton, while bone-building anabolic agents stimulate new tissue formation in higher-risk patients.

Because most fractures trace back to an unexpected fall, making the home environment safer is essential:

- Clear walkways: Pick up loose throw rugs, tuck electrical cords along baseboards, and keep clutter off staircases.
- Improve lighting: Use bright bulbs in stairwells and plug in automatic nightlights along the path from bedroom to bathroom.

- Add bathroom safety: Put rubber non-slip mats in tubs and showers, and install secure grab rails near the toilet and bath.
- Pick solid footwear: Wear flat, closed-toe shoes with textured rubber outsoles indoors rather than socks or loose slippers.
- Check eyes and prescriptions: Get regular vision checks, and ask a doctor or pharmacist to review daily medicines for side effects like sudden dizziness or sleepiness.



Source: Google. Gemini [AI-generated image]. Mountain View (CA): Google; 2026

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Science, Technology & Innovation News

HEALTH

WHO: Integration, innovation and community leadership key to ending HIV, hepatitis and STIs

The World Health Organization (WHO) recently launched a new report assessing progress in implementing the Global Health Sector Strategies (GHSS) on HIV, viral hepatitis and sexually transmitted infections (STIs) for 2022–2030. Released during the 26th International AIDS Conference (AIDS 2026) and ahead of World Hepatitis Day(28 July), the report highlights significant achievements and persistent challenges in the global response to these epidemics.

According to the report, by the end of 2025, an estimated 32 million people living with HIV were receiving treatment and since 2010; new HIV infections have fallen by 42%; and AIDS-related deaths by 57%. Yet 9 million people still lack access to life-saving HIV treatment, and new infections continue to rise in several regions, particularly among key populations including men who have sex with men, sex workers, people who inject drugs, transgender people and people in prisons.

Progress has also been made in the response to viral hepatitis. Since 2015, annual hepatitis B infections have decreased by 32%, and hepatitis C-related deaths have fallen by 12% globally. Despite these gains, viral hepatitis remains one of the world's deadliest infectious diseases, claiming an estimated 1.3 million lives in 2024, with mortality continuing to rise.

Progress in the global response to STIs has been mixed. Countries have strengthened national policies and improved syphilis screening and treatment in pregnancy, while HPV vaccination coverage has increased modestly. At the same time, STI rates are rising in several countries and communities, while there is growing resistance to antibiotics used to treat gonorrhoea.

Remaining challenges: Despite progress, major gaps continue to hinder efforts to eliminate HIV, viral hepatitis and STIs by 2030. For HIV, reductions in international donor funding in 2025 disrupted prevention programmes in several countries, including access to pre-exposure prophylaxis (PrEP). Although some governments have stepped in to sustain services, preliminary data indicate that PrEP use has declined in a number of countries and communities.

For viral hepatitis, deaths linked to hepatitis B have increased by 17% since 2015. Diagnosis and treatment coverage remain low, particularly for hepatitis B, despite the availability of highly effective medicines that could prevent millions of deaths. As countries prepare to mark World Hepatitis Day under the theme "Hepatitis: Let's Break It Down," the report highlights the urgent need to remove the financial, social and systemic barriers that continue to limit access to hepatitis prevention, testing, treatment and care for millions of people.

The global STI response remains off track due to rising STI incidence, increasing antimicrobial resistance, and insufficient coverage of HPV vaccination and cervical cancer screening. Persistent gaps in surveillance, diagnostics, funding and health information systems further constrain countries' ability to monitor the epidemic and scale up effective prevention, testing and treatment services.

Priorities for accelerating progress towards 2030: The report identifies integration as one of the greatest opportunities to accelerate progress. Countries reporting the strongest results are increasingly delivering services for HIV, viral hepatitis and STIs through primary health care, together with services for tuberculosis, sexual and reproductive health, maternal and child health and non-communicable diseases. Eliminating mother-to-child transmission of HIV, syphilis and hepatitis B remains a key priority. Further gains can be achieved by expanding digital health solutions, strengthening interoperable surveillance and health information systems, scaling up multi-disease testing platforms and ensuring equitable access to innovations. Strengthening community leadership and embedding community-generated data into national monitoring systems can improve accountability, inform programme improvements and help ensure services reach those who are most often left behind.

www.who.int; 27 July 2026

Regular ketamine infusions offer new hope for treatment-resistant bipolar depression

People living with treatment-resistant bipolar disorder still have options to manage their condition. However, the choices are often limited, may take weeks to work or fail to provide full relief. That has led to a search for faster, more effective alternatives.

In a study published in the journal *JAMA Psychiatry*, scientists led by Dr. Joshua Rosenblat at the University Health Network in Toronto report that serial ketamine infusions can safely and effectively reduce severe depression symptoms in people with treatment-resistant bipolar disorder. What is unusual is that while this fast-acting anesthetic has shown antidepressant effects, there are also concerns that it might trigger mania or psychosis in bipolar patients. To address those long-standing fears, the team needed to design a carefully controlled trial.

Researchers ran a double-blind study with 68 adults with treatment-resistant bipolar I or II depression. Over two weeks, participants received four infusions of either low-dose ketamine or midazolam, a sedative. All patients maintained their regular regimens of mood stabilizers or antipsychotics. As the trial progressed, a clear difference emerged between responses to the two medications.

It was found that depression scores, as measured on the MADRS [Montgomery-Åsberg Depression Rating Scale], fell during treatment, with the ketamine group showing greater improvements than the control group. By day 14, this gap was statistically significant. At this stage, depression scores in the ketamine group were an average of 7.3 points lower than those in the midazolam group. Around 35% of ketamine participants saw their symptoms cut by at least half, compared with 11.8% in the midazolam group. The difference between the groups remained significant for a week after the final infusion, although

depression symptoms gradually returned after ketamine treatment stopped.

Another promising result was that no participant developed mania, hypomania or psychosis, and there were no suicide attempts.

The paper's findings are encouraging. However, the study was small, and outcomes were measured for only two weeks plus a short follow-up period. Consequently, there are no data about whether ketamine is safe or effective when used repeatedly over longer periods for treatment-resistant bipolar disorder. So, for researchers, the next challenge is figuring out how to turn this temporary relief into a lasting solution.

www.medicalxpress.com; 8 September 2026

BIO-ENGINEERING

New method allows scientists to follow gene activity over time in the same cells

In the new method, cells package and export their RNA, enabling researchers to sequence and analyze the RNA without killing the cells.

In recent years, scientists have built methods to measure a cell's transcriptome, or all the RNA produced by a cell, to study the cell's identity and genetic activity. However, these methods rely on killing the cell to access the bits of RNA within, and offer only a one-time snapshot.

Now, researchers at the Broad Institute and at MIT have invented a "cellular self-reporting" approach to make living cells share their own transcriptomes, so that scientists can analyze them without killing the cells. Described in *Cell*, the live cell transcriptomic method relies on virus-like particles, which the cells use to package and deliver RNA to the culture medium they're bathed in. Scientists can simply sample the medium to isolate the RNA, and do this repeatedly to reveal how gene activity in the same cell population changes as the cells mature or respond to perturbations. The researchers applied their method to a variety of cellular model systems, demonstrating its potential to help reveal how cells go awry over time in disease and how drugs affect cells.

A cellular special delivery: The team found inspiration in retroviruses, which over millions of years evolved the ability to package their RNA genomes in protein shells to spread from one infected cell to another. To build their method, the team engineered mammalian cells to express a retroviral structural protein that can encapsulate not only viral RNA but also a cell's RNA. Integrated into the cell's membrane, the viral protein is able to recruit cellular RNA, form a shell around it to create a virus-like particle, and bud off from the membrane to enter the liquid medium around the cell. The scientists then take a sample of the medium, isolate the RNA, and sequence it to get a view of the transcriptome from that cell population — all without destroying or damaging the cells.

"Compared to methods using robotics or mechanical biopsies of cells, our molecularly encoded solution could be much more broadly enabling for the average life science or biomedical lab, particularly the time dynamic questions that we hope to elucidate with this technology," says co-first author Mohamad Najia, research fellow in the Blainey lab and the lab of George Daley at Boston Children's Hospital. Najia and Borrajo led the work along with co-first author Anna Le, a postdoc in the Blainey lab.

To test the method's broad applicability, the researchers showed that it worked in immortalized human cells, in cancer cell lines, in stem cells and neuronal cells made from them, and in primary cells from human donors. They also tested a culture of two human cell types growing together, using tags on the virus-like particles so that the signals from the two cell types could be distinguished during analysis. In addition, cellular self-reporting is useful for studying systems with crucial three-dimensional structures that researchers would rather not disturb. The team demonstrated their method on spheroids of human endothelial cells, capturing short-term transcriptional changes after biochemically stimulating the cells.

They also collaborated with Linda Griffith, a professor of biological and mechanical engineering at MIT, to apply their method to her lab's organ-on-a-chip devices. These models mimic the physiology of organs and can help minimize preclinical or animal model testing, but their complexity makes retrieving cells from the devices for analysis difficult. With cellular self-reporting, the researchers monitored gene expression dynamics in endothelial cells within the devices over time, revealing changes in genes related to how tissues form vascular networks that depended upon the source of supporting fibroblasts, such as from either uterus or lung.

The Broad team is continuing to look for new applications and biological questions to ask with their system, and are working to make the approach feasible for studying single cells.

www.news.mit.edu; 4 September 2026

BIOCHEMICAL ENGINEERING AND FOOD FOR SPACE

NASA-backed scientists turn plastic waste into edible cookies

Plastic pollution and food insecurity are two major global challenges, and researchers at Southern Illinois University (SIU) Carbondale are exploring whether one problem could help address the other. Their goal is to use microorganisms to convert waste materials into food that people can safely eat.

Scientists are engineering yeast to turn plastic waste into protein-rich cookies that could someday feed people on Earth, the Moon or Mars. Scientists have engineered yeast to turn PET plastic and agricultural waste into ingredients for protein-rich, 3D-printed cookies called µBites. Developed partly for NASA's Deep Space Food Challenge, the system can produce proteins, fats, vitamins, and even vanilla flavoring from waste materials. Researchers hope the unusual technology could eventually help

address both plastic pollution and food insecurity, while also supplying food in extreme environments such as deep-space missions.

Plastic bottles and cookies may seem to have nothing in common, but researchers are finding a way to connect the two. By engineering yeast, scientists have developed a system that can transform compounds from plastic and agricultural waste into edible proteins, vitamins, flavorings, and other food ingredients. The approach could provide a new way to reuse difficult waste while also helping produce food in places where conventional supplies are limited. Potential applications range from disaster zones on Earth to human missions deep into space.

A major target is polyethylene terephthalate (PET), a widely used plastic found in products such as soda and water bottles. PET contains carbon-rich molecules that can potentially be broken apart and rebuilt into useful compounds, including components that can ultimately become proteins. Using microorganisms to manufacture useful substances is already well established. Yeast, for example, can be genetically programmed to produce valuable molecules. Insulin, which was once obtained from animal pancreases, can now be made using engineered microbes.

The researchers process PET plastic, discarded corn stalks and leaves, and other biomass using a proprietary technique known as oxidative hydrothermal dissolution. Developed by SIU Carbondale Geology Professor Ken Anderson, the process combines water and oxygen under high temperature and pressure to break resistant materials into compounds microbes can access. Those smaller molecules are then fed to the engineered yeast. The microorganisms transform them into new food components, including proteins, fats, and acids. Once the yeast-derived ingredients have been produced, researchers combine them with fiber, starch, and sweetener. The mixture is then pushed through a 3D printer to create protein-rich cookies called µBites (pronounced "microbites"). The available data indicate that µBites are safe to eat, although the researchers are still waiting for institutional approval before conducting formal taste tests.

The team ultimately wants microbes to produce even more of the ingredients needed for µBites. That includes the starch, fiber, and sweetener that currently have to be added separately.

www.sciencedaily.com; 13 September 2026

AGRICULTURE

Giving farmers a more sustainable way to protect crops - An attempt by a Start up

Robigo, a start up company uses technologies more commonly associated with medical applications, like RNA interference and CRISPR, to engineer self-replicating microbes that target plant pathogens more precisely than chemical pesticides and more effectively than other biologically based solutions. Robigo is trying to address a problem of growing importance to the agriculture industry, and believes in building on nature's foundation to create no-compromise biological solutions that work for growers, consumers, and the environment. The company uses cutting-edge biotechnology to engineer microbes to fight pests, reducing the need for harmful chemical pesticides.

Each year, farmers around the world spend $80 billion on pesticides for their crops. Those pesticides impact not only harmful insects but also bees and beneficial bacteria in the soil. They can also run off into waterways and harm the environment. They are infact being increasingly being linked to human diseases like Parkinson's and cancer. Amid growing awareness of those problems, pesticides made from living microbes are gaining popularity. Unfortunately, such microbial pesticides are often less effective, forcing farmers to choose between potential environmental damage and higher crop yields.

Despite being ignored by humanity for thousands of years, microbes play a leading role in shaping plant health. Through a deeper understanding of the plant microbiome and its underlying genetic code, we can better design a food system that lives in harmony with our planet.

Robigo is equipping naturally occurring microbes with more potent pest-fighting capabilities. The company uses technologies more commonly associated with medical applications, like RNA interference and CRISPR, to engineer self-replicating microbes that target plant pathogens more precisely than chemical pesticides and more effectively than other biologically based solutions. In field trials across five states, the research has already shown its microbes offer comparable results to chemical pesticides. In one trial comparing Robigo's product with another commercial microbial product last summer, Robigo's system led to a 250 percent increase in crop yield. “Many crops, like lettuce, are harvested by hand, and the grower told me if a disease reduces yield even by just 25 percent, it's not economical for them to pay workers to harvest the field at all,” Wallace, the co-founder says.

Engineered biology for agriculture: Wallace's research focused on engineering microbes in an attempt to replicate intricate glass nanostructures produced by single-cell algae called diatoms. The founders' initial idea was to engineer microbes to deliver CRISPR to target and kill bacteria that are harmful to crops. They used a number of MIT resources to get the company off the ground, including the Venture Mentoring Service, MIT Sandbox, delta v, and the MIT $100K Entrepreneurship Competition. Sweeney was involved in the venture for about a year. Padmakumar left Robigo in 2022.

Last year, field trials for its two lead products, with soybeans and lettuce across the U.S. Midwest and West were conducted. Working with third-party testing companies, they showed a single application of their microbes offered protection for crops over the entire growing season and matched the performance of the leading chemical pesticide at a fraction of the cost. “That's very unusual for biological products, and even many chemical products, so we're really optimistic about engineered microbes being a new solution that disrupts the conventional chemical pesticide paradigm,” Wallace says.

www.news.mit.edu; 3 September 2026

JOINT NAM S&T CENTRE – UM, MALANG, INDONESIA POST-DOCTORAL FELLOWSHIP-2026 AWARDEES

Sl. No.	Country	Name of Recipient & Affiliation	Topic of Research	Supervising Guide at UM
1.	**Egypt**	**Dr. Mostafa Mohammed Ahmed Mostafa**, Lecturer (Assistant Prof.), Civil Engineering Department (Structural Engineering), Faculty of Engineering, Al–Azhar University	Sustainable Nano and Cement-Based Composite Materials for Enhanced Structural Performance and Reduced Environmental Impact of Reinforced Concrete	**Prof. Dr. Karyadi**, M.P., M.T.
2.	**India**	**Dr. Dushyantkumar Ranchhodbhai Dudhagara,** Assistant Professor, Bhakta Kavi Narsinh Mehta University, Government Polytechnic Campus, Gujarat	Isolation and Characterization of Indigenous Probiotic Strains from Fermented Foods and Ripe Fruits for Nutritional and Health Applications	**Prof. Dr. Titi Mutiara Kiranawati**, M.P.
3.	**Iraq**	**Dr. Nabaa Hussein Allawi Al-Majmaie,** Researcher, Ministry of Higher Education and Scientific Research, Scientific Research Commission, Baghdad	Stoichiometric Tuning of CZTS Composite Film towards Efficient Hetrojunction Solar Cell	**Prof. Dr. Nandang Mufti**, S.Si., M.T.
4.	**Myanmar**	**Dr. May New Yee Tun**, Associate Professor, Technological University (Thanlyin), Yangon	Dynamic Performance Enhancement of High-Voltage AC Transmission System Using FACTS Controllers	**Prof. Aripriharta,** S.T., M.T., Ph.D.
5.	**South Africa**	**Dr. Pearl Ramushu,** Research Assistant, Department of Biochemistry, Microbiology and Biotechnology, University of Limpopo	Targeted Modulation of Oxidative Stress and Inflammatory Signalling in Lung Cancer: Translational Evaluation of Lithium-Based Therapeutics	**Prof. Dr. Eng. Mokh. Sholihul Hadi**, S.T., M.Eng.

JOINT NAM S&T CENTRE - JSS AHER, MYSURU, INDIA FELLOWSHIP PROGRAMME-2026 AWARDEES

Sl. No.	Country	Name of Recipient & Affiliation	Topic of Research	Research Guide at JSS AHER
1.	**Egypt**	**Dr. Mohamed El Sayed Mohamed Hasan**, Assistant Professor of Bioinformatics, Faculty of Biotechnology, University of Sadat City	Integrative Deep Learning and Multi-Omics Approaches for Early Detection and Drug Target Discovery in Breast and Lung Cancer	**Dr. Suvilesh K N**, Associate Professor, Department of Medical Genetics, JSS Medical College, Mysuru, Karnataka, India
2.	**Indonesia**	**Dr. Joko Pebrianto Trinugroho** , Junior Researcher, National Research and Innovation Agency (BRIN), Jakarta	Novel Plastic Degrading Enzymes' Candidates Through (Meta) Genomic Mining	**Dr. Gowthamarajan Kuppusamy** Professor and Head, Department of Pharmaceutics, JSS College of Pharmacy, Ooty, Tamil Nadu, India
3.	**Kenya**	**Dr. Fidelis Ngugi**, Dean, Faculty of Physical Sciences, Engineering and Technology, Tharaka University, Marimanti	Synthesis of Nanocomposite for Waste Water Treatment	**Dr. Shivaraju H. P.** , Associate Professor, Department of Environmental Science, JSS AHER, Mysuru, Karnataka, India
4.	**Malaysia**	**Dr. Nabilah Afiqah Binti Mohd Radzuan**, Senior Lecturer, Department of Mechanical and Manufacturing Engineering, Faculty - Engineering and Built Environment, Universiti Kebangsaan Malaysia, Selangor	Dielectric and Mechanical Properties Enhancement of Nanoparticle PLA/$BaTiO_3$ Composites Lattice Structure Fabricated Using Fused Deposited Modelling	**Dr. Asha Srinivasan**, Associate Professor, Department of Nanoscience & Technology, School of Life Science, JSS AHER, Mysuru, Karnataka, India
5.	**South Africa**	**Dr. Matlakala Claudia Ntsapi**, Senior Lecturer, The University of the Free State (UFS), Bloemfontein	Decoding the Insulin–Amyloid Pathological Axis in Alzheimer's disease: A 3D Hanging-Drop Neuronal Microtissue Model for Dual Metabolic and Neurotrophic Intervention	**Dr. C. Saravana Babu**, Professor and Head, Department of Pharmacology, JSS College of Pharmacy, Mysuru, Karnataka, India

New Fact File

Fatty Liver Problems in the Developing World: Implications of the Modern Diet



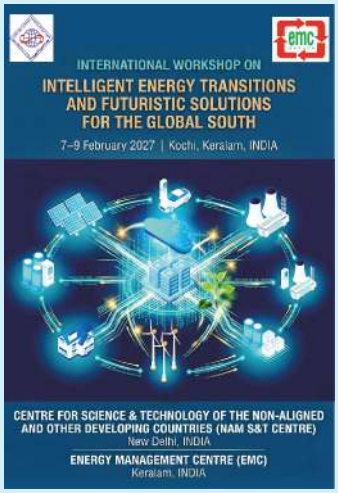
Fatty liver disease is one of the most prevalent non-communicable diseases worldwide and is on the rise, particularly in developing countries. Once considered a relatively uncommon condition, fatty liver disease has become increasingly prevalent due to modern dietary patterns, changing food habits, rapid urbanization, sedentary lifestyles, and the growing burden of obesity, diabetes and other metabolic disorders. Often referred to as a "Silent Disease" because it may progress without noticeable symptoms, fatty liver disease can lead to serious complications, including liver fibrosis, cirrhosis and liver cancer, if left undiagnosed and untreated.

Considering it as one of the most pressing and rapidly emerging public health challenges in the Global South, the NAM S&T Centre has published its fifteenth Fact File titled "**Fatty Liver Problems in the Developing World: Implications of the Modern Diet**". The publication provides an overview of the growing burden of the disease, explains its underlying causes and progression, examines the important role of the gut-liver connection and the microbiome in maintaining liver health. It also discusses the challenges associated with early detection and highlights management and treatment strategies, with particular emphasis on lifestyle modification and appropriate clinical care.

The Fact file has been authored and edited by **Dr. Khayati Moudgil**, Asst. Professor, Faculty of Health Sciences, School of Pharmacy, JSS Academy of Higher Education and Research, Mauritius. The Centre extends its appreciation to **Dr. Praveen Mohadeb**, Vice Chancellor & CEO, JSS Academy of Higher Education and Research, Mauritius, for his kind support and permission to bring out this joint publication as a collaborative scientific activity between the two institutions.

Centre Announces

International Workshop
on
Intelligent Energy Transitions and Futuristic Solutions for the Global South
7–9 February 2027
Kochi, Keralam, INDIA



The global energy landscape is undergoing a profound transformation driven by the urgent need to address climate change, enhance energy security, accelerate economic development and ensure universal access to reliable, affordable and sustainable energy (*SDG 7: Affordable and Clean Energy; SDG 13: Climate Action*). For countries in the Global South, the energy transition presents both significant challenges and unprecedented opportunities. Rapid technological advancements, increasing digitalization, decentralization of energy systems and the emergence of innovative clean-energy technologies, all are creating new pathways towards resilient, inclusive and low-carbon development.

An intelligent energy transition goes beyond replacing conventional energy sources with renewable alternatives. These solutions can enable energy systems to become more flexible, efficient, reliable, affordable and responsive to changing patterns of energy production and consumption. Countries in the Global South face distinctive challenges arising from growing populations, rapid urbanization, industrialization, rising energy demand, limited financial resources and climate vulnerability.

The transition towards intelligent and sustainable energy systems, therefore, requires greater international cooperation, knowledge exchange, capacity building, technology development and innovative policy. Particular attention is needed to ensure that technological progress contributes not only to decarbonization but also to energy access, employment generation, economic growth and improved quality of life.

In order to deliberate on the above issues, the Centre for Science & Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi, India, in collaboration with the Energy Management Centre (EMC), Keralam, India [the State Designated Agency to enforce the Energy Conservation Act 2001, Department of Power, Government of Keralam] is organizing an International Workshop on "**Intelligent Energy Transitions and Futuristic Solutions for the Global South**" during **7-9 February 2027** in **Kochi, Keralam, India**.

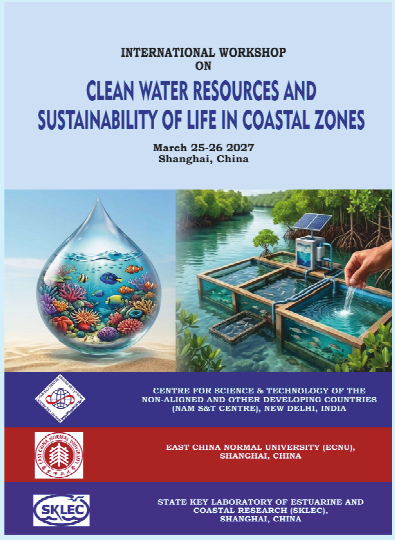
This Workshop will provide a collaborative platform for scientists, researchers, policymakers, technology developers, industry representatives and other stakeholders to exchange knowledge and experiences on emerging energy technologies and innovative approaches for accelerating sustainable energy transitions in the Global South. Experts and professionals working in energy transition, renewable energy, energy conservation and related areas will find this Workshop particularly beneficial.

Scientists and experts desirous of participating in the Workshop, except those from India, should submit their applications electronically to the Director General, NAM S&T Centre, New Delhi at namstcentre@gmail.com, as early as possible but latest by **15 December 2026**.

For further details, please visit Centre's Website: www.namstct.org

Centre Announces

International Workshop
on
Clean Water Resources and Sustainability of Life in Coastal Zones
25-26 March 2027
Shanghai, CHINA



Water resources play a critical role in coastal zones, even though it appears that water itself is not scarce in these regions. The availability as well as spatial and temporal distribution of fresh water in a given coastal area regulates the scale of society and the level of economic development. The quality of marine and terrestrial water in coastal zones has a profound impact on the nature of ecosystems and the diversification of social structures in the area.

Recognizing the critical importance of clean water resources and the sustainability of life in coastal zones, the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi is pleased to announce a Joint International Workshop on "**Clean Water Resources and Sustainability of Life in Coastal Zones**" during **25-26 March 2027** in **Shanghai, China** in partnership with the East China Normal University (ECNU), Shanghai, China and the State Key Laboratory of Estuarine and Coastal Research (SKLEC), ECNU, Shanghai, China. The Workshop will be hosted by the ECNU and SKLEC.

The Workshop will serve as a platform for sharing existing experiences to support adaptive management, capacity development and knowledge exchange. The outcomes of the Workshop will also make a unique contribution towards the *United Nations Decade of Ocean Science for Sustainable Development (2021-2030) Programme.* Moreover, the initiative helps to address the challenges of the United Nations Sustainable Development Goals (SDGs), especially SDG 6, which aims to ensure "availability and sustainable management of water and sanitation for all".

The Workshop is intended for researchers, scientists, academicians, policymakers, government officials, engineers, environmental practitioners, coastal zone managers and representatives of national and international organizations working in the fields of water resources, coastal and marine ecosystems, environmental science, climate change and sustainable development. It will also benefit professionals engaged in water governance, integrated coastal management and the blue economy.

Scientists and experts desirous of participating in the Workshop should submit their applications electronically to the Director General, NAM S&T Centre, New Delhi at email: namstcentre@gmail.com.

For further details, please visit Centre's Website: www.namstct.org

Distinguished Visitor to the Centre



His Excellency Mr. Oday Hatim Mohammaed,
Charge d' Affaires, Embassy of the Republic of Iraq in New Delhi visited the Centre on September 2, 2026.

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