TropSc™ 2024

THE TROPICS MATTER TO THE WORLD

CONFERENCE PROCEEDINGS

2nd International Conference on Tropical Sciences
Harmonising Humanity with Nature

16 – 17 October
Kuching, Sarawak
Malaysia

2024

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2nd International Conference on Tropical Sciences
Harmonising Humanity with Nature

16 – 17 October 2024 | The Waterfront Hotel, Kuching, Sarawak

Supported by:

KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

Organised by:

Tropical Science Foundation

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SUNWAY

2nd International Conference on Tropical Sciences - Harmonising Humanity with Nature
Conference Proceedings

Academy of Sciences Malaysia
Level 20, West Wing, MATRADE Tower
Jalan Sultan Haji Ahmad Shah off Jalan Tuanku Abdul Halim
50480 Kuala Lumpur Malaysia
Tel: +6 (03) 6203 0633
Fax: +6 (03) 6203 0634

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FOREWORD FROM THE CHAIRPERSON

Academician Emerita Professor Tan Sri Dato' Seri Dr Mazlan Othman FASc

Chairperson, TropSc™2024 Steering Committee
Executive Director, Tropical Science Foundation

With a conference theme centred around "Harmonising Humanity with Nature," we embark on a crucial journey to explore sustainable solutions that ensure the well-being of our environment and our communities. As our previous conference held in Kuala Lumpur in 2021, we laid the groundwork for advancing sustainability through tropical sciences. The discussions and insights from that conference paved the way for us to convene once again, this time in Kuching, to further deepen our understanding and hasten actions towards achieving sustainable development goals in the Tropics.

As part of our commitment to this cause, leading up to this conference, we have hosted a series of webinars addressing crucial topics such as the Conservation of the Mangrove Ecosystem and Youth for The Tropics. These webinars have provided effective platforms for dialogue and knowledge exchange, reinforcing our commitment to addressing the challenges and opportunities of the Tropics. The Foundation also held a global essay competition with the theme "The Path Towards a Better Tropics with Science." This competition captured the innovative thoughts of young people on how science can improve life in the Tropics and underscored the Mahathir Science Award Foundation's support for youth involvement in science for the betterment of quality of life in tropical regions. This initiative is especially important as the Mahathir Science Award and this Conference are a rallying call to youth to engage more fully in all aspects of the Tropics, given that by 2050 majority of the young people of the world will be living in the Tropics.

The conference was based on a robust agenda and our main objectives was clear: to plant the seeds for an Alliance for the Tropics, a collaborative network aimed at addressing the region's unique challenges and opportunities, through consensus, we adopted the Kuching Declaration on the Tropics, a strategic framework that will guide sustainable development policies for years to come. I am heartened to see such a diverse and esteemed gathering of scientists, researchers, policymakers, and practitioners from across the globe coming together to share their expertise and experiences. Your contributions and insights are invaluable as we seek innovative approaches to balance conservation and development in the Tropics.

I am grateful to all who have contributed as committee members, moderators, panellists, rapporteurs and usherers, whose support is instrumental in driving the momentum towards a sustainable future for tropical regions worldwide. I would also like to mention the staff of the Tropical Science Foundation and the Academy of Sciences of Malaysia, who have worked patiently and tirelessly behind the scenes to make the conference possible. I hope that the conference will allow us to now foster meaningful collaborations and inspire one another to take bold actions that will leave a positive legacy for future generations. Thank you.

CONFERENCE OVERVIEW

INTRODUCTION

The 2nd International Conference on Tropical Sciences (TropSc™2024) took place on 16 and 17 October 2024 in Kuching, Sarawak, Malaysia. This event is organised by the Tropical Science Foundation (TSF) and the Academy of Sciences Malaysia (ASM) in collaboration and supported by the Sarawak government and the Ministry of Science, Technology and Innovation (MOSTI).

ABOUT

TSF and ASM convened a conference to provide a platform for stakeholders to position the tropics in the context of global development and identify needed interventions by the government, private sector, and academia. High-level policymakers, industry captains, and researchers were invited to engage in a collaborative environment. The conference addressed Tropical Agriculture, Tropical Architecture and Engineering, Tropical Medicine, Tropical Natural Resources and three special themes, Climate Change in the Tropics, Open Science in Tropical Biodiversity, and Protection of Indigenous and Local Knowledge in the Tropics.

MOTIVATION

The Tropics, home to over 3 billion people, held immense potential and critical significance for global sustainability. By 2050, it was projected to host more than half of the world's population and two-thirds of its children. The region encompassed 80% of the world's biodiversity, 45% of forests, and 54% of renewable water resources, while tropical oceans played a pivotal role in regulating Earth's climate. Yet, the Tropics faced disproportionate challenges, including poverty, climate change, and resource exploitation.

Building on the outcomes of TropSc 2021, the International Conference on Tropical Sciences (TropSc) 2024: Harmonising Humanity with Nature provided a vital platform to address these challenges. Stakeholders, including governments, private sectors, academia, Indigenous communities, and youth, came together to highlight the region's potential and discuss targeted solutions.The conference reaffirmed the importance of integrating science, technology, and policy with traditional and indigenous knowledge to advance sustainable development. Discussions focused on biodiversity preservation, climate resilience, equitable healthcare, and food security, while promoting inclusive collaboration across sectors.

Anchored by the Kuching Declaration on the Tropics, TropSc 2024 emphasized the urgent need for transdisciplinary approaches to address the complexities of the region. By fostering partnerships and knowledge-sharing, the conference positioned the Tropics as central to achieving global development goals. TropSc 2024 successfully strengthened collective efforts to harmonise humanity with nature, paving the way for a sustainable and resilient future for the Tropics and the world.

CONFERENCE PROGRAMME

Day 1
16 October 2024, Wednesday

08:00 **Arrival of Participants / Light Refreshments**

09:05 **National Anthem Negaraku, Ibu Pertiwiku and Doa Recital**

09:10 **Welcome Speech**
By Academician Emerita Professor Tan Sri Dato' Seri Dr Mazlan binti Othman FASc
Executive Director, Tropical Science Foundation

09:20 **Opening Speech**
By Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc
President, Academy of Sciences Malaysia & STI Advisor to the Prime Minister and the Nation

09:30 **Policy Dialogue on Facing a Post Normal Era in the Tropics**
Moderator
Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc
Panellists
Professor Ziauddin Sardar
Professor Dr Mahendhiran Sanggaran Nair FASc
Dr Aakash Mohpal

11:00 **Policy Dialoguc on Sustainable Development in the Tropics**
Moderator
Dr Chen Jit Ern
Panellists
Dato Sri Haji Abdul Karim Rahman Hamzah
Academician Professor Emerita Datuk Dr Asma binti Ismail FASc
Professor Eric Meijaard

12:30 **Lunch**

14:00 **Policy Dialogue on The Way Forward for the Tropics**
Moderator
Ambassador Dr Shazelina Zainul Abidin
Panellists
H.E. Ary Norton de Murat Quintella - Ambassador of Brazil H.E. Lisualdo Menezes Coimbra Gaspar - Ambassador of Timor-Leste H.E. Dr Mariyam Shabeena Ahmed - High Commissioner of Maldives

16:30 **End of Day 1**

20:00 **Official Dinner and Keynote Address**
By The Right Honourable
Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg Premier of Sarawak

Day 2
17 October 2024, Thursday

Parallel Sessions

08:00 Arrival of Participants / Light Refreshments

08:30 Panel Discussion – Theme 1

Tropical Agriculture	Tropical Architecture and Engineering	Tropical Medicine	Tropical Natural Resources	Open Science in Tropical Biodiversity

10:00 Oral Presentation

Tropical Agriculture	Tropical Architecture and Engineering	Tropical Medicine	Tropical Natural Resources & Open Science Biodiversity	Climate Change in the Tropics

11:30 Panel Discussion

Protection of Indigenous and Local Knowledge in the Tropics

13:00 Lunch

14:00 Panel Discussion - Theme 2

Tropical Agriculture	Tropical Architecture and Engineering	Tropical Medicine	Tropical Natural Resources	Open Science in Tropical Biodiversity

16:00 Presentation & Adoption of Kuching Declaration on the Tropics

17:30 Closing Ceremony, Light Reception & End of Conference

ACKNOWLEDGEMENTS

The conference and the report would not have been possible without the contributions of those who worked tirelessly on the sessions mentioned. We want to acknowledge them for their efforts and commitment to making the conference a success.

STEERING COMMITTEE

Chairperson of Steering Committee
Academician Emerita Professor Tan Sri Dato' Seri Dr Mazlan Othman FASc

Chairperson of Technical Sub-Committee
Professor Dato' Ir Dr A. Bakar Jaafar FASc

Chairperson of Conference Management & Finance Sub-Committee
Hazami Habib

Chairperson of Mahathir Science Award Laureates Group
Emeritus Professor John Sheppard Mackenzie

TECHNICAL COMMITTEES

Tropical Agriculture

Professor Dato' Dr Zulkifli Idrus FASc (Chairperson)
Professor Dr Mohammad Hamiruce Marhaban
Professor Dr Mohd Rafii Yusop
Professor Dr Ahmad Zaharin Aris FASc
Professor Dr Shaufique Fahmi Ahmad Sidique

Tropical Medicine

Professor Dr Fong Mun Yik FASc (Chairperson)
Professor Dr Lau Yee Ling FASc
Professor Dr Hesham Al-Mekhlafi
Dr Lee Wenn Chyau
Dr Wahib Mohammed Mohsen Atroosh
Dr Cheong Fei Wen

Tropical Architecture & Engineering

Ir Dr Suzana Yusop FASc (Chairperson)
Professor Ir Dr Fatimah Ibrahim FASc
Professor Ir Denny Ng Kok Sum
Dr Nor Adilla Rashidi
Dr Chai Yee Ho

Track: Tropical Natural Resources

Professor Dr Ahmad Ismail FASc (Chairperson)
Dato' Dr Mohd Tajuddin Abdullah FASc
Professor Emeritus Dato' Dr Abdul Latiff Mohamad FASc
Dr Mazlan Madon FASc

Special Theme:
Open Science in Tropical Biodiversity

Professor Dr Noorsaadah Abd Rahman FASc (Chairperson)
Professor Dr Habibah A Wahab FASc
Associate Professor Dr Liew Chee Sun
Dr Nurzatil Sharleeza Mat Ja
Dr Norzulaani Khalid

Special Theme:
Climate Change in the Tropics

Datu Dr Lulie Melling FASc (Chairperson)
Associate Professor Yusri Yusup
Dr Ismail Hj. Parlan
Dr Kaido Soosar

Special Theme: Indigenous and Local Knowledge in the Tropics

Associate Professor Dr Tay Meng Guan (Chairperson)

SECRETARIATS

ACADEMY OF SCIENCES MALAYSIA

Dharshene Rajayah
Nina Azrah Razali
Najib Mohd Idris
Anis Adilla Mohd Arif
Saiful Suhairi Suarni
Matthew Raj Alias
Khairunnisa Kadaruddin
Nur Amirah Sofea Saiful Anuar
Nurul Farhana Farizah
Siti Sarah Abd Rahman
Mohamad Haziq Rosli
Mohd Najmie Mohd Yusoff
Shahridzal Aizat Shahrum
Ahmad Khudri Abd Razak
Muhammad Effandie Nordin
Mohd Zefri Mohd Zulkefli
Muhammad Ikram Latif
Mohamad Firdaus Jamil
Naina Afify Rosli
Muhammad Akmal Hakim
Mohamad Khalid
Abdullah Yuzer Ridzuan

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Nur Hanani Ismalia Ismail
Nuren Irdina Mohd Redzuan
Yeo Kai Wei
Nur Fazlin Zafirah Zaine
Pheodora Pamela Natashya
Tresylia Ipah Anak Ujai

RAPPORTEURS

Shaadah Shariman
Azizul Ahmad
Johanna Jane Anak Donald
Grace Usun Joel
Tang Hui Wen
Abraham Chor Jin Ming
Nur Amalia Binti Shari Amran
Dayang Nurul Anisa Abang Heilman
David Wee Hong-Sheng
Safrullah Iqhram Khan
Lee Jie Ying
Sabella Justin
Thracesy Munah Anak Assan
Nur Azzah Osman
Henry Adam Anak Segaya
Luqman Nul'hakim Jeffry
Abu Huzaifah Latip

PRE-CONFERENCE WEBINARS

17
PRE-CONFERENCE WEBINARS

30
COUNTRIES

2820
ATTENDEES

THE CONFERENCE IN NUMBERS

2
DAYS

16 & 17
OCTOBER 2024

20
COUNTRIES

321
PHYSICAL ATTENDEES

4
STRATEGIC PARTNERSHIPS

4
TRACKS

- **TROPICAL AGRICULTURE**
- **TROPICAL ARCHITECTURE AND ENGINEERING**
- **TROPICAL MEDICINE**
- **TROPICAL NATURAL RESOURCES**

3
SPECIAL THEMES

- **CLIMATE CHANGE IN THE TROPICS**
- **OPEN SCIENCE IN TROPICAL BIODIVERSITY**
- **PROTECTION OF INDIGENOUS AND LOCAL KNOWLEDGE IN THE TROPICS**

18
SESSIONS

(KEYNOTE SPEECHES, PANEL DISCUSSIONS, NETWORKING SESSIONS, ORAL AND POSTER PRESENTATIONS)

SETTING THE SCENE

PREMIER OF SARAWAK

The Right Honourable Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg

Premier of Sarawak

The Sarawak Government is dedicated to fostering research, innovation, and community-led conservation initiatives to ensure our tropical treasures thrive for future generations. Through the efforts of organisations such as the Sarawak Forestry Corporation, Sarawak Biodiversity Centre, and the Sarawak Tropical Peat Research Institute, we are working tirelessly to protect our natural heritage. With these centres, Sarawak plays an essential role in addressing biodiversity loss and offers valuable insights and practical solutions that can be utilised by tropical countries facing similar environmental challenges.

MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION

The Honourable Tuan Chang Lih Kang

Minister of Science, Technology, and Innovation

TropSc™ 2024 continues the important dialogue on the role of tropical ecosystems in tackling some of the world's most pressing challenges. It is well recognised that the tropics cover nearly 40% of the earth's land area, and these regions play a pivotal role in maintaining global biodiversity, regulating climate, and supporting the livelihoods of millions. However, these regions also face disproportionate impacts from climate change, deforestation, tropical diseases, and other environmental threats.

PRESIDENT OF THE ACADEMY OF SCIENCES MALAYSIA & STI ADVISOR TO THE PRIME MINISTER AND THE NATION

Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc

President of the Academy of Sciences Malaysia & STI Advisor to the Prime Minister and the Nation

The tropical region is vital to global biodiversity and climate stability. Rich in biodiversity and natural resources and augmented with a young and growing population, it is well-positioned to make a positive contribution to the scientific, cultural, and civilisational challenges facing the global community. Indigenous, traditional, and local knowledge must be given due recognition to complement scientific knowledge. The conference aims to facilitate knowledge exchange among scientists, community leaders, policymakers, and industry players to formulate holistic and integrated solutions for sustainable development.

CHAIRPERSON OF TROPICAL SCIENCE FOUNDATION

Academician Tan Sri Datuk Dr Ir Ahmad Tajuddin Ali FASc

Chairman of Tropical Science Foundation

The TropSc™ 2024 conference is crucial for addressing tropical regions' pressing environmental and social issues. It brings experts from various fields together to collaborate and find sustainable solutions. We aim to foster a multidisciplinary approach to tackle the challenges and leverage the tropics' immense natural and cultural wealth. Doing so can ensure a sustainable future for future generations.

POLICY DIALOGUES

FACING A POST-NORMAL ERA IN THE TROPICS

Moderator

Academician Datuk
Dr Tengku Mohd Azzman Shariffadeen FASc

President, Academy of Sciences Malaysia
STI Advisor to the Prime Minister and the Nation

Panelists

Professor Ziauddin Sardar

Director, Centre for Postnormal Policy and Futures Studies

Professor Mahendhiran Sanggaran Nair FASc

Pro-Vice Chancellor (Research and Sustainability)
Sunway University

Dr Aakash Mohpal

Senior Economist, World Bank's East Asia

Summary of key points

- The COVID-19 pandemic exposed systemic vulnerabilities in tropical regions, emphasising the need for sustainability and resilience.
- Tropical development requires ethical and culturally relevant approaches, incorporating spiritual and ecological values.
- Persistent challenges in the tropics include stunting, non-communicable diseases (NCDs), and health inequalities.
- Rapid urbanisation and demographic shifts in tropical regions demand tailored service delivery strategies.
- Climate change poses significant threats to tropical health, education, and productivity, requiring climate-resilient approaches.
- The Sustainable Development Goals (SDGs) provide a framework for tropical development but need systemic reforms for effective implementation.

Read the full report on page 76 of Appendix

SUSTAINABLE DEVELOPMENT IN THE TROPICS

Moderator

Dr Chen Jit Ern

Director, Jeffrey Sachs Center on Sustainable Development
Sunway University

Panellists

Dato Sri Haji Abdul Karim Rahman Hamzah

Minister, Tourism, Creative Industry and Performing Arts
Minister, Youth, Sports and Entrepreneur Development

Academician Professor Emerita Datuk Dr Asma Ismail FASc

Vice Chancellor and Chief Executive Officer, IMU University
Immediate Past President, Academy of Sciences Malaysia

Professor Eric Meijaard

Managing Director, Borneo Futures

Summary of key points

- Over 67% of the global population under 15 will reside in tropical regions by 2050, highlighting the tropics' crucial role in future demographic trends and economic growth.

- Tropical youth are key players in climate action, sustainable development, and technological innovation, necessitating targeted policies and inclusive decision-making.

- The tropics' rich biodiversity is threatened by habitat loss, deforestation, and zoonotic diseases, requiring urgent adoption of holistic sustainability frameworks like Planetary Health.

- The National Planetary Health Action Plan integrates 52 strategies and 279 action plans to balance environmental health, human well-being, and economic prosperity in tropical nations like Malaysia.

- Tropical regions, particularly Southeast Asia, are at the centre of the global vegetable oil industry, facing challenges like biodiversity loss, socio-economic impacts, and sustainability concerns.

- Collaborative research, evidence-based policymaking, and systemic governance shifts are essential to address sustainability challenges in tropical agriculture and biodiversity conservation.

Read the full report on page 87 of Appendix

THE WAY FORWARD FOR THE TROPICS

Moderator

Dato' Dr Shazelina Zainul Abidin

Dato' Dr Shazelina Zainul Abidin

Panellists

H.E Ary Norton de Murat Quintella

Ambassador, Federative Republic of Brazil

H.E Lisualdo Menezes Coimbra Gaspar

Ambassador, Democratic Republic of Timor-Leste

H.E Dr Mariyam Shabeena Ahmed

High Commissioner, Republic of Maldives

Summary of key points

- Promotion of sustainable tourism in tropical regions to protect natural resources and benefit local communities.
- Adoption of renewable energy solutions to minimise environmental impact in tropical areas.
- Regional collaboration in tropical regions to implement sustainable practices with minimal investment for community benefits.
- Advocacy for long-term environmental strategies in the tropics beyond short-term political cycles.
- Tropical countries' leadership in forest conservation through initiatives like the Forest Declaration and Forest Forever facilities.
- Importance of international partnerships with private and multinational companies to support tropical forest preservation efforts.

Read the full report on page 98 of Appendix

TROPICAL AGRICULTURE

SMART FARMING: NEW TECHNOLOGY ADOPTION IN THE TROPICS

Moderator

Professor Dato' Dr Ahmad Ibrahim FASc

Tan Sri Omar Centre for STI Policy Studies,
UCSI University

Panellists

Professor Lei Shu

Professor, Nanjing Agricultural University, China
& University of Lincoln, United Kingdom

Professor Dr Siva K Balasundram

Department Head, Department of Agriculture Technology,
Universiti Putra Malaysia (UPM)

Summary of key points

- Agriculture 4.0 and 5.0 adoption in tropical regions integrates IoT, AI, and solar energy systems like PV farms for sustainable food and energy production.
- Smart insecticidal devices using AI and IoT technologies improve pest management, reducing pesticide use and enhancing crop productivity in tropical agriculture.
- Precision agriculture optimises resource application, ensuring efficient use of fertilisers and pest control in tropical farming practices.
- Real-time data collection via AI, IoT, sensors, and drones enhances decision-making and efficiency in tropical smart agriculture.
- Digital agriculture fosters connectivity among tropical farms and marketplaces, addressing food waste and promoting zero-waste practices.
- Tropical regions can benefit from innovations in smart farming to combat labour shortages, adapt to climate change, and ensure sustainable agricultural practices.

Read the full report on page 107 of Appendix

FOOD SECURITY, FOOD-ENERGY-WATER-NEXUS IN THE TROPICS

Moderator

Professor Dato' Dr Mohamed Shariff Mohamed Din FASc

Institute of Bioscience, Universiti Putra Malaysia

Panellists

Professor Asit K. Biswas

Academician and Distinguished Visiting Professor,
University of Glasgow, United Kingdom
Director, Water Management International, Singapore

Professor Clive Phillips

Curtin University Sustainability Policy Institute, Australia
Estonia University of Life Sciences

Dr Wickneswari Ratnam FASc

Managing Director, Nomatech Sdn Bhd

Professor Dr Shaufique Fahmi Ahmad Sidique

Agricultural Economics, Universiti Putra Malaysia

Summary of key points

- The management of food, energy, and water systems in the tropics is interconnected, requiring a holistic approach to address challenges effectively.
- Rising global temperatures are increasing the demand for electricity, particularly for cooling, complicating the management of natural resources in tropical regions.
- Habitat destruction has led to the extinction of 70-80% of species in the past 50 years, significantly impacting biodiversity in tropical ecosystems.
- Ensuring food security in the tropics involves understanding diet quality, agricultural production, market systems, and consumer purchasing power.
- Income levels are closely linked to food security; effective food production alone does not guarantee security without addressing economic growth and poverty alleviation.
- There is a pressing need for sustainable agricultural practices and reduced food waste to improve food security and environmental health in tropical regions.

Read the full report on page 114 of Appendix

TROPICAL MEDICINE

MEDICINE SECURITY IN THE TROPICS (VACCINES, DRUGS AND DIAGNOSTIC)

Moderator

Professor Dr Suresh Kumar P. Govind FASc

Honorary Professor, Department of Parasitology,
Faculty of Medicine, University Malaya

Panellists

Professor Dr Ramendra Pati Pandey

Biotechnology, SRM University Delhi-NCR, Sonepat

Professor Laurent Renia

Senior Fellow and Principal Investigator
A*STAR Infectious Diseases Labs – ID Labs

Dr Cindy Chu

Lao-Oxford-Mahosot Hospital-Wellcome Trust Research Unit

Summary of key points

- Existing treatments for Chagas disease are effective only in the acute phase, leaving chronic cases without viable options.
- Drug repurposing, such as combining chloroquine with other medications, shows promise in improving treatment effectiveness for Chagas disease.
- Antimicrobial resistance is a growing global threat that necessitates a "One Health" approach, integrating environmental, animal, and human health.
- A coordinated, interdisciplinary collaboration is essential to combat infectious diseases and develop sustainable health solutions.
- Tropical regions face unique challenges in infectious disease management due to dense populations and frequent cross-border exchanges.
- Building regional capacity for surveillance, detection, intervention, and prevention is crucial to enhance health security and manage infectious diseases effectively.

Read the full report on page 121 of Appendix

IMPACTS OF ECOLOGICAL CHANGE ON TROPICAL DISEASE + NEGLECTED TROPICAL DISEASES

Moderator

Dr Vickneshwaran Muthu

Disease Control Division, Ministry of Health

Panellists

Professor Emeritus Dato' Dr Syed Mohamed Aljunid

Department of Public Health and Community Medicine
School of Medicine, International Medical University

Dr Kimberly Fornace

Saw Swee Hock School of Public Health, National University of Singapore Senior Fellow and Principal Investigator

Emeritus Professor John S Mackenzie

Curtin University, Perth

Summary of key points

- Natural and artificial disasters lead to significant fragmentation in health systems, complicating effective disaster response and collaboration between the public and private sectors.

- Immediate disaster effects include severe injuries and the resurgence of communicable diseases, highlighting the need for improved disaster preparedness.

- Poor data management and sharing hinder effective disaster response, necessitating better coordination among ministries and healthcare providers is required.

- Deforestation is a key driver of emerging infectious diseases, increasing pathogen spillover from wildlife to humans and facilitating outbreaks.

- Climate change enhances the spread of vector-borne diseases by improving conditions for vector survival and reproduction, expanding their geographic range.

- A One Health approach is essential for integrating human, animal, and environmental health to effectively address the challenges posed by disasters and disease emergence.

Read the full report on page 132 of Appendix

TROPICAL NATURAL RESOURCES

PROTECTION OF BIODIVERSITY IN THE TROPICS

Moderator

Ts Dr Khairul Naim Adham

Deputy Undersecretary (Biodiversity Management Section)
Ministry of Natural Resources and Environment Sustainability

Panellists

Professor Jatna Supriatna

Public Health and Community Medicine
Chairman, Institute for the Sustainable Earth and Resources
FMIPA UI

Datuk Dr John Payne

Chief Executive Officer, Borneo Rhino Alliance

Dr A. Aldrie Amir

Associate Professor, Universiti Kebangsaan Malaysia
Commission Member, IUCN SSC Mangrove Specialist Group

Summary of key points

- Limited funding is a major barrier to effective biodiversity conservation efforts, necessitating innovative financing solutions is required.
- Borneo faces significant challenges such as development pressures, migration, forest fires, and flooding that impact biodiversity.
- Habitat loss leads to a slow drift toward extinction for many species, highlighting the urgent need for conservation leadership beyond government initiatives.
- Protecting large land areas is essential for sustaining species diversity and preventing further loss.
- Mangrove ecosystems provide critical services and require conservation efforts due to their vulnerability to climate change, pollution, and habitat loss.
- Engaging large groups of people in ecosystem conservation can change perceptions and lead to better decision-making regarding environmental protection.

Read the full report on page 140 of Appendix

MINERALS OF THE TROPICS

Moderator

Mr Loganathan Ponnambalam PGeol FASc
Fellow, Academy of Sciences Malaysia

Panellists

Dato' Sia Hok Kiang PGeol FASc
Malaco Mining Sdn Bhd

Professor Emeritus Tetsuro Urabe
University of Tokyo

Ts Raja Shazrin Shah bin Raja Ehsan Shah
Managing Director, Galaxy Tech Solutions (KL) Sdn Bhd

Summary of key points

- Limited funding is a major barrier to effective biodiversity conservation efforts, necessitating innovative financing solutions is required.
- Borneo faces significant challenges such as development pressures, migration, forest fires, and flooding that impact biodiversity.
- Habitat loss leads to a slow drift toward extinction for many species, highlighting the urgent need for conservation leadership beyond government initiatives.
- Protecting large land areas is essential for sustaining species diversity and preventing further loss.
- Mangrove ecosystems provide critical services and require conservation efforts due to their vulnerability to climate change, pollution, and habitat loss.
- Engaging large groups of people in ecosystem conservation can change perceptions and lead to better decision-making regarding environmental protection.

Read the full report on page 146 of Appendix

TROPICAL ARCHITECTURE AND ENGINEERING

DESIGNING TOWARDS NET ZERO IN THE TROPICS (INDIGENOUS DESIGN)

Moderator

Ir Dr Chong Kok Hing
Swinburne University of Technology Sarawak

Panellists

Ar Dr Serina Hijjas
Director, Hijjas Architects & Planners

Laurent Troost
TROOST + PESSOA Architects

Professor Robert Powell
Architect/Author, Robert Powell Studio

Summary of key points

- Modern tropical architecture emphasises sustainable and ecological designs that respond to the unique climate conditions of the tropics, such as high rainfall and humidity.

- Buildings in tropical regions should incorporate passive cooling strategies, such as high ceilings, open spaces, and natural ventilation, to reduce reliance on mechanical air conditioning.

- The use of local materials, like timber, is encouraged in tropical architecture due to their lower carbon emissions and recyclability after decommissioning.

- Nature-based solutions, such as integrating plants into building designs, can help mitigate urban heat island effects and enhance indoor air quality.

- Successful examples of tropical architecture, like the Cinnamon Hill House and Ken Yeang's Bioclimatic Skyscraper, serve as inspirations for future sustainable building practices in the region.

- Collaboration among architects, urban planners, and policymakers is essential to promote sustainable building codes and policies that support ecological architecture in tropical areas.

Read the full report on page 154 of Appendix

NEW AND EMERGING SMART SUSTAINABLE MATERIALS FOR THE TROPICS

Moderator

Professor Ir Dr Sapuan Salit

Head, Advanced Engineering Materials and Composites Research Centre, Universiti Putra Malaysia

Panelists

Professor Dr Suttichai Assabumrungrat

Bio-Circular-Green Economy Technology and Engineering Center (BCGeTEC), Chulalongkorn University

Professor Armando Tibigin Quitain

Director, Research and Innovation,
Edo State University Uzairue, Nigeria

Professor Cristobal N. Aguilar

BBG-DIA Food Research Department
Universidad Autonoma de Coahuila, Mexico

Summary of key points

- Local bio-based materials are vital for promoting sustainability in the tropics, particularly through Thailand's Bio-Circular Green (BCG) Economy model, which integrates sustainability and innovation.

- The BCG model emphasises the responsible use of biomass, including agricultural residues, to produce eco-friendly materials and reduce reliance on unsustainable resources.

- Key challenges in adopting bio-based materials include high production costs, limited government incentives, and insufficient policy frameworks that must be addressed for effective implementation.

- Biotechnology plays a crucial role in integrating agriculture with local biodiversity in the tropics, enhancing crop resilience and reducing pesticide use through innovations like synthetic biology.

- Regional collaborations, such as the ASEAN-Japan initiatives, are essential for advancing biomass technologies and developing renewable energy solutions using tropical feedstocks like algae and palm oil residues.

- The integration of circular economy principles with fungal technologies can transform agricultural waste into biodegradable materials, promoting resilience and reducing dependency on non-biodegradable plastics in tropical regions.

Read the full report on page 160 of Appendix

OPEN SCIENCE IN TROPICAL BIODIVERSITY

OPEN SCIENCE IN TROPICAL BIODIVERSITY

Moderator

Professor Dr Habibah A Wahab FASc

Deputy Vice-Chancellor, Research and Innovation,
Universiti Sains Malaysia

Panellists

Dr Helen Nair FASc

Chairperson, ASM Precision Biodiversity Alliance,
Academy of Sciences Malaysia

Datuk Dr Ghazally Ismail FASc

Fellow, Academy of Sciences Malaysia

Dr Rahimatsah Amat FASc

Chief Executive Officer, Sabah Environmental Trust

Summary of key points

- Two-thirds of the world's biodiversity is found in tropical areas, making it crucial for tropical nations to lead biodiversity management efforts.

- Biodiversity is essential for human needs such as food, shelter, and medicine and is integral to economic activities.

- The Malaysia Biodiversity Information System (MyBIS) repository facilitates access to Malaysian biodiversity data, supporting scientific research and collaboration.

- Open science promotes knowledge sharing and breaks down barriers to data access, which is crucial for understanding and managing biodiversity in the tropics.
- Despite conservation efforts, certain species in Malaysia continue to decline, highlighting the need for improved population estimation and monitoring methodologies.

- Addressing biodiversity loss requires integrating new technologies and understanding ecological complexities, including factors like gender ratios and health conditions of wildlife populations.

Read the full report on page 165 of Appendix

CLIMATE CHANGE IN THE TROPICS

CLIMATE CHANGE IN THE TROPICS

Moderator

Associate Professor Dr Sharina Abdul Halim

Deputy Director, Institute for Environmental and Development (LESTARI), Universiti Kebangsaan Malaysia

Panellists

Professor Edvin Aldrian

Agency for Assessment and Application of Technology (BPPT) Jakarta
Vice Chairperson, IPCC Working Group

Professor Ulo Mander

Physical Geography and Landscape Ecology
University of Tartu, Estonia

Associate Professor Dr Liew Ju Neng

Department of Earth and Sciences and Environment, Universiti Kebangsaan Malaysia

Summary of key points

- Peatland-drained forests in Indonesia emit one-third of the carbon compared to natural forests, highlighting the importance of rewetting peatlands for carbon absorption.

- Oil palm trees can absorb 13.7 tonnes of CO2 per hectare while releasing 3.6 tonnes, indicating their potential role in climate change mitigation if managed sustainably.

- There is a need for advanced climate modelling incorporating soil dynamics and ecological factors to predict better the impacts of climate change on palm oil cultivation.

- Tropical peatland forests store 30% of terrestrial organic carbon and play a crucial role in mitigating greenhouse gas emissions through restoration efforts.

- Inter-regional collaboration is essential for effective peatland protection and restoration, enhancing understanding of these ecosystems and their processes.

- Active convection centres influence the tropical maritime continent's climate, and adaptation strategies must be tailored to local conditions while fostering collaboration across various sectors.

Read the full report on page 171 of Appendix

PROTECTION OF INDIGENOUS AND LOCAL KNOWLEDGE IN THE TROPICS

PROTECTION OF INDIGENOUS AND LOCAL KNOWLEDGE IN THE TROPICS

Moderator

Dr Ramy Bulan

Research Fellow, Faculty of Law,
Universiti Malaya

Panellists

Professor Dr Poline Bala

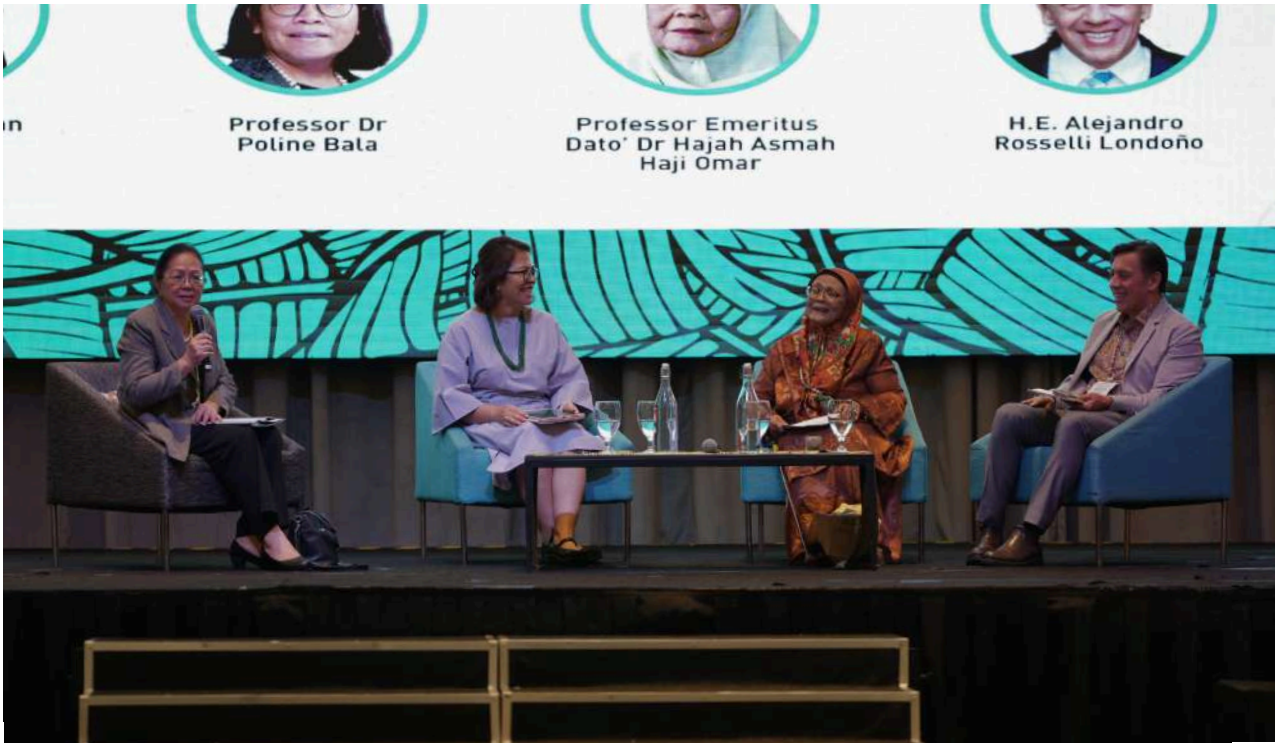
Director, Institute of Borneo Studies
Universiti Malaysia Sarawak

Professor Emeritus Dato' Dr Hajah Asmah Haji Omar

Malaysian Language and Library Council

H.E Alejandro Rosselli Londono

Ambassador of Colombia



Summary of key points

- ·Indigenous knowledge is vital for addressing global issues like sustainability and conservation, especially in tropical regions.
- ·Digital technology offers opportunities to document Indigenous knowledge but raises concerns about ownership and intellectual property.
- ·Indigenous languages in the tropics are endangered, leading to a loss of cultural, historical, and ecological knowledge.
- ·Efforts like Malaysia's "Pupils of Language" (POL) programme highlight the importance of integrating indigenous languages into education systems.
- ·Practical conservation efforts benefit from incorporating local ecological knowledge, as demonstrated by Amazon, Africa, and Asia communities.
- Actively using indigenous knowledge ensures its preservation, fostering environmental conservation and cultural heritage protection.

Read the full report on page 178 of Appendix

KUCHING DECLARATION ON THE TROPICS

KUCHING DECLARATION ON THE TROPICS
THE TROPICS MATTER TO THE WORLD

The International Conference on Tropical Sciences (TropSc) 2024: Harmonising Humanity with Nature, organised by the Tropical Science Foundation and the Academy of Sciences Malaysia on 16 – 17 October 2024 in Kuching, Sarawak,

Reaffirming the principles upheld in the

- UNGA Resolutions: The Future We Want (A/RES/66/288) & The Pact for the Future (A/RES/79/1),
- UNGA Resolution: Transforming our World: the 2030 Agenda for Sustainable Development (A/RES/70/1),
- UNGA Resolution on the International Day of the Tropics (A/RES/70/267),
- Kuching Declaration on Protecting Wildlife Against Illegal Trade and Trafficking in Asia, and
- Other declarations related to the Tropics,

Appreciating the importance of Harmonising Humanity with Nature,

Recognising that tropical countries have made significant progress, but they face challenges that necessitate concerted attention and effort across a range of developmental factors to achieve sustainable sustainability,

Noting that the Tropics, collectively, inter alia, hosts 80% global biodiversity, 45% forest, mostly overlapping with Indigenous peoples' lands, and 54% renewable water resources, and that warm tropical oceans play a critical role in regulating Earth's climate,

Valuing the potential of the Tropics where, by 2050, the region will host more than half of the world's population and two-thirds of children, and where 82% of the world's living languages are spoken in the Tropics,

Cognisant of the vulnerability and unique challenges that the Tropics confront because of climate change and economic pressures on resources, as well as the global ramifications of these concerns,

Emphasising that the Tropics is where 85% of the world's poorest people live in and that tropical diseases affect more than 1 billion people annually,

Aware of the complexity, chaos, and contradictions of a post-normal era and,

Acknowledging the vital role of governments, private sectors, academia, scientists, youth, non-governmental organisations, civil society organisations, Indigenous people and local communities,

1. Proposes the following.

Sustainable Development of the Tropics

- that spiritual and environmental values are integrated into development policies to ensure sustainability and well-being. This includes aligning economic growth with environmental protection and spiritual fulfilment,
- that planetary health be taken into account through transdisciplinary/multidisciplinary collaborations, ethics, and community empowerment while being humanity-centric, STI-enabled, nature-based, and values-internalised,

The Ecosystem

- that priority be given to preserving the biodiversity of the Tropics through scientifically supported sustainable practices, habitat preservation, ecosystem restoration, and active involvement of local communities in safeguarding protected forests and habitats by harnessing both traditional knowledge and advanced technologies,
- that damaging exploitation of minerals be avoided through the practice of Environmental, Social, and Governance framework and traceability measures to ensure that the Earth's mineral wealth is sustainably developed and used,
- that the application of modern technologies and intelligent agricultural practices be promoted to boost output, enhance sustainability, and guarantee resilience against resource constraints and climate change,
- that integrated management of the tropical region's food, energy, and water resources be encouraged to ensure sustainable agricultural systems and practices, sustainable food security, and to guarantee equitable access to vital resources for expanding populations,
- that urgent and concerted worldwide action be implemented in building climate-resilient societies towards a just and equitable transition, adaptation, and mitigation strategies that consider vulnerable Indigenous and local communities in decision-making and planning,

The Human System

- that equitable access to health services and medicine be ensured to improve overall health outcomes of underprivileged and marginalised populations in the Tropics,
- that multifaceted, comprehensive, and coordinated efforts, which combine environmental and forest conservation, health initiatives, and community involvement, be key to mitigating the risks of emerging and re-emerging diseases in the Tropics,
- that Open Science practices are adopted for sharing knowledge from biodiversity research to foster an inclusive approach and empower diverse stakeholders while protecting the rich tapestry and assets of the Tropics,

- that Indigenous design in tropical architecture is prioritised in achieving Net Zero goals, blending traditional methods with modern practices for energy-efficient, climate-resilient, and culturally respectful solutions,
- that new and emerging smart sustainable materials with enhanced performance and durability be harnessed to promote resilience to climate change and eco-friendliness,
- that traditional, Indigenous and local knowledge, language, systems, cultural heritage, customary practices and capacities be protected and preserved, synergies be fostered between these and S&T, and Indigenous people be recognised as custodians of their ecosystem,

Cross-cutting

- that national and international platforms be established for youth leaders to partake in policy discussions, volunteer activities, and civic engagement, and that youth be empowered to become skilful, knowledgeable and employable, thereby ensuring their full potential as active citizens and;

2. ***Pledges***, where possible, to highlight the proposals of this Declaration on the international stage, including, but not limited to, discussions at, and meetings of, the United Nations organs, funds, programmes, and agencies, with a view to mainstreaming issues pertaining to the Tropics,

3. ***Encourages*** stakeholders of the Tropics to include, as appropriate, in their communications the need for recognition of the challenges of the Tropics as a vital and collective issue affecting the global ecosystem and its environment,

4. ***Determines*** to keep the Tropical Science Foundation (TSF) informed, to the extent possible, of the initiatives, programmes, and publications relating to the Tropics, and calls upon TSF to convene the 3rd International Conference on Tropical Sciences (TropSc) in three years time,

5. ***Invites*** stakeholders, inter alia, nations; the United Nations; organisations of the United Nations system; international and regional organisations; civil society, including non-governmental and faith-based organisations; local authorities; the private sector; and the scientific and academic communities to pay particular attention to the needs of the Tropics: its peoples and its unique and special environment; as well as address the specific challenges and invest in emerging opportunities that the Tropics present through:

- International collaborations between academia, industry, and government,
- Adopting multisectoral and multidisciplinary actions and Open Science,
- Ensuring that science informs policy,
- Undertaking strong country responsibility in achieving global goals,
- Investing in human resource development and R&D, and

6. ***Recommends*** the stakeholders of the Tropics to commit to enhancing collaborations for the future in all aspects of this Declaration through a voluntary alliance of the Tropics.

ABSTRACT

ISOLATION AND CHARACTERIZATION OF BACTERIA ASSOCIATED WITH *THRIPS PALMI* KARNY (1895) FOUND ON *SOLANUM MELONGENA* L.

Mintu, Cynthia B.*, Barredo, Michaela Ayesha B.*, Chua, Joanna Monique G., Castaloni, Aaron M., Rosqueta, Joeffrey., Suelo, Jazshua A.[1,A], Reyes, Cecilia P.[2]

[1]Nicanor Reyes Sr. St., Sampaloc, Manila City, Philippines

[2]National Museum of Natural History, Teodor F. Valencia Cir., Ermita, Manila City, 1000, Philippines

[a]cmintu@feu.edu.ph, [b] 2020006681@feu.edu.ph, [c]2020003841@feu.edu.ph, [d]2020007701@feu.edu.ph, [e]20200444251@feu.edu.ph, [f]2020046111@feu.edu.ph, [s]reyescecilia.p@gmail.com

ABSTRACT

This study aims to isolate and identify bacterial species associated with adult Thrips palmi Karny (thrips) from eggplants (Solanum melongena L.) at the Food Machinery and Chemical Corporation Learning Center in Dayap, Calauan, Laguna. Thrips were randomly collected from eggplants within a 200m² area using the tapping method, sorted, and examined under a microscope. Standard procedures for bacterial isolation from thrips, including morphological characterization on Luria-Bertani Agar media, Gram staining, and biochemical tests, were employed. The researchers utilized Bergey's Manual of Systematic Bacteriology Second Edition: Volume 3, to classify samples into two distinct bacterial families: Bacillaceae and Staphylococcaceae. By employing the detailed taxonomic information provided in the manual, the researchers were able to accurately categorize the bacterial samples based on their structural and functional attributes. Eggplants are significant vegetable crops in the Asian continent and are widely cultivated in tropical and subtropical regions globally; additionally, in the Philippines, it accounts for 30% of the overall vegetable production. These crops are highly nutritious and are known to be a good source of vitamins (C, K, B6), minerals, and fiber. Eggplants are also recognized as one of the top 10 vegetables for high content of phenolic acids and antioxidant properties. Moreover, bacteria, despite being known as single-celled organisms that are of micrometers in size, play a massive role in the ecosystem. especially in plant health. This impact may be of positive or negative effects that are vital to plant survival. Furthermore, pests such as Thrips, are notable organisms that pose a great threat to plants such as eggplant crops as they feed on them causing crop loss; more importantly, most pests are considered to be vectors of such plant diseases. With this being said, due to such bacterial organisms and pests, eggplant crops are no stranger to plant diseases that cause decrease in crop production and quality which also affects the economic status of the Philippines, where the country is known to rely on agricultural livelihood. Tomato Spotted Wilt Virus is one of the known diseases of eggplant crops due to Thrips. This disease causes yellowing with chlorotic line patterns in leaves and necrosis at the terminal shoot. Bacterial wilt is also a common disease due to a bacterial infection that causes sudden wilting of eggplant crops. Due to these kinds of manifestations, it causes severe yield and quality losses of crops in temperate and subtropical regions, including the Philippines. In response to these challenges, Food Machinery and Chemical Corporation (FMC) in Dayap, Calauan, Laguna aims to support crop protection through sustainable practices. The research team at the FMC learning center in Laguna has focused on *Thrips palmi* Karny, a pest suspected of causing substantial damage to eggplant crops. This paper focuses on isolating and characterizing bacteria that are associated with *Thrips palmi* Karny (1895) that are found on eggplant crops. With the use of different morphological and biochemical testing, bacterial species will be identified at a family level.

Keywords: biochemical, morphology, agriculture, eggplant

SYNERGISTIC EFFECTS ON THE CATALYTIC CO-PYROLYSIS OF PALM KERNEL SHELL WASTE MIXTURES AND TETRA PAK VIA THERMOGRAVIMETRIC APPROACH

Stephenie Ker Yin Yap[1], Bridgid Lai Fui Chin*[1], Chung Loong Yiin[2], Suzana Yusup[3], Armando T. Quitain[4], Suttichai Assabumrungrat[5], Elisabeth Rianawati[6]

[1] Department of Chemical and Energy Engineering, Faculty of Engineering and Science, Curtin University Malaysia, CDT250, 98009 Miri, Sarawak, Malaysia

[2] Department of Chemical Engineering and Energy Sustainability, Faculty of Engineering, Universiti Malaysia Sarawak (UNIMAS), 94300 Kota Samarahan, Sarawak, Malaysia

[3]Generation Unit (Fuel and Combustion Section), TNB Research Sdn. Bhd., No. 1, Kawasan Institusi Penyelidikan, Jalan Ayer Hitam, Kajang, Selangor 43000, Malaysia

[4]Department of Advanced Science and Technology, Kumamoto University, 2-39-1 Kurokami, Chuo-ku, Kumamoto 860-8555, Japan

[5]Bio-Circular-Green-economy Technology & Engineering Center (BCGeTEC) and Center of Excellence in Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand

[6]Resilience Development Initiative, Jl. Imperial 2, No. 52, Bandung, 40135, Indonesia

*bridgidchin@curtin.edu.my

ABSTRACT

In this study, the catalytic co-pyrolysis of palm kernel shell (PKS) and tetra pak (TPK) was evaluated using thermogravimetric approach. The kinetic analysis and thermodynamic analysis parameters were determined in this study. Kinetic models such as Starink, Flynn-Wall-Ozawa (FWO), and Kissinger-Akahira-Sunose (KAS) were used in this research. The experiments were conducted from room temperature to 1000°C ranging from heating rates of 10°C/min to 100°C/min. The average activation energy, E_a values for PKS, TPK, TPK/PKS (2:8), TPK/PKS – Nickel, and TPK/PKS –HZSM-5 based on these three kinetic models were 208.24 – 302.20, 152.34 – 217.68, 93.63 – 130.85, 126.44 – 179.98, and 81.67 – 112.83 kJ/mol, respectively. Based on the FWO model applied, HZSM-5 had the lowest average E_a of 81.67 kJ/mol and enthalpy change, ΔH of 76.63 kJ/mol among the type of catalysts used. The catalytic co-pyrolysis of PKS/HDPE mixtures yielded positive values for ΔH and Gibbs free energy (ΔG), indicating that the process is non-spontaneous and in an endothermic reaction. Thus, PKS and TPK have the potential to be used as feedstocks to convert into an energy resource via catalytic co-pyrolysis based on the kinetic and thermodynamic studies. In addition, data on thermal deterioration were anticipated using an artificial neural network (ANN). The findings showed an important correlation between actual and expected values. This study demonstrated the utility of the ANN model and the appropriateness of pyrolysis for the simultaneous production of energy products and disposal of the mixtures of TPK and PKS waste energy sources.

Keywords: Kinetic; Thermodynamic; Palm Kenel Shell; Tetra Pax; Co-Pyrolysis

INVESTIGATING COMBUSTION BEHAVIOR OF COAL AND BIOMASS FLAMES THROUGH CCD CAMERA IMAGING

Zulkifli Ahmad Zulazlan Shah*[1, a], Ahmad Sani Nor Salwa[1], Mohd Shamsuri Muhamad Shazarizul Haziq[1], Mohd Noor Noor Akma Watie[1], Abd Halim Ibrahim[1], and Yusup Suzana[1]
[1]*Fuel and Combustion, Genration unit, TNB Reseach Sdn. Bhd.*
azulazlan.zulkifli@tnb.com.my

ABSTRACT

This study presents a comparative analysis of coal and biomass flames under a single combustion condition using image processing techniques. Flame diagnostics are critical for optimizing combustion processes, improving efficiency, and reducing emissions. In this research, key flame characteristics—such as luminous intensity and flame velocity—were extracted from flame images captured using a CCD camera. Advanced image processing methods were used to evaluate flame stability and behavior. The results indicate that coal flames exhibit higher brightness and greater stability, with consistent velocities and minimal fluctuations. In contrast, biomass flames show more significant flicker and variability in brightness, suggesting a less stable combustion profile. Despite these differences, both fuel types performed within acceptable parameters. This study demonstrates the potential of image processing techniques for real-time monitoring and optimization of combustion processes across diverse fuel types.

Keywords Flame analysis; Coal combustion; Biomass combustion; Image processing; Flame stability

FACTSAGE ANALYSIS FOR ASH FLOWABILITY PREDICTION IN COAL AND BIOMASS CO-FIRING

Noor Akma Watie Mohd Noor*[a], Muhamad Shazarizul Haziq Mohd Samsuri[b], Nur Salwa Ahmad Sani[c], Ahmad Zulazlan Shah Zulkifli[d], Ibrahim Abd Halim[e], Suzana Yusup[f]
TNB Research Sdn. Bhd., No.1, Lorong Ayer Itam, Kawasan Institusi Penyelidikan, 43000 Kajang, Selangor, Malaysia
[a]akma.noor@tnb.com.my, [b]haziq.samsuri@tnb.com.my, [c]salwa.sani@tnb.com.my, [d]zulazlan.zulkifli@tnb.com.my, [e]ibrahim.abdhalim@tnb.com.my, [f]suzana.yusup@tnb.com.my

ABSTRACT

The utilization of coal and biomass as alternative fuels in combustion processes has obtained considerable attention due to environmental concerns and resource diversification. This study investigated the ash deposition characteristics and performance implications of coal and biomass co-firing using FactSage simulation. The simulation utilized the ash compositions of coal and biomass data, providing insights into their thermochemical behavior and its implications for combustion performance. Through rigorous simulation analyses, the influence of fuel composition and blending ratios on flowability of slag formation and deposit accumulation were analyzed. This research underscores the significance of predictive modeling in addressing operational challenges associated with biomass co-firing. FactSage simulation can facilitate fuel selection and process optimization, promoting the development of resilient and efficient combustion systems capable of harnessing the benefits of biomass utilization while minimizing its drawbacks.

Keywords: Coal; Biomass; Combustion; Optimization; Ash deposition

HEALTH MONITORING DEVICE IN TROPIC COUNTRY: OBSERVATIONAL EVIDENCE FROM MALAYSIA

Theresia Merdeka Putri[1,2,a] and Normina Ahmad Bustami*[2,b]
[1]Klinik Pratama Putri Kencana, Pekanbaru, Riau
[2]School of Healthy Aging, Aesthetic and Regenerative Medicine, Faculty of Medicine and Health Sciences, UCSI University, Kuala Lumpur, Malaysia
[a]theresiamerdekaputri@gmail.com, [b]normina@ucsiuniversity.edu.my

ABSTRACT

The use of technology to assist in health monitoring is a welcomed innovation. The devices for easy monitoring include daily wearables such as smartwatches, which could monitor pulses, physical activity, and heart rate. A step towards awareness on health and health monitoring is important, especially with the rising data on non-communicable diseases globally. As the prevalence of non-communicable diseases in Malaysia increases, it is imperative to know whether the population is aware and accepting towards the potential of daily wearables such as smartwatch to assist in their health monitoring. Thus, this study aimed to determine the prevalence of smartwatch usage among Malaysian population and the acceptance towards smartwatch use as a health monitoring device. This study also determined the acceptable price range for a smartwatch among Malaysians. This cross-sectional study collected the socio-demographic data of participants, as well as their smartwatch usage, acceptance towards smartwatch use as health monitoring device and acceptable price range for a smartwatch. A total of 210 Malaysians participated in this study, in which 47.1% (n=99) were males and 52.9% (n=111) were females. It was found that only 21% (n=44) of the participants owned a smartwatch, while the remaining 79% (n=166) did not own a smartwatch. Interestingly, 64.5% (n=107) of the participants who did not own a smartwatch were keen to use a smartwatch as health monitoring device. This study also found that majority of the participants (86.2%, n=181) thought that a price of MYR1000 and below was acceptable for a smartwatch, in which the monthly income seemed to be the determining factor for the acceptable price range ($p<0.05$). In conclusion, the use of smartwatch as a health monitoring device seemed to be acceptable by Malaysians, with reasonable price for it to be affordable for the public.

Keywords: Smartwatch; Health monitoring; Health monitoring device; Non-communicable diseases

ENVIRONMENTAL IMPACTS ON SENILE LENTIGINES: AN OBSERVATIONAL EVIDENCE FROM MALAYSIA

Eunice Beh Li Cher[1, a], Edmond Ng Siah Chye[1,b] and Tan Chung Keat*[1,c]
[1]School of Healthy Aging, Aesthetics and Regenerative Medicine, Faculty of Medicine and Health Sciences, UCSI University, 56000 Kuala Lumpur, Malaysia
[a] eunicebic@gmail.com, [b] edmondng@ucsiuniversity.edu.my, [c] cktan@ucsiuniversity.edu.my

ABSTRACT

With chronic sun exposures, populations residing in tropical regions commonly exhibit primary, distinct pigmentary changes, such as senile lentigines, as prevalent indicators of photodamage. While ultraviolet radiation (UVR) is recognized as the primary factor in the development of lentigines, there is a growing body of evidence suggesting that environmental factors also contribute to the formation of these pigmented lesions, giving rise to the term 'environment-induced lentigo' (EIL). This is a cross-sectional study that recruited 101 participants to investigate the association between behavioral and phenotypic factors (age group, gender, Fitzpatrick skin type, hormone replacement therapy (HRT), UV exposure, sunscreen use, smoking, history of sunburn) with the incidence of lentigines and its severity. Our findings revealed that the severity of lentigines over the hands is significantly associated with the gender of participants ($P<0.05$), with increased severity among males due to less sun protection. Age groups correlated significantly with lentigines occurrence on the forehead, forearm, and hand ($P<0.05$), reflecting increased UV exposure with age. Outdoor workers and participants who spent more time outdoors were found to have significantly ($P<0.05$) higher incidence of forearm lentigines. Sunscreen use correlated with hand lentigines severity ($P<0.05$), emphasizing its protective role. No significant associations were found with smoking, sunburn history, or Fitzpatrick skin type. The study underscores the importance of sun protection due to its pivotal role in lentigines development amidst intrinsic and extrinsic risk factors.

Keywords: Senile Lentigines; Environment-Induced Lentigo' (EIL); Sunscreen; Outdoor

PREVENTION OF SILENT HYPOXIA DURING COVID-19 USING HOME PULSE OXIMETER: INSIGHT FROM THE TROPICS

Dewi Maryani[1, a], Rahela Zaman[2,b], Tan Chung Keat[2,c], Lee Siew Keah[3,d] and Eugenie Tan Sin Sing[2,c]

[1]Glowderma Skin and Laser Clinic, Jalan Maleo Raya, South Tangerang Banten Indonesia

[2]Faculty of Medicine and Health Sciences, UCSI University, No.1, Jalan UCSI, UCSI Heights, Cheras 56000 Malaysia

[3]M. Kandiah Faculty of Medicine and Health Sciences, Universiti Tunku Abdul Rahman, Malaysia

[a] drdewimaryanispkk@gmail.com, [b] Rahela@ucsiuniversity.edu.my, [c] cktan@ucsiuniversity.edu.my, [d] leesiewkeah@utar.edu.my, [e] eugenietan@ucsiuniversity.edu.my

ABSTRACT

The COVID-19 pandemic has highlighted the phenomenon of silent hypoxia, where patients infected with the SARS-CoV-2 virus can exhibit dangerously low blood oxygen levels without showing symptoms of dyspnea. In August 2021, Indonesia experienced a significant rise in COVID-19 deaths, with some patients showing signs of silent hypoxia. Following this, the home pulse oximeter has emerged as a valuable tool in monitoring and early detection of silent hypoxia. This study aimed to investigate the practice and level of knowledge related to the application of a home pulse oximeter. Three hundred and two (302) respondents from Suburban Jakarta were conveniently recruited and subjected to a cross-sectional questionnaire consisting of three sections: socio-demographics, knowledge and factors affecting pulse oximetry reading, and lastly, user's experience. Most respondents were female (89.4%), aged 26 to 39 years old (44%), married (64.5%), had tertiary education (44.4%), and history of COVID-19 (51%). Respondents had decent knowledge about using home pulse oximeters, scoring a median 62.5 (IQR 37.5). They understood the importance of a normal pulse rate, normal blood oxygen levels (SpO2), and knew to seek medical help if their SpO2 dropped below 94%. However, respondents demonstrated limited knowledge regarding factors affecting pulse oximetry, achieving a median score of 36.36 (IQR 54.5). Specifically, they did not recognize how nail polish, skin color, skin thickness, and the presence of henna/tattoos can affect SpO2 readings. Respondents' knowledge was significantly associated with their age group, sex, marital status, educational level, healthcare-related profession and history of COVID-19 ($p<0.05$). Overall knowledge scores from this study (median 46.6, IQR 36.9) were statistically different from our Malaysian study (median 62.3 (23.2)) ($p<0.05$). Raising awareness about home pulse oximeters in Indonesia is crucial as they can improve patient outcomes by allowing prompt interventions and mitigating the risk of severe complications related to silent hypoxia.

Keywords: COVID-19, silent hypoxia, home pulse oximeter

ABUNDANCE OF THE SNAIL *Terebralia sulcata* (Born, 1778) ON DIFFERENT ROOT SYSTEMS OF MANGROVE FOREST SPECIES IN CALATAGAN, BATANGAS, PHILIPPINES

Mario A. Cudiamat*[1, A]

[1]Environmental Biology Division, Institute of Biological Sciences, College of Arts and Sciences University of the Philippines Los Baños, Laguna, Philippines

[a]macudiamat@up.edu.ph

ABSTRACT

Mollusks play an important role as decomposers and vital organisms in food webs to maintain the ecosystem health of mangrove forests. Studies on the economically important molluscan fauna particularly gastropods and the mangrove forests are very limited in the country. The study aimed to assess the abundance of *T. sulcata*, an economically significant gastropod in the mangrove forest along different root systems in Calatagan Mangrove Forest Conservation Park, Batangas. The study employed quadrat sampling to determine the species abundance of *T. sulcata* in three different types of mangrove root systems namely: the *Rhizophora* (aerial roots), *Sonneratia* (peg roots), and *Avicennia* (pneumatophores). There were 20 1m x 1m quadrats established randomly in each type of root structure. The study recorded a total of 1,171 individuals of *T. sulcata*. *Avicennia's* pneumatophores were recorded with the highest number of individuals while *Sonneratia's* peg roots with the lowest number. The findings also revealed a significant difference ($p<0.05$) in the abundance of *T. sulcata* along different mangrove root structures using Kruskal-Wallis H' test. With these findings, it is suggested that the integration of this species into the mangrove management plan be considered to monitor its abundance in the mangrove forest.

Keywords: abundance, *Terebralia sulcata*, snail, mangroves, root system

MONITORING MECHANISM FOR EFFECTIVE MANAGEMENT OF WILDLIFE MEAT RESOURCES AND MARKETS IN SABAH, MALAYSIA

Rodney, R.[*1, a], Goossens, B.R*[2, 3, b]., Bakar, M. S. A. [4, c] & Liew, T.S.[1, d]
[1]Institute of Tropical Biology and Conservation, Universiti Malaysia Sabah, 88400, Kota Kinabalu, Sabah, Malaysia.
[2]Danau Girang Field Centre, 88100, Kota Kinabalu, Sabah, Malaysia.
[3]Cardiff University, CF10 3AX, United Kingdom.
[4]Sabah Wildlife Department, Kota Kinabalu 88100, Malaysia.
[a]rayrodneychai@gmail.com, [b]GoossensBR@cardiff.ac.uk, [c]rasofe2@gmail.com, [d]thorseng@ums.edu.my.

ABSTRACT

The relationship between humans and wildlife has existed for thousands of years, with hunting being the most fundamental aspect. Borneo, especially Sabah, is known to be the hotspot for legal and illegal wildlife trade and consumption. Until now, there has been no proper documentation for the baseline date to monitor these legal wildlife markets in Sabah. Since 2016, the Sabah Wildlife Department (SWD) introduced the wildlife market logbook for game meat suppliers. Data from the West Coast (WCD) and Interior Division (IRD) wildlife market logbooks from 2016 to 2019 were analyzed to examine the current status of the wildlife market in terms of wildlife meat species and the temporal patterns of supply and demand in the different areas. A total of 122.4 tonnes of game meat was extracted from the forests, primarily comprising bearded pigs (*Sus barbatus*) and sambar deer (*Rusa unicolor*). In the WCD, the largest amount of game meat was bought in May and December, while IRD was in February and April. This shows that there is always a supply when there is a demand, even outside of the festive months. Six respondents were interviewed, 3 males and 3 females, with 67% stating that the wild meat market is their main source of income and the other 33% for side income. All respondents comply with the terms and conditions in applying for the licence for commercial hunting. However, the male hunters continued using the traditional hunting methods prohibited in the Sabah Wildlife Conservation Enactment 1997 (SWCE 1997). This study showed that the logbook is an important tool in monitoring the legal wild meat market, but its effectiveness depends on data management conducted by the SWD. In conclusion, this highlights the intricate dynamics of human-wildlife interaction and the challenges inherent in monitoring the trade in wildlife in Sabah.

Keywords: Wildlife, Market, Wild Meat, Logbook, West Coast, Interior Division

WHAT DRIVES FOOD SECURITY FOR WILDLIFE IN LOGGED AND INTACT FORESTS OF TROPICAL BORNEO?

Siew Te Wong *[1a] & Casey Keat-Chuan Ng [2b]
[1] Bornean Sun Bear Conservation Centre, PPM 219, Elopura, 90000 Sandakan, Sabah, Malaysia.
* Corresponding author
[2] School of Biological Sciences, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia.
[a]wongsiew@hotmail.com, [b]E-mail: caseywaej@gmail.com

ABSTRACT

Timber extraction is often cited as detrimental to wildlife ecology. Little information, however, in particular from the Southeast Asian tropics, is available on how exactly logging affects wildlife food security. To address the gap, this paper presents the first high-resolution comparison of fruit production between logged and intact forests in lowland Borneo. In the period of 2004–2008, dry weight of fruit litter was assessed as a proxy for food security of wildlife. The pheno-phases of 1,054 trees in 14 sampling plots were monitored for 54 months. A total of 143,184 fruits from 50 tree families were collected from six sampling transects totalling 810 km in 34 months. Surprisingly, logged forest (mean = 23.3 kg ha-1, SD = 48.9) produced more fruit litter than intact forest (mean = 16.7 kg ha-1, SD = 23.3), although the difference is not significant based on Student's t-test; $t(66) = 0.702$, $p = 0.485$. Pheno-phases could not be entirely explained by rainfall and temperature variables. Some evidence, however, indicates tree species composition, stand structure and sunlight exposure were likely determinants of flowering and fruit litter intensity. All things being equal, results imply selective logging if considerately practiced may increase food security for wildlife. The findings, however, should be interpreted with caution since tropical forest phenology and fruit productivity are also driven by a suite of small-scale edaphic attributes and large-scale spatio-temporal meteorological forcing. Recent global climatic change and severe weather patter events may disturb the normal fruit production patterns in the tropic rainforest of Borneo. Although this research deals mainly with Borneo, the principles discussed, and insights offered herein are valuable for furthering conversation around sustainable forestry in tropical Asia and elsewhere globally.

Keywords: frugivore, fruit, insolation, meteorology, phenology

FAIR DATA STEWARDSHIP GUIDELINES FOR BIODIVERSITY RESEARCH

Nurzatil Sharleeza Mat Jalaluddin
Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur
nurzatil@um.edu.my

ABSTRACT

Biodiversity data and datasets are generated in different hierarchical biodiversity levels, from ecosystem, species to genetic diversity. The maximum use of these data enables better understanding and management of biodiversity. However, these biodiversity data are poorly managed, archived, integrated, shared and preserved. Without publicly available biodiversity data, huge numbers of studies that rely on the field identification of specimens are fundamentally not reproducible. Therefore, to ensure the discovery, integration, sharing and preservation of these research datasets, and to secure reproducibility of research, data stewardship support must be provided in each stages of research data lifecycle, from (1) data acquisition, (2) data processing, (3) data analysis, (4) data curation, (5) data sharing to (6) data re-use.

The project objective is to provide support towards strengthening data stewardship for the biodiversity data journey by building the data stewardship capacity and developing guidelines and training materials or manuals for future use. Therefore, data was collected from combinations of document reviews, observations at selected webinars and conferences, stakeholder engagements, expert opinions and capacity building programs. Findings from this project reported four important gaps in current practices at collection centres in Malaysia: (1) Biodiversity data management processes and workflows are not standardized, (2) Errors in data entry, (3) Lack of active taxonomists and expertise in digital and physical curation, and (4) Lack of proper guidance on roles and responsibilities for all stakeholders in the data sharing ecosystem. Engagement with key stakeholders and experts have contributed to the development of Guidelines on FAIR Biodiversity Data Stewardship and Manuals on biodiversity data management, digitisation and data cleaning. These documents were validated with relevant stakeholders and data curators who participated in capacity building programs. Outputs from this project are important to lay the foundation for Open Science journey for biodiversity in the country.

Keywords: Open Science, Data Stewardship, Biodiversity, Data Management, Digitisation, Data Cleaning

MICROBIAL NITROGEN CYCLE IN TROPICAL PEATLAND FORESTS

Mikk Espenberg*[1,a], Kaido Soosaar[1,b], Jaan Pärn[1,c], Lulie Melling[2,d], Lizardo Fachin[3,e] and Ülo Mander[1,f]
[1]Institute of Ecology and Earth Sciences (ÖMI), University of Tartu, Estonia
[2]Sarawak Tropical Peat Research Institute (TROPI), Kuching, Malaysia
[3]Research Institute of the Peruvian Amazon (IIAP), Iquitos, Peru
[a]mikk.espenberg@ut.ee, [b]kaido.soosaar@ut.ee, [c]jaan.parn@ut.ee, [d]luliemelling@gmail.com,
[e]lfachin@iiap.gob.pe, [f]ulo.mander@ut.ee

ABSTRACT

Peatlands forests play an essential role in the regulation of carbon and nitrogen cycles. Tropical peatland forests cover substantial areas in the Amazonian lowlands, the Congo Basin, and Southeast Asia. Despite their importance in climate change and potential climate control strategies, the microbial nitrogen cycle and resulting N_2O flows in tropical peatland forests remain largely unstudied. The aim of this study was to assess the microbiological processes in the nitrogen cycle in the tropical peatland forests, depending on land use, physicochemical parameters, and soil N_2O and N_2 emissions.

The soil microbiome was studied in seven tropical peatland forests across Asia, Africa, and the Americas: Quistococha natural and Zugarococha secondary palm swamp forests (Peruvian Amazon), Maludam natural peat swamp forest and Betong oil palm plantation on former natural peat swamp forest (Sarawak, northern Borneo, Malaysia), Epena peat swamp forest (Republic of the Congo), and two peatland cloud forest patches (La Réunion island in the Indian Ocean). The nitrogen cycle in the forests was studied by quantifying nitrogen cycle marker genes, measuring physicochemical parameters, and assessing N_2O and N_2 emissions. The results show that the abundance of microorganisms involved in the soil nitrogen cycle was most affected by soil moisture, with natural sampling sites exhibiting higher soil moisture content displaying abundances far greater than sampling sites with current or previous anthropogenic disturbances. During the dry season, N_2O fluxes were positively affected by microorganisms with archaeal *amoA* and *nrfA* genes. During the wet season, N_2O fluxes were negatively affected by microorganisms with *nirS*, *nosZII*, and COMAMMOX *amoA* genes but positively affected by the proportion of *nir*/*nosZ*. These soils displayed a high abundance of microorganisms capable of DNRA. The study's findings indicate that hydrological interventions cause significant changes in the microbial N cycle and N_2O emissions of tropical peatlands.

Keywords: nitrification; denitrification; DNRA; N_2O; N_2

IMPACT OF LAND USE CHANGE ON SOIL GREENHOUSE GAS FLUXES IN PERUVIAN AMAZON

Kaido Soosaar[1,a], Sebestian Kalang William[1,2,b], Waldemar Alegría-Muñoz[3,c], Roy Rubio-Vasquez[3,d], Alan Mosquera-Siguas[3,e], Jaan Pärn[1,f], Lulie Melling[2,g], Lizardo Fachin-Malaverri[4,h], Jhon Ever Rengifo-Marin[4,i], Mikk Espenberg[1,j], Rodil Tello-Espinoza[3,k], Richer Rios-Zumaeta[3,l], Ülo Mander[1,m]

[1]Institute of Ecology and Earth Sciences, University of Tartu, Estonia

[2]Sarawak Tropical Peat Research Institute (TROPI), Malaysia

[3]School of Forestry, National University of the Peruvian Amazon (UNAP), Iquitos, Peru

[4]Instituto de Investigaciones de la Amazonía Peruana (IIAP), Iquitos, Peru

[a]kaido.soosaar@ut.ee, [b]sebestian.kalang.william@ut.ee, [c]waldemar.alegria@unapiquitos.edu.pe, [d]rrubio106@gmail.com, [e]alanmos1020@gmail.com, [f]jaan.parn@ut.ee, [g]luliemelling@gmail.com, [h]lfachin@iiap.gob.pe, [i]jrengifo@iiap.gob.pe, [j]mikk.esbenberg@ut.ee, [k]rodil.tello@unapiquitos.edu.pe, [l]richer.rios@unapiquitos.edu.pe, [m]ulo.mander@ut.ee

ABSTRACT

Tropical peatland forests, known for their rich biodiversity and significant carbon and nitrogen storage, are increasingly threatened by agricultural expansion. This expansion often leads to deforestation and conversion of these vital ecosystems to cropland and pasture. The rapid conversion of forests to agricultural land, particularly in regions such as South America, contributes to climate change by releasing stored carbon into the atmosphere. We examined the effect of land use change on annual soil CO_2, CH_4 and N_2O emissions in three study sites near Iquitos, Peru, in the Peruvian Amazon from April 2023 to March 2024: a young secondary peatland forest in Zungarococha, a forest on mineral soil in Puerto Almendra, and a drained peatland used as a manioc field in Puerto Almendra. Soil greenhouse gas (GHG) fluxes were measured twice a month with manual opaque chambers. Furthermore, correlations between the soil gas fluxes and environmental characteristics, like soil temperature and moisture (SWC), groundwater level (GWL) and soil chemical parameters, were analyzed. Preliminary results show that the lowest GWL was in the forest at mineral soil and manioc field, resulting in the highest average annual soil CO_2 and N_2O fluxes. Soil CO_2 and N_2O fluxes were significantly lower in the secondary peatland forest, while soil CH_4 fluxes were relatively high in this ecosystem, especially during the wetter season. Both the forest on mineral soil and the manioc field were CH_4 consumers. Soil N_2O emissions were highest from the manioc field during the drier period and at the beginning of the wetter period. There was no significant correlation between soil temperature and soil GHG fluxes, while significant correlations were found between soil GHG fluxes and GWL and SWC. These results enhance estimates of the global GHG budget and provide information for modeling the regional carbon and nitrogen fluxes. It is strongly advised that ecosystem studies be conducted continuously throughout the Amazon region.

Keywords: carbon dioxide, groundwater level, methane, nitrous oxide, peatland

APPENDICES

(FULL REPORTS ON SESSIONS)

POLICY DIALOGUE

FACING A POST-NORMAL ERA IN THE TROPICS

Date: 16 October 2024 (Wednesday)
Time: 09.25 – 10.45 (GMT +8

Moderator

Academician Datuk Dr Tengku Mohd Azzman Shariffadeen FASc

President, Academy of Sciences Malaysia
& STI Advisor to the Prime Minister and the Nation

Panelists

Professor Ziauddin Sardar

Director, Centre for Postnormal Policy and Futures Studies

Professor Mahendhiran Sanggaran Nair FASc

Pro-Vice Chancellor (Research and Sustainability), Sunway University

Dr Aakash Mohpal

Senior Economist, World Bank's East Asia

Report prepared by

Mrs Shaadah Shariman & Gs Azizul Ahmad

Universiti Malaysia Sarawak

Overview

The Policy Dialogue on "Facing a Post-Normal Era in the Tropics" explored the complexities and paradigm shifts impacting the tropics in the contemporary era, with a focus on scientific revolutions, sustainable development, and human capital. The event featured three panels, each addressing a unique aspect of systemic transformation.

Panel 1: Scientific Revolutions and the Transition to a Post-Normal Era
Presenter: Professor Ziauddin Sardar

The session began with an analysis of Thomas Kuhn's theory of paradigm shifts, where scientific revolutions occur when existing frameworks fail to address new anomalies. Professor Ziauddin used the COVID-19 pandemic as a critical case study to illustrate how systemic vulnerabilities became evident, challenging the viability of pre-pandemic norms. He emphasised that humanity must navigate the current "liminal space" between old and emerging paradigms, advocating for a "new normal" rooted in sustainability, resilience, and ethical governance. Key points included the necessity of interdisciplinary collaboration, technological responsibility, and a redefined notion of progress emphasising equity and long-term sustainability.

Key Takeaways: (i) Paradigm shifts arise when dominant frameworks are insufficient for addressing new challenges, **(ii)** The COVID-19 pandemic underscored the unsustainability of pre-existing norms, and **(iii)** The transition to a "new normal" should integrate technological innovation with societal and environmental priorities.

Panel 2: Development with a Soul
Presenter: Professor Dr Mahendhiran Sanggaran Nair FASc

This panel focused on the need for integrating spiritual and ethical values into development paradigms. Dr Mahendhiran critiqued the prevailing profit-maximisation model, describing it as "development without a soul." He argued for a holistic approach that aligns economic progress with ecological balance and social justice. Drawing on historical perspectives and the SDGs, he proposed a "development with a soul" framework that emphasises moral principles and spiritual reflection. He highlighted the importance of local participation in policymaking and the need for culturally relevant solutions.

Key Takeaways: (i) Current economic models prioritise profit, often at the expense of ecological and social well-being, **(ii)** Incorporating spiritual and ethical values fosters a more harmonious approach to development, and **(iii)** The SDGs provide a blueprint for ethical development, but systemic reforms are necessary for meaningful implementation.

Panel 3: Human Development in the Tropics
Presenter: Dr Aakash Mohpal

Dr Aakash's presentation centred on the evolution of human capital development in tropical regions, particularly in the context of the "post-normal era." He highlighted significant progress in education and health, noting the expansion of educational access over the past 20 to 30 years. Despite this progress, the tropics still face persistent health challenges, including high rates of stunting and the rising prevalence of NCDs. Dr Aakash emphasised the importance of demographic shifts and urbanisation in shaping development strategies and discussed the need for climate-resilient approaches to address the impact of extreme weather events on health and education systems.

Key Takeaways: (i) Significant advancements have been made in education and health, but new challenges, including NCDs and stunting, persist, **(ii)** Demographic changes and rapid urbanisation require tailored approaches to service delivery, and **(iii)** Climate change poses a significant threat to health and productivity, necessitating integrated and resilient development strategies.

Presentations

Presentation Title: Scientific Revolutions and the Transition to a Post-Normal Era
by Professor Ziauddin Sardar

Professor Ziauddin began with an in-depth exploration of Thomas Kuhn's seminal work, "The Structure of Scientific Revolutions", to contextualise the dynamics of paradigm shifts. He explained how scientific progress often operates within a dominant framework, termed "normal science," until anomalies arise that cannot be addressed within the existing model. These anomalies catalyse revolutionary changes, leading to the emergence of new paradigms.

Using the COVID-19 pandemic as a case study, the panel highlighted how this global health crisis exposed vulnerabilities in economic, healthcare, and governance systems, illustrating the limitations of pre-pandemic norms. They argued that the pandemic not only disrupted the status quo, it also emphasised the unsustainability of returning to the pre-pandemic "normal." Instead, the panel called for a "new normal" that aligns technological advancements with ethical, societal, and environmental priorities.

The panel articulated three dimensions of change in the post-normal era: incremental adjustments, abrupt disruptions, and long-term systemic transformations. They emphasised that humanity is currently navigating a liminal space between "no longer" and "not yet", which presents both challenges and opportunities for reimagining global priorities. Panel 1 concluded by advocating for a redefinition of progress that integrates resilience, equity, and sustainability as core principles.

Key points:

- Paradigm shifts arise when existing frameworks fail to address emerging anomalies.
- The COVID-19 pandemic exemplified an anomaly that exposed systemic vulnerabilities.
- The pre-pandemic "normal" is unsustainable and must be replaced with a reimagined framework.
- The "new normal" should prioritise sustainability, ethical governance, and technological responsibility.

Presentation Title: Development with a Soul
by Professor Dr Mahendhiran Sanggaran Nair FASc

Building on the theme of systemic transformation, panel 2 delved into the integration of spiritual and ethical values into development frameworks. They critiqued the prevailing economic paradigm, which prioritises profit maximisation at the expense of social justice and ecological balance. Describing this model as "development without a soul," the panel called for a shift towards a more holistic approach that harmonises human progress with environmental stewardship and intergenerational equity.

The panel traced the historical roots of sustainable values, noting how ancient traditions viewed humanity as stewards of nature. They argued that modern industrial and capitalist systems have eroded this custodial relationship, resulting in environmental degradation and widening inequalities. To counter this, panel 2 proposed a "development with a soul" framework, emphasising the importance of integrating moral principles into policymaking.

The panel highlighted the SDGs as a promising blueprint for ethical development. However, they cautioned that achieving these goals requires systemic alignment, with policies reflecting not only economic growth but also measures of social well-being, environmental preservation, and collective harmony. They concluded by urging stakeholders to embrace spiritual reflection as a foundation for sustainable progress.

Key points:

- The current economic model prioritises profit over ecological and social balance, resulting in unsustainable practices.
- Integrating spiritual and moral values fosters a harmonious approach to development that aligns humanity and nature.
- The SDGs provide a foundation for ethical development but require systemic reforms to achieve meaningful outcomes.
- A "development with a soul" framework offers a sustainable and inclusive vision for the future.

Presentation Title: Human Development in the Tropics by Dr Aakash Mohpal

In the past two decades, the concept of human capital and development has undergone significant changes, especially in tropical regions. Dr Aakash's presentation highlighted the tremendous progress made in education and health, as well as the complex challenges that have emerged in this post-normal era. He stressed the need for a new approach to addressing human capital development that integrates sustainability and takes into account the unique characteristics of the tropical regions.

Progress in Education and Health.
Over the last 20 to 30 years, there has been a remarkable expansion in the field of education, particularly in tropical regions. Previously, access to education was limited, and opportunities were scarce. However, there has been significant progress in building a more inclusive and extensive educational system. This expansion is a significant achievement, as it opened doors to unimaginable opportunities just a few decades ago. Despite these advancements, the current era, often referred to as the "post-normal era," is marked by complexity, chaos, and uncertainty. This era brings new challenges to human capital development, necessitating a re-evaluation of our strategies. It is no longer sufficient to focus solely on expanding educational access; we must also consider the sustainability of our actions and their impact on planetary health.

Challenges in Health: Communicable and Non-Communicable Diseases.

Dr Aakash, with a background in health and education, shed light on the persistent health challenges faced by tropical regions. Although these regions have made progress in controlling communicable diseases, maternal health, and child health, there remain significant pockets of populations struggling with these issues. For instance, countries like Guatemala, Indonesia, and Ecuador still report high rates of stunting, which hampers future human development. In addition to the existing health burdens, there is an increasing prevalence of NCDs, exacerbated by changing lifestyles and rapid urbanisation. Sedentary behaviours, driven by technology and reduced interaction with nature, are contributing to these health issues. The rise of NCDs, such as diabetes and cardiovascular diseases, calls for efficient programmes and strategies to address both communicable and non-communicable diseases simultaneously. It is crucial to integrate health solutions that adapt to the evolving lifestyle patterns of people in these regions.

Demographic Changes and Urbanisation.

Demographic shifts and urbanisation are two major factors shaping the development landscape in the tropics. Although tropical regions benefitted from having a predominantly young population, this demographic advantage is temporary. Rapid aging is becoming a concern, requiring proactive planning to address the needs of an older population in the future. Preparing for this demographic transition is essential to sustaining growth and development. Similarly, urbanisation presents both opportunities and challenges. While it can drive economic growth and poverty reduction, it also creates distinct challenges for service delivery. The needs of the urban poor often differ significantly from those of the rural poor. Providing effective health and education services in urban areas is a complex task that requires innovative solutions. It is essential to distinguish between the needs of urban and rural populations and tailor strategies accordingly to achieve meaningful progress.

Climate Change: A New Threat to Health and Education.

Climate change is emerging as a critical factor impacting health and education in tropical regions. Recent research highlighted the severe consequences of extreme weather events, such as heatwaves and natural disasters, on health and productivity. These events increase the strain on healthcare systems and reduce overall economic productivity. Addressing the impacts of climate change requires integrating climate resilience into human capital development strategies. Dr Aakash emphasised the importance of a paradigm shift in our approach to development. Traditional one-size-fits-all solutions are no longer effective. Instead, there is a growing need for tailored, localised strategies that are grounded in data, innovation, and community input. By involving local communities in the decision-making process, development programmes can better address the specific needs of different regions.

The Role of International Organisations.

The World Bank, under its new leadership—the first president hailing from a tropical region— has recognised the importance of a sustainable development approach. The organisation has revised its mission statement to include a commitment to planetary sustainability. This change reflects a broader shift towards integrating environmental sustainability into the core objectives of development efforts. The World Bank's focus

on ending poverty and boosting prosperity now explicitly includes addressing climate change, aligning financial resources with actions that support sustainable development.

Key points:

1. First: Progress in Education and Health

- Significant expansion in education systems in tropical regions over the last 20-30 years.
- Increased access to education has led to improved human capital, but new challenges have emerged in the post-normal era.
- Persistent health challenges remain, including high rates of stunting and maternal and child health issues in countries like Guatemala, Indonesia, and Ecuador.
- The rise of non-communicable diseases due to lifestyle changes and urbanisation requires new, efficient strategies.

2. Second: Demographic Changes and Urbanisation

- Tropical regions benefitted from a predominantly young population, but rapid aging is becoming a concern that requires proactive planning.
- Urbanisation creates different challenges for the urban poor compared to the rural poor, particularly in providing effective health and education services.
- There is a need to develop tailored solutions that address the specific needs of both urban and rural populations, as their challenges differ significantly.

3. Third: Climate Change and Sustainable Development

- Climate change is a significant emerging threat to health and education in tropical regions.
- Extreme weather events and rising temperatures impact health systems and reduce productivity, necessitating climate-resilient strategies.
- The World Bank has adapted its mission to include sustainability, reflecting a shift towards integrating climate action with development goals.
- Emphasising localised, data-driven solutions that incorporate community input is essential for addressing the complex challenges of the post-normal era.

Discussion

Question
What are the key steps needed to transition from the flawed "normal" to the envisioned "new normal"?

Answer
Professor Ziauddin emphasised the need for interdisciplinary collaboration, systemic reform, and a redefinition of priorities. He highlighted the importance of aligning technological innovation with societal and environmental goals to foster resilience and equity.

Question
How can technological advancements be leveraged responsibly to address societal challenges?

Answer
The panel argued that technology must be harnessed within ethical and regulatory frameworks that ensure its benefits are equitably distributed and its risks are mitigated. Policymakers should adopt a forward-looking approach to guide innovation responsibly.

Question
When you approach the Ministry of Finance, the first question they will likely ask is: "How much will it cost?". In our current situation, we cannot simply leap from the present state to a certain future; we are in a transitional period known as the "post-normal" era. The challenge now is how we nurture the future generation and how we navigate the role of universities to effectively prepare students for the future, avoiding the same kind of outdated arguments and approaches. We need a common goal: to establish a clear direction and align our educational efforts towards what we need to achieve.

Answer
In any corporate setting or at the Ministry of Finance, the initial focus will often be on costs and potential profitability. This emphasis on monetisation is part of the problem we face today. At the same time, we continue to teach students using outdated methods, failing to prepare them for the transformative changes they will encounter in the next five to 10 years. Universities still focus on traditional subjects like history, mathematics, science, and economics, but very few offer courses on understanding the future. It is crucial to remember that students will spend most of their lives in the future, not the past. While historical knowledge is important, we must also prepare them for the evolving economic activities and the world they will inherit. We need to start preparing students for the future now, even if it requires us to go beyond conventional monetisation models during this transition period. By developing a new paradigm, we can respond effectively to the changing needs. It is important to note

that 70% of the world's youth population lives in the tropics. The future belongs to these young people, not to the aging societies like those in the United Kingdom or the United States, which are facing their own internal challenges. The tropics, with its youthful demographic, offer immense opportunities and challenges. Our task is to redesign the education system to equip students for the kind of future they will face. If we succeed, we will fulfil our responsibility and create a new paradigm that emerges from this effort. With proper focus and transformation, we can change the world within a single generation, which typically spans 20 years. By building a new generation, we have the potential to create a new society in this region. However, to achieve this, we must sit down and work together to find practical solutions. The issue is not that our existing knowledge is insufficient, rather, it is that our growing knowledge often leads to deeper ignorance. Paradoxically, over the past decade, the field of "ignorance studies" has emerged, highlighting the limits of what we know. Therefore, our task is complex: we must discover what we need to teach while also preparing students to handle the unknown. The old curriculum is no longer suitable. If we manage this transition successfully, we will witness a true paradigm shift.

Question
How can spiritual and ethical values be measured and incorporated into policy frameworks?

Answer
Panel 2 suggested developing metrics such as natural capital accounting and ecological impact assessments. These tools can quantify the social and environmental dimensions of development, ensuring alignment with sustainability goals.

Question
What role do communities play in implementing value-based development models?

Answer
The panel emphasised the importance of local participation in policymaking. They argued that solutions must be context-specific, culturally relevant, and designed with input from grassroots communities to ensure inclusivity and effectiveness.

Question
The debate between profit maximisation and purpose maximisation often reflects one's beliefs, including the concept of accountability in the afterlife (as suggested by the principles of Maqasid al-Shariah). You mentioned the importance of the protection of life. My question is: Should we monetise happiness? If so, what would be the best method to measure it?

Answer
Happiness and harmony are interconnected. When individuals are happy, there are noticeable economic benefits. For instance:

- Improved Health: Happiness contributes to better health, which can be quantified by reduced medical expenses.
- Increased Productivity: When people are happy and healthy, they tend to be more

productive, leading to significant contributions to society.

If we carefully assess this, it is possible to quantify these aspects at the micro level, creating values for both individuals and the society. For instance, lower medical costs reduce government expenditures. However, if happiness is neglected, issues such as mental stress can emerge, leading to long-term societal costs. These effects may not be immediate but can accumulate over time, requiring someone to bear the consequences.

Professor Ziauddin emphasised that the concept of monetising happiness may be flawed, as we have become obsessed with monetising everything, including desires, preferences, and even ambitions. We need to reconsider this approach. While some quantification is necessary, especially to convince stakeholders during transitional phases, it is not always essential to turn everything into a monetary value.

Dr Aakash provided another perspective: In today's world, improving the quality and quantity of life is crucial. When approaching the Ministry of Finance, for example, they often require a clear demonstration of how an initiative will contribute to GDP and productivity before allocating funds. They tend to prioritise projects like road construction, which generate direct revenue through tolls or user fees. Therefore, a balanced approach is required, and some level of quantification is necessary to gain support from stakeholders.

Conclusion and Recommendations

In conclusion, the complexity of human development challenges in the tropics necessitates a more localised and sustainable approach. The post-normal era brings new and unforeseen challenges that require innovative solutions tailored to the unique needs of tropical regions. By embracing sustainability and integrating climate resilience into development strategies, organisations like the World Bank are adapting to the evolving paradigm. The future of human capital development in the tropics depends on our ability to harmonise local solutions with global sustainability goals, paving the way for a healthier and more prosperous future.

Cross-Panel Recommendations

- Integrate Values-Based Metrics: Develop decision-making frameworks that incorporate spiritual, social, and environmental indicators alongside traditional economic measures.
- Redefine Development Goals: Shift away from profit-driven models towards frameworks prioritising sustainability, equity, and ethical governance.
- Educational Reform: Prepare future generations with skills in critical thinking, ethical reasoning, and adaptability to thrive in a post-normal era.
- Foster Interdisciplinary Collaboration: Encourage partnerships among scientists, policymakers, and local communities to co-create innovative solutions to complex systemic issues.
- Ensure Systemic Implementation of SDGs: Develop clear mechanisms for monitoring progress and accountability in achieving the SDGs, focusing on localised, actionable solutions.

The dialogue underscored the need for a paradigm shift in addressing the challenges of the post-normal era in the tropics. Each panellists highlighted the importance of reimagining progress through a lens that integrates sustainability, ethical governance, and local engagement. By aligning human capital development, spiritual values, and climate resilience, stakeholders can build a more inclusive, equitable, and sustainable future for the tropical regions. The event concluded with a call to action for stakeholders to work together towards systemic change, embracing the complexities of the era while remaining grounded in a shared vision for progress.

SUSTAINABLE DEVELOPMENT IN THE TROPICS

Date: 16 October 2024 (Wednesday)
Time: 11.00 – 12.30 (GMT+8)

Moderator

Dr Chen Jit Ern

Director, Jeffrey Sachs Center on Sustainable Development, Sunway University

Panelists

Dato Sri Haji Abdul Karim Rahman Hamzah

Minister, Tourism, Creative Industry, and Performing Arts
Minister, Youth, Sports and Entrepreneur Development

Academician Professor Emerita Datuk Dr Asma Ismail FASc

Vice-Chancellor and Chief Executive Officer, International Medical University Malaysia
Immediate Past President, Academy of Sciences Malaysia

Professor Erik Meijaard

Managing Director, Borneo Futures, Brunei Darussalam
Chairperson, IUCN Oil Palm Task Force
Honorary Professor, University of Kent

Report prepared by

Grace Usun Joel & Johanna Jane anak Donald

Universiti Malaysia Sarawak

Overview

The tropics present both significant opportunities and challenges in the pursuit of sustainable development, especially as projections indicate that over 67% of the global population under 15 will reside in these regions by 2050. This demographic shift underscores the vital role of youth in driving economic growth and climate action. Engaging young people in technology and advocacy is crucial for environmental monitoring, disaster management, and achieving Sustainable Development Goals (SDGs). To effectively address local challenges, inclusive policies and investments in youth-led initiatives are essential. In Malaysia, rich biodiversity faces severe threats from habitat loss and zoonotic diseases. The National Planetary Health Action Plan (NPHAP) adopts a comprehensive framework with 52 strategies and 279 action plans aimed at balancing environmental health, human well-being, and economic prosperity. This balance requires systemic governance shifts, sustainable financing, and behaviour change. Additionally, a nuanced understanding of vegetable oil production is necessary; while smallholder systems support food security, rising global demand raises sustainability concerns. A collaborative and evidence-based approach is essential to counter biases and promote sustainable practices that balance production with land use while minimising environmental impacts. This collective effort calls for inclusive policies, systemic frameworks, and global collaboration to advance sustainability in tropical regions. The speaker emphasises the importance of youth engagement in sustainable development, advocating for targeted policies to enhance participation across Southeast Asia. They highlight the potential for economic growth through technology and innovation while addressing the complexities of vegetable oil production, particularly palm oil. By fostering inclusive decision-making and promoting sustainable practices, we can work towards a healthier planet.

Presentations

Importance of Youth in Sustainable Development in the Tropics

Dato Sri Haji Abdul Karim emphasised the vital role of youth in sustainable development during his speech on the Malaysia Youth Index 2023. He highlighted the significant demographic shift expected by 2050, with over 67% of the global population under 15 residing in tropical regions, creating opportunities for economic growth and innovation. He stressed the importance of nurturing youth leadership and technological expertise to address social issues and engage in climate action. The speaker advocated for targeted policies to enhance youth participation and collaborative solutions that amplify youth voices in decision-making processes.

Key points:

- Youth's critical role in shaping the future and the community's responsibility to nurture leaders.
- Reference to ASEAN and Global Youth Development Indices for targeted policy enhancement.
- Demographic trends indicating a younger population in tropical regions by 2050.
- Youth as key players in climate action and sustainability initiatives.
- Efforts to engage ASEAN youth leaders in promoting environmental stewardship.
- Importance of youth participation in advocacy and decision-making processes.
- Youth's role in technological advancements supporting sustainable practices.
- Community engagement fostering social cohesion and contributing to SDGs.
- Recognition of interconnected challenges like climate change and economic inequality.
- Advocacy for policies and strategies to empower youth as change agents.
- Emphasis on inclusivity in policymaking to amplify youth voices.

National Planetary Health Action Plan (NPHAP): Malaysia's Call to Action for a Promising Future for Our Future

Datuk Dr Asma highlighted Malaysia's rich biodiversity and its pressing challenges, such as habitat loss and zoonotic diseases due to deforestation. She advocated for the adoption of the Planetary Health framework to address the interconnectedness of human, animal, and environmental health. The NPHAP, initiated by the National Science Council in 2021, aims to balance environmental health, human well-being, and economic prosperity through 52 strategies and 279 action plans. Datuk Dr Asma emphasised the need for systemic governance shifts, sustainable businesses, and a cohesive approach to sustainability across all sectors to prevent irreversible damage to Malaysia's ecosystems.

Key points:

- Malaysia's biodiversity is under threat from habitat loss and zoonotic diseases caused by deforestation.
- The Planetary Health framework promotes a holistic approach to human, animal, and environmental health.
- The NPHAP includes 52 strategies and 279 action plans for balanced progress.
- Systemic shifts in governance and sustainable financing are essential for achieving sustainability goals.
- Rebranding the National SDG Council as the National Sustainability Council enhances strategic direction and progress monitoring.
- A whole-of-nation approach is necessary to ensure no community is left behind in sustainability efforts.
- Urgent action is required to address biodiversity loss and promote environmental stewardship.
- The importance of integrating environmental health with economic prosperity for sustainable development.
- Collaborative efforts across government and society are crucial for the effective implementation of NPHAP.
- Emphasising shared values and community engagement as vital components of successful sustainability initiatives.

The Future of Oil Crops and the Many Things We Do Not Know but Should

Professor Erik, chairperson of the IUCN Oil Crops Task Force, addressed the complexities of vegetable oils, particularly palm oil, concerning biodiversity during his recent presentation. He emphasised that understanding palm oil's impact requires a broader examination of all vegetable oils within their societal, environmental, and nutritional contexts. The growing global demand for vegetable oils, which occupy 37% of agricultural land, necessitates sustainable production practices. Professor Erik criticised the oversimplified view of palm oil as solely harmful, urging a nuanced perspective that considers the social and environmental issues associated with other oils. He called for addressing knowledge gaps and promoting informed policymaking to ensure that vegetable oils contribute positively to society while minimising environmental harm. Minimising environmental impacts.

Key points:

- The complexity of vegetable oils necessitates a comprehensive understanding of their impacts on biodiversity.
- The perception of palm oil is often unfairly negative compared to other oils like peanuts and sesame.
- Increasing global population drives rising demand for vegetable oils.
- There is a critical need for more research into the socio-environmental impacts of various oil crops.
- Supporting smallholder and local vegetable oil production systems enhances food security and socio-economic outcomes.
- The oil palm industry faces a complex global narrative that requires balanced discussions.
- Collaboration in research and international forums is essential for promoting sustainable agricultural practices.
- Evidence-based policymaking is crucial to bridging knowledge gaps and guiding sustainable oil production decisions.
- A systematic approach is needed to address sustainability challenges in the face of rising demand for vegetable oils.
- Informed discussions should replace emotional rhetoric to promote global sustainable development goals effectively.

Discussion

Question
We have been talking about awareness when it comes to everything (biodiversity, conservation, etc.) even in the next 30 years. The missing link to this is the responsibility, the need to create responsible individuals. In order to inculcate responsibility, we need to educate individuals from a young age. Would that be the way forward for Malaysia?

Answer
Datuk Dr Asma: Awareness alone is insufficient without proper education and actionable steps. While many individuals acknowledge the importance of planetary health and express concern, they often fail to act due to a lack of understanding or resources. To bridge this gap, education should be integrated into the school and university curriculum across all disciplines, from law to business. This approach ensures that future leaders and professionals comprehend the broader implications of planetary health. Additionally, communication strategies need to evolve to resonate with diverse audiences. Effective communication, tailored to different languages and cultural contexts, is key to empowering individuals and fostering meaningful change. Communication is vital in translating awareness into action. It must adapt to various audiences, utilising simple language and culturally relevant methods to convey complex scientific ideas. During the COVID-19 pandemic, for example, clear and accessible information was critical to counter misinformation. Similarly, efforts like fact sheets and media guidelines helped bridge gaps in understanding. Beyond education, communication must inspire action in current generations by addressing the "how" — providing practical steps and clear instructions to make sustainable choices more accessible.

Question
The pillars of SDGs may be a threat among them. But why is it mostly in the tropics, there are good and bad? They are not prosperous, have a high gene ratio, and suffer from bad quality of the environment. What do you think of the statement, “Palm oil is the black gold for Malaysia and Indonesia”? Are certifications like RSPO, MSPO and ISPO enough?

Answer
Professor Erik: Sustainable management of vegetable oils, including palm oil, requires addressing both production practices and consumer perceptions. While consumers often label certain oils as “good” or “bad,” the reality is more nuanced. The focus should be on improving management practices to ensure environmental and economic sustainability. Palm oil, for instance, yields significantly more oil per hectare than other crops, reducing the need for land expansion. Efforts such as agroforestry in Sabah and Sumatra and sustainable practices in Brazil demonstrate the potential for better management. Certification schemes like Malaysia's and Indonesia's sustainable palm oil standards are steps forward but require more scientific backing and broader adoption to create meaningful impact. Consumer perceptions often simplify complex

issues into binary opinions, such as favouring coconut oil over palm oil, without understanding the broader implications. These perceptions can hinder informed decision-making and policy development. Awareness campaigns must encourage consumers to evaluate products based on evidence, such as environmental impact and production efficiency, rather than superficial judgments. By addressing biases and providing transparent information, the industry can foster more balanced and sustainable consumer behaviour.

Question
What does the Sarawak government consider to be the most important problem? Why are these initiatives considered important to complete?

Answer
Dato Sri Haji Abdul Karim: One of the biggest challenges in Sarawak is creating an environment where young people, especially those in rural areas, can engage with government plans. Development should not be limited to urban areas, which is why initiatives like the Youth Tour programme have been introduced to reach young people in remote locations. The lack of infrastructure, such as roads, and the high costs of providing facilities to these areas pose significant obstacles. To address this, the government is fostering environments that promote digital and technological entrepreneurship. This includes startup programmes to cultivate talent in digital enterprise and technology, particularly in areas like artificial intelligence. Additionally, agencies like the Sarawak Digital Economy Corporation (SDEC) are actively working to establish technology companies and promote digital innovation among the youth. These efforts aim to build creativity, foster innovation, and enable continuous development for young entrepreneurs across Sarawak, ensuring that opportunities are inclusive and widespread.

Question
How do tropical countries balance economic, social, and educational development to ensure well-being to achieve development goals while considering the role of youth in this process?

Answer
Datuk Dr Asma: The key to achieving this balance lies in strong leadership and political will. With the right leaders and policies, well-being initiatives can be implemented effectively across all states. Leadership must focus on long-term goals, emphasising the need for research and development (R&D) to drive impactful change. In addition to leadership, there must be a paradigm shift in how businesses operate. Businesses should prioritise sustainability and planet-friendly practices, such as adopting nature-based solutions and reducing plastic usage. For instance, promoting urban farming with vertical gardens could minimise plastic waste and foster sustainable consumption habits. Ultimately, achieving a balance between development goals and well-being requires awareness, knowledge, and behaviour changes. These shifts must be informed by strong leadership, effective education, and partnerships between government and the private sector.

Question
How can the youth of Malaysia contribute to the National Energy Transition Plan and broader state and national development goals?

Answer
Dato Sri Haji Abdul Karim: Young people play a crucial role not only in energy transition efforts but also in the broader development of the state and nation. To contribute effectively, they must be equipped with the right knowledge and skills. Education is vital in this process, as it empowers youth to understand and engage with critical industries such as energy, oil and gas, and other emerging sectors. Sarawak is committed to providing educational opportunities to its youth, including free education at its universities by 2026. Beyond university-level education, Technical and Vocational Education and Training (TVET) programmes are being emphasised to ensure young people are well-prepared for various industries. By fostering a conducive environment for education and skill development, Sarawak aims to encourage its youth to contribute meaningfully to state and national progress. This includes ensuring that young talents return to Sarawak to participate in its development, thereby strengthening the region's growth and stability.

Question
What are the challenges to achieving sustainability through regional cooperation in conservation management? In your opinion, which organisation, initiative, or institution has been the most effective in enabling PEN Borneo or PEN Southeast Asia Conservation Corporation?

Answer
Professor Erik: The primary challenges to effective regional cooperation in conservation management include leadership commitment, financial incentives, and capacity building. Conservation efforts can succeed in various contexts, whether within timber, palm oil, or pulp and paper concessions, as long as strong leadership, proper infrastructure, and adequate financial resources exist. For example, a biodiversity valuation study conducted in an oil palm concession in Indonesia revealed a value of $197 million for just one estate, which supported species such as orangutans, bears, and gibbons. This valuation highlighted the economic potential of biodiversity, demonstrating that conservation can align with financial incentives. However, the challenge lies in converting biodiversity value into cash flow to attract investment and steer management practices more sustainably. Engaging with leaders and businesses at a high level is essential to bridging the gap between academic research and practical application. Scientists play a vital role by asking critical questions and inspiring leaders to adopt innovative approaches for sustainable conservation.

Question
As a fresh graduate with expertise in microbiology, how can I make myself employable in industries focused on sustainability, given that my skill set might not directly align with industry demands?

Answers
Datuk Dr Asma: As a microbiologist, you can align your expertise with sustainability by focusing on nature-based solutions. For instance, research in Japan has demonstrated how understanding microbial interactions in soil can reduce reliance on synthetic fertilisers and pesticides, thereby promoting eco-friendly agricultural practices. When approaching industries, emphasise your ability to conduct R&D that addresses both human and environmental needs. Highlight your adaptability and focus on solutions that prioritise responsible innovation. Employers value candidates who can propose planet-friendly, science-based solutions.

Professor Erik: Additionally, you should consider starting your own initiatives or projects. Many industries claim to be sustainable but often engage in greenwashing. By critically analysing these claims, you can offer genuinely sustainable alternatives, creating an impactful niche for yourself. Funding opportunities often exist for innovative ideas in sustainability, so do not hesitate to pursue independent projects if your values align with addressing systemic issues.

Question
How is Sarawak addressing the language gap in disseminating information about the climate crisis, especially given its cultural and linguistic diversity?

Answers
Dato Sri Haji Abdul Karim: Sarawak has taken proactive steps to address the language gap by officially recognising both Bahasa Malaysia and English as their state languages. English is widely used in the state assembly debates and official bills and as a medium for trade, business, and research. The state has also established five international schools where the medium of instruction is English to cultivate future leaders and technocrats. While prioritising English for global communication, Sarawak also values Bahasa Malaysia for its cultural and national significance. Efforts are underway to improve proficiency in both languages, ensuring accessibility of information across diverse communities.

Datuk Dr Asma: Moreover, the method of delivering information is equally critical. Surveys have shown that while people often access the internet for initial knowledge, they trust scientists and experts more than online sources. To bridge this trust gap, strategies like expert-led podcasts and centralised information hubs are being developed. These platforms aim to provide credible and accessible information while tailoring messages to diverse audiences, ensuring awareness and action on critical issues like climate change.

Question
I believe a paradigm shift is essential in the post-science era, but it must be revolutionary rather than evolutionary due to the urgency of modern challenges. This urgency is exacerbated by advancements in technologies like AI. How can we execute a rapid paradigm shift, especially considering resistance from traditionalists in the scientific community?

Answer:
Professor Erik: The call for a revolutionary shift resonates strongly, but the challenge lies in translating urgency into action. Institutions, while essential for leadership, often move slowly, resulting in frustration and prolonged inaction. A prime example is the deterioration of ecosystems over decades despite conservation efforts. Achieving a rapid paradigm shift requires rethinking traditional structures and fostering innovative, cross-disciplinary approaches. While there is no definitive blueprint for this revolution, breaking free from institutional inertia and catalysing change through leadership by design rather than chance could expedite the process. Stakeholders must align their efforts and focus on actionable solutions rather than endless discussions.

Question
Are we implementing the SDGs effectively? The current approach seems compartmentalised, treating each of the 17 SDGs in isolation. Should we shift towards a more integrated, longer-term perspective beyond the 2030 deadline?

Answer
Datuk Dr Asma: The current approach to SDGs indeed faces significant challenges, primarily due to compartmentalisation. Ministries and organisations often work in silos, focusing on their specific goals without coordinated efforts. This fragmented approach hampers progress and prevents achieving the intended balance across the SDGs. To address this, we must adopt an integrated strategy that breaks down silos. Collaboration among ministries, businesses, and communities is critical. For example, establishing a national centre for nature-based solutions could serve as a hub for addressing environmental, sustainability, climate, and planetary issues collectively. Furthermore, the 2030 deadline, while necessary for driving immediate action, should not be the ultimate goal. Countries and organisations should embed SDG principles into their systems with a longer-term vision, ensuring that sustainable practices extend well beyond the target year. Revolutionary leadership and collective action are essential to create systemic change.

Conclusion and Recommendations

To build a sustainable future, policies must engage youth in environmental initiatives through education, leadership development, and technological innovation. Malaysia's National Planetary Health Action Plan should focus on cross-ministry collaborations to implement the SDGs, strengthen governance, and foster strategic partnerships. Raising awareness of environmental health and promoting sustainable practices will reduce ecological footprints. Furthermore, investing in comprehensive research on vegetable oils and ensuring the accessibility of translated reports will help fill knowledge gaps and support informed decision-making in regions affected by oil production. This integrated approach will support social cohesion and contribute to a healthier planet. Encouraging youth involvement in climate action and entrepreneurship through inclusive policies and educational programmes will drive sustainable innovation and economic growth. Incorporating sustainability and planetary health into curricula across disciplines will cultivate actionable knowledge among future leaders. Supporting cross-border conservation initiatives with strong leadership, financial incentives, and capacity-building will protect biodiversity and promote sustainable practices. By embracing frameworks like Planetary Health, we can address the interconnected challenges of human, animal, and environmental health in tropical regions while fostering multi-stakeholder collaboration to achieve long-term progress on SDGs beyond 2030.

THE WAY FORWARD FOR THE TROPICS

Date: 16 October 2024 (Wednesday)
Time: 14.00-15.30 (GMT +8)

Moderator

Ambassador Dr Shazelina Zainul Abidin

South & Central Asia Division, Ministry of Foreign Affairs, Malaysia

Panelists

H. E. Dr Ary Norton de Murat Quintella

Ambassador, The Federative Republic of Brazil

H. E. Lisualdo Menezes Coimbra Gaspar

Ambassador, The Democratic Republic of Timor-Leste

Her Excellency Dr Mariyam Shabeena Ahmad

High Commissioner, The Republic of Maldives

Report prepared by

Abraham Chor Jin Ming & Tang Hui Wen

Universiti Malaysia Sarawak

Overview

Her Excellency Dr Mariyam Shabeena Ahmad focused on eco-friendly tourism, renewable energy solutions, and international advocacy. She emphasised the importance of promoting sustainable tourism practices that protect natural resources and support local communities. Additionally, Dr Mariyam advocated for the adoption of renewable energies to reduce environmental impact and addressed the need for a global commitment to environmental sustainability.

H.E. Lisualdo Menezes Coimbra Gaspar discussed strategies for eco-friendly income generation and the importance of awareness campaigns. He highlighted the need for regional collaboration on sustainable practices that require no investment but offer significant benefits to communities. Dr Lisualdo urged stakeholders to look beyond short election cycles, calling for long-term cooperation and reliable financial support to drive lasting environmental change.

H.E. Dr Ary Norton de Murat Quintella led a session on the Forest Declaration and Forest Forever facilities initiatives aimed at protecting tropical forests. He underscored the collective efforts of tropical countries to assert their leadership in forest conservation and to communicate their expertise on the global stage. Dr Quintella emphasised the role of international collaboration, partnering with both private and multinational companies to support these forest conservation efforts.

Presentations

Governance and Environment

H.E. Dr Ary Norton de Murat Quintella, Brazil's ambassador, played a crucial role in strengthening the Brazilian government, which acted as a liaison between President Lula and DS Anwar Ibrahim. He advocated for the reform of global governance, emphasising that preserving the environment required not only financial support but also a change in how financial institutions managed and distributed resources. The Brazilian government has been actively protecting its forests through the work of ambassadors, and Dr Norton said that Brazil will chair COP30 soon. Brazil also spearheaded the adoption of the United for Our Forests declaration by eight Amazonian countries and Indonesia, with Malaysia joining the initiative. This led to improved dialogue between Malaysia and Brazil. Additionally, Dr Quintella was involved in establishing a Tropical Research Facility to gather funds and support sustainable practices. Brazil's chairmanship of the G20, with a focus on combating hunger and poverty, aligned with Malaysia's MADANI vision, further strengthening the ties between the two nations.

Regional Collaboration Efforts:

The Government of Brazil has been actively protecting its forests by appointing ambassadors dedicated to this mission. Brazil is set to chair the upcoming COP30 conference, strengthening its leadership in environmental conservation on the global stage. Recently, Brazil, along with eight Amazonian countries and Indonesia, adopted the "United for Our Forests" declaration to support developing nations in their efforts to preserve forest ecosystems. Malaysia has also joined this initiative, fostering improved dialogue and collaboration between Malaysia and Brazil. Additionally, Brazil is working to establish a Tropical Research Facility aimed at gathering funds to further conservation efforts.

The Way Forward for the Tropics

The government must supervise private firms involved in mineral extraction to ensure responsible and sustainable practices. Recognising the diversity of contexts and challenges, it is clear that a one-size-fits-all policy would not be effective in managing these resources.

Bridging the Gap in Knowledge and Practice

A recent meeting at the UN focused on building connections between academia and politicians, aiming to shape new policies within the next decade. Brazil, formerly chairing the G20, extended an invitation to Prime Minister Anwar Ibrahim to further international cooperation. Efforts are being made to work at the local level to raise environmental and economic awareness, emphasising the importance of local population participation in economic processes to strengthen and support the broader economy.

Key points:

- No one-size-fits-all policy
- Work as locally as possible to raise awareness
- Work with other tropical countries and companies to enhance environmental safety

Timor-Leste and the Environment

H.E. Lisualdo Menezes Coimbra Gaspar highlighted the facets of Timor-Leste, which experiences a dry season from June to November and a wet season from December to May, with temperatures ranging from 25 to 30 degrees Celsius. The country is known for its rich biodiversity, including a variety of flora, fauna, aquatic species, and tropical forests. Coral reefs and sea turtles are also present. Despite being one of the least developed countries, Timor-Leste has made significant strides in environmental remediation, earning recognition as a success story. It has provided substantial assistance to other countries and received support from the World Health Organization (WHO). Special ambassadors for climate change have represented the country at international conferences, and it has benefited from bilateral assistance from other nations.

However, Timor-Leste faces several challenges, including management issues, abnormal weather patterns that affect food production, and rising water levels that reduce land area. Pollution from littering, the need for agricultural sustainability, and the pressures of deforestation also pose significant problems. Economic challenges such as rising living costs and poverty exacerbate these issues, with short-term gains often prioritised over long-term stability. Additionally, traditional houses, constructed using locally sourced materials, do not always have a positive environmental impact as each house requires land for housing construction, eating into local habitats.

Regional Collaboration Efforts

Timor-Leste has demonstrated strong support for other countries while receiving valuable assistance from organisations such as the World Health Organization (WHO). The country has appointed special ambassadors to represent its interests in climate change at international conferences, showcasing its commitment to addressing global environmental challenges. Additionally, Timor-Leste benefits from bilateral assistance from other nations, fostering cooperative relationships that enhance its capacity to tackle both domestic and international issues

The Way Forward for the Tropics

Timor-Leste has implemented policies that prohibit the harvesting of local trees and require the use of imported building materials, aiming to preserve its natural resources. The country has also launched a coral reef rebuilding and protection programme to safeguard marine biodiversity. To support sustainable tourism, Timor-Leste has introduced eco-friendly features that help prevent pollution, attracting environmentally conscious visitors and promoting the country's commitment to conservation.

Bridging the Gap in Knowledge and Practice

Timor-Leste acts as an advocate for neighbouring countries to bring out bilateral ties.

Key points:

- Bilateral assistance from other countries is needed
- Special ambassadors for climate change are needed
- Find ways to merge income and eco-friendliness like ecotourism

Environmental Challenges in the Maldives

Her Excellency Dr Mariyam Shabeena Ahmad, originally from the Maldives, represented a nation known for having the most dispersed land area per country in the world and the sixth smallest by land size. The Maldives faces unique challenges due to its geography, with over 99% ocean and less than 1% land. Freshwater contamination by saltwater is a persistent issue, and freshwater shortages require costly desalination processes. Economically, the Maldives grappled with significant developmental challenges and a high vulnerability to climate change impacts, particularly the rising sea levels that threatened its very existence. With 80% of the islands less than one meter above sea level, the Maldives relies heavily on its natural resources, especially for tourism and fisheries, making it a case study for climate-related issues in the tropics. Additionally, biodiversity loss posed a serious threat, as coral reefs, vital for coastal protection, faced risks from ocean acidification and coral bleaching.

Regional Collaboration Efforts

In the Maldives, NGOs play a vital role in educating communities about environmental changes by providing mentoring programmes and stipends to increase awareness. With survival closely linked to the health of the oceans, these initiatives highlight the importance of marine conservation. The Maldives has also introduced IGCSE courses in marine and fisheries science, equipping students with knowledge and skills to protect and sustain their unique marine ecosystems.

The Way Forward for the Tropics

The Maldives has undertaken extensive conservation efforts, supported by financial assistance that fuels various environmental initiatives. These include planting mangroves, which help stabilise coastlines, and the restoration of coral reefs and beaches essential to both biodiversity and tourism. The nation is also working to transition away from fossil fuels, embracing cleaner energy sources. With national conservation plans in place, the Maldives aims to protect up to 93 designated sites, demonstrating a strong commitment to preserving its natural resources and combating the effects of climate change.

Bridging the Gap in Knowledge and Practice

The Maldives has been an active advocate for the needs of tropical and small island nations on the international stage. Notably, at the 2009 UN Guarded Action Summit, the Maldives played a key role in pushing for greater support and action from larger nations to address the unique challenges faced by these vulnerable regions.

Discussion

Question
Brazil recently provided Malaysia with natural rubber, a sustainable and renewable resource. Can we showcase natural rubber as a sustainable polymer with multiple uses? Convey this to the Rubber Board, please.

Answer
Malaysia is known in Brazil partly due to the British taking rubber seeds from Brazil and planting them in Malaysia, which helped establish Malaysia as a key player in the rubber industry.

Question
How do you adapt education systems to focus on environmental and conservation purposes?

Answers
Her Excellency Mariyam: NGOs can play a role in mentoring and providing stipends to educate communities about environmental changes. There is a strong connection between survival and ocean preservation, reflected in IGCSE marine and fisheries science programmes.
H. E. Lisuado: Environmental awareness in schools can be enhanced by involving multiple stakeholders and updating the curriculum.
H. E. Norton: Symbolic acts, or "pretty acts," can serve as protective measures for the environment, acting as subtle safeguards.

Question
How can we capitalise on and sustain national resources while resisting external pressures?

Answers
H. E. Norton: It is important to declare protected areas and species, acknowledging that the Amazon is not an untouched paradise but home to human communities. Only areas currently facing deforestation should participate in certain development initiatives.
H. E. Lisuado: In Timor-Leste, tree-cutting is prohibited, and building materials are imported to protect local resources. There are also coral reef restoration and eco-friendly tourism initiatives aimed at preventing pollution.
Her Excellency Mariyam: Financial assistance is crucial, along with initiatives for mangrove planting, coral reef restoration, and moving away from fossil fuels. National conservation plans cover up to 93 sites for preservation.

Question
Rural areas still depend on rivers as a water source, which can expose them to untreated water. What strategies can be implemented under these constraints?

Answer
Her Excellency Mariyam: A think tank could be formed to promote biodiversity in shared waters among island states, facilitating collaborative solutions for managing water resources.

Question
One of the things we do is bring environmental issues to international attention. Is there an initiative you could push forward globally, such as an International Day of the Tropics? Could an alliance between Asian states be established to secure funding and strengthen advocacy?

Answers
H. E. Lisuado: We should advocate for bilateral ties with neighbouring countries to enhance regional collaboration.
Her Excellency Mariyam: International advocacy targeting larger nations is essential; for example, the 2009 UN Guarded Action Summit addressed the needs of tropical and small island nations.
H. E. Norton: Brazil, as the current chair of the G20, invited PM Anwar to highlight the importance of local participation in sustainable economic practices, aiming to boost environmental awareness.

Question
How about a loose coalition of interested parties, including NGOs and international environmental groups, to voice unified concerns?

Answer
Dato Shazelina: A side meeting at the UN could help establish links between academia and policymakers. Within the next decade, these connections could influence the development of new environmental policies.

Question
The tropics supply a large amount of resources to the global economy. How can we encourage responsibility to maintain resource sustainability? How about Brazil's role in managing large mineral resources sustainably?

Answer
H. E. Norton: Government oversight is needed to monitor private firms involved in mineral extraction and ensure sustainable practices.

Question
For Brazil, how about sharing the country's shift from fossil fuels to biomass?

Answer
Brazil has embraced diverse energy sources, including sugarcane power, wind, hydroelectric power, and algae-based aviation fuel. Each country can contribute unique resources to the global energy landscape, showcasing a range of sustainable solutions.

Conclusion and Recommendations

It is recommended that initiatives similar to the Forest Declaration and Forest Forever facilities be undertaken and commitment secured to unite tropical countries in demonstrating leadership and responsibility in the problems that are uniquely theirs. Collaborations with private and global companies should be actively pursued to enhance these efforts. Additionally, eco-friendly income generation and awareness campaigns should be implemented, with a focus on regional collaborations to reinforce sustainable practices. Further efforts should also be directed towards promoting eco-friendly tourism, developing renewable energy sources, and engaging in international advocacy to advance environmental sustainability.

PANEL DISCUSSIONS

TROPICAL AGRICULTURAL

SMART FARMING, NEW TECHNOLOGY ADOPTION IN THE TROPICS

Moderator

Professor Dato' Dr Ahmad Ibrahim FASc

Tan Sri Omar Centre for STI Policy Studies, UCSI University

Panelists

Professor Lei Shu

Professor, Nanjing Agricultural University, China
& University of Lincoln, United Kingdom

Professor Dr Siva K Balasundram

Department Head, Department of Agriculture Technology, Universiti Putra Malaysia

Report prepared by

Nur Amalia Shari Amran

Universiti Malaysia Sarawak

Overview

The agricultural sector, including in the tropics, has an important role to play in the global pursuit of NetZero. With the advent of smart or sustainable farming, where resource-efficient technologies are deployed, there is a good chance that agriculture will deliver that role. Dubbed Agriculture 4.0, smart farming uses IoT and AI to address food security targets amidst challenges posed by climate change and population growth. While Agriculture 5.0 combines food production with energy harvesting through photovoltaic (PV) farms, the need for sustainable and innovative solutions to modernise agriculture is undeniable. High technology-driven farming may be the solution the sector is looking for to attract young talent to the farming profession.

Presentations

Professor Lei Shu

There is a question that has been lingering for some time, crucial for the future of agriculture: "What will agriculture look like in the future?". Agriculture faces numerous challenges, particularly with the rising global population and the impacts of climate change, such as extreme weather. While Malaysia has not yet seen the full extent of these changes, China is already experiencing a shift from traditional gasoline-powered vehicles to electric vehicles (EVs). This transition prompts a broader question about how to support growing populations and meet the demand for food while also considering energy needs and whether we have enough land to support agricultural production.

The highlighted concept of Agriculture 4.0 is a vision inspired by the Industrial Revolution and the rise of IoT technologies in factories. Over time, this concept has evolved into smart agriculture, which applies IoT, AI, and computer vision to solve future agricultural production problems. Introducing the concept of Agriculture 5.0, which envisions the integration of energy harvesting and food production. In this model, land is used to both produce crops and generate solar energy, giving rise to new agricultural systems such as PV farms.

This concept was first introduced by a research group in China in 2019 and has since gained global traction. In fact, Malaysia already has some PV farms, though they might not yet be widely recognised. China, for example, has many private cars that would require an enormous area of PV farms to meet their energy needs. The scale of such operations could surpass even the size of major cities like Beijing.

A specific innovation currently being developed by Professor Lei Shu and the research team concerns a smart insecticidal device designed for intelligent pest management and to combat the lack of manpower. This device, which uses AI and IoT technology, targets pests with light-based attraction (wavelength of the lights are adjustable) and high-voltage discharge, then uses computer vision AI technology to identify and analyse the captured pests. The device is designed to adjust the timing to switch on and off the light. Such devices are already popular in China and could have significant potential in Malaysia, where they have yet to be introduced. This technology aims to reduce the need for manual labour in farms and improve efficiency in pest control, ultimately helping to protect crops and ensure sustainable agricultural practices.

Key points

- Agriculture 4.0 is a vision inspired by the Industrial Revolution and the rise of IoT technologies in factories and has evolved into smart agriculture, which applies IoT, AI, and computer vision to help make agricultural production sustainable.
- Agriculture 5.0 envisions the integration of energy harvesting and food production. The land is used to produce crops and generate solar energy, giving rise to new agricultural systems such as PV farms.
- A smart insecticidal device is designed for intelligent pest management which uses AI and IoT technology that targets pests with light-based attraction (wavelength of the lights are adjustable) and high-voltage discharge, then uses

computer vision to identify and analyse the captured pests, which will help farmers reduce pesticides and increase crop production.

Professor Dr Siva K Balasundram

The concept of smart farming is increasingly appealing to a wide audience, even those without a deep agricultural background, due to its integration of various technologies. At its core, smart farming, or digital farming, revolves around precision agriculture, which emerged in the early 1990s with the goal of optimising agricultural practices. Precision agriculture focuses on efficiently applying inputs like fertilisers and pest control, ensuring that resources are neither over-applied nor under-applied.

The tools used in precision agriculture are diverse, ranging from spatial-temporal modelling to decision support systems. As the field evolved, smart agriculture emerged, focusing on real-time data collection enabled by technologies such as AI, IoT, sensors, drones, and telemetry. This shift allowed farmers to capture data in real-time, providing a significant advancement over earlier methods, which lacked real-time capabilities.

Further progression led to the development of digital agriculture, which emphasises connectivity—linking farms with one another and with marketplaces. This connectivity helps address issues like food waste, which the UN estimates is around 30-35% of agricultural production. The concept of digital agriculture, therefore, includes the goal of achieving zero waste. These three interconnected technologies—precision agriculture, smart agriculture, and digital agriculture—are all driven by data, often referred to as the "new oil". With data playing such a crucial role, modern agriculture not only focuses on crop yields but also anticipates future challenges and outcomes.

Key points:

- Smart farming, or digital farming, revolves around precision agriculture, which emerged in the early 1990s with the goal of optimising agricultural practices.
- Precision agriculture focuses on the efficient application of inputs like fertilisers and pest control, ensuring that resources are neither over-applied nor under-applied.
- Smart agriculture emerged, focusing on real-time data collection, enabled by technologies such as AI, IoT, sensors, drones, and telemetry. This shift allowed farmers to capture data in real-time, providing a significant advancement over earlier methods, which lacked real-time capabilities.
- Digital agriculture, which emphasises connectivity—linking farms with one another and with marketplaces. This connectivity helps address issues like food waste, which the UN estimates to be around 30-35% of agricultural production using the concept of digital agriculture, therefore, includes the goal of achieving zero waste

Discussion

Question
How can Frontier Technology enhance our rice yield? and please offer some practical strategies.

Answer
Dr Siva: To digitise the rice check manual and put it into the smartphone of these farmers and monitor. I think the rice authorities should step up to manage and coordinate these, and they should work with universities or have a task force that can monitor this kind of thing.

Professor Lei Shu: Why don't you think about using the device I just mentioned, the solar insecticide or lamp, a cheap device we can install in the farmland? It can kill insects without or somehow reduce the use of pesticides.

Question
What is the scale and size of farms that will be feasible for the adoption of smart farming technology? Does it not matter for any crop, whether paddy, rice, fruits, or vegetables? What is the scale like? So that it will be viable for adoption.

Answers
Dr Siva: The truth is, size does not matter anymore. If you are using technologies like AI, you can even do it in a glasshouse. You can even do it in your backyard. It technically does not matter because its data-driven. But if you are using remote sensing, for example, then yes. The bigger your farm is, the more economical it is for you. If you are using IoT, for example, size does not matter. It should not matter. But if you go bigger, then your cost is bigger. I say it depends on the suite of technologies you are interested in, which will solve your problem. So, like rice, for example, a typical rice field is about 2 hectares. Let's say you have even smaller plots, and group farming might be the answer. I think that will not only share your costs, but you will also reduce your risk.

Professor Lei Shu: In smart farming, there are many small problems with a lot of different kinds of technologies. All these disciplines are now evolving to get into the field of smart agriculture and smart farming, and then different technologies they consider invented can be to different sides of the field. I agree with Professor Siva. If we consider the UAV, then it can be applied to a hillside. But talk about the device I just mentioned, the solar, exact set of lamps, can be applied for 10,000 square metres. It can be applied to some spaces. So, I think whether to use this technology is a local problem. It depends on the country's situation. If currently the human source and its cost are not very high, then probably you can still consider using that way because you can still support some people and families, which is quite important.

Question
What can the government do to encourage more agriculture-technopreneurs to

venture into smart farming so that we can have more locally produced technology?

Answer
Dr Siva: I am happy to note that in the department where I work, we have a programme called 'Bachelor of Technology in Smart Agriculture'. We will produce our first batch of graduates in a year. The first cohort is 19 students, and this is the first programme in the country. Many young people already like the idea of smart and digital agriculture because they like to play with gadgets. So I think we should capitalise on that.

Question
What do you think is the impact of smart and sustainable agriculture on farm employment? What is the ultimate objective of smart farming? Is behavioural change important to drive the shift to smart farming? What is your opinion?

Answers
Dr Siva: The match between young people and smart agriculture is very good at the moment. I think we should capitalise on that. This is why I say it is changing the game because it is the farmers who are in their late fifties and sixties are the ones who are struggling to make sense of smart agriculture. I also agree with that comment where he talked about regenerative agriculture because I feel that we should not be so weighted only into technology without considering the indigenous knowledge that is so rich among rice farmers, herb growers, and all that. In some cases, you do not need tools to do the job. For example, spatial variability or spatial site-specific approach to farming can be done without many tools. You just need to place your solutions strategically. So, in places with high pressure of snails, put more of your herbs. In places that have fewer snails, put fewer.

Professor Lei Shu: It depends on the country's situation. If currently the human resources and its cost are not very high, then you can probably still consider using that way because you can still support some people and some people's families, which is quite important. Why would we invent new technology and remove those people's jobs and probably even destroy their families? So that is something depending on different countries or different local situations. Another feedback is that technology can be applied to different kinds of crops. Think about this in different kinds of targets. Some targets may allow you to use new technology to make more money. Some may still need more time to use such technology until they realise that smart agriculture or smart farming can truly solve the problem.

Question
Whose role is it to lead the discussion on ethics and governance? We talked about two views: One from the computer science and the engineering sides, but the other on the agriculture side. And so, what would that look like in terms of policy and institutions? And finally, have you seen any successful examples from your experience and your work?

Answer

Dr Siva: I am biased. I think agriculture should be at the forefront because everybody can learn computers, but not everybody can learn agriculture, the way I look at it now. But I think we should work together with the engineers and the computer experts. The real problem in the field sometimes is not just about when to plant and when to harvest. It is what happens in between. So, for that, you need people who understand agriculture in and out before you can intervene. So, I mentioned the three stages in the growth of rice to you. The middle stage is probably the most important part. If that is not well-achieved at the right time, you know you will have a yield delay. So, this is why I say you need a good agronomist on board. The other thing is the ethical issues. I think this is where policies have to come in to prevent that from happening.

Question

So, what kind of incentive can the panellists suggest if smart farming can be made more accessible to farmers, especially in lowering the cost, including in the implementation as well?

Answer

Dr Siva: You could either give at least 10 to 15 per cent expenditure support, bonuses, tax breaks, or similar benefits to them from the agencies. Alternatively, farmers who successfully implement smart farming practices could be rewarded with bonuses or similar incentives.

Conclusion and Recommendations

Farmers should be encouraged to adopt smart farming technologies through incentives such as 10 to 15 per cent expenditure support, bonuses, tax breaks, or similar benefits while prioritising data security to prevent third-party breaches. Efforts should be made to digitise rice farming manuals to simplify monitoring and usage, and rice authorities must enhance coordination by collaborating with university experts and establishing a dedicated task force for effective monitoring. The government could introduce a dual-income arrangement for farmers, allowing them to earn from both agriculture and maintaining photovoltaic (PV) systems. Advanced pest control technologies, such as light-based attraction systems with adjustable wavelengths, high-voltage discharge, and AI-powered computer vision for pest identification and analysis, should replace traditional pesticides. Developing locally appropriate technologies tailored to specific conditions is essential, and farmers should work together to share costs and reduce risks. Additionally, practising regenerative agriculture and tapping into the rich indigenous knowledge among rice farmers can significantly improve productivity and sustainability.

TROPICAL AGRICULTURAL

FOOD SECURITY, FOOD – ENERGY – WATER – NEXUS IN THE TROPICS

Moderator

Professor Dato Dr Mohamed Shariff Mohamed Din FASc

Honorary Professor, Universiti Putra Malaysia

Panelists

Professor Asit K. Biswas

Academician and Distinguished Visiting Professor, University of Glasgow, United Kingdom
Director, Water Management International, Singapore

Professor Clive Phillips

Curtin University Sustainability Policy Institute, Australia
Visiting Professor, Estonia University of Life Sciences

Dr Wickneswari Ratnam

Managing Director, Nomatech Sdn. Bhd.

Professor Dr Shaufique Fahmi Ahmad Sidique

Agricultural Economics, Universiti Putra Malaysia

Report prepared by

Dayang Nurul Anisa Abang Heilman

Universiti Malaysia Sarawak

Overview

Currently, about 40% of the world's population resides in the tropics, which comprise 36% of the planet's landmass. It encompasses 40% of the global agricultural land and 80% of the biodiversity. Water, energy, and food are nexus at the heart of sustainable development. The challenge of managing these three sectors holistically has grown difficult, and the problem of climate change makes it even more difficult. Therefore, finding solutions to these problems is crucial for the tropical region, which is rich in diverse resources. It is necessary to disseminate the Nexus Approach to enhance the adaptability of people in the tropical zone for food security and sustainable agriculture. The dialogue was convened to highlight the challenges, risks and innovative opportunities shaping the future of sustainable growth in agriculture.

Presentations

Can the Nexus Approach be Implemented to Tropics: Challenges and Opportunities

Professor Asit K. Biswas started his presentation by highlighting the interdependence of food, energy, and water and how decisions made in one system can affect the others. He explained that to handle the natural resource sectors holistically, the government must break them into smaller sectors. He added that managing natural resources is becoming a more complicated issue because of climate change. He used the example of how global temperatures are rising so rapidly that there is a growing demand for electricity to cool buildings, which results in more energy consumption. He concluded that while managing water, energy, and food systems holistically presents challenges worldwide, it remains a feasible endeavour.

Key points:

- By around the 1700s, knowledge had advanced so much that no one could know all the knowledge that needed to be known.
- Natural resource issues must be divided into subsections to manage them comprehensively.
- Water, food, and energy systems are interconnected, but it is challenging to manage them holistically.
- Temperatures in every country are rising abnormally and increasing further each summer. With the higher temperature, the need for electricity is increasing enormously.

Are Animals a Secure Way of Providing Feed for Humans

Professor Clive started his presentation by pointing out that habitat destruction has caused 70 to 80% of species to become extinct in the past 50 years. He continued by saying that one of the causes of habitat loss is population expansion, which is expected to reach 10.4 billion people by the end of the century. He mentioned that the ability to produce food for animals, followed by soy production, is the main cause of deforestation. In addition, he stated that the global animal industries are expanding quickly in response to population growth. According to the survey, only nine nations worldwide showed a decline in meat consumption, and he attributed this to economic factors. A few nations, including Canada, Switzerland and New Zealand, have acknowledged that excessive meat intake is deleterious and have seen a decline in meat consumption. He concluded that switching the Western diet to a more traditional, plant-based one would benefit significantly.

Key points:

- 70 to 80% of the wildlife has disappeared in the last 50 years due to habitat destruction.
- 10% of carbon emissions globally are due to deforestation caused by the burning of land and trees.

- Production of foods for humans in terms of livestock production is not very efficient.
- Many governments around the world are now advocating reducing meat consumption not just due to environmental causes but also due to the impact on human health and the need to secure food for much larger populations towards the end of the century.

Ensuring Food Security in the Tropics: Exploring for Sustainable and Healthy Staple Foods

Dr Wickneswari started her presentation by emphasising that governments, academic institutions, industries, and consumers collectively have an important role to play in ensuring food security. She stressed that while discussing food security, it is important to consider the quality of the diet, the food environment, and the advancements made in taking risks to create nutritious staple foods. She also emphasised the significance of knowing how to involve the industry to establish positive collaborations in smart farming and the government's commitment. After that, she outlined four crucial elements to guarantee food security. She provided examples of low-risk foods and addressed how dietary choices impact life quality. She stated that 60% of the world's population comes from Asia, and rice is one of the sources of staple foods. She then suggested that the consumers must be educated to consume whole grain rice, which meets all the minimum requirements for the diet.

Key points:

- The central to the food environment is diet quality, which means very diverse food is required, and the food needs to be adequate and safe.
- Four important aspects to ensure food security:
  a) Agricultural production
  b) Market and trade systems
  c) Food transformation and consumer demand
  d) Consumer purchasing power
- Intervention in agricultural production can contribute to a healthier food environment by stimulating consumer choices.
- One of the primary contributors to disability-adjusted life is dietary risk.

Economic Growth, Agriculture Sustainability, and Food Security

Dr Shaufique started his presentation by stressing the importance of realising that food security encompasses more than just food production and caloric intake. He stressed that a thorough grasp of the food system's intricacy and the ways in which one component influences another is necessary to achieve sustained food security. He added that income and food security are related. He continued by saying that while food insecurity might result from the force involved in food production, food security can be achieved if food is produced effectively. He used Argentina as an example, which has a very high level of calorie self-sufficiency but a low level of food security. He emphasised that there are no assurances that the country will become self-sufficient if it produces enough food. He then concluded that lowering food waste could

improve the country's food security.

Key points:

- Food insecurity needs to be resolved at a macro level before any intervention at a micro level could work.
- Macroeconomic dimensions that need to be made before any micro-level or policy intervention could be effective:
  a) Economic growth and globalisation
  b) Poverty alleviation
  c) Stable food prices
- Food security is extremely correlated with income, as shown by the Global Food Security Index (GFSI) graph and GDP Per Capita.
- The United States, France and Canada are the only countries that are self-sufficient and highly food-secured, and they have huge amounts of resources and technologies.
- Food security in the country can be increased if the food waste is reduced.

Discussion

Question
If we go to our policymakers, how do we tell our leader that we need food, energy, and water to work together to ensure the successful use of this technology?

Answer
Professor Asit: It is going to be a very difficult process. The country's leader (prime minister) is interested to know how to reduce the current poverty situation in the country, how to increase the employment rate of the citizens, and how to increase the country's standard of living. The prime minister told me that if I wanted to talk about water as a catalyst, how it can generate employment, and how it can improve the quality of life of the people, then she would be very interested in hearing my advice. However, she is not interested as a prime minister if I talk about the efficiency of water and why improve the water quality and suggested I talk about it to the water minister. Since then, I have been using my career to show water as a catalyst for regional development. The way we present the issues to policymakers is very important.

Question
The Netherlands has a small land area, but it is one of the countries with the highest food exports. What can we learn from them?

Answer
Dr Shaufique: It is due to the efficient use of resources and technology. They are not self-sufficient in terms of calories because they do not produce oil seeds. However, they produce fruits and vegetables, and do it very efficiently using the highest technology.

Question
How can we ensure that every human in the tropics can enjoy safer and nutritious food at affordable prices?

Answer
Dr Wickneswari: It is all about how efficiently we produce the food. If we can increase the efficiency of food production and do good agricultural practices, then we can produce safe food at an affordable price.

Question
What would the panel's opinion be about the deployment of GMO food crops, and how safe and healthy it would be?

Answers
Dr Wickneswari: There is nothing wrong with GM food. I would say that the technology used is acceptable. Right now, we have not utilised all the diversity of

germplasm to increase our production and produce crops that are resilient to climate. We have naturally occurring wild relatives that have not been explored well. So, we need to explore that before deploying to produce GM food for threats not found naturally.

Professor Clive: There is no strong evidence that organic foods are safer than conventional foods. I think the problem with organic food is that we cannot feed the world with it. There is no doubt that with the expanding population, we force the consumer to accept that their food will be produced with a large number of fertilisers and pesticides, which does not make it unsafe, but it means there are pretty severe environmental consequences. Fertiliser production is hugely energy expensive, and that is the damage we are doing to our food production system.

Question

In Malaysia today, chicken is the cheapest source of animal protein. The fish used to be much cheaper than chicken. Fish is well known to be healthier than chicken. To transition from eating less chicken to more fish, if fish is not affordable to some Malaysians, how can this be a reality?

Answer

Professor Clive: I agree fish is healthier than chicken and beef. It would be good to transition from eating chicken to fish. The problem is that we are not going to get the fish out of the ocean because we depleted the stocks far too dramatically to be able to harvest cold-water fish, which those fishes tend to be healthier. In terms of freshwater aquaculture, it can be done efficiently and relatively cheaply. Fishes are poikilotherms, so they should be more efficient than chickens, which are homeotherms, which need to keep their body temperature higher than fishes. For seawater agriculture, the pollution problems are just too great and it's going to be difficult.

Dr Wickneswari: We don't rely on one source of protein or two sources of protein, we keep it diverse. We have many different types and diverse kinds of foods that provide more choices for the consumers.

Conclusion and Recommendations

To ensure policymakers better understand the concerns, issues must be presented effectively, emphasizing how their resolution benefits regional priorities to capture more attention. Transforming agriculture for food security and sustainability in the tropics requires the widespread adoption of advanced technologies, such as Artificial Intelligence (AI). Collaboration with local and regional institutions, implementing complementary interventions, and addressing local food security challenges are crucial for achieving positive outcomes. The diverse issues in the tropics demand varied responses, as many challenges arise not only from tropical conditions but also from systemic flaws, highlighting the need for appropriate and targeted measures.

TROPICAL MEDICINE

MEDICINE SECURITY IN THE TROPICS (VACCINES, DRUGS AND DIAGNOSTIC)

Moderator

Professor Dr Suresh Kumar P. Govind FASc

Honorary Professor, Department of Parasitology
Faculty of Medicine University Malaya

Panelists

Professor Dr Ramendra Pati Pandey

Biotechnology, SRM University Delhi-NCR, Sonepat

Professor Dr Laurent Renia

Senior Fellow and Principal Investigator
*A*STAR Infectious Diseases Labs – ID Labs*

Dr Cindy Chu

Lao Oxford Mahosot Hospital Wellcome Trust Research Unit

Report prepared by

Dayang Nurul Anisa Abang Heilman

Universiti Malaysia Sarawak

Overview

The tropical regions face complex challenges in managing infectious diseases and strengthening healthcare infrastructure, compounded by high population density, limited resources, and environmental factors. These areas experience recurrent outbreaks of diseases such as Chagas, malaria, and zoonotic infections, with few effective treatment options and an increasing risk of antimicrobial resistance. Addressing these issues demands a comprehensive approach, including rigorous surveillance, precise detection, timely intervention, and preventive measures, especially as rapid population movement accelerates disease spread across borders. Furthermore, healthcare delivery to remote and underserved areas faces logistical and infrastructural barriers, hindering access to essential services. Effective healthcare in the tropics thus requires regionally tailored strategies, coordinated networks, and resilient systems that facilitate information flow and resource sharing. This discussion brings to light the pressing need for innovative, collaborative solutions that address these unique challenges and promote equitable, sustainable healthcare frameworks across tropical regions.

Presentations

Chagas disease in Latin America caused by parasite *Trypanosoma Cruzi*

The discussion, led by Professor Dr. Ramendra Pati Pandey, centers on the challenges of combating infectious diseases, particularly Chagas disease in Latin America. Dr. Pandey highlights the limitations of existing treatments, which are only effective in the early stages of infection, leaving chronic cases without viable options. He underscores the need for drug repurposing and the combination of existing medications to address this gap, focusing on the example of combining chloroquine with other drugs. Additionally, he addresses the broader issue of antimicrobial resistance, emphasizing the urgent need for a "One Health" approach. This approach considers environmental, animal, and human health as interconnected to prevent the spread of resistant pathogens. The conversation concludes with a call for interdisciplinary collaboration across borders to develop sustainable solutions for global health security.

Keypoints:

- Challenges in treating Chagas disease:
  - Existing drugs (benznidazole and nifurtimox) are effective only in the acute phase of Chagas disease.
  - Chronic cases lack effective treatment options, highlighting a critical gap in therapy.
- Drug repurposing and combination therapy:
  - Dr Ramendra proposes repurposing existing drugs, such as combining chloroquine and colchicine with traditional treatments, to improve effectiveness.
  - This approach was tested successfully on cell lines and animal models, indicating potential for treating Chagas disease.
- Antimicrobial resistance:
  - There is an urgent need to address the growing issue of antimicrobial resistance, which poses a global threat to health security.
  - Excessive use of antibiotics in various sectors has led to environmental contamination and resistant pathogens.
- One Health approach:
  - Dr Ramendra advocates for a "One Health" approach, which integrates environmental, animal, and human health to tackle antimicrobial resistance and prevent pathogen spread.
- Call for interdisciplinary collaboration:
  - A coordinated, cross-border effort is needed to combat infectious diseases, involving experts from multiple fields, including drug and vaccine research, health science, and environmental science.
- Sustainable health security:
  - Emphasis on creating sustainable health solutions that address interconnected health systems to mitigate the spread of infectious diseases and improve global health outcomes.

Vaccines: Hopes and Hurdles in the Era of New Pandemics and Infodemics

Professor Dr Laurent Renia emphasised the urgent need for a comprehensive approach to infectious disease management in tropical regions, which are highly vulnerable due to dense populations and frequent cross-border exchanges. He outlined four key pillars: surveillance, detection, intervention, and prevention. Surveillance and data collection help identify outbreaks, while effective detection systems are essential for tracking mutations. Intervention involves testing drugs, and prevention includes vaccination, vector control, and antimicrobial measures. Dr Renia also discussed the importance of regional capacity-building, particularly in research, manufacturing, and vaccine distribution, to avoid reliance on global suppliers. Additionally, he stressed the need for public trust, transparent government communication, and community engagement, particularly as misinformation about vaccines is widespread. His recommendations underscore that addressing infectious diseases effectively requires collaboration and investment in regional health infrastructure.

Key points:

- The tropical regions face unique challenges in infectious disease management due to dense populations, frequent cross-border exchanges, and regional vulnerabilities that facilitate the spread of diseases.
- Effective disease control in the tropics requires a comprehensive approach, including surveillance (data collection), detection (tracking pathogen mutations), intervention (drug testing), and prevention (vaccination, vector control, and antimicrobial practices).
- Regional networks through ASEAN are essential for coordinated infectious disease management efforts across Southeast Asia.
- Building regional capacity for genomic sequencing enables the rapid identification of pathogen mutations, crucial for effective outbreak response.
- Enhancing regional capacity in R&D, manufacturing, logistics, and distribution ensures timely access to vaccines and treatments tailored for the Asian phenotype.
- Establishing regional networks for standard operating procedures (SOPs) and training will create uniform practices, improving preparedness and response to health crises.
- Public trust in disease control relies on transparent communication and the government's ability to deliver clear and accurate information.
- Combatting vaccine misinformation requires targeted public engagement and educational initiatives to build community trust.
- A collaborative approach involving regional and interdisciplinary partnerships is necessary to strengthen health infrastructure and enhance health security in tropical regions.

Health Service Challenges in Tropical Medicine

PDr Cindy Chu discussed the healthcare challenges faced in Southeast Asia, particularly in remote and resource-limited settings. She identified major obstacles such as difficult terrain, limited infrastructure, and seasonal accessibility issues, which complicate patient access to healthcare services. In many areas, healthcare facilities are modest, often lacking sufficient equipment and supplies, requiring alternative treatment methods for conditions like jaundice. Dr Cindy emphasised the need for effective human resources, including training healthcare providers, fostering community engagement, and creating region-specific guidelines. She also highlighted the importance of mobile clinics and outreach programmes to increase patient access in isolated areas. Rapid regional changes, such as flooding and urbanisation, require adaptive strategies to safeguard healthcare infrastructure. Dr Cindy underscored the need for regional networks and capacity building to strengthen healthcare systems, improve disease surveillance, and ensure a reliable flow of health information from local to central levels.

Key points:

- Geographical and accessibility challenges:

Remote and mountainous regions, often accessible only by boat or difficult to reach during rainy seasons, pose significant challenges to healthcare delivery.

- Infrastructure limitations:

Many healthcare facilities in these areas are modest, with limited equipment and supplies, leading to alternative treatments, such as sun therapy for jaundice.

- Need for trained human resources:

Effective healthcare requires trained personnel to deliver care and engage in public education and outreach within communities.

- Mobile clinics and outreach programmes:

Mobile clinics and outreach initiatives are essential to extend healthcare access to isolated populations.

- Impact of rapid regional changes:

Frequent flooding and rapid urbanisation necessitate adaptable strategies to protect and maintain healthcare infrastructure.

- Regional networks and capacity building:

Establishing regional networks is crucial for supporting health systems, especially in peripheral areas. Capacity building in disease surveillance, diagnostics, and SOPs is needed to ensure that health information flows effectively from local to central levels.

- Development of Local Guidelines:

Region-specific guidelines are essential to make diagnoses and treatment decisions more relevant to local healthcare needs.

Discussion

Question
To what extent were International Health Regulations (IHR) incorporated into the processes undertaken? Given that these regulations are essential for managing emerging diseases, with a key requirement for countries to inform the World Health Organization (WHO) promptly to enable rapid response actions, was this approach included in the plan?

Answer
Dr Laurent: Integration with the World Health Organization (WHO) and various response schemes is essential. The approach should not be exclusively regional, though initiating efforts within the region is important rather than relying solely on WHO directives. This collaboration should function bilaterally among neighbouring countries, allowing for immediate response and shared responsibilities. A key realisation during the COVID-19 pandemic was that public health policies cannot operate in isolation; they must be extended across borders. For instance, Singapore initially focused internally but has since shifted its strategy to actively engage with partners. Building networks for surveillance, sharing resources, and conducting senior-level training has become critical for a cohesive and effective public health response.

Question
In relation to the One Health approach, could additional aspects that may be relevant to disease emergence be highlighted? Specifically, given the role of zoonotic and respiratory pathways in transmitting emerging diseases, what role does One Health play in addressing these factors?

Answer
Dr Ramendra: The One Health approach is indeed essential, especially in light of climate change and its impact on resources like water. This issue transcends national boundaries and requires a global perspective. For example, pathogens and genetic diseases, much like pollutants, are not confined to any single country but spread globally, indicating that we are part of one interconnected climate system. The notion that local health measures alone suffice is inadequate; as pathogens and infectious agents adapt rapidly, our strategies must keep pace. While we gather knowledge through conferences and discussions, pathogens evolve continuously, often outpacing human responses. Additionally, the pressures of overpopulation compound this challenge, as densely populated areas provide more opportunities for pathogen transmission and genetic mutations. This highlights the significance of maintaining both environmental and public health. Efforts to improve public health are undermined if environmental conditions are poor. Therefore, the interconnectedness of environmental and public health must be a central consideration in developing effective health strategies.

Question
What criteria are used to select and modify existing antibiotics for the treatment of Chagas disease? Specifically, in the case of using nifurtimox and benznidazole to treat *Trypanosoma cruzi,* what process determines the suitability of these particular drugs for this purpose?

Answer
Dr Ramendra: Selecting and modifying existing drugs for Chagas disease treatment involves careful evaluation, particularly due to potential side effects associated with these drugs. For instance, while benznidazole, a commonly used drug for Chagas disease, is effective against *Trypanosoma cruzi,* it can cause adverse skin reactions and other allergic responses. Similarly, nifurtimox may also lead to health complications. When assessing a drug's effectiveness, attention must be paid to minimising side effects and improving biocompatibility. To address these issues, collaborative efforts among pharmacists, clinicians, pharmacokinetics (PK) and pharmacodynamics (PD) specialists, and microbiologists are essential. This multidisciplinary approach allows for combining existing drugs effectively, ensuring they target the parasite without causing significant harm to the patient. The outcome of such collaborative research yields a treatment with improved efficacy and minimised toxicity. Initially, research may begin individually, but to achieve substantial results, as in this case, extensive collaboration involving over 50 specialists contributed to the development of a more effective drug combination for Chagas disease treatment.

Question
Given the promising results of combining existing drugs, how might this approach impact pharmaceutical companies currently focused on developing new drugs?

Answer
Dr Ramendra: This question highlights the distinct but increasingly collaborative roles of academia and industry. Traditionally, the academic sector focuses on raising awareness and expanding knowledge, while the pharmaceutical industry prioritises business and profitability. However, recent global health crises, particularly the COVID-19 pandemic, have underscored the need for a unified approach, blurring the lines between these two domains. During the pandemic, it became evident that academia and industry must work together to address urgent health challenges. Consequently, many pharmaceutical companies have shown greater openness to supporting academic research and adopting insights from the academic community. This shift is evident in the industry's limited introduction of new antibiotics over the past few years, as both sectors recognise the ongoing "silent pandemic" of antimicrobial resistance. Pharmaceutical companies are thus increasingly engaged in collaborative efforts with academia to develop effective solutions within shared laboratory settings.

Question
With regard to vaccine accessibility during pandemics, how can vaccine prices be kept low, especially considering the high costs and limited production capacity observed at the start of the COVID-19 pandemic due to the strains used? Additionally,

should vaccines be made available to the public free of charge?

Answer

Dr Laurent: Vaccine affordability is largely determined by government subsidies, making it a political rather than scientific decision. For a vaccine to be available at low or no cost to the public, government funding is necessary to cover production costs. Biotech companies, which invest heavily in developing vaccines, seek substantial returns on their investments and are, therefore, unlikely to produce low-cost vaccines independently. In some cases, state-supported companies, such as the Serum Institute of India, have successfully lowered vaccine prices using local manufacturing and government support, making vaccines more accessible in specific regions. However, without new, cost-effective production methods, especially for advanced vaccines like mRNA, large-scale vaccine production remains an expensive undertaking.

Question

What strategies are employed to conduct outreach in rural areas, particularly for NGOs with limited funding? How can costs be sustainably managed in long-term projects where medications and equipment are often expensive?

Answer

Dr Cindy: Sustainable outreach in rural areas often focuses on providing low-cost but effective diagnostics and treatment at the local healthcare level. For example, instead of relying on costly tools like pulse oximeters, simpler methods such as physical examinations can be employed for diagnoses. While I have not worked in extremely remote settings without resources, in moderately resourced areas, access to rapid diagnostic tests or training local staff to conduct malaria smears can be viable options. Over time, equipping staff with microscopes and providing ongoing training has proven cost-effective. In some cases, global funding for rapid diagnostic tests, particularly for malaria, offers an additional low-cost, time-efficient solution. However, in resource-limited settings, healthcare delivery often occurs with limited infrastructure and staffing. For instance, during malaria outbreaks, two staff members may screen hundreds of patients out of a village home. While large-scale clinical operations require more resources, smaller, focused visits to local communities may be a more manageable and cost-effective approach to rural healthcare delivery.

Dr Suresh: Healthcare delivery in rural settings can be understood as a triangle involving three main elements: the community, healthcare providers, and the corporate sector. In rural areas, communities face significant healthcare challenges, yet healthcare specialists often concentrate solely on clinical care delivery, while the corporate sector, although potentially capable of providing funds through corporate social responsibility (CSR), may lack the vision or direct involvement needed to address these challenges on the ground. NGOs play a critical role in bridging these elements, uniting community needs, healthcare expertise, and corporate resources. By collaborating closely with healthcare providers to determine precise needs and costs and presenting CSR programmes with well-defined, impactful plans, NGOs can create a model that offers not only financial returns but also meaningful value to all

parties. NGOs, driven by passion and commitment, are particularly well-suited to integrate these three components, leveraging CSR funds effectively to make sustainable healthcare delivery possible. Establishing clear, trusted avenues for corporate funds can greatly enhance rural healthcare, allowing all three sectors to contribute effectively toward a common goal.

Question
In pandemic mitigation, reliance on passive surveillance often delays the cascade of control and preventive actions, potentially slowing down the overall response to disease outbreaks. What strategies or measures could be implemented to improve the efficiency and effectiveness of surveillance systems for faster pandemic mitigation?

Answer
Dr Ramendra: To enhance pandemic preparedness and secure global health for future outbreaks, two key strategies are essential. First, there must be a continuous, collaborative effort to update and expand collective knowledge, engaging experts from multiple fields rather than working in isolation. This integrated approach ensures a well-rounded understanding and response to evolving health threats. Second, global health awareness and education are critical. Public knowledge about microbes, viruses, vaccines, and hygiene practices must be strengthened worldwide. By promoting health literacy across all regions, individuals and communities become better equipped to recognise and respond to health risks, reinforcing broader pandemic mitigation efforts. These combined strategies of shared expertise and widespread health education form a solid foundation for faster, more effective pandemic response.

Dr Laurent: In developing effective pandemic surveillance, establishing a comprehensive, well-structured system is essential to identify where and when outbreaks occur. This requires strategically placed surveillance sites staffed by trained personnel capable of gathering and analysing data. The goal is to not only monitor known diseases but also to detect emerging threats and predict potential spread, differentiating significant signals from background noise. Predictive modelling is crucial in this context. Beyond standard laboratory diagnostics, tools such as landscape and climate mapping can help model factors like disease patterns, rainfall, humidity, and other environmental conditions, contributing to a predictive framework that anticipates outbreaks. However, surveillance infrastructure demands substantial investment, and funding is often a challenge as its benefits may not be immediately visible. Multiple sites across regions are needed, supported by a robust network to ensure comprehensive coverage. This approach is vital as infectious diseases do not recognise borders, making international cooperation in surveillance imperative for effective pandemic mitigation.

Dr Cindy: To strengthen pandemic surveillance, three key elements should be considered. First, incorporating a One Health approach is essential, as it emphasises the interconnectedness of human, animal, and environmental health. Health services often overlook this aspect and may not plan for cross-border issues critical for effective surveillance. Second, active engagement among healthcare workers is

crucial. Ground-level healthcare providers must be observant and responsive, identifying unusual patterns or surges in symptoms, such as an unexpected rise in fever during a chikungunya outbreak where dengue tests were negative. In such instances, alert healthcare workers can report anomalies for further investigation, allowing laboratories to conduct comprehensive tests and detect new pathogens early. Third, shifting from passive to active surveillance could enhance pandemic detection capabilities. An active approach, which includes monitoring animal health, human health indicators, and cross-border interactions, is more effective for the early identification of pandemics, enabling faster and more coordinated responses.

Question

In light of the significant controversies surrounding recent vaccines, with numerous contradictory reports and widespread dissent from various groups, including NGOs, globally, what is your perspective on this issue?

Answer

Dr Laurent: The most important approach to addressing vaccine controversies is encouraging people to consult scientific literature, as all critical information about vaccine effectiveness and purpose was detailed in published studies from the beginning. Vaccine discussions often included protection against severe disease and, secondarily, against transmission, yet misunderstandings arose when some believed vaccines offered universal protection. This misinterpretation was further complicated by inconsistent messaging from various governments, which led to public distrust when vaccinated individuals still contracted COVID-19. Clear, timely, and accurate communication is essential, particularly when there is incomplete knowledge. Sticking to the literature and data ensures responsible messaging, which is often undermined in social media, where partial information on side effects circulates widely. Education is key, as all drugs—including vaccines—have side effects. Properly informing the public about expected side effects helps build realistic expectations. A structured system for monitoring and reporting vaccine side effects is crucial. With the vast number of doses administered globally, unexpected reactions may emerge in specific groups. For example, the AstraZeneca vaccine revealed unforeseen responses as distribution expanded from thousands to millions. Post-vaccine monitoring is vital to identify these groups, adapt responses, and, where necessary, offer alternative vaccines, such as protein-based or inactivated options. A comprehensive approach that includes side effect tracking, continuous testing, and education ensures that vaccines remain both safe and effective for diverse populations.

Conclusion and Recommendations

Adopting a One Health approach is crucial in tropical regions, emphasising the interconnectedness of human, animal, and environmental health to address the prevalence of various diseases. Promoting cross-border scientific collaboration through a "science without borders" philosophy is essential for tackling shared health challenges. Simple, effective measures, when applied consistently, can yield significant impacts on disease control and health outcomes. Increasing diversity in decision-making by including stakeholders with varied expertise and perspectives ensures more inclusive and effective solutions. A consolidated and integrated approach is needed, where ministries and organisations work together with authority and commitment to drive meaningful change. Strengthening the One Health Initiative requires strong coordination across sectors to enhance health management systems and vaccine communication strategies. The Academy of Science Malaysia should be more active in bridging knowledge and action by collaborating with ministries and organisations to apply research findings in public health initiatives. Transforming knowledge into action is vital, shifting from isolated research efforts to coordinated implementation that connects science with practical solutions to achieve tangible health goals.

TROPICAL MEDICINE

IMPACTS OF ECOLOGICAL CHANGE ON TROPICAL DISEASES AND NEGLECTED TROPICAL DISEASES

Moderator

Dr Vickneshwaran Muthu

Senior Principal Assistant Director, TB Sector at Disease Control Division, Ministry of Health Malaysia
Member, Malaysia Society of Parasitology and Tropical Medicine, Asia Pacific Alliance for the Control of Influenza (APACI), Malaysian Medical Council (MMC) and Negeri Sembilan Medical Council

Panelists

Professor Emeritus Dato' Dr Syed Mohamed Aljunid

Chairman, Malaysian Health Economics Association and Malaysian Pharmacoeconomic and Outcome Research Association

Dr Kimberly Fornace

Associate Professor and Head, Climate, Environment and Health Programme at the Saw Swee Hock School of Public Health, National University of Singapore

Emeritus Professor John S Mackenzie

Emeritus Professor, Curtin University in Perth
Member, Quadripartite (FAO, UNEP, WHO, WOAH) One Health High Level Expert Panel

Report prepared by

Sabella Justin

Universiti Malaysia Sarawak

Overview

The World Health Organization (WHO) identifies 34 diseases of interest in tropical diseases, with 20 classified as concerning, including protozoal diseases like human African trypanosomiasis and leishmaniasis and viral diseases such as rabies and scabies. This dialogue emphasises the interconnectedness of neglected tropical diseases (NTDs) and their significant health impacts. Professor Emeritus Dato' Dr Syed Mohamed Aljunid highlighted the fragmentation in health systems due to disasters, stressing the need for better collaboration and data sharing between public and private sectors to enhance disaster preparedness. Concurrently, Dr Kimberly Fornace pointed out that deforestation increases the risk of emerging infectious diseases through wildlife interactions. Emeritus Professor John S Mackenzie further noted that climate change exacerbates vector-borne diseases. Together, these insights called for integrated multisectoral, multidisciplinary One Health approaches that strengthen human, animal, and environmental health systems, improve data management, and promote biodiversity conservation to mitigate the effects of disasters and emerging and re-emerging health threats.

Presentations

Health Aspect of Disaster

Professor Emeritus Dato' Dr Syed Mohamed Aljunid emphasised the critical implications of disasters on health systems, particularly the fragmentation that hampers collaboration between public and private sectors. This lack of effective coordination complicates disaster response efforts, especially when mobilising support from private entities during crises. Additionally, inadequate data sharing among various ministries further undermines disaster preparedness and response, as timely information is essential for managing future events. The fragmentation of healthcare delivery can lead to inefficiencies and gaps in care, adversely affecting health outcomes. Both natural and man-made disasters exacerbate these challenges, highlighting the necessity for a more integrated approach to healthcare. To enhance resilience against future disasters, it is essential to strengthen collaboration across sectors, improve data management practices, and address the root causes of fragmentation within health systems.

Keypoints:

- Disasters can be categorised as natural or man-made, each with distinct implications for health systems.
- Immediate effects of disasters include severe injuries and a resurgence of communicable diseases, such as cholera and malaria.
- Health systems face significant challenges, including a lack of political support and financial resources, inadequate preparedness and trained personnel, and fragmentation between public and private healthcare sectors.
- Poor data management and sharing hinder effective disaster preparedness and response.
- Unethical practices, such as corruption and conflicts of interest, undermine the efficiency of disaster management efforts.
- Strengthening health systems requires improved collaboration, better resource allocation, and enhanced data-sharing mechanisms to mitigate the impacts of future disasters.

Impact of Deforestation on Emerging Infectious Diseases

Dr Kimberly Fornace presented on understanding infectious disease outbreaks, including bird flu, SARS, and COVID-19, emphasising the emergence of various infectious diseases and their common drivers. Her presentations highlighted the link between land use changes, particularly deforestation, which are key contributors to the spillover of pathogens from wildlife to humans. She discussed how human encroachment into wildlife habitats increases the likelihood of contact between domestic animals and wildlife, which can lead to the risk of disease transmission. She pointed out that deforestation can lead to zoonotic malaria by creating new breeding grounds for disease vectors like mosquitoes. To address these emerging health issues, there is a growing interest in conserving natural habitats to prevent spillover events

and enhance public health outcomes. Collaborative efforts are essential to balance biodiversity conservation with protecting human, animal and environmental health, including ecological integrity.

Keypoints:

- Deforestation and land use changes are key drivers of emerging infectious diseases, enabling pathogen spillover from wildlife to humans and contributing to outbreaks like bird flu, SARS, and COVID-19. Significant tree cover loss from 1982 to 2016 in tropical regions has increased the risk of disease emergence.
- Deforestation fosters mosquito breeding and leads to the spread of malaria, which includes the previous rising cases of Plasmodium knowlesi in Malaysia that are linked to habitat disruption.
- Protecting natural habitats and integrating biodiversity conservation with health initiatives through a triangular approach that includes aquatic habitats, landscape composition, and human-wildlife interactions is essential for monitoring tropical zoonotic diseases.
- Addressing the underlying causes of spillover through conservation strategies and careful reforestation modelling is essential, along with enhancing pandemic response by tackling primary and secondary spillover causes.

Climate and Vector-borne Diseases

Emeritus Professor John S Mackenzie began his presentation by emphasising the significance of climate change in increasing the spread of vector-borne diseases, with over 130 diseases linked to climate change. Rising temperatures and extreme weather events enhance the survival and reproduction of vectors, such as mosquitoes, leading to faster disease transmission and geographic expansion into previously unaffected areas. For instance,Aedes albopictus, the Asian tiger mosquito, has proliferated into temperate climates, facilitating the spread of diseases like dengue and Zika in Europe and North America. Additionally, factors such as ocean warming, rising sea levels, and increased rainfall contribute to higher transmission rates. Non-climatic influences, including population density, poverty, urbanisation, and international travel, further complicate disease dynamics. The One Health approach highlights the interconnectedness of human, animal, and environmental health in addressing these challenges. Effective multidisciplinary communication, coordination, and collaboration across sectors are essential for mitigating the impacts of climate change on vector-borne diseases. Understanding the ecological dynamics of zoonotic disease transmission is crucial, especially in urban areas where biodiversity and agricultural practices influence vector behaviour.

Keypoints:

- Climate change in terms of rise in temperature, sea level and extreme weather events can enhance vector survival and accelerate pathogen development.
- Vectors can expand their geographic range into new regions, thereby increasing the risk of disease transmission.
- Non-climatic influences such as urbanisation and population density are critical in disease dynamics.

- One Health approach emphasises the need for integrated strategies across human, animal, and environmental health sectors.
- Effective public health responses are essential to mitigate the risks of climate-induced changes in vector-borne diseases.

Discussion

Question
Many pathogens are found in wildlife that have the potential to jump or spill over humans, right? There are some suggestions that we should characterise all of them so that we can predict those that can jump. However, can we predict those that can jump even if we could molecularly characterise every single one?

Answer
Professor John: We have had a major programme out of the US called PREDICT from UC Davis, Yonah Mazet, which isolated about a thousand new viruses, and only one was linked to human disease. That happened to be in Africa, and it had to be a rhabdovirus, an unusual situation. But it is very difficult to recognise whether those viruses going to be pathogenic or not. This indicates that predicting which pathogens will be pathogenic is extremely challenging. We are still far from having reliable predictive capabilities regarding viral spillover.

Dr Kimberly: I would add that instead of focusing solely on prediction, we should enhance our surveillance capabilities. By identifying high-risk areas and utilising various data sources, including satellite data, we can better monitor the potential for spillover events.

Professor John: There is a concept known as the viral virome, which involves isolating every known virus to identify potential new pathogens. However, the effectiveness of this approach remains uncertain due to the unpredictable nature of viral behaviour. (for further reading: https://pmc.ncbi.nlm.nih.gov/articles/PMC8182890/)

Dr Vickneshwaran: My experience with wildlife veterinarians suggests that while diseases in wildlife are often not treated, understanding the dynamics of these pathogens is crucial. If a virus establishes itself in farm animals, it may adapt and eventually spill over to humans. This adaptation process can lead to either a dead-end host situation or facilitate human-to-human transmission.
Suggestion from the audience: The focus on genomics for prediction may overlook critical factors such as exposure. Developing serological methods could provide more relevant insights into potential spillover risks. It is important to recognise that multiple host interactions are often necessary for a successful species jump.

Professor John: There are concerning viruses like H5N1 that show the ability to infect various mammal species, raising fears about their potential to mutate and become more transmissible among humans. Although we have been fortunate so far that there is only an occasional transmission between humans, the possibility of a mutation allowing for efficient human transmission remains a significant risk.

Question
How can we address the impact of urbanisation, particularly in slum areas, on the transmission of diseases, given that it often receives less attention compared to deforestation?

Answer
Dr Kimberly: Urbanisation plays a significant role in the transmission of diseases, often overshadowed by the focus on deforestation. Besides, disease ecology varies by region. For example, dengue is more prevalent in urban areas due to suitable breeding conditions for its vectors, while malaria is typically studied in rural settings. Sustainable urban development is crucial, as cities can become incubators for epidemics if not managed holistically. It is essential to consider not only the effects of deforestation but also how land use changes impact disease dynamics in urban environments.

Professor John: It is important not to be in silos. Adopting an interdisciplinary approach in tropical science is crucial, as focusing solely on deforestation overlooks other significant factors like urbanisation. Notably, Sarawak has emerged as a key area for studying diseases such as dengue and West Nile virus, highlighting the need for comprehensive research encompassing various ecological and urban dynamics.

Question
How does reforestation impact mosquito communities, and what considerations should be made regarding public health?

Answer
Dr Kimberly: Reforestation can significantly influence mosquito populations, with effects varying over time as forests grow. Research shows that younger forests may present different risks than older ones, particularly concerning mosquito breeding habitats. While there are public health concerns related to reforestation, such as the potential for increased mosquito populations, the benefits of green spaces for mental health and biodiversity are substantial. Therefore, it is essential to monitor these changes closely and implement effective surveillance strategies to manage any associated health risks while promoting the advantages of reforestation.

Question
Do the role of surveillance can really combat the newly emerging disease and what challenges does it face?

Answer
Professor John: The surveillance is quite hard, particularly for mosquito-borne diseases, and it should take into account the area in which we do our surveillance. If it is in urban area settings such as Singapore, the surveillance is simpler compared to an area which is more sparsely inhabited without hospitals or laboratories. While it can be challenging to monitor emerging diseases, different experts come into partnerships with organisations like WHO to enhance the support and resources for countries in need. For example, Ebola cases in Uganda's early 2000s have much expertise from different countries that come in partnership with WHO to assist in

facilitating the emerging diseases. Although surveillance may consume time and resources, it remains an essential tool for early detection and response to public health threats.

Dr Kimberly: *It is important to balance surveillance and feasibility. We suggested using syndromic surveillance and targeting priority areas with environmental and spatial data to make it more cost-effective. We also highlighted the need to simultaneously examine exposure to multiple diseases, potentially without knowing the exact disease, to assess responses to specific groups.*

Dr Vickneshwaran: *Syndromic approach surveillance had been established in the country to monitor common illnesses, which include surveillance for upper respiratory tract infections, severe acute respiratory infections, acute gastroenteritis and hand, foot and mouth disease to monitor impending epidemics in the community. It is mentioned that veterinarians also conduct surveillance on animal diseases, with over 120 sentinel surveillance programmes. We have noted that clinics and hospitals provide daily reports on the number of cases, which helps identify hotspots and trends.*

Conclusion and Recommendations

Developing improved conservation strategies focused on maintaining biodiversity is essential to control zoonotic disease transmission in tropical regions. Enhancing surveillance efforts in key areas and among vulnerable populations is crucial for effectively monitoring disease emergence. Engaging local communities in sustainable practices and incorporating advanced technologies, such as remote sensing for biodiversity assessments, can further strengthen conservation planning. Additionally, recognising the impact of climate change on zoonotic transmission requires adopting a broader perspective in tropical science, emphasising the need for enhanced research, surveillance, and conservation efforts to address these risks. By prioritising these actions, we can reduce the threat of zoonotic diseases while preserving the integrity of tropical ecosystems.

TROPICAL NATURAL RESOURCES

PROTECTION OF BIODIVERSITY IN THE TROPICS

Moderator

Ts Dr Khairul Naim Adham

Deputy Undersecretary (Biodiversity Management Section),
Ministry of Natural Resources and Environmental Sustainability

Panelists

Professor Dr Jatna Supriatna

Public Health and Community Medicine
Chairman, Institute for Sustainable Earth and Resources FMIPA UI

Datuk Dr John Payne

Chief Executive Officer, Borneo Rhino Alliance

Associate Professor Dr A. Aldrie Amir

Associate Professor, Universiti Kebangsaan Malaysia
Commission Member, IUCN SSC Mangrove Specialist Group

Report prepared by

Thracesy Munah Anak Assan

Universiti Malaysia Sarawak

Overview

The panel on tropical biodiversity highlighted critical challenges and solutions for conservation in the tropics, where biodiversity faces severe threats. Expert panellists shared their insights and experiences on critical environmental issues during the session. The panellists highlighted findings from the Global Assessment Report of Biodiversity and Ecosystem Services by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), where biodiversity is declining faster than ever in human history. The main drivers of biodiversity loss identified in the report are changes in land and sea use, direct exploitation of organisms, climate change, pollution and invasion of alien species.

Professor Dr Jatna Supriatna emphasised limited funding as a significant barrier and called for innovative financing mechanisms and the involvement of a global science panel to enhance biodiversity management. Datuk Dr John Payne discussed the difficulty of conserving large mammals, noting the need for extensive habitat conservation to maintain healthy populations and the importance of strong leadership and timely action to prevent slow-moving extinctions. Associate Professor Dr A. Aldrie Amir pointed out that many protected areas were designated without biological planning, stressing the need for strategic design and management to ensure these areas truly support biodiversity.

Presentations

The Global Science Panel

Dr Jatna discussed the importance of funding for conservation efforts, noting that limited financial resources hinder biodiversity initiatives. He stressed the need for innovative financing solutions to support conservation activities, highlighted the challenges and opportunities facing Borneo, and emphasised the role of a global science panel to enhance biodiversity management. He reiterated that biodiversity conservation requires collaboration beyond government efforts and calls for increased financial services related to biodiversity.

Keypoints:

- Funding is one the most important means for the conservation of biodiversity.
- The challenges include land-use change due to socioeconomic developments, migration, forest fire, and flooding.
- Science as one of the tools for better conservation management.
- International collaboration will promote information exchange.

Large Mammals in Malaysia

Datuk Dr John discussed the impact of habitat loss on large mammals in Malaysia, emphasising the historical context of habitat changes over the past 20,000 years. He presented a satellite image illustrating the significant reduction in natural habitats due to rising sea levels and human activities. He explained the species-area curve, illustrating the relationship between habitat area and species diversity. He noted that as habitat area decreases, the number of species also declines, highlighting the critical need to preserve existing habitats to prevent further species loss. He also emphasised the slow drift to extinction of species, indicating that immediate actions are necessary to mitigate this trend. He discussed the significance of protected areas in biodiversity conservation, pointing out that the lack of biological criteria of many protected areas in Malaysia compromises their effectiveness in conserving biodiversity.

Keypoints:

- Species are slowly drifting to extinction.
- Leadership is important in making significant decisions for conservation.
- An approach beyond government is needed.
- A larger landscape is required to sustain and maintain the number of species.

Mangrove Ecosystem Conservation

Dr Aldrie emphasised the application of knowledge to ecosystem restoration and conservation. He introduced the concept of ecosystem services, highlighting the adaptability of mangroves to tidal areas and the zonation of different species within

these ecosystems. Protecting specific areas can support biodiversity and provide essential services, such as habitat for apex predators in the mangroves. He outlined three major challenges facing ecosystems: climate change, pollution, and habitat loss. Protecting habitats allows for the provisioning of food and regulating services, which are vital for maintaining ecological balance. He also discussed the historical significance of river deltas in human civilisations, emphasising the importance of these ecosystems for both biodiversity and human development. Sea level changes affect the dynamics of habitats and ecosystems, potentially leading to the shrinkage of mangroves. The panellists warned against development in coastal areas, as it can exacerbate the impacts of climate change and pollution. He highlighted the interconnectedness of ecosystems, where pollution from land can ultimately affect marine environments.

Keypoints:

- Ecosystem conservation (mangroves) is necessary since plants cannot rejuvenate by themselves.
- Highlighting and addressing knowledge can change people's perceptions and lead to better decision-making.
- Large groups of people are involved in the conservation of the ecosystem.

Discussion

Question
How could this organisation provide solutions to our current situation?

Answer
The three main solutions are funding, leadership and appreciation of knowledge. Dr Aldrie emphasised the need for active habitat management rather than a passive approach. He argued that simply protecting areas without intervention is insufficient for effective conservation. The discussion touched on the importance of funding and leadership in biodiversity conservation, with a call for more proactive and courageous decision-making in policy. The conversation shifted to the complexities of biodiversity conservation, highlighting the need for clear values and investment in conservation efforts. He reflected on the challenges faced by civil servants and the need for genuine leadership in biodiversity-related agencies. Dr Aldrie stressed that without brave policy decisions, conservation efforts are likely to fail. The importance of collaboration between scientists and policymakers is emphasised. The panellist advocated for a bottom-up approach to conservation, where local needs drive protection efforts.

Question
What can we do about the two generations of conservationists being formed? The way older generations studied conservation in the past and what is happening now, and the willingness of new generations to spend time in the field and understand what is happening there.

Answer
The panellists highlighted the difficulties of developing new ideas and the importance of communication and understanding. The other panellist underscored the necessity of introducing innovative ideas to the private sector and concentrated on the funding constraints. The panellists' views differ in their emphasis, but both acknowledge the challenge of developing new ideas.

Question
How can the continuation of knowledge in conservation efforts influence perceptions and engage a broader audience?

Answer
Dr John believed that by presenting knowledge through photos and figures, they could change people's perceptions. He also discussed the importance of conservation and protection, emphasising the need for a team effort. Overall, the discussion features diverse views and opinions on topics such as funding, perception, and conservation. Dr John highlighted the importance of team effort, rebranding, and making conservation sexy to attract the younger generation.

Conclusion and Recommendations

The discussion highlighted the diversity of views on decision-making and accountability in environmental issues. The panellists emphasised the need for a more responsible approach and drew from their personal experience to highlight the importance of accountability. The conversation demonstrated the complexity of environmental issues and the need for collaboration and careful consideration in addressing them. The session produced the following key recommendations:

- Conservation requires collaborative efforts, and everyone has an important role to play, including individuals, governments, academics, the private sector, media, and local communities.
- Dedicated species conservation plans and actions to protect habitats are required to avert species extinction and enable the recovery of their populations.
- Landscape-level conservation is necessary because biodiversity depends on the various interconnected ecosystem services that support life. Programmes like the orangutan school reveal that addressing habitat loss and species needs directly impacts success.
- Governments often lack financial resources, necessitating a new approach that engages communities, businesses, and global allies. Tropical countries like Malaysia, Brazil, and Indonesia could lead this shift, moving beyond outdated methods.
- Communication, education, and public awareness (CEPA) are crucial, and effective programmes to reach all segments of society will significantly contribute to conservation. In this view, celebrities could help raise awareness.
- Knowledge sharing is essential. Learning from past actions can shape better policies, especially with community collaboration and multimedia engagement. Partnerships with countries like Sri Lanka and Thailand, which have implemented conservation moratoriums, offer valuable lessons. Therefore, countries must intensify their efforts to promote knowledge exchange and learn good management practices at the regional and international levels. The Topical Science Foundation also suggested creating a central repository for scientific information, which could strengthen knowledge sharing and support global conservation efforts.

TROPICAL NATURAL RESOURCES

MINERALS OF THE TROPICS

Moderator

Mr Loganathan Ponnambalam PGeol FASc

Fellow, Academy of Sciences Malaysia

Panelists

Dato' Sia Hok Kiang PGeol FASc

Executive Chairman, Malaco Mining Sdn. Bhd.
Senior Council Member, Malaysian Chamber of Mines
Adjunct Professor, Faculty of Science, University of Malaya

Professor Emeritus Tetsuro Urabe

Chief Geologist, Geological Survey of Japan
Professor, Department of Earth and Planetary Science, University of Tokyo

Ts Raja Shazrin Shah Raja Ehsan Shah

Founder and Managing Director, Galaxy Tech Solution (KL) Sdn. Bhd.

Report prepared by

Nur Azzah Osman

Universiti Malaysia Sarawak

Overview

The global population is projected to reach 8.5 billion by 2030 and 9.7 billion by 2050, increasing the demand for essential minerals that support societal progress. Minerals underpin the global economy, supporting various sectors such as transportation, technology and agriculture. Despite this, public opposition to mining is sky-high. This is due to the undeserved reputation related to unregulated mining, which poses significant issues such as the unsustainable rare earth mining in Myanmar, the artisanal mining leading to conflicts and “blood diamonds” in Congo, and illegal gold mining causing environmental damage in Columbia. This dialogue calls for sustainable and responsible mining practices to protect the environment and the industry’s reputation. Stopping illegal mining is crucial for achieving this goal.

Presentations

Economic Mineral Deposits in the Tropics

Dato' Sia Hok Kiang started his presentation by addressing the fundamental importance of minerals to life and civilisation, supporting everything from agriculture to modern technology. He raised the topic of environmental and ethical malpractice in tropical mining, discussing ways to handle and tackle these issues for sustainable mining practices. He emphasised that the future of mining depends on achieving net gain for humanity through technological progress and responsible resource management. Dato' Sia concluded his presentation by stressing the importance of collaboration to curb illegal mining and transform the outdated perception of mining into a vital component for human progress.

Keypoints:

- Tropical regions are significant for mining due to their unique weather conditions, such as high rainfall and temperature, which naturally weather and break down rock formations. This process creates secondary mineral deposits, making extraction easier and more energy efficient.
- Mining in tropical regions has a smaller carbon footprint due to the natural weathering process. This reduces the energy required for extraction, contributing to more sustainable mining practices.
- Tropical regions face issues with illegal and irresponsible mining, which harms the environment and damages the industry's reputation. A collective effort to curb illegal mining can be achieved by implementing product passport tracing for miners/mining companies.
- To achieve net gain, we need advanced technology and international collaboration to extract minerals sustainably, especially in challenging tropical regions.

Is it possible to ensure a secure supply of deep-sea mineral resources for future generations while preserving biodiversity and the environment?

Professor Emeritus Tetsuro Urabe began his presentation by discussing hydrothermal areas on the ocean floor, known as seafloor massive sulphide (SMS) deposits. These areas, located at depths of 1000 to 5000 metres, precipitate economically important minerals. He described these hydrothermal zones as an ecosystem teeming with many exotic animals inhabiting the area. In 2017, Japan successfully conducted pilot-scale mining of these mineral deposits. Professor Urabe emphasised the need to research and explore mineral deposits on the continental shelf in tropical regions. He also highlighted the importance of developing monitoring instruments to minimise environmental impact during exploration.

Keypoints:

- Hydrothermal areas, known as seafloor massive sulphide (SMS) deposits, feature hot springs at temperatures of up to 300°C that precipitate minerals like copper, zinc, lead, gold and silver.
- The SMS hydrothermal vents support a unique ecosystem with the presence of exotic animals relying on chemosynthesis rather than photosynthesis.
- There are three types of deep-sea minerals: SMS deposits, cobalt-rich crusts and ferromanganese nodules.
- Currently, there is a lack of research and exploration in the Malaysian Exclusive Economic Zone (EEZ). More exploration is needed to identify mineral deposits within the continental shelf.
- Mass mineral exploration and extraction in the hydrothermal vent ecosystems will bring environmental risks. Hence, it is important to develop monitoring systems to ensure sustainable mining.
- Hydrothermal sites are interconnected through larvae dispersal. Due to its connectivity, mining one site will affect the entire ecosystem.

ESG in Mining and Mineral Industries

Ts Raja Shazrin Shah Raja Ehsan Shah started his presentation by explaining the ESG (Environmental, Social, and Governance) Materiality Model as a straightforward reporting framework that will serve as the basis to map out the NR-REE (now known as Ion-Adsorption Clay Rare Earth Elements) business supply chain in Malaysia. He highlighted the crucial role of materiality in understanding the impact of business activities on stakeholders and underscored the need for standardised reporting to ensure transparency and traceability. He advocated for regional collaboration in research and development to better understand ecosystem interactions. Ts Raja Shazrin concluded his presentation by emphasising the importance of raising awareness about sustainability and managing impacts responsibly.

Keypoints:

- The ESG Materiality Model for NR-REE Industry in Malaysia is a framework that encapsulates the interactions between stakeholders and materiality components within the environment, social, and governance pillars of ESG.
- The ESG Materiality Model will describe the materiality (significance) of each topic with the lifecycle stages of the NR-REE ecosystem. Mapping lifecycle stages (e.g., startup, expansion) with materiality topics (e.g., waste management, emissions) is crucial for transparency.
- ESG Materiality analysis will map the NR-REE business supply chain in Malaysia, identifying the risks and opportunities associated with each component.
- Materiality in ESG refers to the importance and financial impact of specific measures within a company's overall ESG analysis. Material factors are financial elements considered crucial for the long-term success of a company's ESG strategy.
- Implementing a standardised ESG Materiality Model for the NR-REE industry in Malaysia is essential for better traceability and control over the supply chain.

- Encouraging regional collaboration for the research and development of a standardised ESG Materiality Model for NR-REE industry to understand the interaction between mining activities and ecosystem services.
- Integrating Planetary Health Science and Environmental Impact Assessment (EIA) into the ESG Materiality Model for NR-REE industry to assess the impact of large projects on the environment is crucially essential.

Discussion

Question
Can we continue to progress by extracting more minerals and expanding mining operations indefinitely, or is there a limit to growth? At what point must we acknowledge that resources are finite and may eventually run out? Are resources truly infinite, allowing us to carry on without concern, or must we recognise the potential for depletion and plan accordingly?

Answer
Dato' Sia: Humanity must progress, and achieving net zero is not the sole solution. Back then, we used Fortran with punch cards; now, we have advanced technology. Progress stems from discovering new minerals and improving extraction methods. Recycling is essential but limited, as it cannot recover 100% of materials. Therefore, a holistic approach is needed, combining recycling with new discoveries and more efficient extraction methods. If we can recover 90%, we will still lose 10%, which will hinder progress. Thus, recycling must be complemented with new discoveries and better extraction techniques. This balanced strategy ensures sustainable advancement for human civilisation.

Ts Raja Shazrin: The concept of sustainability is widely discussed, and its definition is often debated. Historically, when we first talked about sustainability and the depletion of resources, we were primarily concerned about the nightmare scenario of running out of fossil fuels. Ironically, if fossil fuels had run out 10 years ago, it might have been a blessing in disguise. The real question now is not whether minerals will eventually be exhausted, but rather whether their extraction will cause significant destruction and disturbance to ecosystem services. That is the critical issue we need to address.

Question
Are there any international protocols currently in place that either discourage or encourage the mining of deep-sea minerals?

Answer
Professor Tetsuro: There is much debate about mining the deep-ocean floor due to the unique and exotic creatures living there. Environmentalists often argue against it, but their concerns are based on limited information. Research is crucial because the deep-ocean floor is highly interconnected, and species have survived millions of years of Earth's history. Understanding these ecosystems and individual life forms is essential for developing sustainable mining practices. If we need more metals in the future, deep-ocean mining could be a viable option as it does not necessarily harm rainforest systems. This approach requires thorough knowledge and careful planning.

Question
How long do you think it will take to fully understand these ecosystems and confidently say that our knowledge is complete? Additionally, I have a speculation: there is significant research on asteroid mining, and similar debates are being raised. The first sample has already been dropped. Is there any collaboration between

n researchers working on deep-sea mining and those involved in asteroid mining?

Answer

Professor Tetsuro: That is a very difficult question to answer. As an environmentalist and a member of an environmental NGO in Japan, I understand the importance of caution. The principle often applied is, “If we do not know, we should not act”. To convince others to accept mining, we need a solid scientific foundation. In Japan, for example, when conducting exploration research, I always collaborate with biologists and microbiologists, and we often invite young students from neighbouring countries. This interdisciplinary approach is crucial. Collaboration among scientists from various fields is essential to finding solutions. Regarding asteroid mining, while it may not be my area of expertise, the issues raised are indeed very similar.

Dato’ Sia: As a follow-up to your question, humanity must continue to grow. Is there a limit to growth? Personally, I do not believe there is. With advancements in AI and other technologies, our next generation will keep progressing. However, there will come a time when easily accessible terrestrial resources are depleted. The Japanese research is expanding our scope and potential, exploring horizons that are not yet within reach. Sustainable deep-sea mining methods could soon supplement our resource needs. Although this effort is not currently feasible for mining, it represents a treasure chest for future generations, falling into the "not yet" category.

Question

What percentage of the current mineral market cannot meet chain-of-custody requirements?

Answer

Ts Raja Shazrin: I am working with the Department of Minerals and Geoscience to establish a carbon emissions baseline for minerals in Malaysia. While I do not have an exact chain of custody data, responsible miners tend to comply. Similar to the timber industry, many miners are unregistered. I recommend digital product passports (DPP) using QR codes or blockchain to ensure secure, tamper-proof information. This could improve compliance and value. The framework must be useful, with gatekeepers ensuring materials are only bought if they come with a DPP.

Dato’ Sia: The rare earth industry in Malaysia is still emerging, with rare earth-bearing ion-adsorbed clay deposits discovered around 2015. Illegal mining in Malaysia has been an issue, but legally, only one pilot mine has been approved by the government to operate, adhering to a specified set of Standard Operating Procedure (SOP) guidelines. In its study, which was conducted as a strategic partner to the Ministry of Natural Resources and Environment (NRES), the Academy of Sciences Malaysia promotes and recommends digital product passports (DPP) for a better chain of custody. From 2027, manufacturers like those in Clank using Chinese rare-earth materials will face restrictions. Malaysia's mining industry is transitioning from primitive methods to international standards. Compliance and responsible mining are crucial for global market acceptance. I am developing an ESG-compliant rare earth separating plant to ensure high standards and market competitiveness.

Conclusion and Recommendations

Promoting sustainable mining and advancing research is critical to addressing global resource demands while preserving the environment. This includes implementing product passport tracing to ensure compliance with ESG standards and adopting best practices for responsible mining in tropical and deep-sea regions. Increased exploration in underexplored areas, such as the Malaysian Exclusive Economic Zone (EEZ), is essential for identifying mineral deposits, including placer heavy-mineral deposits. Additionally, investing in innovative technologies to locate and extract deep-sea minerals can drive sustainable mining forward. International scientific collaborations play a vital role in developing sustainable extraction methods, sharing global knowledge, and adopting best practices. Simultaneously, environmental protection must remain a priority by using monitoring systems to minimise mining impacts and safeguard unique ecosystems, such as hydrothermal vents and tropical biodiversity hotspots, while balancing current needs with long-term sustainability.

To ensure responsible mining practices, it is important to establish a standardised ESG Materiality Model for Malaysia's NR-REE industry to guarantee transparency and traceability across the supply chain. Raising awareness about sustainability as a core value, comparable to deeply held cultural beliefs, can inspire stronger commitments to responsible mining. Additionally, mapping the lifecycle stages of mining activities and identifying their material impacts—such as land clearing, process changes, and new technology applications—will help minimise environmental disruptions. By integrating these efforts, sustainable resource management can be achieved while fostering a deeper understanding of how mining activities affect stakeholders and ecosystems.

TROPICAL ARCHITECTURE AND ENGINEERING

DESIGNING TOWARDS NET ZERO IN THE TROPICS (INDIGENOUS DESIGN)

Moderator

Ir Dr Chong Kok Hing

Swinburne University of Technology Sarawak

Panelists

Ar Dr Serina Hijjas

Director, HIJJAS Architects & Planners

Arq Laurent Troost

TROOST + PESSOA Architects

Professor Robert Powell

Architect/Author, Robert Powell Studio

Report prepared by

David Wee Hong-Sheng

Universiti Malaysia Sarawak

Overview

Climate change has brought about negative consequences in the tropics. Rising temperatures necessitate the need for cooler buildings for inhabitation. However, the effort to actively cool buildings using air-conditioning systems comes with expensive energy expenditure and additionally heats the surrounding environments. A positive feedback loop is thus created, increasing the need for cooler buildings in an increasingly hotter world. Therefore, it is pressing to redesign buildings to be greener by using architectures that can exploit natural passive cooling and ventilation processes to drive down both energy expenditure and heat generation. Despite this, implementation of green architecture is not widespread mainly due to higher associated costs and efforts. Action by relevant authorities is needed to incentivise and promote the construction of greener buildings by implementing relevant building codes and policies.

Presentations

Modern Tropical Architecture

The presentation started off by citing that meaningful architecture and urban planning in response to climate change come from individual visionary architects and urban planners. It was emphasised that the architecture of modern buildings needs rethinking to be more sustainable and ecological. Examples of different buildings with sustainable designs tied to their functionalities were provided. In these examples, a central theme can be observed that buildings need to be cooler by exploiting passive processes by incorporating plants, and strategically designed with natural geographical features in mind. The showcasing of successful ecological buildings in real-life is important as it serves as inspiration and success story to the international community, pushing for more greener building architecture in the future.

Keypoints:

- Examples of modern architecture employing ecological and sustainable designs were provided.
- The Cinnamon Hill House in Lunuganga by Geoffrey Bawa is ideal in the tropics and would have features such as being built around trees, an open-to-sky living room, and tall roofs for ventilation.
- For larger buildings such as skyscrapers in the tropical megacities, he cited the work of Ken Yeang's Bioclimatic Skyscraper, which incorporated designs such as shading, solar- and wind-related orientations, and spaces for landscaping to highlight regional flora expression.
- The plant box house designed by Lee Cherng Yih was used to illustrate the incorporation of plants and food crops in houses, with architecture strategically designed to allow for stack ventilation and ground cooling.
- Incorporating features such as those found in the Blimbingsari International Airport allows a reduction in energy expenditure for air cooling systems by taking advantage of passive cooling associated with plants.
- To achieve net-zero emissions, international action and collaboration are required to unite stakeholders.

Adopting Sustainable Designs

The tropics has a relatively stable climate throughout the year, with certain notable localised weather conditions. Thus, building architecture in the tropics needs to be contextualised with the local climate in mind. Urban development coupled with climate change has led to cities getting hotter, worsening the heat stress in urban areas known as the urban heat island effect. There is a need for cooler environments, to bring about cooler buildings, which drive towards cooler cities. This can be achieved by carefully planning buildings such as geographical orientation, sustainable construction materials, and employing trees. Overall, advancing towards net zero requires prioritising nature-based solutions with passive designs, followed by active solutions such as energy efficiency and renewable energy.

Keypoints:

- The tropics has a relatively stable climate throughout the year with certain typically associated parameters such as being warm and humid, longer exposure to solar irradiation, and a lot of rainfall.
- Hotter cities increase energy expenditure, leading to a rise in indoor air-cooling systems. This, in turn, leads to an increase in indoor air pollution associated with decreased indoor ventilation.
- It is incentivised to build green buildings to reduce energy consumption, water usage, and carbon dioxide emissions.
- Nature-based solutions such as growing trees on buildings can passively reduce temperatures.
- Timber as a building material – compared to concrete – has lower carbon emissions and can be recycled after a building is decommissioned. This highlights the need to think about the lifecycle of building materials.

Incorporating nature as part of building design

Instead of constructing new buildings, there is a need to reduce the number of underutilised buildings. Several building projects incorporating plants into building architecture were introduced. Buildings should also be tailored to fit their natural environment rather than tempering the environment to fit the building. Despite this, policies and building codes are the best pushers in promoting the development of ecological buildings. Different tropical countries should share ideas and learn from one another in furthering this endeavour towards sustainable cities.

Keypoints:

- Plants could be incorporated as part of a building structure. The presenter gave real-life examples of flowering creeper plants used as cladding to cover the exterior of building walls, provide natural shade and cooling, and be aesthetically pleasing and dynamic. Instead of traditional roofing, arches could be built to support the growth of creeper plants to cover small-scale buildings.
- Construction of buildings should not be done in a way that alters the habitat of the area. Instead, the habitat can be preserved in a way that becomes part of the atmosphere of the building environment.
- The bottleneck of constructing more sustainable buildings can be lifted by pushing for more relevant policies and building codes, in which different countries may be able to learn from one another due to regional differences in governance.

Discussion

Question
There is a lot of emphasis on building greener buildings, but is there a way to transform existing buildings greener?

Answer
Dr Serina: There is a shift towards the idea of incorporating more regenerative design into buildings. Green design can involve the incorporation of plant elements and performative aspects such as energy, water, waste reduction, and other areas of sustainability science. Different countries would need to respond differently depending on the regional context. For example, the main driver of pushing for green buildings in megacities like Singapore is to tackle urban heat stress. On a larger scale, cities can also be made greener by providing better connectivity for optimal transportation networks as well as having more shaded areas present. There is also difficulty in pushing for universal adoption of greener buildings. For poorer households, it may be difficult to push for the adoption of green building elements as the priority is on financial security.

Question
How to tackle the issue of humidity associated with incorporating plants in green buildings?

Answer
Arq Laurent: Humidity is generally not considered an issue, but heat is the main problem. In parts of Brazil that are far from the sea, steel could be incorporated into buildings to reduce structural damage caused by humidity.

Question
Are there guidelines to ensure that the tropical plants being incorporated to add aesthetic value are indigenous?

Answer
Dr Serina: The information could probably be found in ILAM (Institute of Landscape Architects Malaysia).

Professor Robert: A book titled “Gardens of Imagination” could also serve as an inspiration to landscaping design and ideas for tropical architecture.

Question
Do architects need to take responsibility for the “monstrosity” of poorly designed buildings in our city? Also, what is the pricing for some of the green buildings that have been shown, and how can those designs be translated into the low-cost housing ecosystem in Malaysia?

Answer
Dr Serina: The responsibility largely falls on the housing developers. In Malaysia, the development of low-cost housing is done by housing developers, not the government.

Low-cost housing in Malaysia suffers from a lack of insulation, poor ventilation, and poor spatial designs. The poorly insulated concrete structures of low-cost housing act as a heat sink, heating houses during the day and releasing the heat at night. Housing developers will try to build as cheaply as possible, and the government needs to take responsibility for this realm. Housing developers also want to avoid the responsibility of maintaining infrastructure associated with green buildings, such as gardens.

Arq Laurent: For the housing developers to build green buildings, they had to be convinced that the development costs were lower. Part of the rationale is that green buildings can reduce other costs, such as glazing costs, cooling infrastructure, and so on. An effort must be made to convince housing developers about the financial incentives associated with green buildings.

Question
How do we move forward with implementing green design in low-cost housing?

Answer
Arq Laurent: Ideas about building codes should be shared between different regions and adapted to suit local contexts.

Dr Serina: There is a need to implement passive cooling processes into low-cost housing to make them more liveable for residents.

Professor Robert: There are three ways to move forward. Firstly, there is a need for the right leaders. Secondly, the education system needs to move forward in contextualising climate change into the respective subjects. Thirdly, architects and engineers should have the vision of changing the world for the better.

Conclusion and Recommendations

There is an urgent need to implement green building designs to address the rising temperatures in cities, which is becoming an increasingly critical issue. However, systemic challenges exist in translating technical knowledge in green architecture into practical, real-world applications. To overcome these obstacles, better leadership is needed to implement effective policies and building codes that incentivise the construction of green buildings. Additionally, lowering the costs of green buildings could further encourage developers to invest in sustainable construction practices. It is also essential to showcase successful green building projects to the international community, as these can inspire and motivate others to adopt similar practices for a more sustainable future.

TROPICAL ARCHITECTURE AND ENGINEERING

NEW AND EMERGING SMART SUSTAINABLE MATERIALS FOR THE TROPICS

Moderator

Professor Ir Dr Mohd Sapuan Salit

Head, Advanced Engineering Materials and Composites Research Centre,
Universiti Putra Malaysia

Panelists

Professor Dr Suttichai Assabumrungat

Bio-Circular-Green Economy Technology and Engineering Center (BCGeTEC)
Chulalongkorn University

Professor Charles Oluwaseun Adetunji

Director, Research and Innovation
Edo State University Uzairue, Nigeria

Professor Armando Tibingin Quitain

Deputy Director, Center for International Education
Kumamoto University, Japan

Professor Christobal Noe Aguilar

BBG-DIA, Food Research Department
Universidad Autonoma de Coahuila, Mexico

Report prepared by

Saffrullah Iqhram Khan

Universiti Malaysia Sarawak

Overview

The tropics, known for their abundant biodiversity and natural resources, face significant sustainability challenges due to environmental degradation and resource inefficiencies. This dialogue emphasised leveraging local bio-based materials and advancing biodegradable alternatives to address these issues. The discussions explored the potential of tropical biomass for renewable energy, the use of synthetic biology for environmental restoration, and the development of eco-friendly materials using cutting-edge technologies. Panellists highlighted the importance of interdisciplinary approaches, fostering regional and international collaborations, and integrating biotechnology with traditional knowledge. The outcomes stressed the need for inclusive policies, private-sector partnerships, and community engagement to drive sustainable innovations tailored to the unique needs of the tropical region.

Presentations

Local Bio-Based Materials and the Bio-Circular Green Economy

Professor Dr Suttichai Assabumrungrat focused on Thailand's approach to leveraging local bio-based materials within its tropical environment to promote sustainability. He elaborated on the Bio-Circular Green (BCG) Economy model, which integrates principles of sustainability, circular economy, and innovation to address the United Nations Sustainable Development Goals (SDGs). The BCG model advocates for the responsible use of biomass, including agricultural and natural residues, to produce eco-friendly materials and reduce dependence on unsustainable resources.

Despite the model's potential, Professor Suttichai identified key challenges such as the high costs associated with bio-based material production, the limited incentives provided by governments and industries, and insufficient policy frameworks. To overcome these barriers, he suggested stronger policies, including bans on unsustainable materials, alongside support for green production practices. By fostering policy reform and encouraging public-private collaborations, tropical regions can unlock the potential of bio-based solutions.

Keypoints:

- Bio-based materials are essential for sustainable development in the Tropics.
- Thailand's BCG Economy emphasises circularity, sustainability, and innovation.
- Key challenges include high production costs, lack of incentives, and weak policy support.
- Strong government policies and industry incentives are needed to drive adoption.

Biotechnology and Agricultural Integration in the Tropics

Professor Charles Oluwaseun Adetunji explored the transformative potential of biotechnology in the tropical context, particularly its integration with agriculture, to address key environmental and sustainability challenges. He emphasised the importance of understanding and cataloguing tropical biodiversity to identify unique traits that can be harnessed for agricultural innovation. Through synthetic biology, researchers are developing crops more resilient to tropical climates, requiring fewer pesticides, and providing enhanced nutritional value.

Professor Charles also discussed the role of biotechnology in conservation and environmental restoration. Notable examples include the development of cassava-based bioplastics and algae-based renewable energy solutions, which tackle issues such as plastic pollution and fossil fuel dependency. He highlighted the importance of involving local communities and leveraging traditional knowledge alongside modern science to create culturally relevant and sustainable solutions.

Keypoints:

- Cataloguing tropical biodiversity is critical for innovative agricultural practices.
- Synthetic biology enhances crop resilience, minimises pesticide use, and improves nutrition.
- Tropical resources like cassava and algae are being utilised for bioplastics and energy production.
- Local community involvement and integration of traditional knowledge are vital for success.

Advancing Biomass Technologies Through Global Collaboration

Professor Armando Tibingin Quitain emphasised the role of global collaboration and regional partnerships in advancing biomass technologies for tropical regions. He described Japan's initiatives, including the JST Sakura Science Exchange Program, which facilitates student mobility between ASEAN countries and Japan to promote the development of tropical science. These programmes enable ASEAN researchers to explore Japan's biomass technologies, such as hydrochar production and microwave carbocatalysis.

Professor Armando highlighted the use of tropical biomass feedstocks, including algae and palm oil residues, for developing renewable energy and biodegradable materials. Innovations such as water-based catalytic processes and advanced material synthesis were also discussed, showcasing eco-friendly technologies that minimise environmental impact. By fostering collaborations between academia, industry, and governments, these initiatives aim to accelerate the adoption of sustainable technologies across the tropics.

Key points:

- ASEAN-Japan collaboration drives innovation in biomass technologies.
- Biomass feedstocks like algae and palm oil residues are key to renewable energy solutions.
- Eco-friendly technologies include hydrochar processes and catalytic methods.
- Regional and global partnerships are essential for scaling sustainable innovations.

Circular Economy and Fungal Technologies for Sustainable Materials

Professor Christobal Noe Aguilar discussed the integration of circular economy principles with fungal and microbial technologies to address sustainability challenges in the tropics. He highlighted the potential of agricultural waste, such as corn and cassava residues, to replace conventional plastics through fungal treatments and bioprocessing methods. These technologies not only reduce dependency on non-biodegradable materials but also provide innovative ways to manage agricultural waste.

Professor Christobal shared successful examples of public-private collaborations, such as working with Kelogg's Mexico to convert cornflake starch into biodegradable packaging. He emphasised the role of interdisciplinary research and industry engagement in developing scalable and impactful solutions. Additionally, he called for stronger government policies and community involvement to support research initiatives and raise awareness about sustainable practices.

Key points:

- Agricultural waste can be transformed into biodegradable materials using fungal and microbial technologies.
- Circular economy principles promote resilience and waste reduction.
- Public-private partnerships are essential for scaling bioprocessing solutions.
- Policies and community engagement are necessary for advancing sustainable materials.

Conclusion and Recommendations

It is crucial to foster regional and global collaborations to advance biomass technology, sustainable materials, and renewable energy in the tropics. Developing inclusive policies and government incentives will help promote the adoption of bio-based and biodegradable materials, encouraging sustainable practices. Interdisciplinary research and public-private partnerships should be encouraged to tackle pressing environmental challenges, such as waste reduction and plastic pollution. Increased investment in capacity-building initiatives, including student and researcher exchange programmes, can enhance knowledge sharing and spur innovation. By utilising biotechnology and local resources, integrating traditional knowledge with modern science, we can create culturally relevant and sustainable solutions. Strengthening circular economy practices is also vital to improve climate resilience and minimise waste, ensuring a more sustainable future for the tropics.

OPEN SCIENCE IN TROPICAL BIODIVERSITY

COMPATIBILITY & INTEROPERABILITY OF TROPICAL BIODIVERSITY DATASET

Moderator

Professor Dr Habibah A Wahab FASc

Deputy Vice-Chancellor, Research and Innovation, Universiti Sains Malaysia

Panelists

Dr Helen Nair FASc

Chairperson, Precision Biodiversity Alliance, Academy of Sciences Malaysia

Datuk Professor Dr Ghazally Ismail FASc

Former Project Director,'Bringing Back Malaysia's Natural Heritage Held Overseas', Ecotourism and Conservation Society Malaysia

Dr Rahimatsah Amat FASc

Chief Executive Officer, Sabah Environmental Trust

Report prepared by

Henry Adam Anak Segaya

Universiti Malaysia Sarawak

Overview

Malaysia holds unique responsibilities in protecting its ecosystems as the 12th mega-biodiversity nation. In facing pressures, open science can provide transformative tools that can promote data sharing, collaboration efforts, and informed actions. This approach supports conservation efforts within Malaysia and aligns with Global Biodiversity Goals by creating reliable data accessible across borders, enabling more robust and coordinated responses to ecological challenges. Malaysia can leverage its rich biodiversity through open science for sustainably informed stewardship. Open Science promotes transparency and a collaborative approach to research by encouraging the sharing of data, methodologies, and findings across platforms and institutions. This initiative allows for a more accessible and inclusive experience, allowing researchers, policymakers, and even the public to benefit from the collective knowledge produced by scientific efforts. Malaysia's open science platform has been acknowledged by the Academy of Sciences Malaysia, whereby this initiative aligns with the vision by advocating for openly accessible data and research practices that enhance collaboration across scientific disciplines. It is pertinent to discuss the practicality of open science to local conservationists and global scientists to access and contribute to national biodiversity data. This initiative not only forces this innovation but also ensures biodiversity management in Malaysia is informed by the latest research, shared responsibly, and used to strengthen conservation outcomes.

Presentations

Precision Biodiversity Strategic Report and How Open Science in Technology and Innovation is Shaping the Future of Biodiversity Composition in Malaysia

Dr Helen Nair FASc started her presentation by highlighting the importance of biodiversity through the 2020 Global Biodiversity Outlook report, which discusses the loss of a significant number of animals if no interventions are taken. She stressed that those from the tropics should take charge of the direction of biodiversity management since most of the biodiversity is found in the tropics. Open science can help complement next-generation technological approaches to conserve, monitor and manage biodiversity. The vision is for nations to become informed and inspired to value and conserve bio-resources while recognising the importance of investing in frontier technologies and ensuring responsible and ethical stewardship of our ecosystem, incorporating advanced technology such as artificial intelligence (AI) and the internet of things (IoT) to build ecological simulations and sustainable management of biodiversity. Currently, digitalisation has been done on 2 hectares out of 50 hectares of the Forest Research Institute Malaysia (FRIM) plots. Collaborators on board are UPM and UTM on flora and fauna, as well as insect collections of UKM. Software development will be implemented in collaboration with organisations within an alliance with other states, including Sabah and Sarawak. This repository will be openly available and usable by other data scientists, hopefully facilitating collaboration within research communities.

Keypoints:

- Two-thirds of the world's Biodiversity are known to reside in tropical areas.
- Biodiversity is important as it supports mankind's necessities such as food, shelter, medicine, etc., and is even useful for anthropogenic activities in economics.
- MyBIS acts as a one-stop repository to manage the deposited data and facilitate the access of these Malaysian biodiversity data to other researchers.
- The MOSP initiative helps to strengthen the science, technology and innovation ecosystem, including local biodiversity.

What is Open Science and Digitalisation of Local Data Using ALAM-BoT

Datuk Professor Dr Ghazally Ismail FASc started his presentation by describing the definition of open science and the differences between the ideology of science as knowledge and power from the previous generation to the new generation. Science should not be selfish and should be accessible. Through promoting open science, barriers to propriety rights can be broken through the sharing of knowledge. An open science platform implemented on Malaysian biodiversity can help to keep researchers informed on the current biodiversity status and species, which was previously associated with data accessibility issues without the proper platform. In climate change, the main components usually discussed are global warming and carbon

emissions, whereas loss of biodiversity should also be discussed as it is an outcome of the immediate effects of climate change. Knowledge of Malaysian biodiversity can be turned into resources using artificial intelligence (AI). The digitalisation of local data from Malaysian biodiversity knowledge made these resources accessible and usable for research collaborations and data repositories by implementing ALAM-BoT.

Keypoints:

- Open science helps break propriety rights barriers by sharing knowledge across a shared platform.
- No changes in local data when searched online, and currently, no access to the thesis done by local researchers on local biodiversity data.
- Biodiversity can be turned into resources by digitalising local data done by local researchers on Malaysian biodiversity, and this knowledge can be made accessible using the newly implemented artificial intelligence ALAM-BoT.
- Loss of biodiversity is worth noting as it can be an immediate outcome of climate change apart from climate change and carbon emissions.

Biodiversity at Risk Despite Efforts to Manage it

Dr Rahimatsah Amat FASc began his presentation by talking about the framework from Sabah Environmental Trust. Threats to certain wildlife have been identified, and efforts have been put into place, but species are still declining. Camera trapping can be used to estimate the number of populations, such as the tiger species in Peninsular Malaysia and even the Amur tiger in the Russian Far East and North China. The correct estimation of the population number of species should use software analysis to determine the same patterns implying the same individuals to avoid multiple counting. Other species affected are also implied. Other factors should be accounted for when doing analysis and estimation, such as gender and other important physiological characteristics. Better understanding can be achieved using new technology to study healthy populations.

Keypoints:

- The framework of Sabah Environmental Trust is based on the Value and Complexity
- Despite efforts to mitigate and conserve certain wildlife after threats have been identified, the number of individuals of certain species is still declining.
- Software can be used to identify stripe patterns from the camera trapping data and found that the same male tiger can be found in both countries, China and Korea.
- Examples of upcoming threatened species are the banteng, tapir and pygmy elephant due to upcoming issues.
- Apart from numbers, the mindset should be changed, and other factors should be investigated, such as gender ratio, age groups (productive groups), and the distance of gender locality as well as mass-body conditions such as health.
- In ensuring better count, research should adapt to new technology in making better decisions and understanding the viable wildlife populations.

Discussion

Question
On the role of open science in enhancing biodiversity research, what should stakeholders understand as the most important issues addressed in the report?

Answer
Dr Helen: It is shown from the presentations of other panellists that there are lots of data gaps from the country and the region of the tropics. If researchers can document and store the data while allowing it to be accessible to the tropics and globally, this will put environmental management in a better position. Good leadership is needed for good support and direction. In Malaysia, this step has been supported by ensuring that the government and the alliance group implement and roll out the projects' findings responsibly. The data deposited into the Malaysian Open Science Platform should be reproducible, accessible and acceptable worldwide.

Question
How can AI such as the ALAM-BoT enhance open science initiatives by making biodiversity data more accessible and useful to a broad audience?

Answer
Datuk Dr Ghazally: The generative AI will help break the barriers of proprietary rights and turf-guarding by making data openly accessible as knowledge. Knowledge of biodiversity data will remain unchanged unless it is turned into a resource using the ALAM-BoT and will be used for environmental, social and governance (ESG). ESG reports require mitigation factors for climate change, which usually describe rising temperatures. Industry leaders could not see the impact of the company initiatives. This is where ESG reports state that loss of biodiversity should also be used as a parameter termed biodiversity credits. This is an example of how biodiversity knowledge can be used as resources in the form of biodiversity credits.

Question
Given the diverse datasets and AI applications, what are the key steps to help align this new data with the existing biodiversity database within Malaysia and across Asia? How can we ensure that this technology truly enhances compatibility rather than just adding complexity?

Answer
Datuk Dr Ghazally: The AI named ALAM-BoT was done by a developer who previously developed the same AI software used for Buddhism regarding philosophy and teachings. Generative AI has been successful in several countries and has even been invited to present the findings. The ALAM-BoT was then conceptualised on the software but using the Malaysian biodiversity data as well as the unpublished thesis that was previously written in the Malay language. This will help to make the findings from these resources known publicly using ALAM-BoT.

Question
Most technologies like remote sensing and IoT are evolving rapidly; how do these innovations contribute to more consistent and interoperable biodiversity data, especially in remote or protected areas? What are its unique benefits to conservation efforts in this challenging environment?

Answer
Dr Rahimatsah: Using current technology, a larger area can be covered. Such facilities that can be used are wildlife cameras and surveillance cameras to study the mass-body conditions of a studied animal population. Besides that, collared rings for elephant satellite images are an example of tracking wildlife movements. Network coverage is also important in surveillance, such as the network availability and network platform. Looking into the different sides of open science, readily accessible might provide unwanted impacts such as information checking by poachers such as elephants, rhinos or even agarwood. Inter-department data are not readily accessible, which inhibits researchers. The technology of open science can also help in terms of recording or even animal calls.

Datuk Dr Ghazally: Currently, AI is intended to be used for colour recognition, where it works by using satellite images to detect illegal logging through image or colour changes.

Conclusion and Recommendations

Strong collaboration is essential to support the movement of open science, promoting knowledge sharing for better-informed decision-making in conservation efforts and the digitalisation of data. Researchers should actively document and make their findings accessible through open science platforms, ensuring continuous data collection for ongoing projects. Malaysian biodiversity data deposited into repositories such as ALAM-BoT and My-BIS should not only be accessible but also compatible and usable for researchers both within the tropics and globally. Conservation and management efforts should expand beyond conventional methods, incorporating advanced technologies like AI, IoT, and Big Analytics to provide rapid insights and enhance decision-making.

CLIMATE CHANGE IN THE TROPICS

Moderator

Associate Professor Dr Sharina Abdul Halim

Deputy Director, Institute for Environment and Development (LESTARI, UKM)

Panelists

Professor Edvin Aldrian

Agency for Assessment and Application of Technology (BPPT) Jakarta
IPCC Working Group, Vice Chair

Professor Ülo Mander

Professor, Physical Geography and Landscape Ecology, University of Tartu (UT), Estonia

Associate Professor Dr Liew Ju Neng

Department of Earth Science and Environment, Universiti Kebangsaan Malaysia (UKM)

Report prepared by

Abu Huzaifah Latip

Universiti Malaysia Sarawak

Overview

The impacts of climate change in the tropics are becoming very critical. Being part of the community in the tropics, we are on the front line of this issue. As the front line, we must address this situation in an urgent manner and think strategically about how we could bring the collective effort together in addressing this critical moment. The recent Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) confirms that humans are the primary cause of climate change. The temperature has increased to about 1.1 degrees warmer than previously reported from 1850 to 1900. This dialogue addressed climate change impacts, especially on the increasing urgency and action we must take to build climate resilience development in the tropics.

Presentations

Sustainable Palm Oil under Climate Change in Indonesia

Professor Edvin Aldrian started his presentation by addressing the peatland-drained forest in Central Kalimantan, Indonesia. According to Professor Edvin, emission from peatland is one-third (314 gC m-2 y-1) compared to absorption or sink from natural forest (970 gC m-2 y-1). The largest source of absorption (carbon pool) in Indonesia proves that the accusation of the large emission contradicts the large absorption capacity of Indonesian soil and forest. Rewetting of peatland must be conducted. Professor Edvin said that from research, oil palm trees can absorb 13.7 tonnes of CO2 per hectare but release 3.6 tonnes per hectare of CO2. It seems okay because, from all the CO2 released from the palm tree, about 75% of the gas will be absorbed again. From the statistics, Kalimantan has a higher percentage of planting oil palm on peat. We must use artificial intelligence (AI) to adapt and mitigate climate change.

He concluded his presentation with a few points. First, we need a third of an acre of virgin forest to balance the effect clearance of an acre of forest for plantation. Second, he said that future climate model scenarios using SRES scenarios indicate a reduction of suitable areas for palm oil in Indonesia and Malaysia, especially after 2700. Last but not least, Professor Edvin emphasised that there is a need to improve climate modelling using soil type dynamics, the new IPCC model scenario of RCP and SSP, as well as ecological dynamics.

Keypoints:

- Emission from peatland is one-third (314 gC m-2 y-1) compared to absorption or sink from natural forest (970 gC m-2 y-1).
- Rewetting of peatland must be conducted.
- Using artificial intelligence (AI) to adapt and mitigate climate change.
- A third of an acre of virgin forest is required to balance the effect clearance of an acre of forest for plantation.
- Climate modelling needs to be improved using soil type dynamics, a new IPCC model scenario of RCP and SSP, and ecological dynamics.

Tropical Peatland Forest

Professor Ülo Mander started his presentation by introducing tropical peatlands. Tropical peatland forests, covering just 3% of the earth's land, play a critical role in climate regulation, storing 30% terrestrial organic carbon and 10% global nitrogen. These ecosystems are key to mitigating greenhouse gas emissions through peatland restoration, which preserves carbon and reduces CH4 and N_2O emissions. However, the role of the canopy (phyllosphere) in transforming CH_4 and N_2O remains poorly understood, and studies on N_2O fluxes and canopy transformation processes are limited. Professor Ülo Mander emphasised the need for advanced techniques for continuous measurement because the current process-based models do not consider the unimodal relationship between soil water content and N_2O fluxes.

According to Professor Ülo Mander, to effectively address these challenges, inter-regional collaboration is essential for peatland protection and restoration. Such efforts combat climate change and enhance our understanding of peatland processes. Filling these knowledge gaps and adopting innovative methods will strengthen peatland management strategies, making them a critical pathway to mitigate greenhouse gas emissions and sustain these vital ecosystems.

Keypoints:

- Tropical peatland forests are critical in climate regulation, storing 30% of terrestrial organic carbon and 10% global nitrogen.
- We need advanced techniques for continuous measurement of the role of the phyllosphere in transforming CH4 and N2O.
- Inter-regional collaboration is essential for peatland protection and restoration.
- Understanding peatland processes will strengthen peatland management strategies.

Variation and Changes Over the Tropical Maritime Continent

The presentation started with an introduction to the interaction between climate and global warming. According to Associate Professor Dr Liew Ju Neng, the climate is shaped by interactions between air, sea, and land, but these interactions are increasingly disrupted by global warming. The tropical maritime continent hosts one of three active convection centres, which supply energy to drive global circulation through the Hadley and Walker systems, linking it to other parts of the world. However, changes in the tropics are evident, including altered tropical cyclone frequency, expansion of tropical zones causing biological shifts, and rising marine heatwaves, which are expected to intensify further.

Professor Liew said that collaboration is essential at three levels to adapt and mitigate climate change. Owners of small- and large-scale plantations must adapt practices, regional countries need to cooperate geographically, and interdisciplinary efforts among chemists, biologists, and scientists are vital for a comprehensive understanding. Collaboration between these three interactions is a must. Local-level adaptation strategies are equally important, as different areas face unique challenges requiring tailored solutions.

Effective communication between scientists, policymakers, and engineers is crucial but challenging in the way forward. Scientists struggle with modelling and computational limitations, policymakers often lack access to up-to-date scientific findings, and engineers may not fully understand climate change's complexities. Bridging these communication gaps is key to translating scientific discoveries into effective policies and practical solutions.

Keypoints:

- Tropical maritime continent hosts one of three active convection centres, which supply energy to drive global circulation through the Hadley and Walker systems. One of the convection centres will be disrupted (due to global warming), and the other convection centres will also be disrupted.

- Three collaborations must be done; small and larger plantation, inter-region, and inter- discipline.
- Local-level adaptation strategies are equally important, as different areas face unique challenges requiring tailored solutions.
- Effective communication between scientists, policymakers, and engineers is crucial but challenging.

Discussion

Question
Is there research on using microbes to change dry peat into soil without open burning? Adaptation is difficult because it depends on the country (economic issue). So, what is your opinion on this?

Answer
Professor Edvin: We must adapt globally by collaborating with countries. Countries around the world are coming together, investing in forest fire adaptation, and leveraging research data through artificial intelligence (AI) platforms like ChatGPT to benefit from these advancements in adaptation strategies.

Professor Ülo: We do not have enough research on microbes yet, but if forest fires, especially in peatlands, occur, the microbes may not survive. Adapting to this challenge is difficult and costly, but it is something we must still pursue.

Professor Liew: Real adaptation must be done at the local level. Conditions can vary greatly even within a country, as seen in Malaysia. Therefore, adaptation must go hand in hand with mitigation efforts.

Question
I heard at a national conference that our sea level can increase to 4 metres. What do you think about this? and what action can we take even if the sea level rises 0.5 metres?

Answer
Professor Liew: Scientists calculate the expected sea level rise using 2 methods. First, the warming of ocean level, melting of glaciers and sea ice. However, with this method, the sea level projector will only rise by 0.3 or 0.35 metres. In worse conditions, maybe it can go to 1.2 to 1.4 metres. However, using methods scientists are not entirely certain about, such as sea cliff instability, presents a challenge. While the likelihood of a 4-metre sea level rise is low, it remains a possibility. For mitigation, coastal areas can plant mangroves, which can help protect against waves, but this solution is limited. Several perspectives need to be considered for both adaptation and mitigation, but we have yet to explore these perspectives fully.

Question
We must strategise the plan for climate change adaptation and mitigation, not only at the country level but throughout the whole tropic. What do panellists think about this?

Answer
Professor Edvin: I agree with the idea of hybrid engineering. For example, paddy. We must have paddy that can survive in very wet conditions.

Professor Liew: I agree that decisions are often made too quickly without proper consideration. The question is, how do we measure the knowledge and information across the board and ensure it reaches other countries effectively?

Conclusion and Recommendations

Food security in Malaysia and Indonesia faces challenges due to climate change, particularly in rice production. So, Professor Edvin recommended doing targeted research to develop effective adaptation strategies. According to Professor Ülo, scientists must play a critical role in climate change and present facts transparently, whether the findings indicate improvement or worsening conditions. Professor Liew said that decision-making at all levels, from local to national, must be informed by sound knowledge and a clear understanding of the policies and strategies to address these challenges.

PROTECTION OF INDIGENOUS AND LOCAL KNOWLEDGE IN THE TROPICS

Moderator

Associate Professor Dr Ramy Bulan

Director, Centre for Legal Pluralism and Indigenous Law at the Faculty of Law

Panelists

Professor Dr Poline Bala

Director, Institute of Borneo Studies, Universiti Malaysia Sarawak

Professor Emeritus Dato' Dr Hajah Asmah Haji Omar

Dewan Bahasa dan Pustaka, Kuala Lumpur

H. E. Alejandro Roselli Londono

Ambassador of Columbia

Report prepared by

Luqman Nul'hakim Jeffry

Universiti Malaysia Sarawak

Overview

Indigenous and local communities have a deep, often unique understanding of their environment, shaped by centuries of cultural practices, observations, and spiritual beliefs. This knowledge is vital for managing ecosystems, conserving biodiversity, and ensuring sustainable use of natural resources. It also extends to areas like medicinal plants and other traditional practices. Indigenous people, particularly in tropical regions, are recognised for their expertise in preserving their fragile ecosystems, even in the face of human and environmental threats.

However, despite the value of this knowledge, it is often not properly recognised or supported by governments, leaving these communities vulnerable. There has been increasing global acknowledgement of their role in conservation and sustainability, especially with frameworks like the Kunming-Montreal Global Biodiversity Framework. This framework highlights the importance of respecting Indigenous peoples' rights and their traditional knowledge, ensuring it is documented, preserved, and protected with their consent.

It also emphasises the need for Indigenous communities to be meaningfully involved in decision-making, especially concerning environmental policies. A key part of this is ensuring the transmission of knowledge to future generations, which includes protecting and revitalising Indigenous languages. Languages are not just a means of communication but a crucial part of preserving cultural identity and traditional heritage. So, safeguarding indigenous knowledge, practices, and languages is essential not just for the communities themselves, but for the future of the planet as a whole.

Presentations

Deploying Contemporary Digital Technology and Meaningful Community Engagement Events for the Protection of Indigenous and Local Knowledge in the Tropics

Over the past two years, I have worked with indigenous communities in Malaysia, including Sabah, Sarawak, Kelantan, and Pahang, focusing on bridging the digital divide in rural areas. Drawing from my 25 years of experience with groups like the Penan, Lun Bawang, and Kadazandusun, I have seen a growing recognition of the importance of Indigenous knowledge in addressing global issues. Indigenous knowledge is deeply experiential and passed down orally, differing from scientific knowledge that is taught through formal education and categorisation.

Digital technology has made it easier to document this knowledge but also raises concerns about intellectual property. Indigenous communities fear that once their knowledge is recorded, they lose control over it, as seen in situations where they are charged to use their own stories or cultural expressions in new formats. This issue underscores the need for meaningful engagement with technology, ensuring communities maintain ownership and consent over their cultural knowledge.

Indigenous knowledge is often misunderstood and reduced to songs, dances, and cultural practices. However, it also includes a broader worldview of a native philosophy that emphasises relationships, spiritual values, and the natural environment. Unlike scientific knowledge, which categorises and breaks things down, Indigenous knowledge sees the world as a dynamic, interconnected system. This philosophy shapes how Indigenous people relate to nature, often in a place-based, context-specific way.

In short, Indigenous knowledge is a multi-dimensional system that is deeply tied to place and culture, and its preservation and transmission require respect for the communities' rights and an understanding of their unique worldview.

Keypoints:

- Indigenous knowledge is increasingly recognised for its relevance in addressing global issues like sustainability.
- Unlike scientific knowledge, Indigenous knowledge is passed down orally through lived experiences.
- Digital tools help document knowledge but raise concerns about ownership and control over cultural content.
- Technology must be used respectfully, ensuring Indigenous communities maintain control and consent.
- Indigenous knowledge includes a native philosophy emphasising relationships, spirituality, and the environment, not just songs and culture.
- Indigenous knowledge views the world as interconnected, in contrast to the scientific focus on categorisation.

- Indigenous knowledge is deeply tied to specific places and contexts, emphasising a holistic understanding of nature.
- It is important to respect Indigenous knowledge, ensure fair use of technology, and understand Indigenous worldviews.

Protecting the Indigenous Linguistic Heritage

This year, Malaysia has about a hundred Indigenous languages in addition to the well-developed Malay language. Linguists have studied over 50 languages in Sarawak, 30 in Sabah, and 15 in Peninsular Malaysia. Indigenous languages face endangerment, a concern long recognised by linguists and anthropologists. When a language and its speakers disappear, valuable knowledge about culture, history, land, flora, fauna, and migration is also lost.

Indigenous knowledge has traditionally been passed down orally, but the lack of a written system has hindered its preservation. For example, in Sarawak, only Iban had a writing system for much of the 20th century, while other languages like Melanau and Bidayuh did not. The speaker, who first visited Sarawak in 1964, helped introduce Iban as an elective subject at Universiti Malaya (UM). His work led to the development of Iban studies at the university, even before it was taught in schools.

The Malaysian Government has long been committed to protecting indigenous languages. Since the 1956 Razak Committee's philosophy that "every language has a place under the Malayan sun", indigenous languages like Iban and Kadazandusun have been included in the education system. The "Pupils of Language" (POL) programme was introduced in 1970, allowing languages such as Iban, Kadazandusun, and some aboriginal languages in Peninsular Malaysia to be taught in schools, helping to preserve the country’s linguistic heritage.

Keypoints:

- Many Indigenous languages, including valuable knowledge about culture, history, land, and the natural world, are at risk of disappearing.
- Indigenous knowledge is passed down orally, but the lack of written systems makes it difficult to preserve and transmit this knowledge long-term.
- The speaker helped introduce Iban as an elective subject at Universiti Malaya in the 1960s, making it part of university studies before it was taught in schools.
- The Malaysian Government has long supported Indigenous language preservation. The 1956 Razak Committee emphasised the importance of every language having a place in Malaysia.
- The "Pupils of Language" (POL) programme, introduced in 1970, allows Indigenous languages like Iban, Kadazandusun, and some Peninsular Malaysian aboriginal languages to be taught in schools, supporting linguistic heritage preservation.
- It is important to protect and preserve Indigenous languages in Malaysia, addressing the challenges they face and the efforts made by both academics and the government to ensure their survival.

Case Studies and Practical Ways of Helping Local Community

In 1996, while researching endemic bird species on San Andreas Island in Colombia, I encountered a local man who challenged my conservation efforts. As a biologist, I was focused on protecting endangered birds, but he questioned the need for conservation, arguing that he needed to practice slash-and-burn farming to sustain his livelihood. Despite his deep knowledge of local ecosystems, including harvesting honey from stingless bees and catching black crabs, he had no alternative to slash-and-burn. This experience led me to reconsider how conservation efforts could incorporate local knowledge.

Over the years, my work took me to communities around the tropics, including Africa, Asia, and the Amazon. In the Amazon, where over 500 languages are spoken, Indigenous people manage vast tracts of forest, offering critical insights into conservation. One example is how the Gachua Indians in Peru and Bolivia observed the cinchona tree's bark as a cure for malaria, which became the first known treatment.

In Suriname, I worked with the Wayana people, whose livelihood depends on Brazil nuts. They taught us that certain butterflies and rodents play a crucial role in the sustainable production of these nuts, highlighting the importance of local knowledge in forest management. Similarly, in the Amazon, we worked with local communities to harvest Tonka beans for perfume production, ensuring the forest was preserved, and the species were monitored by the community using their own ecological knowledge.

These experiences reinforced a key lesson: the best way to preserve indigenous knowledge is to use it. Knowledge that is actively applied remains alive, helping conserve both nature and the cultural practices of the people living there.

Keypoints:

- In 1996, while studying bird species on San Andreas Island, the speaker was challenged by a local man about the purpose of conservation efforts, highlighting the gap between scientific conservation and local livelihoods.
- Despite the local man's extensive knowledge of ecosystems (e.g., stingless bee honey harvesting, black crab catching), he continued to practice slash-and-burn farming due to a lack of alternatives, prompting the speaker to reconsider conservation approaches.
- The speaker's work later took him to tropical communities in Africa, Asia, and the Amazon, where Indigenous people manage vast forests and possess critical knowledge for conservation.
- The Gachua Indians in Peru and Bolivia discovered the medicinal properties of cinchona tree bark, which led to the first known malaria treatment, illustrating the value of Indigenous observations.
- The speaker collaborated with the Wayana people, who taught him that certain butterflies and rodents were key to the sustainable production of Brazil nuts, demonstrating the importance of local ecological knowledge in forest management.

- In the Amazon, the speaker worked with communities to harvest Tonka beans for fragrance, using local knowledge to monitor the forest and species. This proves that communities can be guardians of biodiversity.
- The best way to preserve Indigenous knowledge is to use it actively. Knowledge that is applied remains intact and helps conserve both nature and cultural practices.
- It is important to integrate local knowledge into conservation efforts to protect both the environment and cultural heritage.

Discussion

Question
How can we make codified knowledge as valuable as basic knowledge, instead of just documenting everything?

Answer
Professor Asmah: Scientists produce knowledge based on their findings, but linguists do not codify knowledge directly. We codify the language itself. We take the knowledge scientists share and put it into language. For example, when working with Iban in Sarawak and Kadazandusun in Sabah, my task was to help these communities create standardised spelling and grammar systems. Iban was easier because it had more variations but fewer complex issues, while Kadazandusun was more challenging due to regional differences. I worked with the communities to develop a system that allowed them to write, create manuals, and preserve narratives in their own languages. Linguists help by understanding the phonology and grammar of a language so that all variations can be captured in a system that enables communication and understanding, regardless of dialect.

H. E. Alejandro: In the Amazon, we were working on conserving Arowana fish in small lakes. Initially, we used a scientific methodology for monitoring the fish population based on research from Brazil and Peru, expecting the population to increase. However, when the results were still low, the local Indigenous people disagreed, claiming there were far more Arowanas than the data showed. They suggested a new approach: instead of counting the fish along the lake's edges at night, they climbed trees during the day to count Arowanas in the lake's centre. Their method revealed much higher numbers. The key insight was that the giant otters, predators in the lake, were hunting the Arowanas along the edges but not in the deeper parts. The indigenous people's keen observation helped us realise this, and their method became the new fish monitoring protocol. This experience underscores the importance of local knowledge and observation in scientific work, challenging the assumption that scientists always have all the answers.

Professor Poline: When we introduced the e-Bario project to the council of elders in Bario, 99% of them had never seen or heard of a computer. I was explaining the concept of this new technology, and one elder stood up and asked, "Do you mean the computer works like the fridge?". Confused, I asked what he meant. He explained that just like how they freeze meat and fish in the fridge to preserve it for later, they could use the computer to "freeze" their languages, knowledge, and songs, which were disappearing as younger generations moved away. He wanted to preserve it so that one day, when younger people are interested, they could "take it out" and access it again. This conversation highlighted the tension between recording cultures and the evolving nature of traditions, as the elder also noted that songs cannot just be frozen —they need to evolve.

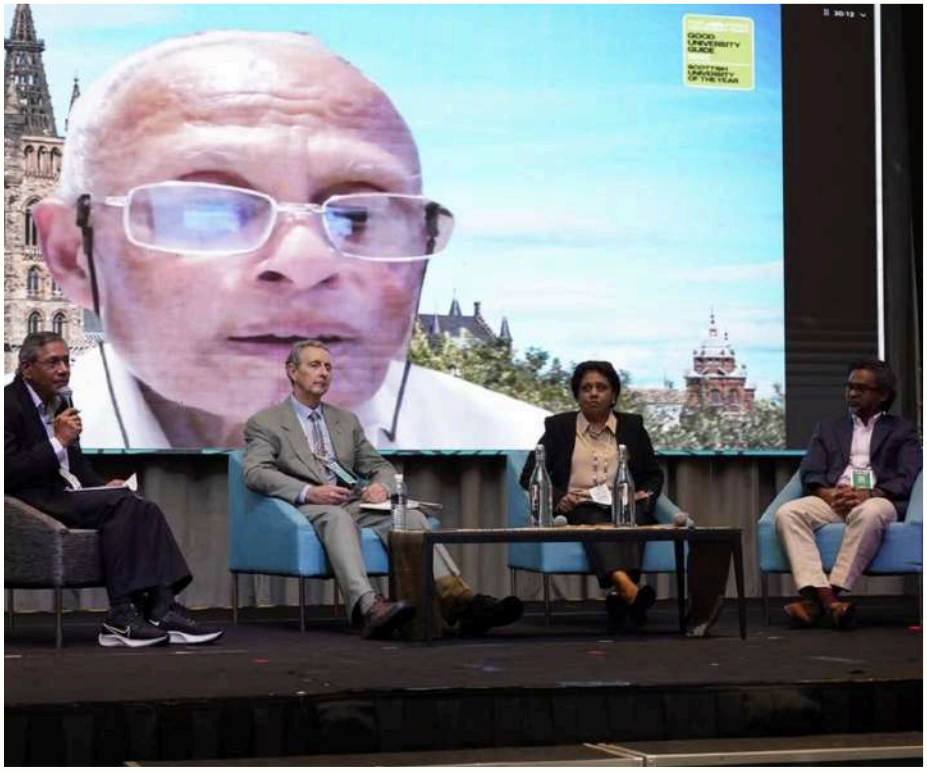
Question
What do you think of the strategy of trust disciplinary for preserving knowledge?

Answer
H. E. Alejandro: These initiatives are crucial, especially as government policies often focus on funding. They are unlikely to succeed if interdisciplinary efforts are driven solely by academia, activists, or individuals. It is important to recognise that global frameworks, like COP16 in Colombia, are pushing to preserve local knowledge. One key goal is implementing Article AJ, which emphasises protecting local knowledge and ensuring its benefits reach local communities. However, these efforts will struggle to thrive without proper funding mechanisms, as seen in Mexico.

Conclusion and Recommendations

The modernisation of culture and values is essential to ensure their relevance in today's world. Encouraging the younger generation to take the lead in developing technologies and cultural practices that help preserve languages is a critical step in this process. While technological solutions already exist, greater creativity is needed to effectively apply these tools in ways that promote language preservation and cultural sustainability.

CONFERENCE PHOTOS

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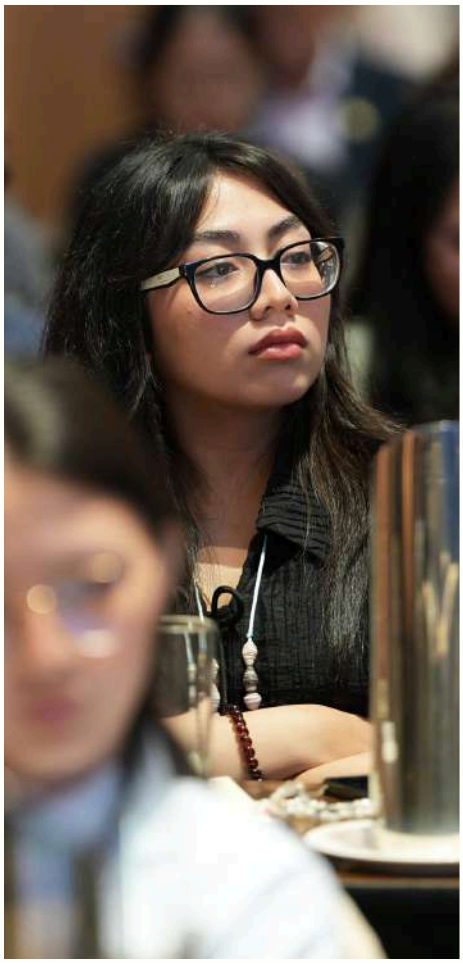
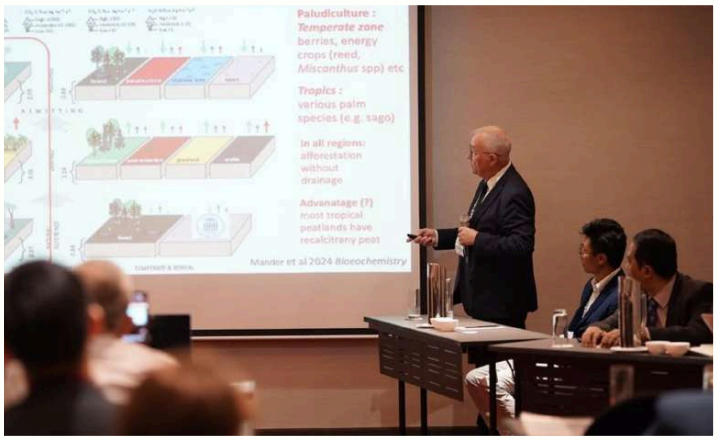
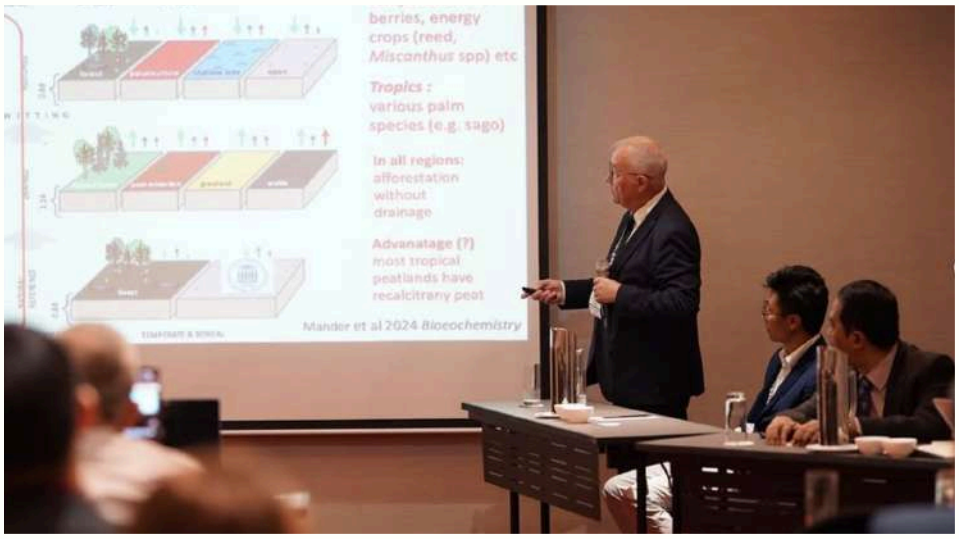



Paludiculture :
Temperate zone
berries, energy crops (reed, Miscanthus spp) etc
Tropics :
various palm species (e.g. sago)
in all regions:
afforestation without drainage
Advantage (?)
most tropical peatlands have recalcitrany peat
Manzer et al 2024 Bioeochemistry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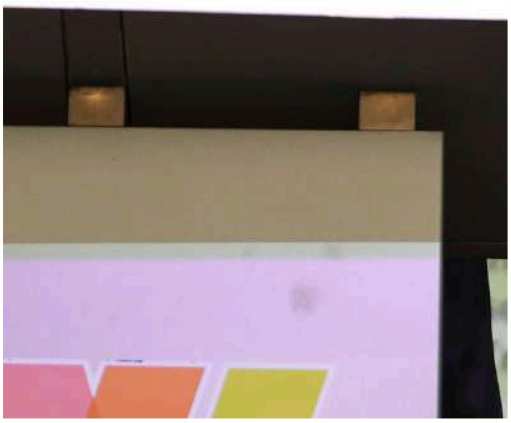


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