# THE 5TH INTERNATIONAL CONFERENCE ON

# CLIMATE CHANGE 2021

18th – 19th February 2021

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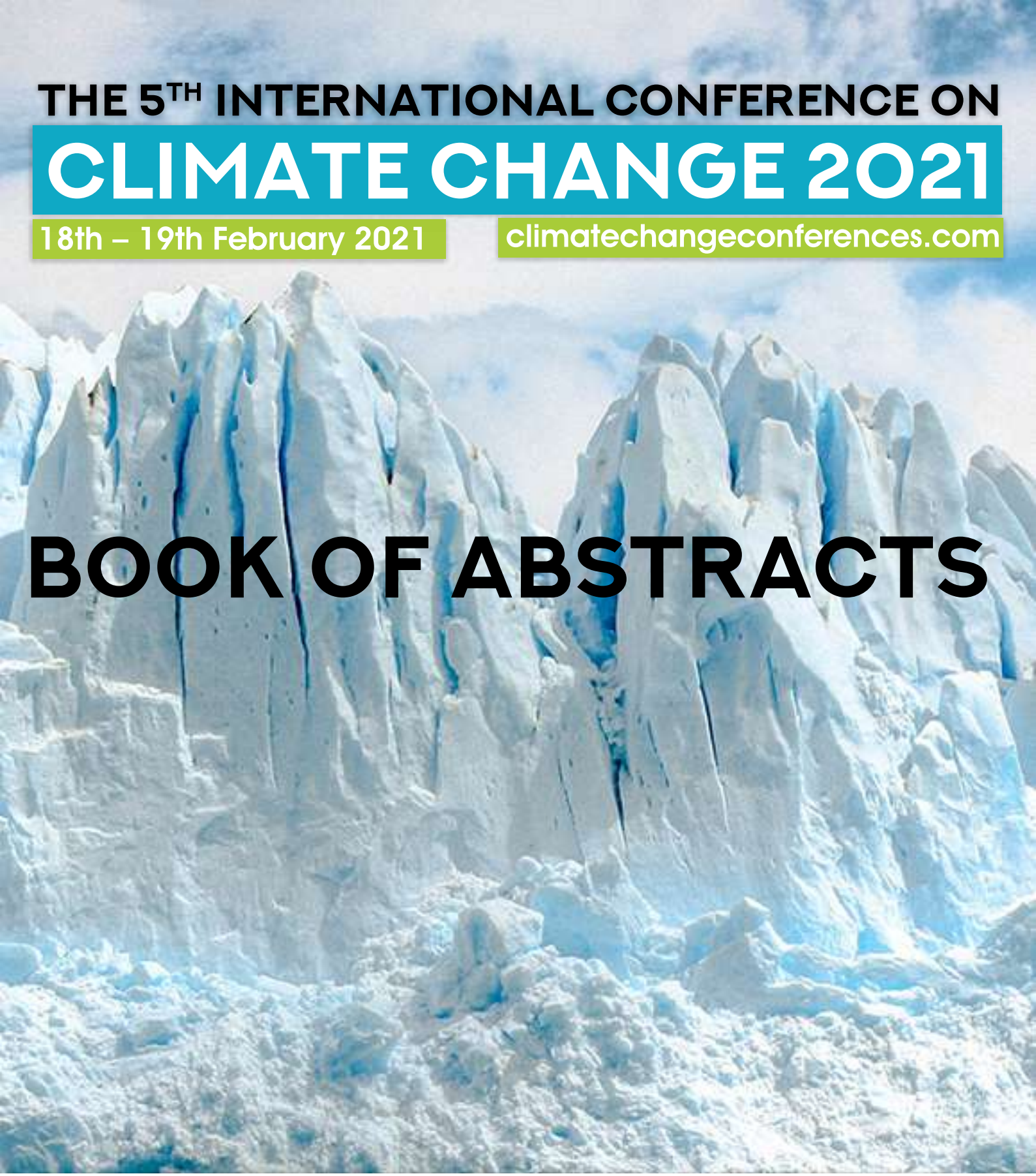

# BOOK OF ABSTRACTS

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# Book of Abstracts

# 5th International Conference on Climate Change 2021

# (ICCC 2021)

18th – 19th February 2021

Committee of the ICCC - 2021

The International Institute of Knowledge Management (TIIKM)

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## MESSAGE FROM THE CONFERENCE CO-CHAIR - ICCC 2021

Dealing with climate change has been one of the biggest challenges faced by humanity since the dawn of the century. It has been a major concern in both developing and developed countries, due to increased frequency and intensity of extreme events, impacts, and vulnerability. The loss and damage due to climate change has particularly impacted the economies and societies of the developing and the least developed countries (LDCs) in an era focusing on achieving global sustainable development goals (SDGs). The Paris Agreement and UN SDGs adopted in 2015 go hand in hand to ensure a better future than what would be predicted by the existing environmental and socioeconomic trends. However, achieving SDGs would be the biggest challenge for certain developing countries, LDCs, and small island developing states (SIDS), given the continued vulnerability to climate change, and reaching SDGs requires more solid strategic planning. Thus, the 5gh International Conference on Climate Change has focused on '*Sustainable development and climate change in developing and least developed countries'* as its theme.

We have been having this very successful conference since 2017. The 1st International Conference on Climate Change 2017 (ICCC-2017) was held with the theme *'Climate Change, Facing the challenge beyond COP21*', and the theme of the 2nd International Conference on Climate Change 2018 (ICCC-2018) was '*Climate change and global sustainability: Action for bridging the gap*'. Both the first and second conferences were held in Colombo, Sri Lanka, and the third and fourth conferences in the series were held successfully in Kuala Lumpur, Malaysia. A main goal of the 5th International conference on climate change 2021 (ICCC 2021) is creating an effective dialogue and sharing experiences among the participants and the experts in different related fields on climate change-related research and development activities, , with an emphasis on the challenge faced by the developing and the least developed countries, particularly in achieving SDGs under the global 2030 Agenda for Sustainable Development. Given the global COVID-19 situation, it was decided to transform the conference to a virtual meeting. As a Co-Chair of the conference, I hope this event will create continued dialogue during and beyond the ICCC 2021, with the involvement of the scientists/researchers from all around the world. Through this event, it is envisaged to share and disseminate information relevant to research and development experiences encompassing important areas such as climate change risk prediction, adaptation, mitigation, climate change-related policies, business and finance, impacts and remedial measures involving the society. For better efficacy, given the virtual nature of the conference, only a limited number of participants could be accommodated for this two-day international conference. I wish all the presenters, resource persons, and participants a pleasant and fruitful virtual event and hope ICCC 2021 will provide the ideal platform for you to share your valuable insights and experiences.

**Prof Erandathie Lokupitiya**
Department of Zoology and Environment Sciences
Faculty of Science
University of Colombo, Sri Lanka

## MESSAGE FROM THE CONFERENCE CO-CHAIR - ICCC 2021

When the United Nations Inter-Governmental Panel on Climate Change (IPCC) released its Fifth Assessment Report (AR5) in 2013, the global mean temperature was about 0.86oC higher than the pre-industrial temperature level. Today the global mean temperature has increased to about 1.1oC above pre-industrial level and on track towards the Paris Agreement's 1.5oC warming threshold. According to the IPCC's AR5, the Earth is in radiative imbalance with more energy is absorbed by the surface of the Earth than exiting at the top of the atmosphere since at least four decades ago. This resulted into heat accumulation in the climate system in which more than 90% has been absorbed by the Ocean causing temperature to increase and the heat content of the Ocean, especially the upper layer of the ocean, to rise steadily. Due to this, climate patterns have been changing and weather and climate extremes have been strengthening and become more erratic. Floods and droughts have been becoming more frequent and intense. Climate projections indicated that without substantial and sustained mitigation efforts, temperature is projected to increase to a level that will cause catastrophic impacts to human and civilizations.

Despite the global mean temperature increase is only 1.1oC so far, climate change has been affecting many countries and areas around the globe, particularly developing and least developed countries. Livelihoods have been severely affected especially those of vulnerable, exposed, and marginalised communities. Many sectors from agricultures to tourisms have been affected, climate refuges have increased in some countries, losses due to meteorological and hydrological disasters have increased. However, what has already been experienced would probably in no comparison to the impacts that would be expected in many decades in the future if warming continues and temperature increases reach beyond 4 - 5oC.

There must be a solution to this calamity that facing humankind. IPCC's findings advocated both mitigation and adaptation measures to ensure that the greenhouse gases emission can be curtailed to a level that is compatible with 2.0oC warming and the impacts can be minimised. However, these would need to be a concerted effort at various levels --- from global to national and local scales. The world must embrace sustainability. The right policy must be devised and implemented. However, robust policy must be evidence-based and this is where researchers play an important role in advancing scientific knowledge for robust policy formation. This is especially critical for developing and least developed countries. The organisation of this International Conference on Climate Change for the fifth consecutive year in 2021 (ICCC 2021) with the theme of "Sustainable Development and Climate Change in Developing and Least Developed Countries" would provide a right avenue for researchers, practitioners, policy makers to discuss, deliberate and exchanges knowledge and ideas in addressing climate change issues in developing and least developed countries.

I wish all participants have a fruitful deliberation.

**Professor Dr. Fredolin Tangang**
Chairperson, Department of Earth Sciences and Environment
The National University of Malaysia
Conference Co- Chair
ICCC 2021

## ORAL PRESENTATIONS

### CLIMATE CHANGE: RISK PREDICTION, ADAPTATION, AND MITIGATION (A)

## POSTER PRESENTATIONS



## SYMPOSIUM PRESENTATIONS

# ORAL PRESENTATIONS

**A1** **[01]**

# MITIGATING CLIMATE CHANGE WITH MICROALGAL BIOMASS GROWN WITH IRON BASED NANOPARTICLES

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***ABSTRACT***

About 70% of total global GHG (meaning of GHG) emissions are in the form of CO2 due to the combustion of fossil fuels. Many countries are heavily investing in biofuel generation from microalgae as renewable energy to mitigate climate change. Algae are a third-generation renewable biofuel which supports for lowering GHG emission. Microalgae can provide several different types of renewable biofuel including methane produced by anaerobic digestion of the algal biomass; biodiesel derived from microalgal oil and photobiological produced biohydrogen. The use of nanoparticle-based nutrient formulations may offer a highly effective novel platform for yield enhancement compared to conventional mixtures as plants need iron for many metabolic processes. The aim of this study was to determine the effect of three different types of iron-based nanoparticles (NP's) using 1mg/L iron concentration; 1mg/L Fe3O4 magnetic NP's, 1.08 mg/L Fe3O4 coated with gallic acid and 1.36 mg/L Fe3O4 Conjugate (Sugar + Gallic acid) NP's on the growth of *Nannochloropsis sp.* The *Nannochloropsis sp.* cells were grown under outdoor natural conditions with continuous agitation by bubbling at a constant airflow rate, using Guillard & Ryther's modified F2 Medium. The experiment was designed as Complete Randomized Design (CRD) with three replicate and control treatment was without nano-particles in the growth medium. Samples were collected every day over 14 days period to estimate the growth of *Nannochloropsis sp.* using absorbance values of Spectrophotometer. Dry weight and lipid content of samples was determined after harvesting. Statistical analysis, using ANOVA one way Dunnett's test showed that there were significant differences ($p<0.05$) in dry weight and lipid content of *Nannochloropsis sp.* at different types of iron-based nanoparticles. These differences could be related to specific differences in cell metabolism. Fe3O4 nano-particles and Fe3O4 conjugate nanoparticles were shown highest lipid content (13.6 ± 1%, 12.3 ± 2%), total dry matter weight (1.863 ± 0.222 g/L, 1.714 ± 0.286 g/L) and significantly higher cell growth rate. The results revealed that iron-based nano-particle has the potential to increase the lipid yields of microalgae.

Keywords: Iron,Nano-particles, lipid content, Biomass dry weight, climate change

**A2** **[02]**

# CARBON SEQUESTRATION POTENTIAL OF RUSSIAN BOREAL FORESTS: REGIONAL SPECIFICS AND OPPORTUNITIES FOR CLIMATE CHANGE MITIGATION

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***ABSTRACT***

The Government of the Russian Federation (Resolution No. 1228 dated 21.09.2019) has ratified the Paris Agreement, stating, among other things, that the Russian Federation takes into account the importance of preserving and increasing the absorption capacity of forests, as well as the need for its maximum possible accounting. In order to fulfill its obligations to reduce greenhouse gas emissions identified in its nationally determined contribution (NDC), Russia takes action to improve the methodology and information base for assessing forest carbon sink in addition to reduce the industrial emissions and direct the economy towards low-carbon development. The prospects of applying the updated methodology for assessing the carbon sequestration of Russian forests and the results of experimental studies are discussed. The calculations made by us within the framework of the IBFRA Insight Process: Sustainable boreal forest management–challenges and opportunities for climate change mitigation show that the annual net carbon sink in boreal forest biomass was 467.5 Mt C yr-1 for the last 15 years. Significant differences in biomass carbon absorption and net carbon sink were identified between the European-Ural and the Asian parts of Russia. The average annual carbon absorption by forests of the Asian part was almost twice less than that in the European-Ural part, 0.7 t C/ha yr-1 and 1.36 t C/ha yr-1 respectively. The biomass carbon losses caused by timber harvesting, forest fires, pests and others per unit area were comparable in both regions. The average value of net carbon sink for forests in the Asian part estimated at 0.53 t C ha $yr^{-1}$, and for forests in the European-Ural part - 0.9 t C ha $yr^{-1}$.

Keywords: Russian boreal forests, carbon absorption, carbon emissions, carbon sink

**A3** **[03]**

# SUSTAINABILITY OF THE MINOR IRRIGATION SYSTEMS OF THE CASCADES IN DRY ZONE OF SRI LANKA: CHALLENGES AND POTENTIALS A CULTURAL ECOLOGICAL ANALYSIS

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***ABSTRACT***

This article describes the cultural ecology of terraced tank clusters (Cascades) in the Dry Climatic Zone (DCZ) of Sri Lanka. As recognized by Julian Steward in 1950s, Cultural ecology is a theoretical approach that attempts to explain similarities and differences in the culture in relation to the environment (Tucker 2013). The traditional settlements linked with small tanks called 'Wew gam' (Tanks villages) and the interrelationships between human activities and the natural ecosystems of the cascades are good examples of the cultural ecology in Sri Lanka. According to the study, the ecology and the and culture sustainably go together and ecology deals with patterns of relations of plants, animals, and people to each other and their surroundings, and culture deals with all products of human thoughts. There are however certain aspects of both ecology and culture that have very interesting and intimate relationships. The Sri Lankan cultural and water heritage is one of the richest and most colorful heritages in Asia. Therefore, there are much to be re-learned from our ancient hydraulic civilization. In history, the people of agricultural communities lived sustainably, respecting the environment, dealing well with wild animals, and coping with natural hazards. A village tank cascade ecosystem exemplifies a sustainable system. Concerning the historical behavior and the contribution to make a sustainable environment in drought prone areas of the DCZ of Sri Lanka, the village tank system was recognized on 19th April 2020 by FAO as one of the "Globally Important Agriculture Heritage System" in the world. It is an ancient, widely used, and unique traditional agriculture system. The system provides water for irrigation, domestic purposes, animals, and ecosystems.

Keywords: Casacdes, Small Tanks, Ellanga, Terraced tanks clusters

**V1** **[04]**

# QUALITATIVE PHYTOCHEMICAL SCREENING OF WOOD VINEGAR FROM LAND CLEARING WASTE IN MENSIAU VILLAGE, WEST KALIMANTAN, INDONESIA

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***ABSTRACT***

Clearing land for agricultural or plantation by using fire resulted air pollution which had an impact on global warming. Meanwhile, the solution to reduce these negative impacts was clearing land without burning. The Dayak Iban tribe in Mensiau Village, Kapuas Hulu District, West Kalimantan processed the wood waste from clearing land methods into wood vinegar. Pyrolyzers were a tool to process wood waste into wood vinegar without smoke pollution . The first combustion of pyrolization resulted in grade 3 wood vinegar with a blackish color. Grade 3 wood vinegar was then distilled and resulted in wood vinegar with a clearer color (grade 2). In addition to reduce the impact of fire and climate change, wood vinegar can be used as a natural liquid fertilizer, disinfectant and insecticide. However, the chemical content w as not yet known, so the wood vinegar formula cannot be applied optimally. Grade 2 and 3 wood vinegar samples were tested qualitatively using specific reagents to determine the content of secondary metabolites in wood vinegar. The results showed that grade 2 wood vinegar contained alkaloids, flavonoids, and phenolics, while grade 3 wood vinegar contained alkaloids, flavonoids, terpenoids, and phenolics. Thus, grade 2 wood vinegar was suitable for use as a disinfectant, while grade 3 was used as liquid fertilizer.

Keywords: land clearing, phytochemical compounds, pyrolization, wood vinegar

**A5** **[05]**

# ESTIMATION OF LAND SURFACE TEMPERATURE (LST) IN THE KANDY MUNICIPAL COUNCIL AREA USING REMOTELY SENSED DATA

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***ABSTRACT***

Land Surface Temperature (LST) is one of the key parameters that help to determine the variability of climate change from a micro-climatic perspective in a macro scenario where the global mean temperature is predicted to be increased crucially. Since Sri Lanka too is experiencing such increment in LST simultaneously with the urban demographic, economic, land use, and land cover changes; it is worthy of incorporating remotely sensed data in order to critically respond and understand the adverse consequences of it. Hence, this study is aimed to identify the spatial variation of LST during 2017 in the Kandy Municipal Council (KMC) area. Study methodology consists of an LST calculation along with a gradient analysis deriving zonal statistics from random points utilizing geo-informatical visualizations. The results revealed that the LST in the KMC area is within the range of 18 – 31 0C. Grid city area, Kandy teaching hospital premises and the roadsides of Mulgampola recorded the highest Land surface temperature (27-310C) while few small pockets were also identified. Lowest LST values (<20 0C) were reported from Aruppola, Katugastota, Mawilmada, Lewella, around Srimath Kuda Ratwatta Mawatha, and in the University of Peradeniya premises. It was concluded that the unique Kandyan morphological setup housing natural blue-green spaces controls its micro-climate, and the heat trapped in the middle of the city declines once moving away from the dense city center. Furthermore, LST decreases along the urban-rural gradient while elevating along the urban built-up area. Roadside urbanization and efforts to develop Katugasthota as an economic hub have a tremendous impact on LST. These findings could be later referenced or developed for futuristic micro-climatic research endeavors executing green measures to combat the urban heat-island effect.

Keywords: Land surface temperature, Kandy Municipal Council area, Remotely sensed data, Climate change

**A6** **[06]**

# MINI REVIEW OF NATIONAL REFERENCE LEVEL ESTIMATED ACCORDING TO REDD+ ACTIVITIES IN DEVELOPING COUNTRIES

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***ABSTRACT***

Developing countries are eligible for financial incentives by reducing greenhouse gas (GHG) emissions from deforestation, forest degradation (REDD+), and for increasing GHG removals through sustainable management of forests, conservation and enhancement of forest carbon stocks where the results are reported as countries' REDD+ national forest reference levels (FRL). FRLs are a crucial measure of development and environmental integrity in developing countries. FRL accuracy and the reliability of future projections depends on the technique and the length of historical data availability in countries. We reviewed 50 FRL reports submitted to REDD+, aiming to summarize the features of estimation and the total CO2 emission projection to 2025 based on the given reference levels and deforestation rates. Deforestation and forest degradation were found to be responsible for 15% of the total global GHG emissions. Considering the timeline variation and the emission factors, total CO2 emissions by deforestation were 3,281,199,566.44 t CO2 equivalent in 2018, and expected to increase by 62,891,973.62 t CO2 equivalent/year unless the deforestation rate is reduced in future. According to the linear extrapolation of FRL projection, Democratic Republic of the Congo is accounted for the highest emission of 1474.57Mtons of CO2 equivalent and average increasing rate of 1,251,630,549 t CO2 equivalent/year. The highest deforestation accounted for African continent with 3,909,863.5 ha in 2014 and American and Asian regions with 3,786,141.88 ha and 1,565,086.71ha, respectively. Since only 31% of the developing countries have constructed the FRL and with few latest updates of them, the results of predictions remain under/over estimations in different countries. Monitoring forest inventories, carbon pools and land use changes over time is essential to update the FRLs considering national circumstances in order to have insight of GHG emissions by REDD+ activities in future.

Keywords: Developing countries, Forest reference level, Greenhouse gas emission, REDD+ activities

**A7** **[07]**

# LEVEL OF PREPAREDNESS OF THE RESIDENTIAL BUILDING INDUSTRY IN AUSTRALIA TO CLIMATE CHANGE ADAPTATION: A CASE OF RESIDENTIAL BUILDING COMPANIES IN BRISBANE, QUEENSLAND

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***ABSTRACT***

The consequences of climate change are profound for the residential building industry and, unless appropriate adaptation strategies are implemented, will increase exponentially. The consequences of climate change, such as increased repair costs, can be reduced if buildings are designed and built to be adaptive to climate change risks. This research investigates the preparedness of the Australian residential building sector to adapt to such risks, with a view to informing the next review of the National Construction Code (2022), which at present does not include provisions for climate change adaptation. Twelve semi-structured interviews were conducted with construction managers from residential building companies in Brisbane Queensland to understand their level of preparedness to adapt with climate change risks. Three aspects of preparedness were investigated: participant's awareness of climate change risks, their company's capacity to include climate change information in planning, and actions taken to address climate change risks. Participants were also asked about climate change adaptation policies and what they thought the path towards increased preparedness in the residential construction industry to climate change risks might involve. Qualitative analysis of interview data was undertaken using NVivo software, and illustrative examples and direct quotes from this data is included in the results. The results indicate a low level of preparedness of the residential building industry to adapt with climate risks. Levels of awareness in terms of managing the consequences of climate change risks, analytical capacity and the actions taken to address climate change were all found to be low. Legislating climate adaptation practices and increasing the adaptation awareness of the residential constructors are some of the recommendations to enhance the preparedness of the residential construction industry in Australia to adapt with climate change risks.

Keywords: climate change, adaptation, risks, residential building, awareness

**A8** **[08]**

# ASSESSMENT OF GREEN INFRASTRUCTURE FOR SUSTAINABLE URBAN WATER MANAGEMENT

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## *ABSTRACT*

Green Infrastructure (GI) offers a contemporary approach for reducing risk of flooding, improve water quality and harvesting storm water for sustainable use. Green Infrastructure (GI) promotes landscape planning to enhance sustainable development and urban resilience. However, existing literature is lacking in ensuring the comprehensive assessment of GI performance in terms of ecosystem function and services for social, ecological and economical system resilience. We propose a robust indicator set and Fuzzy Comprehensive evaluation (FCE) for quantitative and qualitative analysis for sustainable water management to assess the capacity of urban resilience. Green Infrastructure in Urban Resilience Water Management System (GIUR-WMS) supports decision making for GI planning through scenario comparisons with urban resilience capacity index. To demonstrate the GIUR-WMS we have develop five scenarios for five sectors of Chandigarh (12, 26, 14, 17 and 34) to test common type of GI (rain barrel, rain gardens, detention basins, porous pavements and open spaces). Result show that open spaces achieves highest Green Infrastructure urban resilience index of 4.22/5. To implement the open space scenario in urban sites, suitable vacant areas can be converted to green spaces (example: forest, low impact recreation areas and detention basins) GIUR-WMS is easy to replicate, customize and apply to cities of different sizes to assess environmental, social and ecological dimensions.

Keywords: Green Infrastructure, assessment, Urban resilience, Water management system, Fuzzy Comprehensive evaluation

**A9** **[09]**

# URBAN VEGETATION AND MORPHOLOGY PARAMETERS AFFECTING MICROCLIMATE AND OUTDOOR THERMAL COMFORT IN WARM HUMID CITIES – A REVIEW OF RESEARCH IN THE PAST DECADE

C. Dissanayake, U. G. D. Weerasinghe and K. W. J. P. Wijesundara

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***ABSTRACT***

Urbanization provokes major modifications on natural landscape. As the urban population reaches 60% of the world's population by 2030, this constant development, neglecting the planning and design of open spaces has negative effects on microclimate. This leads to local climate change, urban heat islands, and outdoor thermal discomfort. This paper is based on the recent studies of urban morphology and vegetation parameters affecting urban microclimate and outdoor thermal comfort in warm humid cities in the past decade. Three factors are of paramount importance and affect the thermal comfort level; urban space morphology, the orientation of elements and spaces, and vegetation. The results of the review reveal that the parameters of urban morphology and vegetation are categorized as parameters of Geometry, density, configuration, and the physical properties of plants. Configuration of urban vegetation that affect thermal comfort of urban spaces have not received adequate attention in previous research yet. Therefore, future studies on the effects of planting patterns, arrangement of various species, diverse tree forms and shrubs, the connection of green spaces in the landscape, planting directions with prevailing wind conditions in terms of microclimate enhancements are recommended. By the end of this review, a theoretical framework is suggested as an approach to assess the impact of urban vegetation and morphology parameters on outdoor thermal comfort in warm humid climates. The framework guides further research adopting more specific and comprehensive approaches of urban vegetation configuration with reference to specific urban morphologies to improve the local microclimate of cities, where the space for planting is critical.

Keywords: Urban vegetation, Urban morphology, Vegetation configuration, Outdoor thermal comfort, Warm humid cities, Climate change

**A10** **[10]**

# SUSTAINABLE USE OF EPPAWALA ROCK PHOSPHATE

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***ABSTRACT***

Eppawala Rock Phosphate (ERP) is one of the locally available mineral resources in Sri Lanka which known as the one of the high P containing apatite source in the world. With the exponential population growth, there is an accelerated demand for natural resources. The mineral resources have not received the necessary holistic consideration. Therefore, scientific evidence is necessary for proper appreciation and sustainable utilization of the ERP. Though many studies were conducted on geochemical characterization of ERP, very few information is available on mineralogical composition. This study was conducted to identify the mineralogical composition of ERP for sustainable usage as a mineral resource. The ERP samples were collected from the mining site at Eppawala. Collected samples were analyzed using X-ray powder diffraction technique. According to the findings, ERP contained Calcium (Ca), Phosphorus (P), Sodium (Na), Aluminum (Al), Zinc (Zn), Copper (Cu), Cobalt (Co), Chlorine (Cl), Fluorine (F), and Chromium (Cr). The P was present in the Chlorofluro apatite form that resembled the XRD pattern of hydroxylapatite present in bones and tooth enamel. Also, the ERP contained heavy metals, including Chromium (Cr) and Arsenic (As) and can impose adverse effects on humans and the environment during processing. Therefore, further studies are necessary to assess the levels of heavy metals and optimize various methods to remove these impurities in ERP.

Keywords: Mineral, Supplement, Bioavailability, Nutrition

**V4** **[11]**

# ABOVEGROUND BIOMASS AND CARBON STOCK OF VARIOUS LAND COVER TYPES OF NAGA CITY, PHILIPPINES USING REMOTE SENSING

A. S. De Los Santos[1,2] , M.A.L.G. Guzman[1] and M.C.T.M.Vicente[1,3]

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***ABSTRACT***

Land use and land cover change have been considered the second key driver influencing the imbalance in the Earth's climate system. The quantification of the carbon storage capacity of different land cover types is indispensable for the development of management strategies in increasing the city's productivity in terms of carbon stocks, land cover/soil combinations, and the reduction of carbon footprint by enhancing carbon sequestration. The study assessed the aboveground biomass and carbon stocks of various land cover types of Naga City, Camarines Sur, Philippines using remote sensing. Aboveground biomass and carbon stocks were estimated using Landsat 8 OLI/TIRS satellite imagery and five spectral vegetation indices as predictors, namely: Simple Ratio (SR), Difference Vegetation Index (DVI), Normalized Difference Vegetation Index (NDVI), Soil-adjusted Vegetation Index (SAVI), and Enhanced Vegetation Index (EVI). The correlation analysis of the field-sampled and VI-estimated aboveground biomass and carbon stocks revealed that SR was the best performing model for grasslands (r=0.78; R2=0.61), DVI for rice cropland (r=0.57; R2=0.32), and EVI for both corn cropland (r=0.69; R2=0.47) and forestland (r=0.73; R2=0.53). The city's total aboveground biomass is approximately 2.7M Mg, with a total carbon stock of 1.2M C Mg. The highest average aboveground biomass is stored in forestland (165 Mgha-1), followed by grassland (61 Mgha-1), corn cropland (48 Mgha-1), and rice cropland (46 Mgha-1). These values will provide scientific inputs to the repository of carbon budgets and inventories necessary for policy, management, and conservation of these land cover ecosystems to improve strategies to curtail land degradation. The findings are also fundamental in addressing the city's carbon storage, emissions, offset, and carbon-based revenue opportunities.

Keywords: Aboveground biomass, carbon stocks, remote sensing, Naga City

**V2** **[12]**

# AN EVALUATION OF CLIMATE CHANGE FROM A LEGAL PERSPECTIVE OF TURKEY IN THE SCOPE OF INTERNATIONAL LAW

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***ABSTRACT***

Climate change is a global emergency and each country's efforts and responses to climate change are of significance. The legal regimes serve as one of the means for this aim. Since this is the case, it is pertinent to examine here the level of implementation of climate laws in Turkey as an example. Also, at present, the level of implementation of climate laws in Turkey is of particular significance, given the European Commission's aim for Europe to become the world's first climate-neutral continent by 2050, as Turkey's territory encompasses portions of Europe. Thus, the question of the level of implementation of climate laws in Turkey arises. To achieve this aim, first, the existing efforts made by the international community and Turkey are examined alongside the relevant scientific facts. Second, the legal frameworks are analyzed, with specific reference to the situation in Turkey. Finally, key points regarding common but differentiated responsibilities, the relationships between international and national laws, and the importance of laws with comparing regulations and political instruments are addressed, to see how these points can inform recommendations for an efficient response to climate change. In light of these evaluations, it is concluded that the ratification of the Paris Agreement, enriched legal perspective in international law, and new specific climate laws in national laws are a necessity to provide a meaningful legal response to this global threat. It is hoped that other legal systems may benefit from an understanding of Turkey's response and analyze its legal perspective. Every country will need to contribute to the shared enterprise of combatting climate change if the future of humanity and the natural world is to be assured.

Keywords: Climate Change, Turkey, Legislation

**B2** **[13]**

# CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT: ROLE OF PRIVATE COMMERCIAL BANKS IN BANGLADESH

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***ABSTRACT***

The key objective of this paper is to assess the role being played by the private commercial banks (hereinafter referred as to PCB) in Bangladesh to address the effects of climate change while ensuring the sustainable development for the economy. To focus the issue the initiatives taken by the PCBs have been studied widely through a secondary data analysis of annual disclosures. Banks play a pivotal role in the development of an economy and in case of a developing nation the role becomes more challenging while addressing the crosscutting issues like industrialization and environmental protection. The banking policy and operational guidelines of Bangladesh is gradually entering into a balanced condition of ensuring profit maximization in a sustainable manner. To address the environmental and social challenges, Bangladesh Bank, as the central bank, has meanwhile introduced Policy Guidelines for Green Banking, Environmental Risk Management (ERM) Guidelines, Environmental and Social Due Diligence Risk Assessment Tool and so forth. In light of the policy support, a well number of PCBs are on right track to address sustainable development agendas through tools like Green Finance, Agriculture Finance, MSME, Financial Inclusion, Mobile Banking, Agent Banking, Internet Banking, Digitalization, etc. Business decision of PCBs in Bangladesh is nowadays largely dependent on addressing environmental and social risk alongside the credit risk management. These activities of PCBs have been taken into a reporting framework and have become an integral part of the banking compliance. To bring accountability, many of the PCBs have introduced Sustainability Reporting under the module of GRI (Global Reporting Initiatives).

Keywords: Sustainable, bank, environment, risk, policy, compliance

**B3** **[14]**

# BUILDING REGULATORY PRACTICES IN TEN AFRICAN COUNTRIES IN THE FACE OF CLIMATE CHANGE

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***ABSTRACT***

The expected increase in building activities on the African continent and the anticipated future vulnerability of the continent in the face of climate change, require investigation. This paper compares the building regulatory practices in ten African countries to determine their individual responses to climate change. Various studies highlight the contribution of the built environment to total global greenhouse gas emissions. Additionally, the relationship between greenhouse gas emissions and construction activities is generally accepted. With just ten years left, the United Nations Sustainable Development Goals are unlikely to be achieved by the year 2030. The main aim of this paper is to establish whether the built environment of the ten identified countries currently take cognisance of climate change effects and if so, to determine the response and format. The desktop study compares present-day built environment regulatory policies on the African continent, with a particular focus on energy efficiency measures. The results could be interpreted as a baseline when evaluating current policies, making the study not only beneficial to the selected countries but also the broader African built environment. The desktop study points towards a lack of building energy codes by the biggest emitters on the African continent. As part of the recommendations, African countries are encouraged to consider revising the regulatory documents governing the built environment to contribute towards reducing greenhouse gas emissions on the continent.

Keywords: Building regulatory practices, climate change, greenhouse gas emissions, energy efficiency and policies.

**B4** **[15]**

# TAXONOMY AND TENDENCIES IN SUSTAINABLE FINANCE: A LITERATURE AND BIBLIOMETRIC ANALYSIS

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***ABSTRACT***

This study identifies the trends in the literature related to Sustainable Finance (SF) by means of a bibliometric analysis of publications taken from the Web of Science (WoS) database. A search in WoS for the associated terms came up with a total of 7370 entries, showing a particularly noticeable growth in scientific production in the aftermath of the Paris Agreement of 2015. The analysis of the bibliometric networks was performed using VOSviewer, from which were obtained the bibliographic coupling networks of journals, the analysis of the co-citation of authors and references, the analysis of co-authorship by country and research center and the analysis of key words. Using this last analysis in particular, five cluster groups were identified, showing the main themes of research: (i) *Climate risk and adaptation*, (ii) *Low carbon energy economy* or *Low carbon economy*, (iii) *Environment, finance and governance*, (iv) *Low carbon emission technologies*, (v) *Economic model and social cost.* According to the evidence shown in the study, further research is recommended into the themes of *Low carbon energy economy* and *Environment, finance and governance (ESG)*, as they are considered key themes in the immediate future.

Keywords: Sustainable finance, Sustainable economy, Low carbon economy, Climate risk, ESG, bibliometric analysis

**C1** **[16]**

# THE APPLICATION AND BENEFITS OF CLIMATE DATA IN RESEARCH

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***ABSTRACT***

Climate data is critical to conducting appropriate scientific research to allow stakeholders to make informed agricultural production decisions under a changing climate. The relevant use of climate data can also complement educational endeavors for enhancing science literacy, regarding climate and climate variability. This study details the use of climate data in the context of exploration of climatic parameters, navigating data repositories based on research requirements, data selection, and the importance in agricultural practices. Parameters of interest such as minimum and maximum temperature and precipitation will be used to demonstrate relevant application in crop and livestock production decisions. Examples of how climate data can be correlated with market signals and prices that impact profitability for agricultural producers will also be depicted. Results from this study will comprise the finding of multiple analyses in the aforementioned areas and discuss steps for data procurement from national databases and weather stations, as well as techniques for collecting, simplifying, and converting climate data to a usable format for potential use in undergraduate research. This has implication for future studies highlighting the need for climate data in agricultural research and the importance of using the correct format and units in climate data-based analyses. Understanding the appropriate application and use of climate data allows both the global research community as well as the mass population to have the ability to understand and analyze the data and opens opportunities to collaborate both globally and nationally for projects that are beneficial to the society.

Keywords: Agriculture, Climate Data, Databases, Research, Stakeholders

**C2** **[17]**

# EFFECT OF DIFFERENT MULCHING MATERIALS ON THE GROWTH AND YIELD PERFORMANCE OF TOMATO (*Solanum lycopersicum*) VARIETIES

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***ABSTRACT***

Tomato (*Solanum lycopersicum*) belongs to the family Solanaceae is one of the important vegetable crop grown in Sri Lanka. A field experiment was conducted to evaluate the effect of different mulching materials on the growth and yield performance of tomato (*Solanum lycopersicum*) varieties. Two factor factorial experiment was carried out in Randomized Complete Block Design (RCBD) with three replicates. Six mulches (un-mulch - control, mulch film, white polythene, paddy straw, sun-hemp and *Gliricidia*) and three varieties ($KC_1$, Mahesha, and Rajitha) were used as treatment combinations. All other management practices were performed based on the recommendation of Department of Agriculture except weed control. The effect of mulching materials on weed population, modification of soil microclimatic condition, growth and yield parameters were recorded and data were analysed in ANOVA using SAS 9.1 package. The means were compared by using Duncan Multiple Range test. Mulches were proved their effectiveness in weed control, ameliorating the soil temperature and soil moisture conservation than un-mulch treatment, but the least weed population was observed under the polythene mulch. There was a significance difference in vegetative growth traits (Plant height and number of branches) and yield parameters (fruit weight, circumference number of fruits per plant and yield) of tomato among mulches and varieties. In growth and yield parameters, the highest growth and yield parameters were observed under Gliricidia mulch in Mahesha variety. The usage of organic mulches economically profitable compare to un-mulched and plastic mulched cultivation. It can be concluded that Gliricida mulch and Mahesha variety can be recommended as the best combination for growing of tomato in Kilinochchi District during *Yala* season based on the growth and yield performance of the plant.

Keywords: Mulching, Tomato Varieties, Treatment, Growth Parameter, Soil Parameters, Economic

**C3** **[18]**

# GENDER DIMENSIONS IN CLIMATE CHANGE ADAPTATION: UNDERSTANDING ROLES OF WOMEN IN NYANGORES SUBCACHMENT OF MARA RIVER BASIN, KENYA

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***ABSTRACT***

Women in rural areas of low and middle-income countries are more vulnerable to climate change than their male counterparts. Despite their daily productive and reproductive roles in society, women are often marginalized in climate change adaptation and mitigation strategies. There have been numerous interventions through gender-sensitive policies, programs and activities in climate adaption strategies, to enhance their involvement but the effectiveness of such remains unknown. In this study, we assessed the effectiveness and gains made by the community-based natural resource management initiative that was established to address gender in climate change adaptation among communities in the Nyangores sub-catchment. This study also sought to determine factors that affects active participation of women in climate change issues. A mixture of interviews and structured questionnaires were used to collect data for this study amongst selected members of community forest association (CFA) and water resource users' association (WRUA). Overall, the study established an increasing trend in women's participation in CBNRM. This was mainly achieved by organizing members of WRUAs and CFAs into self-help groups where gender-based climate change interventions and training on on-farm income generating activities and table banking were undertaken to increase their respective incomes. The study also established that there are still many more women who are yet to participate because most of the activities of the initiative are tied to land ownership, which is largely controlled by men. This has in turn affected some women enrollment in CBNRM. Perhaps there is need to sensitize men also on the role of women in climate change adaptation for them to give support where necessary or work together.

Keywords: Gender, Women, Vulnerability, Climate change, Adaptation

**C4** **[19]**

# AN INITIAL STUDY ON CALCULATING CARBON EMISSIONS FROM AGRICULTURAL PRODUCTION IN WEST TENNESSEE

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***ABSTRACT***

Carbon sequestration is the storing of carbon in soil and plant biomass. Agricultural practices are partially responsible for greenhouse gas (GHG) emissions that are impacting climate change. The practice of soil sequestration in agriculture can help to mitigate the effects of climate change by reducing GHG emissions. Existing research in Tennessee in this area of climate change is lacking focus on reducing carbon emissions in agriculture, specifically if these emissions can be reduced through management practices supporting sequestration. The purpose of this study is to assess carbon emissions in West Tennessee and determine how different cropping practices in the agricultural production sector can have an impact on the environment. The methods of this study will include crop budget data from the University of Tennessee Extension Agency and crop acreage data from the National Agricultural Statistics Service to calculate carbon emissions for input applications such as fertilizers. The potential results will provide information on overall carbon emissions from crop production for Weakley, Obion, Gibson, and Carroll counties in the West Tennessee region. This data will also allow for additional future studies to be done to calculate carbon sequestration and the net carbon footprint. This would be the impetus to numerous future studies that have the potential to help producers make production decisions that will assist in reducing carbon emissions and improving overall farm profitability in the long run while mitigating adverse impacts on the environment.

Keywords: Agriculture, Crops, Carbon emissions, Carbon sequestration, West Tennessee

**V3** **[20]**

# DECARBONIZATION OF THE ENERGY MATRIX WORLDWIDE - SYSTEMATIC REVIEW OF THE INCENTIVES AND ECONOMIC COSTS INCURRED FROM RENEWABLE ENERGY SOURCES

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***ABSTRACT***

The Paris Agreement on climate change and the Sustainable Development Goals call for urgent, radical, and transformative actions for the reduction of greenhouse gas emissions, in which the energy sector is one of the main callings to contribute to this purpose. Renewable energy sources could provide 90% of the $CO_2$ emission reductions necessary to achieve the goal set by 2050 (IRENA, 2020). In addition, according to the Outlook of the International Energy Agency in October 2020 and the International Renewable Energy Agency, photovoltaic solar energy in 2020 has positioned itself as the cheapest source for the generation of electricity worldwide, going from 0.378 USD / kW in 2010 to 0.068 USD / kW in 2019. Correspondingly, the average price of the auctions for long-term contracts, with this generation source is expected to decrease from 0.195 USD / kW in 2013 to 0.039 USD / kW in 2021. Initially, incentives such as Feed-in-Tariff (FiT), discounts and certificates for the use of renewable energies and tax benefits were the most used, however, in recent years, market mechanisms, such as auctions have become a trend (IRENA, 2019). The paper aims to review the incentives and economic costs that have been incurred for the decarbonization of the energy matrix at the international level from renewable energy sources and the efforts of the countries to reduce CO2, mainly in Europe, the US, India, China, Japan, Australia, and Colombia, by (1) examining the progress of economic incentives and costs, (2) identifying the markets with the greatest advances in decarbonization, (3) determining the main strategies implemented.

Keywords: Decarbonization of the energy matrix, economic incentive, decarbonization costs, renewable energy sources, economic regulation.

**D1** **[21]**

# MODELING DISCHARGE TO ASSESS THE INFLUENCE OF INCREASED IMPERVIOUS AREAS IN CAGAYAN DE ORO CITY, PHILIPPINES

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***ABSTRACT***

Climate change has led to the occurrence of natural disasters. Flooding events, in particular, occur with increased magnitude and frequency. Understanding the contributing factors of flooding events can help find solutions to mitigate them and prevent further damage to properties and loss of lives. This study investigated extreme flooding events in Cagayan de Oro City, Philippines. It specifically looked into how impervious surfaces influence discharge generation which leads to flooding. ArcGIS and PCRaster were used to process the required input data for flood modeling which are digital elevation model, rainfall data, land cover maps, soil map, road map, and comprehensive land use plans of the study area. The openLISEM flood model was used to perform the flood simulations. Five land cover scenarios were simulated under six rainfall scenarios. The land cover scenarios were the 2003, 2010, and 2015 land cover maps. The city's Comprehensive Land Use Plans (CLUPs) were also considered as scenarios. The rainfall scenarios were the light, moderate, and heavy rainfall and extreme rainfall events of Tropical Storm Sendong, Typhoon Pablo, and Typhoon Vinta. The results showed that there were no major changes in the impervious surfaces from the 2003, 2010, and 2015 land covers. Furthermore, the discharges generated from these land cover scenarios were similar. Considering a 17% increase in impervious surfaces as observed in the CLUPs, the discharges increased. These results support findings of earlier studies where discharge generation was influenced by the increase of impervious surfaces. This study is helpful in guiding local officials and policy makers in drafting and implementing effective flood disaster risk reduction and management plans for the safety of the city residents.

Keywords: flooding, impervious surfaces, extreme rainfall, modeling

**D2** **[22]**

# A STUDY OF THE EFFECTS OF CLIMATE CHANGE IN THE EASTERN STATES OF AUSTRALIA

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***ABSTRACT***

The objective of this research is to study the impacts of climate change in the eastern states of Australia: New South Wales, Queensland and Victoria, during November 2019 to March 2020 and do period-over-period analysis in order to raise awareness on the climate change impacts. Air quality and pollutant PM 2.5 data were collected on an hourly basis for 5 representative cities in New South Wales: Lower Hunter, Sydney East, Sydney North-west, Sydney South-west and Upper Hunter-Muswellbrook, 3 representative cities in Queensland: South Gladstone, Boyne Island and Rocklea, and 3 representative cities in Victoria: Churchill, Wangaratta and Moe. After that, the average data on each day in each city were plotted in graph for each month; the previous year's comparisons were made to analyze the climate change impacts. The results show that the air quality and pollutant PM 2.5 in New South Wales, Queensland and Victoria, during the time of the study, are much higher than the previous years due to the Australia's most devasting bushfire season, resulting from climate change; the density of smoke exposure from bushfire can irritate the respiratory system. In this research, multiple factors affecting the destructive bushfire season were also analyzed compared to previous years. In addition, during the time of the study, there were storms, flash floods and thunderstorms after overnight hail in Victoria, indicating that hot and dry weather resulted in extreme climate change impacts in 2019 as a result of global warming.

Keywords: Bushfire, Rainfall, Temperature, Climate Change, Extreme Event, Australia

**D3** **[23]**

# ADAPTING THE ESG FRAMEWORK AS AN ASSESSMENT TOOL TOWARDS DEVELOPING A COMPREHENSIVE ENVIRONMENTAL MANAGEMENT PLAN FOR THE SAN JUAN RIVER SYSTEM IN METRO MANILA

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***ABSTRACT***

Since pre-Hispanic times, Manila Bay has been a locus of socio-economic and cultural development, containing local and international ports and linking trade routes. It provides livelihood to millions of Filipinos, and habitats to a multitude of marine organisms. Pollution has become a major issue of the Manila Bay system, owing to improper waste management, lack of centralized sewage treatment facilities, and governance issues, resulting in its degradation. Existing initiatives have been geared towards addressing environmental issues through Pasig River and Manila Bay. With current rehabilitation efforts, a new ecosystem approach focusing on river system management is proposed by the researchers to address root problems of Manila Bay, providing a different perspective in its rehabilitation. The San Juan River System, which contributes between 60 to 70% of Pasig River's pollution, was chosen as the focal point of the study. The river system comprises the San Juan River and its tributary creeks, which empties into Pasig River, itself a major tributary of Manila Bay. The river system flows through the water systems of four component cities in the National Capital Region. The river itself is considered to be biologically dead, with average BOD and COD levels at 35 mg/L and 60 mg/L, respectively. Recognizing the need for a whole-of-nature approach, the researchers frame issues within an environmental, social, and governance (ESG) framework to complement current government efforts and rehabilitation plans. This paper presents an environmental management plan with recommendations on technological, management, and infrastructure approaches, founded on a framework that may then be replicated along the different tributaries and networks of the Manila Bay system as appropriate to local conditions and ecological histories.

Keywords: San Juan River, Pasig River, Manila Bay, environmental management, pollution, water quality

**D4** **[24]**

# QUALITATIVE AND QUANTITATIVE ANALYSIS OF CHARACTERISTICS OF WATER IN ATTANAGALU OYA BASIN, SRI LANKA

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***ABSTRACT***

Gampaha is a district in the Western Province of Sri Lanka with many industrial zones, factories and dense residentials. It is the district having the second-highest population in the country. Attanagalu Oya basin, with an extension that almost covers the entire Gampaha district, is the main hydrological feature in determining the seasonal variation of surface water and groundwater characteristics of the region. In this study, the water characteristics of the Attanagalu Oya basin were qualitatively and quantitatively analyzed using representative samples to identify the trend of variation of those characteristics during pre-monsoon and post-monsoon periods. The qualitative parameters such as pH, electrical conductivity, turbidity and concentrations of calcium, magnesium, nitrate, phosphorous, ferrous and heavy metals were individually analyzed and compared with national as well as international standards. The periodic tendency in quantitative variation was observed through data loggers installed in the wells. The recorded values besides the meteorological data were used to primarily model the surface runoff pattern of the basin for a period of six years by using self-written Fortran codes. The comprehensive runoff flow pattern obtained from the model was spatially and temporally analyzed with the water balance parameters such as precipitation, evapotranspiration and infiltration. Though, there was a sensible fluctuation in the qualitative parameters during the pre and post-monsoon periods, it was the pH and the Phosphorous concentration that exceeded the permissible limits typically after the monsoon recharge. Specifically, the downstream region of the basin experienced both qualitative and quantitative deterioration of the water characteristics over the study period. This emphasizes the timely need for immediate implementation of a sophisticated water management system to the entire basin.

Keywords: Gampaha, Hydrological, Monsoon, Data loggers, Fortran, Runoff

**D5** **[25]**

# ASSESSMENT OF URBAN ECOSYSTEMS FOR RESILIENCE

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***ABSTRACT***

The fast urbanizing Indian cities are grappling with rising ecological challenges. Pollution, w ater insecurity, urban heat, flooding etc. have resulted in loss and disruption of many lives. Cloudbursts, heavy storms and heavy precipitation events have increased the vulnerability of urban population. There is a need to look at urban settlements as a functioning natural ecosystem delineated by administrative boundaries and to evaluate the health of this complex ecosystem on a regular basis through a comprehensive, easy to adopt, structured approach. The objective of this study is to track and evaluate the ecosystem health of three different urban settlements: a metropolitan ward, a growing peripheral city and an emerging town, through OECD's PressureState-Response (PSR) framework. This can enable defining the hotspots and identifying restorative, mitigative and preventive ecological solutions for them. The methodology includes indices driven identification of ecosystem components and pressure points through change detection using spatial and non-spatial data, developing an impact matrix and networks and building eco plans for future action. Increasing built – up surface in the growing peripheral city (20.8%) and transforming town (64%), show increased pressure on their ecosystem in the form of reducing pervious surfaces and increasing water turbidity, temperatures and aerosol content in air. A significant decrease observed in heavy vegetation in the metropolitan ward (38% in last 5 years) and increase in industrial activities and is observed in conjunction with increasing air temperatures in 30-year period. Significant increase in aerosol in air and exceedance and violations in ground water parameters over last 5 years is evident. The study concludes by recommending sustainable solutions which can mitigate, reduce the pressure and restore back the balance in the ecosystem.

Keywords: Urban ecosystem, PSR Framework, Ecological solutions

# POSTER PRESENTATIONS

**P1** **[26]**

# THINKING OF CLIMATE DIFFERENTLY

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***ABSTRACT***

Climate justice has emerged as one of the 21st century's defining issues. It is acknowledged that there are ethical questions of our Anthropocene epoch in which human domination and exceptionalism ingrain our human-centric worldviews. They are centering humans over non-humans leading to ecological crisis and climatic injustice. In response to climate change as a wicked problem, many scholars criticize those conventional humanist worldviews and argue that it is timely to systematically rethink and expand emerging conversations of climate knowledge creation. The question of alternative ways the Anthropocene offers to think of the climate in moving beyond those human-centered approaches is asked. The purpose of this paper is to review and map the literature in rethinking and troubling human exceptionalism, and binaries of human/nature and nature/culture. Through theoretical, ontological, and methodological turns, this paper will discuss several different approaches to examining climate issues, and provide potentialities and possibilities that new materialisms/post humanism and post qualitative offer to think about climate and weather differently and implications for reimagining and reconfiguring practices in responding to the climate challenges ahead.

Keywords: Anthropocene, New materialist and post humanist thinking, Becoming-with climate

**P2** **[27]**

# SCREENING OF POTENTIAL PLANT EXTRACTS TO CONTROL COMMON LAB CONTAMINANT TRICHODERMA spp

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***ABSTRACT***

The antagonistic fungi *Trichoderma* is called plant doctor fungi due its ability to control many plant diseases. This *Trichoderma* is also cause green mold disease which is a serious threat to mushroom industry. Green mold fungi adopted to survive wide environmental conditions due unexpected climate change over the last few decades. To control this disease in mushroom cultivation through fungicide is not possible because of both are fungi, and unwanted fungicides application can damage the environment, biodiversity, and raise unwanted health issues to human. Moreover, after cultivation of mushroom, mushroom wastes are being dumped into the environment. This study was carried out to find out an environmental friendly management of green mold disease using extracts form agro-based industries' by-products. Two sets of *in-vitro* experiments containing three different 5%, 10% and 20% extracts, from agro-based industries, such as, coffee (*Coffea Arabica*) waste powder, tea (*Camelia sinensis*) dust and Mahua (*Madhuca longifolia*) oil cake were prepared separately. *Trichoderma* and *Pleurotus* cultures were inoculated into each set with not treated control. All the experiments were conducted using complete randomized design with three replications. Collected data were subjected to ANOVA using SAS 9.1 statistical package. The data on mycilal growth and sporulation of both fungi were measured. Significant among the treatments were analyzed through DMRT mean separation at *P* value of 0.05. *In-Vitro* results showed that the *Trichoderma* mycelial growth was significantly minimum in Mahua (2.5 cm) and coffee (3.6 cm) in comparison to control (PDA-9 cm), whereas, with decreasing concentration of coffee, tea and Mahua extract *P. ostreatus* showed enhanced growth. *Trichoderma* sporulation had significantly affected in coffee treatment and it didn't sporulate in *Mahua* treated plants. From another in-vivo study, it showed that tea and coffee increase the yield of mushroom when it adds to the mushroom substrate straw. Therefore, it is consultable that adding of tea and coffee extracts to the mushroom bed will arrest the *Trichoderma* growth.

Keywords: *Trichoderma*, *Pleurotus ostreatus*, green mold, plant extracts, coffee

# SYMPOSIUM PRESENTATIONS

**[28]**

# ENVIRONMENTAL CHANGES IN THE CACAO LANDSCAPE AND THE IMPACT ON NATURAL ENEMY DIVERSITY

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***ABSTRACT***

Cacao is grown in a multilayered agricultural landscape developed through mixed cropping systems in the Philippines. Accrued insect pest management practices also vary widely among the cacao orchard owners and the farms are visibly entirely weedy, partially weedy, and totally weed-free due to herbicide application. All these factors generated environmental changes that may impact on the incidence of insect pests and its natural enemies. We documented that cacao farms subjected to partial weeding or totally weedy have a more diverse pool of natural biological control agents regulating insect pest populations below damaging levels compared to weeded and herbicide-treated fields. Partial circular weeding half meter around the cacao tree and non-removal of weeds provided large refuge areas or island habitats between trees that may have provided the source of nutritional requirements essential to survival and reproduction of natural enemies. The pool of natural enemies constituted 115 species of invertebrates and 12 species of vertebrates belonging to 21 and 8 families, respectively. Of the invertebrates, the Parasitic Hymenoptera representing 10 families followed by the predatory spiders [10 families], predatory dipterans [4 families], predatory orthopterans [2 families] and the predatory ant [Formicidae] are most preponderant. Within the parasitic Hymenoptera, Mymaridae, Encyrtidae and Eulophidae and among the predators, Gryllidae [Orthoptera] and Formicidae [Hymenoptera] are the most abundant and recommended for conservation.

Keywords: Biological control, integrated pest management, climate change, agricultural engineering, habitat structure, biodiversity

**[29]**

# ALTERED LEPIDOPTEROUS PEST PHENOLOGY AS A POTENTIAL EFFECT OF CLIMATE CHANGE

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***ABSTRACT***

Lepidopterans are not new to adjusting to a number and variety of spatial as well as temporal changes in the environment. (Not clear, please rewrite.) Hence their responses to climate change can vary depending on the abiotic (e.g. host plant) and abiotic (e.g. temperature, rainfall, etc.) characteristics of their habitat. The archipelagic nature of the Philippines makes it further challenging to link the direct and indirect effects of climate change on life cycles of lepidopterous pests like armyworms and cutworms. Many onion farmers in the country are affected by sudden and unpredictable armyworm or harabas outbreaks. In 2018, around 500 hectares of land planted to onion were affected by the feeding activities of these insects. Even the growing asters for ornamental purposes have been affected by armyworms. Meanwhile, established patterns of occurrences have not been documented or monitored. As a result, farmers remain vulnerable to the surge of pest outbreaks. Our study therefore aims to present patterns and observations on the changes of lepidopteran pest occurrence that have been reported in the Philippines. We also have described the plant-insect herbivore interactions resulting therein.

Keywords: lepidoptera, monitoring, phenology and pest

**[30]**

# SAVING LIVELIHOODS FOR CLIMATE CHANGE ADAPTATION: THE CASE OF PHILIPPINE AGRICULTURE

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***ABSTRACT***

The increased risk of the Philippines due to climate Change combined with its high exposure to natural hazards such as tropical cyclones, moisture stress and storm surges due to its geologic circumstances makes agriculture sector more vulnerable to such hazards. The damage and loses to the agriculture sector due to weather and climate-hazard reached Php 100.80 billion, with an annual average of Php 20.16 billion from 2016-2020. The Department of Agriculture (DA) Disaster Risk Reduction and Management (DRRM) Operations Center (OpCen) serves as an operating arm for technical and operational support on matters related to DRRM. Due to the early advisories before typhoon struck the country saved Php 32.07 billion on rice and corn. The DRRM OpCen will continue to be more proactive when it comes to disaster risk reduction and management.

Keywords: Calamities, crop damages, OpCen, climate change, DA DRRM, agriculture sector

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# A STUDY ON E-WASTE MANAGEMENT AS A KEY ELEMENT TO ACHIEVE CLIMATE RESILIENCE IN THE PHILIPPINES

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***ABSTRACT***

The electronic gadgets are one of the key stressors that have an effect on the overall impact of climate change mainly at three levels- production, operation and improper e-waste management. While the high greenhouse gas emission during the production and operation processes of the electronics is under scrutiny, the improper disposal of the redundant and non-functional electronic products in the form of e-waste pose a range of environmental and human health problems due to the leaching out of hazardous chemicals present in these electronic products. In the Philippines, there has been a tremendous increase in the sheer volume of the locally generated e-waste as well as the foreign e-waste that ends up in the country for recycling purposes. The improper recycling practices lead to the release of the hazardous chemicals into the environment. Using Atomic absorption spectroscopy (AAS), heavy metal contamination (Cu, Pb, K, Ni and Cd) was detected in the soil and aquatic bodies close to e-waste dumpsites located near Metro Manila as well as in the hair samples of the e-waste recyclers. The Allium cepa assay and micro-nuclei in the human buccal epithelium of the e-waste recyclers confirmed the genotoxicity of the e-waste. With Philippines ranked second in the list of the vulnerable countries most affected by climate change in the Global Climate Risk Index 2020, the contaminant-dominant or climate change dominant interactions between the climate change and the e-waste pollutants needs to be investigated. This study highlights the importance of proper e-waste management to mitigate its role on the overall impact of climate change in order to make Philippines, climate change resilient.

Keywords: E-waste toxicity, e-waste management, Philippines, climate-change dominant interactions, contaminant-dominant interactions, heavy metals

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# CONTRASTING ADAPTIVE GENETIC CONSEQUENCES OF STREAM INSECTS UNDER CHANGING CLIMATE

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***ABSTRACT***

Riverine biodiversity experiences unexpected degradation due to climate change. Researchers have inferred the impacts of climate change on neutral genetic diversity, assuming the fixed spatial distributions of alleles. Previous studies, however, have overlooked mostly the adaptive genetic evolution of populations that may change the spatial distribution of allele frequencies along environmental gradients (i.e. genetic rescue). We developed a novel approach that projects the comparatively adaptive and neutral genetic diversities of four stream insects, using empirical neutral/nonneutral loci, ecological niche models, and a distributed hydrological-thermal simulation under climate change. Of the studied species, with different ecologies and habitat ranges, Ephemera japonica (Ephemeroptera) lost their rear-edge habitats (i.e. downstream) but retained the adaptive genetic diversity because of genetic rescue. In contrast, the range and diversity of upstream-dwelling Hydropsyche albicephala (Trichoptera) were declined dramatically. The two Trichoptera species that gained new habitats upstream (Hydropsyche orientalis and Stenopsyche marmorata) displayed the same mechanistic reductions in their genetic diversities as observed for the H. albicephala, owing to the removal of the leading-edge populations. The findings emphasize the genetic rescue potential, depending on the extent of species-specific local adaptation.

Keywords: Adaptation, Genetic rescue, Hydrological simulation, Machine learning, Macroinvertebrates, Species distribution models,

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# ELEVATIONAL PATTERNS OF GENETIC DIVERSITY IN RIVERINE POPULATIONS IN JAPAN

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***ABSTRACT***

The influence of elevation on spatial-structuring patterns of biodiversity has long been a central topic. The integrated genetic effects of a species' dispersal mode and landscape connectivity on a metapopulation have been recognized in habitat networks. Gene-flow and genetic-drift processes can produce the patterns of genetic diversity related to changes in elevation. In this study, we used a mechanistic framework to evaluate elevational genetic divergence at the metapopulation scale by considering the structuring processes. Empirical genetic data from stream macroinvertebrates having aerial adults were collected from streams in Japan to determine the elevational roles on metapopulation genetics. Results indicated that elevational factors allow the formation of topographic constraints. Asymmetric dispersal can influence isolation among local populations. Changes in genetic diversity along the elevation gradient could be modeled using the integrated actions of structuring processes within the metapopulation genetic modeling. These results suggest that the evolutionary processes can shape the genetic patterns along the elevational gradients. This strong association between elevational factors and evolutionary processes highlights the importance of spatial architecture in assessing the effectiveness of conservation and management strategies.

Keywords: Diversity, Japan, Model, River, Landscape

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# TAXONOMIC REVISION OF JAPANESE SNOW CRANE FLIES (CHIONEA, LIMONIIDAE): A FIRST STEP TO UNDERSTAND THE EFFECT OF CLIMATE CHANGE ON WINTER ACTIVE INSECTS

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***ABSTRACT***

In the temperate zone, several arthropod groups adapted to low temperature are active during the cold seasons. The snow crane fly genus Chionea (Diptera: Limoniidae) is one of the most remarkable members of insects active in winter. The wingless, spider-like adults are highly adapted to the soil-inhabiting life and the low temperature; however, these adaptations also make them more vulnerable to the changing climate. Surveying and modelling the effects of climate change on snow crane flies requires a taxonomical clarification first. The unique appearance of the snow crane flies has attracted the attention of both biologists and amateurs since the early 19th century, and several species have been described from the Holarctic areas. However, non-specialists created many confusions in the taxonomy and systematics of Chionea. The revisions of North-American and European species revealed that 1/3 of the described species are synonyms. The fauna of the East-Palearctic remains unclarified, from where 9 species have been reported so far. After an intensive collection of Chionea in Japan and the revision of the type specimens of the three Japanese species, results suggest that our taxonomic knowledge on this genus is insufficient and many new species will occur in Japan. Our preliminary results suggest that one previously described species is a synonym, one species is first recorded from Japan, and 7 new species are identified. Furthermore, Chionea nipponica and C. kanenoi are erroneously reported from Russia and South-Korea.

Keywords: Taxonomy, Snow, New species, Type specimens, East-Palearctic

**[35]**

# INCREASED RISK OF ENVIRONMENTALLY-INDUCED CANCER DUE TO URBAN POLLUTION

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***ABSTRACT***

In recent years the severity and duration of traffic congestion have significantly increased in major urban areas worldwide. Emissions from vehicles, established as a dominant source of toxic gases and particulate matter, pose danger to human health. In rapidly urbanized cities like Metro Manila, some groups of people by the nature of their work, are exposed to these toxic substances longer than the rest of the population. These high-risk groups include drivers, policemen, traffic enforcers, garbage collectors, street cleaners, street vendors and daily commuters. Population- as well as laboratory-based methods have been conducted to estimate the potential risk of these people to develop environmentally associated diseases like cancer. Many of these studies claimed that urban air pollution increases lung cancer risk and suggested that vehicle emission is an important risk factor. In the local setting, a very few studies have been done to assess the health impact of air pollution. We present very preliminary and modest data on the estimation of cancer risk for environmentally induced cancer on jeepney drivers. Using bleomycin-assay, a cell-based assay, we found a significant difference in the number of chromosome breaks per cell (b/c) in the lymphocytes of jeepney drivers compared to the control group. It is highly recommended that more studies be conducted to look into the potential risk of air pollution on health in urban population.

Keywords: Environmentally induced cancer, urban air pollution

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# THE TIME VARYING EFFECT OF WEATHER VARIABLES AND ITS INTERACTION ON DENGUE OCCURRENCE DURING 2009-2015, IN BANDUNG CITY, INDONESIA

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***ABSTRACT***

Weather has been found as a strong driver for occurrence of mosquito-borne diseases such as dengue. The pathway of dengue transmission is determined by the dynamic and complex nature of interaction between weather, virus, dengue vector lifecycle, human behavior, at their ecosystem. This very complex nature of dengue ecology makes us harder to find a universal pattern between weather and the disease despite various approaches being utilized. Previous studies often used a family of regression models and the findings were varying and inconsistent. Traditionally, relationship of weather, for example rainfall, and dengue has been viewed as linier and static over a year. The objective of this study is to explore the changing effect of weather on dengue occurrence over the time and to investigate whether one weather variable effect will depend on the other weather variables in driving dengue incidence in the community. We investigated the dynamic relationship of weather with dengue case in the community from 2009 to 2015 in Bandung City, Indonesia by Bayesian dynamic Poisson model using integrated nested Laplace approximation. Given the data limitation, we were able to find that, annualy, there were both positive and negative independent effect of 1-month lag of minimum temperature, rainfall, and relative humidity on Dengue occurrence at different months. We also found that the temperature effect on dengue occurrence depends on rainfall parameters. From our findings, we suggest that weather have time-varying and potentially interaction effect each other (Not clear, please rewrite) for dengue transmission in the community. It is important to assess the dynamic and interaction effect nature in future studies on the association of weather and dengue.

Keywords: Weather, Dengue, Dynamic Effect, Rainfall, Temperature

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# POTENTIAL IMPACTS OF CLIMATE CHANGE ON HEALTH IN THE CONTEXT OF PHILIPPINE MEDICINAL PLANTS

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## *ABSTRACT*

The use of traditional medicines or natural products from plants is not just popular among indigenous and rural communities, but is also gaining more acceptance even in urban areas as more research studies proving the benefits of plant-derived biomolecules for the prevention and treatment of human diseases are being conducted. The pharmaceutical industry also considers designing safe, effective, and cheaper drugs based on the plants' secondary metabolites. Since plants are important for health, its natural habitats should be kept healthy, diverse, and dynamic. Unfortunately, during the last thirty years, worldwide changes in average temperatures, weather events, seasonal patterns, and other related phenomena are being experienced, and these are attributed to global climate change. Climate change can influence environmental factors such as temperature, precipitation, light intensity, and carbon dioxide level which can then affect plant growth, secondary metabolites production, as well as its associated bioactivities. Philippines is one of the world's biodiversity hotspots, and its people have long relied on plants due to its phytonutrients. However, long-term changes in climate are predicted to have disruptive effects on plants. It is the goal of this presentation to provide information on some of the plants found in the Philippines, its known bioactivities, and also to give a short review of some of the possible effects of climate change on health in the context of medicinal plants. For example, the introduction of related abiotic stresses to plants may likely lead to modifications in its phytochemical properties and these will have a direct impact on its health and therapeutic benefits.

Keywords: climate change, health, natural products, secondary metabolites, bioactivities

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