

THE 3RD INTERNATIONAL CONFERENCE ON
**CLIMATE
CHANGE**
KUALA LUMPUR, MALAYSIA

“Adaptation and Mitigation in Practice : Local and Global Innovations”

BOOK OF ABSTRACTS

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MESSAGE FROM THE CO-HOSTING PARTNER ICCC 2019



On behalf of Universiti Putra Malaysia, I like to take this opportunity to congratulate the International Institute of Knowledge Management (TIKM), Sri Lanka for organizing The 3rd International Conference on Climate Change 2019 (ICCC 2019) on 21st-22nd February 2019 in Kuala Lumpur, Malaysia.

With the theme “**Adaptation and Mitigation in Practice: Local and Global Innovations**” is an auspicious occasion to assemble all stakeholders involved directly or indirectly in the fields related to climate change. Climate change is real and its impacts may be irreversible if urgent measures are not taken. We have seen the devastating effects of extreme weather that resulted in economic loss and reduced quality of life. Continuous research innovations and the implementation of adaptation and mitigation strategies are essential to reduce the impact of climate change. As the champion for Malaysian universities in Universitas Indonesia (UI) GreenMetric World University Ranking 2018, Universiti Putra Malaysia (UPM) is always committed to conserve the environment through various eco-friendly approaches, particularly in the area of transportation, infrastructure, energy and climate change. With Sustainable Development Goals (SDGs) adaptation into university management and operation, the Green@UPM strategic plan was introduced to promote environmental awareness in reducing carbon footprints and create a sustainable environment for our future. As the co-host of this conference, the university believes that ICCC 2019 is timely to make progress towards in combating climate changes and achieving Sustainable Development Goal 13 (Take urgent action to combat climate change and its impacts). This conference brings together educators, researchers, as well as students from around the world, providing them a networking platform to discuss ideas and research findings relative to climate change worldwide.

I hope that ICCC 2019 will offer ample opportunities in sharing experiences and fostering research collaborations among delegates as we proceed with our work towards a sustainable future.

I wish this conference a great success!

Thank you

A handwritten signature in black ink, appearing to read 'Zaharin'.

Prof. Dr. Ahmad Zaharin Aris
Dean, Faculty of Environmental Studies
Universiti Putra Malaysia
Malaysia

MESSAGE FROM THE CONFERENCE CHAIR ICCC 2019



Climate change has become the biggest environmental issue of the century significantly impacting the global economy while reducing the chances for having sustainable development by the vulnerable countries. Due to high costs associated with the potential adaptation and mitigation measures, more sustainable remedial measures, international cooperation and sharing of technological knowhow with regard to new developments in the field are very important. The Paris Agreement adopted at the 21st Conference of the Parties of the UNFCCC (COP21) held in Paris in 2015 aims at limiting the global average temperature rise during the century to well below 2 °C above pre-industrial levels by taking necessary action. Having this concern, the 1st International Conference on Climate Change 2017 (ICCC-2017) was held in February 2017 with the theme ‘Climate Change, Facing the challenge beyond COP21’, and the 2nd International Conference on Climate Change 2018 (ICCC-2018) was held in February 2018 with the theme ‘Climate change and global sustainability: Action for bridging the gap’. Both conferences were successful events held in Colombo, Sri Lanka with a large number of participants including scientists, students, representatives of research institutes and other government- and non-governmental organizations all around the world.

The 3rd International Conference on Climate Change 2019 (ICCC-2019) will be held in Kuala Lumpur, Malaysia, with the theme ‘Adaptation and Mitigation in practice: Local and Global Level innovations’. The key goal of this conference is to share the research findings and experiences among the participants, particularly focusing on more sustainable innovative adaptation and mitigation options in different economic sectors that are impacted by climate change. As the Chair of the conference I hope ICCC 2019 will create the ideal platform for continued dialog, sharing and dissemination of information relevant to research and development experiences considering the climate change impacts on food security, biodiversity and natural resources, health and sanitation, etc., and other relevant aspects such as greenhouse gas measurements, modeling and climate predictions, and new trends in adaptation and mitigation related research. Both ICCC 2017 and ICCC 2018 received a large number of abstracts from all around the world providing a valuable opportunity for sharing knowledge and experiences. I wish the presenters of the ICCC 2019, including young scientists, a pleasant and fruitful event.

Dr. Erandathie Lokupitiya

Senior Lecturer

Department of Zoology and Environment Sciences

Faculty of Science, University of Colombo, Sri Lanka

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ORAL PRESENTATIONS



A1

[01]

A COMPARISON OF FLOOD RISK MANAGEMENT IN JAPAN AND MALAYSIA

N.A.B. Mabahwi and H. Nakamura

*Shibaura Institute of Technology, Japan****ABSTRACT***

Floods are dangerous disasters that often lead to loss of houses, belongings and lives. Malaysia is a country prone to flooding, especially during the monsoon season that brings heavy rain to the east coast of Peninsular Malaysia and states of Sabah and Sarawak. Nevertheless, Japan also suffers from floods in parts of the country. Thus far, there has been little discussion on the comparison of flood risk management in Japan and Malaysia. The aim of this paper is to compare flood risk management in the two countries. This study uses comparative analysis to compare flood damage incidents over the 10-year period from 2008 to 2018, structural and non-structural measures, flood disaster risk as well as flood mitigation, preparedness, response and recovery programmes in the two countries. It also examines the role of each flood risk management measure and investigates the flood hazard maps of the countries. It is not yet mandatory for every state government in Malaysia to prepare a flood hazard map. Therefore, there is a lack of available flood hazard maps for every state in Malaysia even though the country suffers from flooding every year. Moreover, to determine which level of government and which government organisations are more responsible for flood risk management, this paper compares flood management organisations (flood risk governance) and flood-related laws in both the countries. The outcome of this analysis provides a suggestion for better flood risk management and improvements in flood mitigation, flood risk governance and flood preparedness in Malaysia.

Keywords: flood, Japan, Malaysia, comparison, management

A2

[02]

**TOWARDS AN INTEGRATION OF WATER RESILIENCE AND CLIMATE
ADAPTIVE GOVERNANCE: A CASE STUDY OF WUHAN, PRC**

J. Yang

*China Academy of Building Research (CABR), China***ABSTRACT**

Though it is true that China has experienced an astonishing transformation in its economy over the past three decades, the increasingly severe water scarcity is seriously undermining the socio-economic development and the sustainability of this country. In response to the issue and other environmental concerns, the concept of “Two-Oriented Society (TOS)” was proposed in 2008 by Chinese central government. In this paper, a case study of Wuhan, characterized by its massive area of lakes and wetlands, will be performed to review the institutional framework established by Wuhan municipality for promoting the capability of water and climate adaptive governance. As one of the authorized pilot cities constructing TOS, Wuhan has put forward a series of comprehensive plans and large-scale projects depicting the vision, objectives and measures of constructing TOS since 2009. After a systematic analysis of panel data and a comparative study on action plans and projects, the following two questions are addressed: 1) What challenges does Wuhan municipality face in employing adaptive and resilient water and climate governance arrangements? 2) How has Wuhan authority integrated water and climate issue into the socioeconomic development during the recent 10 years? The paper finds that the integration of water resilience and climate adaptive governance requires not just possessing these characteristics but combining and constructing on them. i.e. , the integration needs well-funded, transparent knowledge systems combined with broad, multilevel participatory processes that support learning, strong institutional arrangements that establish authorities and regulations and allow flexibility as conditions change, and resources for integrated planning and allocation.

Keywords: Water Resilience, Climate Adaptive Governance, Institutional Framework

A3

[03]

**POWERING ATMOSPHERE DECARBONIZATION WITH ENERGY CANE
BIOMASS**

P.F. Hernandez, L.C. Carvalho and D.S. Arantes

*Department of Communications, School of Electrical and Computer Engineering, University
of Campinas – Unicamp, Brazil*

ABSTRACT

This paper addresses the critical problem of atmosphere decarbonization for climate change mitigation. A phenomenon supported by thousands of renowned researchers, the amount of carbon dioxide already accumulated in the atmosphere, due mainly to fossil fuel combustion, is certainly the most important problem faced by humankind today. As it goes hand in hand with severe environmental degradation, either in the air, continents, oceans and polar caps, an efficient solution to reverse these degradations is of utmost importance. However, such a solution depends not only on world leaders, politicians, researchers and corporate decision-makers, but also on the support of the whole society. Its urgency should always be haunting the minds of concerned people around the world. It is important, therefore, to address the technical aspects of climate changes in a way as to reach a much wider range of attentive listeners with a minimum scientific background. For this purpose, the object of this paper is to synthesize the relevant technical findings in recent years and to emphasize the technological and financial resources required for addressing this problem. A simple extension of the carbon budget equation for the balance between emissions and absorptions of carbon dioxide in the atmosphere is proposed, to better characterize the primary causes of climate changes. An equation for quantifying the cost of carbon sequestration and storage is also proposed. Preliminary results indicate that the cost of decarbonization with energy cane biomass is at least one order of magnitude lower than with direct air capture machines.

Keywords: climate changes, fossil fuels, biofuels, biomass, energy cane

A4

[04]

ESTIMATION OF ABOVEGROUND AND BELOWGROUND CARBON STOCKS IN URBAN FRESHWATER WETLANDS OF SRI LANKA

D.D.T.L. Dayathilake and E. Lokupitiya

University of Colombo, Sri Lanka

ABSTRACT

Freshwater wetlands hold a significant potential for climate change mitigation owing to their high capacity to sequester and store atmospheric carbon dioxide (CO₂). Despite this recognized potential, estimation of wetland carbon pools is still in its infancy in most parts of the world. Thus, carbon estimation across different ecosystems has become a timely necessity. The current study was undertaken to quantify the carbon stock in the Kolonnawa marsh which forms the largest segment of the Colombo Flood Detention Area of Sri Lanka. Three discrete carbon pools were analyzed: aboveground biomass (AGB), belowground biomass (BGB), and soil organic carbon (SOC). Stratification of the marsh was achieved via the Normalized Difference Vegetation Index. Field measurements were coupled with allometric tree biomass regression for the estimation of AGB and BGB. SOC was determined using three parameters: depth of soil, bulk density, and SOC concentration where the SOC concentration was determined using the technique of loss on ignition. Total carbon stock was estimated at 241,301 t CO₂ equivalent (CO₂eq) with an overall precision level of 10 % of the true value of the mean at 95 % confidence level while the overall mean plant biomass carbon stock and SOC stock were estimated at 221.19 ± 84.41 t CO₂eq/ha, 676.01 ± 144.74 tCO₂eq/ha, respectively. The largest fraction of stored carbon was found in soil, viz., as high as over 90 %. These findings further indicate that freshwater wetlands store disproportionately large volumes of carbon. The study proposes freshwater wetlands as a viable solution for the ever increasing concentrations of atmospheric carbon dioxide and thus suggests the optimization of these ecosystems for the enhancement of the net carbon sink in the island.

Keywords: Aboveground biomass, Belowground biomass, Soil carbon, Freshwater wetlands, Carbon estimation

A5

[05]

RETHINKING CLIMATE GOVERNANCE IN MALAYSIAJ. Ilham^{1,5}, C.M. Tan^{2,5}, V. Muralikanth^{3,5} and L. Yamin^{4,5}*¹Jeffrey Sachs Center on Sustainable Development, Sunway University, Malaysia**²Nicholas School of the Environment, Duke University, United States**³School of Geographical Sciences, University of Bristol, United Kingdom**⁴Department of Science and Technology Studies, University of Malaya, Malaysia**⁵Malaysian Youth Delegation, Malaysia***ABSTRACT**

For the first time since its independence, Malaysia enacted its own climate change ministry, the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), post-14th General Elections in 2018. The general elections resulted in a change of government after 60 years, with the Pakatan Harapan coalition as the new ruling party. The Pakatan Harapan's Manifesto, released prior to the General Elections, promised a balanced economic growth with environmental protection. Promised deliverables include setting up a "National Coordination Council for Climate Adaptation and Mitigation", increasing renewable energy usage from current 2 per cent to 20 per cent by 2025 and reducing 40 percent carbon emissions by 2020. During the 24th Conference of Parties (COP24) in Katowice, Poland, many countries, including Malaysia, came together to produce a comprehensive Katowice Climate Package as part of the Paris Agreement Work Programme. This paper explores the climate governance that goes beyond the international climate negotiations, and how it translates at a national level in Malaysia, from a developing country and Global South perspective, incorporating narratives of "New Malaysia." The objective of this paper is to examine the intricacies of implementation of climate action at a national scale, and to provide recommendations through an inter-ministerial and multi-sectoral approach. This paper put forward significant focus on horizontal linkages between newly reformed ministries, as well as key actors from different sectors. We hypothesize that national policies and regulations will be effectively fulfilled with clear delegation of responsibilities and increased cooperation, thus resulting in greater climate action.

Keywords: Malaysia, climate governance, adaptation, mitigation, COP24, Paris Agreement Work Programme

A6

[06]

INTEGRATED APPROACH TO MANAGE WEEDS ON PERFORMANCE OF CASTOR UNDER CHANGING CLIMATE

A.H.K. Naik¹, P. Chandravamshi¹, D.A. Sumana¹ and D. Chndrappa¹

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ABSTRACT

Castor is a hardy crop grown under rainfed conditions on a variety of soil and climatic conditions. Weed infestation is one of the constraints limiting the production of castor. Due to changing environmental conditions with variations in the onset of south-west monsoon, sowing dates are affected, causing losses in crop yield as well as changes in cropping systems in this region; weed population dynamics also vary. Furthermore, prevalence of high temperature coupled with relative humidity and frequent rainfall favors luxuriant weed growth which smother crop by restricting its growth particularly during early stages by offering severe weed competition for essential resources and first 40 days appeared to be critical. The conventional method of weed control is very effective, expensive, labour intensive and time consuming and do not allow weeding at rains during the critical period resulting in poor weed control. Information regarding the use of herbicides in castor under rain fed conditions is meager and hence an attempt has been made to work out an effective weed management strategy using herbicides alone or in combination with inter-culture/hand weeding in Central Dry Zone of Karnataka.

Keywords: Castor , weed, management, and yield

A7

[07]

**ENERGY COOPERATION BETWEEN CHINA AND ASEAN ENERGY INDUSTRY
IN THE CONTEXT OF GLOBAL CLIMATE CHANGE**

X. Yang and D. Huang

ASEAN Research Center, Huazhong University of Science and Technology, China

ABSTRACT

The Paris Agreement requires developing countries such as China and ASEAN countries to undertake global emission reduction responsibilities through nationally determined contribution for the first time. Under the pressure of the Paris Agreement and national economic development needs, renewable energy, which brings less carbon dioxide emissions but achieve higher efficiency, will become the driving force to achieve emission reduction target as well as economic development goal. At present, China and ASEAN countries have huge market demand for renewable energy, while there is still much room for exploring the new possibilities. Strengthening China-ASEAN energy cooperation can not only drive related technologies, engineering construction, energy equipment manufacturing and other Chinese enterprises to go abroad, but also alleviate China's domestic excess capacity and make up for the shortcomings of ASEAN countries in terms of technology, talents and management experience. Moreover, energy cooperation is significant to achieve regional infrastructure connectivity. In order to further promote China-ASEAN energy cooperation and achieve target in the first commitment period of the Paris Agreement, we should not only follow the existing development pace of China and ASEAN but also rely on the unique advantages of both sides. Therefore, during the post-Paris Agreement era, China and ASEAN countries should improve the renewable energy cooperation policy system, scientific planning in power construction, interconnection and industrial cooperation.

Keywords: the Paris Agreement, China-ASEAN, energy cooperation, renewable energy

B1

[08]

**IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH: A STUDY ON
MANIKGANJ, BANGLADESH**

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ABSTRACT

This research was carried out to correlate between climate change and human diseases. Time series of climatic parameters were collected from Bangladesh Meteorological Department (BMD). Time series of disease data were collected from the Upazilla Health Complex. Pearson's correlation was used to correlate between climatic parameters and incidences of diseases. The primary data collection tool includes household survey, FGD and in-depth interview. Information on health disorders, perception on seasonal changes of climatic parameters etc. were collected. Statistical techniques have been used for analyzing the relationship between climate change and health related variables. Trend analysis of climatic parameters and diseases has been carried out based on available annual time series data. Seasonal index of diseases reflecting the monthly variations in the disease pattern have constructed using series. The study indicates that climatic factors including temperature, rainfall and salinity have positive correlation with diarrhea, skin diseases, kala-azar etc.

Keywords: Climate Change, Disease, Positive Correlation, Impact

B2

[09]

ADAPTATION STRATEGY OF INDRAMAYU FEMALE FARMERS IN DRY SEASON

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ABSTRACT

This study aims to analyze the adaptation strategies of female farmers in the Indramayu, Indonesia in the face of the dry season. Every year, the city of Indramayu experiences drought from May to October. August is the worst month in that phase. This research was conducted in rainfed lowland areas in Indramayu Regency, Indonesia which included three districts, namely the districts of Haurgeulis, Gantar, and Indramayu. These three districts experienced the worst impact in the drought in Indramayu. The method used is descriptive survey approach. The population in this study were female farmers in 3 districts and the samples were taken using snowball techniques. The results showed that during the dry season, female farmers switched professions to non-agricultural jobs to fulfill their lives; e.g. becoming a freelancer at a slipper factory, shrimp peeler in a frozen food factory, and tailor veil. The income earned is sufficient to meet the basic needs until the planting season arrives, the season in which they return to their basic profession of farmers. The female farmers in Haurgeulis and Gantar District do their side jobs in the same area, but not with female farmers in Indramayu District who have to migrate outside the district to get and do their side jobs.

Keywords: Dry Season, Female Farmers, Adaptation Strategy

B3

[10]

**ASSESSMENT OF WORRINESS, TRUST IN GOVERNMENT, PREPAREDNESS
AND INTENSION TO RELOCATION OF POST FLOOD VICTIM COMMUNITY IN
KELANTAN**

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ABSTRACT

Kelantan State was the most hit by worst flood in the late of December 2014, due to a heavy monsoon rainfall affecting huge number of people, settlements, agriculture, and infrastructure, which require massive and extensive work after flooding. The victims lost their properties, family members and security for survival making them psychologically and mentally traumatized and they are also vulnerable to health hazard. They have to struggle to piece together their lives while facing new challenges which, rely on their capacity to adapt over time. The purpose of this study is to determine the level of worriness, trust in government, preparedness and intention to relocation of the post-flood victims in Kelantan, Malaysia. Data was obtained through open-ended and close-ended questionnaire surveys. The survey was conducted by interviewing 507 respondents who have directly or indirectly experienced the flood in 2014. The questionnaires were divided into six (6) sections covering physical and mental aspects which consist of demographic information, vulnerability, adaptive capacity, resilience, exposure and general knowledge. Eight components from thirty-eight components were retained using principal component analysis (PCA). Multiple linear regressions (MLR) analyses were used to create regression equation of four factors identified as influencing factors of worriness, trust in government, property and emotion, preparedness and transportation of the post-flood victims. Several mitigation steps and ways could be identified and recommended.

Keywords: Disaster, trust in government, worriness, preparedness, intension to relocation, multivariate analysis

C1

[11]

MITIGATING CARBON DIOXIDE EMISSION FROM PADDY SOIL WITH SAWDUST BIOCHAR AMENDMENT

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ABSTRACT

Biochar application to cropland has been recommended as a strategy to reduce greenhouse gases and mitigate climate change. This study aimed to clarify the effects of sawdust biochar and in different combinations of chemical fertilizers on the soil productivity, rice yield and the possibility for mitigating CO₂ emission from paddy field. A field trial was conducted in the Department of Agronomy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh with 6 treatments: i) Control (No fertilizer) (ii) soil test based chemical fertilizers (STB) (iii) urea super granule (USG) (1.8 g) + P, K, S and Zn as STB (iv) sawdust biochar @ 2.5 ton carbon ha⁻¹ (v) sawdust biochar @ 2.5 ton carbon ha⁻¹ + Integrated plant nutrition system (IPNS) based chemical fertilizers and (vi) sawdust biochar @ 2.5 ton carbon ha⁻¹ + USG (1.8g) using a randomized complete block design with four replicates. The results showed that sawdust biochar decreased by 16% CO₂ emission rate compared to the STB based chemical fertilizers treated paddy field in entire growing period. Sawdust biochar along with IPNS based chemical fertilizers increased rice yield by about 24% compared to the control plot. Sawdust biochar in combination with IPNS based chemical fertilizers improves soil pH, organic carbon, nitrogen, phosphorus, sulphur, potassium and zinc to favorable levels. This suggests that sawdust biochar application in paddy fields could aid in mitigating climate change effects through reduced CO₂ emission.

Keywords: Sawdust biochar, carbon dioxide, climate change effect

C2

[12]

**USE OF ICT-BASED AGRO-APPLICATION “RICE CROP MANAGER” TO
IMPROVE SOIL HEALTH, FARM PRODUCTIVITY AND PROFITABILITY OF
RICE CROP**

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ABSTRACT

In India, the use of fertilizers in rice crop is quite imbalanced and one of the major reasons is the limited knowledge of farmers about the doses and role of various nutrients on crop growth and efficiency. In rice crop, the most frequent and highly used fertilizer is urea, which owing to the massive subsidy is affordable and highly favored by the farmers. As farmers rely on only nitrogenous fertilizers to increase their crop production, the other equally important nutrients and micro-nutrients are massively ignored thus resulting in decreased crop productivity, profitability and soil fertility. The imbalanced use has detrimental effect on air and water bodies and the excessive release of nitrogenous gases also contributes to global warming. To combat all these issues associated with improper nutrient usage, International Rice Research Institute has developed a web- and mobile phone based application/software ‘Rice Crop Manager’, which uses Site Specific Nutrient Management principles, to calculate a field specific nutrient management recommendation based on information provided through a farmer’s interview about field and crop management. In India, this tool is catering to the rice growers of three states, viz. Bihar, Eastern Up and Odisha and after successful evaluation of this tool, it is being disseminated widely among the resource poor, small and marginal farmers and till date around hundred thousand farmers have been benefitted through this tool. Different extension channels viz. state agricultural department, NGOs and private sectors, have been identified and a mix of them is being deployed to reach out to more and more farmers.

Keywords: Fertilizers, climate, ICT, farmers

C3

[13]

**ENHANCING WATER PRODUCTIVITY, YIELD AND QUALITY OF SUGARCANE
UNDER SUBSURFACE DRIP FERTIGATION SYSTEM WITH PAIRED ROW
TECHNIQUE FOR SUSTAINABLE PRODUCTION**

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ABSTRACT

The sugarcane is an important commercial crop which requires more water for its growth and development. It occupies nearly 2500 ha area in Bhadra command. Farmers are growing sugarcane in command area without scientific water management practices which resulted in lower water productivity. The information on enhancing water productivity in command area is limited since most of farmers follow flood irrigation method. The participatory frontline demonstrations under RKVY project were carried out in Davangere district in southern transition zone and central dry zone (zone-7 and 4) of Karnataka during 2012-13 under irrigated condition in different farmers field comprising total area of 16 ha. Treatments of the present investigation included T1- without paired row planting + Rec.NPK (Based on soil test) T2- Paired row planting + Rec.NPK (Based on soil test) T3- Paired row with sub surface Drip +Rec.NPK (Based on soil test) T4- Farmers practices. The results revealed that Paired row with sub surface Drip irrigation recorded highest cane yield of 220 t ha⁻¹ followed by Paired row planting + Rec.NPK (160 t ha⁻¹) and lowest yield obtained in farmers practices (120 t ha⁻¹). Similarly water use was 145 ha cm in case of sub surface drip irrigation, followed by parried row surface irrigation of 165 ha cm and highest was 269 ha cm in case of farmers practices with normal planting. The water productivity of sugarcane in sub surface drip irrigation was 1517 kg ha cm⁻¹ whereas under farmers practice with normal planting was only 446 kg ha cm⁻¹. Further, it was observed that sugarcane production and water productivity was enhanced by 83.3 and 240 per cent respectively with sub surface drip irrigation. The improvement in soil nutrients availability, yield and water productivity was attributed to maintenance of available moisture in root zone throughout crop growth period with substantial water saving which resulted in enhanced production and water productivity under sub surface drip irrigation.

Keywords: Subsurface drip fertigation, water soluble fertilizers, paired row, cane yield

C4

[14]

SOIL FERTILITY STATUS OF SELECTED BT COTTON GROWING AREAS OF NORTHERN TRANSITION ZONE OF KARNATAKA

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ABSTRACT

Cotton enjoys a predominant position amongst all cash crops of India and Karnataka. The required fertilizer inputs for cotton vary with soil type and other factors such as inherent fertility, previous crop, nutrient management and cropping practices. The development of information for managing soils and the use of needed inputs will establish reasonable expectations for productivity of fields and increase profits through efficient use of inputs followed by management practices. Therefore, assessment of fertility status of soils that are being intensively cultivated with high yielding crops needs to be carried out. A survey study was carried out in selected Bt cotton growing areas which covers Belagavi and Bailhongal taluks of Belagavi district, Hubballi taluk of Dharwad district and Shiggaon taluk of Haveri district coming under Zone 8 of Karnataka to evaluate the fertility status with respect to major and micronutrients. Twenty soil samples (10 samples from Vertisols and 10 samples from Alfisols) from 0 - 22.5 cm depth soil. Bt cotton growing both Vertisols and Alfisols of Belagavi, Dharwad and Haveri districts were observed acidic to alkaline in soil reaction, non-saline and low to high status in organic carbon content. The study also revealed that Vertisols and Alfisols of Belagavi, Dharwad and Haveri districts were found low in available N, low to medium in available P₂O₅ and medium to high in available K₂O. Among the soils studied, all the available micronutrients (Cu, Fe and Mn) were present above critical limits except zinc. But, Vertisols and Alfisols of Bailhongal taluk and some Alfisols of Belagavi taluk recorded Zn deficiency.

Keywords: Fertilizer, nutrients, organic carbon, cotton, Vertisols, Alfisols

D1

[15]

**ASSESSING HOUSEHOLD CARBON EMISSION AND THE DRIVING FACTORS:
A CASE STUDY IN BALANGODA DIVISIONAL SECRETARIAT DIVISION, SRI
LANKA**

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ABSTRACT

Carbon emissions has a considerable impact on humans as well as the environment. It also plays a vital role in accelerating global warming. Increasing population and human activities are key factors of carbon emissions in the world, while households too are accountable for it. The present study focuses on identifying drivers of household carbon emission in three selected Grama Niladari Divisions (GN) in Balangoda, Sri Lanka. Ten Percent of total households belonging to three GN divisions representing high (Balangoda), medium (Ellepola) and low (Pallekanda) magnitudes of carbon potential were selected for the study. Land surface temperature, land use and land cover, vegetation and fuel consumption were considered in understanding the background knowledge of existing pattern of carbon emission in study area. Emission concentrations were determined through a survey using a questionnaire for collecting quantitative data on fuel and electricity consumption and transport and secondary expenses of households. Carbon footprints were calculated using an online carbon calculator and manual formulas. The results revealed that the highest emission ranges from 0.8 MTCO_{2e} to 4.35 MTCO_{2e} in Balangoda (urban area), the second highest from 0.33MTCO_{2e}-3.76MTCO_{2e} in Ellepola (semi urban area) and the lowest from 0.27MTCO_{2e}-1.7MTCO_{2e} in Pallekanda (rural area). More than 95% of each household emission is due to electricity consumption and secondary expenses. 92% of the households in the city use Liquid Petroleum Gas, thus ranking Balangoda GN Division top among the highest emitting areas. The results indicate that, the household level carbon assessment plays an important role in regularizing measures for global level carbon decrease and making the world a green planet.

Keywords: Household carbon footprint, Carbon driving factors

D2

[16]

**ASSESSMENT OF CLIMATE CHANGE AND ITS IMPACT ON RAINFALL-
RUNOFF CORRELATIONS IN MAZAM RIVERWATERSHED, INDIA**

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ABSTRACT

Changing climate has a significant impact on rainfall and runoff in the rivers and Water Resources. An assessment of the availability of water resources in the context of future requirements and expected impacts of climate change and its variability is critical for relevant national and regional long-term development strategies and sustainable development. Changes in the climate have been assessed through assessing the parameters and their trend analysis with daily maximum and minimum temperature of the month, daily average temperature, annual rainfall, monthly rainfall of the monsoon season, and maximum daily rainfall of the year, number of rainy days in the year and number rainy days in each month of monsoon season. It is observed that the 1) Maximum daily temperature shows an increasing trend in summer season (March to June) and a decreasing trend in winter season (October to February) at weather stations in the study area. 2) The monthly rainfall trend shows an increasing trend for the magnitude of annual rainfall and an increasing trend at rain gauge stations in the study area. 3) The number of rainy days in the monsoon season (June to October) shows a decreasing trend. Rainfall- Runoff regression analyses have been carried out for baseline and advance/climate change scenarios to investigate the impact of climate change on Water Resources. This study will be helpful to the water resources planners and decision makers regarding the strategies to be followed in view of the changing climate.

Keywords: Temperature analysis, climate change, Climate change scenario, Trend Analysis, Rainfall-Runoff

D3

[17]

**IMPACTS OF WEATHER PATTERN CHANGES AND THE RATIO BETWEEN
POTENTIAL EVAPOTRANSPIRATION AND PRECIPITATION AS A DROUGHT
INDEX ON TEA PRODUCTIVITY IN SELECTED LOCATIONS OF SRI LANKA**

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ABSTRACT

Tea is one of the major export crops in Sri Lanka and grown in high, mid and low elevations. The highest yields have been recorded from low elevations and the recent tea yields show a decreasing trend comparatively to the past. This study was conducted to analyze the impact of changing weather patterns and the effect of a drought index (DI) incorporating potential evapotranspiration (PEP) and precipitation on tea. The period of study was 2006 -2017. Six tea estates were selected, two representing three different elevations. The productivity data and rainfall measurements from the estates were considered for the analyses. Temperature and Humidity data were collected from the Department of Meteorology and Tea Research Institute. Regression analyses were conducted between the tea productivity and weather parameters. According to the findings, previous month's total rainfall, mean temperature of the current month and the relative humidity positively impact the tea yield in low elevations. Monthly relative humidity negatively impacts the tea yields of mid elevations while the rainfall of the previous month and the mean temperature of the current month impact positively on the yield at mid elevations. There was no significant impact of relative humidity on the tea yield of upper elevations, but the yield was positively impacted by rainfall and temperature. According to the statistical model relationships DI two months prior to the current month positively effect on the tea yield of low elevations and DI four months prior to the current month negatively affected the tea yield of mid elevations. In high elevations DI of the previous month and two months prior to the current month had a positive impact on tea yield.

Keywords: Drought Index, Potential evapotranspiration

D4

[18]

ASSESSMENT OF CLIMATE CHANGE IN ORSANG RIVER BASIN, INDIA

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Climate change is a global phenomenon resulting in long-term changes in weather. India is a predominantly an agricultural country. The economy and the development of the nation have to rely on the water resources. Thus it is important to assess the climate change within the watershed boundary and to assess the impact of the climate change on the water resources for food security, Economy and development of the nation. In this study, monthly time period of the monsoon season and annual rainfall trends have been studied to assess the impact of climate change in the region. The monthly rainfall data series from 1970 to 2016 (47 years) have been made available for the rain gauge sites in the Unch watershed of Orsang river. The Orsang river is a tributary of the Narmada River in the Gujarat state of India. The monthly and annual rainfall data series trend analysis has been carried out for these rain gauges installed in Orsang river basin. The change in the climate by assessing the trends in the parameters temperature, annual and monthly rainfall have been carried out in the Orsang river basin in this study. There are four rain gauge stations namely Devhat, Dhandodha, Pavi-Jetpur, and Rangpur. The annual and monthly rainfall pattern and trend are analyzed at these stations within the Orsang river basin. There are 2 weather stations located in the Orsang river basin namely Dhandodha and Naswadi. The annual rainfall trend at rain gauging stations in the study area shows the either reducing trend or slight increasing trend. The M-K tests have been carried out and trends are verified. The most important component of hydrologic cycle – rainfall runoff correlations in baseline scenario and climate change scenario is also investigated for annual rainfall averaged over the catchment area of the Bodeli river gauging station on Orsang river have been also investigated. It is found that runoff potential is reducing in this river basin. Authors are thankful to the Higher Education and Climate change Department of Government of Gujarat, India for funding this study.

Keywords: Trend Analysis, Temperature, rainfall, Climate change scenario, annual rainfall

D5

[19]

HOW DOES CLIMATE CHANGE AFFECT CORAL REEFS?T.F.K. Tengku¹ and J.R. Turner²

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ABSTRACT

Coral reefs known as ‘rainforest of the sea’, is the most biodiversity rich ecosystem in the world, and it is a habitat for one third of all marine species. The marine species from benthic organisms to nekton species are living in coral reef ecosystem because of the nutrient richness. Moreover, the diverse ecosystem has been supporting millions of people worldwide for its economic value (fisheries, tourism and coastal development). However, coral reefs is also one of the most threatened ecosystems due to climate change, plus with the anthropogenic impacts. According to UNESCO, coral reefs might be vanished by 2050 due to global warming. When the sea temperature changes, corals can expel their symbiotic algae and cause them to lose their colours which is known as coral bleaching. As the ocean warming occur over years, there are more frequent events of mass coral bleaching and disease outbreaks among coral reefs. Severe and long-term bleaching make the corals very vulnerable to other threats or they die. This study investigated the historical pattern of coral bleaching events in 2009 until 2011 using the online databases which operated the twice weekly global 50-km satellite coral bleaching monitoring products. Two environment variables to detect coral bleaching were examined for the islands around Peninsular Malaysia and East Malaysia: Sea Surface Temperature (SST) and Degree Heating Week Coral Reef Watch (DHW CRW). These methods can help the marine park managers or reef conservation organisations to study and predict data for any future mass coral bleaching events.

Keywords: coral bleaching, global warming, Degree Heating Week, Coral Reef Watch

D6

[20]

CLIMATE CHANGE IMPACT ASSESSMENT ON RAINFALL FOR KIM RIVER BASIN, INDIA

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ABSTRACT

There are various governing factors for changing climate such as manmade activities, the extent of the gas, land use pattern and land cover of the region etc. Each governing factor causes the impact to change the climate of the region. Even though the climate change is a global phenomenon, its extent varies from region to region. Thus it is important to establish the regional assessment of the changing climate and its impact. In India, it is important to assess the rainfall variability and trend, because the rainfall is an important characteristic of the climate variability. The changing of the climate triggers extreme rainfall events. This study examines the variability and change in the trend of the annual and monthly rainfall over a small-scale region. i. e. Kim river basin. The Kim River is one of the west flowing rivers in the state of Gujarat India. It originates from the Saputra hill ranges in Bharuch district of the Gujarat state, India and emerges into the Gulf of Cambay after flowing in the length of 107 km. There are three raingauging stations namely, Mangrol, Uteva and Zhankhvav installed in the study area i.e. the catchment area of the Moti Naroli river gauging station, of Kim river basin, which is of 804 Km². The normal annual rainfall at stations Mangrol, Uteva and Zankhvav is found to be 1203 mm, 1209 mm, and 1128 mm respectively. These three stations in the study area are found to be adequate as the optimum number of raingauge stations, even with 5% error in determining mean rainfall. Trend of the annual and monthly rainfall for each monsoon month within this river basin have been investigated. The rainfall-runoff correlations for base line and advance climate changes scenario have been also established in this study. It is identified that annual rainfall trend shows an increasing trend. The M-K test has also been performed to verify the trends. It is concluded that for any recurrence interval and frequency of annual rainfall, the magnitude of annual rainfall increases in advance scenario in comparison to the baseline scenario. Rainfall – runoff response in a river basin is indicative of the changing climate. It is found that the runoff potential increases in climate change scenario. This study will be helpful to the water resources planners and decision makers regarding the strategies to be followed in view of the changing climate. Authors are thankful to Higher Education Department and Climate Change Department of Government of Gujarat, India for funding this study.

Keywords: Regional climate change, Climate change scenario, Trend Analysis, Rainfall- Runoff

E1

[21]

MANAGING SMALL TANKS IN SRI LANKA IN A CHANGING CLIMATE

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*Institute of Sustainable Futures, University of Technology Sydney, Australia***ABSTRACT**

Small tanks are an invention of early settlers of the dry zone of Sri Lanka. A literature review revealed that small tank water storages enabled the establishment of settlements in dry plains of Sri Lanka since prehistoric times (300 BC). Small tanks evolved into more extensive small tank cascade systems (STCS) as the population expanded. This encouraged co-evolution of community-led governance systems providing multiple social and ecological services. These community modes of management were abandoned during British colonialism leading to the degradation of STCS. Despite this, STCS show potential as a climate change adaptation strategy for small farmers. Field observations/experiences indicate STCS can help mitigate climate-induced risks by storing water, stabilizing groundwater table, supporting livestock, provisioning food and sustaining livelihoods. The governance of STCS has changed over time from community-led polycentric forms to centralised management led by government agencies. This has led farming communities to become passive participants rather than determiners of decision-making processes. Currently, decisions are not adhered to by all members of the community and this increases the vulnerability of the system to extreme weather/climatic events. However, STCS provide opportunities to manage climate-induced risks provided some management rights are transferred to local communities to enhance their capacities to take decisions that suit local conditions/needs. We conclude that while greater community autonomy is desirable, under the current legal framework, legacy issues such as top-down authoritative decision making, lack of trust, degradation of social cohesiveness, loss of traditional land rights, and political or relational affiliations would make this transfer problematical.

Keywords: Climate change, Water governance, decision-making

E2

[22]

**URBANIZATION AS A DRIVER OF FLOOD DISASTER EVENTS: A STUDY
BASED ON SRI LANKAN FLOOD EVENTS**

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ABSTRACT

Disasters are one of the global issues, which have become a huge threat on developed and developing nations in maintaining and gaining Sustainable Development Goals. Disasters can be divided into two broad categories, namely, Natural disasters and manmade disasters. Currently the frequency of natural disasters has developed over time with alteration of ecological systems especially due to increasing changes in urban populations. An analysis was done based on worldwide percentage urbanization over forty years, disaster occurrence and impact. Secondary data was collected from disaster profile and from United Nations Population Division (World Urbanization Prospects: 2014 Revision). Data analysis was carried out using SPSS. Extent of exposed communities, disaster mortality, compensation of infrastructure, and loss of livelihood were analyzed against the urban population growth rate. According to results, countries with urban population with a percentage growth of more than 50% were observed to have a higher impact. A higher number of exposed people, destroyed houses, damaged houses, economic losses, damage to infrastructure, and loss of livelihood were identified with the increase in urban population growth. This resulted in a positive correlation between urban population growth, disaster occurrence and disaster impacts. Due to the habit of seeking luxuries and easy access to infrastructure, more people are attracted towards the cities for settling, especially closer to the center of economy. In general, the ecosystems and the earth are formed naturally in a way to maintain and balance the natural disaster phenomena and to reduce the impact. However, at present, as the naturally available space in the city areas to supply the needs is less than what is expected, people tend to alter the natural ecosystems to develop settlements, industries and cultivations creating and inducing the disaster prevalence and related impacts.

Keywords: Population, Urban, Disasters, Impact

E3

[23]

**WATER RESOURCES MANAGEMENT SYSTEM: A WAY OF CREATING
CLIMATE SMART VILLAGE ENSURING WATER SUFFICIENCY
THROUGHOUT THE YEAR**

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ABSTRACT

Chure range is formed by depositing the debris and pondered as the youngest and fragile hill in the southern Nepal. These hills annually face different natural calamities like flash flood, land cutting in summer and extreme drought in dry season. A village Rajbash, situated in the lap of non-Perennial Ratu River, was facing similar problem of too much water and too little water. In rainy season, there used to be heavy rain causing flood and land. Similarly, there used to be no water in dry season creating no water for drinking and irrigation. To solve problem, water management technology was develop along the Ratu Water shed by CDAFN, Bardias on the support of Caritas Nepal and Caritas Germany. In most of the torrents, rain water harvesting pond was created to harvest the rain water which ultimately control landslide and flood. In dry season, harvested water was uplifted through solar pump for the irrigation. Similarly, along the Ratu River, underground seepage canal was constructed with raising seepage water technology. This technology has been boon for the villages as there was sufficient water being collected for drinking water and irrigation even in dry season. Technology of water harvest and raising of seepage water has made a water deficit village to water sufficient village with creating many livelihood option. Through water management, 217 hhs are getting pure drinking water and irrigation facility for 114 hectare of land. Initially people used to have only one crop in a year but after these technologies, villagers are having 3 crops in low land whereas vegetables in uplands. Government has decided to scale up these technologies to manage water resources and create water smart village in Chure Area.

Keywords: Water Harvest Technology, Raising Seepage Water, Water Smart Village

E4

[24]

INTENSIFYING CLIMATE CHANGE AWARENESS PROGRAMMES THROUGH INTERNATIONAL COLLABORATION IN SABAH, MALAYSIA

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ABSTRACT

Sabah, Malaysia established an international collaboration for three years from March 2016 to March 2019 to increase awareness and change behavior towards the prevention of global warming in Sabah, Malaysia. The memorandum of understanding (MOU) for this project was signed between the Ministry of Tourism, Culture and Environment, Sabah (MTCE) with the Conference of Earth Environment from Akita, Akita City, Japan on 24 March 2017. It is funded by the Environmental Restoration and Conservation Agency of Japan. The Environment Protection Department Sabah (EPD), a department under the MTCE is implementing this MOU. The project has given vast opportunities for officials from Sabah to understand about global warming which was delivered by the Japan Centre for Climate Change Actions (JCCCA) in Tokyo.

The lessons learnt from the training in Japan have been extended to the citizens in Sabah. Within two years after the trainings, EPD and partners have conducted 149 awareness programmes throughout the State involving 15,082 participants consisting of mainly primary and secondary students, teachers, parents and communities. The awareness materials used in these programmes comprised of a set of slides provided by JCCCA presenting the scientific facts with figures and charts, the Paris Agreement and mitigation measures against the global warming, hands-on tool explaining a food chain, pamphlets, quizzes and others.

This international collaboration indeed has significant contribution to advocacy and awareness of prevention of global warming, by localising the Sustainable Development Goals at the state level. Such collaboration is crucial and urgently required for everyone to understand the meaning of global warming, the fundamental requirement to change behaviour and mindset, and to mitigate global warming.

Keywords: collaboration, climate change, awareness, programme

E5

[25]

**RIDING OUT THE TIDE: LABOR MOBILITY AND CLIMATE CHANGE
VULNERABILITY IN KIRIBATI**

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ABSTRACT

Billed as a global-south empowering alternative to force climate migration, *migration with dignity* has become synonymous with the plight of climate change adaptation in Kiribati. More than a decade after the implementation of New Zealand's Recognized Seasonal Employer scheme (RSE), low-skilled labor mobility opportunities have allowed thousands of I-Kiribati workers to fill employment shortages throughout the region. To what extent however, exists a relationship between labor mobility reduced vulnerability to climate change? Overseas labor mobility not only serves to perpetuate *migration with dignity* but as a concurrent gatekeeper to employment for outer-island communities. With current training and selection protocols taking place in South Tarawa, potential candidates from remote outer-islands relocate to the urban center. Successful candidates consequently hang in the limbo that is South Tarawa between temporary employment overseas and barriers of remoteness, logistics and lack of investment opportunities available in their home islands. Based on qualitative fieldwork conducted while embedded in the Kiribati Ministry of Employment and Human Resources (MEHR) between July and September 2018, this paper will argue that current labor mobility procedures contribute to the continued overpopulation of South Tarawa and an increase in climate change vulnerability and will call for a decentralization of low-skilled labor migrant training to outer-island hubs.

Keywords: labor migration, migration with dignity, Kiribati

F1

[26]

LOCAL KNOWLEDGE OF AGRO-PASTORALISTS IN THE FACE OF CLIMATE CHANGE: CASE OF THE REGION OF RAS EL MA (WESTERN ALGERIA)Z. Bensmira¹, M. Bensmira¹, H. Benchaben² and S. Bouju³*¹University of Mascara, Algeria**²University of Tiaret, Algeria**³University of Bordeaux Montaigne, France****ABSTRACT***

Climate change and its impacts are now recognized as one of the greatest challenges facing the world, people, its environment and its economies (GIEC, 2007). According to (GIES, 2015), it appears that in a climate change and increasingly random, farms will be weakened. The arid zones of Algeria, face climatic risks that weigh heavily on their inhabitants and their development perspective (Ayouz *et al.*, 2012). This area, which is the leading supplier of sheep meat, is experiencing profound changes in the climate and socio-economic environment. Droughts have become frequent and climate change is a burden on the steppe, a vital sector of pastoral populations. The absence of data for a retrospective analysis of the climate over a long period is a major handicap, hence the need to resort to local knowledge (Tidjani et al., 2016). This know-how reveals many logics of breeders to adapt to an environment with strong constraints. This study focuses on the understanding of the strategies developed by agro-pastoralists in Ras El Ma in a climate change situation and the measures adopted to deal with them. The survey introducing quantitative and qualitative dimensions is carried out at the level of the 3 municipalities of the Ras El Ma region. To counter this situation, agro-pastoralists begin by modifying their practices and adopt two kinds of long-term and short-term strategies. It is through these ways of adaptations that the breeders of Ras El Ma reconstitute their productive capital during environmental crises.

Keywords: Ras El Ma, pastoral system, climate change, adaptation

F2

[27]

**CONCEPTUALISING THE ROLE OF TRADITIONAL ECOLOGICAL
KNOWLEDGE (TEK) IN CLIMATE CHANGE ADAPTATION**

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ABSTRACT

It is well known that indigenous people live close to the land. Such intimacy not only provides an early warning about climate change but also means that they will face greater difficulties in the face of such change compared to their non-indigenous counterparts. Making up approximately 5% of the global population, indigenous people generally live in poverty and are the most marginalised group in the world. Although climate change is set to exacerbate their ongoing dilemma, traditional ecological knowledge (TEK) possessed by indigenous people due to their intimate knowledge of the land may be the key to dealing with climate change. This paper aims to describe the role of TEK in the context of climate change based on four interrelated TEK typologies. The findings indicate that TEK can provide insights at site-specific levels, which can complement the explanatory power of global climate models and provide grounded information on the actual impact of climate change.

Keywords: traditional ecological knowledge, indigenous people, climate change adaptation

F3

[28]

IMPROVEMENT OF BIODIVERSITY THROUGH GREEN INFRASTRUCTURE: A CASE STUDY OF HAZARIBAGH TANNERY AREA

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ABSTRACT

Hazaribagh area started to establish as a potential industrial estate for tannery from 1947. The effluents from industries with the wastewater were discharged into Buriganga River. Tannery has already been relocated to Hemayetpur, Savar Upazila, leaving this area as a barren land. Top soil of this area and water of Buriganga River are highly contaminated with Chromium (23148 mg/kg). Among the effluents, Chromium (VI) is the most harmful for humans, animals, insects and other species. The biodiversity of this area is disrupted because of the severe contamination of soil, water and air. This area has high demand for commercial office, shopping centers and residential development for being adjacent to Dhanmondi Residential area. So, haphazard construction of buildings on untreated soil will result into unplanned area which will be a major health threat to the inhabitants. The method of this study includes primary data collection (PRA sessions with tannery owners, local people survey and expert interviews), secondary data collection, analysis, findings and recommendations. PRA sessions of this study reveals that 65% landowners are agreed to sacrifice a portion of their lands by attracting FAR incentive and low rate finance from Government of Bangladesh. This paper identified possible ways to improve biodiversity in the study area. This highlights the strategies to be undertaken for the reclamation of contaminated land. The soil must be excavated minimum 8 feet before using the area. Plantation of trees, especially *Polyalthia longifolia* and creating urban forest will work to improve the biodiversity of the area. It also incorporates how Redevelopment or Regeneration can be a solution to secure green public spaces with mixed use infrastructures.

Keywords: Biodiversity, Green, Space, Hazaribagh, Redevelopment, Regeneration

F4

[29]

**MOVEMENT OF EDUCATIONAL INSTITUTIONS IN ENVIRONMENTAL
PRESERVATION (STUDY ABOUT THE EFFORT OF CREATING ECO-
PESANTREN IN PESANTREN SPMAA LAMONGAN JAWA TIMUR)**

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ABSTRACT

The movement of educational institutions in environmental preservation is currently developing and spreading in Indonesia as an effort to preserve the environment. As a country that has a population density which occupies the top ten of the world, it allows for environmental problems caused by human activities. In 2009, the United Nations through the UNESCO organization launched Education for Sustainable Development (ESD) which aims to provide long-term solutions to changes in human behavior in order to live sustainably to find solutions to environmental problems as they are now facing. One of the typical Indonesian educational institutions is the "pesantren" educational institution. One of the efforts to conserve the environment is by building an environmentally caring attitude. The potential for caring for the environment is applied through an Islamic approach in Islamic boarding schools. One of the Islamic boarding schools in East Java is the Lamongan SPMAA boarding school. The approach of the Educational Institution is expected to foster awareness of santri and the surrounding community towards the environment. . The results of the study found that the movement of the SPMAA boarding school is an "Eco-pesantren" movement, namely the movement of Islamic education institutions that have concern for activities that are responsive to environmental preservation

Keywords : Environmental Conservation Movement, Ecopesantren.

F5

[30]

**TECHNOLOGY TRANSFER TOWARDS CLIMATE CHANGE: A CASE STUDY
ON THE EFFECTIVENESS OF CLEAN TECHNOLOGIES IN SOUTHERN AFRICA**

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*Turku School of Economics, University of Turku, Finland***ABSTRACT**

Clean technology is being hailed as a best option to mitigating global climate change. With several scientific reports showing strong evidence of global warming as seen from frequent occurrences of natural disasters in part of the world. The objective of this research is to acquire a deeper understanding into the usage, perception and attitudes of people in rural communities, towards clean technologies as an effective solution for mitigating climate change. The study can be divided in two parts. Firstly, to know how clean technologies are contributing people's wellbeing and environment, if any. Secondly to analyze clean technology transfer phenomenon with international cleantech firms. This research adopts an exploratory case-based research approach through ethnography as a qualitative methodology to be executed in 2-3 selected rural communities in Southern Africa. The research findings are intended bring in new approaches to climate change mitigation, to help in organization restructuring of climate change efforts to build a more cohesive framework to close the gaps in clean technology adoptions in marginalized rural communities in developing countries.

Keywords: Clean-technology, Climate Change, ethnography, Southern Africa

**POSTER
PRESENTATIONS**



P1

[31]

**SETTLEMENTS RESPONSIVE TO CLIMATE CHANGE IN LOW ELEVATION
COASTAL BANGLADESH**

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ABSTRACT

Settlements in low elevation coastal zone (LECZ) of Bangladesh are exposed to the risk of sea born hazards at present and anticipated sea level rise (SLR) resulting from climate change. Climate change will have serious impact on life and livelihood of low elevation coastal community including loss of habitable land. To arrest mass exodus of population, vulnerable community and groups need to be accommodated in places through local level adaptive measure. The present study is, therefore, an attempt to identify key vulnerabilities of coastal community in selected areas with an aim to set criteria for settlement planning and design responsive to climate change in general. Two village communities of Dhulasar union at Kalapara Upazila are selected for socio-spatial analysis of settlement vulnerability. Primary data about socio-spatial profile of the area including settlement pattern and built form, different aspects of vulnerability and present adaptive measures to cope with the risk have been collected from field survey. The study reveals that, the level of vulnerability within same geo-physical exposure is not alike and depends on the degree of community resilience i.e. the capacity of settlement component or community or groups to recover. In addition to the geo-climatic risk, the existing physical and socio economic condition of the dwellers including dispersed settlement pattern, transient nature of houses and poor access to services and shelter makes the coastal community most vulnerable. The study suggests that the vulnerability can be reduced by improving the community or group resilience through planned densification of settlement pattern and management of geomorphology and hydrological process of the context (allow natural siltation, afforestation, improve water drainage, rainwater harvesting etc).

Keywords: Climate Change, Coastal Community, Community Resilience, Settlement Pattern, Vulnerability

P2

[32]

MALAYSIAN REDD+ AND THE POSSIBLE ROLES OF NON-STATE ACTORSS. Bacon¹, B. Perumal¹, S. Chikamatsu² and N.A. Anak²*¹Malaysian Nature Society, Malaysia**²Ecological Economic Solutions Sdn. Bhd. , Malaysia***ABSTRACT**

Malaysian government under the Intended Nationally Determined Contribution (INDC) have committed to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. The scope of GHG emission covers Land Use, Land Use Change and Forestry (LULUCF) as forest is key source of GHG removal in Malaysia. Up until 2005 LULUCF sector of Malaysia has been offsetting all the GHG emissions from its energy sector and industrial processes sector combined. Malaysian government have also committed to maintain at least 50% of the forest cover, which is currently at around 55%. Furthermore, protection and management of its forest is important for Malaysia if it wants to export its commodities including palm oil as “sustainable produce”. It is therefore crucial for the Malaysian Government to implement effective REDD+ strategy and achieve these goals. REDD+ mechanism could assist Malaysia achieve its goals especially through formulation of REDD+ strategies and action plans, calculation of Forest Reference Levels (FREL), strengthening of National Forest Monitoring Systems (NFMS), and implementation of Safeguards Information Systems (SIS). However, there have been limited discussion, within Malaysia, on the role of non-state actors in achieving REDD+ partly due to the novelty of the mechanism and lack of understanding of REDD+ by the non-state actors themselves. This is by no means demonstration of lack of participation of non-state actors in forest governance. There has been notable partnership between the Malaysian government and the non-state actors, including Malaysian Nature Society, such as the “Central Forest Spine” and “Heat of Borneo” initiatives. This paper will therefore examine the Malaysian REDD+ strategy, and possible applications of existing government and non-state actor partnership mechanisms. Furthermore, the paper would explore possible new roles for non-state actors in achieving Malaysian REDD+ ambitions.

Keywords: Malaysian, REDD+ , GHG, forest, non-state actors

P3

[33]

**DEVELOPMENT AND EVALUATION OF TRACTOR OPERATED ONION SEED
DRILL**

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ABSTRACT

Onion is the one of the major vegetable crops of Chitradurga district in Central Dry Zone –VI of Karnataka. Area under onion cultivation in Chitradurga is 16,054 ha with production of 3,15,620 MT. Manual and animal drawn onion seeder was developed, but its capacity was low so there is a need to develop a tractor drawn, high capacity machine for timely sowing of onion and to cover large area under the crop. The development of the onion seed drill was carried out in the workshop, Zonal Agricultural and Horticultural Research Station (ZAHRS), Babbur Farm, Hiriyur. Onion seed drill was designed based on the crop and machine parameters. The major components are bund former, ground wheel, seed metering mechanism and seedbox. The vertical rotors with cells are used as seed metering mechanism. The power to drive the feed shaft is taken from the ground wheel through chain and sprocket with speed ratio of 1:1. The unit consists of 13 slit type furrow opener. Tractor operated onion seed drill was tested for its performance at research field, ZAHRS, Hiriyur. The seed rate of the seed drill was 2 kg/acre. The field capacity and field efficiency were observed as 0.41 ha/h and 81 per cent, respectively. The developed onion seed drill worked satisfactorily for sowing onion and also reduced the labour requirement in both seeding as well as bund making.

P4

[34]

TEMPORAL VARIABILITY OF TRACE ELEMENTS IN SURFACE WATER OF LANGAT RIVER, MALAYSIA

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ABSTRACT

The sources of trace element pollution in surface water can vary both spatially and seasonally. The information on variations is vital in managing the risks associated with elemental contaminations. Thus, this study aims to investigate the temporal variation of trace elements in tropical climate of Malaysia. Surface water samples were collected from 30 sampling stations along the Langat River during wet and dry seasons. The concentrations of selected trace elements (aluminium (Al), arsenic (As), barium (Ba), cadmium (Cd), cobalt (Co), copper (Cu), chromium (Cr), iron (Fe), manganese (Mn), nickel (Ni), lead (Pb), and zinc (Zn)) were determined using inductively coupled plasma mass spectrometry (ICP-MS). The results revealed that the concentrations of trace elements showed temporal variation and most elements had higher concentrations in the wet season. Most of the studied metals in the river water were below than the Drinking Water Quality Standard stipulated by the Malaysian Ministry of Health and the World Health Organization, except for Al, Fe, Mn, As, and Ni at certain sampling stations. Principal Component Analysis (PCA) showed that variables controlling water quality in both seasons are attributed to hydrogeological and anthropogenic factors. The results from this study are beneficial for relevant agencies in settling monitoring priorities and allocating resources in managing elemental pollution. The study would also help to develop water conservation strategy for countries experienced tropical wet and dry climate.

Keywords: Principal component analysis, Temporal variation, Trace elements, Wet and dry climate

P5

[35]

IMPACT OF CLIMATE CHANGE AND ITS ADAPTATION FOR SUSTAINABLE FOOD PRODUCTION IN SOUTHERN REGION OF BANGLADESH

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ABSTRACT

The study was conducted in Sandwip upazila of Chittagong district and Subarnachar upazila of Noakhali district. The study consisted of 80 randomly selected farmers of both the upazilas. The study revealed that the level of education of the farmers had highly positive and significant relationship with their adoption of climate change. The average farmer's score measured for the "knowledge on impact of climate change" was found to be 22.21 where 75 percent had medium knowledge, 16.25 percent farmers had high knowledge and 8.75 percent had low knowledge in Sandwip. In case of Subarnachar the score of knowledge on impact of climate change was found to be 21.12 where 68.75 percent had medium knowledge, 13.75 percent farmers had high knowledge and 17.50 percent low knowledge. On the other hand, the agricultural adaptation score of climate change was found to be 39.57 in Sandwip and 38.43 in Subarnachar. The highest, 72.50 percent of the respondents had medium adaptation knowledge while 20.00 percent of them had high adaptation and 8.75 percent had low adaptation of climate change in Sandwip and the highest 70.00 percent of the respondents had medium adaptation knowledge while 18.75 percent had high adaptation and 11.25 percent had low adaptation of climate change in Subarnachar. In Sandwip, "cultivation of saline tolerant varieties of crops" got the 1st rank among the statements with the total Adaptation index (AI) of 234 and in Subarnachar upazila, "Cultivation of saline tolerant varieties of crops" got the 1st rank among the statements with the total Adaptation index (AI) of 231. Correlation analysis indicated that age, education, annual family income, communication exposure, media contact and knowledge of impact of climate change had positive and significant relationship with agricultural adaptation of impact of climate change in both the study areas the higher age, education, annual family income, communication exposure, extension media contact and knowledge of impact of climate change were likely to ensure higher agricultural adaptation of climate change. The majority of the farmers (83.75 percent and 80.00 percent in Sandwip and Subarnachar, respectively) various high problems due to adverse climatic conditions. Among the different problems, salinity in agricultural land and limited knowledge on adaptation measures, were two major problems in the study areas.

P6

[36]

**DETERMINATION OF GROUNDWATER QUALITY AND NUTRIENTS
CONCENTRATION IN LANGAT RIVER BASIN**

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National Hydraulic Research Institute Malaysia, Malaysia

ABSTRACT

Groundwater is widely used especially for drinking water. Therefore, it is crucial to know and monitor the groundwater quality for the safety of public health. The purpose of this study is to determine the spatial distribution of groundwater quality in Langat River basin and to identify the nutrients contamination in the groundwater. Groundwater samples are taken and collected from 15 wells. The parameters that are analyzed are in-situ (pH, temperature, salinity, conductivity, total dissolved solids and dissolved oxygen), major ions (Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Cl^- , HCO_3^- and SO_4^{2-}) and nutrients (NO_3^- and PO_4^{3-}). The pH mostly lower than the permissible limit by WHO and MOH. TDS exceeded the permissible value of 1000 mg/L. Sampling station 14 is the station that has high minerals that has concentration beyond the permissible value. The piper diagram shows that the groundwater type is sodium chloride (Na-Cl) and mix of sodium bicarbonate chloride (Na- HCO_3 -Cl). The mix water type is due to the mixing of freshwater and salt water. The dominance of sodium ion is due to the ion exchange of calcium and magnesium. Nitrate has concentrations below permissible value except for sampling station 14. All sampling stations has phosphate concentrations within the permissible values. Frequent monitoring should be done to ensure good public health and safe freshwater supply.

Keywords: groundwater, hydrogeochemistry, nutrients, Malaysia

P7

[37]

**THE CLIMATE SOOTY AGENT: MEASUREMENT OF BLACK CARBON (BC)
USING LOW-COST EFFECTIVE METHODS**

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ABSTRACT

Black carbon (BC) belongs to one of climate forcing compounds and its sources are dominated by combustion process typically from anthropogenic activities of diesel engines emissions, biofuels and biomass burning. It is part of particulate matter and soot constituent which contributed to multiple effects to air quality, global climate change, and public health. It has become imperative to evaluate the current trend of BC to mitigate climate change and to protect public health. However, the monitoring campaign may be limited to high cost equipment and analytical techniques especially in the resource constrained countries to measure personal exposure to BC. This study aims to provide a straightforward and low-cost method to estimate (BC) concentrations in different environmental settings. Two novel techniques were developed using reflectance measurements and digital scanned images. Incremental changes of filter darkness and scanned values were quantified using EEL 43D Smoke Stain Reflectometer and flat-bed office scanner respectively over different monitoring period. AE51 Aethalometers were co-located and operated over identical time periods of monitoring. Measurements were made in the laboratory, indoor office, university campus walking route and a nearby outdoor urban background environment. The two reflected light techniques studied provide a good linear relationship with variation of 99% of reflectance and 97% of scanned values. Our study suggests the use of flexible traditional and state-of-the-art monitoring devices with appropriate validation techniques will improve the characterization of BC exposure in different microenvironments. Therefore, these approaches can be applied to approximate BC values and estimate exposures to human health and mitigate climate change.

Keywords: Black Carbon, Air Quality, Climate Change, Soot

P8

[38]

**THE SPATIAL VARIATION *MELALEUCA CAJUPUTI* POWELL ESSENTIAL OIL
IN PENINSULAR MALAYSIA**

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ABSTRACT

The genus *Melaleuca* comprises of about 260 species covering in excess of eight million hectares (including native and introduced species) and distributed mostly in Australia, but also occurring in South-East Asia, the Southern United States and the Caribbean. *Melaleuca* populations predominantly occur in wetland or/and coastal ecosystems where they have been significantly affected by climate change. This paper assesses the potential responses of the *Melaleuca cajuputi* to climate change, based on the variation of the essential oil extracted from the trees. The main findings include: (i) that the MC has a variation in terms of the essential oils, and significant chemotype diversity in a variety of ecosystems; To best of our knowledge, the major chemotypes in essential oils in the Malaysian MC has yet to be explored, hence, the knowledge on their contribution to the therapeutic effect remained unknown. This study was carried out to determine the spatial variation of essential oil of MC around Peninsular of Malaysia by mean of FTIR fingerprinting. Lack of data base on the spatial distribution of these chemotypes resulted unsustainable cut down of the trees. In addition, climate change is expected to strongly affect tree species distribution and also reduce tree diversity at its natural habitat. Therefore, it is important to document and make inventories of these valuable trees.

Keywords: essential oils, *melaleuca cajuputi* powell, spatial variation, climate change

P9

[39]

EFFECT OF CHANGING METEOROLOGICAL DRIVERS ON SPRING WHEAT IN INDIA

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ABSTRACT

Weather and climate play a significant role in controlling agricultural production. Unfavorable meteorological conditions, especially during the critical stages of crop growth can cause production losses. This study attempts to quantitatively understand the impact of changes in meteorological drivers due to climate change on spring wheat in northwest India using numerical experiments with the Simple and Universal CROp growth Simulator (SUCROS) model. First, the model was calibrated and evaluated for spring wheat using observed crop and meteorology data from a field site at the Indian Agricultural Research Institute, New Delhi. Next, we conducted sensitivity studies by incrementally changing the meteorological drivers to understand the underlying processes through which meteorology affects spring wheat crop growth. Finally, we conducted numerical experiments with bias-corrected projections of meteorological drivers from various RCP scenarios for mid and end century. Results show a reduction in crop growth and yield due to increased incoming shortwave radiation, increased temperature, decreased vapor pressure, increased wind speed and the soil moisture change depending on the soil properties. Apart from improving our understanding of crop growth processes, this study has also policy implications for agriculture and food security.

Keywords: SUCROS, Meteorology, Quantitatively, Crop growth, Yield, Wheat



VIRTUAL PRESENTATIONS



[40]

**IMPACT OF CLIMATE CHANGE ON RICE AND SOY BEANS YIELDS OVER
WEST AFRICA IN THE 21st CENTURY**

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*Department of Physics, University of Ibadan, Nigeria***ABSTRACT**

Climate change impact on yield of staple crops is crop - and location dependent. Gepic climate impact model is used to study the impact of climate change on soy beans and rice yield over West Africa. Bias corrected EWEMBI datasets from Geophysical Fluid Dynamics Laboratory (GFDL) on ESM2M-pressure based vertical coordinate with developmental path of GFDL'S Modular Ocean were used. The simulations carried out with full irrigation were analysed in order to test the effectiveness of irrigation as adaptation for false onset and abnormal precipitation characteristics in projected climate. In the historical simulation, higher yield of rice is produced in the southern part of West Africa than in the north. Reduction of up -20% is projected at the southern part of West Africa. Only about 0-10% increase in yield is projected at the south while about 20% increase in yield is projected between 15 and 25°N. There is generally higher increase in rice yield where rice yield is low in the historical simulation. Irrigation effort at the Sahel can improve rice yield, it can also increase rice at the south. Soy beans yield is lower than rice yield in general over West Africa. Soy beans reduce over West Africa under RCPs 2.6 and 6.0 with higher yield in the mid-century for rcp2.6. For RCP6.0, yield increases towards the end of the century. Central northern Burkina Faso and North-north Nigeria experience increase of about 20% yield.

Keywords: climate-impact, rice-yield, soy-beans, full-irrigation

[41]

RENEWABLE ENERGY FOR RURAL ELECTRIFICATION AND ITS CARBON ABATEMENT POTENTIAL: THE CASE OF EAST NUSA TENGGARA PROVINCE, INDONESIA

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ABSTRACT

Energy poverty in the form of limited electricity access remains a significant issue, particularly in many rural and remote areas in Indonesia. Coupled with the climate change challenge, providing the energy supply for these communities should transition from the business-as-usual scenario to more renewable-energy based scheme that caters to the local resource potential. This paper seeks to focus on the region of eastern Indonesia, with particular attention to East Nusa Tenggara as one of the provinces with the lowest electrification ratio nationally. First, the general profile of rural electricity demand in the East Nusa Tenggara province was modelled based on the data from the literature review. Two renewable energy options, solar photovoltaic and micro-hydropower were considered for the off-grid power plants to replace the commonly used diesel-based generator for the rural electrification. The paper then estimated the potential of carbon footprint using the Life Cycle Assessment (LCA) method for all three types of energy sources. Carbon abatement was measured by the difference of emission from the conventional diesel and two renewable energy options. The study found that under this single rural model in the East Nusa Tenggara, the utilization of solar PV and micro-hydropower could reduce up to 27 and 28 tonne of annual CO₂ emission respectively. Further policy analysis reveals the lack of incentive from the government to develop the decentralized renewable energy scheme as a climate-friendly approach to the energy poverty problem in rural Indonesia.

Keywords: renewable energy, rural electrification, carbon abatement

[42]

ILLUMINATING THE COMMUNITY-RELATED LESSONS FROM THE INTERNATIONAL ENVIRONMENTAL PROJECTS: AN ANALOGICAL STUDY BETWEEN ‘CONSERVATION OF BIODIVERSITY IN CENTRAL ZAGROS LANDSCAPE’ AND ‘TORRES STRAIT CLIMATE CHANGE STRATEGY: BUILDING COMMUNITY ADAPTIVE CAPACITY AND RESILIENCE’

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²Social Safety Net Officer, Nigeria

ABSTRACT

The United Nations Sustainable Development Goals (SDGs) and the Paris Agreement have certain combined dimensions, the core of which are the Sustainable Socio-Environmental projects. Thus, the number of such projects is predicted to increase significantly over the following several years. However, it is necessary to boost the efficiency of the next similar implementing projects. Therefore, it is crucial to analyse the lessons that could be learned from such strategic projects to date, and consequently, address some of the key issues for the next projects. This study aims to achieve that by establishing an analogical investigation between the two different projects that have common community effects. The projects are selected from two separate and globally-important socio-climatic sites, which are highly considered by the international community, regarding both the Climate Change Adaptation and the Sustainable Indigenous Community Development concepts. Thematic analysis was emulated to illustrate the distinguishable and available lessons, based on the indicators. Accordingly, the lessons are rationally presented and discussed. The findings suggest a meaningful relation between the social impacts of both projects and their success and challenge causes. These results are discussed as a potential reflection upon the other projects.

Keywords: Climate Change Adaptation, Indigenous Community Development, International Projects, Paris Agreement, Sustainable Development Goals, United Nations

[43]

ECOLOGICAL EDUCATION AS THE ENVIRONMENT PROTECTION AWARENESS AND A HEALTHY LIFE GUARANTEE

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ABSTRACT

Living in a safe and healthy environment is one of the basic human rights. The protection of this right is an important precondition for health, welfare and sustainability of the population. Unfortunately, environment around the world is suffering from acute ecological crisis. The third millennium is characterized by the greatest achievements of material-technical progress, simplifying the living environment on the one hand and on the other hand deteriorating ecological situations by causing new health problems.

The aim of the article is to demonstrate the role of ecological education in the environmental awareness, the importance of ecological culture establishment and a healthy environment in life extension, to show the necessity of ecological education, to ensure society that a guarantee of a healthy life is ecological education as a future education. In order to identify and study the problem, the following research methods were utilized: observation, analysis of the previous research, interview. Existing situation analysis revealed that environmental risk factors for human health include polluted air, water and soil, ultraviolet radiation, noise and electromagnetic field, climate change caused by human impact, ecosystem change, among others. Analysis of the survey results showed that each of us has the obligation to realize the problem and to take decisive measures. People should listen to the environment as if they listen to the rhythm of their heart. Otherwise, it will lead to the destruction of natural processes and the planet Earth will not be able to provide life-saving conditions for humanity.

Keywords: ecological culture establishment, environmental awareness, environmental risk factors, healthy environment, methods of ecological education

[44]

WATER QUALITY PARAMETER DETECTION FROM LANDSAT 8 OLI IMAGE IN COASTAL BANGLADESH

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ABSTRACT

Quality of coastal surface and groundwater is deteriorating day by day due to the combined effects of climate change and unwise activities of coastal people. Total Dissolved Solids (TDS) is an important water quality parameter that should be monitored regularly. It is very cost effective and time-consuming to keep the track of the change in TDS by collecting numerous water samples and performing laboratory tests. This process can be made more convenient with the help of remote sensing techniques. Several studies focused on the detection of water quality parameters from the band combinations of Landsat images but there is a research gap in the case of coastal Bangladesh. This study aims to evaluate the applicability of Landsat 8 OLI images to detect TDS of surface water of coastal Bangladesh. It employs 14 different band compositions to compute an equation through multiple regression analysis among the band values and 18 sample TDS values collected from field visit in the last week of November 2018. Level 2 product of Landsat 8 OLI image (path/row: 138/44) dated 27 November 2018 has been used for the analysis. A regression equation has been computed with the bands Blue, Green and Red, which can predict TDS (mg/L) 83.6% correctly. Using the equation, change in TDS level has been detected from Landsat 8 OLI image dated 16 November 2014. Analysis revealed that water areas with TDS level 100 – 600 mg/L have been reduced 28.9% and water areas with unacceptable TDS level (>1200 mg/L) have been increased 32.7% between 2014 and 2018. Contamination of surface waters has led to freshwater scarcity and health hazard for the coastal people.

Keywords: Coastal Bangladesh, Landsat 8, TDS, Multiple Regression, Change Detection

[45]

SOCIO-LEGAL PERSPECTIVES OF CLIMATE DISPLACED PERSONS IN BANGLADESH

M. Dasgupta

Supreme Court of Bangladesh

ABSTRACT

Climate change is causing loss of homestead and livelihood of the people of affected areas all over the world. They are being compelled to desert their homes and locality to secure self-existence and thus being displaced, which is known as climate displacement and these people are being marked as climate displaced persons. Bangladesh is one of the country's most vulnerable to climate change and displacement due to that as well. This study is aimed to ascertain vulnerability of climate displaced persons of Bangladesh and to discuss the measures essential to ensure their protection. It is an analytical and mixed method research having convergent or parallel design. Field study was comprised of a survey among 127 victims, 3 case studies, 2 focus group discussions, 8 key informant interviews and 5 applications to various government and autonomous bodies to get relevant information by implementing right to information. Area of the study was Chittagong District. Finding shows, in Bangladesh this community got no legal recognition by any parliamentary enactment till now. Though there are a few government projects to facilitate people in distress which may provide for this community also, still, no criteria are specified to ascertain the actual need and vulnerability of the beneficiaries. Steps should be taken to meet their immediate needs like foods, drinking water and sanitation, mid-term wants like alternative employment generation and long term protections like rehabilitation. Both government and non-government bodies should pressurize the international community to attain a common consensus about this issue throughout the world.

Keywords: climate displacement, climate displaced persons, legal protections

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