Compiled by

Dr. S. N. Tripathi

Dr. Rajkumari S. Devi

Dr. Sandeep Kumar

Dr. Virat Jolli

Dr. Varnika Bhatia

ABSTRACT BOOK

NATIONAL CONFERENCE
ON

CLIMATE CHANGE: IMPACTS, ADAPTATION, MITIGATION SCENARIO AND FUTURE CHALLENGES IN INDIAN PERSPECTIVE

02 & 03 MARCH, 2015

Venue:
Conference Centre
University of Delhi
New Delhi

Organised by

DEPARTMENT OF BOTANY
DEEN DAYAL UPADHYAYA COLLEGE
(UNIVERSITY OF DELHI)
NEW DELHI-110015

Supported by

Department of Science and Technology- Science and Engineering Research Board (Government of India)

Biodiversity and Environmental Sustainability (BEST)

MESSAGE OF THE CONFERENCE

ॐ द्यौः शान्तिरन्तरिक्षं शान्तिः पृथिवी शान्तिरापः शान्तिरोषधयः शान्तिः ।
वनस्पतयः शान्तिर्विश्वेदेवाः शान्तिर्ब्रह्म शान्तिः ।
सर्वं शान्तिः शान्तिरेव शान्तिः । सा मा शान्तिरेधि ॥

ॐ शान्तिः शान्तिः शान्तिः ॥

Om dyauh shantir-antariksham shantih
Prithivi shantir-apah shantir-oshadayah shantih
Vanaspatayah shantir-vishve-devah shantir-brahma shanti
Sarvam shantih shantireva shantih
Sa ma shantir-edhi
Om shanti, shanti, shanti

Om~May there be Peace in the heavens. May there be Peace in the sky (atmosphere). May there be peace in the Earth. May there be Peace in the waters. May there be peace in the herbs (plants). May there be peace in the Trees (forests). May there be peace in the Gods, peace in Nature. May there be peace in all
May that, the true Peace, be mine (ours) also.
Om~Peace, peace, peace.

NATIONAL CONFERENCE
ON

CLIMATE CHANGE: IMPACTS, ADAPTATION, MITIGATION SCENARIO AND FUTURE CHALLENGES IN INDIAN PERSPECTIVE

02 & 03, MARCH, 2015

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Biodiversity and Environmental Sustainability (BEST)

Compiled by
Dr. Sachchidanand Tripathi, Dr. Rajkumari Sanayaima Devi
Dr. Sandeep Kumar, Dr. Virat Jolli
Dr. Varnika Bhatia

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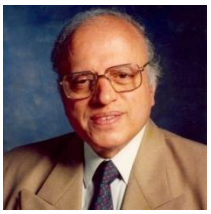

MESSAGE

I welcome and congratulate Department of Botany, Deen Dayal Upadhyaya College (University of Delhi) for organizing National Conference on Climate Change especially focusing on Indian perspective. Climate change research is in its infancy in India and needs greater involvement and participation of Indian Universities, Research Centre and NGOs for combating this problem. The endeavour of DDU College is highly appreciated in this regards.

I wish great success for conference.

M S Swaminathan

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Prof. Ved Pal Singh
Head
Department of Botany
University of Delhi
Delhi-110 007

MESSAGE

I am extremely delighted to know that the Department of Botany of Deen Dayal Upadhyaya College (university of Delhi) has taken lead in the beginning of this year during March 2-3, 2015 to organize a National Conference on "**Climate Change: Impacts, Adaptation, Mitigation Scenario and Future Challenges in Indian Perspective**", which is very relevant in the present day context, as the life support system keeps changing under the influence of climate change and becomes a harsh reality at times globally. The climate change associated disasters have been witnessed in the recent past that has brought wide spread misery and huge losses to Indian economy, human and animal health as well as the environment. The world faces two challenges dealing with climate change, first to reduce carbon dioxide emission by moving alternative technology as early as possible; and second to build community resilience to deal with recurring impact of climate change which has now become inevitable. The deliberations of the Conference would highlight the implementation of disaster management strategies to deal with climate change-mediated health and environmental hazards. I am sure, the recommendations made in the Conference would impress upon the scientific community as well as policy makers.

I congratulate Deen Dayal Upadhyaya College management, its Principal and the faculty of Botany for organizing this National Conference on wonderful themes of national interest that would certainly add to the list of extremely important events being organized by the College under the umbrella of Delhi University; and I wish the Conference a grand success.

Ved Pal Singh

काशी हिन्दू विश्वविद्यालय BANARAS HINDU UNIVERSITY

ESTABLISHED BY PARLIAMENT BY NOTIFICATION NO. 225 OF 1916

Institute of Environment and Sustainable Development

Message

I am happy to note that Deen Dayal Upadhyaya College of the University of Delhi is organizing a DST-SERB supported national conference on "Climate Change: Impacts, adaptations, mitigation scenario and future challenges in Indian perspective" from 2-3 March, 2015. Climate change has become a major national, regional and international problem cutting across developed and developing countries. Recent climate change impact projections indicate that it will affect all important sectors of the economy, including agriculture and forestry, hydrology and water resources, natural ecosystems and biodiversity, coastal areas, settlements and health.

An increase in variability of monsoon rainfall is expected to increase water shortages in many areas of India. Urbanization, population growth, economic development, and increasing demand for water from agriculture and industry are likely to aggravate the situation further. India's summer monsoon is likely to become highly unpredictable. Increased risks of physical damage from landslides, flash floods, glacial lake outbursts, and other climate-related natural disasters are also likely impacts of climate change. Sea-level rise and storm surges would lead to saltwater intrusion in the coastal areas.

Rapid urbanization and the growth of cities is generally accompanied by a change in people's lifestyle and patterns of human settlement, increased demand for energy, transportation, infrastructure, etc. Therefore, urbanization itself acts as a driver of climate change due to an in increase in GHG emissions, waste disposal and unsustainable land use, etc. With built-up urban areas rapidly becoming "heat-islands", urban planners will need to adopt measures to counteract effect of climate change. Frequent heat waves due to climate change are likely to result in a very substantial rise in mortality and death, and injuries from extreme weather events are likely to increase. Thus effective polices and strategies are needed to address issue of climate change and to create resilient liveable cities. Appropriate urban planning and mitigation efforts are urgently needed for the reduction in GHG emissions which will also lead to the better environmental conditions in urban India.

I hope that the proposed conference will offer a comprehensive coverage of the theme and depth of understanding. I also firmly believe that deliberations will increase the awareness of the emerging effect of climate change which has stared influencing our lives, economy and society as a whole. I extend my best wishes for the grand success of this seminar.

A.S. Raghubanshi
Professor and Director
IESD-BHU

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Shivaji Marg, Karampura, New Delhi - 110015
http://dducollege.du.ac.in

Dr. S. K. Garg
Principal

MESSAGE

It is a matter of immense pleasure that Department of Botany, Deen Dayal Upadhyaya College is organising a National Conference on "Climate Change: Impacts, Adaptation, Mitigation Scenario and Future Challenges In Indian Perspective on 2nd & 3rd March, 2015 at Conference Centre University of Delhi. The myriad of the themes that this conference has chosen to address provide an affirmation of the emerging challenges posed by climate change in Indian perspective. The conference manifests the confluence of diverse disciplines ranging from Botany, Zoology, Geology, Environmental Sciences to Geography, Economics.

I wish the organising team and student volunteers a great success in this academic endeavour.

(Dr. S K Garg)

96, Vasudha Enclave, Pitam Pura, Delhi-110034 Ph. : 27351700

ORGANISING COMMITTEE

NATIONAL CONFERENCE
ON
CLIMATE CHANGE: IMPACTS, ADAPTATION, MITIGATION SCENARIO AND FUTURE CHALLENGES IN INDIAN PERSPECTIVE
02 & 03, MARCH, 2015

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PREAMBLE

Impact of climate change has become a harsh reality for India and the world. Climate change related disasters have brought wide spread misery and huge economic losses to India adversely affecting human health, agriculture and food security, natural resources and energy security; and biodiversity. Various national and international institutions like IPCC have shown a stark picture in Indian context. The scenario is anticipated to worsen as humans continue to pump greenhouse gases into the atmosphere without being aware of the contribution they are making for their own downfall. Over the past decades, climate change has become one of the most heavily researched subjects in science. However, in recent years the impact of climate change has become prominently visible with an erratic monsoon creating drought in some areas and extreme deluge in others like Uttarakhand and Jammu and Kashmir. Annual mean temperature in India for the past 110 years shows an increasing trend. There is also a definite increase in the sea-level and sea surface temperature. Simply put, the values in India are comparable to global values and yet, public participation in addressing this issue is only minor. India and the world faces two challenges dealing with climate change, first to reduce carbon dioxide (CO_2) emission by moving to alternative technologies as early as possible and second to build community resilience to deal with recurring impact of climate change which now have become inevitable.

Under the above scenario Department of Botany, Deen Dayal Upadhyaya College (University of Delhi) is organising a National Conference during March, 02-03, 2015 to provide a common platform for the students, academicians and scientific community (scientists / researchers) from different disciplines to share their observations and experiences so as to generate sufficient interest for further research in the areas of climate change, adaptations and particularly the mitigations.

ABOUT THE COLLEGE

Deen Dayal Upadhyaya College is one of the constituent colleges of the University of Delhi in India, located at Shivaji Marg, Karampura, New Delhi. It is fully funded by the Government of Delhi. It was established on August 1990 in the memory of Pt. Deen Dayal Upadhyaya, a renowned philosopher, thinker and social worker. The college offers 16 undergraduate courses in sciences, commerce and humanities. It is the first college of University of Delhi to get accredited by NAAC.

DEPARTMENT OF BOTANY

Department of Botany endeavors to promote and inspire students to pursue higher studies in plant sciences, orienting them towards learning and investigation. The faculty members initiate innovative projects with active involvement of students to instigate scientific temperament in them. The students are encouraged to enthusiastically participate in all the activities of the department throughout the year thereby constantly evolving them as vibrant personalities. The various activities of the department include awareness programs for preservation of environment, conferences, plant identification and various competitions pertaining to the field of Botany. The sustained efforts of teachers bring students closer to Mother Nature through botanical excursions. Founded with a vision to empower our students in various upcoming thrust areas of basic and applied sciences viz. microbiology, plant biotechnology, molecular biology, bioinformatics, environmental sciences etc., the department provides them the stepping stone to reach higher heights in their career. The Botanical Society 'Kalpavriksha' publishes an annual serial **"Contemporary Plant Sciences" with an ISSN: 2393-8676.**

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DST-SERB SUPPORTED NATIONAL CONFERENCE ON "CLIMATE CHANGE: IMPACTS, ADAPTATION, MITIGATION SCENARIO AND FUTURE CHALLENGES IN INDIAN PERSPECTIVE"

02 & 03 MARCH, 2015

ORGANISED BY:
DEPARTMENT OF BOTANY
DEEN DAYAL UPADHYAYA COLLEGE
UNIVERSITY OF DELHI, KARAMPURA NEW DELHI-15

DETAILED PROGRAMME

Registration: 8:30 am- 9:30 am

DAY- 1 (02 March, 2015)

INAUGURAL SESSION

(9:30 am to 10:30 am)

INAUGURAL ADDRESS BY CHIEF GUEST

PROFESSOR AKHILESH KUMAR TYAGI

Director, NIPGR, New Delhi

KEYNOTE ADDRESS

DR. SURUCHI BHADWAL

Associate Director
Earth Science and Climate Change Division
TERI, New Delhi

TEA BREAK (10:30 am – 11:00 am)

TECHNICAL SESSION-I

(11:00 am -1:00 pm)

CLIMATE CHANGE SCENARIO IN INDIA

Venue: Main Conference Hall

Prof. A.S. Raghubanshi (11:00 -11:25)	CLIMATE CHANGE AND SUSTAINABLE URBAN DEVELOPMENT: ISSUES AND CHALLENGES BEFORE INDIA.
Dr. C.S. Jha (11:25 – 11:50)	NATURAL RESOURCE MANAGEMENT, CLIMATE CHANGE AND ISRO'S INITIATIVE ON INDIAN CARBON CYCLE
Dr. S.D. Singh (11:50-12:15)	IMPACT OF CLIMATE CHANGE ON CROP PRODUCTIVITY, QUALITY AND BIODIVERSITY
Dr. H. Pathak (12:15-12:40)	ENHANCING RESILIENCE OF INDIAN AGRICULTURE TO CLIMATE CHANGE
Mr. Nagraj (12:40-1:00)	THE URGENCY AND CHALLENGE OF GLOBAL WARMING

LUNCH BREAK (1:00 pm – 2:00 pm)

TECHNICAL SESSION-II

(2:00 pm – 4:15 pm)

NATURAL RESOURCES AND FOOD SECURITY UNDER CLIMATE CHANGE

Venue: Main Conference Hall

Prof. C.S.P. Ojha (2:00-2:25)	CLIMATE CHANGE AND WATER SECURITY
Prof. N. Parthasarthy (2:25 – 2:50)	ENVIRONMENTAL CHANGES AND UNDERSTORY VEGETATION OF TROPICAL FORESTS
Dr. Ajay Arora (2:50-3:15)	IMPACTS AND ADAPTATIONS IN CROP PLANTS UNDER CHANGING CLIMATE: PHYSIOLOGICAL ANGLE
Dr. Geetika Sirhindi (3:15- 3:40)	SALT INDUCED STRESS AND PHENOLS AUGMENTATION REINFORCED BY JASMONIC ACID
Dr. C. Shekhar Seth (3:40- 4:00)	EFFECTS OF CLIMATE CHANGE ON PLANTS AND ECOSYSTEMS AND CERTAIN APPROACHES FOR PLANT RESPONSE STUDIES UNDER CLIMATE CHANGE SCENARIO
Dr. Jagriti Kher (4:00-4:15)	WATER VULNERABILITY AND CLIMATE CHANGE: ASSOCIATION WITH GENDER INEQUALITIES.

TEA BREAK (4:15 pm – 4:30 pm)

POSTER SESSION (4:30 pm – 5:30 pm)

DAY 2

BREAKFAST

(8:30 am -9:30 am)

TECHNICAL SESSION-I

(9:30 am -12:10 pm)

THEME: ROLE OF SCIENCE AND TECHNOLOGY UNDER CLIMATE CHANGE

Venue: Conference Hall-I

Prof. Paramjit Khurana (9:30-9:55)	ROLE OF BIOTECHNOLOGY UNDER CHANGING CLIMATIC CONDITIONS
Prof. R.B. Singh (9:55-10:20)	ASSESSMENT OF BIOPHYSICAL VULNERABILITY FOR MITIGATING CLIMATE CHANGE IMPACT IN RAJASTHAN
Prof. Renu Bhardwaj (10:20-10:45)	PLANT ADAPTATIONS AND STRESS TOLERANCE IN THE ERA OF CLIMATE CHANGE
Dr. Girdhar Pandey (10:45-11:10)	NEGATIVE AND POSITIVE REGULATOR OF STRESS SIGNALING: A RICE PROTEIN PHOSPHATASE 2C IS KEY REGULATOR OF ABA AND ABIOTIC STRESS RESPONSES
Dr. F.A. Lone (11:10-11:25)	CLIMATE CHANGE IN KASHMIR HIMALAYAN VALLEY: INDICATORS, IMPACTS AND ADAPTATION STRATEGIES

Dr. J. Subramanyan (11:25-11:40)	PROTEASE ACTIVITY IN PINEAPPLE FRUITS
Dr. S. S. Das (11:40-11:55)	VARIATION OF INDIAN MONSOON REGIME DURING THE LATE QUATERNARY: SEDIMENTOLOGICAL EVIDENCES
Dr. Santosh K. Prajapati (11:55-12:10)	COMPARATIVE STUDY ON EFFECTS OF HEAVY METALS/METALLOIDS PRESENT IN FLY ASH FROM COAL FIRED THERMAL POWER PLANT ON PHOTOSYNTHETIC PARAMETERS OF FICUS BENGALENSIS AND PLUMERIA RUBRA.

YOUNG SCIENTIST SESSION- I

(9:30 am -11:00 am)

(Eight minutes rapid presentation for each participants)

Venue: Conference Hall-II

Dr. Anwesha Borthakur	CLIMATE CHANGE TECHNOLOGIES AND THE PROBLEM OF ELECTRONIC WASTE
Mr. Abhishek Kumar	BIOCHARS PRODUCTION AND THEIR APPLICATIONS IN CO_2 SEQUESTRATION AND SOIL FERTILITY IMPROVEMENT
Ms. Aprajita Singh	ILLEGALE-WASTE BURNING IN MORADABAD–A FUTURE CHALLENGE
Ms. Shivani Nagar	PHYSIOLOGICAL AND MOLECULAR MECHANISM OF CYTOKININ INDUCED DROUGHT TOLERANCE IN WHEAT (*TRITICUM AESTIVUM* L.)
Ms. Rupa Sharma	DEVELOPMENT OF LOW COST SUSTAINABLE GREEN BIOSORBENT TO MITIGATE WATER POLLUTANT
Ms. Neha Goyal	DOES VARIABILITY IN LANTANA CAMARA L. (SENSU LATO) BEHOLD IMMENSE INVASION POTENTIAL IN FUTURE CLIMATE CHANGE SCENARIOS?
Ms. Anju Ojha	PATTERN OF LITTERFALL AND NUTRIENT RETURN IN SEMI-ARID FOREST OF ARRAVALLI REGION OF DELHI
Mr. Prabhat Kumar	EMISSION STUDIES OF GREENHOUSE GASES FROM DIFFERENT PADDY FIELDS OF INDO-GANGETIC REGION USING CLOSE CHAMBER TECHNIQUES
Ms. Anshu Gupta	GREEN HOUSE EFFECT REDUCTION BY RECOVERING ENERGY FROM MUNICIPAL SOLIDWASTE LANDFILLS
Mr. Suraj Meena	ASSESSMENT OF BIODIVERSITY AND CONSERVATION PERSPECTIVE IN TROPICAL DRY DECIDUOUS FOREST OF KUMBHALGARH WILDLIFE SANCTUARY, RAJASTHAN

TECHNICAL SESSION-I
(11:00 am – 12:00pm)
ECONOMICS AND CLIMATE CHANGE
Venue: Conference Hall-II

Dr. Purnamita Dasgupta	THE ECONOMICS OF CLIMATE CHANGE
Ms. Vaishali Kapoor	IMPACT OF ECONOMIC ACTIVITY ON CLIMATE CHANGE
Ms. Maria Khan	FDI AND CLIMATE CHANGE: EVIDENCE FROM INDIA ON CO_2 EMISSIONS

TEA BREAK (12:00 pm – 12:15 pm)

POSTER SESSION: 12:15 pm - 1:00 pm

LUNCH BREAK (1:00 pm – 2:00 pm)

TECHNICAL SESSION-II
(2:00 pm– 5:00 pm)
CLIMATE CHANGE ADAPTATION AND MITIGATION SCENARIO
Venue: Conference Hall-I

Dr. Anil K. Gupta (2:00-2:25)	MODELLING CLIMATE RESILIENT - DISASTER SAFE INFRASTRUCTURE IN SOUTH AND SOUTH EAST ASIA: TECHNO-LEGAL AND FUTURISTIC FRAMEWORK
Dr. Anjali Shrivastava (2:25-2:50)	CLIMATE CHANGE, URBANISATION AND SUSTAINABLE DEVELOPMENT
Prof. J.I.S. Khattar (2:50-3:15)	THE CYANOBACTERIUM *SYNECHOCYSTIS* SP. PUPCCC 62: A POTENTIAL CANDIDATE FOR THE BIOREMEDIATION OF HEXAVALENT CHROMIUM
Dr. D.P. Singh (3:15-3:40)	CARTAP HYDROCHLORIDE TOLERANCE AND UPTAKE BY CYANOBACTERIUM *LEPTOLYNGBYA FOVEOLARUM*
Dr. G. P. Sharma (3:40-4:00)	EXPLORING PLANT INVASIONS & CLIMATE CHANGE
Dr. Manju R. Ranjan (4:00-4:15)	CONTROLLING METHANE EMISSION FROM MUNICIPAL SOLID WASTE (MSW) LANDFILL AREAS
Dr. Sadab Javed (4:15-4:30)	MAPPING GROUNDED ACTIONS AND CLIMATE CHANGE: A CASE STUDY OF TEA GROWERS IN ASSAM
Mr. Thomas Kiran M (4:30-4:45)	PHYCOREMEDIATION AND SUSTAINABLE BIODIESEL PRODUCTION USING DIATOM ALGAE CULTIVATED IN URBAN WASTE WATER
Dr. Nayar A. Kirmani (4:45-5:00)	RS AND GIS TECHNOLOGY FOR EIA UNDER CHANGING CLIMATIC SCENARIO OF KASHMIR HIMALAYAN VALLEY

TECHNICAL SESSION-II
(2:00 pm – 3:45 pm)
ENERGY SECURITY UNDER CLIMATE CHANGE
Venue: Conference Hall-II

Prof. N.C. Gupta (2:00-2:25)	CLIMATE CHANGE AND ENERGY SECURITY
Dr. S. B. Tripathi (2:25-2:50)	POTENTIAL AGRICULTURAL BIOTECHNOLOGIES TO MITIGATE CLIMATE CHANGE: CASE STUDIES FROM TERI'S RESEARCH
Dr. Shiv Prasad (2:50-3:15)	BIOFUELS: AN OPTION FOR CLIMATE CHANGE MITIGATION
Ms. Gaganpreet Kaur (3:15-3:30)	DEVELOPMENT AND VALIDATION OF ICT FOR YOUTH EMPOWERMENT TOWARDS EFFICIENT ENERGY MANAGEMENT: A STEP TOWARDS CLIMATE CHANGE MITIGATION THROUGH SUSTAINABLE RESOURCE USE.
Mr. Rahul Majumdar (3:30-3:45)	INDIA'S CLIMATE CHANGE POLICY : PAST, PRESENT AND FUTURE

YOUNG SCIENTIST SESSION-II
(3:45 pm – 5:00 pm)
(Eight minutes rapid presentation for each participants)
Venue: Conference Hall-II

Ms. Sonam Wangmo	SHIFT IN TRADITIONAL ECOLOGICAL KNOWLEDGE IN AGRICULTURAL PRACTICES OF HIGHLAND MOUNTAIN AGRICULTURAL SYSTEMS OF LADAKH (INDIA)
Ms. Sakshi Saini	WOMEN AS KEY AGENTS OF CLIMATE CHANGE ADAPTATION
Ms. Prachi Singh	LEAD REMOVAL FROM WATER USING DEVELOPED ENERGY CANE MAGNETIC AND NONMAGNETIC BIOCHAR
Ms. Meenal Jain	LEED-EB IN INDIA: INITIATIVE TOWARDS GREENING EXISTING BUILDINGS
Mr. Abhishek Kumar	HEALTH EFFECTS OF EXPOSURE TO AMBIENT CARBON MONOXIDE WITHIN CLOSED OFFICE SPACE AS A RESULT OF ROOM HEATER OPERATION DURING WINTER MONTHS IN DELHI
Mr. A. K. Verma	MODELLING FIRE HAZARD IN RAJAJI NATIONAL PARK, UTTARAKHAND USING REMOTE SENSING AND GIS TECHNOLOGY
Ms. Gagan P. Kaur	FOSTERING SUSTAINABLE PRACTICES IN INDUSTRIES: AN ACTION RESEARCH ON CAPACITY DEVELOPMENT OF MANAGERS TOWARDS CLIMATE CHANGE MITIGATION AND GREEN INDUSTRIALIZATION
Ms. Shikha Sharma	ASSESSMENT OF SPATIAL VARIATION OF DISSOLVED NUTRIENT CONCENTRATION IN YAMUNA RIVER SYSTEM
Ms. Chandrabala	STUDY OF DROUGHT ADAPTATIONS THROUGH PRESSURE VOLUME CURVES IN CO-OCCURRING SHRUBS OF SEMI-ARID REGION
Dr. Saloni Bahri	EFFECT OF NANOPARTICLES ON ENVIRONMENT AND HUMAN HEALTH

TEA BREAK (5:00 pm – 5:15 pm)

ANNOUNCEMENT OF RESULTS : (5:15 pm – 5:30 pm)

PANEL DISCUSSION AND VALEDICTORY (5:30 pm – 6:30 pm)

KEYNOTE ADDRESS

INVITED LECTURES

P. No.

CLIMATE CHANGE SCENARIO IN INDIA

NATURAL RESOURCE AND FOOD SECURITY UNDER CLIMATE CHANGE

CLIMATE CHANGE AND ENERGY SECURITY

ROLE OF SCIENCE AND TECHNOLOGY UNDER CLIMATE CHANGE

ECONOMICS AND CLIMATE CHANGE

ADAPTATION AND MITIGATION UNDER CLIMATE CHANGE

Oral Presentation **151**

Evaluation of Antioxidative and Antiproliferative Potential of Brassinosteroids Isolated 15from *Brassica juncea* L. Plants raised under Nickel and Arsenic ions stress

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KEYNOTE ADDRESS

CLIMATE CHANGE: IMPACTS, ADAPTATION, MITIGATION SCENARIO AND FUTURE CHALLENGES IN INDIAN PERSPECTIVE

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The 20th century has observed changes in the climate including increase in overall global mean temperatures, change in humidity levels and varying precipitation patterns. These changes in the climate are attributed to human induced change in the concentrations of greenhouse gases in the atmosphere since the pre-industrial era. Along with the gradual changes happening in the climate, the number of abrupt and extreme events has also increased almost exponentially and has intensified. Of the total 890 events recorded in 2013 and early 2014 majority of the loss events are of a hydro-meteorological and climatological nature. The losses from these events in the form of fatalities and overall losses amount to a total of 125 billion USD compared to 135 bln USD when considering all types of events. In terms of the exposure most of these events have been concentrated over the Asian, North American, Central American, Caribbean and the European domain. The number of fatalities and overall losses are the highest in Asia amounting to 85 % and 50 % respectively but interestingly though the losses are pretty high in Asia, the amount of insured losses are the least after Africa and S America.

Given the rate at which greenhouse gas emissions have been continuing to increase there are changes in the climate projected over the 21st century and beyond. Globally the Intergovernmental Panel on Climate Change (IPCC) has been bringing out conclusive reports and findings since 1990s updating the science and its understanding on this global issue. Recent scientific reports from the IPCC have concluded that the warming of the climate system is unequivocal and that the world is moving towards a warmer and extreme climate. Such trends hold true even for India where significant warming trend of 0.51^{o}C/100yrs has been observed for all Indian annual mean temperatures over the period 1901-2007 (Hingane et. al 1985 and Kothawale et.al., 2010). Many scientific publications (Rupa Kumar et al., 1994, 2002, Kothawale et al., 2005, 2010, MoEF, 2010) and government reports (MoEF, 2010 and Attri and Tyagi, 2010 monograph 01/2010) have also conclusively established an increasing trend of extreme climate events (Goswami et.al., 2006) and increasing heat & cold waves in India. Also of the 10 deadliest events recorded in 2013, 3 were reported in India including floods and flash floods in the states of Uttarakhand, HP, UP and J & K, Heat waves in AP, Odisha, Rajasthan, Assam and Floods in Bihar. However the insured losses are pretty negligible while the risks are portrayed to be high. The future projections of climate over India also indicate a warming trend. Significant rise of annual mean temperatures (~4°C for 2071-2098 period relative to 1961-1990) along with substantial rise in day and night temperatures with increase in

frequency and intensity of temperature and rainfall extremes have been projected (Krishna Kumar et.al., 2010 and 2011).

These changes in the climate have direct and indirect impacts on a number of sectors, including implications on agriculture, water resources, forestry and biodiversity, health and infrastructure and therefore need adequate response measures to address them.

ROLE OF BIOTECHNOLOGY UNDER CHANGING CLIMATIC CONDITIONS

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Climate change and abiotic stress affects agriculture and crop production adversely. Agricultural sustainability requires among others; high yield, low input and long-term management of soil fertility. In a broad sense, crop yield improvement can be achieved by tolerance of abiotic environmental factors, like drought, salinity and heat stress. The discovery of novel genes, determination of their expression pattern in response to abiotic stress and an improved understanding of their roles in stress adaptation (obtained by functional genomics) will provide the basis of effective engineering strategies leading to greater stress tolerance and sustainable agriculture. Water stress, high temperature stress and high irradiance stresses are some of the abiotic factors addressed by genetic engineering techniques. The barley *HVA1* gene, coding for a late embryogenesis abundant (LEA) protein, has been introduced into mulberry by *Agrobacterium*-mediated co-cultivation. Most of the transgenics tested displayed improved agronomic traits under simulated water stress conditions for drought and salinity tolerance. These transgenics have also been tested for their suitability for silkworm rearing, with encouraging results and transferred to the CSRTI, Mysore, for field level analysis. Other genes used for water stress tolerance are the *osmotin* gene under both a constitutive and an inducible promoter, and different transgenics displaying better adaptability against biotic and abiotic stresses. Additionally, *bch*, coding for beta-carotene hydroxylase appears to confer tolerance against high irradiance, temperatures and UV stresses. Prospects of engineering plants with these genes would be discussed with respect to their suitability to the changing climate. Wheat is a temperate crop and prone to various abiotic stresses therefore mapping and characterizing ESTs offers a manageable approach to understanding the complex architecture and functioning of the wheat transcriptome in relation to several abiotic stresses responses. We have been focussing on moisture limitation and heat stress, factors adversely affected under the changing climatic scenario. Wheat transgenics with *HVA1* gene have also been developed for their tolerance against moisture stress. Dihaploids have been used to create a homozygous population in bread wheat which prevents segregation of the introduced gene in the progeny.

Tolerance to heat stress is a complex phenomenon and controlled by multiple genes, hence a program on functional genomics of heat stress has been initiated to understand the transcriptional profile of the sensitive and tolerant cultivars of wheat under heat stress by subtractive hybridization, both at the vegetative and reproductive stages. Heat tolerance related gene transcripts were identified based on their putative functions and validated experimentally with the aim to unravel the complexity associated with heat stress response in wheat. Thus with the advent of genomics, a new era of plant sciences is beginning which helps not only in gene discovery and functional analysis of novel genes, but also aids in mining efficient alleles for introgression in desired plants by molecular breeding resulting in crop improvement and generation of agriproduct diversification.

CLIMATE CHANGE AND SUSTAINABLE URBAN DEVELOPMENT: ISSUES AND CHALLENGES BEFORE INDIA

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By the year 2030, about 40% of the India's population will be living in the cities. Rapid urbanization and the growth of cities is generally accompanied by a change in people's lifestyle and patterns of human settlement, increased demand for energy, transportation, infrastructure, etc. Therefore, urbanization itself acts as a driver of climate change due to an in increase in GHG emissions, waste disposal and unsustainable land use, etc. Urban infrastructures are becoming increasingly vulnerable to the extreme weather events such as heat and/or cold waves; changes in amounts and patterns of precipitation, including extreme rainfall events and flooding; changes in storm tracks, frequencies, and intensities; and sea-level rise. Holistic management of storm water, flood waters, water supply, and wastewater management is essential for climate change adaptation. Therefore, effective and long-term polices and strategies are needed to address issue of climate change and to create resilient liveable cities. Appropriate urban planning, adaptation and mitigation efforts are urgently needed for the reduction in GHG emissions which will also lead to the better environmental conditions in urban India. High resolution climate data needed for decision making is also essential. In light of above, present work will summarize major vulnerabilities of key urban conglomerates of India and possible options to overcome it.

Keyword: Urban planning, GHG emissions, Sustainable development

NATURAL RESOURCE MANAGEMENT, CLIMATE CHANGE AND ISRO'S INITIATIVE ON INDIAN CARBON CYCLE

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In the early eighties, Bruntland Report brought the holistic concept of sustainable management which became the key word for the developing nations and of late became a universal global model of development. Incidentally, the same report identified the visualisation of earth as blue planet from the space and identified as the space technology as the integrating tool for the comprehensive development. ISRO through its Space programme has been addressing the management of natural resources with its IRS series of satellites and has made several advancements, of late. In recent years CO2 has received much attention because of its increasing concentration in the atmosphere to approximately 30% above natural background levels. This increase is the primary cause of climate change and invoked a need to understand carbon cycle more comprehensively. Carbon either exists in the 'carbon pools' of the earth system, e.g., wood, atmosphere, soils, oceans, and crust or in the form of movement/exchange (flux) between these reservoirs. In any integrated system, fluxes connect reservoirs together to create cycles and feedbacks. It is necessary to study land, atmospheric and oceanic processes as a reliable means for estimating the C fluxes as an independent source and integrated function of C transport and exchange to understand the carbon cycle. This involves knowledge and inventory of carbon across major carbon pathways viz., terrestrial carbon cycle, atmospheric CO2, ocean carbon cycle, hydro-geochemistry of carbon flux and requires integrated modeling to assess the total carbon cycle. In this context, a need for national level initiative for understanding of terrestrial carbon cycle over India has been felt, considering the diversity terrestrial ecosystems over India, associated land use land cover changes and trace gas emissions in to atmosphere, monsoon climate and controls on C fluxes over land and oceans, commitments to UNFCC international protocols, and limited studies with national perspective. In addition an integrated approach of intense field measurements and experimentation, use of remote sensing data and process based geospatial models is also considered important for reliable carbon cycle assessment and monitoring over India. The NCP was implemented in the 11th five year plan with three major components–(A) vegetation carbon pools, (B) Soil carbon pools and (C) Soil and Vegetation–Atmosphere Fluxes. In order to make the NCP more comprehensive and complete, Ocean, coast and atmospheric component has been added in the 12th five year plan. A total of 6500 field plot data from forests and trees outside forests have been collected. 1500 field plots have been inventoried for the soil carbon based on the remotely sensed data stratification. A nationwide network of carbon flux towers in different ecosystems for the measurement and modeling of the net carbon flux using eddy covariance techniques is being established and upscaling using satellite remote sensing data and modelling is under process. So far four flux towers shave been established in natural ecosystems including mangrove of Sunderbans and one in agroecosystem. The amplitude of the diurnal variation in NEE increased with growth of wheat and reached its peak around the pre-anthesis stage. Besides, under NCP, satellite diurnal CO_2 have also

analyzed the data obtained from AIRS and SCIAMACHY over India and surrounding oceans and was correlated with surface fluxes. The CASA model simulations over India using NOAA AVHRR NDVI.

Keywords: Carbon, Vegetation, Atmosphere, GIS, Forestry, Soil, Oceans

ENVIRONMENTAL CHANGES AND UNDERSTORY VEGETATION OF TROPICAL FORESTS

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Ecosystems response of vegetation to various environmental changes including climate change are spatio-temporally more explicitly exhibited in forest understory vegetation than in other strata. Understory species constitute one of the most biodiverse and sensitive components of forest ecosystem as well. They form up to 45% of plant diversity in tropical forests and particularly, more diverse in south and south-east Asian and Neotropical rain forests. Despite the ecological importance that trees have in tropical forests, majority of plants belong to other life-forms. Many studies on tropical forest plant diversity have concentrated on woody species diversity, while understory component remains under-studied and that too studies that deal with response of understory vegetation to environmental changes are even more limited. Majority of ground flora are heliophytes in tropical rain forests and hence, when forests are subjected to disturbance and exposed to light, the growth performance and reproduction of understory species are drastically affected. Further, there are other plant traits that are very peculiar to ground flora – some being ephimerals, some are annuals and few are perennials but, their longevity is less than a decade for many species. A striking exceptional group is *Strobilanthes*, various species of which bloom in 3 – 30 -year gap. The other important groups which are also shade-loving species include, the forest gingers, begonias, marantas etc. largely from rain forests. Forest vegetation when cleared for various purposes leads to biological invasion of weeds, which affects the local biodiversity and functional ecology of forest ecosystem. Hence, considering the high diversity, endemism, sensitivity of understory species to environmental changes and many economic potential, including their medicinal values, the need for their conservation is emphasized.

Keywords: Heliophytes, *Strobilanthes*, Environmental changes, Ephimerals

PLANT ADAPTATIONS AND STRESS TOLERANCE IN THE ERA OF CLIMATE CHANGE

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Due to rising concentrations of CO_2 and other atmospheric trace gases, global temperatures have increased by about 1°C over the course of the last century, and will likely rise even more rapidly in coming decades. The latest scientific data confirm that the earth's climate is rapidly changing and it is predicted that temperatures could rise by another 3-9°C by the end of the century with far-reaching effects. Increased drought and salinization of arable lands are expected to have devastating global effects. Plants are continuously affected by a variety of environmental factors. Biotic environmental factors are other organisms like symbionts, parasites, pathogens, herbivores, and competitors and abiotic factors include parameters and resources which determine plant growth like temperature, relative humidity, light, availability of water, mineral nutrients, and CO_2, as well as wind, ionizing radiation, or pollutants. Desertification can hinder efforts for sustainable development and introduces new threats to human health, ecosystems, and national economies. The immediate solutions are desperately needed, such as the improvement of drought and salinity tolerance of crops, which in turn requires a detailed knowledge about tolerance mechanisms in plants. These mechanisms comprise a wide range of responses at molecular, cellular, and whole plant levels, which includes the synthesis of compatible solutes/osmolytes and radical scavenging mechanisms. These compounds are thought to play a role in osmotic adjustments and protect subcellular structures. The biggest challenge to modern plant scientists is to develop stress tolerant plants without compromising yield. Researchers should look for defined sets of markers to predict tolerance towards particular type of stress. Modern techniques like genomics, proteomics, ionomics and metabolomics will be helpful to study plant responses to abiotic/biotic stresses. It would be desirable to develop model plants not only for understanding stress tolerance mechanisms but also their interaction with elevated atmospheric CO_2 concentration in order to assess the suitability of plants as crops in future.

Keywords: Osmolytes, Free radicals, Biotic environmental factor

THE CYANOBACTERIUM *SYNECHOCYSTIS* SP. PUPCCC 62: A POTENTIAL CANDIDATE FOR THE BIOREMEDIATION OF HEXAVALENT CHROMIUM

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The cyanobacterium *Synechocystis* sp., an isolate from polluted water of Satluj River, was found resistant to chromium up to 200 nmol mL^{-1}. Chromium uptake studies revealed that the organism removed more amounts of Cr(VI) from 0.2 M imidazole-HCl buffer compared to nutrient medium. Parameters such as pH of the buffer, temperature and biomass load were optimized for maximum removal of Cr(VI) by the test organism. At optimized pH (6.0), temperature (28 °C), biomass load (200 µg protein mL^{-1}) and initial metal concentration (100 nmol mL^{-1}), the organism removed 250 nmol Cr(VI) mg^{-1} protein in 8 h. Due to structural similarity of chromate (CrO_4^{2-}) to SO_4^{2-} and PO_4^{3-} , Cr(VI) uptake by the test organism in the presence of these anions was studied. In the presence of 200 nmol phosphate mL^{-1}, Cr (VI) uptake by the organism decreased to 135 nmol Cr(VI) removed mg^{-1} protein but same concentration of sulphate did not affect the Cr(VI) uptake. Similarly, presence of Cr (VI) in the solution affected phosphate uptake but not sulphate uptake by the test organism. The kinetic studies on Cr (VI) uptake in the presence of phosphate revealed that phosphate and Cr(VI) acted as a competitive inhibitors for one another. Phosphate starved cells of the organism removed more amount of Cr (VI) than the basal medium grown cells. Cinnamic acid, a phosphate transporter inhibitor, inhibited Cr(VI) uptake by the organism. Results clearly demonstrated that the test organism takes up chromium ions by phosphate transporter and not by the sulphate transporter. In 6 h period, the organism reduced 2.7 µmol of Cr (VI) to Cr(III) intracellulary after its uptake from the solution. Both Cr (VI) and Cr(III) were observed in the solution only and not on the surface or inside the cells indicating that after reducing Cr(VI) to Cr(III) intracellularly, the organism excreted Cr(III) outside the cells. Chromium (VI) reduction by the organism is carried out by soluble chromate reductase. Parameters for the optimum activity of chromate reductase have been optimized. Results indicated that this cyanobacterium can be effectively used for the bioremediation of hexavalent chromium from the industrial effluents before their discharge into water bodies.

Keywords: Cyanobacteria, Bioremediation, Chromium

ASSESSMENT OF BIOPHYSICAL VULNERABILITY FOR MITIGATING CLIMATE CHANGE IMPACT IN RAJASTHAN

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The world's climate is continuing to change at rates that are projected to be unprecedented in recent human history. The risks of climate change and extreme climatic events have dramatic impacts on economy and natural systems especially agriculture, livestock and water resources. In Rajasthan more than 60 per cent of population in dependent on agriculture sector. Vulnerability assessment of agriculture sector aids in prioritisation of planned management and adaptation actions for production systems. Vulnerability is a function of exposure to climate factors, sensitivity to the change and capacity to adapt to the change. The State of Rajasthan occupies 342,239 km^2 and 10.41 per cent of the land area of the country. The average rainfall of Rajasthan is 574 mm compared to the all-India average of 1,100 mm. Temperature of the state is very high during summer especially in Churu, Bikaner, Jodhpur, Jaisalmer etc. which receive more than 45° C. While during winter temperature of these areas falls to 0° C. The population of state has increased from 68,621,012 in 2001 to 1,210,193,422 in 2011. The biophysical vulnerability assessment is based on 11 indicators viz. Monsoon Rainfall Variability, Total Annual Rainfall Variability, Albedo, Land use, Soil Fertility, Land Capability, Slope, Surface Water Availability, Ground Water Availability, Irrigation and Vegetation cover. The data for the study has been taken from India Meteorological Department (IMD), Survey of India Toposheet, BHUVAN open Data Portal, District Agriculture Statistics Handbook, Agriculture Census of India and Ground Water Commission. The biophysical assessment shows that transitional plain of Luni has highest area under very high vulnerability i.e. 38 per cent followed by 23.26 per cent in dry zone with internal drainage. Very low vulnerable area is observed in humid eastern plain and flood prone eastern zone i.e. 47.95 and 40.34 per cent respectively. The biophysical vulnerability shows that the regions which have high vulnerability have scarce natural water resources and are also not having artificial water sources like canal. The regions with high vulnerability need to increase green cover through afforestation programmes and community participation. The revival of traditional water conservation techniques in agriculture should also be promoted in the region for reducing the vulnerability.

Keywords: Climate change, Biophysical vulnerability, Agriculture, Dry region, India

THE ECONOMICS OF CLIMATE CHANGE

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Climate change, its impacts and measures to tackle these, has several dimensions. This talk covers some of the aspects with specific reference to the economic implications of observed impacts of climate change, the future risks that climate change poses and the policy for managing these risks. Climate change is increasingly being considered as a major threat to sustainability globally. Some impacts of climate change such as adverse impacts on agricultural production in India have been attributed to climatic changes that have already taken place. Although some of these observed impacts are as of now relatively minor of the world, many of these impacts have economic consequences which could be wide ranging, especially in terms of risks projected for risks have been identified for different regions of the world. Responding to climate change is about managing the risks of climate change. A range of response options are available, with their implied economic benefits and costs for long term planning in particular. Climate policy in India, has for instance considered both adaptation and mitigation responses to climate change. The climate challenges are best addressed in terms of a multi-stressor framework which recognizes the social, economic and biophysical synergies and trade-offs of the available responses to tackle climate change.

Purnamita Dasgupta has held positions as a Professor at the University of Cambridge, UK and The Carey Business School, Johns Hopkins University, USA. She has been researching on economic issues related to climate change mitigation and adaptation, forests and hilly terrains in India, with particular focus on impact assessment, costing and governance. She is a co-ordinating lead author for the Intergovernmental Panel on Climate Change (IPCC), a member of its Summary for Policy Makers and Synthesis Report writing teams, and a member of the IPCC's Scientific Steering Group on Economics Costing and Ethics. She has contributed to economic modeling for India's national communication to the UNFCCC and has served on several national level environment related committees of the Government of India.

IMPACT OF CLIMATE CHANGE ON CROP PRODUCTIVITY, QUALITY AND BIODIVERSITY

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Now it is established fact that global climate has changed gradually during the last one and half centuries and likely to change substantially in 21st century. Marked increase in the concentration of greenhouse gases in the atmosphere due to anthropogenic activities has finally led to global warming and climate change through greenhouse effect. During the climatic change scenario, the levels of two important climatic components such as carbon dioxide and temperature have elevated which may severely affect both the biotic and abiotic environments directly and indirectly through their interactions with biotic components. Carbon dioxide is plant nutrient, and atmospheric enrichment has the potential to enhance plant productivity. It has been observed that rising CO_2 level in the atmosphere has positive growth and productivity effects on C_3 crop plants mainly through increasing the net photosynthesis owing to reduction in photorespiration, while manifested negative effects on nutritional status/quality of vegetative as well as reproductive organs (seed/grain/fruit etc.) in the same. The rise in atmospheric temperature especially during nighttime however showed detrimental effects on growth, yield and quality of both C_3 and C_4 plants mainly through shortening the growth duration and enhancing the dark and photorespiration of crop plants. Increased temperature not only decreases the crop growth and productivity but also posed serious concern on the sustainability of several valuable temperate crops such as apple, cherry, cauliflower, cabbage, basmati rice, and the animals where sex is determined by temperature like crocodile, in other word global warming may cause spatial and temporal loss of biodiversity. Food security is a major problem around the world both in developed and developing countries with the climate change. In many countries, large area of arable lands are still under rain fed agriculture, so food production in these areas is highly uncertain and risky due to their greater vulnerability to natural calamities such as drought, high temperature etc. Thus, any changes in climatic components may lead to the problem of food security both at regional and national levels. Since most of the experiments on elevated CO_2 and temperature have been conducted under controlled conditions where changes in the levels of temperature and CO_2 may not be resemble to the conditions actually occurs under gradual changing scenario of climate change, thus the magnitude of increase/decrease in crop growth and yield reported under controlled condition cannot be compared with the real effects of climate change. Hence experimental conditions under climate change experiments should be created such that could be almost at par to the real climate change /variability scenario to assess the factual effect of climate change on crop.

keywords: Food security, Groundnut, Climate change, Elevated temperature

ENHANCING RESILIENCE OF INDIAN AGRICULTURE TO CLIMATE CHANGE

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Agriculture is crucial for ensuring food, nutrition and livelihood security of India. It engages almost two-third of the workforce in gainful employment and accounts for a significant share in India's Gross Domestic Product (GDP). Several industries depend on agricultural production for their requirement of raw materials. Indian agriculture is highly prone to the risks due to climate change caused by increase in the concentration of atmospheric greenhouse gases (GHGs); i.e., carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The IPCC 5th Assessment Report reiterated that the warming of the climate system is unequivocal. Anthropogenic influence on the climate system is evident from the increasing greenhouse gas concentrations in the atmosphere and positive radiative forcing.

Climate change can affect agriculture through their direct and indirect effects on the crops, soils, livestock and pests. Increase in atmospheric carbon dioxide has a fertilization effect on crops with C_3 photosynthetic pathway and thus promotes their growth and productivity. Increase in temperature can reduce crop duration, increase crop respiration rates, alter photosynthesis process, affect the survival and distributions of pest populations and thus developing new equilibrium between crops and pests, hastens nutrient mineralization in soils, decrease fertilizer use efficiencies, and increase evapo-transpiration. Climate change also have considerable indirect effects on agricultural land use in India due to availability of irrigation water, frequency and intensity of inter- and intra-seasonal droughts and floods, soil organic matter transformations, soil erosion, changes in pest profiles, decline in arable areas due to submergence of coastal lands, and availability of energy. Potential adaptation strategies to deal with the impacts of climate change are developing cultivars tolerant to heat and salinity stress and resistant to flood and drought, modifying crop management practices, improving water management, adopting new farm techniques such as resource conserving technologies (RCTs), crop diversification, improving pest management, better weather forecasts and crop insurance and harnessing the indigenous technical knowledge of farmers.

Concerted efforts are required for mitigation and adaptation to reduce the vulnerability of Indian agriculture to the adverse impacts of climate change and making it more resilient. A win-win solution is to start with such mitigation strategies that are needed for sustainable development. There is a need to develop policy framework for implementing the adaptation and mitigation options so that the farmers are saved from the adverse impacts of climate change. Development of technologies for adaptation and mitigation and their uptake at speedy rate by the farmers are essential for climate change management. Development and operationalization of adaptation strategy necessitate socio-psychological empowerment of farmers besides developing competencies in acquiring knowledge and skills related to adaptation practices.

Keywords: Gross Domestic Product, Resource conserving technologies

CLIMATE CHANGE AND WATER SECURITY

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With over half of the total population of India dependent upon agriculture for their livelihood, there will be a vast influence of the changing climate and constantly increasing atmospheric temperatures on the socio-economic balance of the country. Climate change has both direct and indirect effects on agriculture. The rising temperature can reduce the crop duration and increase the crop respiration rates. Indirectly, land use is affected due to the melting snow from the glaciers, frequent floods and droughts. Evapotranspiration of the crop being highly sensitive to the atmospheric temperature will shoot up due to the increase in temperature. Not only, there will be an increase in the crop water requirements due the increase in the evapotranspiration of the crop but also the irrigation water resources will diminish because of the higher evaporation rates. India is dependent upon the monsoons for the major share of its annual rainfall and the timing of agricultural seasons is also partially governed by the onset of the monsoons particularly in east, north-east and south India which are predominantly rain-fed. According to the IPCC reports, the monsoons have been projected to vary erratically in the coming years due to the changing climate resulting in frequent and intense floods and severe droughts. This will affect not only the rain fed areas but also the canal-irrigated parts of the country. The developing country will suffer more from these changes than the developed ones (agriculture in India makes up roughly 20% of GDP and provides nearly 52% of employment as compared to 1% of GDP and 2% of employment for the US (FAO, 2006)). In view of all these and other impacts of the changing climate on the water resources of the country, research integrating the atmospheric/ climatological and hydrological models is required to understand and mitigate the effects of climate change. With a view to study the effect of the changing climate on the irrigation requirements and irrigation scheduling of the crops, farm experiments are being carried out at Hydraulic Engineering field lab, Department of Civil Engineering, I.I.T., Roorkee.
The lecture will focus on experimental results and their subsequent use in optimizing the use of irrigation water through a better appraisal of root water uptake.

Keywords: Climate change, Water security, Hydrological model

CLIMATE CHANGE AND ENERGY SECURITY

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Climate change carries serious implications for energy security in any country. With the decline of the available crude oil and gas reserves the global energy system is struggling to meet the ever increasing requirements of new energy consumers. The pressing obligation for any country to reduce greenhouse gas emissions compounds these challenges. While these issues have prompted widespread environmental and energy security fears, they are also directly linked to positive trends that include increasing access to modern energy in the Asia-Pacific region. Viewed on a global platform, the primary energy security challenges are to manage the required energy demands of 7 billion teeming people within the context of environmental security. This paper investigates these dynamics by examining how the concept of energy security is being transformed in the era of climate change.

Energy is vital input for the economic development and is the main driver of climate change as it introduces most of the greenhouse gases in the atmosphere. Addressing climate change necessitates a good scientific understanding as well as coordinated action at national and international level. The dependence of the world on fossil fuels and their ever increasing consumption has led to the present chaos. Unless the issue of energy supply with all its ramifications is tackled, the climate change issue will not be solved. India has been on forefront for arguing that developing countries should incur no expense in controlling emissions that cause climate change. The west has caused the problem and it should tackle it seriously. Such logic is increasingly untenable both in the fundamental arithmetic of climate change, which is a problem that is impossible to solve without the participation of the developing country of the world. The political reality is that important western partners will increasingly demand more of India and other developing countries participation in the years to come. It is concluded that a large number of options like increasing energy efficiency of existing thermal power plants and to switch to the renewable to reduce the greenhouse gases are in India's own interest, and relax on emissions cut could amount to several hundred million tons of CO_2 yearly over the next decade and an even larger quantity by 2020.

Keywords: Climate change; challenge; greenhouse gas reduction; energy security; India

IMPACTS AND ADAPTATIONS IN CROP PLANTS UNDER CHANGING CLIMATE: PHYSIOLOGICAL ANGLE

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Assessing the impacts of climate change will be a vital task in developed as well as in developing countries because of many interdependent physical, biological and chemical processes are ongoing in earth and human systems. These processes can be affected by change in climate, causing an effect on natural resources (water resources, forest products, etc.), on biodiversity, ecosystem services and on plants in general, some positive and on others negative effects, such as, altering biophysical relationship, shrinking of habitats, desertification and general shift in natural world. Warming directly affects rate of plant respiration, photosynthesis, and other biogeochemical processes. For instance, enhanced CO_2 concentration can increase photosynthetic rate especially for plants growing under warm and dry condition such as C_3 plants. Naturally, plants have their own mechanism to tolerate a certain level of increased temperature. As soil temperature increase, the decomposition rate of organic matter will increase, and then nutrient mineralization and availability for plants uptake become increased at presence of sufficient water if other conditions are unchanged. Thus, the interaction and different combination effect of rise CO_2 concentration and temperature is determined by soil properties, water, mineral and nutrient availability etc, as a result the expected response of plants in different environments and climate variability can be either positively or negatively affected. Therefore, in summary two basic measures are necessary to reduce impacts of climate change: 1) practicing mitigation (reducing causes of climate change) by reducing emission of greenhouse gases (GHGs) from the source, by substitution and conservation of energy, improving carbon sequestration, etc and 2) practicing potential adaptation measures, (e.g. reducing the impacts of climate change). Important examples of adaptations are: a) reducing vulnerability (degree of susceptibility of a system to a certain damage) to climate change impacts, focusing on coping strategies and practices to become beneficial by using opportunities associated to climate change by reducing susceptibility and external forces to develop the ability of resilience (increasing tackling capacity of the community and sectors to reduce risk and damages); b) have effective conservation strategies to maintain natural distribution of biodiversity and ecosystem services, and conserve species and genetic diversity; c) Improving productivity in terms of quality and quantity is vital to satisfy human needs, through adjusting different growth factors and solving effects of extreme events and associated problems, e.g. preventing spread of pathogens, weeds, dispersion of insect and pests etc; d) minimize impacts of climate change (its cause and effects) moving forward in researching to identify the responses of plant species to different variable climate conditions, and identifying uncertainty in climate and try to avoid challenges in practicing adaptation; e) finally, increased environmental benefits from forest ecosystems by afforestation and reforestation to reduce degradation and loss of habitats.

Keywords: Climate change, Greenhouse gasses, Carbon sequestration

MODELLING CLIMATE RESILIENT - DISASTER SAFE INFRASTRUCTURE IN SOUTH AND SOUTH EAST ASIA: TECHNO-LEGAL AND FUTURISTIC FRAMEWORK

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Countries of Asia-Pacific and Africa are witnessing major transformations in the extent of infrastructure aimed at improving quality of life, sustainable growth and production to pace with that in the developed world. Issues related with water & sanitation, agriculture, power, health, education, communication, etc. end up calling for infrastructure and functional capacity for sustaining the desired levels in human development. South Asia and South East Asia, home for major share of poor, marginalized and disaster affected populations is also known to be highly vulnerable to climate change impacts. Climate change is known to precipitate more intense hydro-meteorological hazards like floods, drought, cyclones, heat wave, cold wave, cloudburst, etc, associated landslides, health epidemics, plant diseases, and also modifying thresholds in chemical and technological safety risks. Countries of these regions are highly vulnerable also due to the underlying factors governing land, landscape and land-use, poverty, structural designs and strength, and capacity of people and systems. An illustrious analysis of recent climatic disasters, for example, floods in Mumbai, Pakistan flood, Uttarakhand flood, J&K flood, and Cyclones like Aila, Phailling and Hudhud, have been extrapolated to identify appropriate models of safe and sustainable infrastructure models in South and South East Asia regions. Policy, planning and technical framework have been emphasized while recommending a roadmap for future, with India's specific examples of flagship programmes like Smart Cities, Aadarsh Gram (Model Villages), Swachch Bharat (Clean India drive) and 'Make in India' drives. A cross examination of Bangkok declaration, HFA-2 input for Asia-Pacific and critical points for World Conference Sendai 2015 have also been enumerated.

Keywords: Modeling climate resilient, Smart Cities, Policy

NEGATIVE AND POSITIVE REGULATOR OF STRESS SIGNALING: A RICE PROTEIN PHOSPHATASE 2C IS KEY REGULATOR OF ABA AND ABIOTIC STRESS RESPONSES

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Abiotic stresses such as drought, high salinity, cold and heat adversely affect the plant growth and productivity. To combat various environmental cues, as an adaptive mechanism, various signalling cascades get activated in the plant cell leading to altered cellular function and responses. Reversible protein phosphorylation mediated by kinases and protein phosphatases is one such adaptive cellular response to maintain a critical balance in phospho-regulation during normal and adverse growth conditions. Protein phosphatases have been known to mediate abiotic stress triggered signaling pathways and members of major phosphatase class PP2C, have been variably implicated in a number of studies. *Arabidopsis* PP2C belonging to clade A have been extensively worked out and known to negatively regulate ABA signaling. However, rice (*Oryza sativa*) orthologs of *Arabidopsis* clade A PP2C are scarcely characterized functionally. My group has identified a clade A PP2C from rice (OsPP2C), which is highly inducible under ABA, salt and drought stresses and localized to the nucleus. Genetic analysis revealed that *Arabidopsis* plants overexpressing OsPP2C are highly insensitive to ABA and tolerant to high salt and mannitol stresses during seed germination, root growth and overall seedling growth. At adult plant stage, OsPP2C overexpression leads to high tolerance to salt, mannitol and drought stresses with far better physiological parameters such as water loss, fresh weight, chlorophyll content and photosynthetic potential (Fv/Fm) than wild type plants. Expression profile of various stress marker genes in OsPP2C overexpressing plants revealed interplay of ABA dependent and independent pathway for abiotic stress tolerance. Detail molecular investigation identified OsPP2C as a novel regulator of stress signaling, where it negatively regulates ABA signaling but acts as positively regulator of abiotic stress signaling in plants. In future, transgenic rice plants overexpressing this gene might provide an answer to the problem of low crop yield and productivity during adverse environmental conditions.

Keywords: *Arabidopsis*, Abiotic stress, Photosynthetic potential, Protein phosphatases

BIOFUELS: AN OPTION FOR CLIMATE CHANGE MITIGATION

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This paper reviews the biofuels as an option for climate change mitigation. The biofuels production and combustion is carbon neutral or even carbon negative as the carbon, which is stored during biomass growth, is released and does not add new carbon to the active carbon cycle, whereas fossil fuels such as coal, oil and natural gas remove carbon from geologic storage and contribute to climate change by emission of GHGs. Biofuel also controls the carbon emissions from biomass facilities which would have been released back into the atmosphere through natural decay or disposal through open-burning. Inspite of these GHG benefits, the progress in biofuels expansion is at crossroads as it is influenced by various factors like land use changes and food security related issues. However biofuels from degraded land and from non-food crops are promising option for climate change mitigation. Proper planning in land use and identifying most appropriate policies for promoting this will help in tackling the global issue and in achieving the goal. The technology utilizing carbon sequestered in various sources, for ethanol, biodiesel and other biofuels production is a sustainable solution to climate change rather than biofuels from food crops.

Key words: Biofuel, Biomass, Climate change

CARTAP HYDROCHLORIDE TOLERANCE AND UPTAKE BY CYANOBACTERIUM *LEPTOLYNGBYA FOVEOLARUM*

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Use of pesticides in paddy fields besides eliminating target organisms also affects non-target microorganisms including cyanobacteria. Thus, there is a need to select pesticide tolerant cyanobacterial strains which can be used for biofertilizer technology. The present study was aimed to characterize the cartap hydrochloride tolerance and its uptake by the cyanobacterium *Leptolyngbya foveolarum* isolated from paddy fields of Punjab, India. The microorganism tolerated commercial grade insecticide up to 80 ppm. Lower concentration (20 ppm) of cartap supported good growth with increased dry weight of biomass, total protein content, photosynthetic pigments, photosynthesis and respiration compared to untreated control cultures while higher concentrations (40 and 60 ppm) inhibited these parameters in a dose dependent manner. Treatment of the microorganism with 60 ppm cartap lowered the content of photosynthetic pigments with maximum inhibitory effect on phycoerythrin (70% decrease) followed by allophycocyanin (66% decrease). Photosynthesis and respiration rates were inhibited by 63% and 45%, respectively, while PS-I, PS-II and whole chain photosynthetic activity were decreased by 45, 67 and 40% respectively, compared to untreated control cultures. Cartap at 60 ppm decreased nitrate and nitrite uptake by 31 and 61%, respectively, whereas uptake of ammonium was slightly increased (18%) in cartap (60ppm) treated cells. Nitrate reductase and nitrite reductase, and glutamine synthetase activities of the microorganism decreased by 36-50% in 60 ppm cartap. The low levels of growth, photosynthetic pigments and activities of nitrogen assimilating enzymes in cells grown in nitrogen depleted medium supplement with insecticide indicated that insecticide is used by the organism as a nitrogen source. This was further confirmed by cartap uptake studies. The results revealed that the test microorganism took up insecticide intracellularly and metabolized it. The rate of cartap uptake was fast when the cartap was supplemented in nitrogen depleted medium than nitrogen containing medium. Cartap (20 ppm) from medium was completely removed by test microorganism within 48 hours. Biomass, pH and temperature influenced the insecticide removal and the organism exhibited maximum cartap removal at 100 mg protein/L, pH 8.0 and 30 ^{o}C.

Keywords: Cyanobacteria, Insecticide, Cartap, Nitrite reductase, Nitrate reductase

CLIMATE CHANGE, URBANISATION AND SUSTAINABLE DEVELOPMENT

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Actually urbanisation & development is a matter of discussion since a long time. Present urbanisation is synonym of development and is mainly based upon the Western pattern that gives more emphasis upon human improvement. This has accrued into constantly increasing distance between nature and humanity. Brooks (2006) has said that it is due to "the imposition of “one size fits all” developmental models on diverse societies situated in a variety of different environments." These models have tended to ignore the role of the environment in shaping the development of human societies and the livelihoods that sustain human populations (e.g. Brooks, 2006). The present path of development is not leading us to achieving the goal of sustainable development. This means our development pattern is compromising the ability of future generations to meet their-own needs. Climate Change is one of the direct consequences of Unsustainable Consumption driven by wasteful, consumerist, energy intensive production & consumption systems. This presentation attempts to deal with the idea to look into the depth of global climate change and other environmental problems as a consequence of wrong approach towards development and sustainability. There exists the longing for more improved quality of life and points towards our failure to understand the main motto of development. Understanding of distinction between quality of life and standard of life is being attempted .We must inbuilt sustainability in our lifestyle and inculcate these values into our Science & Technology capacity building efforts to usher in an environment friendly development pattern. This requires not only a change in the way policies are formulated, but arguably a much deeper philosophical transition, involving the rethinking of the way human societies interact with the wider physical environment at the local, regional and global scale.

Keywords: Sustainable development, Urbanization

SALT INDUCED STRESS AND PHENOLS AUGMENTATION REINFORCED BY JASMONIC ACID

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Jasmonates is group of plant oxylipins includes jasmonic acid (JA) and its derivatives such as methyl jasmonate (MeJA), *cis*-jasmone, jasmonoyl isoleucine (JA-Ile), jasmonoyl ACC (JA-ACC) and several other metabolites are the oxidation products of unsaturated fatty acid linolenic acid. These substances are reported to exert promotional and protective activities either as signalling molecule in plant during normal growth and development and also under array of stress conditions. Most of the potential exploring properties of JAs in plants is during wounding and insect and pathogen attack or direct anti-microbial substances that are toxic to the invader. Since its discovery from essential oil of jasmine flowers, biological and anti-stressor roles of JA have received attention of researchers which is going on increasing day by day. JA is now recognized hormone in defence and reproductive phenomenon in plants. JA and its conjugates are reported to be directly involved in growth, development and regulation of responses to various biotic and abiotic stresses. Salinity in soil is a major abiotic stress which may be one of the causes of breakdown of the ancient Sumerian civilization and till triumph that adversely affects the crop productivity and quality. Considerable efforts have been made to unravel plant salt tolerance mechanisms with the ultimate goal of improving the crop productivity under salt stress by using plant breeding methods. However, the success of plant breeding methods depends upon number of factors and numbers of inherent impediments are there which make the story unsuccessful after putting lot of labour. Use of some ecofriendly chemicals or growth regulators in making plant tolerant to salinity is technically simple method and this practice is now esteemed world over to make plants tolerant to salinity. *Vigna radiata* is an important leguminous crop of India which is grown in major parts of the country where high salinity in soil is detrimental to crop productivity and yield. In our laboratory an endeavours have been carried out to explore the role of JA against salt stress in *V. radiata* and what could be the possible mechanism or secondary metabolite regulation which made the plants more tolerant towards salinity. The secondary metabolism which is under question in present study was phenol metabolism. Exogenous application of JA under normal conditions showed inhibitory effect on seed germination of *V. radiata* as compared to control seeds and similar detrimental effects results were found in salinity treatment also on rate of germination which enhanced with increasing concentration of salinity in the medium. Supplementation of different concentrations of JA prior to salinity exposure in seeds helped in surmounting the toxic effect of salinity. Antagonistic results were found for priming treatments of JA on inhibition of root growth but in very dose dependent manner and same observations were of JA treatment were observed in shoot growth where interactive role of salt stress and JA was establish in managing the shoot growth. Different treatments of salt and JA alone or in combination suggested that increase in salt concentration in growth medium causes osmotic stress

which may induce synthesis of more sugars and carbohydrates along with other organic metabolites. Priming treatment of JA before exposure to salt stress conditions made the plants more tolerant to salt stress, might be by triggering some proteins or inhibit the activation and/or synthesis of enzymes which are involved in degradation of photosynthetic pigments.

Phenols are assorted secondary metabolites which showed immense antioxidant potential by chelating the transition metal ions and inhibit lipid peroxidation by directly scavenge molecular species of active oxygen formed as free radicals from primary metabolism under normal as well as under stress. Exogenous application of different JA concentrations, ameliorate the accumulation level of total phenols and activity of enzymes involved in metabolism of phenols as PAL and PPO but in dose dependent manner. JA ameliorative potential was more pronounced when seedlings of *V. radiata* were exposed to high salinity stress conditions affirmed the protective role of JA under salt stress in plants. Further, HPLC analysis illustrated that JA treatment can induce synthesis of new sort of phenols which were not identified in control untreated seedlings with or without stress. The induction and enhancement of biosynthesis of diverse type of phenols supported by the observation of enhancement in antioxidant potential of JA treated seedlings raised with or without salt stress which may be due to occurrence of higher as well as varied type of phenols which exert pleitotropic effect on plant growth and development which was more pronounced under stress conditions. From these it can be concluded that application of JA can trigger the biosynthesis as well as reallocate different phenolic compounds which help the plants to tolerate the high salt stress.

Keywords: Jasmonates, Salt stess, Phenols secondary metabolites

POTENTIAL AGRICULTURAL BIOTECHNOLOGIES TO MITIGATE CLIMATE CHANGE: CASE STUDIES FROM TERI'S RESEARCH

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Food and energy security are the two major issues of the current world in the context of a growing population and climate change. The yield improvements achieved during the Green Revolution have plateaued and may decline in the future as the sources of phosphate and fossil energy used to produce nitrate fertilizers are getting exhausted. New approaches to yield improvement as well as new varieties are, therefore, desperately needed to produce more climate resilient crops for food and energy. In the current presentation, two examples from our own research, namely, *stay green* in wheat and genetic improvement of Jatropha, will be presented. *Jatropha curcas* L. has received great attention during the last decade as a source of biodiesel. Large plantations of Jatropha were raised under various government and industry funded programs in India between 2004 and 2008. Unfortunately, none of these plantations gave the promised returns. This was primarily due to use of untested and unimproved planting material and unrealistic assumptions on plant productivity which in turn led to failure of the entire Jatropha biodiesel initiative and loss of confidence among different stakeholders. Consequently, there happened a remarkable shift in Jatropha related activities, from plantation to research towards its genetic improvement. Interspecific hybridization was used to widen the genetic base and to create prebreeding material in Jatropha. Donor genotypes for several important traits were identified which are currently being used for Jatropha breeding. On the other hand, a large number of molecular markers such as microsatellite and SNPs were developed and used in linkage and QTL mapping studies. Thus, an excellent foundation in the form of genetic and genomics resources has been created and is being used for genetic improvement of Jatropha. The application potential of these resources will be discussed.

Keywords: Genetic diversity, Doubled haploids, Stay green, Marker assisted breeding, Interspecific hybridization, Genetic transformation

EXPLORING PLANT INVASIONS AND CLIMATE CHANGE

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Invasions are to a great extent driven by anthropogenic disturbance and selective introductions. With the rapid pace of development, humans are significantly altering the stable natural system. Altered local environmental conditions in natural systems may provide invasive species with potential prospects for their expansion. Extensive expansion of invaders seriously affects ecosystem structure, function, interactions and subsequently human well-being. The abundance and distribution of plant species is highly influenced by climatic factors. Changes in climatic conditions may cause major shifts in plant invasive species' spatial distribution and population dynamics. Analyzing different plant invasive species will aid in understanding how global climate change affects their expansion.

Key words: Ecosystem services, Global change, Human well-being, Plant invasions

THE URGENCY AND CHALLENGE OF GLOBAL WARMING

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My talk will start with the basic science and roots of global warming. It will also touch upon recent impacts in different parts of India, including impacts on other species. This is partly based on my travels to a few places in different regions.
It will then discuss why global warming is so urgent, the lack of urgency being displayed by various governments in ongoing negotiations in the COP, and the challenges faced in building a climate movement in the country. It will end with some suggestions of what college students and teachers can do to engage further with the issue.

VARIATION OF INDIAN MONSOON REGIME DURING THE LATE QUATERNARY: SEDIMENTOLOGICAL EVIDENCE

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The present investigation is based on sedimentology of gravity core SK-221 (Lat. $8^0 7.12^/$ N; Long. $73^0 16.38^/$ E and Water Depth- 2188m) located near the Chagos -Laccadive Ridge in the southeastern Arabian Sea to evaluate the monsoon driven paleoenvironmental changes during last 30 kyr. The clay mineralogy, biogenic carbonate ($CaCO_3$), acid insoluble residue (AIR), magnetic susceptibility (MS) and total organic carbon (C_{org}) are utilized to correlate with paleoenvironmental changes. The clay mineral assemblages predominantly consist of illite, kaolinite and chlorite with small amounts of smectite. The low values of clay based humidity proxies (kaolinite to illite and smectite to illite ratios) and better illite crystallinity indicate relatively weak summer monsoon condition that resulted reduced chemical weathering during glacial period, which was interrupted by a discrete event of winter monsoon intensification at ~20-17 ka. The high AIR, MS and low $CaCO_3$ along with low C_{org} during glacial period also indicate weak summer monsoon and terrigenous dilution. The convective mixing of waters due to intense winter monsoon resulted in to very high $CaCO_3$ content during early stages of glacial period. The increased kaolinite content, humidity indices and poorer illite crystallinity reflect high humidity during the preglacial and Holocene periods. The increased $CaCO_3$ and C_{org} during major parts of above periods suggest summer monsoon led high biogenic productivity. The characteristic clay mineral associations broadly suggest dry to semi-dry conditions during Heinrich Events H1, H2, and H3 and also during Younger Dryas. The low values of biogenic carbonate and organic carbon also indicate low productivity associated with weak summer monsoons during Heinrich Events. The abrupt increased humidity was recorded at 15-12.7 ka (Bølling/Allerød Event) sandwiched between two lows of Heinrich Events. The clay mineralogical data indicated global monsoonal oscillations in millennial timescale variations of 2300, 1800, 1300 and 1000years.

Keywords: Monsoon, Arabian Sea, Quaternary, Holocene, Clay mineral, Biogenic carbonate

ILLEGALE-WASTE BURNING IN MORADABAD–A FUTURE CHALLENGE

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E-waste is one of the rapidly growing waste stream and it has also become a global concern because of it's over production. Recycling and illegal burning of the E-waste leads to release of various toxic metals such as Pb, Cd, Cr, Cu, Hg, hydrocarbons, dioxins, furan and can produce emissions of several greenhouse gases (GHGs), which contribute to global climate change.. According to some estimations, 50% of the printed circuits boards (PCBs) used in appliances end up in Moradabad, it is also known as Brass City "*Peetal Nagri*". Recyclers in Moradabad buy PCBs mainly from Delhi, Kolkata, Chennai, Bangalore and other parts of India. Shrinking of brass market due to decreasing demand nationally and internationally, has left many people jobless here in the last few years. Many households which were engaged in brass work earlier were left with no choices but to explore other means of livelihood. Thus E-waste was one of the natural choices of their metal processing knowledge. Samples of air and soil were analyzed at five sites to see the actual impact of this waste. Improper handling and management of E-waste during recycling and other end-of-life treatment options may develop potentially significant risk to both to human health and environment. Emission of toxic metals can cause various health disorders like skin damage, asthma, lung and heart damage, fertility problems etc. Therefore if the proper recycling is done it may help to address global climate change by decreasing the amount of greenhouse gas emissions therefore less environmental pollution.

Keywords: E-waste, Toxic Metals, GHGs, Brass city, Environment Pollution, Health Disorders.

EFFECT OF NANOPARTICLES ON ENVIRONMENT AND HUMAN HEALTH

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Nanoparticles (NPs) are increasingly being used in commercial applications and eventually will percolate into aquatic, terrestrial and atmosphere environments. The most alarming thing is that their behaviour in these environments is largely unknown. This article concerns the effect of both natural and man-made or engineered nanoparticles on weather patterns and human health all over the world. These nanoparticles can change cloud formations affecting the weather all over the world. Atmospheric nanoparticles can lead to acidic deposition and material damage. They can also reduce visibility. Few studies have focused on the effects and mechanisms of nanomaterials on plants of different ecosystems. We still do not know with certainty whether nanoparticles have a promotory or inhibitory effect on plant growth. In the long run, it has great ramifications on the agriculture sector. There are studies indicating the adverse effect of nanoparticles on human health. The large surface area of NPs makes them more reactive and toxic. They can lead to pulmonary inflammation, cardiovascular problems and oxidation stress. Some reports suggest that aluminium oxide and barium preparations are already being dumped into the atmosphere in mass quantities leading to serious health issues like Alzheimer's and cancer. A very serious consequence is the change in the pH level of soil which can become so toxic that even survival of plant life becomes impossible as aluminium and barium are toxic heavy metals. Barium is known to disrupt the immune system and aluminium (especially aluminium oxide) disrupts the nervous system. The environmental and human health impact of nanoparticles can be staggering. According to the authors, there is a dire need to explore the effects of nanoparticles on environment.

Keywords: Nanoparticles, Weather Pattern, Plant Growth, Human Health, Ecosystems

VARIABILITY IN SOIL CO_2 EFFLUX ALONG RIPARIAN ECOSYSTEM OF GANGA-RIVER IN VARANASI

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Climate change induced by increased CO_2 emission from riparian ecosystem is of major concern recently. Soil moisture and temperatures are considered as the regulatory parameters for CO_2 emission, therefore, its emission from wetland ecosystems would be of higher interest. Rivers like Ganges are considered as the lifeline of the Nation. In addition to their various tangible benefits to humankind, they are indirectly leading to various intangible ecosystem services related with their wellbeing. Assessment of river intangible services with present issues of global concern such as climate change related with enhanced CO_2 emission would be of greater relevance. With this connection, a study was planned for assessing the variability in soil CO_2 efflux (SCE) along the banks of river Ganga in Varanasi. The gradients taken into consideration were: close to river flow (RF), grassy patches (GP) and agricultural landscape (AL) under the proximity of river basin. We also measured the consecutive soil physico-chemical parameters regulating SCE along the gradients. SCE, soil organic carbon (SOC), soil moisture, bulk density and pH are found to vary significantly along the gradients. An increasing trend is observed for SCE, SOC from RF to GP to Al, whereas, soil moisture, bulk density and pH showed reverse trend respectively. Further, correlation analysis revealed that the SCE vary with the gradient types significantly ($p<0.01$, $n=3$) as compared to site-wise variations. Also, SOC (positive), bulk density and soil moisture (negative) are found as the regulatory parameters for the SCE ($p<0.05$, $n=12$). Therefore, this study will bring a major focus for the C footprint analysis along riparian ecosystems for different river basins in the country like India. Further elaboration of this study along the whole river body with temporal variations will give a better understanding of SCE along river basin and its contribution to the C budget.

Keywords: Humankind, River basin, Agriculture, Climate change,

IMPACT OF NITROGEN LOADING ON THE SUSCEPTIBILITY OF THE INVASION IN THE INDO-GANGETIC PLAINS: INDIA.

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Global environmental change not only involves changes in mean environmental conditions but also in their variability. Changes in climate inconsistency are often associated with altered disturbance regimes and temporal patterns of resource availability. The experiment was performed to estimate the response of the studied ecosystem for the changing resource availability. The Indo-Gangetic plains are nutrient limiting ecosystem with high diversity, any increase in the nutrient status of this ecosystem may lead to change in its property and processes. Nitrogen enrichment to the ecosystem has shown the shift in plant composition. In present study revealed, increase in soil nutrients strongly promotes another key process of global change, which is the encroachment of invasive plant species in the area. In experimental area one or more invasive plants, which were either absent or not dominating, became dominant or shown many fold increase in their productivity.

The superior ability to take advantage of variable environments may be a key mechanism of invasive species dominance, and possibly many other plant invaders. Our study demonstrates that increased nutrient variability can promote plant invasion, and that changes in environmental variability may interact with other global change processes and thereby substantially accelerate ecological change.

Key words: Global Environmental Change, Indo-Gangetic plains, Invasive species.

IMPACT OF CLIMATE CHANGE ON HUMAN DISEASES: OUTBREAKS, WEATHER EXTREMES AND DEADLY DISEASES

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Worldwide anthropogenic activities are bringing about drastic changes in the earth's climate. It is estimated that average global temperature will rise from 1 to 3.5°C by 2100 increasing the global spread of many human, particularly infectious diseases. The temporal and spatial changes in temperature, precipitation and humidity that are expected to occur under different climate change scenario will affect the biology and ecology of vector and intermediate host and consequently the risk of disease transmission. Weather extremes like floods are usually accompanied by outbreaks of infectious diseases such as cholera, dengue and malaria (malaria cycles have been strongly correlated with the El Nino cycles in India). Recently, outbreak of Ebola virus in West Africa is associated with long dry periods followed by excess precipitation. Increase in rainfall also promotes spread of vector-borne diseases indirectly by increasing the number of larval habitats and food supply. Various factors such as land use change (such as deforestation, expansion of agricultural and hydropower projects) and overall increasing trend towards urbanization also influence spread of deadly diseases and increase the interaction between host and pathogens. In this study the impact of weather extremes in the outbreak of malaria, dengue, Japanese encephalitis, cholera, avian influenza and Ebola virus disease will be analysed and discussed.

Keywords: Anthropogenic activities, Climate Change, Weather extremes

IMPACT OF NITROGEN DEPOSITION ON THE C AND N DYNAMICS IN THE VINDHYAN DRY TROPICAL FOREST OF INDIA

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Anthropogenic Nitrogen (N) deposition due to agricultural activities, fossil fuel combustion, biomass burning, and changes in land use patterns over the past many decades has a negative impacts on temperate ecosystems of Europe and North America. After habitat fragmentation and climate change it has been considered as third biggest factor for biodiversity loss. Due to high population pressure and anthropogenic activities, it is also substantially increasing in India and China. There is a limit of N that natural ecosystems can sustain, and beyond this threshold severe destruction can be expected. Excess N overwhelms the normal N cycle, deteriorate the soil quality and composition. For example, it affects soil processes (mineralization, respiration, microbial activities, litter decomposition, soil acidification and NO_3^- leaching).

The N mineralization is a measure of soil quality, measurement of N mineralization rate can help in understanding the impact of N deposition on soil health. The studies on N deposition and its consequences on soils are mostly available from temperate regions and very few from tropical regions especially from Indian region, which has been marked under high N deposition category. Therefore diverse effects of N deposition on soil and vegetation health could be expected. The Vindhyan forests are experiencing large scale industrial activities particularly coal mining, thermal power and aluminium production. These activities are accelerating the atmospheric deposition of chemicals which may affect the soil and vegetation composition .Therefore, the present study aimed to assess the extent to which N deposition influence soil nutrient dynamics (C- and N-mineralization rate and the change in microbial biomass) in the dry tropical forest of India.

Keywords: Nitrogen Deposition, Mineralization, Microbial Biomass

HEATER OPERATION WITHIN THE CLOSED CONFINES OF A CAR DURING WINTER MONTHS IN DELHI: EVIDENCE OF TOXIC CO GENERATION

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Worldwide there have been a plethora of studies describing the ill-effects of air pollution arising due to ever increasing usage of cars for commuting. However, most of the investigations on air pollution explain results of studies that have been carried out in traffic (outdoor) and very few experiments illustrate results compiled from measurements computed from car cabin air quality (indoor). With augmented income providing fillip, there has occurred a boom in purchase of cars
specially in tier-1 metro cities of India including Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad etc. The traffic snarls faced by car commuters in these cities has resulted in them spending more than a couple of hours interacting with the stale air within the car cabin enclosure. The problem with car cabin air gets accentuated especially in harsh winter months when people drive with their car heaters switched on with sometimes even the air-vent kept closed.
In the current study carbon monoxide (CO) concentration levels are measured within the cabin space of petrol fired Maruti Suzuki car (Swift LXI model) as a function of time. Specifically, the variation in CO generation characteristics is measured as a function of time and varying fan speed of heater located within the car console. The studies are carried out during the months of January and February 2015 in New Delhi with the car set at idling speed, air-vent closed, heater setting at medium and CO sensor on the rear seat.
It is interesting to note that initially (~ 10 minutes) the amount of CO generation is directly proportional to the rating of the fan speed (settings 1 - 4) keeping the car heater power fixed. With increasing time (> 10 minutes) setting 3 starts generating more CO and that too at a faster rate compared to others. While lower amount of CO generation at settings 1 and 2 can be explained on the basis of slower heater-fan speed combination, the surprising result at higher fan speed (setting 4) can be attributed to leakage of cabin air at higher fan rotation speeds. The detailed study is expected to go a long way in assuaging problems of taxi drivers with unending shifts in cars and understanding ways to prevent formation of COHb (a biological toxic).

Keywords: CO Generation, Ambient Air Pollution, CO Gass Sensors, Room Heater

HEALTH EFFECTS OF EXPOSURE TO AMBIENT CARBON MONOXIDE WITHIN CLOSED OFFICE SPACE AS A RESULT OF ROOM HEATER OPERATION DURING WINTER MONTHS IN DELHI

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WHO defines air pollution as contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. There has therefore arisen a pressing need to revisit exposure-response assessment since Ambient Air Pollution (AAP) has assumed gargantuan proportions. Carbon monoxide (CO), at trace level concentrations (parts per billion) present in the atmosphere, does not adversely affect public health however, at higher concentrations of CO (> parts per million) it is known to affect human health to a great extent. Typically CO is known to affect the central nervous system in humans, especially the globus pallidus and the cerebral white matter. Generally, CO is generated by either accidental or intentional burning of biomass and other carbon-containing fuels. Car engines are another major source of CO in outdoor, ambient air. However, because of cleaner fuels and lean-burn engines the last decade has seen dramatic decline in CO emissions from vehicles. Over the last few years an increase in the CO concentrations from man-made sources has become a public health problem, since high concentrations have disturbed the established natural balance. Concerns about the potential health effects of exposure to CO have been addressed in extensive studies with various animal species as subjects. Under varied experimental conditions, considerable information has been obtained on the toxicity of CO, its direct effects on blood and other tissues, and the indications of these effects in the form of changes in organ function. Lethality of CO that results from extremely high concentrations is well known, but other effects of CO that are equally bad are often overlooked, especially in susceptible individuals. The health effects of low concentrations, such as levels found in ambient air, are far more subtle and considerably less threatening to the general public. Hence greater concern regarding the effect of CO presence in the ambient is currently shifting focus on sub-populations of individuals who are particularly exposed to it on a regular basis thus making them susceptible to gradual CO poisoning. In view of the above it becomes important to investigate how presence of CO in the immediate environment on a daily basis affects the health index of the humans.
In the current study CO generation characteristics of various types of room heaters are investigated and their contribution to AAP pollution studied within closed office space during winter months in New Delhi. Specifically, CO generation characteristics of halogen, filament and fan based room heaters when used in typical span of 6 hours in a typical office day are collated and their ill-effects on human health studied.. It is interesting to note that the level of CO constituent in AAP pollution is not only influenced by human traffic through the office but also the type of room heater under use. The study involved use of MQ series of Co gas sensors.

Keywords: CO Generation, Ambient Air Pollution, CO Gass Sensors, Room Heater

THE CURIOUS CASE OF INDIAN OCEAN WARMING

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Numerous studies have been carried out to determine the cause behind Indian Ocean warming, yet the reasons behind the prominent warming are still debated. These studies have shown that the Indian Ocean has been warming throughout past half century. The results reveal a larger picture- the western Indian Ocean has been warming at a rate faster than any other region of Indian Ocean, and it is also the largest contributor to the overall trend in the global mean sea surface temperature (SST). There was an increase of 0.7°C in Indian Ocean warm pool during 1901-2012 while, the western Indian Ocean experienced anomalous warming of 1.2°C in summer SSTs. In comparison with the rest of Indian Ocean, the western Indian Ocean has cooler SSTs in summer, owing to strong monsoon winds and resultant upwelling over western Indian Ocean. This zonal SST gradient created, regulates strength and flow of moisture-laden winds toward the South Asian subcontinent. Thus, the warming of generally cool western Indian Ocean against the tropical warm pool region alters the zonal SST gradients, and has the potential to change the Asian monsoon circulation and rainfall, as well as alter the marine food webs in this biologically productive region. Apart from the greenhouse gases and anthropogenic activities being the contributor to Indian Ocean warming, a positive correlation is observed between the El Nino-Southern Oscillation (ENSO) teleconnection and western Indian Ocean warming. The number and intensity of El Nino events have significantly increased during the latter half of twentieth century (12 events), in comparison with the former half (7 events). The rate of Indian Ocean warming has also increased during the last five decades. However, the Indian Ocean anomalies associated with La Nina are relatively smaller in comparison with those associated with El Nino. A second prominent reason is the positive SST skewness associated with ENSO, as the frequency of El Nino events has increased during recent decades, which can be attributed to climate change. An SST increase from 26.5°C to 28.0°C can drastically change the convective response and can alter the dynamics of the monsoon.

Keywords: Indian Ocean warming, Sea surface temperature, El Nino-Southern Oscillation

PERCEPTION OF YOUTH TOWARDS CLIMATE CHANGE

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Climate change is posing major threat to mankind in 21st century. If the problem of climate change will not receive enough attention it will cause large scale extinction of species. The effect of climate change will be experienced more in tropics due to poor standard of living, and minimal government support to people to cope with changing environmental conditions. Government in tropics alone can't solve the problem of climate change unless and until people will participate and work together with Government to implement policies. However, there is not enough information available in public domain regarding the people's perception towards climate change, which can be useful in formulation of people sensitive policies. We therefore conducted a climate change survey in Deen Dayal Upadhyaya College (DDUC) to know the perception of youth. We selected youth as they are the one who will going to face the problem of climate change the most and their opinion can make a difference. We prepared a questionnaire containing 10 questions that were related to climate change. Survey was carried out in the DDUC in the month of February 2015. A total of 824 students (18-25 years) were surveyed which covered 40% of the students of DDUC. In majority of case (96%) students knew climate change. Around 90% students were of the opinion that issue of climate change was important to them. 80% of them think that climate change would have negative impact. Almost 80% students think that climate change was affecting Indian economy however 16% students not had any idea about it. Majority of them (77%) think that it was the agriculture sector on which climate would have maximum impact, 46% thinks it was health followed by tourism, energy and industry. Around 75% students were optimistic that we could tackle climate change. 53% students think the use of green technologies was the best option available to mitigate climate change, 36% students think it was the afforestation while nonconventional energy was considered 3rd best option. Only 12% students relied on Government legislation. Only 38% students were familiar with the term UNFCC/IPCC. On the question of daily contribution of carbon emission, most of them (60%) think that they emitted low level of carbon emission, 25% of them didn't know about it while only 13% believed they caused high carbon emission. The current study showed that DDUC students which represent students of Delhi University were familiar with climate change however they ignored their individual role in carbon emission which is a key finding of this study. Though use of green technologies will help in mitigating the climate change however afforestation will be the much easier and feasible option available to us. We therefore suggest running environmental awareness programs in University colleges.

Keywords: Climate change, Youth, DDUC, Perception, Student

IMPACTS OF VARIABILITY IN CLIMATE IN INDIAN CONTEXT

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All-India summer monsoon rainfall is free from any long-term trend although on sub divisional scale there are regions increasing and decreasing trends. All India mean annual maximum temperature shows a significant trend during 1901-2007. However, in the recent decades 1998-2007, the maximum temperature shows stagnation in trend. Mean annual minimum temperature has significantly increased by 0.27degree Celsius per 100 years during the period 1901-2007. Number of heavy rainfall events (those exceeding 99th percentile) are increased almost over the entire landmass. Also the frequency and intensity of extreme events defined as 1-day maximum precipitation shows increasing trend everywhere except some northern parts of the country. Climate change may pose additional stresses on socioeconomic system that already face tremendous pressures from rapid urbanization, industrialization and economic development. By examining these potential stresses and impacts, climate science seeks to predict future trends to help inform policymaking.

Climate science uses scenario development and forecasting to understand the degree of change in climate that could occur, and the different factors that could affect the degree of climate change. e.g. economic and population growth can increase greenhouse gas emission contributing to climate change, while technological advances may reduce these factors. Given projected high growth in India's economy and population combined with the potential consequences of climate change, information about how these factors inter-relate may be useful to guide policy making at the community, regional and national level. There is a great variation in India's climate all over. Some reasons can be explained below 1) Ocean Currents: Some areas of the world have warm ocean currents, and others have cool ocean currents. This is what causes the climates in coastal areas. The southern part of India is surrounded by Arabian Sea, Indian Ocean which gives effect of breeze and humid conditions to the southern part of India. 2) Latitude: The closer a location is to the Equator, the warmer it is. Equator does not pass from India but is very near to the equator Chennai is approximately 1400 km away from equator. Tropic of cancer is the one which passes through India. 3) Angle of Insulation from the Sun: The angle of insulation that comes from the Sun determines how warm an area will be, these changes with the seasons. This also explains why the Poles will have 6 months of complete darkness and 6 months of complete light.

Keywords: Impact, Climate change, Landmass

EFFECT OF CLIMATE CHANGE ON INDIAN MONUMENTS

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Rapid urbanization, industrialization, agriculture activity and development projects have caused number of disastrous consequences. These disasters appear among us sometimes as pollution, sometime acid rain and now Climate change. These changes are disrupting the life supporting systems of earth. Apart from its effect on living beings it is also affecting the landforms structure by accelerating the weathering process. Indian being an oldest civilization in the world has many ancient monuments. This comes under our national heritage and therefore need to protection. We searched online information on impact of climate change on Indian monuments. Climate change badly affects our historical, cultural heritage, which are specially made up of natural stones. There were evidences that rising temperature were affecting structure of famous Indian monuments like *Taj Mahal* (Agra) and *Charminar* (Hyderabad). If concentration of CO_2 will keep on increasing in the atmosphere, it will result in acid rain (carbonic acid) and will deteriorate our monument. Furthermore, increasing temperature is intensifying wind speed which can damage our heritage structures. Thus in near future climate change will affect our monuments to great extent and India's Archaeological Survey of India (ASI) should be prepared to face the above mention problem.

Keywords: Heritage, Monuments, Climate Change, Weathering.

EFFECT OF TEMPORAL VARIABILITY OF RAINFALL ON VECTOR-BORNE DISEASES

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We investigated whether climate change has role in spread of vector-borne diseases. We selected vector borne diseases as their spread is expected to be dependent on variability of rainfall and temperature. We searched online literature on vector-borne diseases whose emergence has increased in recent past. We collected data from published sources like newspapers, reports and research articles. In India, most prevalent vector borne diseases that affected human population was *Malaria*, *Dengue*, and *Chickungnya*. The analyses showed incidences of *Malaria* infection were stable from the year 2004 to 2013. The anti-malaria programme seemed to be successful in controlling the spread of *Malaria* in India. Incidence of "Dengue" had increased in last 10 years. In 2012, incidence of dengue cases increased by >250% and in 2013, it was increased by >150%. However, very weak correlation was found between incidence of *Dengue* cases and rainfall. This suggests there were some other key influencing factors causing higher incidence of Dengue in India. Cases of *Chickungnya* infection were negatively correlated with rainfall (2006-2011). This suggested that with increase in rainfall, the incidence of *Chickungnya* cases decreased. Thus annual rainfall is not the only factor contributing to increase in the incidence of vector-borne diseases. These diseases are affected by other physical factors which need further investigation.

Keywords: Rainfall, vector-borne disease, Dengue, Chickungnya, Malaria

CLIMATE CHANGE IN INDIA AND ITS IMPACT ON HIMALAYAN GLACIERS

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The Himalayas have the largest concentration of glaciers outside the polar region. There is clear evidence that Himalayan glaciers have been melting at an unprecedented rate in recent decades; this trend causes major changes in freshwater flow regimes and is likely to have a dramatic impact on drinking water supplies, biodiversity, hydropower, industry, agriculture and others, with far-reaching implications for the people of the region and the earth's environment. One result of glacial retreat has been an increase in the number and size of glacial lakes forming at the new terminal ends behind the exposed end moraines. this in turn give rise to potential threat of Glacial Lakes Outburst Flood (GLOF).Such floods often cross boundaries.

Climate change can be particularly hard-hitting for developing countries, relying on natural resources for the economy. India is one among these developing countries, with diverse physiographical characteristics. Population is widespread and the capacity of people and the country to cope with climate change impact is low. The country is dominated by the Asian monsoon system. The main occupation is agriculture, based upon various farming practices. Nepal is also one among these countries. In Nepal poverty is widespread and likewise India, the capacity of the people to cope with the climate change is even lower. Nepal has a large hydropower potential. While only 0.75% of the theoretical hydropower potential has been tapped, Nepal can greatly benefit from this natural resource in the future. Climate change can adversely impact upon water resources of India and other sectors of Nepal. The source of water in Nepal is mainly summer monsoon precipitation and the melting of the large reserve of snow and glaciers in the Himalayan highlands. Observations show clear evidences of significant warming. The average trend in the country is 0.06°C per year. The warming rates are progressively higher for high elevation locations. The warming climate has resulted in rapid shrinking of majority of glaciers in Nepal. Formation, growth and likely outburst of glacial lake are phenomena directly related to climate change and deglaciation. For example, recent Kashmir incident. Many people lost their lives due to heavy flood. The main reason behind the occurrence of flood was said to be Glacial Lake Outburst (GLO). The change in climate is likely to affect both minimum and maximum-recorded temperatures as well as triggering more extreme rainfall events and storms.

Keywords: Glacial Lake Outburst, Climate Change, Mitigation

CLIMATE CHANGE: ITS EFFECTS ON HEALTH CONDITIONS

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"Climate change is the Everest of all problems, the thorniest challenge facing human kind" Climate change has already started to transform life on earth. Across the globe, seasons are changing, temperatures are climbing and sea levels are rising. While, the planet is still responsible to supply us and all living things with air, water, food and safe places to live. Thus, any change in the climatic conditions impose question on the very sustenance of living beings and in turn causes alarming threat to 'Health Conditions' across the globe. Weather and climate play a crucial role in people's health. The most direct way in which climate change affects public health is by projecting changes in mortality rates associated with exposure to ambient temperature. Developing nations face a major host of health problems due to climate change, including vector borne and water borne disease such as malaria cholera and dengue. Meteorological factors including temperature, humidity and rainfall patterns influence transmission intensity of various infectious diseases and numerous studies around the world has shown a significant connection between cold weather and respiratory diseases.

India is a large developing country, with the great Himalayas in the north and densely populated coast line in the south. Over half of its population lives in rural areas and are directly dependent on climate sensitive sectors and natural resources for their subsistence and livelihood. Climate change is likely to impact all the natural economic systems as well as socio economic system. Heat wave, floods and droughts are very frequent because of which Malaria, malnutrition and diarrhoea are major health problems. As per IPCC scenarios India is expected to show an annual mean surface temperature rise ranging from 3-5 °C with warming more pronounced in the northern parts of India which in turn increases mortality rates. In 1998 heat waves in Orissa was recorded as one of the worst, claiming more than 2000 lives. Andhra in 2003 experienced a similar story claiming 1421 lives. Scientists predict an increase in frequency of floods due to greater intensity of rainfall and glacier lake outburst floods in Mountain regions. Floods create conducive environments for numerous health consequences resulting from disease transmission. For example if flood water gets contaminated with human or animal waste the rate of faecal-oral disease transmission might increase, allowing diarrhoeal disease and other bacterial and viral illness to flourish. In developing countries like India increase in diarrhoeal disease, cholera, dysentery and typhoid is of immediate concern.

Climate changes are likely to change frequency, lengthen the transmission seasons and modify the geographic range of important vector borne diseases and might lead to the outbreak of several new viruses and other pathogens. Mosquitoes need stagnant water to breed and adults need humid conditions for viability thus spread of such diseases drastically increase in conditions of natural calamities.

Keywords: Climate change, health conditions, Himalayas

EFFECTS OF CLIMATE CHANGE ON PLANTS AND ECOSYSTEMS AND CERTAIN APPROACHES FOR PLANT RESPONSE STUDIES UNDER CLIMATE CHANGE SCENARIO

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Global climate change is a ground reality and a continuous process that needs to be taken seriously. Two main implications of climate change are the rise in atmospheric CO_2 and increase in global mean temperature. It has already affected plant diversity, as demonstrated by changes in species distribution, creation of new assemblage of plants, changes in population structure near to coastal zone and extinction of several endemic plants. A comprehensive knowledge of plant responses are needed against the projected concentration of CO_2, possible at the end of this century. This will be helpful to understand how the plants are currently responding and how they could be adapted in changing scenario. Earlier techniques were based on the controlled environment such as growth chambers, controlled environmental chambers, green houses, phytotrons, open top chambers (OTCs), which are unable to mimic natural environmental conditions, in which plants generally grown. However, facility like Free-Air CO_2 Enrichment **(**FACE) with holistic approach has been developed and is being currently used for plants as well as ecosystem response studies. The data base generated using this facility would be more realistic for impact analysis against rising atmospheric CO_2 on plants along with the mathematical models to predict the possible responses in future climatic conditions. In view of above, present article brings together existing bits of information to create a new direction for future research, identify critical gap in knowledge and presents a new perspective on FACE and its implication in climate change scenario.

Keywords: Carbon dioxide, Climate change, Crop model, Ecosystem, Free Air CO_2 Enrichment, Open top chamber, Photosynthesis

WATER VULNERABILITY AND CLIMATE CHANGE: ASSOCIATION WITH GENDER INEQUALITIES

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Women and water are very closely associated since water is at the core of their traditional household responsibilities. Rural, peri-urban, and slum women and girls spend several hours every day in water accession and management. Provision of safe water is a Practical Gender Need (PGN) of women along with fuel, sanitation and other basic services. Lack of fulfillment of these needs leads to the neglect of Strategic Gender Needs (SGN) pertaining to education and training, access and control over resources and decision-making. While the requirements of water are continuously increasing due to demographic, socio-economic and technological changes, the availability of water faces a serious threat from human induced climate change. Due to decreased availability of water women will be impacted the most, since they spend maximum time at home. It is therefore important to study the association between various parameters of gender development with the availability of water at the household level. The present study was undertaken to assess the vulnerability of women to water and climate related stresses by analyzing the relationships between various indicators of gender development/inequality and climatic and water related stresses. The former were represented by Gender related Development index, Inequality adjusted Human Development Index and indices of status of women with respect to education, health, economic as well as political participation. The water related vulnerability was represented by Water insecurity index (WII), based on a similar Water Poverty Index developed by Sullivan et al., in 2002.

An analysis of the results showed that there was a significant and inverse relationship between different indices of gender and human development with the vulnerability of people to water insecurities. The states with higher values of HDI and GDI were also the ones least vulnerable to water insecurity. Similarly in regions where more females were literate or enrolled in higher levels of education, the enhanced awareness, knowledge and income levels resulted in enhanced adaptive capacity to deal with water insecurity leading to reduction in their vulnerability. Adaptation to climatic and water related stresses in future should therefore include measures that would empower women, improve their status in society in terms of education, health, participation in economic and other activities.

Keywords: Practical gender need , Strategic gender needs, Water insecurity index

PROTEASE ACTIVITY IN PINEAPPLE FRUITS

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The pineapple plant has several uses. Most commonly the plant is grown for its delicious fruits. The leaves are used to extract a durable textile fibre. Bromelain, a mixture of proteases usually extracted from the stem, has health benefits and finds use in folk medicine, and as a meat tenderizer. The present study was carried out to understand protease activity in pineapple fruits using gelatine (1%) as the substrate. An aqueous extract of the ripe fruit or cylinders of uniform size bored out from the ripe fruit was used as the crude protease. The biuret test was conducted to study the extent of protein (gelatine) degradation by observing the intensity of violet colour that developed visually or colorimetrically at wavelength 590 nm. The progression of protease action on gelatine was studied by two methods, firstly by the biuret test and secondly by the conductivity probe, in separate experiments. The effects of enzyme (E) and substrate (S) concentration on protease activity were also studied using the biuret test.

The results showed that the pineapple fruit is rich in protease activity. Interestingly, the protease activity was retained to a great extent on boiling the fruit juice. Also, the fruit juice lacks proteins. The absorbance of the pineapple fruit juice + gelatine (E+S) mixture containing biuret reagent decreased gradually from 0 min to 40 min, reflecting the progression of degradation of gelatine. The conductivity of the E+S mixture increased gradually up to 50 min from incubation. As the digestion of gelatine proceeds, peptides and amino acids form and contribute to the increase in conductivity of the E+S mixture. When the concentration of the enzyme was increased by increasing the number of pineapple fruit cylinders keeping the substrate concentration constant, there was a concomitant decrease in the absorbance of the E+S mixture. This was because of the fact that as the enzyme concentration increased, more was the substrate degradation and less the intensity of violet colour on adding biuret reagent, resulting in a decrease in the absorbance. When the substrate concentration was increased keeping the enzyme concentration constant, there was a corresponding increase in the absorbance of the E+S mixture. With increase in gelatine concentration, there was an increase in the absorbance. The increased concentrations of gelatine and oligopeptides formed as a result of protease action on gelatine contribute to the increase in the absorbance.

The pineapple plant grows in tropical and near tropical regions, and India is a major producer of the fruit. The plant is hardy and adapted to grow in a fairly wide range of temperatures. It is suggested that pineapple, a multipurpose crop, could replace the traditionally cultivated crops in areas where climate change has an impact. Estimating the protease activity would also be an easy and quick method to determine the effect of changes in climatic conditions on the pineapple crop.

Keywords. Pineapple fruit, protease, biuret test, colorimeter, conductivity probe, climate change

ASSESSMENT OF BIODIVERSITY AND CONSERVATION PERSPECTIVE IN TROPICAL DRY DECIDUOUS FOREST OF KUMBHALGARH WILDLIFE SANCTUARY, RAJASTHAN

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Present study was carried out with the aim to assess biodiversity and its conservation in Kumbhalgarh Wild Life Sanctuary located in the northern part of Udaipur. This area was selected for study as it is an Ecotone between two different ecosystems of hilly forests of Aravallis and Thar Desert. With *Tectona grandis* (teak) forming western most limits, the wild life is home for many threatened and rare flora and fauna. Along with this, it is comparatively less disturbed that ensures better setting for the biodiversity surviving in it. The biodiversity of the sanctuary includes 309 plants species, 17 fish, 7 amphibian, 19 reptile, 126 birds and 22 mammal species. The forest in the study area is Tropical Dry Deciduous forests, further classified as tropical dry deciduous forest and tropical dry mixed deciduous forest. The vegetation type was mapped and all the available secondary information was compiled along with inventory of the floral (higher plants) diversity. Vegetation is broadly dry deciduous with some deciduous forest patches. The vegetation analysis was made at 3 representative sites from each area selected for the study. A total of 45 species were recorded in tree group in the study. Species diversity, richness and evenness were found to be highest in site 1. The highest tree density, at site 1, was recorded for *Aegle marmelos* (41.38 tree/ha) and *Bombaz Ceiba* had lowest (1.50 tree/ha). At site 2, *Boswellia serrata* (43.49 tree/ha) showed the highest density and *khogriya* exhibited the lowest (1.41 tree/ha) whereas the same was highest for *Anogeissus pendula* (48.10 tree/ha) and lowest for Wrightia *tinctoria* (1.26 tree/ha) at site 3. Forty plant species were found to have great potentiality both from the economic and medicinal point of view. Four plant species namely *Ceropegia bulbosa*, *Ceropegia tuberose*, *Corallocarpus epigaeus* and *Citrullus colocynthis* were found to have vulnerable biological status. The critical threats were identified as over-grazing by livestock, cutting for fuel wood, lopping for fodder, fire, spread of invasive species and weeds, small timber and other MFP, encroachments in the buffer zones and presence of road. Conservation actions need to be taken up as part of management so as to reduce the existing high levels of disturbances. The present study reveals that wild plants of the Aravalli hills are facing severe future threat due to overexploitation and uncontrolled harvesting. Because of their medicinal importance endemic flora are receiving ever-increasing attention from the scientific community and commercial enterprises also.

Keywords: Biodiversity, Deciduous forest, Conservation, Vulnerable biological status.

Comparative Study on Effects of Heavy Metals/Metalloids Present in Fly Ash from Coal Fired Thermal Power Plant on Photosynthetic Parameters of *Ficus bengalensis* and *Plumeria rubra*

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In the present work heavy metals/metalloids present in the fly ash emitted from a coal fired thermal power plant were estimated. The effects of heavy metals/metalloids present in the ash on various photosynthetic parameters (fluorescence, Fv/Fm, fluorescence quenching coefficients, relative electron transport rate, photosynthetic active radiation, ETR-Factor absorptance of photons by photosynthetic pigments etc.) were estimated using JUNIOR-PAM, Chlorophyll Fluorometer, Heinz Walz GmbH, Germany. Heavy metals/metalloids were estimated using atomic absorption spectrophotometer (AAS, 7000 Shimadzu) for Fe, Zn, Pb, Cd, Mo, Cu, Cr, Co and Ni and the standard solution was prepared using standard metal solution of Inorganic Ventures. The observed value of Fv/Fm (indication of the maximum and effective photochemical quantum yield of PS II) for *Ficus bengalensis* and *Plumeria rubra* were 0.775 and 0.689 respectively. The heavy metals/metalloids present in the fly have negative effects on *Plumeria rubra* as compared to *Ficus bengalensis* because for a healthy plant Fv/Fm should not be less than 0.75. Similarly other parameters were also adversely affected by the presence of heavy metals/metalloids present in the fly ash that were deposited on the plants leaves. The reduction in yield of PS II will ultimately lead to overall reduction in the plant productivity and ultimately ecosystem productivity. Therefore, the issue of fly ash emitted from thermal power plants need to be addressed in a proper way

Keywords: Heavy metals; Fluorescence; ETR-Factor; Fv/Fm.

PATTERN OF LITTERFALL AND NUTRIENT RETURN IN SEMI-ARID FOREST OF ARRAVALLI REGION OF DELHI

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Litterfall and nutrient return pattern in semi-arid forest ecosystem of Arravali region was estimated in six sites with varying density and basal area for two consecutive two years. Litter production for six tree species Prosopis *juliflora, Azdirachta indica, Leucaenca leucopcephala, Acacia leucophloea* , *Cassia fistula* and *Pongammia pinnata* was estimated. Total annual average Litter fall was found to be positively correlated tree density and basal area. Values of r and R^2 give Pearson correlation and linear regression was (r=0.90 R^2=0.90, r=0.84 R^2=0.91) respectively for basal area and tree density. Average annual litterfall among all the study sites ranged from 7.55 Mg ha^{-1} y^{-1}(Site 2) to 12.71 Mg ha^{-1}(site 6). Total annual litterfall in two consecutive years was higher in first year as compared to second year. Significant difference in total litter production was found among sites, months and species (p>0). Percentage contribution of different species varied in different sites. *P. juliflora* showed maximum mean monthly litterfall in all the sites expect site 2 where *A. indica* showed maximum litterfall. All the species showed major part of litterfall in dry and warm season and most of peaks are observed between Octobers to March. Leaf litterfall constituted maximum percentage of litterfall and showed a clear pattern of litterfall, wood fall showed no clear seasonal pattern. Reproductive litterfall showed a clear seasonal variation depending on timing of flowering and fruiting of particular species. Variation in concentration of N, P and K among all the litter types was found in the order of N>K>P, however concentration of nutrient was found to be highest in reproductive litter followed by leaf litter and least in wood litter. Amount of nutrient return via litterfall was found to be proportional to amount of dry matter added to the litter of various species and hence the amount of nutrient return was found to be highest through leaf litterfall. Difference in litterfall in each site is governed by species composition as well as by percentage contribution of basal area of dominant species, since Prosopis *juliflora*, is the dominant as well as invasive species in the study area and with different degree of invasion; *Prosopis juliflora* therefore has greater influences total litter production in all the sites.

Keywords: Litterfall, Litter decomposition, *Prosopis juliflora*, Semi-arid, Forest ecosystem.

DOES VARIABILITY IN *LANTANA CAMARA* L. (*SENSU LATO)* BEHOLD IMMENSE INVASION POTENTIAL IN FUTURE CLIMATE CHANGE SCENARIOS?

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Lantana camara L. (*sensu lato*) is considered among the world's worst invaders. The extent and impact of the *Lantana camara* invasion on ecosystem structure and function is well-recognized. However, the efforts to control the invader have met with limited success. We assert that this might be due to lack of knowledge pertaining to composition of the species complex, *L. camara* L. (*sensu lato*). Endless episodes of horticultural improvement within the genus and on-going hybridization events in the wild tend to increase the complexity. Importantly, the species complex is highly variable to be simply resolved and managed this makes it extremely difficult to infer what facilitates complex constituents' success as invaders.

Key researches indicate that ever-expanding adaptive fitness of the complex constituents to heterogeneous environmental conditions owing to increasing diversity may significantly increase their invasion potential. High diversity in the complex may potentially broaden complex constituents' ecological tolerance in climatically suitable as well as unsuitable areas, thereby increasing their likelihood of successful establishment and performance in spite of local selective pressures. Moreover, realizing the remarkable spread and augmented performance of the invasive genets in warmer areas, it is highly probable that invasive *Lantana* will increase its expanse remarkably in future climate change scenarios. This paper seeks to highlight the need for clear terminology to examine all possible weedy, naturalized and/or invasive complex constituents and understand how different complex constituents evade the challenges of altered environmental regimes, focusing particularly on elevating temperatures. Appraising the genetic diversity in the complex, we do caution that it would be extremely challenging to check invader's future spread risks. We highlight the need to collaboratively focus on disentangling the complex and integrate the knowledge into management and control programs so as to delimit constantly expanding invasion potential of the complex constituents in future climate change scenarios.

Keywords: Control, Diversity, Genetics, Invasive, Species complex

INTERPLAY OF CLIMATE CHANGE AND NUTRITION INSECURITY

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Under nutrition still remains one of the world's most serious but least addressed socioeconomic and health problems. The number of people suffering from hunger stood at 925 million in 2010 and maternal and child under nutrition remain persistent. Statistics reveal that in developing countries nearly one-third of children are underweight or stunted. Under nutrition, including micronutrient deficiencies (also referred to as "hidden hunger") is caused by inadequate dietary intake and disease which in turn stem from food insecurity, poor maternal and child care practices and inadequate access to clean drinking water and safe food, sanitation and quality health services. The human and socioeconomic costs of under nutrition are enormous, falling hardest on the poorest, especially on women and children. The resulting impacts in terms of lost national productivity and economic growth are gigantic, and the recent food and economic crises and economic downturn have magnified the challenge of hunger and under nutrition. It is predicted that during this century the average surface temperature of the earth in likely to exceed the safe threshold of a 2ºC rise above preindustrial average temperature, this in turn will result in changes in rainfall patterns and increased frequency of extreme weather conditions- both flooding and drought causing further stress to the already food insecure populations living in developing countries. Droughts and water scarcity diminish dietary diversity and reduce overall food consumption and this may lead to malnutrition. The risk of flooding may increase, from both sea-level rise and increased heavy precipitation in coastal areas. This is likely to result in an increase in the number of people exposed to diarrhoeal and other infectious diseases, thus lowering their capacity to utilise food effectively. Deforestation, agriculture and livestock production systems further accelerate climate change. Mitigation is critical to limit impact of climate change on food security and nutrition in developing countries in the future. Sustainable and appropriate solutions need to be urgently explored, tested and implemented for climate change mitigation strategies that do not harm food and nutrition security. Some evidence-based direct interventions to prevent and treat under nutrition include: Promotion of good nutrition and hygiene practices, such as breastfeeding, complementary feeding for infants above six months of age, improved hygiene practices including hand washing and deworming programs; Micronutrient supplementation for young children and their mothers (e.g. periodic Vitamin A supplements and therapeutic zinc supplements for diarrhoea management); Provision of micronutrients through food fortification for all (e.g. salt iodization; iron fortification, etc.); Therapeutic feeding for malnourished children with special foods, including the prevention or treatment for moderate under nutrition and the treatment of severe under nutrition ("severe acute malnutrition") with ready-to-use therapeutic foods (RUTF); nutrition education and promotion of homestead gardening.
Keywords: Climate change, under nutrition, maternal & child deaths, dietary diversity, mitigation, evidence based direct interventions.

CLIMATE CHANGE: A THREAT TO BIODIVERSITY

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India is endowed with rich flora and fauna and thus ranked among twelve mega biodiversity countries of the world. The country harbors many economically important plants that are endemic to it or serves as keystone species in the ecosystem. Plant phenology, flower production, seed set, plant-pollination interactions have been largely controlled by a wide range of ecological factors such as temperature, light, wind, humidity and diverse habitat. Increasing anthropogenic activities (deforestation, habitat fragmentation, and industrialization, overexploitation of economic species and introduction of exotic plants) have threatened such ecological interactions leading to loss of biodiversity. Nevertheless, rise in temperature and CO_2 concentration have greatly influenced the mutualistic ecological interaction between plants and pollinators; as more than 80% of plants depend on animals for pollination services. Such alterations affected not only the symbiotic association but also the adaptive co-evolution of both the organisms thereby influencing community structure, composition and functioning of the ecosystem.

Elevated temperature affects physiology of flowers in terms of flower number and size, pollen development and anthesis, floral scent and nectaries formation. The manipulated floral phenology forced pollinators to adapt themselves towards the changing environment. Similar to flowering plants, pollinators too are susceptible to diverse global changes. They have been affected in a number of ways such as foraging activity, body size, maturation period and life span. However, both the symbiotic partners endeavor hard for their respective growth and reproductive success, but climate change has proved to be an emerging challenge for their survival generation after generation. As a consequence of such physiological changes in flowering plants and their respective pollinators the biodiversity is greatly threatened.

Many authors have addressed the effect of climate change in terms of alterations in plant height, leaf formation, chlorophyll concentration, secondary metabolite concentration and overall plant growth rate. But the information is scarce regarding the physiological responses affecting plant-pollinator interactions. The review summarizes all the possible effects of rise in temperature on flowering plants, their beneficial counterparts (pollinators) and its effect on plant-pollinator association. It will shed light on possible consequences for future generations of flowering plants and pollinators. The work will advance the knowledge on the strategies to be followed by ecological partners towards the changing environment and mechanisms necessitated for the conservation of both plants and pollinators. It is also suggested that the future research should lay emphasis on standardizing the methods for conservation and restoration of threatened and vulnerable plants on priority. The conservation phenomenon should receive urgent attention for reproductive success and regeneration potential of the species for sustainable development.

Keywords: Biodiversity, Industrialization, Climate change

CLIMATE CHANGE: A THREAT TO SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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One of the potential threats to agriculture is the impact of climate change in attaining sustainable development of agriculture coupled with food security. Climate change phenomenon is now a global reality. India is one of the most vulnerable countries to climate change that is affecting agricultural production. Forecasts are made by the Indian Council of Agricultural Research using crop simulation models incorporating future projections. Climate change is projected to reduce timely sown irrigated wheat production by about 6% by 2020. In the case of late sown wheat, the projected levels are alarmingly high, to the extent of 18%. Similarly, a 4% fall in the yield of irrigated rice crop and a 6% fall in rain-fed rice are foreseen by 2020 due to climate changes. The warming trend in India over the past 100 years is estimated at 0.60°C. The projected impacts are likely to further aggravate yield fluctuations of many crops with impact on food security. It requires a serious attention on adaptation and mitigation strategies to overcome the problems of climate change. Beside this, sustainable food security is further affected by persistent land degradation, land fragmentation, labor problem, overexploitation of natural resources, etc. Hence, there is need to focus on sustainable production systems by strengthening the ecological foundations. This requires a holistic approach by considering technological, biophysical, socio-economic, political and environmental factors. Food security and environmental sustainability can be attained by improved land and water management, adopting eco-friendly technologies and initiating good agricultural practices in different agro-ecosystems. Further, strategic research and technology in agriculture and adoption of sustainable practices are necessary to meet current and future threats to food security. Ensuring sustainable food security is an important challenge for our nation as well as elsewhere in the world. There is a great need to work towards a specific national policy to reach the goal of sustainable agriculture and food security.

Keywords: Climate change, Sustainable agriculture, Food security, Agricultural production

CLIMATE CHANGE: A THREAT TO AGRICULTURE IN INDIA

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The heat of climate change has been felt globally touching every sphere of life. Agriculture sector also had to bear the brunt of this change which is manifold. Nearly 18% GDP of the Indian economy is generated by agriculture alone and any threat to its productivity can have dwindling effect on the food security and eventually to the country's economy. Besides the direct impact on the crop yield, its effect on the pest population, their distribution, behaviour, etc. has indirectly resulted in decline in crop productivity. Fluctuations in agricultural productivity owing to these factors affect the food security. Food security has become a prime concern more so in developing nations like India owing to lack of resources to mitigate the adverse effect of climate change on agriculture; and greater (~50%) dependence of the population on agriculture for livelihood. This paper examines some of the threats associated with the increasing global temperature on the agriculture sector and some mitigation strategies by different stakeholders in India.

Keywords: Climate Change, Agriculture productivity, Food security

CLIMATE CHANGE AND PLANT BIODIVERSITY LOSS

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World's climate is changing fast, which is evidenced by few warmest years recorded in the last 100 years. Year 2014 is alarming as the warmest year on record. This is caused by continued rise in occurrence of extreme weather phenomena and higher unpredictability in stabilized climate patterns. Worldwide changes have been noticed in living conditions for plants, due to climate change. With major regional differences, worldwide relatively warmer climatic conditions may promote habitat space for an increased number of species. But from long term sustainability point of view, this is not going to be an advantage. The redistribution of plant species over a relatively short period of time will intensify uniformity across regions in the composition of species at the cost of unique species, which have adapted to special habitat conditions over long evolutionary periods. Specific studies on quantification of its impact on global plant diversity and subsequent interrelationship have scarcely been begun. A big unknown is the degree to which the biodiversity of any given region will adapt to new conditions. We know too little as to whether favoured regions will see additional species migration or there would be mass loss of species in disadvantaged areas. This will alter the stability and diversity of ecological systems, reducing functional attributes such as invasion resistance and taking away the buffering effects of high species diversity. This combination of fast environmental change and diversity loss also carries the risk of abrupt and potentially irreversible ecosystem collapse - a precursor to mass extinctions of the past. Recent data and studies have established the link between diversity loss and changes in processes, important to the productivity and sustainability of Earth's ecosystems. A reduction (5 - 10 %) in plant production in an area has been observed with the intermediate levels of species loss (21 - 40%). Further, the identification of lost species added extreme variability in consequences and impact of local sub area species loss was as significant as the effect of larger climatic changes.
Therefore, there is an urgent need of global cooperation, reflecting the consensus that addressing the challenge of climate change as an integral part of achieving sustainable development to create a better world for all our people. There should be actions with the principles of equity and common but differentiated responsibilities.

Keywords: Stabilized climate patterns; Sustainability; Habitat; Biodiversity; Ecological systems; Mass extinction

FOOD SECURITY: AN INFOMETRIC ANALYSIS IN LAST 25 YEARS

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In this paper, we have tried to identify upcoming trends in the field of *food security* with the help of bibliometrics, knowledge systems and data mining for the last 25 years (1989-2014). The corpus was defined by building logical conclusions and observations and user-directed expert elicitation from the said field which was combined with appropriate boolean logic and queries emphasizing research groups, research lines, and institutions. All this was examined statistically accompanied by tabulation and network mapping. This was done with efficient tools to perform automatic textual analysis. According to our findings, publishing in this field increased linearly over these two decades and this trend appears to continue. In terms of subject area, most papers are published under the agricultural and biological Sciences followed by social sciences. We have also tried to analyze the factors leading to erosion of food security in India due to climate change. Disasters like floods, cyclones and droughts and freak weather patterns affect agricultural output and food security. They have been discussed.

Keywords: Food security, Data mining, Agriculture output

FOOD SECURITY UNDER CLIMATE CHANGE

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Food security as a ‘‘situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life’ Food security is determined by the options, people have to secure access to own agricultural production and exchange opportunities. These opportunities are influenced by access to water. Climate change induced crop yield change affects food production of countries to varying degrees, depending on the location of the farming activities. Climate change will act as a multiplier of existing threat to food security; it will make natural disasters more frequent and intense, land and water more scarce and difficult to access and increase in productivity even harder to achieve. More extreme weather events will have serious impacts on livelihood assets in both rural and urban areas and threaten the stability of food supply. Many countries are already dealing with the climate change impacts resulting from irregular, unpredictable rainfall pattern, increased incidence of storms and prolonged drought.

Climate change will affect all four dimensions of food security: Availability, Accessibility, Stability and Utilization. It will reduce food availability because it negatively affects the basic elements of food production- soil, water and biodiversity. Rural communities face increased risks including recurrent crop failure, loss of livestock and reduced availability of fisheries and forest products. Developed countries are mostly located in higher latitudes and climate change benefits the crop yield of these areas. In contrast, developing countries of the lower latitudes suffer from the reduction in crop yield being induced by climate change. Changing temperature and weather patterns furthermore create conditions for the emergence of new pests and diseases and affect animals, trees and crops. This has direst effects on the quality and quantity of yield as well as the availability and price of food, feed and fibre. Decreasing availability of water and food will also increase sanitation and health problems and increase the risk of disease and malnutrition. Climate change and increased water demand for agriculture in future decades is anticipated to be an added challenge to trans boundary framework agreements, increasing the potential for conflict Paper will highlight the major issues related with the climatic changes and its impact on the agriculture, fishery and diversity of crop species.

Keywords: Food security, Climate change, Biodiversity, Rainfall

Cu STRESS AMELIORATION BY SEED PRE-SOAKING TREATMENT OF 24-EPIBRASSINOLIDE IN *BRASSICA JUNCEA* L. PLANTS

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Heavy metal contamination has sharply increased since last few years and it poses a major environmental threat. Accumulation of heavy metals in high concentrations in plant tissues leads to alteration in a variety of physiological processes like biosynthesis of chlorophyll, cell membrane integrity, transpiration, photosynthesis and photosynthetic electron transport. Among various heavy metals, copper (Cu) is one of the essential metals for normal cell metabolism but in higher concentration it causes chlorosis in leaves, growth retardation, generation of reactive oxygen species, oxidative stress and disturbs metabolism of plants and also causes damage to macromolecules. Brassinosteroids (BRs) are steroidal phytohormones having involvement in various growth and developmental processes of plants. They also play significant role in protecting plants against various environmental stress conditions such as chilling stress, heat stress, salinity, drought stress and heavy metal stress etc. Keeping in view, the present work was designed to study the stress ameliorative role of different concentrations of 24-Epibrassinolide (0, 10^{-11}, 10^{-9} and 10^{-7} M) in 90-days old *Brassica juncea* L. plants grown in Cu containing soil (0, 0.25, 0.50 and 0.75 mM). Changes in various plant parameters such as shoot and root lengths, total sugars, phospholipids, plant growth regulators like indole acetic acid (IAA) and abscisic acid (ABA) and polyphenols were studied. It was observed that Cu stress inhibited the shoot and root lengths, phospholipids and IAA contents, whereas, the total sugars, ABA and polyphenols contents were elevated. The pre-soaking treatment of 24-EpiBR to the plants improved all these parameters.

Keywords: 24-Epibrassinolide, Copper, Sugars, Phospholipids, Plant growth regulators, Polyphenols.

EXPLORATION THE ROLE OF TWO ANALOG FORMS OF BRASSINOSTEROIDS (24-epiBL AND 28-homoBL) ON TWO VARIETIES OF *BRASSICA OLERACEA* L. VAR. BOTRYTIS AND ITALICA UNDER HIGH TEMPERATURE STRESS

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Transitory and constantly extreme temperature fluctuations due to climate change cause an array of morphological, physiological and biochemical changes in plants affecting metabolic activity, growth and photosynthesis. Applications of brassinosteroids helps the plants to overcome stresses, the present investigation has been undertaken to explore the role exogenous applications of 24-epibrassinolide (24-epiBL) and 28-homobrassinolide (28-homoBL) on the photosynthetic pigments, carbohydrate and protein content under the influence of temperature stress in *Brassica oleracea* var. botrytis and var. italica. Priming seeds treatments with various micro molar concentrations of 24-epiBL and 28-homoBL (1µM and1ŋM) were studied. It was observed that 24-epiBL and 28-homoBL treatments enhanced the protein content at 35^0C in nano-molar concentrations of both analogs of BRs. Analogs of Brassinosteroids help in remodulating the thermotolerance by ameliorating the photosynthetic pigments, Chlorophyll a, Chlorophyll b and carotenoids which otherwise showed inhibition in its level with variation of temperature from the optimum 25 ^{0}C, 24-epiBL was significant in mitigating or accumulation of carbohydrates, reducing sugars and non-reducing sugars at nano molar concentrations of BRs. The present study culminates the role of brassinosteroids for protection of the plants from existing stresses there by exhibiting anti-stress property in *Brassica oleracea* var. botrytis and var. italica.

Keywords: Temperature stress, 24-epiBL, 28-homoBL, *Brassica* oleracea var. botrytis, var. italic, Proteins, Carbohydrates.

HEAVY METAL SPECIATION OF FLY ASH LEACHATE AND ITS GENOTOXICITY ASSESSMENT USING TRAD-MCN BIOASSAY

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The present study was conducted for estimating the heavy metal contents of the fly ash leachate. The leachate is coming from the fly ash which are being produced in huge quantity from coal fired thermal power plants and later deposited in dykes. At the same time the genotoxicity test of the leachate was performed. The heavy metals were measured with the help of atomic absorption spectrophotometer. The *Tradescantia* micronucleus bioassay test (Trad-MCN bioassay) was used for assessing the genotoxicity of fly ash leachate. The leachate was contaminated by different heavy metals and the *Tradescantia* plants that were treated with leachate showed the formation of micronuclei. The study confirmed that fly ash can be genotoxic in nature and therefore the groundwater may be contaminated from the fly ash leachate.

Keywords: Genotoxicity, Heavy metals, Micronuclei, Fly ash leachate

IMPACT OF CLIMATE CHANGE AND SPATIAL VARIABILITY IN LEAF TRAITS AND REPRODUCTIVE ATTRIBUTES OF AN INVASIVE SPECIES, *LANTANA CAMARA* L.

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Lantana camara, a dreadful invasive species across the world is invading all over India. A large number of reproductive and vegetative attributes are responsible for its invasiveness. In the present work climate change and spatial variations in specific leaf area, photosynthetic rate, stomatal conductance, water use efficiency, chlorophyll content, leaf water content, soil respiration, litter mass loss and reproductive attributes were studied on three different sites of a dry tropical environment. Specific leaf area, photosynthetic rate, stomatal conductance, chlorophyll content, leaf water conductance, soil respiration, litter mass loss, fruit weight, flower weight and fruit set increased with increasing soil moisture. However, we found no significant relationship between SLA and seed mass as predicted by other authors. It may be concluded that soil moisture plays an important role in the establishment of *Lantana camara* in the dry deciduous forest. These findings may provide the basis for further research and expected invasion areas for *Lantana camara*.

Keywords: *Lantana camara*, climate change, moisture, Specific leaf area (SLA), photosynthetic rate, Soil respiration (R_s), Leaf water content (LWC), Dry deciduous forests.

IMPACT OF GLOBAL CLIMATE CHANGE ON AGRICULTURE AND FOOD SECURITY

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Despite of technological advances, such as improved varieties and genetically modified crops, weather is one of the key factors in agricultural productivity. The international aspect of trade and security in terms of food implies the need to consider the effects of climate change on global scale. Climate change affects human life in a number of ways, including changes in agriculture land cover, average temperature, biogeochemical cycle, snowfall, rainfall and glaciers. Climate change is not only reducing the crop production, quality of crops and availability of water but also affecting the huge economy of the countries. Worldwide, 66.5 million people were affected by weather-related disasters every year between 1990 and 2000. Due to climate change, Central and South Asia could loss more than 30% of its main crops. In 2013, CO_2 emission accounted to 36 billion tonnes in atmosphere with 70 % caused by burning fossil fuels and 30 % from deforestation. The major contributors to fossil fuel emissions are China 27, The United States 14, the European 10 and India 6 %. The world Resources Institute and Intergovernmental Panel on Climate Change (IPCC) reported that emissions of greenhouse gases viz, carbon dioxide, methane, nitrous oxide, fluorocarbon and sulfur hexafluoride, ozone depletion and deforestation, playing important role in global climate variability. In the long run, the climatic change could affect crops such as wheat, maize and apple. Himalayan mountain crops are seriously challenge by climate change and apple is one of the most important commercial crops of the Himalayan region, whose production reduced by 77%. Some of those important locations are Kullu, Sirmaur, Shimla and Chamoli. The National Network Project of ICAR suggests that, these ongoing climate changes are thought to be the main reason for the current decline in apple production in Himachal Pradesh. Observations of climate changes giving warning to us; so in future we need to find new approaches to deal with different aspects of global warming, conservation of natural resource, enhance forest cover, replenish groundwater, use of renewable energy, retreat of glaciers and crop production.

Keywords: Food Security, Climate Change CO_2 , Himalayan mountain

TEMPERATURE *TRITICUM* TRAGEDY

IMPACT OF RISING TEMPERATURE ON WHEAT PRODUCTIVITY UNDER CLIMATE CHANGE

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Rising temperature in current scenario can be directly influenced with climate change, which is ultimately affecting the food security. Changing climatic are also providing suitable environment for the growth of various plant pathogen. Rust disease on wheat which is caused by *Puccinia spp.* There are many types of rust such as yellow rust, black rust, red rust and white rust which are caused by different species of *Puccinia* and affecting various parts of plants like leaf, stem and stripe. The favorable condition for the growth of the rust is temperature ranges between 10-30 degree Celsius and humid condition. Long distance spread of urediniospore is influenced by latitude, wind patterns, hot days and dry canopy. Thus we know that wheat is grown in winter season but due to early or pre heating this disease is increasing. Loss in grain yield primarily attributed to reduced floral set and grain shriveling and causing crop loss .black rust and yellow rust is most dangerous as it is causing around 50% to 100% crop loss under favorable condition. Desiccation or infection by other fungi and bacteria also can occur. As pustules break through the epidermal tissue, it becomes difficult for the plant to control transpiration, so its metabolism becomes less efficient. Now- a- days India is more vulnerable to yellow rust .ultimately it is affecting the food security of not only India but world also as wheat is second most important crop used all over the world. Thus looking into scenario there is an urgent need to control this disease and the most frequent used method is the use of fungicide. It is very toxic to aquatic organism and its continuous use pose a threat to vulnerable aquatic life and drinking water. It is also found in food in excess and this affect quality of our food and food safety concern. This rapid use of fungicide has affected our flora, fauna and mammals too. Complete removal of alternate host. Identification of new sources of durable, adult-plant resistance (APR) genes and tightly linked molecular markers will involve International Maize and Wheat Improvement Center (CIMMYT) and Australian scientists in the Australian Cereal Rust Control Program. Rust initiative is also an organization which is doing work over this problem. So we have seen that due to us climate is increasing which is affecting our crop and again we are using fungicides which is affecting our natural resource and ultimately to us. So we need to move toward advancer method by preventing our crop and environment both. Thus, paper concludes that we need to adapt effective management strategies to deal with this evolving plant pathogen to ensure food security and sustainable development.

Keywords: Adult-plant resistance, Urediniospore, Desiccation, Rust

EFFECT OF CLIMATE CHANGE ON PLANT AND ANIMAL SPECIES

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In present scenario, climate change is a global problem. It is affecting almost each and every aspect to which we are aware of. It not only affects the living condition of biological organism but also the breeding nature of them. A lot of efforts are being made to prevent or to decrease the adverse effects of the changing climatic condition. The emphasis has been given to the habitat of the organisms, which is the main aspect of their life. In INDIA, there are many species which have been adversely affected by the changing climatic conditions. Many species have become endangered and some are on the verge of extinction. This is mainly due to the habitat loss and habitat fragmentation which is at such an alarming speed that organisms are not able to adapt it. Many species have to migrate to different habitats for survival. The increasing temperatures are adversely affecting the breeding pattern of organisms. Some of the endangered species of plants and animals are *Panthera tigris, Mangifera, Malus, Rastrelliger, etc.*

Keywords: Climate Change, Animal species, Plant species

CLIMATE CHANGE: NATURAL RESOURCES AND FOOD SECURITY

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Water and food security are the key challenges under climate change as both are highly vulnerable to continuously changing climate patterns. There is an increase in the average global temperature and substantial reduction in fresh water resources and agricultural yield by the end of 21st century. The Himalayan glaciers are on retreat and will disappear by 2035. The drop in rainfall could lead to reduction in drainage. Majority of fresh water resources has already been depleted and there is reduction in agricultural production globally with escalation in population and food demand. Some of the prominent climate change impacts are growing deserts and increase in magnitude of floods and droughts. An extreme decline in crop yields in arid and semi-arid area globally has caused food shortages and a manifold increase in food inflation. This abstract presents easy and economically feasible options to ensure water and food security under climate change and recommend formation of effective adaptation and mitigation policies and strategies to minimizing the impact of climate change on water resources and irrigation.

Keywords: Water and food security, Natural resource, Floods and drought

BIODIVERSITY HOT SPOTS OF DELHI REGION

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Biodiversity plays a critical role in climate regulation. It is essential to counter and mitigate the impacts of climate change. India holds a special position in the world in terms of biodiversity and is amongst 12 mega biodiverse country. Indian forest possesses rich diversity of life forms, however country's forest cover is low and of poor quality especially in tropical deciduous forest. The forest cover in Delhi region is scattered and covering a small percentage of area. These remaining forest cover provides a refuge for native plants and animal species, thus they are relatively biodiversity rich sites. We surveyed sites that were remaining patches of forest cover of Delhi i.e. in Delhi Ridge. We reviewed online literature and supported it by bird surveys carried out in these sites in October, 2014. We used point count method to count bird species. During the surveys, we recorded a total of 43 bird species. The most abundant birds were Jungle babbler *Turdoides striata*, Rose ringed parakeet *Psittacula krameri*, Red vented bulbul *Pycnonotus cafer*, and Eurasian collared dove *Streptopelia decaocto* and House crow *Corvus splendens*. The bird community in Delhi Ridge included Brown headed barbet *Megalaima zeylanica*, Purple sunbird *Cinnyris asiaticus*, Crimson headed barbet *Megalaima haemacephala*, Scaly breasted munia *Lonchura punctulata*, Grey francolin *Francolinus pondicerianus*, Indian peafowl *Pavo cristatus* in Delhi Ridge which suggested it a tropical semi-arid forest while in Yamuna Biodiversity Park the bird community were largely of wetland type and included Oriental Darter *Anhinga melanogaster*, Little cormorant *Microcarbo niger*, Painted stork *Mycteria leucocephala* and Indian pond heron *Ardeola grayii*. There are some other sites having rich diversity of birds in Delhi Region that include Najafgarh Jheel, Okhla Bird Sanctuary and Aravalli Biodiversity Park etc. These sites not only harbour large variety of birds but also recharge Delhi's groundwater resources. Thus, in era of climate change they will provide resilience to Delhi and will secure us and our future generations.

Keywords: Biodiversity, Delhi Ridge, Birds, Climate Change

ON THE VERGE OF EXTINCTION, *SWERTIYA CHIRAYITA* (ROXB. EX FLEMING) H. KARST., A GENTIAN SPECIES OF HIMALAYAS.

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Owing to its unique geographical set-up topography and undulant landscape, the climatic conditions varies in Himalayas along an altitudinal gradient which attributes to diversified ecological habitat ranging from tropical forest, grassland to alpine meadow with vast and diverse natural resources. Himalayan rich biodiversity harbours some of the most important endangered and rare medicinal plants. Unfortunately some of our unique natural resources are highly exploited for various purpose particularly those which are of high commercial values. Amongst them is *Swertia chirayita*, one of the most valuable plants which is vanishing due to various reasons. *Swertia chirayita*, is an indigenous gentian species of Himalayan region distributed from Kashmir to Bhutan at an altitude of 1200-1300 and also in Khasi hills and Western Ghats at 1200-1500m. The plant has been exploited tremendously for drug and pharmaceutical purposes. It is used as antipyretic, hypoglycemic, antiperiodic, antifungal and hepatoprotective agent. Apart from natural way of extinction, the species has declined in wild due to human activities resulting in the few populations of this species in the Himalayan tract. Research has shown that only few pockets or individuals of *S. chirayita* are now remaining in these areas under diverse climatic conditions. In fact, these patches are also decreasing rapidly due to invasion by several biotic and abiotic factors. Cause of its degradation has been attributed to overexploitation, fragmentation, habitat destruction, low regeneration in the natural habitats, climatic variations etc. Environmental degradation or clearing of forest for different developmental purposes is also one of the major factors adding to its declination. For example, construction of roads and canals in many natural habitats has been responsible for the major loss of biodiversity. Collection of these plant species is banned but status still remains at risk.

Swertia chirayita needs attention with regard to its conservation and cultivation. Keeping this in mind different conservation strategies has been taken into account. Protection of natural populations of *Swertia* in their habitats; detailed study on the phenology of plants, development of elite generations, establishment of nurseries, creating awareness among the local people about importance of the plant can save it from being extinct in the near future. It is well known that genetic diversity in natural populations can significantly affect the long term survival and evolution of species or populations in changing environments. Therefore detailed knowledge of genetic diversity and variation within and between populations of *Swertia* species will help to enhance our understanding of population dynamics, adaptation and evolution of the plant. In turn it will provide information which will be useful for biological conservation of this gentian species.

Keywords: *Swertia chirayita*, Environmental degradation, Genetic diversity, Conservation.

ECO-PHYSIOLOGICAL RESPONSE OF AN INVASIVE PLANT *HYPTIS SUAVEOLENS* TO ALTERED PRECIPITATION REGIME

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Climate change and plant invasions are key processes affecting ecosystem services and biodiversity. Both invasion and climate change are known to affect the nutrient cycling, yet very few studies focused on the interactive effect of plant invasion and climate change on soil properties and their future expansion. Here, we assess the potential of *Hyptis suaveolens*, which is currently invading the forests of India and considered as one of the most serious invaders in the Vindhyan dry deciduous forest of India. In a greenhouse experiment we tested the effect of experimental drought on growth attributes of *H. suaveolens*. We compared aboveground biomass, specific leaf area, photosynthetic rate, water use efficiency (WUE) of *H. suaveolens* under control and water limited condition. The study suggest that *H. suaveolens*is a poor performer under drought conditions. Drought stress adversely affected morphology and physiology of *H. suaveolens*, as a general decrease in photosynthesis, leaf carbon, nitrogen concentration, WUE and total biomass was observed under drought conditions. Plant do not show adaptive differentiation to drier conditions and is therefore unlikely to expand into more extreme drier habitats on a regional scale.

Keywords: Climate change, drought, dry deciduous forest, *Hyptis suaveolens*, plant invasion photosynthetic rate

ADVERSE EFFECTS OF SALINITY ON PLANT GROWTH

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Climate change is referred to as the change in long term weather conditions of a large area. It is caused by both humans and natural processes. It includes a change in various factors including temperature, precipitation, salinity, etc. The change is evident in the production of crops and behaviour of animals. The changes are usually negative. Genetically modified organisms (GMO's) come into place here. They can be modified to fight disease and adapt to environmental stress. The advancements in the field of biotechnology have contributed in producing these GMO's. Climate change results in the increase in global warming which ultimately rise the water levels in the ocean. Thus, it is accompanied by the increase in the salinity of water. Salt tolerance is defined as the right amount of salt in the water, in which plants can grow. Salinity affects the plant growth in two ways. The presence of excess salt in the irrigating water will prevent the plants from absorbing it and therefore results in the reduction of growth rate. It is referred to as 'osmotic or water deficient effect of salinity'. If the salt enters the transpiration stream of the plant, the cells are damaged which again results in decreased growth rate. It is referred to as 'salt specific or iron excess effect of salinity'. This shows us how salt concentration is very important in determining the growth rate of plants and how salty water cannot be used for irrigation. Recently, gene encoding aquaporin (NtAQP1) was identified in tobacco (*Nicotiana tobacum)* and shown to provide protection against salinity stress on transgenic tomatoes (*Solanum lycopersicum).* NtAQP1 plays a key role in preventing root/shoot hydraulic failure, enhancing water use efficiency and thereby improving salt tolerance. A combination of genes is required to affect the adverse impact of climate variability on plants.

Keywords : Climate change, Salt tolerance, Salinity, Aquaporin, Hydraulic failure, Water efficiency

IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

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Climate change will affect water resources through its impact on the quantity, variability, timing, form, and intensity of precipitation. Water resources are important to both society and ecosystems. We depend on a reliable, clean supply of drinking water to sustain our health. We also need water for agriculture, energy production, navigation, recreation, and manufacturing. Many of these uses put pressure on water resources, stresses that are likely to be exacerbated by climate change. In many areas, climate change is likely to increase water demand while shrinking water supplies. In some areas, water shortages will be less of a problem than increases in runoff, flooding, or sea level rise. These effects can reduce the quality of water and can damage the infrastructure that we use to transport and deliver water. As the earth's temperature continues to rise, we can expect a significant impact on our fresh water supplies with the potential for devastating effects on these resources. Water resource users can reduce the negative effects of water shortages through a number of strategies. These include revising water storage and release programs for reservoirs, adopting crops and cropping practices that are robust over a wider spectrum of water availability, expanding and adjusting crop insurance programs adjusting water prices to encourage conservation and the expansion of water supply infrastructure, and supporting water transfer opportunities.

Keywords: Climate Change, Water, Health, Impact, Storage, Availability.

GREENHOUSE GAS EMISSION FROM CROP PRODUCTION AND ITS EFFECT ON CONVENTIONAL CHEMICAL FERTILIZERS ON INDO-GANGETIC PLAINS

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In future, the uses of agricultural nitrogen are expected to be the leading cause of reactive nitrogen (N) release to the environment. Agriculture soils are considered as a major source of nitrous oxide (N_2O) which is an important contributor of enhanced greenhouse effect and stratospheric ozone depletion. The use of nitrogen fertilizer is expanding globally in order to satisfy food, fiber, and fuel demands of the growing world's population. Fertilizer consumers are being asked to improve Nitrogen use efficiency (NUE) through proper management in their fields in order to protect water resources, soil pollution (such as nitrate and nitrite) and also to minimize greenhouse gas (CO_2, CH_4 and N_2O) emissions. Implementation of intensive crop management practices, using principles of ecological intensification to enhance efficient and effective nutrient uptake while achieving high yields, was identified as a principal way to achieve reductions in GHG emissions while meeting production demands. The main objective of application of fertilizers is to provide nutrients to the plants, to increase or sustain optimal crop yield. Thus, by improving fertilizer use efficiency in terms of nutrient uptake and crop yield is important for the fertilizer producers and users. It has been realized that the excessive use of inorganic fertilizers, which is a common practice of green revolution agricultural practices, is unsustainable for any farming practice from both economic as well as ecological point of view. Transfer of the information to fertilizer dealers, crop advisers, farmers, and agricultural & environmental authorities should lead to increased implementation of fertilizer Best management practices (BMPs), and help to reduce confusion over the role of fertilizer Nitrogen on cropping system emissions of GHGs. Gaps in scientific understanding were identified and will require the collaborative attention of agronomists, soil scientists, ecologists, and environmental authorities in serving the immediate and long-term interests of the human population.

Keywords: Best management practice, Ecologists, Greenhouse gas, Green revolution and Nitrogen.

EFFECT OF LIGHT AVAILABILITY AND GRASS COMPETITION ON TREE SEEDLING GROWTH OF FOUR DRY TROPICAL TREE SPECIES

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Forests plays important role in climate change. Degradation of forests contributes to climate change through release of CO_2 in atmosphere. Plantation of new forests can mitigate climate change by removing CO_2 from the atmosphere. Seedlings are the very sensitive and important stage of plant life hence a thorough understanding of how seedlings of individual species in a community perform under changed environmental conditions relative to one another will help to explain the composition of plant communities. Further, response of tree seedlings which coexist with grasses in tropical dry forest to concurrent changes in light availability is unclear. Water and nutrient are considered as most important limiting factors and their effect is modified by the intensity of light in tropical dry forest. In this study we attempt to examine the effect of light intensity in presence or absence of grass on the growth and functional traits of seedlings of four tree species (*Zizyphus mauritiana, Acacia nilotica, Acacia catechu, Terminalia arjuna*). The seedlings were subjected to different combinations of light and grass. Growth parameters, including height, girth, leaf area, number of leaf, leaf nitrogen (N) and phosphorus (P), were recorded to analyze responses of tree seedlings interacting with light and grass competition on tree seedling growth. Significant interactions for availability of light for majority of growth parameters were found. Different species behave differently in different combination of treatments. Presence of grass had overall negative effect on seedling height, girth, leaf number, and total dry weight in different combination of treatments. Broad leaved non-leguminous species were more responsive to full sunlight as compared to fine leaved leguminous species. Foliar N content was higher in fine leaved leguminous species than broad leaved non leguminous speies under all the treatment combinations. We conclude that absence of grass under full sunlight will be effective to enhance woody cover and mitigation of climate change by removing CO_2 from the atmosphere in dry tropical environment for concerned species.

Keywords: Seedlings, Tropical dry forest, Nutrient, Light, Water, Grasses.

GLOBAL CLIMATE CHANGE AND INDIAN AGRICULTURE: IMPACTS, ADAPTATION AND MITIGATION

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Climate is the primary determinant of agriculture productivity. concern over the potential effects of long-term climatic change on agriculture has motivated a substantial body of research over the past decade .Researches addresses that effects of climatic change on agriculture, such as changes in crop and livestock yields, as well as the economic changes. Inter- Governmental Panel on Climatic Change has shown that the earth temperature has increased by 0.74^0 C between 1906 and 2005 due to increase in anthropogenic emission of greenhouse gases. By the end of this century temperature increase is likely to be $1.8\text{-}4.0^0$C which would lead to more frequent hot extremes, floods, droughts, cyclones and gradual recession of glaciers, which in turn would result in greater instability in food production .It is estimated that the crop production loss in INDIA by 2100 AD could be 10-40% despite the beneficial effects of higher CO_2 on crop growth. We could loss 4.5 million tonnes of wheat (*Triticum aestivum* L. emend. Fiori & Paol) with every rise of 1^0C temperature. Potential approaches to reduce these emissions include mid-season drainage or alternate drying in rice, approaches to increase N-use efficiency and soil carbon, and improvement in livestock diet. Simple adaptation strategies, such as change in planting dates and varieties could help in reducing impacts of climate change to some extent. Additional strategies for increasing our adaptive capacity include development of adverse climate-tolerant genotypes and land-use systems, providing value-added climatic risk management services to farmers, and improved land-use policies and risk management though early warning system and crop weather insurance.

Keywords: Earth temperature. Greenhouse gases. Argiculture impacts, Adaptation and mitigation.

CLIMATE CHANGE AND FOOD SECURITY

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Several studies have shown that global population would increase by 39 percent and reach to 9111 million persons by 2050. To meet the food requirement of growing population, agriculture production needs to be increased by 60 percent by 2050. The total arable land in use would rise from 1592 million ha to 1661 million ha and total area equipped for irrigation would rise from 302 million hectare to 322 million hectare by 2050 as compared to 2005/07. Further projections show increase in cereal production to 160 million ton by 2050. Despite increase in above parameters negative trend has been noticed in the growth rate in total agriculture production, annual cereal production, total arable land and irrigation, harvested land and yield. The total agriculture production growth rate is predicted to decline from 1.3 percent p.a. in 2005/07-2030 to 0.7 percent p.a. 2030-2050 and annual crop production growth rate from 1.3 percent p.a. in 2005/07-2030 to 0.7 percent p.a. by 2030-2050. Similarly total arable land annual growth percentage would decline from 1.3 percent p.a. to 0.10 percent p.a. as reported in 2005/07-2050. Thus, these projections show negative correlation with the percent growth rate and actual increase in agriculture production, annual crop production and other parameters as compared to population which shows positive trend in growth rate and actual increase in number. This is accompanied by rise in temperature by 4°C and sea level by 0.82 m by the end of the 21st century as reported by AR5 of IPCC, 2013 which may have deleterious effect on crop productivity.

This has raised concern that agriculture might not be able to produce the food needed to sustain growing world population at levels required to lead a healthy and active life due to continuing decline of arable land (in use) per person even if there are still unused large tracts of land with varying degrees of agricultural production potential due to lack of infrastructure, forest cover and wetlands which should be protected for environmental reasons.

It follows that continued and intensified efforts are needed on the part of the agricultural research community to raise yields (including through maintenance and adaptive research) in the often unfavourable agro-ecological and often also unfavorable socioeconomic environments of the countries where the additional demand will be.

Keywords: Food security, Climate change,

POTENTIAL IMPACT OF CLIMATE CHANGE ON SOIL DEGRADATION AND RELATED ISSUES

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Human activities are aggravating changes in global environment at unprecedented rates with potential severe consequences on various spheres of environment. Soils are closely linked to atmospheric system through different cycles such as carbon (C), nitrogen (N) and hydrological cycles. Climate change both in terms of temperature and precipitation is recognized as one of the major factors responsible for land degradation resulting in significant alterations in soil functions and processes such as soil organic matter (SOM), soil aggregate stability, soil available water, bulk density, microbial flora and fauna diversity, C and N nutrient cycling in environment. Land degradation is a complex process which deteriorates several soil features and reduces the land potential to produce benefits from a particular land use. Soils are crucial to food security and adverse changes in temperature and precipitation are likely to intensify degradation of soil and water resources which limits crop yields. Global food security threatened by climate change through changes in soil properties and processes is one of the most important challenges in the 21st century to supply food for the increasing population. Climate change will most likely result in depletion and altered distribution of natural resources which in turn will decrease crop yields and may heighten human conflicts. Hence this paper addresses land degradation as one of the most important factors assumed to be strongly influenced by global climate change.

Keywords: Global food security, Soil organic matter, C and N nutrient

QUALITY ENHANCEMENT OF MUNG BEAN (*VIGNA RADIATE*) BY APPLICATION OF DIFFERENT LEVELS OF PHOSPHORUS AND SULPHUR IN INCEPTISOLS OF EASTERN UTTAR PRADESH UNDER CLIMATIC CHANGES.

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Changes in climatic condition is one of the major challenge for quality crop production particularly in pulse crop, due to erratic behavior of rainfall and change in annual mean temperature. Response of plant growth directly related with climatic condition as well as magnitude of fertilizer application. Keeping thesefact in mind an experiment was laid out during in *Kharif* Season2009-10 and 2010-11 at Research Farm of Institute of Agriculture Science, BHU, Varanasi-05. For the evaluation of changes in quality(Tryptophan, lysine, Methionine, sugar content and Protein) of Mung bean by the application of different levels of Phosphorus and Sulphur an. The levels of Phosphorus and Sulphur is applied at the rate of 0, 15, 30 and 45 Kg/ha and 0, 10, 20 and 30 kg /ha, respectively with normal dose of Nitrogen and Potassium. The result revealed that, the content of Methionine, Tryptophan, sugar and protein were increased with increasing levels of Phosphorus and Sulphur. The maximum content were recorded with application of Phosphorus and Sulphur @ 30 and 20 kg/ha, respectively.

Keywords: Sugar, Protein, Sulphur and Phosphorus

STUDY OF EXPRESSION PATTERN OF A SET OF DEFENSE GENES IN RESPONSE TO *ALTERNARIA BRASSICAE* INFECTION AND SALICYLIC ACID AND JASMONIC ACID TREATMENTS IN *BRASSICA JUNCEA*

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Alternaria blight is one among the serious diseases of *Brassica juncea* causing up to 45-58% loss in the yield with no proven source of transferable resistance in any of the hosts. The plant hormones salicylic acid (SA), jasmonic acid (JA), and ethylene (ET) are major players in the regulation of signaling networks that are involved in induced defense responses against pathogens and insects. In order to develop resistance thoughtful information of defense mechanism in terms of defense signaling molecules involved and defense genes induced during the plant-pathogen interaction need to be understood at the molecular level. In the present study, *Brassica juncea* (Varuna) was taken for studying expression analysis of important defense genes with SA, JA and *in vitro* fungal infection as three separate treatments. We found that chitinase and thionin transcript levels were elevated in mustard leaves upon treatment with JA and during infection with necrotrophic fungal pathogen *Alternaria brassicae*. Conversely expression levels of *PR1* and *NPR1* were induced exclusively upon SA treatment. They were not induced either by JA or after fungal infection. These results clearly indicate existence of two separate hormone dependent pathways i.e. SA and JA in *Brassica juncea* similar to *Arabidopsis thaliana* reported earlier by Thomma *et al*., (1998). *Glucanase* expression was also seen during SA treatment although some expression was also seen by JA treatment.

Keywords: *Brassica juncea*, Glucanase, SA and JA

FEEDING BEHAVIOUR OF *LABEO BATA* (HAMILTON, 1822) FROM THE LOWER STRETCH OF THE YAMUNA RIVER, UTTAR PRADESH

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Climate change may adversely influence the river flow regimes. Variation in flow regimes is more visible during seasonal changes. Feeding behavior of fishes varied from season to season. Among the various species present in the river Yamuna a minor carp; *Labeo bata* is also forms sizeable fishery. Besides rivers, the fish also forms lucrative pond fishery in West Bengal, Assam, Orissa states in India and also in Bangladesh due to its high market demand and consumer preference. Although some preliminary investigation have been undertaken on the biology of this economically important fish species, but there is dearth of knowledge on its food and feeding habits. The present study was carried out to determine feeding behavior of *L. bata* with respect of changes in thermal regimes from the lower stretch of the Yamuna river at Allahabad, Uttar Pradesh. Samples were collected from Sadiapur landing centre in Allahabad during May 2013 to April 2014. The body size of the samples varied from 13.4 to 32.6 cm. Gut condition of fishes were recorded maximum ¼ to ½ in winter season. Abundance of fish food organisms in the gut was low in winter season compared to summer and monsoon. The gut content analysis revealed that *L. bata* is a herbivorous fish. Green algae were dominated in summer, blue-green algae in monsoon and diatoms in winter season. Green algae constitute maximum proportion (46.26%) of the gut contents, followed by diatoms (36.86 %), blue-green algae (6.77 %) and protozoans (5.11 %) in annual samples. Sand particles were also recorded in sizeable proportion (5.11%). Contribution of the higher aquatic animals in the gut of the fish was minimal (0.50%). Diatom group was recorded maximum diversity, while green algae shared highest percentage in the gut of fishes. Significant seasonal variability in food and feeding was observed from the gut of the fishes. The details on food, feeding and seasonal variations will be discussed in the paper.

Keywords: *Labeo bata*, Feeding behavior, Yamuna river, Minor carp; Climate change

DIATOM FLORA OF THE GANGETIC DRAINAGE IN THE ANCIENT VINDHYA AND THE RECENT HIMALAYA: BIOGEOGRAPHIC PERSPECTIVE IN THE INDIAN SUBCONTINENT

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Distribution of diatom in some drainages of the West Himalaya and Central High land has been estimated to throw some light on its biogeography in the Indian subcontinent. Out of 363 taxa recorded from both of these highlands, 117 taxa (24%) were common. The similarity index (0.489) was at the threshold of significance. The affinities are likely to be high in the Central High land and Himalaya ecoregions because the Gangetic drainage connects these two regions. However, the wide 'Gangetic Plains' can be a physiological barrier for the diatoms (which disperse passively) because of high ambient thermal regime in the Plains. The development of present flora of these highlands might be influenced by the alteration of glacial /interglacial environment during Quaternary. During glaciations there might be migration of the Palearctic elements and Himalayan flora to southward in contrast upward migration peninsular elements during inter glaciations.

Keywords: Diatom, Ecoregion, Himalaya, Vindhya

Desertification: A Major Environmental Concern

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Desertification is the conversion of productive land into unproductive area caused by severe drought conditions. Study by the Intergovernmental Panel on Climate Change (IPCC, 2007) has projected the result of human activities on climate change including desertification. There is over-exploitation of dry lands by and ropogenic activities through deforestation, over-cultivation, poor irrigation practices, overgrazing and mining. On the whole desertification degrades the top-soil, thereby reducing the productive potential of soil by more than 10%. The process is considered to be moderate when there is 10-25% drop in productivity, severe when the drop is 25-50% and very severe when the drop is more than 50%. It is more prominent in arid and semi-arid parts of the world, which is about 35% of earth's land surface. In these areas in extreme cases it will result in the formation of 'deserts'.

Desertification will directly affect 20% of world's population food supply and indirectly the entire Biosphere and its valuable genetic resources. Mitigation of desertification is a major concern for environmental scientists. More than 100 member states of United Nations have pooled in their effort, knowledge and revenue to find means and ways to overcome this global evil.

Keywords: Desertification, Ropogenic activities, Biosphere

PROMINENCES ON BRASSINOSTEROIDS HORMONE UNDER CLIMATE CHANGE IN *CICER ARIETINUM* L.

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Presently all biodiversity is challenged by rapid environmental changes like seasonal fluctuation, rainfall shifting, variation in temperature, drought, wind and increasing concentrations of greenhouse gasses. Fluctuation in rainfall, temperature drought leads the salinization in soil and Salts stress is now become one of the most severe problems of agriculture worldwide and affecting growth and metabolism of flora and fauna. The present study prominences the impact of exogenous applications of 28-homobrassinosteroids (28-homoBL) in concentrations (1uM, 1ηM, 1pM) on morphological and photosynthetic pigments 3, 6 and 9th day old seedlings of Chickpea (*Cicer arietinum* L.) plants. Results suggested that priming treatments with 28-homoBL presoaking treatment to seedlings grown with salt stress, Brassinosteroids treatment enhance the photosynthetic pigments of seedlings significantly alone as well as in combination with salt stress as compared to untreated control seedlings. 28-homoBL also enhanced the plant growth in terms of shoot and root length fresh. These results also indicated that 28-homoBL treatment alleviated salts stress by enhancing and/or modulating the metabolism of *C. arietinum* plants. So these are needed to explore the role BRs on large scale in agriculture crops.

Keywords: Climate Change, Salt Stress, Brassinosteroids hormones, *Cicer arietinum*

EFFECT OF CLIMATE CHANGE ON AGRICULTURE

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The unimpeded rise in greenhouse gas emissions is raising the earth's temperature. The consequences are drastically affecting all the components over the planet. Among them agriculture is extremely vulnerable to climate change. In turn populations in the developing world which are already vulnerable and food insecure are likely to be more seriously affected. The adverse changes in climate drastically affect the agriculture and human well-being. In this sense, especially in the context of environmental policy the climate change has become synonymous with anthropogenic global warming. In the present work, anticipated impacts on agriculture from climate change and its various aspects have been highlighted. The impacts of climate change on agriculture can be briefly summarized within the following scenarios: the biological effects on crop yields; the resulting impact on outcomes including prices, production and consumption; the impacts on per capita calorie consumption and child malnutrition. The biophysical effects of climate change on agriculture induce changes in production and prices, which play out a significant role in economy as the market area participant, adjust autonomously altering crop mix, input use, production, food demand, consumption and trade.

Keywords: Anthropogenic Global Warming, Droughts, Floods, Per capita calorie Consumption, Crop mix.

REMEDIATION OF PESTICIDE BY PGPR: A SUSTAINABLE AGRICULTURE PERSPECTIVE

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Ensuring food security for more than 1.27 billion Indian populations with climate change , and also substantial reduction in crops yields by pest infestation (including pod borers, aphids, jassids, and pod flies), is a tough task. Climate change poses a threat the control of pest and disease invasion. Currently estimates of changes in climate indicate the change in global mean annual temperatures of 1 ^{o}C by 2025 and 3 ^{o}C by the end of the next century. Such increases in temperature have a number of implications for temperature –dependent. So that to achievethis difficult task, farmer s areusing more and moreagro.pesticide like as chemical input But, now objective of food security is closely associated with desire of sustainability. Currently, ,at high risk Indian agriculture is becausethe average consumption of pesticide is lesser as compared to other developed countries, but the problem of pesticide residue in soilis comparatively higher. Due to long-term and over application of pesticides may accumulate in upper soil layers (0–10 cm) exert alternation impact, not only diversity but also on functionality of ecologically and agronomically important soil micro-flora (plant growth promoting bacteria). And also these chemicals are biomagnifying in lipid tissue of higher organism, which increasingly linked to immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer. Under actual agriculture practices, farmers are applied simultaneously pesticide (insecticide, fungicide & herbicide) and commercially available biofertilizer (plant growth promoting bacteria), which interact with each other. Therefore, much attention has been paid to recent objective to introduction of plant growth promoting bacteria in soil to mineralization or remediation of organic pollutant. Some of plant growth promting rhizobacteria (PGPR) genera were commonally reported in pesticide degradation includes*Pseudomonas, Azospirillum, Agrobacterium, Bacillus, Enterobacter*, and *Flavobacterium*erant or Currentally, research focus on pesticide tol . degrading strain is emea healt ging asrhy option for reme hazards esticidediation of p research need to explore the ablity microbes in divers from environment. Hence, future enviromental niches by using metagenomics and use them as tool in order to clean the .environment, improve soil heath and crop yeild as sustainable manner

Sustainble agriculture ,Bioremidation ,PGPR ,Pesticides **: Keywords**

IMPACT OF CLIMATIC CHANGE ON AGRICULTURE PRODUCTION AND FOOD SECURITY

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Climate is the primary determinant of agricultural productivity which is directly or indirectly interlinked with food security. Agriculture has always been highly dependent on climate patterns and variations because solar radiation, temperature, and precipitation are the main drivers of crop growth. Today, humans have been changing the global climate by emitting high amounts of greenhouse gases into the atmosphere, resulting in higher global temperatures, affecting hydrological regimes and increasing climatic variability. Increases in temperature and carbon dioxide (CO_2) can be beneficial for some crops in some places. But to realize these benefits, nutrient levels, soil moisture, water availability, and other conditions must also be met. Climatic changes could create challenges for farmers and ranchers because of changes in the frequency and severity of droughts and floods. For any particular crop, the effect of increased temperature will depend on the crop's optimal temperature for growth and reproduction. The effects of climate change also need to be considered along with other evolving factors that affect agricultural production, such as changes in farming practices and technology. Climate change may affect food systems in several ways ranging from direct effects on crop production (e.g. changes in rainfall leading to drought or flooding, or warmer or cooler temperatures leading to changes in the length of growing season), to changes in markets, food prices and supply chain infrastructure. Therefore food security is diminished when food systems are stressed and such stresses may be induced by a range of factors in addition to climate change and/or other agents of environmental change and may be particularly severe when these factors act in combination. Thus it can be concluded that climate change is projected to have significant impacts on agricultural conditions, food supply, and food security.

Keywords: Agricultural productivity, food security, solar radiation, drought, environmental change, food supply

STUDY OF BLACK CARBON AEROSOL AT DIFFERENT URBAN LOCATIONS OF DELHI

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In recent years black carbon (BC) has become the major subject of interest because of its light absorbing characteristics that reduce albedo of atmospheric aerosols and have possible effects on micro-climate of the region. In the present study the variability of BC aerosols over time scale (weekly) is studied at four typical urban locations namely East Delhi, Mayapuri industrial area, Janakpuri and GGSIP University of megacity, Delhi. Measurements of BC at different locations were carried out in December, 2013 using a portable Aethalometer (microAeth Model AE51, AethLabs, 2011, USA) with temporal resolution of 5 min during the study period. BC surface mass concentration exhibited diurnal variation with their higher values and a larger variability during morning (0900 to 1100 h) peak hours compared to afternoon and evening hours (1100 to 1700 h). The diurnal variations are mainly influenced by the dynamics of local Atmospheric Boundary Layer (ABL). The average concentrations of BC (µg m^{-3}) were found (41.4 ± 16.1), (9.9 ± 7.1), (12.7 ± 6.7) and (9.2 ± 8.2) for East Delhi, Mayapuri, Janakpuri and GGSIP University respectively. It was observed that the East Delhi was comparatively more polluted than other sites. Black carbon is continuously being released into the atmosphere as a byproduct of all combustion processes viz., dry leaf biomass burning, industrial emissions and motor vehicles exhaust. The statistical interpretation of the data indicates that the temperature also play a significant role in affecting the ambient BC concentrations. This study concludes that the levels of BC and changing meteorological conditions at urban locations during winter play crucial role in climatic variability in mega-city of Delhi. Moreover, short-term epidemiological studies provide sufficient evidence of an association of daily variations in BC concentrations with short-term changes in health (Cardiovascular mortality and cardiopulmonary hospital admissions). BC is also contributing to the acceleration of ice cap melting but BC is a particle not a gas. This study suggests that reducing the amount of BC produced by anthropogenic activities can reduce adverse effects on micro climatic changes in the mega cities.

Keywords: Black carbon aerosol; Aethalometer; ABL; Albedo; Climate Change

DEVELOPMENT AND VALIDATION OF ICT FOR YOUTH EMPOWERMENT TOWARDS EFFICIENT ENERGY MANAGEMENT: A STEP TOWARDS CLIMATE CHANGE MITIGATION THROUGH SUSTAINABLE RESOURCE USE

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India is currently facing a mismatch between demand and supply to the tune of 8.5%. Efficient energy management and conservation is found to be the most cost effective and environmentally benign option to augment the gap between demand and supply. Education with Information, Communication and Technology (ICT) strategies towards efficient use of resources such as energy will guides us on our journey towards the goal of climate change abatement and sustainable development. Youth of today are the driving force of tomorrow and combating climate change is the need of the hour. To target adolescents is to target a majority with core values of revolution and influence; it is an affective direction to reach maximum masses with minimum input, future generations, future policies, and ultimately our future developmental direction will be influenced. The study involves designing a need-based capacity building Programme and administering to the sample, the goal is to measure the enhancement of knowledge, perception regarding energy management and energy auditing skills, pre and post intervention. Energy Management was studied in terms of climate change, energy related carbon emissions, energy conservation practices, energy efficient appliances and energy audit. The sample constitutes 470 students from Public school, Government and students from colleges of selected Universities in Delhi.

Firstly, the paper will discuss curriculum analysis, which was done to appraise the inclusion of information on energy management in school and college curriculum, followed by pre intervention outcomes with respect to sample's knowledge, perception towards climate change, energy management and energy auditing skills. The paper also discusses strategies used in designing and administration of the capacity building programme. The capacity building programme comprises of capacity building aids blended with educational technology in an information-sharing mode of instruction. Interactive media such as technology based learning (mobile application, game), simulatiton excercises, multimedia, lectures and group discussions, training material like newsletter, manuals, activities etc. is being used motivate youth to integrate energy conservation and efficiency in their everyday life. Capacity Building programme aims to make the sample understand the implications of their actions – both positive and negative; enabling them to make informed choices in the future. The skill development would aid the sample to measure the savings associated with conserving energy resources

and will act as a constant motivator to make that switch. The study is conducted to establish valid affectivity of such endeavor, which will help chart out our path towards reaching sustainability.

Keywords: Youth, Energy Management, Capacity Building, Climate Change, ICT strategies

INDIA'S CLIMATE CHANGE POLICY : PAST, PRESENT AND FUTURE

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Since 1991, India has been one of the fastest growing economies of the World. Today it is the 11th largest economy nominally and 3rd largest by PPP. However, it is also World's third largest CO_2 emitter, after USA and China. Being one of the major emerging economies, India is looked up to, by developed and underdeveloped countries alike to take the lead in mitigation and adaptation for climate change. India's Integrated Energy Policy 2008 spells out that although India is willing to take actions to mitigate the effects of climate change, the same shall not be at the cost of development and such initiatives will have to be backed financially and technologically by the developed nations.

Broadly, India has two planks for its climate change policy- 1. Promotion of Energy Efficiency and 2. Promotion of Renewables. These two planks have been reiterated by India time and again through its policy instruments like the Energy Conservation Act 2001 and the NAPCC 2008, etc. With the Conference of Parties 21, in Novermber 2015 likely reach a binding agreement on emissions reduction post Kyoto protocol era, it becomes important to analyse India's potential policy options to reduce CO_2 emissions without compromising its developmental objectives. Thus in this context, this paper analyses the framework and policies for mitigation and adaptation for climate change undertaken by India since the commencement of the LPG programme in 1991 and recommends further measures towards the same end. The methodology revolves around the study of key policy documents like legislations, policy reports along with other governmental and non-governmental sources to get a comprehensive view of India's climate change policies. These policies are then used to generate viable recommendations which can potentially enhance India's ability to mitigate and adapt to climate change.

On the basis of our study we recommend that India should continue its focus on renewables while looking at efficiency improvement of its conventional energy consumption. It could also consider innovative solutions like shifting of grid electricity consumption by households towards off grid solutions thereby freeing up energy from grid to supply the industry and other users.

Keywords: Climate change, NAPCC, INDC, Renewables, UNFCCC, Off grid

PHYCOREMEDIATION AND SUSTAINABLE BIODIESEL PRODUCTION USING DIATOM ALGAE CULTIVATED IN URBAN WASTE WATER

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In the context of a shrinking fossil fuels and increasing greenhouse gas (GHG) emissions, microalgae have been suggested as a promising feedstock for biofuel production owing to a number of advantages, including a higher photosynthetic efficiency, higher biomass production, and higher growth rates when compared with other oil crops. Between 1.6 and 2 grams of CO2 is captured for every gram of algal biomass produced (Herzog and Golomb 2004). Population growth poses a serious threat to the environment owing to the release of vast amounts of domestic wastewater. The major effect of releasing wastewater rich in organic compounds and chemicals is the eutrophication of freshwater ecosystems. One possible solution is to use wastewater to grow microalgae for biodiesel production.

The integrated approach, which combines freshwater diatom cultivation with urban wastewater treatment, is a promising solution for nutrient removal and biodiesel production. In this study urban wastewater is used to cultivate Diatom algae. Optimization of growth using a nano micro nutrient mixture Nualgi was tested along with nutrient removal efficiency and lipid production. N and P reduction of 70.3 & 66.6 % was observed with COD & BOD reduction from 350 to 212 to 56 to 14 mg/l respectively. A specific growth rate μ (day^{-1}) of 0.34 was achieved with biomass productivity of 190.9 $mg/L^{-1}/day^{-1}$ and Lipid productivity of 20 mg/g dry biomass with cultures grown in waste water using Nualgi. These results emphasize the potential of diatom algae grown in waste water for production of feedstock for renewable biodiesel production. Efficient carbon fixation ability along with nutrient utilization could make diatoms appealing for co-processes such as CO2 abatement and waste water remediation.

In summary, with India gearing itself for River Ganga Restoration and Swatchh Bharath Abhiyan with 11 crore toilets to be constructed there is an urgent need to think of ways to treat the sewage generated. Microalgae have the potential to offer a simultaneous production technology for bio / green diesel, bioethanol and high-value chemicals using this waste water.

Keywords: Phycoremediation , Green diesel, Bioethanol, Green houses gasses

ROLE OF BIOFUEL AND TRADITIONAL ECOLOGICAL KNOLEDGE IN MEETING ENERGY NEEDS AND CONTROLLING CLIMATE CHANGE

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Global climate change (GCC) and its adverse effects are accepted the world over today. The major cause is increase in concentration of greenhouse gases (GHG), mainly carbon dioxide, in the atmosphere which is a result of anthropogenic activities, including large scale use of fossil fuel. This in turn, is due to enhanced demand for energy by a continuously increasing population. Creating land necessary for agricultural fields, shift from tribal to rural and urban systems and industrialization have led to excessive deforestation. This has resulted in loss of a valuable sink for atmospheric carbon dioxide thus contributing to GCC to a considerable extent. We need to find ways to retard GCC as well as meet our energy requirements. For this, the obvious first step is trying to reduce the concentration of GHG in the atmosphere which can be possible by reduction in use of fossil fuels and increase use of alternate sources of energy which are renewable and which produce lesser amounts of greenhouse gases and other pollutants. Increase in carbon dioxide utilization by reforestation, increase in carbon storage in standing tree biomass, reclamation of wastelands occurring naturally as well as those created by anthropogenic activities can also serve to reduce GCC. A major alternate source of renewable energy with immense potential is biofuel. This can be derived from food crop plants, bio-wastes, nonfood plants (like *Jatropha curcas* L., *Pongamia pinnata*, L.), micro- and macro-algae, or by use of advanced biotechnology to convert plant sugars to a variety of fuels that have properties similar to fossil gasoline or diesel. The relative advantages and disadvantages of these sources, particularly the added role in environment reclamation are discussed. The possible role of an integrated approach of utilizing our present day technical knowledge of growing and using biofuel organisms in conjunction with some of our traditional ecological knowledge is also discussed. This will result in a holistic approach to agriculture, self-maintenance of ecosystems and reducing dependence on external energy, thus helping reducing global climate change.

Keywords: Global climate change, Biofuel from non-food plants and algae, Integrating traditional ecological knowledge

RATIONALISATION OF WOOD: A STEP FORWARD

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India is one of the world's leading emitters of CO_2 and, according to a study (2013) by Yale and Columbia, ranks 126 out of 132 countries on environmental performance—the lowest of any country in Asia. The reason India is so vulnerable is because it is a large country with many living in poverty, inadequate infrastructure, and a lack of government planning to deal with complex weather systems. Recently, a World Bank report emphasized how India will be subject to irregular monsoons, flooding, rising sea levels, and higher temperatures. The monsoon season is vital to the Indian economy because many Indians are agrarian. What happens to India's monsoons will drastically affect the fate of the agricultural sector and the people dependent on it. Climate change is going to continue to create erratic extremes throughout the monsoon season. Preparation for weather irregularities brought by climate change is thus essential to protect the lives of the Indian people and the growth of the Indian economy.

Although India has adapted certain policies aimed at targeting, mitigating and adapting climatic change, the limitation is that it requires multiple stakeholders and the government to act in co-ordination. Also, financial soundness is a major factor when it comes to renewable energy.

Located at the foothills of the Himalayan mountain ranges, Uttarakhand is largely a hilly State, having international boundaries with China (Tibet) in the north and Nepal in the east. On its north-west lies Himachal Pradesh, while on the south is Uttar Pradesh. It is rich in natural resources especially water and forests with many glaciers, rivers, dense forests and snow-clad mountain peaks. People in Uttarakhand are majorly dependent on wood consumption for meeting their daily requirements and producing power. Another interesting fact about Uttarakhand is that Lantana weed is abundantly available.

Keywords: Indian economy, Financial soundness

RURAL ELECTRIFICATION AND ITS IMPACT ON ENERGY SECURITY

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India has a large population of around 1.22 billions with 83.3crore people residing in the rural areas and 37.7 crore people in the urban areas. One of the basic needs of the population is electricity though it might not be the only driven force for the economy but it is certainly a necessary factor. Out of total electricity only 75% of the population have access to electricity (IEA 2010-2014), Unfortunately 400 million Indian have no access to electricity. About 6.4 lakh rural populations still rely on the animal dung, fuel wood and agricultural waste as a fuel for cooking. It's a need of an hour to realize the importance of rural electrification in India.

Although planning out rural electrification act the cynicism reaction among the rural population can also be seen. Rural household use around 10% of their income on the consumption of the basic fuels and energy for either household shores or for farming, the amount spent on fuel consumption depend on his income level, availability of electricity supply and the ownership of the electricity. There are many villages/habitations, where connection through grid may not be possible adding to this there may be various socio-economic hindrances leading to the failure of grid connection, thus off-grid solutions based on 'stand-alone systems may serve as an alternative to supply electricity in the backward area in order to provide access to electricity in villages. But in some remote areas where neither standalone systems nor grid connectivity is possible and thus renewable source of energy similar to solar photovoltaic, may be adopted. Thus to make the Rural Electrification mission successful it is important to increase the dependency of the rural households on the renewable energy.

Efficient use of biomass energy is important in states like Uttrakhand where there is abundance of 'Lantana' and agriculture wastes which can be used for the energy production and can be supplied at the lower rates to the bio mass based power plants, which can be cost effective and reliable. Also there probably no shortage of the feedstock's in the state .Adding to this there can also be other energy sources such as small biomass plant (50-100 kw) various NGO'S can be encouraged to step forward and help in at least few biomass plant for the a village. 165 tons of Co_2 is released by burning biomass cake, fuel wood and agriculture waste from rural areas.

The objective of our paper is to find out the amount of Co_2 emissions in rural areas due to dependence on bio fuels as well as to know to what extend is the air quality of rural areas is being affected and also to find out what steps are being taken by government to have proper grid connectivity in rural areas to reduce the dependency on biomass.

Keywords: Electrifications, Energy, Burning,

POTENTIAL AGRICULTURAL BIOTECHNOLOGIES TO MITIGATE CLIMATE CHANGE: CASE STUDIES FROM TERI'S RESEARCH

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Food and energy security are the two major issues of the current world in the context of a growing population and climate change. The yield improvements achieved during the Green Revolution have plateaued and may decline in the future as the sources of phosphate and fossil energy used to produce nitrate fertilizers are getting exhausted. New approaches to yield improvement as well as new varieties are, therefore, desperately needed to produce more climate resilient crops for food and energy. In the current presentation, two examples from our own research, namely, *stay green* in wheat and genetic improvement of Jatropha, will be presented. *Jatropha curcas* L. has received great attention during the last decade as a source of biodiesel. Large plantations of Jatropha were raised under various government and industry funded programs in India between 2004 and 2008. Unfortunately, none of these plantations gave the promised returns. This was primarily due to use of untested and unimproved planting material and unrealistic assumptions on plant productivity which in turn led to failure of the entire Jatropha biodiesel initiative and loss of confidence among different stakeholders. Consequently, there happened a remarkable shift in Jatropha related activities, from plantation to research towards its genetic improvement. Interspecific hybridization was used to widen the genetic base and to create prebreeding material in Jatropha. Donor genotypes for several important traits were identified which are currently being used for Jatropha breeding. On the other hand, a large number of molecular markers such as microsatellite and SNPs were developed and used in linkage and QTL mapping studies. Thus, an excellent foundation in the form of genetic and genomics resources has been created and is being used for genetic improvement of Jatropha. The application potential of these resources will be discussed.

Keywords: Genetic diversity, Doubled haploids, Stay green, Marker assisted breeding, Interspecific hybridization, Genetic transformation

PHOTOGALVANIC CELL AS A TOOL OF SOLAR ENERGY CONVERSION AND STORAGE: A REVIEW

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Developing country like India requires increasing supplies of energy as the standard of living is directly proportional to the energy consumption of the nation. The solar energy is available in abundance, free resource, environmental friendly and hazard free. Solar energy is so far the most attractive source of energy because its availability for conversion is several order of magnitudes greater than all present world requirements. It is exciting and challenging to realize that we all can share in this inexhaustible energy source. Photochemistry plays an important role in production of photochemical and biological fuels as well as electricity. Photochemical processes are efficient enough to convert over store solar energy for a longer period and that too just in a single step. Photo generation of electricity is still in the primary stage of research and application. This field needs an extensive attention and investigation to increase the conversion efficiency of the solar cells.

Keywords: Solar energy, Photochemistry, Photochemical, Biological Fuels

BIOCHARS PRODUCTION AND THEIR APPLICATIONS IN CO_2 SEQUESTRATION AND SOIL FERTILITY IMPROVEMENT

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The atmospheric CO_2 concentration has been increased by 31% since 1750. Excessive fuel emissions and land-use changes around the globe made researchers to work on the strategies for mitigating global warming threats. Currently, biochar application to sequester CO_2 and to improve soil fertility is gaining interest among researchers and practitioners. Biochar has a potential to reduce CO_2 emissions when amended to soil thereby mitigating climate change negative effects. In the present study, rice husk and corn stover biochars were produced at 550 and 650° C. The surface morphology and chemistry of developed biochars were studied using SEM, SEM-EDX, TEM, FTIR, XRD and BET surface area techniques. Soil samples were conditioned with biochars in different proportions under controlled incubation environment for a period of 117 days to investigate the impact of biochars on physic-chemical properties of soil-biochar mixtures. Cation exchange capacity (CEC), organic carbon, organic matter, water holding capacity, pH, EC and bulk density of soil-biochar mixtures were also analyzed. The CO_2 flux was measured to understand the effect of biochar in CO_2 emission in soil-biochar system. A significant increase in CEC, organic matter, organic carbon and water holding capacity along with a CO_2 reduction were observed. Therefore, the developed biochars can be use as an alternative for CO_2 sequestration and for enhancing soil fertility.

Keywords: Biochar, Cation exchange capacity, Pyrolysis, CO_2 sequestration

ASSESSMENT OF SPATIAL VARIATION OF DISSOLVED NUTRIENT CONCENTRATION IN YAMUNA RIVER SYSTEM

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In climate change scenario fresh water availability for human use is one of the key concerns and with increasing pollution load from various anthropogenic activities such as discharge of sewage and industrial waste along with runoff from agricultural land had put tremendous pressure on available water resources in term of its quality. The measurement of nitrogen and phosphate species in surface water is usually an integral part of basic water quality assessment as their concentration indicates the nutrient status and degree of pollution of any affected water body. Water samples were collected from 20 different locations of Yamuna River starting from Dakpathar to its final confluence with Ganga in the month of June and December; 2014.The water samples were analyzed for physico-chemical parameters and dissolved nutrients concentration following standard analytical methods (APHA, 2005) to determine spatial variation of nutrient concentration in Yamuna river system.

The pH of Yamuna River was found slightly acidic to alkaline in nature. The value of pH ranged between 6.4-8.2. Total dissolve solids (TDS) and Electrical conductivity (EC) have shown significant spatial variation within the river system. TDS concentration varied from 104 to 1421 mgL^{-1} with an average value 558.9 mgL^{-1} . EC was present in the range of 209 -2846 µs/cm. Both TDS and EC showed highest concentration at Palwal which indicates the input from anthropogenic sources. Dissolve oxygen in Yamuna River was ranged between 0.5-12.2 mg/L and its concentration has shown significant spatial variation ($F_{3.59}$=10.50, P=0.001). In stretches of Delhi the DO values were found very low which was not sufficient to sustain aquatic organisms.

Nitrate concentration ranged between 0.15-14.17 mgL^{-1} with highest concentration observed in Agra. Nitrate showed no significant spatial variation ($F_{3.59}$=1.75, P=0.20) in Yamuna river system .Similarly, no significant spatial variation was found in the concentration of Nitrite ($F_{3.59}$=0.63, P=0.54).Phosphate concentration was found in the range of 0.01-6.99 mgL^{-1} and highest was found at Palwal. Phosphate showed no significant spatial variation ($F_{3.59}$=1.40, P=0.27). Ammonia concentration was present in the range of 0.13-8.61 mgL^{-1} showing highest concentration in Delhi at Old iron bridge sampling site due to addition of sewage waste. Ammonia showed significant spatial variation ($F_{3.59}$=28.63, P=3.6E-06) .Silica concentration ranged between 1.5-13.7 mgL^{-1} with highest concentration observed at Nizamuddin bridge. Silica showed significant spatial variation ($F_{3.59}$=28.62, P=3.62E-06) in the river system.

The present study revealed that the water quality of Delhi and its downstream regions is more polluted in term of nutrient concentration when compare with the upstream regions of Delhi mainly due to addition of sewage waste and input from agriculture areas.

Keywords: Yamuna River ; Spatial variation ; Nitrogen; Phosphorous

CLIMATE CHANGE TECHNOLOGIES AND THE PROBLEM OF ELECTRONIC WASTE

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Climate change and its relation to waste menace is relatively an unexplored area of research, deprived of its due attention. In the era of assorted anthropogenic activities which take an inevitable toll on the earth's climate, adaptation and mitigation measures towards combating climate change become utmost priority. Most of the climate change alleviation attempts involve some form of technological intervention(s). Be it catalytic converters to sustain air quality or improved water treatment facilities, solar panels and earth observation systems towards accurate weather forecasts- all are reliant on technological interventions. *As technological solutions become central to climate change combating interferences, the burgeoning problem of* ***Electronic waste (E-waste)*** *arises.* E-waste is nothing but a form of technological waste consisting of obsolete electronic and electrical appliances. In this paper, we argue that although climate change technologies have contributed significantly towards combating climate change, at the same time, it is responsible for contributing to the ever growing mount of E-waste globally. An attempt has been carried out to figure out a range of climate change adapting technologies, their material composition and eventual outcome as E-waste. Major E-waste management challenges in India have been addressed with special focus to the *city of* ***Pune, Bangalore and the State of Assam***. An analysis of the informal recycling sector involving a large number of urban poor (especially in countries like ***India and China***) and its socio-economic-environmental-health hazards are assessed. Both primary and secondary sources of data were evaluated. Results show that a significant number of the initiatives towards combating climate change involve some form of technology. The electrical and electronic equipments involved with these technologies will become obsolete after a specific period of time and eventually would contribute to the E-waste stream. Thus, while ***combating*** *a serious global issue* in the form of climate change, we are ***creating*** *another* by generating the toxic pile of E-waste. Climate change and its relation to waste menace have the potential to challenge the notion of climate justice. It calls for an integrated approach where climate change and waste, both could be dealt with sustainably.

Keywords: Climate Change; E-waste; Management; Climate Change Technologies; Health

GREEN HOUSE EFFECT REDUCTION BY RECOVERING ENERGY FROM MUNICIPAL SOLIDWASTE LANDFILLS

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Landfills around the world are one of the major contributors of global warming and climate change. In developing countries like India municipal solid waste (MSW) generation is increasing enormously and the waste generated is landfilled in open dumping non-engineered sites. Although landfilling should be the last option in the hierarchy of waste management due to high greenhouse gas emissions (GHG) emissions but still due to its economics it is very common around the world. Carbon dioxide, methane, nitrous-oxide are the major GHG's which are emitted from the landfill areas and add significantly to global warming. Methane emissions from landfill is estimated to account for 3-19% of the anthropogenic sources in the world. The global warming potential of methane is 21 times more than that of CO_2 and it has highest generation (40%-60%) than other gases. At present GHG emission from non-engineered landfills remains a big issue for MSW management in India. The landfill gas utilization as energy resource is not well studied and practiced in India. Whereas a large number of studies are available in western countries on landfill gas utilization as renewable energy resource. Therefore, there is a concern for the utilization of CH_4 from the landfill areas. Need to plan, construct a engineered landfill site from where GHG can be trapped and used as a green source of energy as it is done in most of the developed countries which will further reduce the greenhouse effect to some extent.

Key words: Municipal Solid waste, non-engineered landfills, Greenhouse gases (GHG's)

MODELLING FIRE HAZARD IN RAJAJI NATIONAL PARK, UTTARAKHAND USING REMOTE SENSING AND GIS TECHNOLOGY

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Rajaji National Park is an interesting animal habitat because of its location at the meeting point of the lesser Himalayan foothills and the beginning of the vast Indo-Gangetic plains. It spreads over 820.42 sq km area. Forests types mainly consists of moist Shiwalik sal forest, dry Shiwalik sal forest, dry deciduous scrub, upper or Himalayan chir pine forest, khair-sisso forest, west gangetic moist mixed deciduous forest and northern dry mixed deciduous forest besides having artificially developed grasslands to sustain herbivores. Forest fire during summer months is a major problem in the park, which most of the times result into loss of fodder, habitats, as well as death of wildlife too.

In the present study an attempt has been made to develop a hazard model to predict the occurrence as well as spread of fire in Rajaji National Park by using multi source data comprising cartographic documents, satellite imageries and statistical information about the fire history of the region. It is based upon a combination of remote sensing and GIS data. In this study Landsat-8 satellite image, SOI Topo-sheets and Garmin 76 GPS were used. Parameters that affect the fire such as topography, vegetation, drainage, settlements, road network, watch towers and fire stations were integrated within GIS. Multi-temporal fire hot-spot data from MODIS were used as reference data. The relation between the occurrence of wild fires and the influencing factors was searched for. Each factor was divided into thematic classes, and based upon the fire frequency within each thematic class, a thematic hazard function was determined. The hazard of the fire spreading was obtained by applying suitable mathematical operators on different thematic hazard maps. The results of the analysis were shown by reports and graphs. The evolved GIS-based forest fire hazard model of the study area was found to be in strong agreement with actual fire-affected sites. The resulting map can be of great use for the understanding of the fire problem and can be a good tool for the management of forest fire in the park.

Keywords: Fire Hazard, Landsat, Forest Fire, Fire management, GIS & RS.

RS AND GIS TECHNOLOGY FOR EIA UNDER CHANGING CLIMATIC SCENARIO OF KASHMIR HIMALAYAN VALLEY

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A study carried out at Centre for Climate Change and Mountain Agriculture, SKUAST-Kashmir, India during 2013-14 to prepare the natural resource inventory of one of the districts (Budgam) of Kashmir Himalayan valley and to generate thematic maps by using RS and GIS technology. In the phase of generation of the subsidiary layers "ASTER Digital Elevation Model" (30m) was used for Geomorphological Morphometric, Vegetative, Terrain and Land use Land cover studies. The various thematic layers thus generated include terrain and watershed characteristic layers and include watershed maps, drainage map, slope map, stream order and flow path using inbuilt watershed analysis module of TNT-Mips software. The major watersheds of the district include Doodganga (38701 ha), Sukhnag (36827 ha), Hokersar, (15812 ha), Arzan (2207 ha) and Garzan (3509 ha) respectively. Highly steeper slopes (>60%) in the area show less vegetation classes as that of low lying areas with very gentle to nearly level slopes (0-5%) including area under different crops. Profiles generated from any 3D line feature(s) drawn over a surface reveal that the variation of altitude from 1500 m to above 4000 m from SW to NE direction in the middle of district, while as it varied from 4000 m to 3700 m with highly undulating mountainous terrains in the S-Western region of the district. These subsidiary layers give an insight into the overall on ground scenario and thus help in developing a consensus on site specific management and planning of the natural resources and adhering to "Best Management practices" under changing climatic scenario in the valley. The data also shows that district dominated in agriculture land use (33%) followed by forests (22%), snow and glacier (13%), mixed plantation (8%), alpine meadows and grasslands (6%), orchards (5%) and waste lands (4%).

Keywords: RS and GIS technology, Digital Elevation Model, Best Management practices

EMISSION STUDIES OF GREENHOUSE GASES FROM DIFFERENT PADDY FIELDS OF INDO-GANGETIC REGION USING CLOSE CHAMBER TECHNIQUES

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Rice agricultural cropping systems significantly contribute towards the emission of methane (CH_4) and nitrous oxide (N_2O) the two important trace gasses responsible for climate change. The current concentration of 1.72 ppmV of CH_4 in the atmosphere accounts for 15% of the enhanced greenhouse effect and the atmospheric concentration of CH_4 is increasing at the rate of 0.3 percent per year. The CH_4 and N_2O emissions from rice (*Oryza sativa. L*) Paddies are from lowland water irrigation. The paddy crops remain mostly under typical water regimes which are characterized by flooding midseason, re-flooding and moist intermittent irrigations. In the present study, CH_4 and N_2O emission measurements were carried out using the manual close chamber methods. Four datasets of methane and nitrous oxide have been analyzed for Indo-Gangetic region. The irrigated rice paddies measurements for CH_4 and N_2O in morning 09:00 am to 10:00 am and 02:00 pm to 03:00 pm in evening with 00, 30, 60 minutes time intervals were carried out placing close chambers in the fields with different locations in the Indo-Gangetic region. The low land rice soil is considered to be one of the major contributors of atmospheric methane. It was found that the flux of CH_4 varied between 0.86 to 9.32 mg/m^2/hr and N_2O varied between 55.90 to 229.92 ug /m^2/hr in different locations.

Keywords: Rice cropping system; Emissions; Methane; Nitrous-oxide; Close chamber method.

PHYSIOLOGICAL AND MOLECULAR MECHANISM OF CYTOKININ INDUCED DROUGHT TOLERANCE IN WHEAT (*TRITICUM AESTIVUM* L.)

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Wheat is one of the most important cereal crops but water stress during reproductive stages limits its production. Plant growth regulators play an important role in plant response to water stress and cytokinin is important among them, it can induce water stress tolerance by delaying leaf senescence. The present study was conducted to determine the effect of cytokinin treatment under two different water regimes (control and water stressed) in two contrasting cultivars, water stress tolerant C-306 and water stress susceptible PBW-343. In water stressed plants significant reduction were observed in traits related to photosynthesis, nitrogen metabolism, stress tolerance ability, growth related traits and yield attributes which includes RWC, MSI, chlorophyll and carotenoid content, photosynthesis rate, stomatal conductance, photochemical efficiency, total sugar, total starch content, nitrate reductase, glutamine synthetase, plant total nitrogen and total protein content. Cytokinin (BAP; 40 µM) treated plants were observed with higher activity of all the parameters studied in relation to above mentioned traits in both the wheat cultivars under moisture deficit condition. Under water stress condition there was significant decrease in plant growth and yield which enhanced by treatment of cytokinin. However, sensitive cultivar PBW-343 was found to be more responsive to cytokinin treatment under water stress condition, in comparison to drought tolerant cultivar C-306. Expression of Rubisco, Oxygen evolving complex, D1, Isopentenayl transferase, Dehydrin and Cold up regulated gene was also studied and significant enhancement was observed on cytokinin application.

Keywords: Cytokinin, Oxygen evolving complex, Rubisco, Isopentenayl transferase

A PLANT BASED BIOASSAY TO ASSESS THE LEVELS OF POLLUTION IN YAMUNA RIVER (DELHI REGION)

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In the era of climate change we are witnessing erratic pattern of rainfall leading to drought globally. This is directly affecting the food security of countries including India. Further the problem is aggravated by the pollution of rivers. The polluted river water is directly used for irrigation in Delhi as well as other parts of the country. Polluted water contains various kinds of biological and chemical pollutants (pesticides, heavy metals etc.) which undergo bioaccumulation and leads to various health hazards. The Central Pollution Control Board, New Delhi in a recent report stated that Yamuna River in Delhi carries drains not water. The distance covered by Yamuna in Delhi is 2% of total river's length (22 km) and accounts for 70 % pollution. In our study we collected water samples from seven different locations of Yamuna River in Delhi region and tap water was taken as control. Various water quality parameters like pH, salinity, electrical conductivity (EC), turbidity, dissolved oxygen, total dissolved solid (TDS) were measured with the help of standard instruments. Yamuna water at Site 1 (Yamuna Ghat) was found to be least polluted whereas water at Site 7 (Okhla Barrage) was found to be most contaminated. At Site 1 water showed alkalinity whereas maximum salinity in water samples was at Site 4. The TDS, EC and turbidity at Site 5 were the highest. These various water samples were also used for growing onion. After 3 and 7 days growth, onion roots were studied morphologically as well as cytologically. The results showed sharp decline in root length and root number as we moved from Site 1 to Site 7. The root tip squash preparations showed significant cell and chromosomal abnormalities. Tremendous variations were observed in cell shape and size. Cells were found to be very large, conical, elongated and displayed variations in the shape of nuclei. At site 7 maximum numbers of abnormalities in cell as well as nuclei were observed and cell nucleus appeared as an aggregation of micronuclei. Lot of cells were found to be undergoing abnormal mitosis with formation of chromosomal bridge. This report proves the cytotoxic and genotoxic effect of Yamuna water, a cause of major concern. The abnormal images of cells and nuclei can be used for mass awareness campaign to educate people about the harmful effect of water pollution on plant system.

Keywords: Pollution, Yamuna, Chromosomal abnormalities, Water quality, Cytotoxic, Genotoxic

SUPERLATIVE IMPACTS OF A SUPER GREENHOUSE GAS, SULFUR HEXAFLUORIDE (SF_6)

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The greenhouse effect is the natural process that is pivotal in the process of warming earth's surface and hence making it an inhabitable planet. The human-generated greenhouse gas emissions perturb the natural balance in the atmosphere causing the global warming and hence the climate changes. Out of all the greenhouse gases, the concentration of carbon dioxide in atmosphere has shown a quantum jump from the preindustrial levels. Scientists have worked and are still working towards the mitigation of its myriad effects. What really has been lowballed is the predicted catastrophic impacts of the *other* greenhouse gases like fluorinated gases such as perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6) which contribute only 3% of all the greenhouse gases.

In this paper, the source of SF_6 emission in the atmosphere, its impact and the future challenges in its mitigation scenario is reviewed. It is the long lived molecule with the lifetime of 3200 years and with the global warming potential (GWP) of 23,900. SF_6 is emitted through a variety of industrial processes such as from magnesium processing and semiconductor manufacturing industries. Due to its excellent electrical insulating properties, it is also used as insulation in switch gears. Its production is alarmingly increasing worldwide despite the fact that this greenhouse gas is listed undesirable in the Kyoto protocol (signed in 1997 which extends the United Nations Framework Convention on Climate Change). Fluorinated gases can only be removed from the atmosphere when they are destroyed by sunlight in the far upper atmosphere. Hence the Kyoto treaty stipulates that emissions of SF_6 must be reduced and the key to it is spreading the awareness for discouraging its use before it reaches its full potential.

Keywords: Greenhouse gases, Climate change, Sulfur hexafluoride, Carbon dioxide, Fluorinated gases.

EFFECT OF 28-HOMOBRASSINOLIDE ON ANTIOXIDANTS AND OSMOLYTES IN *BRASSICA JUNCEA* L. UNDER TEMPERATURE AND SALT STRESS

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Brassinosteroides biosynthesis takes place from campesterol and is involved in plant defense responses against abiotic and biotic stresses. Temperature played a very crucial role in various important metabolic processes, including crop production and plant disease management. To maintain crop growth under temperature stress, plants needs extra nutrient and water resources which are provided by exogenous application of fertilizers and artificial irrigation. Application of excess fertilizers and artificial irrigation make soil more saline which lead to salinity stress in crops grown in such soils. Combination of temperature and salt stress proved worst for crop productivity, which leads to overproduction of reactive oxygen species resulted in long term damage or even the death of the plant. BRs have shown good potential as an anti-stressor and in mitigation of reactive oxygen species by increasing the activities of antioxidants and accumulation of osmolytes. Present proposal has been made to explore the potential of 28-homoBL in regulating antioxidants and osmolytes under temperature and salt stress. Ten day old seedlings of *Brassica juncea* were analyzed for activities of antioxidants and osmolytes under temperature and salt stress. From results, it has been concluded that 28-homoBL regulated antioxidants and osmolytes production in a positive manner under stress and non-stress conditions.

Keywords: Brassinosteroides, Temperature stress, Salt, Antioxidants, Osmolytes

EFFECT OF TEMPERATURE ON SOME FUNCTIONAL BACTERIA IN GROUNDNUT (*ARACHIS HYPOGAEA* L.) RHIZOSPHERE AT DIFFERENT PHENOLOGICAL STAGES

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The impact of temperature in the present and future climate change scenarios on some functional bacterial populations in rhizosphere soil was investigated. Groundnut variety B-95 was planted with four treatments of temperature. Rhizosphere soil samples were collected at the vegetative, flowering, pod development and maturity. Numbers of bacteria involved in nitrogen-fixing, phosphate-solubilizing and potassium-dissolving were measured with cultivation-dependent approaches. The data presented here showed consistent statistically significant differences in the numbers of different groups of functional bacteria between rhizosphere soil from ambient and above ambient temperature treatment from germination to maturity as well as obvious trends in the numbers of the various group of functional bacteria with the different crop growth stages in groundnut. These studies suggest that +2-3°C elevated temperature conditions from germination to flowering affected the functional bacterial populations in rhizosphere soil positively with 7.0%, 6.6% and 3.0% increase in NFB, PSB and PDB respectively at complete flowering when compared to the ambient. The increase in the count of the functional bacteria in question were also shown to correlate with the various phonological parameters There was a significant variation ($p \leq 0.05$) in plant height, number of leaves, root length, roots dry weight, fine root dry weight and number of nodules of groundnut in elevated temperature condition from germination to maturity. Elevated temperature condition throughout the growing season increased plant height with 1.6 times increase from the ambient at complete flowering. The maximum root length (12.5 cm) was recorded in above ambient temperature condition from germination to maturity at maturity which was significantly 6.4% higher than the ambient.

Keywords: Functional bacteria, Groundnut, Rhizosphere soil, Climate change, Elevated temperature

IN VITRO ANTIOXIDANT ACTIVITY OF *ARAUCARIA CUNNINGHAMII* AITON EX D. DON LEAF EXTRACT

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Free radicals are responsible for numerous disorders in body. It is necessary to find out natural sources of antioxidants like plants. *Araucaria cunninghamii* Aiton ex D. Don is a gymnosperm belonging to family Araucariaceae. The objective of the present study was to explore the antioxidant activity of *Araucaria cunninghamii* Aiton ex D. Don extract. The dried leaves of *Araucaria cunninghamii* were extracted with 80% methanol. The antioxidant activity of the extract was estimated via *in vitro* model systems such as DPPH, reducing power and nitric oxide scavenging assays. The total phenolic, flavonoid and tannin contents were calculated. Several polyphenolic compounds were also investigated using HPLC. Noteworthy antioxidant activity of extract was observed in all the three assays. A positive correlation between the antioxidant activity and phenolic content was observed. Significant antioxidant potential of the *Araucaria cunninghamii* leaves may be due to the polyphenolic compounds present in the leaves.

Keywords: *Araucaria cunninghamii* Aiton ex D. Don, HPLC, Antioxidant activity.

INFLUENCE OF TEMPERATURE STRESS ON LIPOXYGENASE, OXYLIPIN PRODUCTION AND ANTIOXIDANT ENZYMES

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Global climatic changes such as increased temperature, carbon dioxide and ozone can alter growth characteristics of plants. These parameters include membrane lipid peroxidation, osmotic adjustment and activity of antioxidant enzymes such as superoxide dismutase, catalase, and peroxidase. To understand the impacts produced by temperature stress and whether exposure to heat stress would lead to oxidative stress, studies have been performed in plants such as *Zea mays*, *Agrostis palustri*, *Phalaenopsis*, *Olea europaea*. It has been reported that heat stress affects photochemical efficiency, chlorophyll content of leaves, lipid peroxidation of membranes, malondialdehyde production and activities of antioxidant enzymes including superoxide dismutase, catalase, and peroxidase. Decrease in activity of antioxidant enzymes result in an enhanced lipid peroxidation of cell membranes. Fatty acids constituents of membranes function as modulators of a many signal transduction pathways induced by environmental stimuli. In response to specific stresses, plants produce distinct oxylipin signature. Oxylipins are synthesized upon the action of lipoxygenase on polyunsaturated fatty acids. Linoleic acid is oxidized into highly reactive compounds such as 9- or 13-hydroperoxy-octadecatrienoic acids, or a mixture of both, by lipoxygenase. Such compounds are metabolized into different secondary metabolic pathways, responsible for distinct biological functions which also include jasmonates. Oxylipin precursor of 12-oxo-phytodienoic acid has also been reported to be expressed during water stress in *Arabidopsis*, such plants exhibited reduced stomatal apertures and enhanced drought tolerance. Temperature-stress induced activities of reactive oxygen scavenging enzymes indicate that antioxidants enzymes and metabolites both may play an important role in protecting cells against the temperature-stress. Thus, an understanding of physiological and biochemical factors involved in temperature stress would help improve heat tolerance of plant species facing abiotic stress induced by climatic changes.

Keywords: *Arabidopsis*, Oxylipin, Malondialdehyde, Jasmonates

PESTICIDE STRESS PROTECTION BY 24-EPIBRASSINOLIDE IN *BRASSICA JUNCEA* L. PLANTS

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Increasing demands of food due to population explosion has resulted in enhanced use of fertilizers and other chemicals like pesticides. These chemicals being long persistent and non-biodegradable in nature result in toxicity to living organisms. Plants have the potential to take these toxic substances along with their nutrient part from soil. The phytoremediation property of some vegetable plants is useful in cleaning of contaminated soils. Brassinosteroids (BRs) are a new class of plant polyhydroxysteroids which are present in low levels in pollens, seeds, and young vegetative tissues and are distributed throughout the plant kingdom. BRs play key roles in physiology of plants including cell elongation, differentiation, pollen tube development, vascular bundles differentiation and activation of enzymatic as well as photosynthetic activities. They also play very important role in protecting plants from adverse biotic and abiotic stress conditions including temperature, salt, drought, ozone, pesticides and herbicides. Keeping in view the role of BRs in pesticidal stress protecting properties in plants, the present study aims to explore the effect of 24-epibrassinolide in combination with pesticide Imidacloprid (IMI) in *Brassica juncea* L. plants on morphological parameters, photosynthetic parameters and antioxidative defence system including enzymes of antioxidative defense system. It was observed that 24-epibrassinolide resulted in improvement of plant growth, photosynthetic pigments and antioxidative defense system of *Brassica juncea* L. plants.

Keywords: *Brassica juncea*, Antioxidant defense system, Climate Change

CASTASTERONE AMELIORATES OXIDATIVE STRESS IN *B. JUNCEA* L. PLANTS UNDER COPPER STRESS

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Increasing industrialization and development in the technology has led to heavy metal pollution. These heavy metals shows various negative effects on plants such as reduced growth, decreased metabolism, changes in photosynthetic apparatus etc. Copper is one of the heavy metals which is hazardous due to its presence in fertilizers and pesticides. It is toxic to plants and cause inhibition in pigment synthesis, photosynthesis and thus affects growth. Brassinosteroids are plant steroids which have been reported to provide resistance towards various stresses. In the present study, the effect of Castasterone on photosynthetic machinery and morphological parameters was studied under copper stress in *Brassica juncea* L. plants. The seeds were soaked in the castasterone solution for 8 hours and grown in the pots containing Cu treated soil. Plants were harvested on 30th and 60th day and used for various estimations. Decrease in the morphological parameters was observed with metal treatment while the castasterone treatment enhanced the plant growth. Photosynthetic pigments were analyzed using spectrophotometer while IRGA was used to study other photosynthetic parameters. Photosynthetic pigments were reduced with the copper treatment while the treatment of castasterone has shown effective improvement in photosynthetic pigments while other parameters also showed ameliorative effects of the steroidal hormome.

Keywords: Castasterone, Copper, Photosynthesis, Pigments.

CLIMATE CHANGE: MATHEMATICS AND SOME NEW TECHNIQUES

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Mathematics is involved at every level of understanding climate change, including the description, prediction and communication of climate change. In the present era the knowledge of mathematics is a must for every one if we wish to save our planet earth. Mathematics education can play a very important role in understanding and even tackling climate change. In this paper, we shall be discussing the mathematics used in the models which is nothing but a collection of some mathematical equations which collectively make some sense and gives a meaningful outcome after its analysis. This outcome is the key to understand the fast changes arising in climate due to our mistakes and how we can play our role in making it a better place. We shall also give some new mathematical techniques (bicomplex numbers), which can be useful to solve these mathematical models and the results could be faster and easier by using them.

Keywords: Climate change, Bicomplex numbers

IN VITRO INDUCED MUTAGENESIS IN CITRUS JAMBHIRI LUSH. FOR RESISTANCE/TOLERANCE TO PHYTOPHTHORA PARASITICA

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The present study deals with in vitro induced mutagenesis and selection of *Phytophthora* tolerant lines of *Citrus jambhiri* and their regeneration. For in vitro induced mutagenesis cotyledons were treated with EMS 100 mM, 200 mM and 300 mM for different time durations viz. 1h, 3h, 6h and 9h. Callus cultures were established from EMS treated cotyledon explants on MS medium supplemented with 2.0 mg/l of 2,4-D and 500 mg/l of ME. Calli derived from cotyledon were challenged in vitro on selective MS medium containing 5-100% of culture filtrate (CF) of the *Phytophthora parasitica*. Selected mutagen-treated calli showed resistance in vitro on media containing culture filtrate. Calli treated with 100 mM EMS for 6h duration showed tolerance (24%) up to 75% CF after 4th selection cycle. While, calli treated with 200 mM for 6h duration showed maximum tolerance (76%) up to 75% CF. Resistant calli were then transferred to MS regeneration medium for shoot bud regeneration. A dose dependent decrease in the regeneration capacity of the selected calli was observed with the increasing concentration of the culture filtrate. In RAPD analysis, plantlets showed different banding pattern in comparison with the control plant, which confirms the presence of variations at genetic level, which may supports the presence of tolerance to culture filtrate of *Phytophthora*.

Keywords: Culture filtrate, Resistance, *Citrus jambhiri*, EMS and *Phytophthora parasitica.*

RESPONSE OF WHEAT PLANTS TO DIFFERENT LEVELS AND FORMS OF NITROGEN

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Indian soils are deficient in nitrogen and nitrogen use efficiency is between 33-50% depending on the crops. The present experiment was conducted to find out the response of wheat to different N supply and forms. It was noticed that wheat is sensitive to ammonia and N limiting conditions. Wheat seedlings (*var*. PBW 343) were grown under four different N treatments and various parameters of growth and N-assimilation were studied. Growth and nitrogen metabolism was enhanced in seedlings under high NO_3^--N when compared to those grown with low and without N. The growth of the wheat seedlings was severely inhibited in terms of biomass accumulation, leaf area in NH_4^+-N and zero–N treatments. Root: shoot ratio was enhanced in zero- N and ammonium grown plants as compared to the nitrate N fed wheat seedlings. There was a relative increase in shoot length by 20% to 40% in the seedlings grown in solution having N salts. In zero-N and ammonium fed plants the nitrate levels, total reduced N and total soluble protein content was significantly lower as compared to both low and high NO_3-N grown wheat seedlings. These parameters directly correlated with low NR activity in zero-N and NH_4^+-N treatments.

Keywords: Wheat, NR, Nitrogen metabolism, Nitrate

ISOLATION AND SCREENING OF FACE SOIL BACTERIA FOR PRESENCE OF RUBISCO

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Free Air Carbon Dioxide Enrichment (FACE) field was selected as the sampling site. Soil samples were collected from surface soil of FACE (exposed) site being maintained at 600 ppm CO_2 for 5 years. Surface soil samples were also collected from an unexposed field and taken as control. Both samples were serially diluted and six bacterial colonies were isolated from exposed and two from control sites. All the isolated strains were enriched for 30 days in MSM containing 50 mM $NaHCO_3$ solution in eight different culture flasks incubated at 5 % atmospheric CO_2, 30 ºC and 150 rpm. Growth of all the strains was monitored by taking absorbance at 600 nm. All the enriched strains were inoculated in 150 mL LB broth and the bacterial pellets were used for analysis of RuBisCo protein using SDS-PAGE followed by Western Blotting. Detection of protein was done using horseradish peroxidise with luminol as the chemiluminescent substrate. The bacterial colony which showed positive result was identified using 16 S rDNA sequencing.
Keywords: FACE; CO_2 sequestration; RuBisCo; Bacteria; Western Blotting

Keywords: Carbon Dioxide Enrichment, Chemiluminescent, Peroxidase

INFORMATION TECHNOLOGY AND THE ENVIRONMENT OVERVIEW AND FUTURE PERSPECTIVES

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This paper describes how information technology plays an important role to solve the problems related to environment. It analyses the role of information technology (IT) in providing access to environmental information or for the solution regarding the problems related to environment. This paper is divided into two sections. In section A, It describes some basic ways IT may be applied in environmental safety. First, through the use of Information Technology in environmental things, the public can be informed about the basic information and condition of the environment like awareness program. This article analyses the information systems of the Indian Agencies for Environmental Protection and the future possibilities of using these. Second, IT can also be used as a way of regular communication between government policies and public. In accordance with the rules of transparency, government bodies are obliged to provide an adequate way for the public to have an insight into their work. In addition, the authorized person is responsible for the accuracy of this information and for providing public access. In this sense, the paper analyses the legal frame of e-access to environmental information. Third, the application of IT related with environmental matters, how promote public participation in environmental decision-making. If there is a legal framework, the public would be able to participate in procedures, such as environmental impact assessments, by submitting their opinions as a e-documents. This paper points out the co-relations between the application of IT and public awareness regarding the environment and the impact of these relations have on environmental protection. In Section B, It describes the positive and negative impacts of information technology on the environment and how we can find the solutions on environmental challenges that are facilitate by an armaments of information technology like use of database etc. Conclusions are drawn regarding the possibilities for bringing future technological progress optimally into line with environmental management, and the drawbacks associated with this.

Keywords: Information technology, E-access, Environmental information, E-document

SEMICONDUCTOR PHOTOCATALYSIS: A POWERFUL TOOL FOR ENVIRONMENTAL REMEDIATION

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Over a last few decades, problems related to the elimination of hazardous wastes have emerged as a matter of considerable importance for all the developing and developed nations. Significant research has been done and more of it is still underway to develop advanced physicochemical methods for the elimination of hazardous chemical compounds from air, water and soil. Semiconductor photocatalysis is one of the advanced approaches for the decomposition of harmful dyes and organic pollutants. Starting from the first report on TiO_2 as the UV light active photocatalyst, numerous reports can be found in the literature for various UV and visible light based semiconductor photocatalysts thereafter. Successful attempts have been made to synthesize photocatalysts such as ilmenite $AgSbO_3$, defect pyrochlore $Sn_{0.92}Sb_2O_6.2.0H_2O$, and trirutile $ZnSb_2O_6$ by employing approaches other than the conventional synthetic methods known in materials synthesis. These soft chemical routes include methods such as low temperature ion exchange in molten salt and aqueous solutions. Low temperature hydrothermal synthesis also resulted in the synthesis of compounds with smaller particle size and hence larger surface area. These materials were characterized by various techniques like powder X-ray diffraction for phase purity, scanning electron microscopy for surface morphology and UV-visible diffuse reflectance for absorption bands and found to be active for the photocatalytic degradation of pollutants under UV and visible light irradiation. The various organic pollutants decomposed were dyes such as methylene blue (MB), rhodamine B (Rh B), methyl orange (MO) and organic compounds such as 4-chlorophenol. An attempt is made here to give an overview of the principles governing semiconductor photocatalysis combined with the description of a few literature results in the present field.

Keywords: Semiconductor photocatalysis, Hazardous wastes, Organic pollutants

ROLE OF SCIENCE AND TECHNOLOGY IN CLIMATE CHANGE MITIGATION

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Climate change is challenging almost all human events, including future ways in which energy will be produced and disbursed. Over the past 100 years, anthropogenic activities have intensely altered the composition of the atmosphere. The radiative balance of the Earth could be potentially altered by the changes in infrared absorbing gas concentration. Today's world is a place of uneven development therefore, unsustainable use of natural resources resulting in increased fossil fuel consumption, land use changes and continued poverty and malnutrition are some of the major sources of anthropogenic climate change. The United Nations Environment Programme (UNEP) (2010) has noted that "doubling of wealth leads to 80% higher CO_2 emissions". To resolve these problems, researcher should apply direct remediation strategies, such as reducing the atmospheric levels of CO_2 by stimulating photosynthetic processes. A much more effective, short-term remediative strategy would be to recycle extant biomass and reduce anthropogenic fixed nitrogen demands. Biotechnology is a platform technology that may support to reduce greenhouse gas emissions from agriculture, improve adaptation to climate change, offer new sources of renewable energy and transform the current petrochemical industry into a less energy intensive biological industry. The new tools of biotechnology have already contributed to the development of many new products and processes in agriculture and industry that are relevant for climate change mitigation and adaptation. The green biotechnology contributes in field of agricultural and environmental applications thus can help to remediate environment pollution, climate change problem and also solve food scarcity problem worldwide.

Keywords: Climate Change, Anthropogenic activities, Radiative balance

RADIATION AND CLIMATE CHANGE

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Radiation is essentially energy that travels from one place to another in the form of electro-magnetic waves. Radiation is pervasive and is of different kinds. The various kinds of radiation differ in their energy, frequency and wavelength. Radiation sources are mainly natural but partially manmade. The natural sources of radiation include radioactive minerals, cosmic rays and radio nuclides while that of manmade radiation include nuclear power plants, radio-active wastes, nuclear explosions and radio-isotopes. Radiation from manmade sources is chiefly nuclear radiation, a mixture of alpha, beta and gamma radiation which affects the genetic make-up of plant, animal and human populations. We do not have much evidence except for some disaster of the likes of Hiroshima, Nagasaki, Chernobyl and Fukoshima. Nuclear radiation is lethal as it not only causes mutations which get perpetuated in the future generations but also leads to climate changes. Nuclear war can put tons of smoke and dust into the stratosphere blocking sunlight resulting in ice age temperatures on earth, reducing global precipitation, destroying ozone layer thereby allowing huge doses of ultraviolet light to reach the surface. The cold and dust will shorten growing seasons causing widespread crop failures and global famine. The radioactive fallout and toxic pollution can cause global climate change leading to the collapse of the already stressed ecosystem. Thus nuclear radiation is a serious source of high levels of radiation however there are sources that generate low levels of radiation and remain concealed viz. mobile phones, mobile phone towers, cordless phones, as well as televisions, computers, microwave ovens, broadcast antennas, military and aviation radars, satellites, wireless internet etc. The balance in ecosystem is vital for its living as well as nonliving components and any imbalance can lead to serious effects on the environment. The low frequency electromagnetic waves from mobile towers have negative impact on wildlife particularly birds and bees. These waves not only obstruct the flight path of birds but the combined radiation from all towers in the area effect the arrival of migratory birds. The areas more prone to having high density of mobile towers do not receive migratory birds. Amidst these, there comes a climate warning with the installation of new nuclear reactors in India to meet our energy needs. Any disaster to the nuclear energy source is bound to have catastrophic effects not only on the climate but also on the mankind. But the paradox is that we need to have the reactors to become self-reliant for energy.

Keywords: Climate change, Radiation, Nuclear war, Nuclear reactor

FDI AND CLIMATE CHANGE: EVIDENCE FROM INDIA ON CO_2 EMISSIONS

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Climate change is one of the most pressing environmental problems today. United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as change in climate attributed directly or indirectly to human activities that alters the composition of the global atmosphere and that is in addition to natural climate variability. Various activities like burning of fossil fuels, industrial pollution etc and natural phenomenon like volcanic eruptions, forest fires, etc contribute to climate change. These activities increase atmospheric concentration of greenhouse gases like CO_2, CH_4, N_2O, which causes Global warming. The global warming leads to rising temperatures, melting of ice, climatic variability thus contributing to climate change. Most of the time climate change is studied with the scientific point of view which helps us to gain insight into the structure, intensity and impact of climate change. However, social scientists are now becoming interested in knowing the social and economic changes that causes climate change. Globalization has integrated the world economy and allows easy mobility of factors of production. This has lead to flight of capital to the developing and less developed countries where cost of production is low. Though this increases profits of MNCs but it also increases pollution through transportation and lax environmental regulations in these developing countries a phenomenon known as pollution haven hypothesis. Inflow of foreign direct investment (FDI) has increased in India especially in the aftermath of economic reforms. Although this has helped in augmenting production and developmental activities, there is need to analyze the environmental impact of this foreign capital inflow. That's why in this paper we examined the impact of foreign investment on carbon dioxide emissions (CO_2) for India from 1980 to 2010. Since continuous data on all the greenhouse gases is not available for India we have used data on CO_2 only. This can help us to know the impact of FDI on air pollution through CO_2. This is crucial with CO_2 being one of the main principle climate change agent globally and also, since climate has a significant role in the economic development of India. Many sectors of the economy are climate sensitive. Any changes in climate are going to affect not only human, environment but also our economy making us vulnerable to various threats.

Keywords: Climate Change, FDI, CO_2,

IMPACT OF ECONOMIC ACTIVITY ON CLIMATE CHANGE

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This paper uses Shapley decomposition technique to analyze the factor weights of select variables on carbon emissions for the period 1980-2011. The level of human activity may it be economic or non-economic, influence climate. In the recent times, there has been growing concerns on climate change since world is witnessing rise in CO_2 emissions. Rising carbon emissions-as explained by Kaya identity- could be due to three factors viz. increasing carbon intensity of economy, rising economic activity and increase in population. The factors responsible for carbon emissions by India, in descending order are: GDP per capita, Population and Carbon intensity of GDP. In the study, we found that India has witnessed reversal of rising trend of carbon intensity of GDP after 1990. Though India decarbonised i.e. experienced reduced carbon intensity of economy, movement of GDP sway carbon emissions.

Keywords: Kaya identity, Shapley decomposition, Carbon intensity, Decarbonisation

USE OF ECONOMIC INSTRUMENTS IN ENVIORNMENT PROTECTION: AN ANALYSIS

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Concerns over the cost of pollution control and persistence of pollution problems have raised interest in the use of economic policy tools and instruments for environment protection. Economic instruments are applied across a wide range of sectors including land, water and air management, control or reduction of pollutants. They either drive up the cost of environmentally harmful activities or increase the return from sustainable approaches, thereby creating economic incentives to behave in a more environmentally responsible and sustainable manner. By their nature, economic instruments can increase efficiency by allowing polluters greater flexibility in deciding how and when to meet their targets, while encouraging the design of new and improved abatement technologies. Economic instruments can also lower regulatory expenditures as less monitoring and surveillance is often required. In addition, some economic instruments will actually raise revenue for the government. The traditional forms of environment regulation took the form of a so-called command- and control regulatory approach, direct government regulations that require certain types of behavior; either by prescribing uniform environmental standards or the specific process or technology that must be used to be in compliance. In recent years, many of these instruments have proved to be either inappropriate or inefficient in a dynamic and largely integrated world scenario. As a consequence there is a growing interest in the use of different types of policy instruments ranging from green taxes and tradable permits to eco audits and eco labeling. These policy instruments either utilize or improve market power. An ideal instrument would move the nation towards a cleaner environment, be as cost effective and fair as possible and accommodate changes in science and technology. Finding such an instrument that meets all the criteria is a mammoth task. In my paper, I study a range of regulatory and non regulatory instruments to determine the relative effectiveness of these tools in achieving the goal of cleaner environment. The paper seeks to identify, evaluate and apply economic instruments to address a country's environmental problem.

Keywords: Economic Instruments, environment regulation, green taxes, eco audits and eco labeling

Theme: Economics and Climate change

CLIMATE CHANGE IN KASHMIR HIMALAYAN VALLEY: INDICATORS, IMPACTS AND ADAPTATION STRATEGIES

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Climate change is one of the important issues confronting the world and its impacts are also felt in mountainous State of J&K. Some of the indicators of climate Change in J&K Sate are erratic weather behaviour, early blossoming of flowers, shot and warm winters drying of wells, melting of glaciers, low discharge of water in rivers and streams, changing crop patterns, outbreak of diseases, increase in the frequency of wild fires, migration of wild animals to human habitations, successful survival of some new crops and increase in the frequency of natural disasters like floods and droughts. There is a need to combat the impacts of climate change by adopting certain adaptation strategies like, strengthening of agro advisories (weather updates and forecasting), screening of climate resilient varieties, use of traditional methods for the selection of the crops, improving water use efficiency, use of organic manures and resource conservation technologies. Further, mitigation strategies such as reduction in the greenhouse gas emissions, increase of vegetation cover, nutrient management in livestock, conservation of water and rain water harvesting and usage of waste water, use of clean / bio-fuels, solar energy, effective disaster management, promoting low carbon energy sources, cycling in traffic congested areas, and reduced emission from deforestation, management of fallow lands, soil conservation and rehabilitation of degraded lands etc. Moreover, there is an urgency to launch awareness amongst stake holders to cope with challenges of climate change. The paper discuss the weather trends in the past thirty years as well as the indicators, impacts and adaptation strategies to be adopted for combating the climate change in Kashmir Himalayan valley.

Keywords: Climate Change, Biological Effects, Impacts, Adaptation strategies

FOSTERING SUSTAINABLE PRACTICES IN INDUSTRIES: AN ACTION RESEARCH ON CAPACITY DEVELOPMENT OF MANAGERS TOWARDS CLIMATE CHANGE MITIGATION AND GREEN INDUSTRIALIZATION

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The concept of sustainability has been establishing a strong foothold in recent times for mitigation of climate change, with efforts ranging from reducing air emissions from our industrial processes to lowering our energy consumption, and much more. Manufacturing operations of industries have resulted in impact on resources, besides creating impacts on human health and wellbeing. This indicates towards a rampant need for the development and adoption of green building rating systems in manufacturing sector which will help in steering growth towards sustainable industrialization. The Industrial sector has pursued its manufacturing operations without giving much attention to environmental and health issues. This has resulted in an impact on resources, human health and wellbeing. This has resulted in an impact on resources, human health and wellbeing. Thus in this context, Indian Green Building Council (IGBC) has developed green factory rating system which can help address issues like energy efficiency, conservation of natural, betterment of working conditions and enhanced productivity. Its adoption can be accelerated by generating awareness amongst stakeholders of manufacturing sector to voluntarily adopt green practices for their factory buildings. The research brings out the action oriented approach followed to enhance knowledge and perceptions of stakeholders regarding climate change, sustainable development, green built environment and green rating systems with special reference to Indoor Environment Quality (IEQ) technologies since it has major impact on the health and productivity of the workers. Also, newer technologies used for IEQ by operational green factories were also studied in detail.

Newer technologies employed by existing green factories, as revealed by the study were Building flush out, entryway systems, high efficiency filters and so forth. Taking these as a framework, a training programme was prepared to generate awareness. The training programme, dealt in imparting knowledge on various issues such as sustainable development, green built environment, green factory rating system etc. It consisted of modules assisted with comprehensive tools like presentations, videos, pamphlet, training manual and handouts. The training programme resulted in change in knowledge and perception of stakeholders which was statistically analyzed. This change helped them to understand and appreciate how their practices and preferences in their factory buildings can contribute to good working environment thereby leading to a holistic goal of climate change mitigation and sustainable development. Thus, such interventions can be taken up at a wider scale to motivate community stakeholders to adopt green building guidelines.

Keywords: Climate Change, Green Factory Rating System; Mitigation; Industrial sector; Indoor Environment Quality technologies; training programme

LEED-EB IN INDIA: INITIATIVE TOWARDS GREENING EXISTING BUILDINGS

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One of the biggest polluters of the environment is the building sector, accounting for almost 30% of the global energy consumption and its associated GHG emissions. At the same time, it has the largest potential for cutting these emissions responsible for global warming. In India, there is a vast chunk of existing buildings that are not so efficient and thus, there is an immense potential for energy efficiency measures. United States Green Building Council has designed LEED-EB which is a rating system for greening existing buildings. But studies have shown that though there are many new green constructions taking place in India, there are very limited existing buildings going in for LEED-EB. Thus, the key objective of the study was to gain insight into the hindrances and catalysts associated with LEED-EB as a tool for greening of existing buildings. The study was undertaken in India in two buildings, one registered and the other certified under LEED-EB. Hindrances and catalysts associated with LEED-EB were studied from the perspective of building managers, architects and green building consultants. On analyzing the data, it was seen that Prestige, image and reduction in operational costs were the major catalysts behind LEED-EB. Better rental value, Improved Indoor Environmental Quality etc. emerged as catalysts with medium and minor importance. The major hindrances were found to be high renovation costs, difficulty in meeting prerequisites and unavailability of the required data for LEED-EB submission. Some hindrances with medium and minor importance were resistance to make changes in the existing buildings, lack of awareness among the stakeholders, lack of technology etc.

Keywords: Existing building; LEED-EB; Catalysts and Hindrances.

LEAD REMOVAL FROM WATER USING DEVELOPED ENERGY CANE MAGNETIC AND NONMAGNETIC BIOCHAR

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Pb^{2+} increasing contamination in water due to various anthropogenic activities has caused major concern and thus requires immediate attention. Adsorption is one of the emerging techniques for Pb^{2+} remediation. Nonmagnetic energy cane biochar (ECBC) and magnetic energy cane biochar (MECBC) was synthesised, characterised and utilized for aqueous Pb^{2+}remediation. The nonmagnetic (ECBE) and magnetic energy cane biochars (MECBC) were characterised for their BET surface area and porosity. VSM, SEM, TEM, XRD, FT-Raman, FT-IR were studied to analyse their magnetic moment, surface chemistry, mineralogy, crystallinity, elemental composition and functional group identification. Batch sorption studies were conducted for both nonmagnetic and magnetic biochar to find sorption efficiency. Maximum Pb^{2+} adsorption (ECBC: $Q^0_{25^0C}$ = 45.70; $Q^0_{35^0C}$ = 52.01 and $Q^0_{45^0C}$ = 69.37 and MECBC: $Q^0_{25^0C}$ = 40.56; $Q^0_{35^0C}$ = 51.17 and $Q^0_{45^0C}$ = 51.75) was achieved at pH 5.0. Kinetic studies were conducted to establish the mechanism of Pb^{2+} adsorption at different dose and time on biochars. Negative sites developed on biochar due to various oxide groups at higher pH increased attraction between biochar surface and Pb^{2+} ions. This caused the removal of Pb^{2+} ions from contaminated water. Significant amount of oxygen containing groups revealed through studies showed possibility of penetration of water and pollutants below pore surface throughout solid volume of biochar. Higher adsorption capacities were obtained for nonmagnetic biochar (ECBC) versus magnetic biochar (MBC). Furthermore, the Langmuir adsorption capacities are more or comparable to the adsorption capacities reported in literature. Magnetic biochar (MECBC) can easily be recovered from waste water using low external magnetic fields. These findings suggest that developed biochars may be used to remediate lead from contaminated water.

Keywords: Magnetic energy cane biochar, Nonmagnetic energy cane biochar, Adsorption, Bioremediation, Sorption studies, Kinetic studies.

MAPPING GROUNDED ACTIONS AND CLIMATE CHANGE: A CASE STUDY OF TEA GROWERS IN ASSAM

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Livelihood vulnerability linked to climate change has compelled people and communities in India to embrace a range of adaptation strategies. This paper intends to discuss the challenges faced by tea growers in the state of Assam with regard to their coping and adaptation strategies in dealing with recurring seasonal variability and extreme weather events. Tea or *Camellia sinensis* is a large and extensive industry in Assam that spans a huge spectrum of economic and social differences from large plantation owners to small subsistence growers. Studying the implications of climate change hence, as I will argue, will require being attentive as much to mapping the implications of changing weather and rainfall patterns as it will also require us to understand how social and economic differences determine adaptation and coping strategies.

This study while drawing upon my recent ethnographic field work-involving detailed interviews amongst different tea grower in Assam-will also discuss several government initiatives with regard to the Tea Industry. This paper will argue that the internal economic and social heterogeneity amongst tea growers-in terms of land ownership patterns and relative resource capacity-militates against any simple search for homogenous attitudes/perceptions/responses to local weather impacts. In effect, I will argue that policy initiatives to craft adaptation strategies and coping mechanisms with regard to climate change must be attentive to social and economic differences.

Keywords: *Camellia sinensis*, Challenges, Climate Change, Tea industry

SHIFT IN TRADITIONAL ECOLOGICAL KNOWLEDGE IN AGRICULTURAL PRACTICES OF HIGHLAND MOUNTAIN AGRICULTURAL SYSTEMS OF LADAKH (INDIA)

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Ladakh known as the cold desert of India constitutes the easternmost part of trans-Himalayan and lies in the rain shadow region of the Himalayas. This cold desert is characterized by extreme weather conditions like intensive sunlight, strong winds, high evaporation rate and cold nights. The temperature in summers ranges from 20◦ C-27◦ C and in winter it drops to -20◦C to -30◦C. The area receives annual rainfall of only 100-120 mm mostly in the form of snow; the rivers are glacial fed and has low diversity of xerophytes plants. The vegetation period is only 5-6 months long and during this short period agriculture and other economic activities are carried out. The region faces long harsh winters for the remaining six months. Since centuries Ladakh has been living in harmony with nature and traditional practices have sustained the required food demands. This paper aims to study the changes or shift in the traditional ecological knowledge in agricultural practices through personal interviews (especially with aged people above 70 years) and questionnaire method during monthly field visits. The villages chosen for study are Tia (3408 m) and Khardong (4117 m) asl. The altitudinal differences of these two villages result in farmers choosing different agricultural crops, local vegetables and fruits. It can be observed documented that since the last two decades there has been intensive change in the traditional agricultural practices due to change in climate and government development policies. The organic manure made from domesticated animals' waste and 'nightsoil' is slowly being replaced by chemical fertilizers which are provided by the government on subsidised rate. Tractors have become popular as large areas are ploughed easily in less time instead of using domesticated yak or 'dzo'. The traditional threshing and winnowing process which involves man and animal power are being replaced by threshing machines at the cost of soil and fodder quality degradation. Besides using the indigenous machine called 'rantak' (water driven mill) for grinding grains into flour modern machine grinder is used as it consumes less time and man power. With change in local knowledge, traditional knowledge is degrading at the cost of cultural and ecological degradation. Land use pattern and occupational structure is also affected in both the villages.

Keywords: Ladakh, Traditional ecological knowledge, Agricultural practices, Land use.

STUDY OF DROUGHT ADAPTATIONS THROUGH PRESSURE VOLUME CURVES IN CO-OCCURRING SHRUBS OF SEMI-ARID REGION

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Study of pressure volume curves of 8 co-occurring shrubs (*Balanites aegyptiaca*, *Carissa spinarum*, *Capparis sepiaria*, *Flueggea leucopyrus*, *Grewia tenax*, *Lantana camara*, *Rhus mysorensis*, *Ziziphus*) was done in a protected *Prosopsis* - *Acacia* mixed forest at Jawaharlal Nehru University, New Delhi. The study site is a part of Aravalli systems. Turgor loss point (TLP), Osmotic potential (Ψ_s), Relative water content at turgor loss point (RWC_z) and tissue elasticity (ε) were derived seasonally from pressure volume curves to determine responses and possible adaptations amongst the shrub species.
Osmotic potential at full turgor was high, RWC_z and tissue elasticity at turgor loss point (ε = 0-2MPa) were low for *Lantana camara*, *Carissa spinarum* and *Capparis sepiaria* during dry seasons indicating better adaptation of these species as compared to other neighboring species. *Carissa and Capparis* were most adapted evergreen native shrubs. *Lantana camara* showed better adaptations with minimum seasonal variations in tissue properties and lower tissue elasticity, attributing to its successful invasion over the area.

Keywords: Adaptations, Elasticity, Invasion, *Lantana camara*, Water Content.

WOMEN AS KEY AGENTS OF CLIMATE CHANGE ADAPTATION

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Women constitute a large share of the world's poor and lag behind men in education, income, and health. In the developing countries, women play multiple roles as providers, cultivators and care givers to the family members. They are more concerned about environmental issues because of their close association and have a key role in tackling climate change as consumers, educators and change agents in homes and society. They are also innovators, organizers with good social networking skills, which position them uniquely to minimise the harmful impacts of climate change on their families. They have the potential in terms of experience and a strong body of indigenous knowledge to combat the increased disaster risks and enable their families to cope with climate change. However, socio-cultural barriers and women's traditional roles confine them to home giving them little time to participate in community discussions, leadership and in taking action in their own homes for appropriate adaptation and mitigation strategies (UNDP, 2010). Their perspectives and needs are often not heard in policy formulation. Given the knowledge and skills, women can find sustainable solutions to reduce the vulnerability of their families to climate change.

The present study conducted on a statistically defined sample of 300 women drawn from the five major regions of National Capital Territory of Delhi highlighted that women cope to environmental stress by spending less time on household work, cutting down on leisure time, taking help of children or other family members. Women reported cutting down time on income generating activities. The coping strategies adopted by them involved a considerable amount of risk taking as they interfered not only with the household work but also with their income generating activities, education of girls and other opportunities for skill development. Several coping strategies were not sustainable since they shifted the negative impact to alter time or another target group and were in fact equivalent to maladaptation. The current study highlights the positive role that awareness and knowledge enhancement of women can play in dealing with climate stresses, extremes and disasters in a positive way. Access to information, knowledge and skills is one of the principal determinants of adaptive capacity of people to climate change along with institutions, infrastructure, technology, economic wealth and equity among populations (IPCC, 2001). It is therefore essential to engage women in initiatives to build adaptive capacity to deal with climate change and enable them to lead more empowered lives.

Keywords: Coping strategies, Climate Change, Gendered Impact, Women, Adpative Capacity

DEVELOPMENT OF LOW COST SUSTAINABLE GREEN BIOSORBENT TO MITIGATE WATER POLLUTANT

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Bioaccumulation and nonbiodegradability of toxic metal ions pose a serious threat to the environmental healths. The main sources of toxic metal pollution include anthropogenic activities such as discharge of industrialized wastewater without any treatment into natural ecosystems such as soil, surface and groundwater. Most of the heavy metals are carcinogenic in nature and considered as potential threat to human health and the environment. Lead is toxic and causes deleterious effect on living beings. Lead has reported to be responsible for metabolic poisoning and enzyme inhibition in living beings. Various methods are used for removal of heavy metals from aqueous solution such as, like chemical precipitation, coagulation, and ion exchange. These methods are expensive and not environmental friendly. Therefore, there is an urgent need to search for low cost adsorbents. Agricultural or plant waste materials could be used for such purposes. In this study biosorption potential of Pongamia Pinnata pods powder for removal of lead from aqueous solution was investigated. Batch experiments were carried out at different pHs, biosorbent doses, contact time and temperatures (25, 35, and 45°C). The optimum pH for lead metal removal was 5.0 at an adsorbent dose of 10 g/L at 25°C. The isotherm data obtained by experiments, were also fitted by Langmuir and Freundlich models. The effectiveness of this biosorbent for adsorption of lead ions from wastewater could be an ideal alternative to remediate wastewater contaminated with lead.

Keywords: Climate Change, Biosorbent , Impacts, Environmental Healths

CLIMATE CHANGE EXECRATED TOXIC IMPACT AND MITIGATORY EFFECT OF 24-EPIBRASSINOLIDE IN *BRASSICA JUNCEA* L. RLM-619 UNDER HIGH TEMPERATURE STRESS

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Agriculture sector represents a substantial part of the Indian economy and provides food and livelihood activities to much of the Indian population. While the magnitude of climate change impact varies greatly by region however it is expected to influence agricultural productivity and shifting crop patterns. Climatic changes and increasing climatic variability are likely to aggravate the problem of future food security by exerting pressure on agriculture. Increased concentration of greenhouse gases (GHGs) in the atmosphere resulted in warming of the global climate system by 0.74 °C between 1906 and 2005. The trends of rise in temperature, heat waves, droughts and floods, and sea level shown by the Indian scientists are in line with the Inter-Governmental Panel on Climate Change (IPCC) though magnitude of changes could differ. The mean temperature of Indian climate is projected to increase up to 1.7 ºC in Kharif (July to October) and up to 3.2 ºC during Rabi (November to March) season, while the mean rainfall is expected to increase by 10% by 2070. This increased temperature affects the agriculture productivity and shifting crop patterns in India. Acclimatization of crop plants to environmental stresses is dependent upon the activation of cascades of molecular networks involved in stress perception, signal transduction and the expression of specific stress-related genes and metabolites. To mitigate the impact of climate change in term of high temperature on agriculture crops, Biotechnological and breeding approach play a crucial role followed by physiological approaches (by applying phytohormone). Applications of Phytohormones have several advantages over the biotechnological and breeding approaches likes cost effectiveness and time saving or without altering the genome of crops. Present research work was pertaining to explore the role of 24-epiBL (Brassinosteroids) in the mitigation of harsh effect of high temperature on *Brassica juncea* L. RLM 619 at physiological, biochemical and molecular levels. In order to explore the ameliorating potential of Brassinosteroids (BRs) in agriculture crops like *B. juncea* L. subjected to various high temperature stresses (35 °C, 40 °C and 45 °C) with various concentrations of 24-epiBL (10^{-6} M, 10^{-8} M and 10^{-10} M) have been undertaken. The surface sterilized seeds of *B. juncea* L. were germinated in petri-plates containing different concentrations of 24-epiBL. High temperature treatment (35 °C, 40 °C and 45 °C) was given to 7-days old seedlings grown in different treatments for 5 h consecutively up to 3 days. 24 h recovery period was given to high temperature treated seedlings by placing at 25 °C ± 2 °C and harvested for antioxidant enzymes on 10th day after sowing (DAS). In this study, we explore the activity of antioxidant enzymes

(SOD, E. C. 1.15.1.1, APOX, E. C. 1.11.1.11, CAT, E. C. 1.11.1.6) and their effects on osmolytes concentrations (Proline and sugars) and Vit. C concentration along with photosynthetic machinery (Chlorophyll and carotenoids content). The morphology of *B. juncea* L. seedlings has revealed remarkable reduction under high temperature stress and 24-epiBL helps in ameliorating this reduction. Photosynthetic pigments such as chlorophyll and carotenoids decreased significantly in seedlings subjected to high temperature (25 ºC to 45 ºC). 24-epiBL helps in ameliorating photosynthetic ability by protecting chlorophyll and carotenoids content from high temperature stress. All concentrations ameliorate carbohydrate, Vit. C and Proline content in seedlings exposed to different temperatures as compared to control seedlings. Enzymes of antioxidant defense system ameliorate in 24-epiBL treated seedlings as compared to untreated control seedlings when exposed to different temperatures. Observation suggested that photosynthetic machinery reduce their efficiency under high temperature and 24-epiBL treatment helps in maintaining the efficiency of photosynthesis by increasing the activities of antioxidant enzyme followed by enhance level of osmolytes compounds. Improved health of plants with 24-epiBL at morphological level increasing activity of antioxidant enzyme followed by the enhance level of Vit. C and Osmolytes indicate, 24-epiBL can be used to mitigate the toxic effect of environmental stress in agriculture crops.

Keywords: Brassinosteroids, Antioxidant Enzymes, High temperature stress

ENERGY RECOVERY FROM LANDFILL GASES IN INDIAN SCENARIO: A MITIGATION STRATEGY

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Generation of solid waste is closely related as a by-product of industrialized society. Landfills are the most commonly used means to dispose wastes but the current landfill practices are also source of substantial greenhouse gases (GHG) emission. Emissions from landfills contribute around 5% percent of total global GHG emissions and 12% percent of the total global emission of methane. In India most of the landfilling is done in low lying areas around urban centre contribute around 3-19% of the methane emission. If the current waste management policies are followed, the methane emission is projected to reach 254 Gg/year by the year 2025. Landfill Gas (LFG) contains a 40-60% methane content that can be used to drive a gas turbine to generate electricity. It can be used directly in boilers of nearby industries to provide heat or to power mechanical processes. There are multiple technologies available that can reduce GHG emissions and utilize LFG. Currently, India does not have any operational landfill gas to energy conversion techniques, many projects are in the initial stage of planning and testing. The most cost-effective use of the LFG is direct use in industry to run a boiler or other equipment. Delhi, Ahmedabad, Mumbai and Hyderabad are the only states that have taken some initiatives to utilize LFG with foreign collaboration. One of the major hindrance in utilizing LFG in India is the capital cost that may be higher due to importing of machinery but this could be balanced by the lower labour cost. Therefore, in recent years methane recovery from solid waste could be an excellent near-term energy and environmental solution for India and its merits needs further consideration by the government.

Keywords: Greenhouse gases (GHG); Landfill; Waste management; Landfill Gas (LFG); Methane

GREEN BUILDINGS: ADAPTING IN EFFICIENT WAYS

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Green building as a concept has become popular in recent years arising out of concerns of Unsustainability and climate change. In this era of climate change becoming more evident with each year, the concept of green building is premised on being energy and resource efficient from its inception to manifestation; in order to minimize environmental and energy consumption costs.

Although, the concept of green building may seem new, but the practice has been done since many centuries in India in the form of white roofs of Jaisalmer to rain water harvesting methods of baolis (step-wells), hauz (water reservoir) and tals (lakes) in numerous old forts and palaces of India. Even in contemporary India, many sustainable techniques are being promoted by the Government of India in synchronization with State governments, for instance in the case of installing rain water harvesting systems on roofs of individual houses in order to get house completion certificates in Haryana or using solar water heaters and panels to fulfil energy needs and so on. Energy efficiency and use of renewable sources of energy are also promoted in industrial buildings as well by giving subsidies in the form of tax relaxations.

A green building must be in synchronisation with its environment and specifically with its local climatic regime because if this is not the case, then the added temperature controlling mechanisms will render the building non- green and unsustainable as it would consume energy to regulate an adequate temperature regime within the confines of the building. In such a scenario, the important role is played by the design of the building and the construction material because if either of them is not in synchronisation with the immediate environment, then the building will render itself to be unsustainable. Green buildings are the need of the hour because they will help reduce our ecological footprint by adapting to the existing climate and helping us to mitigate the effects of climate change to a considerable level.

Keywords: Green building, Old practices, New energy efficient techniques, Sustainability, urban areas.

GLOBAL CLIMATE CHANGE AND WHEAT: IMPACTS, ADAPTATION AND MITIGATION

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Inter-government panel on climate change has reported that earth's temperature has increased by 0.74^0C between 1905 and 2010 due to increase in anthropogenic emission of greenhouse gases. Global average temperatures are likely to rise by more than 5^OF (3^OC) compared to pre-industrial levels by the end of the next century (Lashof: 7 (1993)). India is one of the largest wheat producers of the world. More than 90% of the area is sown for bread wheat *(Triticum aestivum)*, which is grown throughout the country. Transitory or constantly high temperatures cause an array of morpho-physiological and biochemical changes in wheat, which affect its growth and development and may lead to a drastic reduction in economic yield. The adverse effects of heat stress can be mitigated by either developing wheat crop with improved thermo-tolerance using genetic approaches or by screening of thermo-tolerant cultivars on the basis of physiological, biochemical and molecular factors. For this purpose, however, a thorough understanding of physiological responses of plants, mechanisms of heat tolerance and possible strategies for improving crop thermo-tolerance is imperative. Since, the information on the effect of pre-anthesis thermal conditions and their interaction with high temperature at post–anthesis on final grain yield and quality in wheat is scarce. Therefore the present study was conducted to screen the promising wheat cultivars for high temperature stress tolerance on the basis of physiological and biochemical parameters both under field and laboratory conditions. For the field study, high temperature conditions were induced by delayed sowing of the wheat crop by a month. This led to reduction in crop phenology which in turn had a drastic effect on not only morphological factors (coleoptile and total shoot length, fresh and dry weights of the plant parts, plant height) but also on physiological parameters viz. photosynthetic pigments, photosynthesis, transpiration, respiration rate, that reduced in the range of 4-30% except MTS (40%), CT (2%) where increase in these parameters was reported both in field and laboratory conditions. Based upon the screening the thermo-tolerance potential of two varieties WH 730(thermo-tolerant) and UP 2565(thermo-susceptible) was assessed at the molecular level, that reported higher number of stress specific proteins was induced in tolerant variety relative to susceptible one. Among the protein quality parameters that define the dough characteristics in wheat, it was noted that albumin and glutenin decreased (38, 22%) while globulin and gliadins were increased (22,10%) by high temperature. Correlation and rank analysis of all the varieties was also determined.

Keywords: Wheat, High temperature, Photosynthesis, Yield, Grain quality.

MANAGEMENT OF WASTE AND CLIMATE CHANGE

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Waste generated everyday in the Asia-Pacific region contains readily biodegradable organic matter such as kitchen waste, garden waste and paper, which on an average accounts for about 58% of the total waste generated. In some of the developed cities, the amounts of organic waste accounts for almost 70% of the total waste. Most of this rubbish ends up in dumpsites or in landfills. When organic waste decomposes, green house gases (GHG) viz, carbon dioxide and methane gas is emitted, which contribute to global warming and climate change. Methane is 72 times more potent than CO_2 over a 20-year period- this means every ton of methane will trap as much heat in our atmosphere as 72 tons of carbon dioxide. Every waste management practice generates GHG, both directly (i.e. emissions from the process itself) and indirectly (i.e. through energy consumption). Climate change has accelerated the need to find measures to reduce and ensure safe management of the waste we create. Reduction and reuse of waste will help to decline pressure on the planet's natural resources and also reduce emission of greenhouse gases created through burning of fossil fuels. However, the overall climate impact and benefits of the waste management system will depend on net GHGs, waste treatment and disposal. Climate change impacts are only one of a number of environmental impacts that derive from waste management options. Other impacts include health affects attributable to air pollutants such as NO_x, SO_2, dioxins and fine particles, emissions of ozone depleting substances, contamination of water bodies, and depletion of non-renewable resources. These environmental impacts are in addition to the socio-economic aspects of alternative ways of managing waste. All of these factors need to be properly considered in the determination of a balanced policy for sustainable waste management. Waste generation and waste composition varies between and also within countries, primarily due to differences in population, urbanization and affluence. Overall reduction in waste generation remains a challenge, particularly where populations and global consumption of resources are increasing. This increase has environmental and economic impacts. We must act urgently to reduce our climate impacts, improve resource efficiency and waste management's.

Keywords: Climate Change, Waste Management, Methane Green House gasses

NATURAL RESOURCE: ADOPTION OF COMPOST MAKING (ORGANIC FARMING PRACTICE) BY TRIBAL WOMEN

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A **natural resource** is anything that people can use which comes from nature. People do not make **natural resources**, but gather them from the earth. **Natural resources** occur naturally within environments that exist relatively undisturbed by humanity, in a natural form vanishing. In addition to the benefits, using recovered resources reduces threats to biodiversity. Natural resource extraction, along with other human activities, increases the rate at which species of plants and animals are now has a substantial human cost because wild species and natural ecosystems are important resources. Talking about agriculture and natural resources, organic farming is a better option than any other conserving resource. Producing with the inputs which are easy to reach and which do not destroy or harm any part of nature. **Organic farming** is a form of agriculture that relies on techniques such as crop rotation, green manure, compost, and biological pest control. Done by ancestors which haven't destroyed anything but has given us many things? Adopting its all practices in agriculture can surely lead us to better and sustainable life least effective soil and other resources and conserving much for future. Tribal women practicing it from early and continuing with the same can help a lot. The objectives of the present research were to study the extent of adoption of organic farming practice among tribal women. The study was conducted in four villages of Jadol, Gogunda and Kotra Panchayat Samities of Udaipur district. The sample consisted of randomly selected 100 respondents from the selected villages Findings of the study reveal, that majority of the respondents were from 18-30 years of age, all respondents belonged to scheduled caste (tribe) and adopted farming as main occupation. Findings reveal that all the respondents had medium to high extent of adoption compost making extent of adoption was found to be 62.66 per cent adoption index 1.29 MWS. Over all it can be concluded that, good adoption of organic farming practices by tribal women of organic farming practices this will definitely help in agriculture production.

Keywords: Natural resource, organic farming and tribal women

PROSPECTS OF ORGANIC FARMING IN CONTROLLING CLIMATE CHANGE

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Agriculture is the mainstay of Indian economy; however agriculture also contributes significantly towards climate change. It is reported that the land under agricultural use contributes to about 12% of global greenhouse gas emissions. The classical agricultural practices like use of chemical fertilizers lead to emissions of methane and nitrous oxides gases. The emissions of these greenhouse gases from agriculture are only going to increase significantly in near future due to increase in population and in turn food demand. Thus, there are needs to change the agricultural practices and look for mitigation solutions which can be done by reducing the greenhouse gas emission and carbon sequestration. If the greenhouse gas emission is not controlled by strategic and sustainable approach then there are greater risks of fatal temperature rise which affects agriculture production. The rise in temperature and limited water resources affect considerably to the crop yield which is a major food security issue. The paper presents an overview on how agriculture contributes to climate change; the role of organic agriculture in reducing global warming; and its shortcomings. The importance of organic farming systems in utilizing the traditional skills and knowledge; integration of modern skills and innovation in managing the natural calamities (like drought) or weather extremes, and natural resources to enhance productivity in agriculture is presented. There is a need of flexibility in organic agriculture for better mitigation and adaptation potential and solve food crisis. The cultivation of other minor crops having high nutritive potentials and international market but not explored widely like millets etc. is a good alternative. The Intergovernmental Panel on Climate Change (IPCC), reported that considerable amount of nitrogen applied in farming escapes to atmosphere. It is reported that about 3% of total Indian greenhouse gas emissions is solely contributed through fertilizer manufacturing plants. The one of the solutions to this can be alternative farming technologies like "Organic Farming System". The organic farming is self-sufficient and does not require external nitrogenous fertilizers. Organic production also aids in better soil organic matter fixation, increasing soil fertility and water-holding capacity and yields. Thus to sum-up organic agriculture has various benefits in controlling climate change as it increases carbon capture, reduces greenhouse gas emission by appropriate use of organic fertilizers and reduction in usage of fossil fuels, improves soil carbon-quality-yield and lastly provides income and food security to people.

Keywords: Organic farming, Climate change, Carbon-quality-yield

SALINITY TOLERANCE IN THE RHIZOSPHERIC BACTERIAL ISOLATES OF TURMERIC (*CURCUMA LONGA* L.)

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Climate change is one of the most important issue during the recent years worldwide, which influences the agricultural production. To overcome the problem different strategies have been applied. Application of plant growth promoting rhizobacteria (PGPR) along with the integrated use of fertilizers can reduce the deleterious effect. Salinity is also an important factor which adversely affects the agricultural production. Turmeric (*Curcuma longa* L.) is one of the most important traditional medicine and spice used in the every households of the Indian subcontinent. The rhizome of turmeric contains antibacterial, antidiabetic, antipyretic, antioxidant and anti-cancerous properties. Bacterial strains were isolated from the rhizospheric soil of turmeric rhizome and identified by morphology, biochemical tests and 16S r RNA gene sequence analysis. Identification categorized turmeric rhizobacteria in 9 different bacterial species. *Pseudomonas fluorescens* CLI2, *Bacillus substilis* CL1, *Bacillus* sp. CL3, *Burkholderia thailandensis* CL4, *Agrobacterium tumefaciens* CL5, *Klebsiella* sp. CL6, *Bacillus cereus* CL7, *Pseudomonas putida* CL9, *Azotobacter chroococcum* CL13. *Agrobacterium tumifaciens* CL5 tolerated only 1% NaCl. , *Bacillus* sp. CL3, *Klebsiella* sp. CL6, *Azotobacter chroococcum* CL13 tolerated 4% of NaCl. *Burkholderia thailandensis* CL4 and *Bacillus cereus* CL7 tolerated up to 5% of NaCl, while maximum salt tolerance was observed in *Bacillus subtilis* CL1, *Pseudomonas putida* CL9 and *Pseudomonas fluorescens* CL12 which showed tolerance to (6% NaCl). Salinity is one of the most severe abiotic stresses that limit crop growth and productivity. The alternative and reliable ecofriendly method has been applied to manage or utilized salt affected soil for sustainable agriculture.

Keywords: Rhizobacteria, Fertilizer, Salt tolerence

ADAPTING TO CLIMATE CHANGE: NATURAL RESOURCE MANAGEMENT

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It has long been a subject of research and discussion that how Natural resources, including land, forests, water and energy, can support growth and poverty reduction in the most inclusive and sustainable way. Climate changes disturbing the eco-logical/nomical balance and increases the pressure, in terms of how to adapt to changing conditions in developing countries, but also by increasing interest in using natural resources and their management to achieve climate change mitigation goals. Climate and its variations constitute a dominant core driver of natural systems. Sustainable and effective management of the natural resources requires detailed knowledge of the spatial and temporal characteristics of climate including the ways of utilizing this knowledge. Climate varies naturally, encompassing external forcing and internal dynamics.

Human activities are increasingly an additional source of spatial and temporal variability in climate, at global, regional and local scales. Major ones are greenhouse gases and aerosols including other minors as well. A considerable global rise in temperature has significant hydrological implications. The Changes in atmospheric CO_2, ozone and other gaseous and aerosol constituents have direct but differential physiological effects on vegetation, species competitiveness, amount and quality of light, which in turn affect soil moisture and recharge budgets, plant species composition and community properties. Climate change along with increased salinity, pollution, invasive species and habitat loss will intensify other threats to biodiversity, e.g. reducing great barrier reefs. Climate change ultimately going to negatively impact every type of natural resource and biodiversity. The distributions of plant and animal species will continue to change as rising temperatures alter ecosystems and amplify existing environmental concerns. The conditions are debatable and matter of concern at local and international levels as well. We “the human beings” must utilize the resources in all meaningful and efficient manners to save nature and biodiversity.

Keywords: Natural resources, Water and energy, Ozone, CO_2

ANALYSIS OF ENVIRONMENTAL BENIFITS OF GREEN ROOFS: A REVIEW

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Urban heat islands, air and noise pollution, acid rain, water pollution, emissions from excessive use of fuels and poor health status are some of the environmental consequences that are deemed attributable to anthropogenic activities in urban areas. Rapid urbanization in the past few decades have led to inevitable climate change and heat island phenomenon, thereby leading to an increase in temperature in most cities. Several sustainable practices have been developed, which serve as an antidote to such issues. Green roof is one of such practice that has attracted global attention and is designed not only to deflate heat island and other environmental problems, but also reduces energy consumption of buildings. They act as a tool to reduce absorption of solar radiation in summer and heat loss in winter. This review paper presents a comprehensive study on how green roofs can influence air pollution, carbon dioxide emission and sequestration, storm water runoff quality, noise pollution, durability of roofs and enhance the energy efficiency of buildings. Green roofs play a vital role in enriching the biodiversity and health status as well. This paper also discusses economical perspective and barriers of green roofs.

Keywords: Green roofs, Climate change, Sustainable solution, Green solution, Urban sustainability

ROLE OF BRASSINOSTEROIDS AND CITRIC ACID IN ENHANCED PHYTOEXTRACTION OF CADMIUM BY *BRASSICA JUNCEA.*

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Contamination of soil by cadmium (Cd) on one side interferes with the life cycle of plants; on the other side once bio-accumulated into the plant tissues it enters the food chain poisoning animals and humans. Phytoremediation is a modified agronomic practice used for cleaning and/or rendering contaminated media less harmful. Brassinosteroids have potential to improve phytoremediation efficiency by improving crop yield and stress tolerance. The present study was designed/ planned to explore the interactive effects of BRs, citric acid and cadmium in *Brassica juncea.*Seeds of *B. juncea* Var. RLC1 presoaked in Castasterone (0, 10^{-11}, 10^{-9}, or 10^{-7}) for 8 hrs were sown in cadmium (60 mg/kg) treated and untreated soil. In addition Citric acid (0 or 60 mg/kg) was supplemented. Treatments were replicated three times. Shoot length, root length, fresh weight and dry weight were determined 30 days after sowing seeds. Cadmium uptake was determined by Atomic absorption spectrophotometer. Malondialdehyde (MDA) content, H_2O_2 content, and photosynthetic pigments were analyzed using spectrophotometer. Cadmium treatment reduced morphological parameters, photosynthetic pigments and induced oxidative stress by increasing MDA and H_2O_2 content. Application of citric acid alone and in combination with brassinosteroids increased Cd accumulation in plants roots and leaves. Synergistic effect of Citric acid and brassinosteroid alleviated Cd toxicity by increasing biomass, root length, shoot length, photosynthetic pigments and prevented MDA and H_2O_2 accumulation. The present study indicates that exogenous application of BRs may enhance Cd phytoextraction in combination with chelate such as citric acid by alleviating Cd toxicity.

Keywords: Phytoremidiation, Phytoextraction, Brassinosteroids, Oxidative stress

INTEGRATING BIOCHAR AS CONSERVATION AGRICULTURE TOOL UNDER CLIMATE CHANGE MITIGATION SCENARIO

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Surplus crop residue generated from different cereal crops and their open burning leading to several environmental anomalies are of serious concern, though worldwide but more in developing nations. Residue retention under conservation agriculture strategy is one of the suggested alternatives; however, it is not yet succeeded well in tropical regions due to higher rate of decomposition. Fast release of photo-synthetically locked atmospheric CO_2 to the atmosphere is a major constraint for this strategy. Therefore, instead of earlier complete residue retention or 'slash and burn' approaches, recently 'slash and char' strategy is being promoted for agricultural residue management as well as climate change mitigation in developed countries. However, complete slash and char approach may lead to loss of various ecosystem services provided by crop residue such as soil erosion control and soil physical management. Recently, research is progressing towards biochar-residue integrated approach under conservation agriculture systems. In the present study, we are emphasizing on the judicious use of crop residue and its biochar in integrated manner for agricultural sustainability.

Keywords: Lignocellulosic biomass, Pyrolysis, Biochar, Climate change, Carbon credit

CLIMATE CHANGE MITIGATION

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Climate change is referred to changes in weather conditions over longer period of time, caused by a number of factors such as biotic processes, variation in solar radiations received by Earth, plate tectonics and volcanic eruptions. However, anthropogenic activities have also been considered as the significant cause for climate change that is often referred to as global warming. Climate change mitigation involves reductions in anthropogenic activities that may be achieved by increasing the capacity of carbon sinks. Efforts are underway to prevent emission of greenhouse gases using new technologies and use of low-carbon energy resources. The present mitigation activities involves multidisciplinary science and technology along with climate engineering that ranges from energy conservation, carbon-neutral energy conversions, carbon advanced combustion process that produce no greenhouse gases and that enable carbon capture and its sequestration. Mitigation may also be achieved by increasing the capacity of carbon sinks by improving energy efficiency in buildings through greenhouse construction methods, reducing agricultural waste during storage, distribution, marketing and household use; producing recyclable industrial products; promoting green tourism and establishment of sustainable practices that preserves resources and reduce pollution. To enable these innovations, regulatory reforms and new policies will need to be set in motion as well as mechanisms that ensure environmental cost is factored into producer's calculations.

Keywords: Climate Change, Greenhouse gasses, Mitigation

CONTROLLING METHANE EMISSION FROM MUNICIPAL SOLID WASTE (MSW) LANDFILL AREAS

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Sustainable management of Municipal Solid Waste (MSW) is important to curb the ever rising demand of scarce land for its disposal and Green House gases (GHG) emission. Changing life style patterns, with this thrown away society particularly in urban areas, MSW generation has increased tremendously and municipalities are facing great challenges in its management. In India 80 - 90% of MSW is dumped in landfill areas without segregations. As MSW from Indian cities estimated to have 40% - 60% of organic matter therefore under anaerobic condition untreated Solid Waste in landfill areas results in GHG generation mainly, methane, which contributes to global warming. To reduce the emission of GHG gases from landfill areas, it is essential to reuse the organic part of MSW either as MSW compost or as bio-fuel. The most suitable way to recycle it with low investment is aerobic composting technique using windrow method. With the compliance of Municipal Solid Waste (Management and Handling) Rules 2000, many cities in India are already making compost with MSW. The present study focuses on recycling of MSW to curb the methane emission from it and demand of precious land for landfill areas. Whereas, the application of MSW compost needs further inventories on its toxicity with respect to heavy metals and other toxic products.

Keywords: Municipal solid waste, Compost, methane, landfill areas,

STUDIES ON BIOCHEMICAL AND PHYSIOLOGICAL PARAMETERS OF EARTHWORMS ASSISTED PHYTOREMEDIATION OF NI IN *PENNISETUM GLAUCUM* L.

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Nickel is regarded as an essential micronutrient for plants (0.01–5 µg g^{-1} dry wt.). However, when present at high concentrations in the soil environment, it becomes phytotoxic. Common symptoms of Ni toxicity are inhibited germination, leaf chlorosis and necrosis, increased ion leakage, reduced root development and inhibited photosynthesis. The present work was planned to study the role of *Eisenia fetida* on phytoremediation capacity and stress management of *Pennisetum glaucum* under stress of Ni. Plants were raised in pots and given treatments of Ni 0.5 mM and earthworms. Harvesting of plants was done after 30 and 60 days of sowing. Parameters analyzed were growth characteristics (root and shoot length), photosynthetic pigments (Chlorophyll, anthocyanin, carotenoid, xanthophyll and total flavonoid content), antioxidative enzymes (SOD, CAT, POD, APX, GR, DHAR), non-enzymatic antioxidants (Ascorbic acid, glutathione, α-tocopherol) and Ni uptake was analyzed. It was observed that effects of heavy metals are toxic to plants and *Eisenia fetida* plays important role to ameliorate the stress produced by Nickel. Photosynthetic pigments were enhanced in metal treated plants supplemented with earthworms. *Eisenia fetida* also stimulates the growth of *Pennisetum glaucum* and helps in overcome stress produced by Ni and Cd. Metal uptake was increased significantly in presence of earthworms. *Eisenia fetida* thus improves plant phytoremediation capacity and minimizes destructive effect produced by metals in plants.

Keywords: Nickel**,** *Eisenia fetida, Pennisetum glaucum*

BIOLOGICAL EFFECTS OF RADIATION- HUMAN PERSPECTIVE

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Whether the source of radiation is natural or man-made, a small dose or large, there will be some biological effects. Radiation is one of the best-investigated hazardous agents. Radiation causes ionizations of atoms, which affect molecules, cells, tissues, organs and the whole body. All biological damage effects begin with the consequence of radiation interactions with the atoms forming the cells. They are divided into two categories: first consisting of exposure to ***high doses of radiation over brief intervals of time*** producing acute or short-term effects and second representing exposure to ***low doses of radiation over an extended period of time*** producing chronic or long-term effects. High doses tend to kill cells, while low doses tend to damage or change them. High doses can kill so many cells that tissues and organs are damaged. This may cause rapid whole body response called Acute Radiation Syndrome. Low doses spread out over long periods of time do not cause an immediate problem to any body organ. Every acute exposure doesnot result in death. If a group of people is exposed to a whole body penetrating radiation dose, the above effects might be observed. Effects on the skin include erythema, dry and moist desquamation, hair loss. Other effects include cataracts, sterility which can be temporary or permanent in males, depending upon the dose. The most common delayed effects are various forms of cancer (leukemia, bone cancer, thyroid cancer, lung cancer) and genetic defects. The best prevention for radiation sickness is to minimize the exposure dose or to reduce the dose rate. Treatment is supportive with the use of antibiotics, blood products, colony stimulating factors, and stem cell transplant as clinically indicated. Fundamental to radiation protection is the reduction of expected dose and the measurement of human dose uptake. Radiation protection standards recognize that it is not possible to eliminate all radiation exposure, but they do provide a system of control to avoid unnecessary exposure and to keep doses as low as reasonably achievable. Measures for control of exposure for stochastic effects seek to minimise all reasonably avoidable risk hence called optimising protection. However, risk in this sense may be assessed in terms of risk to a population, and may not ensure sufficient protection of the individual. Consequently, the optimisation approach is underpinned by applying dose limits that restrict the risk to individuals to an acceptable level.

Keywords: Radiation, Biological effects, Doses, Exposure

IMPACT OF CLIMATE CHANGE ON FLOOD CHARACTERISTICS OF INDIAN RIVERS WITH SPECIAL REFERENCE TO RIVER BRAHMAPUTRA

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The very fact that all the major civilizations of the world developed and blossomed beside rivers is a testimony to the fact that rivers are of utmost importance to human race. With a plethora of river systems sprawling all through the subcontinent, India boasts of a huge hydrological system dominated by these rivers. On the other hand, with the advent of climate change, a phenomena that seems to have effects on every sphere imaginable, a sea of change has taken place in the way these systems behave. As it is the highest specific discharge river system of the world, the Brahmaputra experiences a number of long-duration floods during the monsoon season annually. This menace, of the river that gives life to the region, has gripped the whole of its discharge area into a natural calamity so fierce that all the measures taken for mitigation have miserably failed. Now, with the temperature rising due to climate change and the subsequent 'warming' of the earth, the discharge has all but increased in this humongous river system leading to occurrences formerly unheard of like untimely floods and more massive soil erosion.

The gradual change in the climate is considered to be one of the most significant driving forces which has eventually triggered heavy alterations in the regional and local weather and climactic systems, thereby, bringing about a massive change in the socio-economic, cultural and political spheres of life. Since the 1920s, there has been a considerable amount of increment in the temperature globally. Major hydrological processes in the water cycle get affected due to the rising temperature which in turn alters the flood vulnerability in any river basin. Thus, the Brahmaputra River, listed as one of the largest river basins of the world, is bound to be surrounded by areas which are flood-prone. Under the projected climate change scenario, many more catastrophic floods are surely in the making which in turn would adversely affect the very existence of a peaceful civilization in this region.

The current paper is an attempt to highlight the impacts of climate change on the Indian River systems and the effects that this change has on the way the flood systems of these rivers behave while giving special mention and reference to the river Brahmaputra.

Keywords: Climate change, Rivers; Floods; Global warming; Water cycle; Natural calamities.

MITIGATION UNDER CLIMATE CHANGE

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Climate change is not a Science Fiction and it is impacting us right now. Now, time comes to start taking action urgently by working together or individually. Several steps are substantially required to mitigate climate change, such as: Use of renewable resources like solar energy, tidal energy, geothermal energy, wind energy etc. Increase in energy efficiency and conservation. Fuel switching (use of natural resources).Carbon sequestering, Societal control, urban planning, sustainable transport Etc. The above listed points are those we search from many sources. Studying all these and taking this great opportunity of poster presentation, our group decided to introduce these following measures to somehow contribute in mitigating climate change, such as: Introducing Coconut oil: New invention may help cars to runs on coconut oil in which the emissions levels are lower than other forms of biodiesel, making it an ecofriendly. Beneficial algal species: *Ulva paschima Bast* and *Cladophora goensis bast*; act as a potential candidate for carbon sequestration by absorbing high atmospheric CO2. It is also a promising candidate for use as bio fuels. Requesting government to provide funds to areas where maximum agriculture and cow farming going on, or providing “digester machines” there to collect methane gas, preventing from direct release to environment and can use those gas safely as fuels (electricity). Regarding ice-cores, we would like to suggest 2 things: To control climate change as fast as possible to minimize melting of the ice-cores, if not the combine form of methane would melt and release in environment. Or, to drill down, when the depth of it decreases, to safely store the methane gas and use it economically. Most importantly, we ourselves should contribute in every steps of our life to keep nature stable. Our main theme is to introduce simplest life style rather than luxurious one, to cope with nature. Thus, we hope our poster presentation will support to minimize climate change.

Keywords: Climate Change, Renewable resources, Ice-cores, Digester machines

VERMICOMPOSTING: AN ALTERNATIVE GREEN TECHNOLOGY FOR ORGANIC WASTE MANAGEMENT

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In recent years population increase, rapid urbanization and land encroachment for human use has lead to soil and environment degradation. The excessive use of chemical fertilizers has also contributed to loss of soil quality leading to an imbalance in soil flora and fauna e.g. earthworms and micro-organisms responsible for organic decomposition and nutrient release for plant growth. The solid organic wastes generated by human activities are not getting degraded. The disposal of organic wastes from agriculture, domestic and industry is a big environment and economic problem which we are facing today. An environment friendly approach for management of solid organic waste recycle is vermiculture biotechnology involving breeding and propogation of earthworms and using its casts. The tool of vermiculture and vermicomposting can not only detain ecological degradation, sustain complex food webs, modify complex chemical forms of a number of minerals into inorganic forms essential for nutrient dynamics but can also go a long way for meeting agriculture requirements.

Keywords: Urbanisation, Vermicomposting, Vermiculture, Microorganism

Dynamical study of Climate Change (Global Warming)

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Sun is by far the largest supplier of energy to the earth's surface, any change in the radiative output of the sun also affects the energy balance of the earth's surface and atmosphere so that at some level it influences our climate. . But how strong the sun's influence is and which mechanism is playing major role is matter of current research .The study tries to identify new causes which are responsible for climate change in relevance to sun and galactic cosmic rays. We found sunspot number, total solar irradiance, cosmic radiation all have significant role to play in overall temperature increase. Along with this, the study points out three major misconceptions even within scientific world and propose a better method to opt for numerical methods employed in climatic model.

Keywords: Climate change, Solar energy, Galactic cosmic rays

REMOVAL OF TOXIC METALS USING PHYTOREMEDIATION BY *EICHHORNIA CRASIPES* AND *SALVINIA* SP.

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Phytoremediation is a method which uses the potential of plants to remove toxic metals contaminants present in the environment. This is a safe alternative technique because of its applicability to a broad range of contaminants, low cost, environment friendly and aesthetically pleasing nature. The aim of this research is to study the efficiency toxic metal ions from laboratory waste water using two aquatic plants *Eichhornia* and *Salvinia*. Biosorption of toxic ions from aqueous solutions was studied in a batch adsorption system to know the effect of pH and contact time. From the obtained results, it has been observed that the percentage removal of metal ions increase with increasing the contact time initially and after certain time it becomes constant. It also increases with the amount of aquatic plants. Adsorption data was described by pseudo second order kinetics model. Langmuir model for monocomponent adsorption of metal ions by phytoremediation was studied. Various physical parameter of solution were also compared before and after the treatment.

Keywords: Phytoremediation, *Eichornia*, *Salvinia*, Biosorption, Langmuir model

MAPPING GREEN SPACES OF DELHI: UNDERSTANDING THE DRIVERS OF CHANGE & TOWARDS MITIGATION AND ADAPTATION OF CLIMATE CHANGE

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Impact of climate change can be felt in urban centres across the world, affecting its physical and ecological systems and eventually the health and wellbeing of the human societies. There are also efforts to reduce vulnerabilities of the climate change and build resilience to the impacts of climate change. Vegetation is an effective means to reduce heat storage uptake, thus greening of urban areas is one such strategy to reduce the effect of climate change and mitigation. It involves the protection of natural carbon "sinks" like the urban forests or green spaces and creation of the new ones. Delhi, the worlds' second most populous city, has experienced rapid, planned and unplanned expansion, at the cost of its green cover in recent decades. There is also rise in mean annual temperature in past decades. In this study, we use satellite images from 1986, 1999 and 2010 to map changes in urban and green cover, assess the fragmentation of green spaces, and identify the drivers of change. We find that urban patterns of development have shaped the distribution and fragmentation of green spaces, with the city centre containing more green spaces with less fragmentation compared to intermediate areas and the peri-urban periphery. Yet, the city core has also experienced the greatest degree of vegetation clearing and fragmentation over time due to infrastructural expansion, while the peri-urban periphery has shown an increase in vegetation and a decrease in fragmentation due to recent compensatory plantation in these peripheral areas. Forests, archaeological sites, military and academic campuses have played a major role in protecting green cover and limiting fragmentation in the core and intermediate areas of the city. This research helps in advancing our understanding of the pattern-process relationship between urbanization and land cover change/fragmentation. Results can provide important learning for urban sustainability planning in other mega-cities as well as help devise policies intended for mitigation and adaptation to climate change at local level.

Keywords: Land use land cover change; vegetation change; fragmentation; urban institutions; mitigation; climate change.

EVALUATION OF ANTIOXIDATIVE AND ANTIPROLIFERATIVE POTENTIAL OF BRASSINOSTEROIDS ISOLATED FROM *BRASSICA JUNCEA* L. PLANTS RAISED UNDER NICKEL AND ARSENIC IONS STRESS

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Brassinosteroids (BRs) are a group of poly-hydroxy steroidal hormones which are imperative for the growth and development of plants. They influence the plant growth through a spectrum of physiological responses. From past years, reports indicating their anti-stress, antiviral, antitumor and antigenotoxic potential. In the present study, an attempt was made to isolate Brassinosteroids (BRs) from *Brassica juncea* L. plants raised in different concentrations of nickel and arsenic ions stress. These BRs were than characterized with the help of GC–MS (QP plus 2010). Isolated BRs were than analyzed for their antioxidative and antiproliferative properties. The *in vitro* cytotoxicity of natural BRs viz. 24-Epibrassinolide, Castasterone, Teasterone, Dolicolide and Typhasterol against different cancer cell lines was checked by employing sulphorhodamine and MTT bioassay. The antioxidative potential was evaluated by performing DPPH, FRAP and Molybedate ion reduction assay. It was observed from the study that isolated BRs possess significant antioxidative and antiproliferative activity.

Keywords: Brassinosteroid, *Brassica juncea*, 24-Epibrassinolide, Castasterone and cytotoxicit.