7th Regional Science
&
Technology Congress 2024-25
Region-5

(Howrah, Nadia, North 24 Parganas and South 24 Parganas districts)

Date: January 14-15, 2025

ABSTRACT VOLUME

Jointly organized
By

Bidhan Chandra Krishi Viswavidyalaya
&
Department of Science and Technology and Biotechnology
Government of West Bengal

ABSTRACT VOLUME

7th Regional Science & Technology Congress 2024-25

Region-5

(Howrah, Nadia, North 24 Parganas and South 24 Parganas districts)

Bidhan Chandra Krishi Viswavidyalaya
Mohanpur, Nadia

Published by

The Organizing Committee

on behalf of

Bidhan Chandra Krishi Viswavidyalaya

&

Department of Science and Technology and Biotechnology

Government of West Bengal

7th Regional Science & Technology Congress 2024-25

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(Howrah, Nadia, North 24 Parganas and South 24 Parganas districts)

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2	Dr. Aditi Acharya, Senior Scientist, DSTBT, GoWB	-	Additional Nodal Officer

Preface

It is an opportunity to organize the 7th Regional Science & Technology Congress 2024-25 (Region-5: comprising the districts of Howrah, Nadia, North 24 Parganas and South 24 Parganas districts). We present this book of abstract as an important part of this Congress. This book reflected the significant contributions of the students, scholars, researchers, and experts of eminence in their respective areas of study. We wish that the research work presented in this Congress will ignite new ideas for future novel work and enrich the knowledge pool for advancement of knowledge and science, overall.

The various subject areas for deliberation in the Congress are:

1) Physical Sciences
2) Chemical Sciences
3) Statistics, Mathematical Sciences, IT and its Applications
4) Engineering Science and Technology
5) Earth Sciences including Geoinformatics and Hydrogeology
6) Botany
7) Zoology
8) Biotechnology
9) Physiology and Medical Sciences including Forensic Sciences
10) Environmental Sciences including Climate Change
11) Agriculture, Horticulture, Fisheries and Veterinary Sciences
12) Focal Theme: Applications of Emerging Technologies including AI/ML in Sustainable Development

We express our sincere homage to all the participants including authors, presenters, and distinguished speakers for their contributions and deliberations in the Congress. We extend our gratitude to the Vice-Chancellor, the Registrar, the Dean Post-Graduate Studies, the Dean Faculties of Agriculture, Horticulture, and Agricultural Engineering, and the Director of Research, Extension Education and Farms of the Viswavidyalaya for their keen interest in organizing the Congress successfully. We express appreciation to all the members of the Organizing Committee, teachers, students, staff, sponsors, service providers and everyone involved in making this Congress successful.

Organizing Committee

7th Regional Science & Technology Congress 2024-25
(Region-5: Howrah, Nadia, North 24 Parganas and South 24 Parganas districts)

Bidhan Chandra Krishi Viswavidyalaya
Mohanpur, Nadia, West Bengal - 741252

উজ্জল বিশ্বাস
(ভারপ্রাপ্ত মন্ত্রী)
বিজ্ঞান ও প্রযুক্তি এবং জৈবপ্রযুক্তি দপ্তর
পশ্চিমবঙ্গ সরকার
বিজ্ঞান চেতনা ভবন
২৬/বি, ডিডি ব্লক, সেক্টর - ১, সল্টলেক
কোলকাতা - ৭০০ ০৬৪
দূরভাষ ঃ (০৩৩) ২৩৩৪-৮০৭৪, ২৩৩৪-১৪৭৩
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MESSAGE

Department of Science & Technology and Biotechnology, Government of West Bengal organises West Bengal State Science and Technology Congress to provide a forum for Scientific Research especially for young scientists and to synergise new ideas with societal needs. State level programme will be participated by the best participants of six Regional Science & Technology Congresses to be held across the State in collaboration with various colleges and universities as a precursor of the programme.

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia has taken a leading responsibility for hoisting the **7th Regional Science and Technology Congress, Region-5 on 14th and 15th January,2025**. I would also extend my heartfelt gratitude to the organisers.

I take this opportunity to welcome all the participants to 7th Regional Science & Technology Congress to be held at Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia and wish the event a resounding success.

(Ujjal Biswas)

UJJAL BISWAS
Minister-in-Charge
Department of Science & Technology
and Biotechnology
Government of West Bengal

To,

Dr. Kusal Roy, Associate Professor
Nodal Officer, 7th Regional Science and Technology Congress
Region 3 (Presidency Divn except KMC area)
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia

Bidhan Chandra Krishi Viswavidyalaya

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Dr. Ashok K. Patra, *Ph.D (IARI)*
FNASc, FNAAS, FAScT, FISSS, FRMSI
Vice Chancellor

Dated: 10/01/2025

Message from Vice-Chancellor

It is with great pride and enthusiasm that I extend my warmest greetings to Hon'ble Ministers, all participants, organizers, and stakeholders of the **7th Regional Science and Technology Congress**, hosted at **Bidhan Chandra Krishi Viswavidyalaya (BCKV)** on January 14–15, 2025. This event, dedicated to Region 5 of West Bengal—encompassing Howrah, Nadia, North, and South 24 Parganas—represents a significant milestone towards scientific inquiry, innovation, and collaboration in this agriculturally vibrant region.

Since its inception in 1994, the West Bengal State Science & Technology Congress has been a cornerstone of efforts to stimulate scientific curiosity and provide a platform for young researchers and scientists to showcase their ideas. The Congress's theme, **"Applications of Emerging Technologies including AI/ML in Sustainable Development,"** is particularly relevant to addressing the multifaceted challenges faced by agriculture in West Bengal. Climate change, declining soil fertility, erratic weather patterns, and the need for sustainable resource management are critical issues impacting the livelihoods of millions of farmers in this region. Integrating advancements in fields such as artificial intelligence, geoinformatics, biotechnology, and environmental sciences with traditional agronomic practices can help develop precise solutions for these challenges. The inclusion of technical sessions covering disciplines from Physical and Chemical Sciences to Agriculture, Horticulture, Fisheries, and Veterinary Sciences ensures comprehensive discussions that integrate various scientific streams into actionable agricultural solutions. The event also recognizes the contributions of young researchers and encourages innovative ideas, which are crucial for the future of sustainable agriculture in West Bengal. The memorial lectures honoring luminaries such as Sir Jagadish Chandra Bose, Prof. Prasanta Chandra Mahalanobis, and Sir C.V. Raman further enrich the Congress by inspiring participants to align scientific research with societal needs.

I urge all stakeholders—scientists, students, farmers, NGOs, industries, and policymakers—to leverage this Congress as a platform for collaboration and knowledge-sharing. On behalf of BCKV, I express my heartfelt gratitude to the West Bengal Department of Science and Technology for their support and to all those who have contributed to organizing this significant event. May the 7th Regional Science and Technology Congress pave the way for transformative discoveries and impactful collaborations.

(Ashok Kumar Patra)

Vijay Bharti, I.A.S.
Secretary

Department of Science and Technology
and Bio-Technology
Government of West Bengal
Vigyan Chetana Bhavan, 6th Floor,
26/B, Block-DD, Sector-1, Salt Lake,
Kolkata-700064

MESSAGE

Research and innovation are the pivotal drivers of Change and Advancement.The Department of Science and Technology and Biotechnology, Government of West Bengal strives to provide the requisite support and encouragement to accenture this scientific temperament through its various programmes. Hosting the 32nd State Science and Technology Congress on 28th February and 1st March, 2025 is one among them. As a precursor to this prestigious endeavour, the Department is organizing Seventh Regional Congress in six esteemed institutions of the State.

I am glad to note that the Bidhan Chandra Krishi Viswavidyalaya, Nadia has taken the lead in organizing the Regional Congress covering Nadia, Howrah and 24 Parganas North and South (excluding KMC area) on 14th and 15th of January, 2025. The event witnesses the confluence of the best minds of budding researchers and scholars and wisdom of eminent scientists and professionals. The Congress provides an inclusive platform for exchange of ideas in twelve disciplines with focal theme on 'Applications of Emerging Technologies including AI and ML in Sustainable Development'.

I extend my best wishes to the organizers for a successful event.

10/1/25

(Vijay Bharti)

भाकृअनुप-केन्द्रीय पटसन एवं समवर्गीय रेशा अनुसंधान संस्थान
बैरकपुर, कोलकाता-700121, पश्चिम बंगाल, भारत
ICAR-Central Research Institute for Jute & Allied Fibres
Barrackpore, Kolkata-700121, West Bengal, India
(An ISO 9001:2015 Certified Institute)

डॉ. गौरांग कर
निदेशक
Dr. Gouranga Kar,
Director

फा.सं./F.No.: 16(D-II)/2024-25
दिनांक/Date:

MESSAGE

It is with great pride and enthusiasm that BCKV in collaboration with DST, Govt. of West Bengal is organising a regional Congress on advancements in science and technology across West Bengal, particularly in the vital field of agriculture. Agriculture, the backbone of our economy, has always been a sphere where innovation meets necessity, and in recent years, West Bengal has emerged as a shining example of this synergy.

From the adoption of precision farming and biotechnology to the implementation of sustainable practices and smart agriculture systems, the state has embraced transformative technologies to enhance productivity and resilience. Our researchers and farmers alike have shown exceptional adaptability in integrating advancements such as high-yielding crop varieties, soil health management techniques, and post-harvest technologies, ensuring food security and economic growth for millions.

This Congress serves as a platform to recognize these contributions, exchange knowledge, and chart a course for future innovation. By fostering collaboration among academic institutions, research organizations, and the farming community, we can continue to address the pressing challenges of climate change, resource optimization, and market access.

Let us commit ourselves to harnessing the full potential of science and technology to empower our agricultural sector, ensuring prosperity for farmers and sustainability for future generations. Together, we can make West Bengal a leader in agricultural innovation and a model for the nation.

Thank you, and I look forward to the meaningful discussions and ideas that will emerge from this gathering.

Warm regards and best wishes.

Gouranga Kar
Director, ICAR-CRIJAF

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PART – I

MEMORIAL LECTURES
& INVITED TALKS

Sir Jagadish Chandra Bose Memorial Lecture

Exploring new drug targets in bacteria: CgtA a case study, and 2.8Å cryo-EM structure of a plant virus causing huge agricultural loss globally

Partha Pratim Datta

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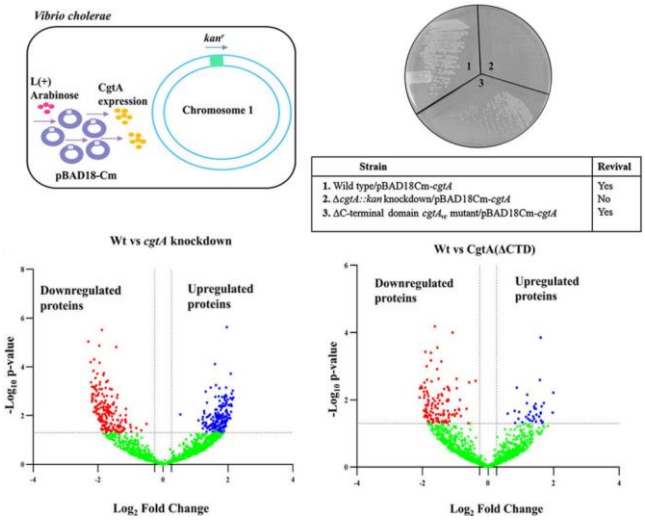
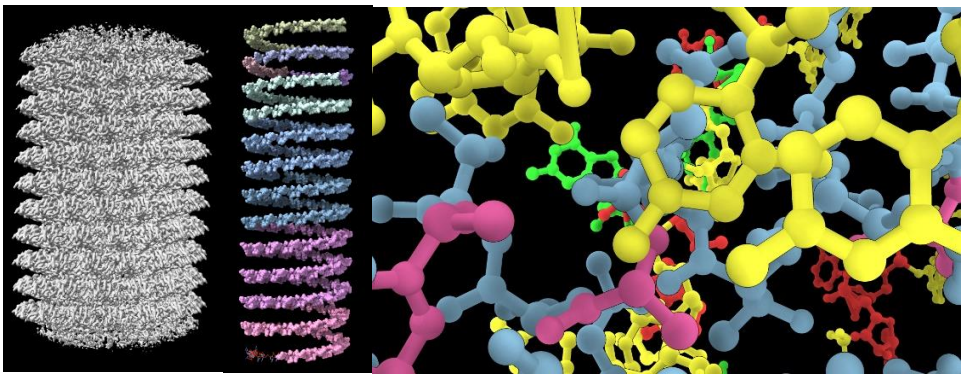
Abstract

Antibiotic resistance is an ever-increasing challenge that severely affects human health leading to the search for new antibacterial drug targets. In this aspect, we are working on one such bacterial protein called CgtA which is considered a drug target. CgtA is an essential multifunctional protein whose many functions are known. But how it works is still not well understood. In this aspect, I will present our research findings, which will reveal further functional roles of CgtA.



In addition to the above, I will also present results from our latest cryo-EM studies of a plant virus, namely CGMMV, which causes huge agricultural losses globally. We solved the structure of this virus to about 2.8Å resolution. From this structure, we were able to create a de-novo atomic model, which clearly shows distinct contact points between its central long spiral single-stranded RNA chain and the surrounding coat proteins.



Prof. Prasanta Chandra Mahalanobis Memorial Lecture

An overview of robust statistical inference

Ayanendranath Basu

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Abstract

As a discipline, statistical science is one of the most modern branches of science. It took formal shape only around the beginning of the 20th century, and remains one of the most dynamic scientific disciplines, which is constantly evolving to keep up with the challenges of the changing nature of real data.

Till about the middle of the 20th century, statistical theory primarily operated under the premise that the parametric model (which was often the normal distribution) was flawlessly specified. Much of this theory was developed in the context of the maximum likelihood estimator, which still forms the backbone of statistical theory. The classical methods including the method of maximum likelihood perform well, often optimally, when model conditions hold.

As the discipline grew, scientists became more and more aware of the fact that specifying the model involves many challenges, and incorrect specifications cannot be avoided all the time. When the model conditions are violated, classical methods fail to remain optimal, often exhibiting severely degraded performance.

This limitation had indeed been observed by scientists for a while. But the systematic study of "Robust Statistics", which deals with the body of methods that provide stable treatment of real data when the specified statistical model is only approximately correct, started only in the late 1950s. However, since then the literature in this area has grown in a furious pace, and robust statistics now forms an important and integral part of statistical techniques, providing useful practical alternatives to the classical methods.

In this lecture we will explain the basic philosophy of robust statistical data analysis, and demonstrate the use and applicability of some robust methods in the age of big data.

Sir C. V. Raman Memorial Lecture

Mobility mass spectrometry: A complementary tool of Raman spectroscopy in chemical analysis

Tapas Chakraborty[a]

Indian Association for the Cultivation of Science, Kolkata

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"History of science has shown that real fundamental progress is always due to those who had ignored the boundaries of science as a whole"

- Sir C. V. Raman

Abstract

Raman Spectroscopy as a widely utilized non-invasive optical technique plays a significant role in elucidating molecular structures through the analysis of molecular vibrations. Nevertheless, as the size of the molecular targets increases, the ability to recover detailed molecular structure parameters using Raman or other spectroscopic methods is limited by uncertainties arising from factors such as isomeric distribution and their interconversions across low energy barriers, thermal and medium-induced spectral broadening, as well as the intrinsic lack of mass selectivity inherent in these methods. My presentation will provide a brief overview of a complementary technique that investigates the mobility spectra of appropriate ionic forms within the mass-selected molecular systems. The speaker will present experimental data from recent studies conducted in his laboratory to support this assertion. Additionally, the discussion will include findings related to host-guest molecular complexes formed between cyclodextrin and curcumin, as well as dimeric complexes involving various model polypeptides.[1-3]

Reference

1. F. Lanucara, S. W. Holman, C. J. Gray and C. E. Eyers, *Nature Chemistry*, **2014**, 6 281.
2. P Chatterjee, S. S. Dutta and T. Chakraborty, *J. Phys Chem* A, **2022**, 126, 1591.
3. P. Chatterjee, S. S. Dutta, M. Agarwal, S. Dey and T. Chakraborty, *J. Phys. Chem. A* **2024**, 128, 548

Invited Lecture in the Session:
Chemical Sciences

Setting dynamic molecules in action with light energy

Subhajit Bandyopadhyay

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Abstract

Photochromic molecules are compounds capable of undergoing reversible transformations between two distinct forms upon exposure to specific wavelengths of light. These light-induced changes involve alterations in molecular structure, optical properties, and electronic states, enabling their dynamic behavior. This characteristic makes photochromic molecules ideal for applications requiring responsive materials activated or modulated by light. In this talk, we will explore the fundamental mechanisms underpinning photochromic transitions, including cis-trans isomerization, ring-opening/closing, and electron-transfer processes. These molecules can act as adaptive optical materials for both biological applications and applications in materials. We will be highlighting our recent adventures and advancements in the fascinating world of these molecules.

Invited Lecture in the Session:
Statistics, Mathematics, IT and its application

Generalized quadratic discriminant analysis

Smarajit Bose

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Abstract

In linear discriminant analysis, the assumption of equality of the dispersion matrices of different classes leads to a classification rule based on minimum Mahalanobis distance from the class centers. However, without this assumption, the resulting quadratic discriminant classifier involves, in addition to the Mahalanobis distances, the ratio of the determinants of the dispersion matrices as a factor. In fact, it has been observed that, for discriminating between populations with underlying elliptically symmetric distributions, such classifiers also incorporate similar factors, apart from the Mahalanobis distances.

In this talk, a nonparametric classification technique which generalizes discriminant analysis has been proposed. The method of cross-validation is used to make the technique adaptive to a given dataset. An extensive simulation study is presented to illustrate the potential of the method. Finally, through implementation on a number of real-life data sets, it has been demonstrated that the proposed Generalized Quadratic Discriminant Analysis (GQDA) compares very favourably with other nonparametric methods, and is computationally cost-effective.

Invited Lecture in the Session:
Engineering and Technology including Emerging Technology

Minding the Machines: Ethics and Accountability in AI Development

Subhadip Basu

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Abstract

As Artificial Intelligence (AI) systems increasingly influence our lives, ensuring their ethical development and deployment has become a critical concern. We need to explore the intricate relationships between ethics, accountability, and AI development, highlighting the need for a more nuanced understanding of the complex interplay between technical, social, and moral factors. We argue that the development of AI systems must be grounded in a deep understanding of ethical principles, human values, and social norms. To this end, we propose a multidisciplinary framework that integrates insights from ethics, philosophy, computer science, and social science to guide the development of AI systems that are transparent, accountable, and aligned with human values. Our framework emphasizes the importance of accountability mechanisms, value-aligned design, and ongoing evaluation and refinement. By "minding the machines," we can ensure that AI systems serve humanity's best interests and promote a more just and equitable society.

Keywords: AI Ethics, Accountability, Responsible AI, Value-Aligned Design.

Invited Lecture in the Session: Zoology

Insects do matter: Identification, diversity, and application in forensics

Subhankar Kumar Sarkar

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Abstract

Perhaps the most fundamental query in science, particularly in animal science, is to know the total number of species on planet Earth. Unfortunately, data on the exact number of species inhabiting/inhabited Earth is not known till date. This might be due to the reason that most species remain un-described and indirect attempts to answer this query are highly controversial. It is predicted worldwide that the Earth is home for ~8.7 million (± 1.3 million) eukaryotic species, of which ~2.2 million (± 0.18 million) are marine. According to a recent report of IUCN, published in 2022, there are approximately 2.16 million animal species on Earth, of which 20% are likely to be duplicates or are cryptic. Among all eukaryotic organisms, insects are the most abundant of all life forms collectively accounting for nearly one million species described till date. Some recent studies also advocate that each insect species primarily identified by erroneous techniques might hide on an average of three cryptic species. India being among the top 12 mega biodiverse nations in the world accounts for 7.1% of the world insect fauna representing about 60,000 insect species discovered so far. This calls for a comprehensive approach for identification, diversity assessment, and exploring the ecological functions of insects in order to assess the impact of major human concerns such as climate change.

Additionally, nowadays an emerging field of insect science is Medico-legal Forensic Entomology, which helps in death investigation by estimation of minimum postmortem interval (PMI) from development of fly larvae (maggots). Development of maggots in outdoor decomposing bodies under the influence of fluctuating environment is non-uniform in nature and significantly varies from growth model generated in laboratory experiments. Therefore, mathematical models on age of maggots are conservative to particular geographical locations that vary from place to place. In India, first of its kind a prototype human “Body farm” setup is prepared with unclaimed body parts, to assess the pattern of maggot development in different seasons, with a futuristic outcome on scientific validation regarding entomological evidence analysis.

Invited Lecture in the Session: Biotechnology

Understanding Plants' Defense Response Mechanism in Genomic Era

Sampa Das

Former Professor of Bose Institute, Kolkata

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Abstract

Plant kingdom is the most important asset of planet earth. With their unique photosynthesizing ability, they are not only the source of food, feed and several other commodities, but provide shelters to various life forms, protect and refresh environment, balance the ecosystem in many ways.

As a rich source of nutrients, plants are often attacked by several pathogenic enemies. Also, various environmental factors like excessive heat, cold, drought, UV impart deleterious effect on pants' growth and metabolism. Being sessile in nature, plants have to withstand such stresses because neither they have adaptive immune system nor they possess any defender cells. However, several plants exhibit some kind of innate immunity and are able to apply several layers of strategies to shield themselves from the damage caused by stress factors. Successful pathogens breach this immune defense and cause disease on hosts. Usually, two layers of immunity exist in plants in the first place of which pathogens are recognized by the hosts' extracellular receptor protein mediated by exposed molecular pattern and a kind of immunity develops known as pattern triggered immunity (PTI).

Aggressive pathogens break PTI by secreting toxin molecules known as Effectors. When plants recognize these effectors aided by intracellular receptors, second layer of stronger immunity is built up in plants known as effector triggered immunity (ETI). More virulent pathogens elicit modified effectors to suppress the power of ETI. In due course of evolutionary journey some plants acquire resistance genes (R genes) to counteract the virulence which are activated by different plant transcription factors (TF) like WRKY, MYB etrc.

Like mammalian system reactive oxygen species (ROS) generation is also one of the primary indications of plants' own defense activation. ROS molecules induce cascades of mitogen activated protein kinases (MAP kinase) which activate different TFs by phosphorylating them which in turn regulate expression of several defense related genes. Underlying mechanism of this resistance response in plants will be discussed.

Invited Lecture in the Session:
Environmental Science Including Climate Change

Environmental challenges under projected climate change scenarios over India

Lalu Das

Department of Agricultural Meteorology and Physics,

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ABSTRACT

21st century is projected to be full of challenges for the mother earth due to the unexpected occurrance of several climate related environmental problems like global warming and climate change, toxic waste, water and air pollution, acid rain, and shrinking energy supplies etc that may threaten several economic sectors of India including agriculture.

Keywords: climate change scenarios, downscaling product, impact study, crop simulation model, global circulation models (GCMs), RCPs, SSPs, agricultural productivity.

Recommendations:

- Multi-level stakeholders should have high resolution downscaled climate change information beforehand to implement any adaptation and mitigation option towards combating climate change at local level
- To adequately assess the impact of climate change on agricultural sector, crop specific process-based crop simulation models must run using local scale downscaling information as inputs instead of raw GCMs to produce future productivity scenarios over each homogeneous zones of India

Invited Lecture in the Session:
Agriculture, Horticulture, Fisheries and Veterinary Sciences

Entropy, chaos and co-creation:

Resilience in farming ecosystem confronts threats and opportunity

S.K. Acharya

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Dean, PGs, BCKV

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Abstract

In the evolving extension science, the need of extrapolation of principles of physics, biology or material sciences have become a unique approach to re-engineering conceptual inputs of extension science. August Comte, the father of sociology dealt with social physics, Durkheim experiments with functionalism. Green revolution in India has triggered up technology led development of agriculture in a swashbuckling manner. Indigenous technologies are increasingly being invaded by exotic technologies. Industrialization of agriculture has not progressed uniformly throughout India because small and marginal farmers are often confronting with the new prescribed technologies and simultaneously displaying negative cognitive behavior such as discontinuance, disagreement, rejection, conflict, dissonance, reinvention and confusion about the imposed technologies. In technology led development of agriculture farmers are motivated to adopt modern technologies by any means, but at the same time there is a gap between motivation unleashed and achievements made. This gap is nothing but negative behavior which can be referred to Social entropy. Social entropy in closed and isolated system always increases and ultimately leads to collapse or death of a system. Through an empirical study, it has been evinced the factors like failed promises, reality of of lost venture against a guided imagery, fragmentation of holding, uncertainties in weather-market-income have been organically linked with increasing disillusionment , chaos and entropy. In thermal entropy, the residual energy S equalizes entropy; here in this study residual motivation can be responsible for psychic entropy. This is so relevant when farmers are promised high; achievements remain far below to unleash residual motivation.

Key words: Social entropy; Social metabolism; technology socialization, farm modernization, Urbanization**.**

Invited Lecture in the Session:
Application of AI and ML for Sustainable Development

Deep Learning Applications for Medical Image Analysis and Deepfake Detection

Ram Sarkar

Professor, Department of Computer Science and Engineering, Jadavpur University, Kolkata, India

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Abstract

My talk will begin with an overview of the fundamentals of deep learning models, particularly convolutional neural networks (CNNs). Then I'll talk about two significant deep learning application areas that have a big impact on society: medical picture analysis and deepfake detection. I'll go over how a CNN model can be modified for medical image analysis by including an attention module to it. I will next go over the process of creating deepfake images and videos using a special type of deep learning model known as a Generative Adversarial Network (GAN). My discussion will conclude with a deep learning-based method for detecting deepfake images and videos.

PART – II

SUBJECT AREA WISE
ABSTRACT OF THE PAPERS
FOR
ORAL PRESENTATION

ABSTRACTS OF THE

SUBJECT AREA:
PHYSICAL SCIENCES

Table of Content

Presenting author*

Early findings on the relationship between the atmospheric electric field and air quality index monitored from two tropical sites

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Understanding changes in the atmospheric electric field (AEF) and how they relate to air quality metrics such as the Air Quality Index (AQI) is essential for comprehending the behaviors of both local AEF and global electric circuits (GEC). This study examines the diurnal and seasonal fluctuations of AEF at two distinct sites in Bagula (BGL) and Purulia (PRL), West Bengal, India. The fair-weather AEF variations from these two sites are compared with the global standard Carnegie curve for AEF and with other sites. The rural site's diurnal variation in fair weather more closely resembles the Carnegie curve than the urban site's. Additionally, the AEF variations are examined in relation to the AQI values in those two locations to assess how local air pollution affects atmospheric electricity. AEF and AQI show moderate to high correlations that varies with daily, monthly and seasonal time scales. The seasonal AEF variation and AQI have a strong link for the winter season ($r = 0.75$, $p \leq 0.01$), the post-monsoon season ($r = 0.59$, $p \leq 0.01$) at BGL and that of for the monsoon season ($r = 0.61$, $p \leq 0.01$), the post-monsoon season ($r = 0.63$, $p \leq 0.01$) at PRL. Moreover, the pre-monsoon and monsoon coefficients at BGL are 0.48 ($p \leq 0.05$) and 0.34 ($p \leq 0.05$), and at PRL, they are -0.12 ($p \leq 0.05$), and 0.18 ($p \leq 0.05$). BGL recorded higher correlation coefficients ($r>0.70$) on a daily time scale in March, while PRL recorded higher correlation coefficients in November.

Synchronization of heterogeneous oscillators through inductor coupling: Insights from Chua and LC Tank Circuits

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The study of coupled oscillators has traditionally focused on interactions between identical systems. However, both natural and engineered systems often involve heterogeneous interacting components. Recent research has shown that inductor-based field coupling can effectively control chaos, offering potential applications in neuro-computing and neural networks due to its low power consumption and fast communication capabilities. In this work, we numerically investigate the interaction between two heterogeneous periodic oscillators connected via an inductor: the Chua oscillator and an LC tank circuit. The circuit was simulated using SPICE-based NI Multisim™ software, and the model equations were derived in dimensionless form through scaled transformation from the circuit equations. The Chua oscillator was set to operate in a periodic regime, with specific parameter adjustments. Upon establishing inductor-based coupling between the oscillators, the system exhibited chaotic behavior through a multi-periodic route for certain coupling strengths. Numerical analysis was performed, exploring the system dynamics through bifurcation diagrams, Lyapunov exponent spectra, and phase-space plots. The Lyapunov spectrum revealed a single positive Lyapunov exponent in the chaotic regime, ruling out

Study of Wigner Function as a measure of non-classicality for photon-added Schrodinger Cat State

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This paper investigates the Wigner function as a tool for measuring non-classicality in photon-added Schrödinger cat states. The study begins by exploring the theoretical foundations of coherent states, the Schrödinger cat state, and their corresponding Wigner functions. A Schrödinger cat state is a superposition of coherent states with opposite phases. When photon creation operators are applied to these coherent states, photon-added Schrödinger cat states are formed. The focus of this work is on understanding the non-classical properties introduced through photon addition. In this context, the Wigner function serves as a powerful measure of non-classicality. The greater the negativity observed in the Wigner function, the more non-classical the state is considered to be. The Wigner function is extensively calculated using the coherent state representation of photon-added Schrödinger cat states. Emphasis is placed on the changes in non-classicality observed with the addition of photons to the cat state. Non-classical states, such as the Schrödinger cat state, display phenomena like superposition and entanglement. Understanding the non-classical properties of these states also helps to quantify entanglement. There is a direct, linear relationship between non-classicality and entanglement. Thus, this paper not only examines the non-classical characteristics of photon-added Schrödinger cat states but also reveals their potential for quantum entanglement, which has significant implications for quantum information theory.

Na^+ Substitution effects on $GdMnO_3$: Structural integrity and enhanced dielectric properties for next-generation electronics

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This study investigates the impact of Na^+ substitution at the Gd site in $GdMnO_3$ multiferroic oxides on the structural, dielectric, and electrical properties. Polycrystalline samples of $Gd_{1-x}Na_xMnO_3$ (x = 0.05, 0.10, 0.15) were synthesized using the solid-state reaction method. Structural analysis through X-ray diffraction confirmed the orthorhombic perovskite structure, with Na doping leading to enhanced lattice stability. The dielectric properties were measured over a wide temperature (3 K to 300 K) and frequency range (20 Hz to 1 MHz), revealing a significant influence of temperature and frequency on the dielectric constant and loss tangent. The dielectric behaviour, characterized by multiple relaxation peaks, suggests a thermally activated electron hopping mechanism, especially at high temperatures, contributing to enhanced polarization. AC conductivity measurements indicate that Na-doped samples follow a localized hopping conduction mechanism, making them promising candidates for high-frequency electronic applications. Impedance spectroscopy further supports the existence of grain and grain boundary effects, with non-Debye-type relaxation processes observed. These findings provide a pathway to optimize Na-doped $GdMnO_3$ for use in advanced electronics and energy storage technologies.

Enhanced magnetocaloric performance of $Y_{0.10}Ca_{0.90}MnO_3$

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This study investigates the synthesis, structural characterization, and magnetocaloric properties of $Y_{0.10}Ca_{0.90}MnO_3$, a promising candidate for magnetic refrigeration applications. The sample was synthesized using the solid-state reaction method, with its orthorhombic perovskite structure confirmed through X-ray diffraction. Yttrium substitution was found to enhance lattice stability, which is essential for optimal magnetic performance. Magnetic measurements revealed a second-order phase transition from paramagnetic to ferromagnetic at 106 K, with Arrott plot analysis supporting the second-order nature of this transition. Furthermore, the inverse susceptibility versus temperature plot exhibited a sharp downturn at 156 K, indicative of a Griffith's like phase, which underscores the material's complex magnetic behaviour. The effective magnetic moment in the paramagnetic region was determined to be 4.048 μ_B, reflecting the material's strong magnetic characteristics. The magnetocaloric effect was notably significant, with a maximum entropy change ($-\Delta S_M$) of 6.611 J/kg·K observed under a 7 Tesla magnetic field. This substantial entropy change, coupled with a wide operational temperature window, positions $Y_{0.10}Ca_{0.90}MnO_3$ as a suitable candidate for advancing energy-efficient and environmentally friendly magnetic refrigeration technologies. Overall, this work provides essential insights into the material's properties, paving the way for its application in sustainable cooling solutions.

All-optical method of developing OFSK using photonic band gap crystal

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The use of photonic Band Gap (PBG) crystals has been shown to be essential in superfast optical data processing systems. Frequency Shift Keying (FSK) is demonstrated to expand a possible use in optical communication and computing. The FSK can demonstrate its use in PBG as well. The primary innovation of our proposed work is the use of an all-optical Octal Frequency Shift Keying (OFSK) system to be developed on a 2D PBG crystal. GaAsInP-doped rods positioned in an air-based substrate provide a structure in the above-mentioned construction, which also includes photonic crystal-based semiconductor optical amplifiers (pc-SOAs). A theoretical model that effectively illustrates the behaviour of OFSK system in the optical domain was also given by the present authors. This work provides a very high-speed operation and requires a small amount of input power. Here, the OFSK model is realized by including ring cavity resonators in photonic band gap structure. The OFSK scheme is established here using intensity-encoded Boolean signals and the photonic crystal-based Semiconductor Optical Amplifiers (pc-SOAs). Since the OFSK was created in the optical domain by utilizing the switching characteristics of PBG, this implementation may be carried out with a minimal amount of light power. Ultimately the present scheme offers a nice transformation of three paralleling intensity encoded Boolean bits to a single frequency encoded bit. In long-haul communication, the proposed scheme may be potentially usable.

Photoelectrochemical hydrogen production using copper(I) oxide based semiconductors

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Hydrogen generation through photoelectrochemical (PEC) water splitting using renewable energy sources like sunlight is considered a green approach and an efficient way to solve global energy issues and environmental problems by replacing carbon-based fuels. The p-type copper-based oxides have attracted much attention for PEC devices due to their non-toxicity, low cost, direct band gap of 1.8-2.2eV and wide applications in photoelectrochemical, photovoltaic, sensor and supercapacitor devices. In the present study, we successfully synthesized Cu(I)-based oxide semiconductors through anodizing metallic copper substrate in a suitably modified alkaline solution, which is believed to be a green approach and environmentally friendly technology. SEM, UV-vis absorbance spectra were carried out to study their morphological and optical properties, whereas the electrochemical impedance and linear sweep voltammetry were employed to check the photoelectrochemical water splitting applications. A solar water to hydrogen production photocurrent higher than 500μA/cm^2 was recorded from the copper(I) oxide semiconductor thin film. The lower R_{ct} value (charge transfer resistance) suggests facile charge transfer occurs under illumination of UV-Vis light at the electrode/electrolyte interface. Mott-Schottky analysis confirms the p-type semiconducting properties of the films.

Unveiling galactic Wolf-Rayet Stars through machine learning

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Wolf Rayet (WR) stars are a class of Population I massive stars that represent the last evolutionary stage of massive O-type main sequence stars (>25 times solar mass) before they undergo Type Ib/Ic supernovae explosions. WR stars are known for peculiar spectra exhibiting broad emission lines propelled by supersonic stellar winds of highly ionized elements such as helium, nitrogen, carbon, and oxygen which are products of He-fusion reactions at the stellar core. Extreme mass outflows from their outer envelopes mechanically and chemically enrich the interstellar medium and trigger young star formation in the Galaxy making them probes of massive star formation regions in the Milky Way (MW). In this study, we utilize ensemble-based Machine Learning algorithms such as eXtreme-Gradient Boosting (XGB) and Random Forest (RF) to facilitate the accurate identification of WR stars based on their intrinsic colors in the InfraRed (IR) bands and equatorial coordinates. We used the near and mid-IR observed data of 6555 stellar objects in the MW and employed an XGB classifier to identify WR stars with an 86% accuracy, surpassing the RF classifier. These models perform way better than the manual identification (50% accuracy). Further application to an unknown dataset of 6457 objects led to the discovery of 58 new WR sources that are primarily embedded in the MW's Local arm which hosts massive star-forming regions.

ABSTRACTS OF THE

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Presenting author*

Tyrosine kinases as targets for anticancer agents: Study of receptor drug-interaction by pharmacophore and molecular docking Studies

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Tyrosine kinase plays a major role in the targeting of anti-leukemic drugs. The Human Genome Project's sequencing has created numerous opportunities for medicinal research. Tyrosine kinase is encoded by the ABL1 proto-oncogene. This protein is involved in stress response mechanisms, DNA repair, cell adhesion, differentiation, and division. The creation of effective anti-leukemic medicines has been greatly facilitated by computer-aided drug design (CADD) techniques, which have also been crucial in revealing molecular patterns that may be responsible for the emergence and progression of anti-leukemic activity. A pharmacophore is a set of structural features present in a group of compounds and is responsible for the biological activity of the compounds. Several protein tyrosine kinases (derived from Homo sapiens) are examined in this work for pharmacophore analysis. QSAR models using a huge and diverse compound database were made against tyrosine kinase. These models demonstrated exceptional statistical quality and predictive anti-leukemic capacity. Several fragments are found to be responsible for protein inhibition. Novel compounds were proposed as effective inhibitors of the proteins. Energy minimization and subsequent dynamics simulation were conducted for proteins complexed with potential ligands. The dynamic trajectory analysis provided information on potential hydrogen bond donors and acceptors, as well as positive and negative ionizable regions, likely hydrophobic regions, and stacking interaction sites This will make it easier to identify the key areas for a certain compound's pharmacological activity.

Effect of β-sitosterol additive for enhancing oxidative stability and health benefits in sesame-mustard oil blend

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During deep-fat frying, vegetable oil undergoes hydrolysis, oxidation, and polymerization, reducing its oxidative stability towards deterioration in sensory and nutritional quality, which is harmful for human health. Although deep-fat frying is a very common method during cooking, the high fat content in fried foods raises concerns for cardiovascular health. Additionally, it produces harmful compounds such as acrolein and malondialdehyde, both mutagenic. This study focused to scrutinize the antioxidant effect of β-Sitosterol additive in preventing oxidative degradation in continuously deep-fried blended oil (a 1:1 ratio of mustard and sesame oils) under high temperatures for ~12 hours. Blended oil with and without β-Sitosterol was utilized for potato chips frying at every hour to simulate commercial frying atmosphere. Then, total 5 samples of 50 grams of oil samples with or without β-Sitosterol, were collected at every 3 hours interval at 60 °C starting from 0 hour to 12 hours. The samples were cooled, stored in airtight amber-coloured glass bottles and then refrigerated. Various chemical parameters were utilized to assess oil quality such as 4-HNE value, acid value, peroxide value, iodine value, p-anisidine value, and conjugated diene and triene values. The results demonstrates that oil with β-Sitosterol had improved oxidative stability over its absence in oil. To promote healthier cooking, people should ensure frying oil does not exceed 180 °C (355 °F) and reduce the temperature to 120 °C (250 °F) when not in use. Therefore, use of natural antioxidants like β-Sitosterol in oil can reduce oxidative damage during frying to benefit health.

Development of zinc (II) complexes of anthracene-based based organic ligand as potent antibiofilm agents against multi drug-resistant bacteria with biomedical applicability

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MRSA, a highly resistant bacterium, is a major health concern due to its biofilm formation capability and evasiveness to antibiotics, making its classification as one of the notorious "ESKAPE" pathogens. Novel zinc(II)-based metal complexes, supported by anthracene-based ligand have developed as potent antibacterial and antibiofilm agents with a new approach in medicinal chemistry with biomedical applicability. So, three zinc(II) complexes, *i.e.,* 1-3, were prepared by using the ligand in amalgamation with $ZnCl_2$, $Zn(CF_3CO_2)_2{\cdot}H_2O$, and $Zn(NO_3)_2{\cdot}6H_2O$, respectively. After that, the complexes were subjected to complexation pattern studies as well as various analytical methods and structural characterization. All three complexes showed considerably high antibacterial and antibiofilm efficacy against MRSA. The antibacterial efficacy was determined by the determination of MIC, time-kill study, and live-dead assay. CV assay and microscopic investigations were carried out to assess the anti-biofilm efficacy of the complexes. The complexes were found to have an impact on the important virulence factors. ROS production, membrane depolarization and damage, lipid peroxidation, and cellular leakage detection were determined to understand the mechanism of action. Furthermore, the complexes demonstrated improved antibacterial activity in combination with the commercial antibiotic. The complexes also exhibited effective biofilm removal from the surface of the *ex vivo* model, including medical implants (catheter). Even, there were no cytotoxic effects of the complexes on human cell line. The complexes were also evaluated for their efficacy against MRSA clinical isolates. Overall, our study showed that complex 1 could be a promising antimicrobial agent from a therapeutic perspective, compared to 2 and 3.

All-photon photoswitching in a photochromic dyad with overlapping absorption bands

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Molecular switches offer high-precision tools for achieving photoresponsive control across a wide range of applications. From molecular solar thermal (MOST) energy storage systems and super-resolution fluorescence microscopy to information processing and photopharmacology, molecular switches are central to the development of sustainable technologies. A molecular switch can generate two distinct, addressable states, and increasing system complexity has driven the creation of photochromic dyads or coupled photoswitches, enabling multiple responses while maintaining orthogonality. However, orthogonal photoswitching in hybrid photochromic systems remains an emerging field, with significant challenges yet to be addressed. In this work, we discuss the development of an all-photon orthogonal hybrid photochromic dyad, integrating two distinct photoswitches: dimethyldihydropyrene (DHP) or benzo[e]-fused dimethyldihydropyrene (BDHP) with azobenzene. Despite the significant spectral overlap between these systems, careful design and selective wavelength application have successfully decoupled the individual photoswitches. As a result, four distinct states can be selectively controlled using light alone. To demonstrate this approach, we constructed an all-photon-enabled molecular logic gate, showcasing the potential of these systems for advanced molecular information processing.

Electrochemically Deposited Molecular Imprinted Polymer (MIP) based Sensor for Detection of Noro Virus-like Particles

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The recent spreading of viral diseases has led to the outbreak of pandemic situation and caused severe threats to public health worldwide. Early detection of virus is necessary to prevent its outbreak as the vaccination is a time taking process. The commonly used detection of viral surface proteins relies on antibodies or aptamers, which have storage limitations and cannot be reused. To address these challenges, we are trying to develop an antibody-free sensor using electrochemically deposited Molecular Imprinted Polymer (MIP) of Polyaniline (PAni) for detecting Virus-like Particles (VLPs). The main advantage of the MIP-based sensor over conventional methods is its use of polymer-based cavities or cages for virus detection, rather than relying on biological elements like antibodies or aptamers. MIP-based sensor utilizes polymer cavities created through molecular imprinting, which have a high binding affinity for specific molecules. In this case, our target is the surface protein of Noro virus. Gold-Polyaniline (Au-PAni) nanocomposite is used for the synthesis of the sensor and the sensor matrix is developed through electro-polymerization of aniline. To evaluate the performance of the sensor, we conducted Electrochemical Impedance Spectroscopy (EIS) using various Noro VLP concentrations ranging from 10^{-6} to 10^{-12} mg/ml. The results showed significant changes in impedance, indicating the ability of sensor to detect different concentration of the target virus. This approach aims to provide a reliable, reusable, and storage-friendly alternative to traditional virus detection methods, potentially improving our ability to respond to viral threats and prevent future pandemics.

Discovery of novel uracil-containing cyclic hypervalent iodine reagent and its application

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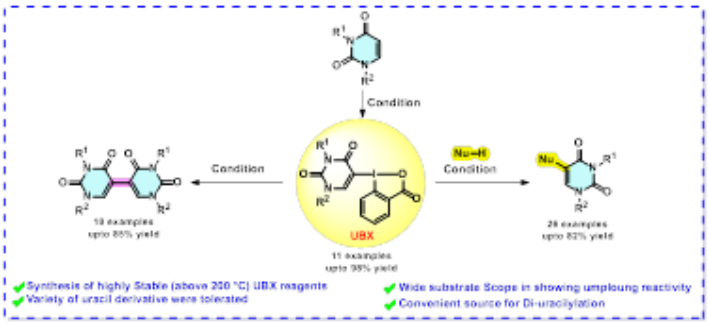
A novel uracil-containing cyclic hypervalent iodine (UBX) reagent has discovered, which marks a breakthrough in the field of organic synthesis. The development of this reagent allows for the synthesis of a wide variety of uracil derivatives, demonstrating excellent tolerance for structural diversity, and opens new possibilities for reactions involving these biologically relevant compounds.



These UBX reagents are unique as they incorporate uracil, a biologically important nucleobase, into their cyclic structure, providing new avenues for synthetic transformations. A standout property of these reagents is their exceptional stability, withstanding temperatures above 200 °C. Additionally, these reagents offer several distinct advantages in synthetic chemistry. One of the key benefits is their ability to facilitate umpolung reactions, which reverse the natural polarity of uracil derivatives, enabling access to unique reactivity patterns that are otherwise difficult to achieve.

Moreover, UBX reagents provide a convenient and efficient source for di-uracilylation, simplifying the incorporation of two uracil units into target molecules. This dual-functionalization potential has vast implications, particularly in the development of pharmaceuticals and advanced materials, where uracil derivatives are frequently used. The stability, broad applicability, and unique reactivity of UBX reagents position them as powerful tools for future innovation in both academic research and industrial applications.

Arylazopyrazoles photoswitch-based flexible organic single crystals

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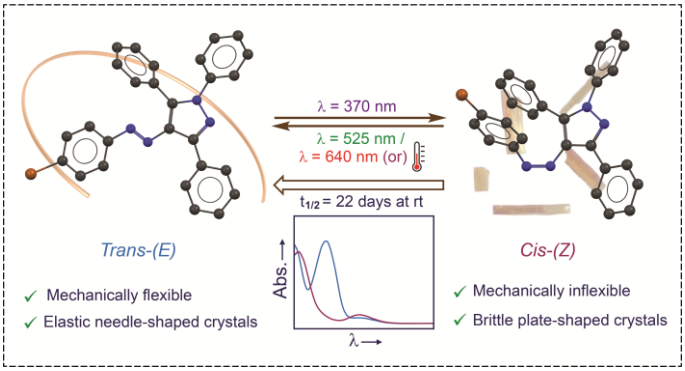
Arylazopyrazoles stand out among the azoheteroarene photoswitches for use in materials science and biology. Here, we report a photoswitchable azoheteroarene, arylazo-*N*-phenyl-3,5-diphenyl pyrazole (**AAP1**), that acts as an optimal photoswitch in terms of near-quantitative two-way photoswitching, high fatigue resistance, and prolonged half-life of the *cis*-isomer (22 days at 298 K). The structural features of **AAP1** enabled the *cis* → *trans* reversal to function under red light quantitatively. Single crystal structures were obtained for both the *trans*- and metastable *cis*-isomers of **AAP1**. Structural analysis of the *cis*-isomer revealed that the phenyl groups in the pyrazole ring are engaged in an intramolecular pi-stacking interaction, which enhances its remarkable thermal stability (E_{act} > 26 kcal/mol). The thermodynamically stable *trans*-**AAP1** grows as needle-shaped crystals with exceptional elastic mechanical flexibility, whilst the *cis*-isomer crystallizes as plate-like crystals that are brittle. The quantitative mechanical properties of both the isomers have been quantified and compared with the aid of nanoindentation experiments. The *trans* crystals were significantly softer than the *cis* ones, as evident from the wider indent impression and low resistance of crystals to elastic deformation. Remarkably, in the macroscopically brittle *cis*-form, a three-fold increment of elastic modulus (*E* = 10.05 GPa) and hardness (*H* = 450 MPa) values have been identified compared to the elastically flexible *trans*-form (*E*= 3.8 GPa and *H* = 120 MPa). Theoretical insights derived from DFT, TDDFT, and crystal explorer predictions are qualitatively correlated well with the experimental findings. Hence, **AAP1** can be the optimal photoswitch for applications in materials science.



Switching racemase activity on and off: A photo-tunable pyridoxal-5'-phosphate mimic incorporating dimethyl-dihydropyrene

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Pyridoxal-5' phosphate (PLP) is an essential cofactor for numerous enzyme functions, including racemization, transamination, decarboxylation, and β-elimination, especially in amino acid metabolism. PLP's versatility comes from its capability to produce highly reactive intermediates like aldimines (Schiff bases) and quinonoid species, which is a very crucial intermediate for many enzymatic reactions involves using PLP. One of the key challenges for the biochemists to control the enzymatic activity in spatiotemporal manner. Inspired by the PLP's versatility in enzymatic activity we aim to develop a dimethyl-dihydropyrene (DHP) based PLP mimic which can allow us to control the activity using the external stimuli like light and heat.

In this work, we have synthesised the synthetic mimic of PLP racemase by incorporating the DHP core in between the pyridinium and formyl functional group with some modification. This incorporation allows us to electronically control the communication between two group, effectively turning on and off the activity of racemase. The light modulated PLP mimic can not only be used for the racemase but also other PLP based enzymatic reactions. This approach could open the potential application in the field of therapeutic development and biochemical applications controlled by the external stimuli.

L-DOPA based versatile organogelator for potential oil spillage recovery and waste water treatment

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Phase selective organogelators with low molecular weight have recently emerged as candidates as "smart" oil scavenging material to mitigate oil spill problem. Adsorption of harmful dyes present in the waste water by low molecular weight organogelators (LMWGs) is also a low cost and highly efficient technique for removal of dyes and/or other contaminants to prevent water pollution. This abstract describes the synthesis of L-3,4-dihydroxyphenylalanine (L-DOPA) based small amphiphilic organogelator in a single step with high yield having tertiary-butyldimethylsilyl (TBDMS) moiety as the protecting group for the two phenolic –OH group. The amphiphilic gelator exhibits excellent solvent immobilizing efficacy in wide range of solvents ranging from aromatic solvents, alcohols, chlorinated solvents, petroleum fractions and crude oil. The minimum gelation concentration (MGC) varies from 0.25-1.5% (w/v) in these solvents. Interestingly, the formations of these gels are instantaneous and are thermoreversible in nature. Various spectroscopic and microscopic studies such as field emission scanning electron microscopy (FESEM), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) etc. confirmed the crucial role of different non covalent interactions in gel formation. Rheological experiments confirmed the mechanical stability and viscoelastic nature of the prepared gels. Interestingly, the gelator exhibits selective gelation of various petroleum fractions like petrol, diesel, and kerosene from a biphasic mixture of oil-water. Importantly, the gelator also exhibits selective gelation of crude oil having high and low sulphur content from a biphasic mixture of oil-sea water. Additionally, the xerogels from the gelator are useful in removing various toxic dyes from wastewater.

High performance rapid fluorescence and colorimetric sensing of Al^{3+} and Fe^{3+} ions and selective mitochondria tracking by lanthanide (Eu^{3+}, Tb^{3+}) metal organic frameworks

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Here we synthesized a family of isostructural excited state intramolecular proton transfer (ESIPT) based fluorescent metal organic frameworks (LnMOF) constructed with Eu^{3+}, Tb^{3+} and 2, 5 dihydroxybenzenedicarboxylic acid. By exploiting the –OH group these LnMOFs engage in an acid-base type complexation with highly acidic metal ions such as Al^{3+} and Fe^{3+} which manifest into the fast response and highly sensitive sensing phenomenon. Such complexation triggers chelation enhanced fluorescence (CHEF) for Al^{3+} as well as ligand to metal charge transfer (LMCT) and chelation enhanced quenching (CHEQ) for Fe^{3+} ions. Therefore, in aqueous medium these LnMOFs demonstrate a 'turn on' intense green (λ_{Em}= 493 nm) fluorescence in presence of Al^{3+} and a visible dark bluish color (λ_{Ab}= 670 nm) with fluorescence quenching for Fe^{3+} ions. The sensitivity of such sensing behavior was further elucidated with low limit of detection (21 nM for Al^{3+} and 46 nM for Fe^{3+}), high recyclability and fast response time. We also demonstrate the relevance of LnMOFs in biological field as fluorescent cancer cell labelling probes. Live cell confocal microscopy with MCF7 cells reveal a selective mitochondrion targeting ability of these LnMOFs. The study also divulges in the enhanced mitochondria localization by LnMOF conjugated with a lipophilic cation. With nominal cytotoxicity these LnMOFs are found to retain exclusively in mitochondria for a long time (24 h). Therefore, the present work demonstrates successful application of a family of lanthanide MOFs as remarkable chemosensor and exclusive mitochondria marker.

Spectral chameleons: Broadcasting TADF and RTP dynamics in flexible polymorphic optical waveguides

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From a single molecule, polymorphism is essential in producing a variety of crystalline materials with unique mechanical and photophysical properties. Here, we present two different polymorphs of 5'-(9-ethyl-9H-carbazol-3-yl)-[2,2'-bithiophene]-5-carbaldehyde (CZ-CHO): green (G) emissive and yellow (Y) emissive crystals. With G displaying room temperature phosphorescence (RTP) and Y displaying thermally activated delayed fluorescence (TADF), these polymorphs exhibit different optical properties. Furthermore, both polymorphic crystals exhibit optical waveguiding properties and mechanical flexibility. We place the G optical waveguide at different lengths perpendicular to the Y waveguide by utilising the AFM-tip-based mechanophotonics approach. By carefully regulating the optical path length of crystal waveguides, this method makes it easier to investigate the interaction between TADF and RTP phenomena. In essence, our method opens the door for improvements in polymorphic crystal-based photonic circuit technologies by offering a clear route for comprehending and managing the photophysical processes in organic molecular crystals.

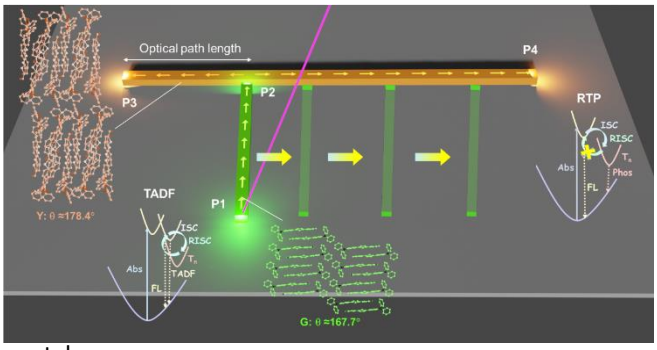

Photo-responsive generation and depletion of a stable organic radical cation

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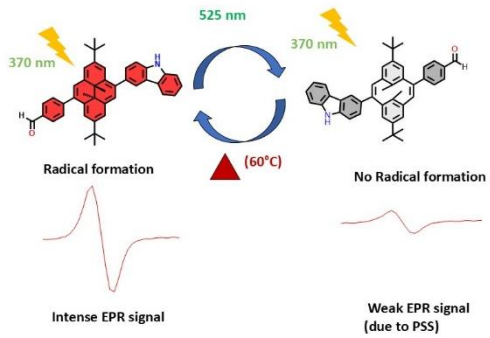
Photochromic materials are extensively utilized in various research fields due to their stimuli-responsive properties under external stimuli, namely, light and heat. This study focuses on a photochromic system based on the negative T-type photochromic system dimethyldihydrolpyrene (DHP), which undergoes isomerization from the closed, colored, and conjugated form to the open, less conjugated, and colorless cyclophanediene (CPD) form upon exposure to visible light. The closed DHP form reverts to its original state under UV irradiation or heating. In this work, we have successfully synthesized a donor-acceptor conjugated DHP system integrated with a donor carbazole moiety and an acceptor carbonyl moiety. DHP system is a 14p aromatic system which is highly electron-rich in the closed form than its open CPD photoisomer. When subjected to UV light, the closed carbonyl-DHP-carbazole triad transforms, forming a radical species that is detectable by electron paramagnetic resonance (EPR). Interestingly, on the other hand, the open CPD form exhibits less intense paramagnetic behaviour due to the loss of p electron density of the aromatic core, which shows less intense EPR spectra when subject to UV light. This system enables precise control over the generation and elimination of radicals by applying distinct stimuli, such as light and heat.



Unveiling the bonding and coordination dynamics of carbon in protonated methane (CH_5^+): Insights from molecular handycam technique

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The bonding nature and geometric structure of CH_5^+ have remained a subject of debate for nearly 75 years since its discovery. To investigate the existence of a five-coordinated carbon in CH_5^+, the Molecular Handycam Technique (MHT) was employed at the CCSD//cc-pVDZ level of theory. The MHT analysis suggests that CH_5^+ adopts a structure that can be approximated as a square pyramidal geometry, where the central carbon atom appears to exhibit pentacoordination. This finding introduces potential new avenues for exploring carbon's bonding flexibility, with possible implications for carbon chemistry. However, no clear evidence supports the existence of a true pentavalent carbon. Among the five hydrogen atoms in CH_5^+, four are equivalent, each with a C–H bond length of 1.13 Å, while the fifth hydrogen is more strongly bonded to the carbon atom, with a shorter C–H bond length of 1.08 Å. Of the four equivalent hydrogens, any three form covalent bonds with the carbon atom, imparting a partial negative charge on it. The remaining hydrogen engages in an ionic interaction with carbon due to its partially positive charge. This bonding pattern resembles the hyperconjugation effect observed in other organic systems. Thermodynamic analysis reveals that the free energy of formation of CH_5^+ from CH_3^+ and H_2 is -32.91 kcal/mol, indicating that the reaction is exergonic. However, the reaction involves a substantial free energy barrier of 48 kcal/mol, suggesting kinetic challenges for its formation.

New synthetic route of bioactive pyrrolonaphthoquinone and benzimidazolequinone

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We have developed an efficient synthetic route of naphthoquinone fused pyrrole derivatives (up to 93% yield) via intramolecular cyclization. Sonogashira coupling of bromonapthoquinone converted to our designed 2-(arylethynyl) naphthalene-1,4-dione which on treatment in NH_4OAc in aqueous methanol at room temperature converted to desired naphthoquinone with 2,3-fused pyrrole. Metal free easy method and presence of bioactive core (utahmycin B (an antibiotic) analog) made it is an important molecule. Besides antimicrobial and antibiofilm properties are also interesting and documented. In addition, 2,3-dibromonaphthoquinone reacted with 2-amino pyridine in presence of CuI in methanol furnished new heterocycle, benzimidazolequinone.

One-pot fabrication of enzyme encapsulated covalent organic framework

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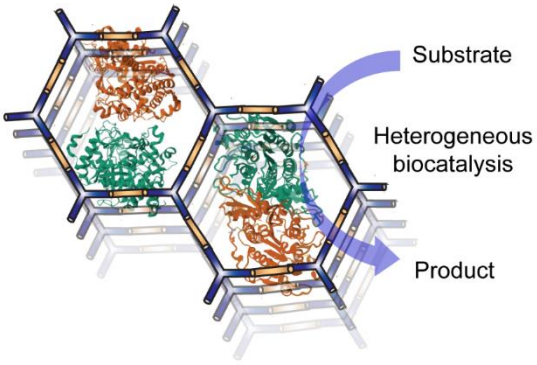
Biocatalysis is a complementary tool to traditional chemo-catalysis. Enzymes play a major role in the biocatalysis. Higher selectivity, better turnover number, and mild reaction conditions have established biocatalysis as a more benign tool than state-of-the-art catalytic systems. The major concern associated with enzymes is that their tertiary structure is sensitive to reaction conditions. Enzymes lose their active site conformation in harsh conditions. In addition, these enzymes cannot be recovered from the reaction system. To overcome these challenges, improving the stability of enzymes is a major concern. In this context, immobilizing enzymes in solid support has been burgeoned over the years. Covalent organic framework (COF) is a promising porous material for enzyme immobilization. Despite the development of several strategies for enzyme immobilization, one-pot enzyme encapsulation in COF brings important attention. Here, we have developed a one-pot enzyme encapsulation methodology to fabricate enzyme@COF in an aqueous medium. We have encapsulated. *β*-glucosidase (BGL) to fabricate BGL@TpAzo COF, which is active towards the catalysis and is recyclable for ten cycles. This BGL@TpAzo COF has been characterized by solid-state NMR spectroscopy. BGL@TpAzo COF is stable in the presence of a denaturing agent, 10% SDS solution (sodium dodecyl sulfate), unlike the free enzymes for several days. We have successfully encapsulated eight different enzymes following this methodology.



Integrating theory and practice: A comprehensive undergraduate chemistry experiment in rotaxane synthesis and anion removal

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An innovative chemistry experiment for under graduate students involve synthesizing macrocyclic and macrobicyclic ligands, rod like axles, and [2] rotaxanes and there with multiple functional groups by using click reactions, achieving yields of up to 71%. As the synthesis involved multiple steps towards synthesis, students are involved to take part in performing these reactions. This hands-on laboratory experience employs a proactive methodology, engaging students in dynamic learning as they explore favorable reaction conditions and confirm the interlocked structure using TLC, UV-Vis, NMR spectroscopy. By reinforcing fundamental laboratory, students develop essential skills and gain understanding of mechanical bond chemistry, non-covalent interactions, and supramolecular chemistry. The experiment's flexible design allows adaptation to various undergraduate course curricula, accommodating diverse teaching needs. Students take an active role in experimentation, designing experiments, and analyzing spectral data. This lab experience introduces students to the chemistry of mechanical bonds, reinforces basic lab skills, and enhances structural elucidation techniques. Key concepts include rotaxanes, noncovalent interactions, mechanical bonds, and supramolecular chemistry. Furthermore, the metallo-macrocyclic host complexes are utilized for the effective removal of anions from laboratory wastewater, showcasing their potential in environmental remediation applications. Assessment opportunities include student-designed experiments, laboratory reports, poster presentations, and spectral analysis. This adaptable experiment provides a comprehensive learning experience, bridging theoretical knowledge with practical application, and fostering critical thinking, problem-solving, and collaboration among students.

Synthesis of N-bridgehead Route of new pyridopyrimidinium ion and its DNA intercalation studies

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Straightforward neat synthesis and application of water-soluble quaternary *N*- bridgehead pyridopyrimidinium ions in good yield (up to 90%) have been demonstrated. These pyridopyrimidiniums are moisture tolerant, stable, and have good fluorescent properties. A remarkable fluorescent enhancement has been observed when a particular tetracyclic pyridopyrimidinium probe was treated with CT-DNA, showing its strong DNA binding properties. The binding constant value obtained from UV–Vis spectral analysis is 2.6×10^5 M^{-1}. Compound also displaced ethidium bromide from ethidium bromide-DNA complex and hence proves to be a strong DNA intercalator. It also shows promising antimicrobial and anti-biofilm activities against *S. aureus.*

Modeling on heterogenous catalytic performance of 1,2-propanediol production from bio-glycerol using artificial neural network

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The depletion of fossil fuel sources and its negative consequences on the environment compels researchers to quest for alternative fuels. During recent years, conversion of biodiesel derived glycerol (~10 wt.%) to valuable chemicals has increased attention to the sustainability and economic viability of the biodiesel industry. Hydrogenolysis of glycerol to 1,2-PDO has been considered as one of the promising routes as 1,2-propanediol (1,2-PDO) is an important commodity chemical and has significant commercial importance. In our earlier paper we found that Cu-ZnO-MgO catalyst showed excellent catalytic activity. In this study, the optimization of glycerol conversion and 1,2-PDO selectivity in the presence of Cu-ZnO-MgO catalyst was performed by using Artificial Neural Network (ANN) multilayer framework coupled with MATLAB. Levenberg–Marquardt algorithm is applied for this study. The various factors such as temperature, glycerol concentration, catalyst concentration and reaction time which affect the glycerol conversion and 1,2-PDO selectivity were considered for optimization study. The reaction parameters and the experimental range chosen for analysis are as per the following: temperature range of 190-220^oC, concentration of glycerol in the range of 10-50%, catalyst loading 5-9 wt% and reaction time in the range of 6 to 14 h, respectively. ANN model predicted output response for a set of input parameters that were well-fitted with the experimental data. The values of the regression coefficient (R^2) obtained for output parameters such as glycerol conversion and 1,2-PDO selectivity were > 0.85. The study will be very useful for optimization and prediction of parameters affecting the catalytic performance.

Electrochemical detection of ammonia for food quality monitoring using Cu_3N-PANI nanostructures

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Monitoring ammonia is essential for assessing food freshness, as ammonia buildup indicates spoilage in products such as meat, fish, and dairy. This work presents a new electrochemical approach for ammonia detection, utilizing copper nitride (Cu_3N) nanoparticles deposited on polyaniline (PANI)-coated disposable printed carbon electrodes (PCEs). The gas-sensing capability of Cu_3N has not been reported previously, making this a key advancement in the field. The PANI layer, coated on the PCEs, enhances electrical conductivity and provides a stable platform for Cu_3N deposition. The platform was tested with real meat and fish samples, where it successfully detected ammonia released during spoilage. It exhibited fast response times, high sensitivity, and strong selectivity, even in the presence of other gases commonly found in food storage environments. The disposable nature of the printed electrodes makes the platform cost-effective and suitable for widespread use. Additionally, the stable operation under different temperature and humidity conditions ensures consistent results throughout food storage and transportation. This work offers a practical solution for monitoring food quality and reducing waste by enabling early detection of spoilage. Its compatibility with smart packaging and real-time monitoring systems further enhances food safety and ensures fresher products reach consumers.

Electronic structure-based designing of non-metal electrodes for energy harvesting from seawater

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Sea water, an abundant and underutilized resource for energy generation, holds significant potential for electricity harvesting – especially considering the increasing demand for renewable energy due to the rapid development of modern civilization. While current research efforts predominantly focus on solar energy harvesting and hydrogen fuel cells, large-scale industrial electricity production using these methods remains a distant goal. In contrast, harnessing seawater for electricity by utilizing suitable electrodes to sequester metal ions presents a viable path toward industrial-level energy generation soon. This work focuses on the development of metal-free electrodes optimized for electricity production from seawater using a concentration cell configuration. Recent findings demonstrate that graphene and graphene oxide, when fabricated onto carbon cloth, are highly effective for harvesting energy from seawater, offering high energy density and making them promising candidates for scalable electricity generation. It has been reported that a cubic meter of seawater mixed with freshwater can generate approximately 0.8 kW of energy. Additionally, a galvanic cell utilizing metal electrodes has been shown to produce energy density over 90 W/m^2, a highly promising result for large-scale energy generation. Similarly, graphene-based electrodes hold the potential for producing electricity with significant energy density under comparable setups. To better understand and optimize this system, DFT modeling was employed to simulate the behavior of these electrodes. MD simulations were conducted to evaluate electrode potential and energy density across varying salt concentrations. Moving forward, pilot projects are being planned to validate these theoretical findings through practical experiments, contingent upon the availability of research funding.

Integrating extracts from Indian gooseberry into polymers to develop antibacterial composite films for the preservation of dry fruits/ vegetables and other food items

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The emergence of new microorganism strains exhibiting antibiotic resistance complicates efforts to curtail their proliferation. Infections pose the most significant health threat to the increasing global population, particularly among the lower middle class. Expensive commercial antimicrobials frequently produce adverse effects. Pharmaceuticals and items incorporate botanical elements. The therapeutic herb Indian Gooseberry (Amla) is ancient. It possesses antibacterial, antifungal, and anti-inflammatory properties. Emblica treats dyspepsia, conjunctivitis, diarrhoea, asthma, haemorrhage, and dermatological conditions.

The proposed method aims to utilize amla extracts to produce antimicrobial polymer surfaces capable of resisting bacteria and fungi. A simple technique produces antibacterial polymer surfaces with medicinal natural extracts. The surface may eliminate pathogens but is unlikely to impact normal cells. This selective surface is exceptional for both daily and sophisticated applications. Films can also combat bacteria, prolonging food shelf life. This approach can enhance the water resistance of films in humid situations conducive to rapid bacterial growth.

Heteroepitaxial growth of ZnO shell on Ln3+-Li+ co-doped Y2O3 phosphor core

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In this work, a heteroepitaxial layer of ZnO was grown on Ln3+-Li+co-doped Y2O3 microspheres by three different techniques- the colloidal solution approach, hydrothermal method, and linker-assisted hydrothermal method. The synthesis procedure is optimized based on the thickness and compactness of the developed shell. The growth kinetics and synthesis mechanism of each adopted method have been explained in detail using XRD, FESEM, TEM, SAED, and EDX characterization techniques. YYETL microspheres give UCPL emissions in the entire visible range under 980 nm excitation. These anti-Stokes emissions undergo changes after coating with ZnO. The colloidal solution approach developed a dense and thick coating of zinc hydroxide, which decomposed to form ZnO nanoparticles at 350℃. The hydrothermal method, without linkers, resulted in non-uniform deposition and free-flowing ZnO nanostructures in solution. The linker-assisted hydrothermal method resulted in the deposition of a thin layer of ZnO on the phosphor microspheres. The linker-assisted hydrothermal method proves to be the best technique for developing a thin, compact layer of ZnO shell on the upconversion microsphere core for various applications like photovoltaics, photocatalysis, and energy storage.

Enzyme instructed selective disruption of bacterial membrane by bioengineered antibacterial peptide

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Methicillin-resistant Staphylococcus aureus (MRSA) stands out as one of the most formidable pathogens. This organism is also a major culprit in a variety of serious infections, including bacteraemia, endocarditis, skin and soft tissue infections, as well as bone and joint infections. The swift rise of antimicrobial resistance poses a critical global health crisis. Pathogens responsible for life-threatening infections are increasingly resistant to conventional drugs and antibiotics. Consequently, developing new therapeutics to tackle this growing resistance is an urgent and essential focus for researchers worldwide. Cationic amphiphilic peptides represent a promising frontier in theranostic approaches due to its exhibition of a high binding affinity for lipopolysaccharide or peptidoglycan at bacterial surfaces. The cationic side chains of these peptides interact electrostatically with the negatively charged bacterial outer membranes, leading to membrane destabilization. This disruption causes the leakage of vital cellular components, ultimately resulting in bacterial cell death. These unique features inspired us to construct a castle against bacterial family with small three building blocks (1) recognition motif heparin sulfate binding unit Lys-Lys-Gln-Lys (KKQK), (2) gelatinase responsive linker Pro-Leu-Gly-Val-Arg-Gly (PLGVRG), and (3) self-assembling unit Pyrene-Phe-Phe-Arg (Py-FFR). Thus we, designed Py-FFRPLGVRGKKQK (Py-FK), which recognise the heparin receptor and then cleaved by gelatinase enzyme. After cleavage, the peptide self-assembled in to fibers, binds with bacterial membrane and causes its' disruption. This resulted excellent therapeutic index and promising wound healing of our designed peptide amphiphiles Py-FK.

Electrodeposited bismuth vanadate thin films for photoelectrochemical applications

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The photoelectrochemical (PEC) water splitting process is basically a solar driven reaction, where water molecule splits into hydrogen and oxygen molecule. The hydrogen generated can be stored and used as green fuels for future demands of energy crisis. In 1972, Fujishima and Honda first conducted the water splitting reaction with TiO2 semiconductor [1]. Various metal oxides have gained attention towards PEC water splitting afterwards. $BiVO_4$ is one of the most promising photocatalysts and a best-fit candidate for the PEC water splitting reaction [2]. Monoclinic Bismuth Vanadate ($BiVO_4$) has a suitable band gap of 2.45 eV for visible light absorption. This semiconductor is also non-toxic and cheap. Among the various synthetic techniques, this report mainly focuses on the 2-electrode electrodeposition technique of $BiVO_4$. The LSV analysis, EIS analysis, Mott-Schottky analysis and DRS analysis of the developed $BiVO_4$ has been performed for determining the PEC water splitting efficiency of the semiconductor. The developed pure $BiVO_4$ semiconductor shows the water oxidation photocurrent of ~ 100 µA cm^{-2}.

ABSTRACTS OF THE

SUBJECT AREA:

ENGINEERING SCIENCE AND TECHNOLOGY

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Presenting author*

Does non-consumptive effects influence hunting strategy? An illustration through the lens of classical mechanics

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The inevitability of non-consumptive effects (NCE) is evident within the dynamics of prey-predator relationships. These non-lethal effects, notable for their variability, significantly influence the behavioral responses and reproductive patterns of the prey population, leaving a distinct mark on predation numbers. It's worth noting that the bulk of existing research has focused on assessing the impact of NCE on the prey population or identifying suitable hunting strategies. However, there exists a noticeable research gap that fails to thoroughly explore the pervasive influence of NCE on predator hunting strategies, a central point emphasized in this manuscript. Our analysis leads to the assertion that the optimal selection of predation mechanisms arises from the interplay of prey-predator velocities and the non-lethal effects perceived by the target populations. To delve into this, we employ two important metrics. Through rigorous simulations and a thorough analysis of real data, particularly focusing on Elk and Mule deer, we illuminate the fact that a predator can benefit from employing the "sit-wait" hunting tactic when the prey population surpasses the velocity of the predator. Conversely, the "active-search" predation mechanism emerges as the viable choice for the hunting population unless the prey population outpaces the speed of the predator.

Brain inspired quantum spiking neural network for medical image classification

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Medical image classification diagnoses diseases by identifying patterns in medical images such as fundus images, X-Rays, MRIs etc. It helps medical professionals to make faster and more accurate diagnoses. Quantum Spiking Neural Network (QSNN) is an integration of quantum neural network (QNN) and Spiking Neural Network (SNN). We propose a QSNN system for classification of medical images. SNNs are advantageous for low power consumption and event driven in-memory computing. Pre-processed image features are passed into input of SNN. The input features are converted to output spikes by SNN. These output spikes are fed as input of QNN and converted to qubits using amplitude embedding. The qubits are trained using quantum neural network consisting of entanglement and rotation gates. The angles of the rotation gates are optimized using classical Adam optimizer. The QNN combines the computational power of quantum computing with the principles of classical machine learning. It utilizes the superposition and entanglement properties of quantum computing to represent image features as more discriminative than classical features. The QNN system uses fewer number of parameters and fewer features and faster than classical models. The test accuracy achieved using the proposed QSNN is comparable to the accuracy of convolution neural network. The test accuracy is also satisfactory in presence of quantum noise,

Exploring the impact of viral infection on population dynamics of zooplankton-fish system

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Abstract: The field of mathematical biology is enhanced by eco-epidemiological models, which provide useful examples of non-linear dynamics. Zooplankton and other aquatic animals undergo behavioral and other changes as a result of viral infections. The way that ecological systems interact can be drastically changed by infectious illnesses. To investigate how viral infection affects the predator-prey relationship in the marine environment, we propose and study a three-compartmental eco-epidemiological model of differential equations connecting zooplankton and fish with SI-type disease in the zooplankton population with non-linear infection rate and assumed that the fish population as the only predator of the zooplankton population. Our research shows that the system has five distinct steady states that are biologically viable. According to local bifurcation analysis, the fish-free steady state is connected to the coexistence steady state through a transcritical bifurcation. Additionally, the model experiences a Hopf-bifurcation related to specific life cycle trait parameters of both zooplankton and fish species around the coexistence steady state. Ultimately, two parameter bifurcation diagrams of the model were displayed, showing the oscillatory coexistence steady state, stable fish free steady state, and stable coexistence steady state area. A lower infection rate and greater fish growth ascribed to predation of vulnerable zooplankton are desirable for a healthy ecosystem. However, a higher infection rate could lead to the fish population's collapse.

An EOQ model for deteriorating items with time- and reliability-dependent demand and partial backordering using triangular intuitionistic fuzzy numbers

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This work highlights the practical applications of the EOQ model in managing inventory under uncertain conditions while optimizing costs and improving customer service. By optimizing inventory, companies can enhance their market share, productivity, and profitability. Thus, an EOQ model is demonstrated here to emphasize on the importance of maintaining customer satisfaction through timeliness, reliability, and high-quality products, which are essential for controlling an organization's inventory. This model is examined under both crisp and uncertain scenarios, where triangular intuitionistic fuzzy numbers is used to represent ambiguity and vagueness. To obtain the optimal solution of the problem in uncertain environment, a removal area technique is developed to de-intuitificate the fuzzy numbers. The work also explores the impact of reliability and time-based demand rates on the inventory management system using the EOQ model. In this context, partial backlogging is considered, allowing for ongoing degradation and shortages. The primary objective of this system is to minimize inventory costs while maintaining high levels of customer service. Additionally, the work presents a comparative analysis of intuitionistic and crisp values, showing that the model performs more effectively under unpredictable scenarios. A numerical example is provided to support the research findings.

The future of mosquito control: Wolbachia and beyond

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Mosquito-borne diseases remain a significant public health challenge in India, necessitating effective mosquito control measures to limit their spread. One promising approach is Wolbachia-based population suppression, which involves releasing male mosquitoes infected with a specific Wolbachia strain into wild populations. In this study, we develop and analyze a mathematical model to assess the effectiveness of various release strategies of Wolbachia-infected male mosquitoes in reducing arboviral disease transmission. Using the concept of basin stability, we identify early warning signals that can predict potential mosquito population outbreaks, allowing for proactive measures to mitigate their impact on human health. We also investigate the role of seasonal variations in the efficacy of these release strategies and the outbreak early warning system, further enhancing our preparedness. Furthermore, we address the challenges and future directions for Wolbachia research, including the need for ongoing monitoring, public engagement, and the development of complementary control methods.

A study of Galois group of covering spaces as a topologicalgroup

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Let DeckX(˜X) denotes the set of all covering transformations of a covering p: (˜X, ˜x) → (X, x), where (X, x) is a path connected, locally path connected pointed topological spaces, then DeckX(˜X) is a group[ref.7]. If p: (˜X, ˜x) → (X, x) is a Galois covering, then we write GalX(˜X) for DeckX(˜X) and call it the Galois group of ˜X over X. We have studied the Galois covering through the sheets in [ref.8]. Also, in [ref.9], we have studied the Galois group of covering spaces. In this paper, first we will show that GalX(˜X) is a topological group if we consider ˜X is compact. Then we will study some properties of it.

Advanced clustering and multivariate analysis for unveiling patterns in active Galactic nuclei classification

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This study focuses on the classification of Active Galactic Nuclei (AGNs) using advanced clustering techniques combined with multivariate analysis and machine learning methods to uncover patterns within their observational properties. AGNs, powered by accretion processes around supermassive black holes, are key to understanding galaxy evolution and extreme astrophysical phenomena. Given the complexity and high dimensionality of AGN datasets, including photometric magnitudes, colors from the Gaia EDR3 and WISE catalogs, and redshift from SDSS/BOSS surveys, sophisticated methods are employed to overcome challenges such as missing data and high-dimensional visualization. The MICE algorithm is utilized to impute missing data, ensuring dataset robustness for clustering. To identify distinct AGN subtypes, the optimal number of clusters is determined using internal evaluation metrics, and multivariate mixture model clustering is performed using skewed and symmetric multivariate distributions. The EM algorithm is applied for model fitting, with AIC and BIC values compared for model selection. AGNs are categorized into two separate clusters by the best-fit mixture model with a multivariate skewed t-distribution. Further analysis of variable importance reveals key drivers of AGN diversity, such as photometric properties and redshift, with Bayesian Networks employed to visualize the relationships between variables. Additionally, UMAP, a dimensionality reduction technique, is applied to enhance the interpretability of the clusters in lower-dimensional space. By addressing these challenges and employing advanced statistical techniques, this study provides new insights into AGN substructures and their underlying astrophysical processes, contributing to the refinement of AGN classification and the broader understanding of extragalactic astrophysics.

Exploring sterile mosquito release strategies with natural enemies for mosquito control

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The sterile insect technique (SIT) is an environmentally friendly insect management tool that primarily focuses on suppressing or eradicating wild insects by releasing sterile insects into the wild-type insect population. This paper analyses a combined SIT and natural enemy entomological model aimed at controlling the wild-type mosquito population. We investigate the dynamic interactions between juvenile and adult mosquitoes under a steady supply of natural enemies and two different release methods for sterile mosquitoes: constant release (CR) and saturating proportional release (SPR). By comparing the dynamics of the system with these two release strategies, we observe that the CR strategy serves as a better alternative to the SPR strategy in eradicating the wild mosquito population. Further, we investigate the dynamic optimization of the controls associated with the SIT-natural enemy model to suppress the wild mosquito population while minimizing the cost of the control. Interestingly, the SPR strategy exhibits greater efficacy in suppression than the CR strategy and can thus be considered a viable strategy for suppressing the wild-type mosquito population.

Study of the effect of booster vaccination on disease control

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In this study, we have developed a new nine-compartmental deterministic COVID-19 model to study the impact of vaccination including first, second, and booster doses. Positivity and boundedness of the model are studied initially. Then we have focused on steady-state analysis. After exploring the model, we get two equilibrium points: COVID-free equilibrium (CFE) and COVID-endemic equilibrium (CEE). The stability of equilibrium points has also been analyzed with the help of the reproduction number (R_0), which is derived by the next-generation matrix approach. The CFE point is locally asymptotically stable for $R_0 < 1$ and unstable for $R_0 > 1$. Further, the model has been validated by real data reported from India during the second wave of the COVID pandemic and estimated model parameters. In order to control or protect the disease, we have found influential model parameters by carrying out sensitivity analysis. Finally, with the help of numerical simulation, we have discussed the impact of first, second, and booster doses of COVID vaccine on the disease dynamics and their impact on disease dynamics. Our finding shows that first and second doses are not sufficient to eradicate the disease from the population, booster dose along with first and second doses are essential to control the disease from our environment.

Random pricing, product collection, and green investment strategies in a closed-loop supply chain with price dependent demand and remanufacturing

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The most crucial parameter in all commercial ventures is a product's price. However, there always lies a gap between what the retailer wants to charge and what the market is prepared to pay. This propensity coupled with a few other variables lead to an unpredictability in the real price, which in turn causes a randomness in demand. In the modern world, environmental issues are also important. Investments in greening initiatives and product recycling are thought to have a good impact on environment in addition to raising corporate profits. Keeping these factors into consideration, the current study explores a two-period closed-loop integrated supply chain model while taking the product collection into account. Considering both the manufacturing and remanufacturing to be uncertain in nature, the authors first illustrate the traditional model without the environmental consideration, and extend the model considering the carbon emission & carbon cap-and-trade policy under greening investment. The model is further elaborated through numerical examples to establish the business opportunity associated with the said investments. Green investment is seen to boost profit when carbon emission is considered, and remanufacturing is also seen to be a profit-enhancing option. The model suggests that the business manager should focus on market expansion, demand forecasting, and boosting customers' awareness towards using green products in general, and on efficient production process and cost control in a high-cost business scenario. Sensitivity analysis provides elaborate managerial insights on how the manager should act with change in model parameters.

Gravitational waves in the paradigm of f(Q) gravity

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Gravitational waves were first predicted by Einstein in 1916, but their physical characteristics were unrevealed for many years. The use of gravitational waves in the study of the cosmos has enormous significance. In this paper I have investigated the evolution of gravitational waves under f(Q) gravity. The basis of f(Q) gravity is the non-metricity scalar Q. I analyse and explain the mechanism of gravitational wave background evolution in a flat FRW universe. Here I have considered two different f(Q) toy models. The field equations have been used to obtain the perturbation equations governing the evolution of gravitational waves in terms of redshift z in the backdrop of the FLRW Universe. Next, I have examined the gravitational wave qualities in the framework of f(Q) gravity and observed some interesting results.

A mathematical perspective on parasitic infections: Taeniasis and Cysticercosis

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Taeniasis and cysticercosis are neglected zoonotic diseases in underdeveloped countries. The disorder known as neurocysticercosis is brought on by the swine tapeworm Taeniasolium's larval stage infecting the human neurological system. In many less developed countries, this leads to epileptic convulsions and fatalities. It is now more frequently seen in more developed nations because of immigration from endemic areas. This article proposes a four-dimensional mathematical model of cysticercosis and taeniasis. We investigate the system's dynamical behavior analytically and validate it numerically. To treat the illness, we use an optimal control therapy method. In this study, we examine the endemic equilibrium (EE) as well as the disease-free equilibrium (DFE). We determine the sensitivity indices of R0 and the basic reproduction number (R_0) in relation to various parameters. It has been noted that the sickness resolves when $R_0<1$, but it continues when $R_0>1$. We investigate a range of control tactics in diverse populations and examine the model system's behaviour using an ideal drug therapy control plan. Additionally, we show R_0 contour plots as a function of several sensitive parameters.

Norm and numerical radius of one parameter family of matrices

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This study investigates the norms and numerical radius of a one-parameterfamily of matrices, specifically focusing on the implications of parameter variations on matrix properties. We define the one-parameter family as

$$A(t) = A_0 + tA_1$$

Where A_0 and A_1 are fixed matrices. The norms considered include the operator norm and the Frobenius norm, which are critical for understanding the behavior of matrix transformations under varying conditions.

We derive expressions for the numerical radius, defined as

$$w(A) = \sup\{|\lambda| : \lambda \in W(A)\}$$

Where $W(A)$ denotes the numerical range of A. Here we establish relationships between the norms and the spectral properties of the matrices.

The findings reveal that the numerical radius is not only dependent on the individual matrices A_0 and A_1 but also exhibits unique behaviors as the parameter varies.

Furthermore, we discuss the implications of these results in the context of stability analysis and control theory, providing insights into the design of systems that rely on matrix representations. This work contributes to the broader understanding of matrix analysis, offering valuable tools for researchers dealing with parametrized systems in various applied mathematics fields.

Random pricing, warranty and green strategy in a two-echelon closed-loop supply chain

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Price of product is the key factor that affects business dynamics the most. In a volatile market, there are issues related to pricing and demand which are beyond control, thereby introducing randomness in pricing and demand. Green level of product also has considerable impact on demand as customers are aware of environmental concerns. The present work considers random pricing problem in a closed-loop supply chain where demand depends on price, warranty period and greening level of the product. During the warranty period, the manufacturer takes back any defect item with a new replacement for it and re-manufactures or refurbishes the returned item to sell it as a new one. The proposed model is solved to find out how the random nature of the pricing policy impacts the other policies of the system. With comprehensive analytical and numerical discussion, the model gives crucial insights into how a farm should act to make the most of its diversified surroundings. It is observed that a higher salvage value for the goods helps the retailer to maintain the price level low, demonstrating the relevance of contracts. Reduction in profit in absence of green sensitivity proves the superiority of business with green products. The present model is applicable in the industries such as electronic goods, where the bargaining power of customers matters a lot for pricing or online stores and supermarkets where the customers usually wait for offers and discounts.

AI-enabled autonomous farming

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Traditional farming methods often result in labour shortages, rising labour costs, and the challenges of manual labour in agriculture have increased the demand for automation. Traditional farming practices often rely on manual labour, which is time-consuming, labour-intensive, and prone to errors. Autonomous farming provides a solution by automating repetitive and physically demanding tasks. Innovation in autonomous farming is essential to addressing key challenges in the agricultural industry. By improving efficiency and lowering costs, it can enhance profitability and sustainability. It also helps address labour shortages and ensures a steady food supply. Moreover, autonomous farming promotes sustainable agriculture by reducing chemical usage and minimizing soil disturbance. Autonomous farming, driven by artificial intelligence, is revolutionizing agriculture. Through robotic technologies and advanced algorithms, autonomous systems can handle planting, harvesting, and weeding without human intervention. This approach improves efficiency, reduces costs, and ensures operational consistency. One major benefit of autonomous farming is increased productivity. Automation allows farmers to focus on other vital areas like crop management and market analysis, while autonomous systems work continuously, maximizing planting and harvesting windows and mitigating crop losses caused by labour shortages or adverse weather. Autonomous farming also contributes to sustainability by reducing chemical usage and limiting soil disturbance, which helps preserve soil health and protect the environment. Additionally, it enhances food safety by minimizing contamination risks and maintaining consistent quality. By automating key tasks, farmers can reduce labour costs and optimize resource use, leading to significant cost savings. As AI and robotics technologies advance, autonomous farming is set to become a widespread practice, offering farmers the tools to succeed in an evolving agricultural landscape.

FUCOM -MABAC strategy to identify the most suitable waste to energy technologies for converting waste into green energy under Q-rung orthopair fuzzy set environment

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The Challenge of Municipal Solid Waste Management (MSWM) in India has become increasingly significant due to the large volumes of waste produced daily. In response, governments are prioritizing the development of effective waste management systems, including establishing a timeline for the creation of waste processing and disposal facilities to mitigate waste. Waste-to-Energy technologies have been identified as a promising solution due to their capacity to transform waste into renewable energy while addressing related concerns. This study examines various Waste-to-Energy technologies, evaluating them based on environmental impact, cost-effectiveness, technical feasibility, and social implications. The first part of the model employs the Full Consistency Method (FUCOM) to evaluate the weights of the criteria. The subsequent part employes the Multi-Attributive Border Approximation Area Comparison (MABAC) method in Q-rung orthopair fuzzy set environment. Thus, combing them, FUCOM-MABAC strategy is developed. The developed strategy is used to identify the most suitable waste to energy technologies for converting waste into green energy in India. An illustrative numerical example is solved to reflect the utility of the developed FUCOM-MABAC strategy.

Supply chain management of single deteriorating item during production crisis

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During the off-season when supply is limited or at adverse weather conditions for highly deteriorating items, the tendency of the wholesaler is to buy inventories at wholesale price and often hold those, with expectation of price increases, it can lead a temporary supply shortage, resulting in price increases. To avoid this production crisis manufacturer can halt the direct supply to wholesalers. Instead, they can opt to sell their inventory directly to retailers and ordinary customers. Thus, in this scenario, the inventory model is multi-dimensional.

In our present study a three-dimensional EPQ model is formulated by incorporating the dynamics of manufacturer, retailer and consumer. For each dynamic we must consider the deterioration rate of the item. The aim of our study is to reduce the overall cost over a fixed time interval (representing the seasonal period) while deriving analytical expressions for the optimal inventory levels of the manufacturer, retailer, and consumer. Additionally, the goal is to determine the optimal production level that can prevent a market crisis by using Pontryagin's Maximum Principle. The graphical solutions are also obtained under special choice of parameters.

Regulated data baffling scheme

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The precariousness of cloud computation gets augmented when the data is shared with users who differ in their levels of trustworthiness. This work proposes and explores a two-layer data obfuscation protocol. The first layer creates an irreversible data obfuscation through variance-controlled noise incorporation, which is modulated according to the users' trust (the noise variance and, consequently, the level of obfuscation will be high for a less trusted user and vice versa). However, the obfuscation mechanism is susceptible to several forms of statistical and practical vulnerabilities. To this end, a second layer of obfuscation is proposed for additional security. The construction is based on sinusoidal decomposition and is of a reversible nature; users aware of this decomposition mechanism can recompose the data up to the first layer. The key novelties of the scheme lie in i] its ability to obfuscate the data according to the user's trust and ii] the incorporation of a two-layer mechanism consisting of reversible and partially reversible reconstructions, adding to its robustness. Experiments on seventeen real-world datasets and three competing methods in two unsupervised learning contexts demonstrate the overall and layer-specific computability of the proposed scheme. A theoretical analysis of the procedure is also provided.

Evolution of prey body size under the influence of fear of predators and its carry over effect

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The article explores the Darwinian dynamics of a prey species influenced by the fear induced by predators and its associated carry-over costs. An investigation of ecological dynamical behaviours of single prey population, comprising the existence of viable steady states, global stability, and bifurcation scenarios, is conducted. Depending on the predator's attack rate, prey species might undergo Allee induced extinction. Next, under Darwinian dynamical framework, the evolution has an impact on the body size of the prey species. As a result, the trade-off between prey growth and anti-predator behaviour is utilized in the construction of the G-function, as well as the analysis of coupled population and strategy dynamics. The evolutionary stable strategies corresponding to prey body size are identified. The results indicate the evolution of body size may prevent the Allee effect and prey extinction. However, it's possible that the prey species has developed to a size where it is beneficial to avoid predators; but it decreases prey growth making extinction inevitable. The fitness of the prey species is determined by the variation in prey growth and anti-predator behaviour with prey body sizes. The analytical results obtained in this study are validated by extensive numerical illustrations.

Application of machine learning techniques for forecasting yield of agricultural crops: A case of rice in Tamil Nadu, India

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Statistical modeling of agricultural data can provide valuable insights into trends, predictive abilities and decision-making. The key aspect of prediction is effective planning which involves using past data to anticipate future outcomes, managing data generation and understanding the mechanisms driving these trends. Predicting yield accurately found its importance in Indian agriculture suggesting better planning for sustainable growth and aiding policymakers. And also, early yield predictions will empower farmers to enhance productivity. Various Machine Learning Techniques have emerged as a promising alternative for data analysis and future prediction. The present paper is an attempt to employ some of the ML approaches along with classical methods in the field of agricultural crop prediction.

The present study endeavors to get best model to predict area, production and yield of rice production in Tamil Nadu using time series data. Machine Learning techniques viz., Time Delay Neural Network (TDNN), Support Vector Regression (SVR) and some hybrid models are employed to explore the most efficient algorithms. Annual data of rice production in the state of Tamil Nadu for a period of 1950 to 1921 was utilized for the purpose. Using epanechnikov kernel smoothing, the trend of rice cultivated area, production and yield was estimated with selected diagnostic criteria. The study revealed that Hybrid models like ARIMA- TDNN and ARIMA-NLSVR exhibit superior performance compared to individual models, particularly in datasets with nonlinear patterns and higher fluctuations.

Generalized theory of magneto-thermo-diffusion in rotating media with memory-dependent derivatives and four-phase lag

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This study presents an analytical model for a novel generalized magneto-thermodiffusion, integrating memory dependent derivatives (MDD) through a four-phase lag framework. Assuming traction-free boundaries and exposure to thermal and chemical shock, we employ Laplace transformation and eigen value methods to derive analytical solutions in Laplace domain for non-dimensional thermo-physical fields. The Laplace Inversion method is applied to derive real-field solutions. The influence of the magnetic fields on key parameters is then visualized through graphical and numerical representations and highlighted the effect off memory-based derivatives and four-phase lag model.

F-index: Properties and applications in bipolar fuzzy graphs

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Topological indices are graphical invariants that describe chemical compounds' connectivity and structure. Although topological indices were first developed to apply in chemistry, they were later used in different real-life scenarios. These indices have been created based on the degrees of the vertices, distances among the vertices, and eccentricity. One such degree-based topological index is the F-index or the Forgotten Index. Bipolar fuzzy graphs are graphs where vertices and edges represent two opposite-sided characteristics. In real-life situations, when two conflicting characteristics occur, bipolar fuzzy graphs can easily represent those situations. In this article, we apply the F-index in bipolar fuzzy graphs and discuss some theorems regarding the bounds of the F-index and relationships of the F-index with some other topological indices. We have also proved a few theorems regarding the F-index for different types of bipolar fuzzy graphs, like regular bipolar fuzzy graphs, complete bipolar fuzzy graphs, etc. Then, we discussed its application areas in real-life scenarios. We have explored its application mainly on matrimonial websites. At last, we have concluded the article with future works.

A mathematical approach to understanding the moral hazard problem in Government Education Subsidy Policy

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Two major categories of education subsidy prevailed in India. Some subsidies are not aligned with any performance evaluation of the beneficiary, on the contrary, some subsidy policies are performance-based subsidy. Thus, this paper is an attempt to the starkest debate about the effectiveness of either of the policy using a mathematical model of strategic interaction between the government and the beneficiary. This paper developed a sequential move game with complete information between two players, namely, 'government' and 'beneficiary'. The mathematical model and the timeline of the game are as follows. First, the government offers two policy options. In 'policy 1' it offers a lump sum amount subsidy unconditional to performance evaluation of beneficiary, whereas in 'policy 2', government provides two different subsidies conditional on 'good' and 'bad' performance. Second, the family chooses the best policy for the child (the beneficiary). Third, the family decides what effort level they should put on child's education where the effort levels are classified as 'high' or 'low' effort. Lastly, the outcome based on the family's effort depends on respective probabilities of the good and bad outcome. Thus, it is not necessary that high effort always leads to better outcome on the contrary low effort does not necessarily results bad outcome as educational outcome depends upon the given educational and social infrastructure besides the effort level that leads to a 'moral-hazard' problem. This paper shows the mathematical conditions and properties how government can form an effective education-subsidy policy under various socio-economic circumstances.

Construction of 2^n row-column factorial designs using incidence matrices of incomplete block designs

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Factorial design is a type of experimental design which allows the researcher to manipulate two or more factors or independent variables at multiple levels each and study their individual as well as combined effects on the outcome or dependent variable. In comparison to other experimental designs, factorial designs are time saving and cost effective. Row-column design layouts are used to deal with bi-directional heterogeneity in a field experiment. So far, such kind of row column factorial designs are constructed by using different kinds of arrays for construction of 'Array Generating Matrices' (AGMs). In the present study, incidence matrices of incomplete block designs have been used to construct 2^n factorial designs in row-column set-up with double confounding. The methods followed for the construction of the design is comparatively easier and more effective than the methods described by Godolphin (2018). The main effects and maximum possible number of 1^{st} order or 2-factor interaction effects are estimable from the design layout developed. The analysis of variance (ANOVA) models for analysis of such designs have been developed for the experiments with a single replication. The main effects and maximum number of 1^{st} order interaction effects can be successfully estimated by the above model.

A fractional-order mathematical approach to dengue transmission: encompassing genetic algorithm-based optimization

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This paper proposes a fractional-order seven-compartmental model ($S_h A_h E_h I_h R_h S_v I_v$) to describe the transmission dynamics of dengue fever. We consider the saturated treatment function while forming the model, incorporating three controls: awareness control, treatment control, and insecticide control. The intricate dynamics of the system, encompassing the existence and uniqueness of solutions as well as their biological feasibility, are thoroughly examined. The threshold parameter of the system, known as the basic reproduction number, is derived, along with the conditions for the occurrence of backward bifurcation and transcritical bifurcation. We also acquired the equilibria and their stability in relation to variations in the basic reproduction number. The analytical result is verified through some numerical work. Finally, we apply the genetic algorithm optimization technique to minimize the basic reproduction number by optimizing three control parameters and cure rate.

Stability analysis of a delayed predator-prey model with Cosner-type functional response

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We consider a predator-prey model with a Cosner-type functional response. We incorporate time delay in the predation process. Delay played an important role in the population dynamics. The analysis of a positive solution in the delayed model is challenging. We have use some sophisticated technique to proof the positivity of the delayed model. We have also proved the boundedness of solutions for both the delayed and non-delayed model. Apart from trivial and boundary equilibrium under some conditions, the system consists of either no interior equilibrium, a unique interior equilibrium, or two distinct equilibria between boundary equilibria. We observed that there are either two positive equilibrium or no positive equilibrium. Trivial equilibrium is a saddle point and boundary equilibrium is locally asymptotically stable for both non-delayed and delayed models. It is established the boundary equilibrium is globally stable under some parametric restriction. We discuss different dynamic behaviors due to variations in time delay. Based on the parameter conditions, the stable co-existing equilibrium of the non-delayed model remains stable for increasing time delay. For some other parameter restrictions, the stable equilibrium may experience instability through a Hopf bifurcation at a critical delay threshold. There does not exist any delay induced stability switching phenomena in this system.

Construction of balanced incomplete block designs (BIBD) from Sudoku Square Designs

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The word 'Sudoku' is a worldwide popular Japanese mathematical puzzle. Sudoku is a special type of Latin square, where each row and each column contains every element under consideration exactly once and only once. Additionally, the entire square of order *n* can be partitioned into *n* number of subzones of order a x b (= n, either a = b or a $\neq b$) with all *n* elements occurring only once. In Latin square design or normal row-column design, the three main sources of variations are row, column, and treatment. But in the sudoku square design, one more variable is included which is the internal sub-zone effect. Hence, sudoku square is a special type of row-column design. The additional fourth source of variation is the sub zone which will be estimated in sudoku square designs without increasing the number of experimental plots, which is why presently the sudoku square designs are getting more interest to the statisticians. The main objective of the present article is to focus on the construction of Balanced Incomplete Block Designs (BIBDs) from Sudoku Square Designs. The constructional methods of Balanced incomplete block designs are presented by developing several methods given in the article with suitable examples for easy understanding. The efficiency value of the listed designs is also presented.

ABSTRACTS OF THE

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Application of soil bio-technology for treatment of grey water

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On-site Sanitation systems are practiced in un-sewered urban areas in India and thereby black waters generating from residential and institutional buildings are mostly treated in septic tanks. Parallelly, grey waters of un-sewered urban areas are mostly conveyed through surface drains and get discharged without treatment in rivers, canals, lakes, water bodies or in low lying areas and thereby causing surface water and ground water pollution. A study was undertaken with an aim to treat grey water through natural process and accordingly a mechanism has been developed by using graded soil to facilitate growth of attached consortia for treatment of grey water by the application of soil bio-technology. A bench scale model was installed with different sizes of gravel, sand and prepared sandy soil inoculated with micro-flora. The model unit (total depth 53 cm) was operated continuously with grey water collected from Safuipara canal, South Kolkata. As per operational monitoring data the average hydraulic loading rate (HLR) and organic loading rate (OLR) were recorded as 505 lts / m^2. day and 0.07595 kg BOD / m3.day. The performance evaluation study of the model reactor indicated BOD and COD removal range as 82.05% to 82.79% and 84.73% to 88.09% respectively. Total Suspended Solids removal was found to be between 86.36 % and 91.98%. Faecal Coliform removal in the treatment process was recorded as 98.36 %. The study indicated promising scope of application of Soil bio-technology for treatment of grey water.

An internet of things (IoT) based continuous monitoring system for fruit ripening chamber

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Fruit losses following harvesting in developing nations are usually triggered by inappropriate transportation, storage, and handling infrastructure. In India, poor handling and improper monitoring practices result in annual fruit production losses of 15-20%. A low-cost, real-time monitoring system is necessary to optimize ripening conditions in fruit ripening chambers and supply chain containers, reduce these losses, and determine the optimal consumption period. This study focuses on designing and developing a low-cost Internet of Things (IoT)-based system for continuous monitoring of fruit ripening, aimed at observing key parameters that vary during the ripening stage. The proposed design incorporates an economical sensing unit that tracks levels of ethylene, carbon dioxide, oxygen, temperature, and humidity. This IoT-enabled system utilizes a NodeMCU ESP8266 microcontroller to collect and transmit data to the Thingspeak cloud, allowing users to monitor real-time data remotely using digital devices. The developed system underwent validation by continuously monitoring Manzano bananas (Musa acuminata) for 96 hours in a partially airtight fiberglass container under laboratory conditions. Real-time data for each parameter was gathered through the Thingspeak cloud server using IoT technology, indicating satisfactory results.

Model development and analysis of a greenhouse air-conditioning system coupled with a desiccant-coated heat exchanger and dew point indirect evaporative cooler

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In hot and humid countries with tropical and subtropical climates, there is a sharp increase in the plea for air conditioning. The conventional vapor compression air-conditioning system consumes high energy as they are incorporated with overcooling and reheating. They are also harmful to the environment. So alternate cooling technology is essential, which has energy-saving potential and an eco-friendly nature. A desiccant-coated heat exchanger and Dew point indirect evaporative cooler combined system is a promising technology for greenhouse air-conditioning since both latent heat and sensible heat loads are handled together. In this paper, a thermal model of a greenhouse is developed using the Engineering Equation Solver software (version 2020). The combined system can supply conditioned air to the greenhouse to cultivate strawberries. It is observed that the average greenhouse temperature can be obtained below the wet bulb temperature of the ambient for the full calendar year, which will provide the appropriate temperature range of 18-25℃ for strawberry cultivation. It is also observed that, inside vapour pressure deficits also stays in the optimum range (200-1200 Pa) Average greenhouse relative humidity can be maintained within 55-70%. The study highlights the need and viability of such systems for cultivating strawberries in the areas of tropical and sub-tropical climates that witness scorching and humid weather for a substantial part of the year.

Advanced deep learning based object detection for physical attendance management system

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In this era of artificial intelligence and machine learning algorithms it has been understood that any kind of existence of a particular object in a particular position is associated with each other. From this scenario it can be recognized that the presence of an object in a particular place does exist or not. That's why the physical attendance of a particular object can be predicted. We have gone through the various strong deep learning algorithms to find out the best solution for this research problem and seems that it is an important research matter for the ahead mankind. Various working sectors like school, office, any govt. and private working sectors are facing attendance related fraudulence and failed to overcome the problem. Most of the research have been done to recognize face for attendance management system. Here, we are recognizing not only the face of an object but also the associated object of the located place. Face recognition-based application for the attendance management system is widely used. Our system includes several phases- Database creation, location object detection, location object recognition, face detection, face recognition. Located object and face detection and recognition is performed using ONNX model of object detection technique. Using live stream video of the object and the face are detected and recognized to avoid proxy attendance. Physical attendance of the user or the worker will be sent to the respective admin controller.

Design and development of a moisture sensor based automated drip irrigation system

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Due to erratic nature of rainfall in our country and increasing scarcity for availability of fresh water, the conventional irrigation processes are facing difficulties. These facts necessitate the strong need of development and application of modern water saving irrigation technologies at the field level. Drip irrigation system can resolve those issues. It enhances water use efficiency as well as crop benefit ratio which brings the maximum income to the farmer. Automation in drip irrigation system further improves the efficiency of drip irrigation by applying irrigation water based on real time data and providing maximum return by reducing the unnecessary labour cost and other costs. Considering these aspects, an automated drip irrigation system was developed in the current study, where a micro-controller was used to control the whole system by receiving input as soil moisture content from soil moisture sensors inserted in the soil, displaying the same on a 16*2 liquid crystal display and sending the soil moisture data through SMS to the handset of the concerned person. Based on this received SMS, a pump could be operated using the commands 'ON' or 'OFF' to provide necessary water to the field without actually visiting the field. Thus, the developed system would ensure a water and time saving irrigation technology based on real time data. Although this method needs proper technical knowledge to operate but it has several benefits such as real-time, control from distance, water and wage savings, farmer friendly system.

Approach to design smart T-shirt for health monitoring

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This smart T-shirt is the amalgamation of advanced wearable technologies that monitor healthy body metrics. The sensor capabilities in this T-shirt further increase with embedded features like heart rate monitors, body temperature sensors, posture correction sensors, and breathing monitors at strategic points on the chest, underarm, back, and shoulder for accurate data collection. Owing to the ultra-slim and foldable shape, these sensors are placed within the fabric in an invisible and nonintrusive form. Polyester blend in the T-shirt guarantees that these sensors fit very tightly concerning flexibility and comfort. Also, cleaning the detachable modules of the sensor is quite easy, and hence, the life of the product can be prolonged. Through IoT, all this information captured by sensors is wirelessly sent to an application on a smartphone. This will be provided with real-time health and fitness values. It makes Smart T-shirt very useful for all fitness enthusiasts, athletes, and the ones who can really be quite keen on tracking their health. Further, regarding pricing, it is affordable, along with features such as sweat monitoring that can be marketable in India. Since health-related wearable devices are on huge demand, this smart T-shirt would be a product seeking proper market space both in the domestic as well as foreign markets as competitive offering.

Simulation of shovel type furrow opener using the discrete element method (DEM)

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Furrow openers are important tools for dropping seeds and fertilizer. Their interaction with soil develops horizontal, vertical, and lateral forces, which affect seeding performance and selection of prime mover. Therefore, an experiment was conducted to investigate the performance of a shovel-type furrow opener using an indoor soil bin and discrete element method (DEM). In the soil bin experiments, the furrow opener was tested at different depths (4cm, 6cm, and 8cm) and different speeds (2 kmh-1, 3 kmh-1, and 4 kmh-1). Here, DEM model was used as a validation tool for comparing the results with experiments. The furrow profile, helped in deriving the soil disturbance index (SDI), obtained as the ratio of disturbed area and maximum depth. Both the physical experiment and the model showed an increasing trend of the draft with depth and speed. The maximum experimental draft (920 N) and model draft (840 N) were obtained at 4 kmh-1 speed and 8cm depth setting and the minimum experimental draft (190 N) and model draft (150 N) were obtained at 2 kmh-1speed and 4cm depth setting. The SDI increased as the depth and speed of operation increased in both the experimental and model cases. In comparison with the experimental results, the model results had relative errors of 8.69% for draft requirement and 10.73% for SDI at maximum speed and depth. Hence, the DEM model showed good validation with relative errors within acceptable limits for performance evaluation of shovel-type furrow openers.

Entrapment of polyphenol extracted from *Centella asiatica* in biopolymeric hydrogel matrix

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"Thankuni" or *Centella asiatica* has long been employed as a medicinal plant, being rich in phytochemicals, especially triterpenes and caffeoylquinic acids that impart neuroprotective, anticancer and antioxidant activities. The present investigation mainly concerns the formulation of a polyphenol-containing hydrogel. Furthermore, a hydrogel was created with honey and *Centella asiatica* extract. Calcium chloride cross-linked alginate supplemented with honey entrapped *Centella asiatica* extract in the hydrogel matrix. It showed appropriate hydrophilic and encapsulating properties. This phenol content in the hydrogel was found 197 mg GAE/100 g and gradually decreased over time because of slow degradation. The bioactive chemicals were released slowly in simulated intestinal fluid because of their release from encapsulation in the gel; hence they exhibited significant antioxidant activities. At ambient temperature, it spoiled in two weeks, but refrigeration increased its shelf life to two months. Future research will focus on integrating a targeted organ delivery method to maximize the gel's medicinal potential. The polyphenol entrapped gel exhibits promise as a nutraceutical biomaterial product for the usage in functional food applications, presenting encouraging prospects for the development of nutraceuticals as well as wound healing.

Design of an advanced automated system for cleaning metropolitan underground drainage networks

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The increasing urbanization and rapid expansion of metropolitan areas have led to a significant rise in the need for efficient underground drainage systems which is 15 – 20 feet below the surface of the ground. Blockages in these drainage systems due to solid waste accumulation often result in flooding, water-logging, and health hazards. Thus, an automatic underground drainage cleaning apparatus must be created. The proposed system utilizes a combination of sensors and IoT technologies to monitor the level of waste accumulation within the drainage pipes while also measuring parameters like water flow rate. Once the waste level reaches a critical threshold, the system automatically sends real-time notifications to the concerned municipal authorities, prompting timely cleaning and maintenance actions. The model involves the use of trolley or garbage carrying model car, steel wires, pulley, DC motor, rods, battery and netted bucket. There is a loop of several pulleys connected together. It's the work of the pulleys which collect the garbage, carry it all the way up with the help of fluid pressure and dump it into the garbage dump cart. Along that that there will be an arrangement of an application which would notify when the cleaning needs to be done and when that cleaning is over. This innovation offers a proactive approach to maintaining the efficiency of drainage systems, preventing potential flooding, and minimizing environmental hazards. This would benefit to the development of sustainable cities by optimizing resource use, enhancing the overall resilience of urban infrastructure.

A new activation function and its impact on recently proposed CNN-based models for multimodal brain tumour segmentation

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Activation functions are crucial in enabling convolutional neural network (CNN)-based models to accurately learn complex patterns and relationships, enhancing model performance. Without activation functions, neural networks are restricted to linear relationships, limiting their ability to tackle complex real-world tasks. In this paper, we introduce a novel activation function, TS_ReLU, which integrates aspects of ReLU, hyperbolic tangent, and softsign activation functions to address the "dying ReLU" issue that arises from negative input values. Our experimental analysis compares TS_ReLU to several established activation functions, including ReLU, Leaky ReLU, ELU, Swish, Mish, SiLU, GELU, and FTS. Results demonstrate that TS_ReLU outperforms these alternatives across various measures. We further evaluate the impact of different activation functions on four CNN-based models—U-Net, SE-Net, S-Net, and SA-Net—using the BraTS benchmark brain tumor segmentation datasets (BraTS 2018–2021). Among these, S-Net and SA-Net demonstrate superior performance, with S-Net achieving notable dice scores of 0.9956 and 0.9914 on the BraTS 2020 and 2018 datasets, respectively. Similarly, SA-Net achieves dice scores of 0.9958 and 0.9932 on the BraTS 2021 and 2019 datasets, respectively. These results underscore the efficacy of TS_ReLU in enhancing CNN-based models for medical image segmentation tasks.

Development of green paving mix for low volume road

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Many rural roads in West Bengal are experiencing significant pavement distress. Reclaimed asphalt pavement (RAP) is collected from deteriorated pavements, and offers a potential solution for creating cost-effective and eco-friendly paving mixtures for rural road construction. RAP is a waste material generated when a distressed asphalt layer is milled off existing pavement. One sustainable approach is to use the green paving mix technique, which recycles RAP and provides environmental benefits. This technique presents a cost-effective alternative for low-volume roads that connect to major district roads. This research aims to explore the possibility of using a higher percentage of RAP in bituminous and granular layers of low-volume roads. The coarse and fine RAP has been used to replace natural aggregate to produce the WMM, GSB, and Emulsified Bituminous Macadam for rural road construction. The geotechnical characteristics of granular mixes and Marshall and volumetric properties along with the performance properties of asphalt mixers have been evaluated. The study compared the properties of the green paving granular and emulsified mix with a conventional mixture of their counterpart for this specific application. Findings revealed a considerable cost reduction of rural road construction by recycling coarse and fine RAP. Further, these findings could help to deploy local unskilled villagers in rural road construction.

An experimental study on soft soil improvement by admixture using fiber

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Soft and compressible soil exists in numerous regions globally, particularly in alluvial plains and coastal areas. These kinds of soils are prone to undrained shear failure or excessive settlement, which can cause foundations for civil infrastructures to collapse. It is essential to augment the soft soil by increasing its bearing capacity and decreasing its compressibility. Diverse methodologies are employed globally for the enhancement strength of soft soil. The insertion of certain admixtures into soft soil is an effective and convenient strategy, enhancing the load-settlement performance of the soil through either mechanical reinforcement or chemical reactions with soil particles. This study presents a series of experimental studies conducted on the enhancement of soft soil utilising various admixtures, including natural banana fibres and synthetic china nylon cord fibres. Banana fibres are derived from the banana stem, while China nylon chord fibres are sourced from discarded tires. Fibres are cut into segments and combined with soft soil in varying proportions. A comparative investigation on the improvement of the treated soil has been done by a series of Proctor, California Bearing Rato and Unconfined Compressive Strength tests. Significant findings on optimum moisture content, maximum dry density, penetration and shear strength characteristics are derived from the comprehensive analysis.

Targeted delivery of ketoconazole using smart chitosan-based polymeric nanoparticles: A novel approach in antifungal therapy

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Innovative approaches to efficient drug administration are required due to the rise of antifungal resistance, especially for medications like ketoconazole, which is frequently used to treat fungal infections. This work describes the creation of potent polymeric nanoparticles (NPs) based on chitosan that are intended to distribute ketoconazole precisely, improving therapeutic effectiveness while reducing systemic adverse effects. Because of its natural qualities that promote drug encapsulation and controlled release, chitosan, a biocompatible and biodegradable polymer, is an excellent matrix for the creation of nanoparticles. The produced nanoparticles have advantageous properties, such as high drug-loading capacity, surface charge, and ideal size. We have found through our produced CNPs that the particle size of the chitosan nanoparticle is 117 µm, the optical density of the supernatant solution is 0.589, with a drug entrapment efficacy of 59.41%. In vitro release studies demonstrated a sustained release of ketoconazole over 1440 hours, with release kinetics best fitting the first-order model (R2 = 0.97) and during that time the % drug release was 99.98%. Continuous drug release over long periods of time is indicated by regulated release patterns, which maximize antifungal action while lowering the frequency of dosing. We will discuss about current initiatives assess the pharmacokinetics and bio-distribution of these Nano carriers in vivo as well as optimize formulation parameters.

Formulation and In vitro evaluation of density-dependent floating tablets of ofloxacin: A comparative study of formulation parameters and release kinetics

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Floating drug delivery systems (FDDS) offer a promising approach to enhance the bioavailability of drugs with a narrow absorption window or poor solubility in intestinal fluids. Ofloxacin, a widely used fluoroquinolone antibiotic for gastrointestinal infections, is an ideal candidate for such a system. This study focuses on the formulation and optimization of effervescent floating tablets of ofloxacin using density-dependent mechanisms to achieve prolonged gastric retention and controlled drug release. Two formulations (F1, F2) were prepared using carboxymethyl cellulose (CMC) and ethyl cellulose (EC) as release retardants, with PVP K30 as a binder. The granules were prepared via wet granulation, followed by compression into tablets. The prepared formulations were evaluated for various parameters, including hardness (F1=3.8 kg/cm^2, F2= 4.8 kg/cm2) flow properties [For F1: Bulk density = 0.403, tapped density = 0.493, Hausner ratio = 1.22, Carr's index = 20.23, angle of repose = 25.867 and For F2: Bulk density = 0.386, tapped density = 0.458, Hausner ratio = 1.18, Carr's index = 18.59, angle of repose = 24.564] and in vitro drug release. The dissolution studies in 0.1N HCl demonstrated a cumulative drug release of 93.43% and 90.38% for F1 and F2, respectively, over 5 hours. The floating tablets exhibited satisfactory buoyancy (6 hours) and prolonged gastric retention, making them suitable for local delivery of ofloxacin to the gastrointestinal tract. This research presents a promising approach for enhancing the efficacy of ofloxacin by utilizing density-dependent floating tablets. The developed formulations demonstrate controlled drug release and prolonged gastric retention, offering a potential solution for improved treatment of gastrointestinal infections. Further in vivo studies are warranted to validate the efficacy and safety of this novel delivery system.

Formulation and characterization of ciprofloxacin-loaded niosomes: A comprehensive approach to drug delivery

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Niosomes, non-ionic surfactant-based vesicular systems, have emerged as promising nanocarriers for controlled drug delivery, offering improved stability, bioavailability, and targeted drug release. This study focuses on the optimization and evaluation of ciprofloxacin-loaded niosomes for enhanced antibacterial efficacy. The thin-film hydration method was employed to prepare niosomes, with systematic variations in surfactant types (Span 40, Tween 60, Tween 80), cholesterol ratios, and other critical parameters to achieve optimal vesicle size, drug entrapment efficiency, and release profile. Characterization studies revealed particle sizes ranging from 186.5 nm to 717.7 nm, with encapsulation efficiencies between 5.34% and 85.62%, demonstrating the significant influence of surfactant type and cholesterol concentration on niosomal properties. In vitro drug release studies showed a sustained release profile of ciprofloxacin over 360 minutes, reaching up to 44.5% cumulative release. The release kinetics followed the Higuchi and Korsmeyer models, indicating diffusion-controlled drug release. The use of non-ionic surfactants combined with cholesterol resulted in stable niosomal vesicles capable of effectively encapsulating both hydrophilic and lipophilic drugs. The optimization process, facilitated by Design Expert software, enabled fine-tuning of the formulation to achieve desired niosomal characteristics. The results highlight the potential of ciprofloxacin-loaded niosomes as a promising drug delivery system for enhancing antibacterial efficacy while minimizing systemic side effects. This study provides a comprehensive approach to niosome formulation, contributing to the expanding field of nanocarrier-based drug delivery systems.

Enhancing image steganography: A hybrid approach using edge detection technique

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In the digital age of information technology, infringement of copyrights and information leakages have assumed vital significance. Steganography embeds hidden data across the cover medium and offers a level of protection for confidentiality, integrity, and availability that is unmatched by classical data-hiding techniques. Over the last two decades, steganography has evolved from an ancient and straightforward technique for message concealment to a highly advanced and complex digital security tool. In comparison to text, audio, video or other types of steganography, image steganography is becoming more prevalent due to the advent of social media, high degree of invisibility, enormous data capacity, and resistance to steganalysis. In this study, we propose an image steganography scheme that enhances this process by categorizing image content into edge and non-edge regions using a hybrid edge detector that combines the Difference of Gaussians (DoG) and Laplacian of Gaussians (LoG) methods. This advanced steganographic technique utilizes the embedding space completely by concealing more secret image information along edge regions compared to non-edge because edges offer higher tolerance for changes with reduced risk of detection. This study achieves an optimal balance between data embedding capacity and minimal visual distortion. The results and comparison analysis clearly indicate the efficacy of the method in concerns of secure and safeguarded communication.

Enhancing antimicrobial activity of silver nanoparticles through natural polymer conjugates

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The growing threat of antimicrobial resistance necessitates innovative strategies to combat infections, particularly those caused by resistant bacterial strains. This study explores the development of polymer-conjugated silver nanoparticles (AgNPs) as an emerging antimicrobial agent, designed to enhance stability, reduce toxicity, and improve bioavailability, as well as comparing their efficacy to the antibiotic Gentamicin. Chemical reduction method was employed for the synthesis of AgNPs, where silver nitrate ($AgNO_3$) was used as the starting material and sodium borohydride ($NaBH_4$) acted as the reducing agent. Subsequently, to improve their stability and reduce aggregation, biocompatible polymer sodium carboxymethyl cellulose (sodium-CMC) was conjugated to the AgNPs. The successful formation of these nanoparticles was confirmed through several methods, such as dynamic light scattering, UV-visible spectroscopy, and X-ray diffraction. Characterization of the prepared AgNPs using DLS method revealed particle sizes ranging from 10 nm to 30 nm and that of polymer-conjugated AgNPs ranges from 650 nm to 800 nm. Moreover, the optimization process using Design-Expert software was allowed for fine-tuning the formulation to achieve desirable AgNP characteristics. Antimicrobial efficacy of the polymer-AgNP conjugates was tested against *Staphylococcus aureus* and *Escherichia coli*. Both minimum inhibitory concentration (MIC) assays and zone of inhibition tests showed that the polymer-conjugated AgNPs had improved antimicrobial activity compared to bare AgNPs and were similarly effective to the antibiotic Gentamicin. This study underscores the potential of polymer-conjugated AgNPs as next-generation antimicrobial agents, offering a synergistic approach for combating resistant microbial infections.

Energy-efficient and fault-tolerant power systems: A federated learning approach using digital twin models

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The increasing demand for sustainable energy requires innovative power management solutions. A digital twin model integrated with federated learning (FL) offers an energy-efficient, fault-tolerant approach. In this setup, each power node trains locally and shares only essential updates with a central server, leveraging an enhanced model for failure management. The digital twin provides real-time feedback from the complex power system, enabling timely modifications and improvements. During the federated learning process, the status of each node—whether active or failed—is monitored, enabling adaptive training. After each training round, the model calculates the total energy consumed through communication and computation, providing a clear overview of energy efficiency. In a traditional centralized learning setup, the system consumed 70.00 units of energy, achieving an energy efficiency of only 30.00%. By contrast, the federated learning model significantly reduced total energy consumption to just 1.75 units, with a remarkable energy efficiency of 96.50%. These results highlight the potential of technologies like federated learning and digital twin frameworks to drive sustainable development, optimize resource use, and reduce environmental impact. This research underscores the synergy between digital twins, federated learning, and sustainability. By dramatically lowering energy consumption while maintaining system resilience, this approach paves the way for more efficient and sustainable power systems. The energy savings achieved align with global sustainability objectives, illustrating how cutting-edge technologies can address pressing challenges in energy management and environmental conservation.

Smart solar-powered EV with vehicle-to-vehicle (V2V) charging for sustainable mobility solutions

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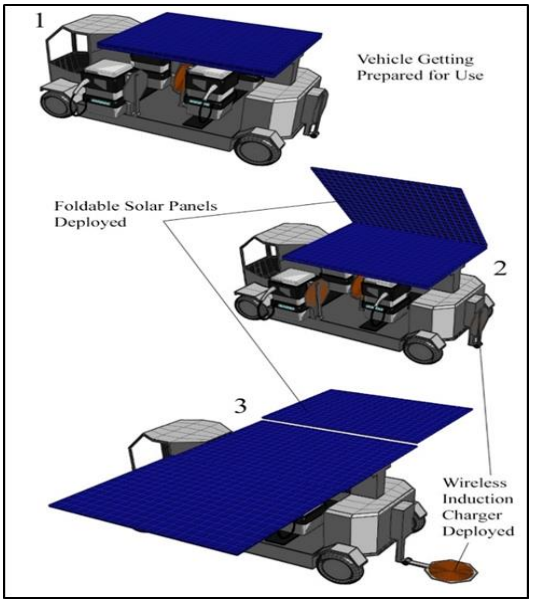
The recent advancements in the communication, charging, and energy-sharing of electric vehicles (EVs) will herald a new age of transportation. The present work is a solar-powered Vehicle-to-Vehicle (V2V) charging system that advances this initiative by using a completely Renewable Energy Source (RES) and establishing an edge-based network of mobile EVs that function as both energy consumers and suppliers. Here, the integration of high-efficiency solar panels, equipped with Maximum Power Point Tracking (MPPT) technology, ensures the optimal capture of solar energy. This energy is then efficiently stored in lithium-ion batteries, managed by an advanced Battery Management System (BMS). The BMS intelligently regulates and distributes the stored energy, ensuring seamless and efficient power delivery throughout the system. The mobility of the charging station facilitates efficient energy capture and distribution, ensuring flexible deployment in various locations. The test results confirm the feasibility of the project, thereby, demonstrating its capability to address the challenges posed by limited charging infrastructure while promoting sustainable energy integration. By coupling software and hardware simulations, the prototype can store charge, generate a matrix of current settings, and safely deliver energy. The portable nature of this prototype is expected to reduce the high costs associated with installing fixed-charging infrastructure. The design of the proposed mobile EV charging station is illustrated in Figure 1. It provides a clear visualization of the EV's foldable solar roofs, which can be fully deployed to harvest solar energy and store it in batteries for future use.



Entropy-driven federated learning for energy efficient and sustainable internet of underwater things

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The proposed entropy-driven federated learning framework for the Internet of Underwater Things will advance a solution that enhances both efficiency and sustainability for underwater sensor networks. Underwater environments have a low bandwidth, are subject to high latency, and also impose an energy constraint as significant challenges in efficiently monitoring or sending useful data. This framework optimizes both communication efficiencies and saves energy, both being vital aspects in the efficient and sustainable execution of underwater missions. Federated learning works on the network edge, thus allowing for private data-enabled model generation at a reduced number of central data aggregation. We simulate the proposed work with 100 sensor nodes distributed into clusters. Dedicated cluster heads aggregate local model updates. A node performing Support Vector Machine (SVM)-based classification on all its data uses federated averaging at the cluster head as the solution that minimizes energy-intensive transmissions of data. Packet Delivery Ratio (PDR), latency and energy consumption are observed through simulation. The proposed method consumes 29% more energy than traditional data communication methods. Entropy optimization also leads to an increase in the amount of information diversity in a network. Consequently, this improves the efficiency of processing data in a network. This approach minimizes energy waste, extends the underwater operational lifetime of sensor nodes, and reduces the environmental impact through infrequent sensor replacements and power replenishments. High energy efficiency and communication reliability will provide minimal-intervention, continuous underwater ecosystem monitoring and ensure long-term environmental sustainability while aiding in vital underwater conservation efforts.

The impact of operating parameters on an atmospheric-type condenser's heat transfer characteristics

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The aim of this study is to investigate the effects of operating parameters on the heat transfer characteristics of an atmospheric type condenser in the vapor compression refrigeration system of a commercial potato cold storage facility. Atmospheric type condensers utilize ambient conditions to reject heat from the system to the environment. They are frequently installed in cold storage facilities that use ammonia as a refrigerant. The nearby cold storage facility has the capacity to store 6,000 metric tons of potatoes and provided the design features and input parameters for this study. The collected input data includes a condensation temperature of 40°C, an ambient air-dry bulb temperature of 33°C with 50% relative humidity, a cooling water temperature of 30°C, and mass flow rates of water and air at 0.013 kg/sec and 0.015 kg/sec, respectively. A generalized methodology derives the total heat transfer coefficient and rate from the condenser, using empirical equations to compute dimensionless numbers like Reynolds and Prandtl. After analyzing the effects of ambient air conditions and flow rates of air and water, equations were developed to predict heat transfer parameters under varying operating conditions. Results show that increasing mass flow rates of air and water enhance both the total heat transfer coefficient and the heat transfer rate, while higher relative humidity and ambient air temperature lead to a decline in these parameters.

Designed and developed low-cost 3D printed prosthetic arm for medical rehabilitation

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With the increasing need for affordable, high-performance prosthetic solutions,this project focuses on developing a 3D-printed prosthetic arm that utilizes Electromyography (EMG) signals to interpret muscle activity, enabling intuitive and responsive control. We have designed our device to improve the quality of life for individuals with limb loss. EMG signals are particularly advantageous in this application due to their ability to provide real-time feedback, allowing the prosthetic to closely replicate natural arm movements. In our prosthetic arm sensors help us to enable intuitive and precise control of arm movements. Machine learning algorithms are integrated into our device to enhance arm functionality. Each servo motor corresponds to a specific finger, enabling individual and coordinated movements for a natural and dexterous hand function. The novelty of our project is our prosthetic arm can adapt to each user's unique muscle patterns concerning time and easily useable responsive. In our innovation lab, we utilized 3D printing technology for accessibility and affordability. This technique is useful in the Indian market for rapid customization and this reduces productioncosts. Our project focused on the significant need for unique user-friendly functional, adaptable, and affordable prosthetic solutions. We can use a bidirectionalfeedback interference system in our device for the development of an appropriate loop system.

TiO_2-epoxy nanocomposite optical fiber structures for wide-range programmable optically variable resistors

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An innovative strategy is deployed to implement a programmable optically variable resistor (POVR) for modern electronic circuits and systems. The device integrates an RGB-LED as the source and a CdS light-dependent resistor (LDR) as the detector within a short-length (~cm), macro-scale (~mm diameter) round optical fiber (ROF) spacer. The core of the ROF is constructed by casting a TiO_2-epoxy nanocomposite solution inside a PVC cylindrical mould, followed by curing under controlled temperature and pressure. A nitrocellulose-based cladding layer with a lower refractive index is applied to guide visible-spectrum light, while a black pigment absorption layer eliminates ambient light interference. An analytical model is developed to relate the output resistance (LDR resistance) with the input voltage applied across the LED source, supporting both narrow-spectrum (single-color) and wide-spectrum (RGB) operations. POVRs with varying spacer lengths and TiO_2 nanoparticle content (30–60 nm) are fabricated, and their resistance-voltage (R-V) characteristics, modulation range, sensitivity, and frequency response are measured. Experimental results align well with analytical predictions. Future work will explore the thermal stability of POVR devices and construct a data-driven regression model using a backpropagation artificial neural network (ANN) trained on R-V datasets. This ANN will predict input voltage for a given resistance value and control multiple POVRs via a microcontroller for circuit integration. The POVR system offers greater flexibility, accuracy, and range (from a few ohms to several megaohms) compared to conventional digital potentiometers and motorized rheostats, marking a significant advancement in tunable resistance technology.

Enhancement of isolation in a super-wideband MIMO antenna with polarization diversity utilizing a fractal neutralization line

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The paper proposes a novel solution for enhancing the wideband isolation of a microstrip-fed multiple-input multiple-output (MIMO) antenna utilizing a 2nd-order fractal Neutralization Line (NL) for leadless transcatheter pacemaker (TCP), Vehicular to Everything (V2X), fifth generation (5G) metal frame smartphone applications. The suggested antenna is the pioneer in proposing the improvement of isolation in a MIMO antenna with polarization diversity using a fractal NL. The antenna is designed within a compact footprint of 28 (l)×42 (W) mm2 and covers a super wide bandwidth ranging from 3.6-18 GHz accompanying an isolation of >15 dB. The inter-element spacing between the radiators is 0.09λ0 (at 3.6 GHz). The antenna covers the 5G n77, n79, and n96 bands along with the LTE band 46. The design allows the opportunity for the applications of various Machine Learning (ML) optimization techniques for optimizing the length and position of the fractal NL for extracting the maximum bandwidth as well as isolation in next-generation (5G/6G) MIMO antennas.

Acid-hydrolyzed alginate nanoparticles enhance diclofenac sodium delivery: A promising strategy for improved therapeutic outcomes

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Alginate-based nanoparticles have gained significant attention in drug delivery systems due to their biocompatibility and biodegradability. Diclofenac sodium, a widely used non-steroidal anti-inflammatory drug (NSAID), suffers from poor bioavailability. This study investigates the development of acid-hydrolyzed calcium alginate nanoparticles as a novel delivery system for Diclofenac sodium, aiming to enhance drug delivery. This study presents a comprehensive investigation into the synthesis, optimization, and characterization of Diclofenac Sodium-loaded calcium alginate nanoparticles (DS-AlgNPs) using the ionic gelation method. The primary objective was to develop nanoparticles with sizes below 200 nm while maximizing drug encapsulation efficiency and achieving controlled release profiles. The synthesis process was optimized by systematically varying alginate (0.095-1.2 mg/mL) and calcium chloride (0.03-2.7 mg/mL) concentrations. Additionally, the effects of different homogenization techniques, namely bath sonication and magnetic stirring, on particle size distribution and uniformity were evaluated. Nanoparticle characterization included size analysis, drug encapsulation efficiency, and in vitro release studies. Results demonstrated that bath sonication was superior to magnetic stirring, producing smaller and more uniform nanoparticles with sizes ranging from 213.2 nm to 374.2 nm. Optimal conditions were achieved using 0.52 mg/mL alginate concentration and 60 minutes of sonication, yielding particles with a mean diameter of 213.2 nm. Drug encapsulation efficiency varied between 53.3% and 67.9%, with the highest efficiency observed using bath sonication. In vitro release studies conducted in phosphate buffer (pH 7.4) revealed sustained release behavior, with up to 87.76% of the drug released over 24 hours, following the Higuchi kinetic model.

Predicting sildenafil disposition in PAH using PK-Sim: A comprehensive PBPK model

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Pulmonary arterial hypertension (PAH) is a debilitating disease requiring long-term treatment with medications like sildenafil, a phosphodiesterase-5 (PDE-5) inhibitor. This study aimed to develop a physiologically based pharmacokinetic (PBPK) model for sildenafil using PK-Sim® to predict drug behavior across different age groups and explore the impact of age-related physiological changes and enzyme activity on drug disposition. A comprehensive PBPK model was built using PK-Sim®, incorporating detailed physiological, biochemical, and drug-specific data. The model simulated the absorption, distribution, metabolism, and excretion (ADME) of sildenafil in infants, adults, and the elderly. Simulations revealed significant age-related variability in sildenafil pharmacokinetics. Elderly individuals exhibited the highest maximum plasma concentration (Cmax) at 430.80 µmol/L, followed by infants at 277.80 µmol/L, and adults at 95.16 µmol/L. The half-life was prolonged in infants (11.23 hours) and elderly individuals (9.21 hours) compared to adults (5.17 hours). Clearance was also notably higher in adults (10.76 ml/min/kg) compared to infants (0.57 ml/min/kg) and elderly individuals (0.31 ml/min/kg). This research demonstrates the utility of PBPK modeling in understanding age-related differences in sildenafil pharmacokinetics and optimizing dosing regimens for specific patient populations. The findings suggest that individualized dosing strategies based on age and physiological factors may be necessary to achieve optimal therapeutic outcomes in PAH patients.

Next-generation nanocomposites: Sustainable performance of recycled RN66 for dynamic shear application in engineering

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This research aims to improve sustainable materials technology by optimising the performance of recycled Nylon-66(RN66)-Graphene oxide composite nanofiber sheet by melt mixing in RN 66 bed in addition of the reinforced fibre for Dynamic Shear Testing (DST) applications. RN66-GO, a composite nanofiber derived from recycled polymers, has demonstrated significant mechanical and environmental advantages, such as enhanced durability and a diminished carbon footprint. This study seeks to enhance and refine the structural properties of RN66, establishing it as a sustainable and effective substitute for traditional materials in high-stress engineering applications. The main aim is to assess reinforced RN66-GO sheet's performance under dynamic shear pressures, evaluating metrics essential for sectors including automotive, aerospace, and construction. By comparing reinforced RN66 sheets to more traditional nanocomposite options, it will determine their shear strength, elasticity, and fatigue resistance using rigorous DST methods. The study technique includes material preparation, composite sample manufacturing, and standardised DST, guaranteeing a thorough evaluation of RN66's capabilities. Expected results encompass measurable enhancements in resilience, shear resistance, and sustainability parameters, illustrating reinforced RN66's capacity to fulfil both performance and environmental objectives. This research corresponds with the grant's emphasis on sustainable innovation and the advancement of materials science by fostering waste reduction, resource efficiency, and the creation of high-performance recycled materials. This project aims to improve sustainable materials technology by augmenting the performance of recycled RN66-GO composites nanofiber in Dynamic Shear Testing (DST) applications. Reinforced RN66-GO, a nanocomposite derived from recycled polymers, has demonstrated significant mechanical and environmental advantages, such as enhanced durability and a diminished carbon footprint.

Sensor-based detection system for parasites in water: A case study of the Agarpara Region

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Abstract: Parasitic diseases are prevalent in tropical and subtropical regions due to favorable climatic conditions that promote parasite survival and propagation. These issues, compounded by declining water quality and complex host-parasite interactions, have been further intensified by climate change, leading to the rise of waterborne protozoan parasites like Entamoeba histolytica, Giardia, and Cryptosporidium. These parasites, typically found in fecal-contaminated water, cause severe health problems, ranging from dysentery and colitis to life-threatening conditions such as liver abscesses. The parasites exist in infective cyst or oocyst forms, which can survive for extended periods in the environment, making early detection critical for disease prevention and management. Traditional methods for detecting these cysts in water samples rely on conventional microscopy, which is labor-intensive and error-prone. This study presents a sensor-based detection system using optical sensors and biosensors to capture high-resolution images of water samples. These images are then processed by deep neural network models, specifically DenseNet169, to detect E. histolytica, and Giardia from microscopic cyst/oocyst images. The study highlights the importance of image clarity in improving detection accuracy, with the DenseNet169 model achieving a high testing accuracy of 98.81%. This automated system offers a more efficient and reliable solution for monitoring water quality, ensuring early identification of parasitic infections in the Agarpara region.

A holistic approach for reduction of equipment failure applying TPM tools at XYZ Ltd

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In a manufacturing industry, the output primarily depends upon three ‘M’s i.e. Man, Machine and Materials. Many of times, the failure of the machines or equipment, in comparison to other two, plays a significant role in poor performance and causes a threat in a competitive market. Therefore, a reliable health of machines is expected towards quality, productivity of the output and morale of workforce. The conventional maintenance practice normally restores the equipment through repairing or replacement of failed component or assembly and also follows a routine PM-Preventive Maintenance as the manufacturer recommends. But this philosophy does not help much to improve the availability of the equipment and maintain its sustainability. Present study or work shows that if the failures are identified with causes, through ‘Why-Why Analysis’ as TPM (Total Productive Maintenance) suggests, where human lack is also explored, then a long-term actions or strategies can be planned and implemented to take care human causes to reduce downtime and ensure a sustainable improvement. As TPM believes on 8-Pillar activities, so a holistic approach is applied involving relevant five Pillars to enhance knowledge, skill, discipline and improve operating environment in achieving organizational targets.

An efficient sleep apnea detection method using wavelet transform and entropy

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Sleep apnea is a clinically proven acute sleeping disorder which requires timely identification and treatment. This disorder may lead to increased heart diseases, hypertension and stroke etc. Heart diseases and stroke are the burning reason which increases the mortality rate day by day. In one of the leading newspapers- "Times of India" it was reported in last September 2024 that in West Bengal heart attack is the main reason for 35% of deaths, which is highest in all over India. Not only the old people, but the younger generations are also prone to the effect of these diseases. That's why early detection and treatment of this disease is very much important. This paper presented a sleep apnea detection method using electroencephalogram (ECG) signals. At first wavelet transform has been applied on the ECG signal and then the feature is extracted by computing the entropy of different subbands. For each ECG signal total 18 features are extracted and then classified by applying Support vector machine, Decision Tree classifiers, Logistic Regression, Naive Bayes, Neural Network, Random Forest, K-Nearest neighbor. The proposed method is simulated on a publicly available Physionet database and which provides the maximum of 100% accuracy for Random Forest classifier.

ABSTRACTS OF THE

SUBJECT AREA:

EARTH SCIENCES INCLUDING GEOINFORMATICS AND HYDROGEOLOGY

Table of Content

Presenting author*

Transformation of land and livelihood in peri-urban Basirhat: A spatio-temporal analysis

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This paper seeks to explore a GIS based LULC change in the last 23 years and the inter-linkage between land use change and rural livelihoods in the peripheral villages of Basirhat City in the North 24 Parganas District of West Bengal. The role of distance decay is also examined through a comparison of villages sharing boundary with the city and villages located about 3 km away from the city. Satellite images from Landsat TM for 2000 and Landsat OLI/TIRS for 2014 and 2023 were used for prepare of LULC maps, with the help of supervised classification and maximum likelihood algorithm.

The analysis of LULC brings out that water bodies, bare lands and agricultural lands has been reduced and built-up area has expanded quickly due to the growth of population over time of the city and have an impact on transformation of livelihood of fringe area. As a result of land transformation, along with the sectoral diversity of occupation, the value of land near to the city has also increased; there is seen a tendency to cultivate demanding crops. Small-scale farmers have faced challenges as a result of urbanization, but it has also provided benefits for peri-urban people. Based on the analysis of primary survey, it has been seen that maximum people of nearer villages, has diversify their economy into tertiary sectors for improve their well-being; but in case of further villages where most of the people engaged with agro-based economy. There is need to be more sustainable of sectoral diversification.

Integrating soil moisture and temperature data using GIS technology for precision farming

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The integration of soil moisture and temperature data is crucial for advanced farming practices. This study explores the emerging application of Geographic Information System (GIS) technology to combine these critical parameters, enabling precision farming. By leveraging GIS capabilities, we can create high-resolution spatial maps of soil moisture and temperature, allowing farmers to make informed decisions. This research demonstrates the potential of GIS-based integration to optimize irrigation scheduling, crop selection, and yield prediction. The results show significant improvements in water use efficiency, crop productivity, and reduced environmental impact. This innovative approach paves the way for data-driven agriculture, empowering farmers to adapt to changing environmental conditions and meet the growing demand for sustainable food production.

Assessment of groundwater quality for irrigational purpose in the drought prone region of Purulia district of West Bengal

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Globally groundwater depletion coupled with contamination has become a major threat to human life. Especially, hard rock terrain suffers from huge water scarcity each year-round and is increasing day by day. This study focuses on the semi-arid region of eastern Purulia district mainly in Kashipur & Raghunathpur I-II blocks. Here, groundwater is generally confined within the secondary porous units- fractured or faulted granite gneissic complexes, weathered zones. This study mainly focuses on the qualitative aspect of groundwater for irrigational purposes as the local people mainly depends on groundwater for agriculture. Various physicochemical parameters like pH, Total Dissolved Solid, Electrical Conductivity, major cations-anions were studied for the collected groundwater samples during the post-monsoonal season. To understand the suitability of groundwater for irrigational purposes Sodium Absorption Ratio, Permeability index, Magnesium Absorption Ratio and Kelley's Ratio have been analysed along with the Piper trilinear plot and Gibbs Diagram. From the result, it is observed that the order of abundance of statistical mean values of cations are $Ca^{2+}>Na^{+}>Mg^{2+}>K^{+}>Fe^{2+}$ & of anions are $HCO_3^{-}>Cl^{-}>SO_4^{2-}>NO_3^{-}>F^{-}$ and the water quality in some regions are good while some are bad to unsuitable. So, this result would help both the governmental and non-governmental organizations in preparing water resource management programs in the near future from a broader perspective.

Geodiversity assessment and its analytical perspectives for biodiversity conservation and environmental planning in the Darjeeling Himalayan Region, West Bengal, India

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The Himalayan region reserves very high potentials for both the biodiversity and geodiversity and the Darjeeling Himalayan region being a part of the eastern Himalaya is no exception to it. While many attempts have been made to assess the biodiversity of the region, one seldom comes across any experiment in geodiversity. This study aims to cognize the nature of geodiversity for the Darjeeling Himalayan extent and strive to establish its relationship with biodiversity by exploring its role in the conservation of natural resources. Based on the available datasets on diversified regional characteristics owing to lithological diversity, geomorphological variety, drainage density, forest type differences, elevation changes, pedological variability and mineral resource occurrence a geodiversity index has been developed in which geo-spatial techniques played a climacteric role to quantify geodiversity in the concerned region. Analyses the varying nature of contributing indicators e within the studied reach reveals that the zones between the elevation range of 1000 m-2000 m consists of a higher number of species (average number of species = 123) and maximum geodiversity value (6.99). Alternatively, the correlational bi-plot analyses reveals that the two variables i.e., geodiversity and species distribution are positively interrelated as the regression coefficient value signifies a positive trend. In the long run resource management principles on water, agriculture, forest and wasteland management etc. may be based on geodiversity indicators for sustainable return goals, besides the policy drafting for town planning in the hills, identification of eco-tourism spots perhaps uses this information to its stride.

Reconstructing geomorphic changes in Bidyadhari-Padma Palaeo-meander bend region near the Chandraketugarh archaeological site of lower deltaic Bengal

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The geomorphological evolution of the lower deltaic Bengal within the western Ganga-Brahmaputra delta (GBD), is closely interlinked with the existence of dead and dying rivers. This dynamic landscape presents significant opportunities for geo-archaeological investigations, particularly of ancient riverine and estuarine settlements. Chandraketugarh, an important urban centre from around 2000 ± 500 years BP, located within the Bidyadhari-Padma paleo-distributary plain in the mature deltaic zone, lost its significance over time due to river relocations, making it a key site for understanding the impact of fluvial changes on human settlements. Despite extensive archaeological work, there has been a gap in understanding the region's fluvial dynamics and palaeo-geomorphological succession. The current study aims to reconstruct the past geomorphic landscape by analysing the depositional succession and fluvial imprints, spread across the landscape. The methodology involves geomorphological mapping and subsurface sediment analysis, focusing on grain size distribution and palaeo-environmental proxy elements. The depth-wise collected sediment samples had provided valuable insight into the depositionary history of this region, marking Holocene geomorphic environment. The arrangements of cut-offs and scroll pattern within the palaeo-meander bend region, revealed that the site remains well-preserved despite the dynamic shifting of past river course. A 3.5 km long physiographic section, associated with vertical sedimentary sequences across the meander bend confirmed the extent and direction of historical river shifts in the region.

Urban growth and its environmental impact - an analysis on groundwater resource and land subsidence in India

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India - the second largest populous country has significant environmental issues among which groundwater depletion is one of them. The groundwater resources are severely affected by its unplanned extraction and rise in urban population. Several parts of the country are prone to land subsidence especially the Gangetic belt due to expansion of built-up areas and geological features. The quality of the groundwater is equally important as that of the quantity. The requisite data have been obtained from various reliable sources. Missing data points were interpolated and verified by providing certain criteria. The correlation between Normalized Difference Built up Index (NDBI) and Normalized Difference Vegetation Index (NDVI) -0.7852 indicates that the areas with strong built-up index have low vegetation cover. Temperature and rainfall analysis of two decades unveiled an increasing trend in temperature and a decreasing trend in rainfall pattern. The result of Z test at 0.05% significance level is 2.67 > 1.96 the table value, show that there exists difference between land subsidence rates among high and low urban population in India. Such combination of expansion of built-up areas, unplanned extraction of groundwater, deforestation, reduction in soil binding capacity and infiltration rate has resulted in degradation of groundwater and many parts of India have become vulnerable to land subsidence. Understanding these dynamics and to restrict future deterioration of this important resource it is crucial for developing effective mitigation strategies on sustainable groundwater management practices and ensuring long term stability in the subsidence prone areas.

Large-scale classification and monitoring of water bodies' current health conditions - A study in Nadia, West Bengal

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Monitoring and mapping surface water quality are critical for achieving Sustainable Development Goals (SDGs) in both rural and urban areas. This study focuses on the water bodies of Nadia District, West Bengal, as a case study, aiming to map these water resources and assess their quality. Remote sensing and GIS techniques were utilized, incorporating four key indices. The Modified Normalized Difference Water Index (MNDWI) was employed to detect and map water bodies, while the Normalized Difference Turbidity Index (NDTI), Normalized Difference Chlorophyll Index (NDCI), and Normalized Suspended Material Index (NSMI) were integrated to calculate the Surface Water Clarity Index (SWCI), which assesses the health of these water bodies. Sentinel-2 satellite imagery (2023; 10m resolution) was used for the analysis. Through MNDWI, 50,520 water bodies larger than 10 acres were identified in the district. The SWCI further categorized these water bodies into 21,066 with high water clarity, 26,555 with moderate clarity, and 2,899 with low clarity or high turbidity. The findings demonstrate that (1) remote sensing is a cost-effective method for large-scale classification and monitoring of water bodies' current health conditions. Additionally, (2) restoration efforts for low-clarity water bodies using Nature Based Solution (NBS) could significantly contribute to achieving the SDGs.

An assessment of the environmental issues brought about by brick clin industry in parts of Nadia district with emphasis on air quality and human health: a geospatial approach

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Abstract: Brick clin industries increase environmental degradation, biodiversity loss, disbalance of ecosystem due to deforestation and depletion of natural resources. Industrial accidents in the brick kiln industries are a significant concern due to the hazardous working conditions and lack of adequate safety measures. Brick kiln workers are frequently exposed to high temperatures, machinery, and airborne pollutants. These accidents have broader consequences on loss of livelihood and increased healthcare costs for affected families. For assessment of environmental issues brought about by the brick kiln industry, Ghurni and Manikpara in Krishnagar block of Nadia district were selected as the study area. Remote sensing and GIS application were used to assess the level of gaseous components which are emitted from brick kiln industry. The coal used as fuel and electricity to burn the clay bricks enhance the amount of CO_2 and others gases and dust particles of sizes PM2.5 and PM10. Our findings show that the air quality of the industrial field is moderately polluted and harmful to human health and causes environmental damage. As the industry is situated near Jalangi River, the river is affected by aquatic eutrophication and acidification by discharges from this industry. To mitigate these risks, it is crucial to implement comprehensive safety protocols, enhance worker training programs, make safety management to protect environment and enforce strict regulatory oversight. Addressing these issues is essential for the sustainable development of the brick kiln industry and the well-being of its workforce.

Groundwater recharge discharge dynamics in quaternary alluvial aquifers of tropical river floodplains, eastern India, West Bengal

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Groundwater is a critical yet vulnerable resource essential for the survival and continuation of the legacy of the living world. Present study focuses on investigating the recharge-discharge anomalies and imbalance in groundwater equilibrium in the quaternary alluvial aquifers within a multibasin administrative unit composed of older and younger floodplains of varying geological ages, emphasising the critical need of sustainable groundwater development in the study area. The study focuses on the lithological modelling of the static water level fluctuation and groundwater depletion in response to the multiple driving forces, including abstraction of groundwater for irrigation, industrial and domestic purposes. The research integrates both primary and secondary data with on field measurement of static water levels (SWL) and groundwater drafts from hand tube wells, submersible pumps, shallow tube wells and other devices of groundwater abstraction. The groundwater recharge rate was estimated using several scientific methods, including the most prominent method of water-level fluctuation. The results revealed a significant spatial variability in groundwater recharge, ranging from 9,180 to 24,161 ham across different sub units (blocks) within the study area. The study deciphered a concerning trend of groundwater over-abstraction exceeding recharge rates in several areas, contributing to declining SWL and groundwater depletion. Furthermore, the stage of groundwater development exceeds safe limits in several areas, indicating significant mismatch. The study is crucial for tailoring water management strategies at the local level, advocating for changes in groundwater extraction practices, and promoting recharge interventions based on the area's hydrogeological characteristics to ensure long-term sustainability of groundwater resources.

Mapping dynamic reservoir bed topography changes owing to sediment deposition by integrating remote sensing, machine learning, and hydrographic survey techniques

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Soil erosion increases siltation in reservoirs reducing their storage capacity. Hence, monitoring the variation in reservoir bed topography due to varying soil erosion and deposition rates across India, especially under the changing climate is crucial. This study employs the optical-based satellite-derived bathymetry (SDB) technique to map depth variation in ungauged reservoirs. The innovative aspect of this study is to identify accurate variations of reservoir bed topography using satellite data. The main objectives of the present study are 1. Using the SDB technique to gauge the depth of water in a reservoir. 2. Formulating relationships between the depth of water and the band reflectance using state-of-the-art machine learning (ML) techniques. The Sentinel-2 surface reflectance band values are extracted at various echo-sounder surveyed locations using the Google Earth Engine (GEE) platform. Hence, various ML algorithms are employed to map water depth at ungauged reservoirs. The data obtained from RRI is used for training, testing, and K-Fold cross-validation. The best-performing ML model is used to determine the water depth at ungauged reservoirs. The study will help stakeholders and policymakers to develop proper water management strategies.

Land use transformation and subsidence risks: Geoinformatics insights from Joshimath's sinking landscape

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This paper adopts a problematizing review approach to examine the extent of land subsidence and its contributing factors within Joshimath, Uttarakhand. Land subsidence in Joshimath is a critical issue exacerbated by a combination of natural and human-induced factors. The town's location in a seismically active zone, along with its unstable geology, makes it particularly vulnerable to ground sinking. Employing geoinformatics and field survey data, the study assesses the impact of rapid land use transformation on structural stability across vulnerable neighborhoods. Subsidence has intensified in densely populated and high-tourism areas like Singhdhaar and Manoharbagh, where fissures exceeding 4 meters in width threaten both residential and commercial structures. The paper reveals that older buildings, lacking modern engineering standards, are disproportionately affected, highlighting a crucial link between subsidence risks and outdated construction practices. The findings highlight that unregulated construction and deforestation, along with Joshimath's unstable geological foundation of ancient landslide debris, worsen ground instability. Satellite imagery analysis reveals significant shifts in land use patterns, with escalating urbanization pressuring an already fragile landscape. These changes heighten subsidence vulnerability by altering drainage, increasing soil saturation, and destabilizing loose subsoil layers during heavy rainfall. In conclusion, the paper calls for integrated land use planning, stricter construction regulations, and continuous geospatial monitoring to mitigate further subsidence risks. Addressing the interplay between urban expansion and geological vulnerability is imperative for safeguarding Joshimath's infrastructure. This study advances our understanding of how land use changes intersect with geohazards, offering essential insights for sustainable urban management in disaster-prone regions.

Characteristics of avulsion in the braided Ganga River Channel, Haridwar, Uttarakhand

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Comprehensive understanding about characteristics of river channel avulsion plays significant role for land use planning along a river valley. Avulsion is a process of frequently diversion of a river channel. In the Himalayan foothill area avulsion is common fluvial features experienced by the riverbank dwellers. Unfortunately, the inhabitants hardly understand the mechanism of such process. The present work is an effort to illustrate the characteristics of river channel avulsion of the Ganga River in Haridwar. Several physical factors and anthropogenic interferences with river have influenced the varied characteristics of channel avulsion in the Ganga River in Haridwar, Uttarakhand. Extensive braided channel of the Ganga in Haridwar is characterized with different types of channel avulsion. Random and constriction types of avulsions are observed in different parts of the braided Ganga River by the researchers during vivid field survey. In Haridwar, length of the Ganga River is about 72.71km. with salient hydrogeomorphic expression of channel dynamics. In tarai zone magnitude of channel braiding and avulsion in the Ganga is maximum. Several villages located along the river Ganga are facing channel avulsion induced serious hydrogeomorphic problems. Events of foothill floods have enhanced the frequency and magnitude of channel avulsion. Since 1995 occurrence of major flood is increasing gradually, which will enhance the magnitude and frequency of avulsion. Several evidences, field recorded data, satellite data (LISS-III 2005, LISS-IV 2005, Google earth 2010, 2013,2022), topographic data (1967), GPS data, and change detection study of braided channel have been analysed in the work for understanding the characteristics of channel avulsion.

ABSTRACTS OF THE

SUBJECT AREA:
BOTANY

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Presenting author*

Effect of plant growth promoting *Rhizobacteria* (PGPR) on salt stress tolerance of *Capsicum annum* L.

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Plants in the genus Capsicum, which belong to the nightshade family Solanaceae, produce berry-fruits that are known as chili peppers. The most common species of chili pepper, Capsicum annum L., is grown for food, ornamentation, and medical uses among its approximately thirty distinct species. Due to its susceptibility to salt, Capsicum annum L., the plant that produces chilies, is adversely affected by salinity in both growth and yield. Its salt loss accounts for about 14% of its production. Twenty-three percent of all cultivated land, or more than 100 countries, are affected by soil salinisation, a serious agricultural issue and an abiotic stressor for plants. Promoting food production to fulfil rising food demands is one of the current issues facing the entire planet. Numerous strategies for enhanced performance in salt-affected environments may be developed with an understanding of the chili's reaction to salinity stress and its resistance systems. In order to mitigate the negative effects of salt stress and maintain soil fertility, plant health, and overall yield in an environmentally responsible manner, Plant Growth Promoting Rhizobacteria (PGPR) are used. This work explains the effects of salt stress on chili plants and how applying PGPR strains can help them recover.

Quantitative analysis of heavy metals in the roots of *Hemidesmus indicus* by AAS (atomic absorption spectroscopy)

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The elevated level of contamination of heavy metals in medicinal plants creates concerns regarding a wide variety of health risks. This study is based on the detection of heavy metal concentration in the root sample of *Hemidesmus indicus* (Indian sarsaparilla) an important traditional medicinal plant by AAS (Atomic absorption spectroscopy). The root sample was collected, dried, powdered, and digested using standard chemicals to prepare a filtered test solution. The sample was analyzed for its concentration of heavy metals in the filters Zinc (Zn), Chromium (Cr), Lead (Pb), Manganese (Mn), and Cadmium (Cd). The results observed Significant levels of Mn (mean concentration 1.038 mg/L) and Cr (mean concentration 1.089 mg/L), these metals are important for the nutrition value of the plant but their presence in this amount raises concerns about the toxicity risk, further presence of Cr raises concern regarding the harmful Cr (VI). Observed lower concentrations of Zn (mean concentration 0.369 mg/L) and Pb (mean concentration 0.424 mg/L) provided an account that these heavy metals are present in a safer amount. The detected level of Cd (mean conc. 0.012 mg/L) indicates no toxicity risk. This study illustrates the necessity of detecting the presence of these heavy metals and focuses on evaluating their persistence and long-term risks associated with these heavy metals in medicinal plants.

Transcriptome-based identification and validation of selected genes for *Macrophomina* tolerance in Sesame

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Sesame (*Sesamum indicum L*.) is a valuable oilseed crop. Its yield often becomes limited due to *Macrophomina phaseolina* infection, causing charcoal rot disease in the seedlings. The changing global climate, with rising temperatures and erratic climatic patterns, exacerbates the proliferation of this destructive fungus and enables its infestation. It necessitates the development of a superior sesame cultivars with increased charcoal rot resistance, accomplished through our innovative inter-specific hybrid (*S. indicum* x *S. mulayanum*). To capture transcriptomic responses to *M. phaseolina* infection, cultivated (*S. indicum*), wild (*S. mulayanum*), and inter-specific hybrid (R6) were considered for RNA-sequencing. We analysed some promising DEGs from the transcriptome dataset using RT-qPCR. The functions of these promising candidate genes were predicted by annotating them with the model plant Arabidopsis thaliana (Thale cress), based on conserved sequence similarities. We utilized bioinformatics tools to examine the subcellular localization and physical properties, such as isoelectric point (pI) and molecular weight (MW), of the promising candidate genes. Our integrated analysis of the disease susceptibility index alongside the expression levels of the candidate genes underscored the significance of genes related to cell wall structure, the phenylpropanoid pathway, and hydrolases. The expression patterns in the R6 indicated an elevated tolerance to charcoal rot. Further, we identified the crucial role of the Sesamum indicum cinnamyl alcohol dehydrogenase (SICAD) by genome-wide analysis of this gene. The findings will enhance our understanding of Sesame's defence mechanisms against the destructive fungus *M. phaseolina*.

Disrupting quorum sensing (QS) network in *Chromobacterium violaceum* by Epigallocatechin-3-gallate (EGCG)

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Quorum Sensing (QS) inhibition has become a promising strategy to fight bacterial infection since it inhibits pathogenesis without killing the bacteria. The present study has explored the anti-QS and anti-biofilm activity of Epigallocatechin-3-gallate (EGCG), a major phyto-constituent of green tea. EGCG showed a significant reduction in growth, biofilm production, violacein production, and swarming motility in *Chromobacterium violaceum* ATCC 12472 at different sub-MIC concentrations (25-100 µg/ml). EGCG also hampered the growth curve of *C. violaceum*. HPLC studies showed that at selected sub-MIC concentrations, EGCG also reduced the accumulation of C_6-HSL (n-hexanoyl-l-homoserine lactone), the autoinducer of the QS pathway in *C. violaceum*. Transcriptome analysis revealed differentially expressed genes (DEGs) in EGCG-treated bacterial cells. The DEGs mainly included quorum sensing, flagellar assembly, bacterial two-component system, ABC transporter, and secondary metabolite production genes. Quantitative RT-PCR analysis showed that EGCG significantly reduced the expression of QS-related genes (*cviI*, *cviR,* and *vioA*) in *C. violaceum*. This study promotes EGCG as an effective QS inhibitor, which could help develop anti-bacterial medications.

Plantation disparities as influencers in provisions of mangrove ecosystem services: A case study on *Bruguiera gymnorhiza*

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The major mangrove species *Bruguiera gymnorhiza* (L.) Lam., family – Rhizophoraceae, is in focus of this study amongst the rich floristic diversity of Indian Sundarbans. The species with an erstwhile wide distribution is reported to be dwindling in recent times. This habitat is characterised by extreme salinity, frequent flooding, tidal stress and muddy-hypoxic physiologically dry soil. *Bruguiera gymnorhiza*, as a response to the above and like other mangrove species exhibits significant morpho-anatomical and physiological adaptations as survival strategies. This species contributes to ecosystem services by significantly reducing coastal erosion by stabilizing sediments, dispersing wave energy, and reducing storm and high tide impacts among many other services. It is also one of the most preferred species for plantation activity in restoration of the degrading system. But several factors like inadequate tidal inundation, pollution, anthropogenic disturbance and over-crowded plantations cause decrease in stem growth, root growth, above and below-ground biomass and also cause leaf thinning which affects its coastal stabilization ability. A comparative account has been made between plant samples from a natural habitat with normal tidal inundation and without anthropogenic disturbance and plant samples that have survived under anthropogenic as well as, extreme pollution pressures. This study indicates the threats that influence mangrove health in terms of *B. gymnorhiza* and comments on importance of proper plantation strategy for sustainable mangrove restoration.

Estimation of ascorbic acid content of some human dietary food and its correlation with the human dietary reference intakes

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Ascorbic acid is the alternative name of vitamin C. In Humans, many diseases like scurvy and the common cold are prevented by ascorbic acid. Our study estimates the ascorbic acid content of some human food by the DCPIP titration method. we collected five types of human consumables such as 16 different fruits, six medicinal plant leaves, five pulses and seeds, 12 spices and 23 different vegetables. Out of the five categories of human dietary food, ascorbic acid is more abundant in fruits and some vegetables. Some of the dry fruits even contain less amount of ascorbic acid than fresh fruit. The pulses, seeds, and spices also contain less amount of ascorbic acid. The values of ascorbic acid range in fruits 2.57-79.24 mg/100g, medicinal plant leaves 3.33-73.33 mg/100g, pulses and seeds 2.57-5.89 mg/100g, spices 2.56-7.94 mg/100g and in vegetables 2.31-71.55 mg/100g. The study estimates the amount of daily consumption of ascorbic acid in humans. The high (Upper Intake Level) and low (Inadequate Intake Level) amount consumption of ascorbic acid can create several human diseases. So, to maintain the Recommended Dietary Allowance (RDA), it is essential to know which food contains how much ascorbic acid. From the Dietary Reference Intakes (DRIs) chart, we get the RAD and UL values of different age classes. If we know the amount of ascorbic acid contained in human dietary food, then we can maintain the RAD and UL per day, which will be helpful for humans to maintain good health and prevent several diseases.

ABSTRACTS OF THE

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ZOOLOGY

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Assessment of potentiality of tartrazine in promoting liver damage in *Oreochromis niloticus*

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Tartrazine, also known as E102, is a synthetic yellow food dye with a molecular weight of 534.3 g/mol. It is used extensively in the food and beverage industry to impart a vibrant yellow or orange color to a wide range of products, including candies, soft drinks, snacks, and processed foods. Tartrazine is also a chemically proven strong mutagen and carcinogen. Thus, with the frequent use of tartrazine commercially, a huge amount of left-over stale foods as well as processed by-product liquids from kitchens are discarded into local streamlines on a regular basis thereby causing tartrazine contamination of these local aquatic water bodies. Tartrazine contamination in aquatic water bodies may disrupt ecosystems, affecting water quality, aquatic organisms, and biodiversity. It could lead to altered behavior, bioaccumulation, and potential toxicity, impacting the entire food chain. Long-term persistence and degradation issues could further amplify these ecological concerns. Monitoring, research, and regulatory measures are essential to understand and mitigate the potential adverse effects of tartrazine on aquatic environments. Given the potential health effects of tartrazine; the present work thus focuses on the toxic effect of tartrazine on an experimental animal model-in this case fish: Oreochromis niloticus. Findings from the study will reflect the toxic effect of such a widely used synthetic food colorant on the histopathology in the liver of the fish. The data then can be extrapolated and used as reference to further investigate the actual effects of the food colorant on the human population.

Spathodea campanulata, a hidden gem for pollinator conservation

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Spathodea campanulate commonly known as the flame of the forest, is a tropical tree renowned for its vibrant flowers and ecological significance. This study explores its potential as a pollinator attractant and its Brix value. We conducted field observations to assess the floral characteristics and nectar content of *Spathodea campanulate*. Our findings indicate that the bright orange-red flowers are highly attractive to a diverse range of avi-fauna including 12 species which play a crucial role in maintaining biodiversity and ecosystem health. The nectar content revealed a high brix value range between 42% to 70.2% and represent Ph value 9, making it a food source for these organisms and also dual role in supporting pollinator populations and providing nutritional benefits. *Spathodea campanulate* presents an opportunity for agroforestry and sustainable management practices. Its cultivation could enhance biodiversity, support local ecosystems, and offer additional resources for both wildlife and human communities. This research underscores the importance of integrating native species like *Spathodea campanulate* conservation and agricultural strategies to promote ecological resilience and sustainable development. Future studies should focus on the long-term impacts of cultivating *Spathodea campanulate* on pollinator health and local ecosystems.

Morphological insights into the antennal sensilla of true fruit flies (Insecta: Diptera: Tephritidae) – Novel study from the Gangetic Plains of West Bengal, India

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The study of sensory structures in insects is important for understanding the ecological interactions, evolutionary biology and applications in pest management. Antennae, which play a critical role in olfaction and mechano-sensation, are essential for navigation, mating and foraging. True fruit flies (Diptera: Tephritidae) pose as significant agricultural threats due to their ability to cause damage on fruits and vegetable crops worldwide. Despite their ecological and agricultural significance, detailed morphological analyses of Tephritidae antennae is limited. The present study is focused on the antennae structure of Tephritids, collected from various host plants of Gangetic plains of West Bengal, India. We used scanning electron microscopy (SEM) technique to elucidate the morphological variations in the antennae and sensilla for the collected Tephritidae species to correlate structural features with sensory function. A total of five morphologically different types of sensilla were identified namely microtrichial sensilla, sensilla basiconica, sensilla coeloconica, sensilla trichoidea and sensilla chaetica. Significant differences in the length and diameter of these structures were observed. Our results indicated that variations in antennal morphology are closely linked to the specific ecological niches occupied by different species within the family. This is the first-time study from West Bengal reporting antennal sensilla structure, abundance and distribution of Tephritid species. Our novel findings are important towards understanding the sensory mechanisms of Tephritidae. This may play a pivotal role for developing olfaction-based targeted pest management strategies. By potentially reducing reliance on chemical pesticides, this will be a significant approach towards promoting biodiversity conservation efforts through sustainable agricultural practices.

Effect of soil edaphic factors on diversity of collembola in anthropic grasslands of Medinipur, West Bengal, India

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Edaphic factors refer to the physical, chemical, and biological characteristics of soil that influence the diversity, distribution, and health of organisms, particularly soil mesofauna and plants. These factors are crucial components of a habitat and can directly impact the ecosystem. By interacting with climatic, topographic, and biological elements, edaphic factors play a significant role in shaping overall ecosystem dynamics. The influence of these factors on Collembola diversity in anthropic grassland (floricultural field) is not fully understood. Collembola, are essential for maintaining healthy soil ecosystems due to their involvement in ecological processes such as decomposition, nutrient cycling, aeration, fungal control etc. The abundance of springtails is closely associated with edaphic factors like temperature, pH, moisture, electrical conductivity, organic carbon content, nitrogen, phosphorus, and potassium. This study investigates the effects of edaphic factors on Collembola diversity in floricultural field in East Medinipur, West Bengal, India. Soil samples were collected and analyzed for temperature, moisture, electrical conductivity, organic carbon, and nutrient availability (nitrogen, phosphorus, potassium) using standard laboratory methods. Collembola were extracted from soil using an aspirator and modified Tullgren funnel. Statistical analyses were performed using R programming and PAST software. Results indicated that edaphic factors significantly impact the abundance and diversity of Collembola communities. Principal component analysis and diversity indices highlighted the role of nutrient gradients, particularly phosphorus, potassium, and nitrogen, in shaping Collembola biodiversity in these anthropic grasslands. In conclusion, this study emphasizes the critical role of edaphic factors in maintaining Collembola diversity, underlining their importance in healthy soil ecosystems.

Assessing aquatic beetle diversity (Coleoptera) in relation to physiochemical parameters of the coastal region of Purba Medinipur, West Bengal, India

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Freshwater insects, particularly aquatic beetles, play a vital role in aquatic ecosystems, contributing to nutrient cycling, primary production, and material transport. This study aimed to document the diversity and distribution of aquatic beetles in the brackish water habitats of the coastal region of Purba Medinipur District, West Bengal. The research was conducted from August 2023 to September 2024, focusing on measuring various physicochemical parameters such as pH, salinity, total dissolved solids (TDS), and electrical conductivity (EC). Collections were made using D-shaped aquatic insect nets. A total of 18 species belonging to three families (Dytiscidae, Hydrophilidae, and Noteridae) under the order Coleoptera were identified, with the family Hydrophilidae exhibiting the highest species richness among the recorded families. *Canthydrus laetabilis* was the most abundant species in conditions pH 12 and 15‰ salinity. The study revealed that species richness peaked at a water pH of 9, showing a significant decline at pH 12. Similarly, species richness was highest at a salinity level of 5‰ and decreased sharply when salinity rose to 15‰. These findings indicate that specific pH and salinity levels may influence the distribution and diversity of aquatic beetles in brackish water ecosystems. Further long-term monitoring and investigations are recommended to understand the ecological roles and dynamics of these beetle families in the studied environment.

Larvicidal activity of crude leaves extracts of two medicinal plants *Enhydra fluctuans* (Family: Asteraceae) & *Bauhinia picta* (Family: Fabaceae) for the control of mosquito vectors of filariasis & dengue

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Mosquitoes spread many life-threatening diseases. Plants become the alternative sources to control mosquitoes as an eco-friendly way. The present study was carried out to evaluate the larvicidal activities of aqueous crude extracts of *Enhydra fluctuans* and *Bauhinia picta* leaves against filariasis and dengue vectors. Larvicidal activities of these medicinal plants' crude extracts were studied in the range of concentrations (500 ppm, 1000 ppm, 4000 ppm, 5000 ppm, 6000 ppm) against late 3rdinstar larvae of *Cx. quinquefasciatus* & *Aedes aegypti*. About 100% mortality took place between 4000 ppm to 6000 ppm after 48 hours of treatment. The toxic effect of leaf extracts against the larvae having the average values of LC_{50} = 1239.74 ppm. The mortality data were recorded to probit analysis to determine the lethal concentrations of the respective vectors. Morphological and histological damages upon exposure to crude extracts were recorded with optical microscopic, stereozoom, scanning electron microscopic and histological images. The similar treatment was done for the non-target organism; Guppy fish (*Poecilia reticulata).*

How Ditch Jewels overtake others in the race?

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Brachythemis contaminata (Fabricius, 1793) [Common Name: Ditch Jewel] is a dragonfly of family Libellulidae distributed throughout India and probably the most successful dragonfly to breed in both rural and urban waterbodies, known to survive in polluted waters to some extent, hence getting the species name. Being a common species all around *B. contaminata* can be a very good option as bio-control agents for mosquitoes and flies breeding in water. In search of an answer, why ditch jewel is more successful than other species? we conducted the study in different parts of Howrah to understand the Sex Ratio, Intra and Interspecific interactions among the colonies, territoriality, daily activity patterns, mating and oviposition behavior etc. The study showed that Ditch Jewels were dominant in water bodies with less vegetations and high human interference whereas waterbodies with more vegetations and less human interference have less ditch jewels associated with several other species; hence, higher diversity. Ditch jewels also exhibit a nearly 1:1 sex ratio though the males prefer to stay close to water and females slightly away. Despite having higher species density within the communities, ditch jewels show very less aggressive interaction with conspecifics and to other species as well, which indicates presence of non-territorial males. Though we have recorded a sudden rise in the territorial fights between males in the afternoon which somewhat correlates with the oviposition events by the females. This indicates that the ditch jewels choose to be territorial only in presence of potential mates and show rare mate-guarding behavior.

Impact of neonicotinoid pesticides on honeybee molecular physiology and mitigation through hydrogel supplementation

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Honeybees (*Apis mellifera*) are very essential pollinators, and their populations are declining; this is primarily due to exposure to neonicotinoid pesticides. These neurotoxic compounds target nicotinic acetylcholine receptors (nAChRs) that lead to neurophysiological dysfunction, impaired foraging behavior, and colony collapse disorder (CCD). The overproduction of reactive oxygen species (ROS) leads to cellular and molecular damage in honeybees. Hydrogels, due to their high water retention and biocompatibility, can serve as effective carriers for antioxidants such as vitamin C, vitamin E, and flavonoids. Our aim is to assess the molecular physiological damage caused by neonicotinoids and also investigate hydrogel supplementation as a mitigation strategy against it. The hypothesis is that hydrogel enriched with antioxidants can reduce neonicotinoid-induced oxidative stress and enhance detoxification processes. Honeybees that are exposed to neonicotinoids can be studied using gene expression analysis of antioxidant enzymes and biochemical tests for oxidative stress markers, followed by hydrogel treatment. Hydrogel as a potential protective agent improves antioxidant capacity and reduces oxidative damage. This research highlights the need for accessible solutions like hydrogel to counteract neonicotinoid toxicity and protect essential pollinators for sustainable agriculture and ecosystems.

First report of microplastic detection and characterization from the riverine system of three famous tourist spots of Sundarban Delta Region

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The Sundarbans estuarine system, the world's largest delta and a UNESCO World Heritage Site, faces significant environmental challenges from human activity, particularly microplastic (MP) pollution. This delta is formed by the confluence of the Ganges, Brahmaputra, and Meghna rivers, which annually carry millions of tons of plastic waste into the Bay of Bengal. Sources of MP include industrial discharge, agricultural runoff, tourism, and cyclonic events, exacerbating pollution in this ecologically critical region. Mangroves, serving as natural filters, trap these pollutants, impacting local biodiversity. Water samples were analyzed using ATR-FTIR to detect MPs, while seasonal assessments of physico-chemical parameters (pH, dissolved oxygen, temperature, etc.) provided insights into water quality and its influence on MP distribution. The ATR-FTIR interferogram revealed the presence of various synthetic polymers, including nylon, polystyrene (PS), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polypropylene (PP), and polyethersulfone (PES), indicating a high level of contamination. In Godkhali, nylon accounted for 18.38% of the particles identified, followed by 12.58% PVC and 12.0% PS, along with traces of PET and PES. At Dobanki, nylon was the most abundant at 28.93%, with PS at 24.39%, and additional amounts of PVC, PET, and PES. In Netidhopani, nylon made up 44.80%, while PS contributed 20.15%, alongside significant levels of PET, PVC, and PP. These findings underscore the importance of continuous water quality monitoring to preserve this unique ecosystem. Human activities like tourism and urbanization further degrade the area, emphasizing the need for stricter waste management and sustainable practices.

Foraging behaviour strategy of *Camponotus compressus* and *Oecophylla smaragdina* ants in semi-arid area of West Bengal

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This study investigated the foraging behaviour of *Camponotus compressus* and *Oecophylla smaragdina* ants in response to various food items such as food fragments (biscuit, dried fish, dead mosquitoes, and prawn heads) were placed 20 cm from their nests for 20 trials each. *Camponotus compressus* ants exhibited a solitary foraging strategy, carrying self-manageable food items of varying sizes independently. However, *Oecophylla smaragdina* ants employed a cooperative approach, waiting for their nest-mates to join before fragmenting larger food items and transporting them individually. These findings suggest distinct foraging strategies between the two ant species, likely influenced by factors such as colony size, nest structure, and food resource availability. Additional research is needed to understand the ecological implications of these behavioural differences.

The role of ecology in supporting economic growth: An interdisciplinary approach to sustainability

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Ecology and economy are intrinsically linked, with healthy ecosystems providing essential services that underpin economic growth and human well-being. This paper explores the role of ecological systems in supporting sustainable economic development, focusing on the interdisciplinary approaches needed to harmonize environmental conservation with economic activities. Key ecosystem services—such as carbon sequestration, water purification, soil fertility, pollination, and biodiversity—play a critical role in agriculture, tourism, fisheries, and disaster risk reduction, driving productivity across sectors. Through case studies including Costa Rica's Payment for Ecosystem Services (PES) program, the economic benefits of the Great Barrier Reef, and mangrove restoration projects in the Philippines, this research highlights how ecological investments generate economic returns while enhancing resilience to climate change. The paper emphasizes the importance of integrating ecological principles into economic policies, such as adopting market-based mechanisms like carbon markets and conservation credits, to promote sustainable growth. It calls for an interdisciplinary approach that combines economics, environmental science, and policy to design solutions that maintain ecosystem health while fostering economic prosperity. This approach not only ensures environmental sustainability but also strengthens the foundations for long-term economic resilience.

Nanodrug impregnated hydrogel promotes scarless wound healing by reprogramming phase transitions through its redox buffering capacity in preclinical mouse model: A special reference to water dynamics of hydrogel

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Traumatic burn injuries, chronic ulcers, and chronic wounds accompanying metabolic abnormalities are regarded as some of the most significant global public health issues. Ineffective drug distribution, inappropriate dose timing during different healing stages, and scar formation make it difficult to effectively reprogramme the healing of chronic wounds. In this study we have shown how an indigenously made chitosan hydrogel containing citrate capped nanoparticles (nanogel) may be used for redox balancing. The reactive oxygen species are involved at every stage, including haemostasis, inflammation, and proliferation, which culminate in full maturation for scarless wound healing. The tropical application of the hydrogel on pre-clinical murine model (*Swiss albino*) of excisional wound shows the role of numerous signalling proteins and molecular markers. The effectiveness of redox buffering potential for the entire wound healing process is revealed by the histopathological analysis, expression of cytokines i.e. IFN-γ, IL-12 as well as α-SMA protein. We have used SEM, EDAX mapping for physiochemical characterisation of nanodrug impregnated hydrogel. The pH regulated dynamic redox buffering potential has been evaluated through spectroscopic studies. We demonstrated that our nanodrug-hydrogel can perform redox buffering dynamically based on pH of the wound microenvironment. The pH of the wound microenvironment will therefore serve as a sensor, and our nanodrug-hydrogel will perform the redox buffering functions in accordance with the pH. We also evaluated the dynamics of different types of water present within the hydrogel. It will be helpful for development and fabrication of customized hydrogels for the treatment of different diseases.

Estrogen induced Hepatotoxicity in cases of frozen embryo transfer cases of IVF

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'In Vitro Fertilization' (IVF), a process of assisted reproductive technology, revolutionizes the field of reproductive medicine by treating couples with various reproductive failures. IVF procedure particularly the Hormone Replacement Therapy (HRT) introduces several hormonal burdens to mimic the physiological hormonal conditions to the would be mother starting from ovarian stimulations. Following which steroidal supplementation like estrogen for the preparation of the properly thick endometrium for embryo implantation and progesterone and hCG treatment done for the maintenance of pregnancy and to avoid further complications. Steroid hormone supplementation has reportedly remained associated with hepatotoxicity. Hepatoxicity is primarily caused due to oxidative stress arising during xenobiotic metabolism of the estrogen thereby producing toxic metabolites which generates Reactive Oxygen Species, interferes with bile homeostasis and affects other factors. Patients, prescribed with synthetic estrogen supplementation with standard dose regime of 2 mg/day from Day 2-4; 4 mg/day from Day 5-7 and 6 mg/day continuing upto Day 28 or more as per protocol and which is absolutely essential for making the endometrium thick enough to support a pregnancy were found to have elevated SGPT, SGOT, ALP and hepatic triglyceride levels along with Catalase and Superoxide Dismutase. Total antioxidant markers of serum were also found significantly altered. So, the unavoidable step in IVF procedure can become a potential threat to the would be mother.

Activation of FoxO-miR21-FasL axis in neurodegeneration relevant to Parkinson's Disease

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Parkinson's disease (PD) is the second most common neurodegenerative disease resulting from the selective loss of dopaminergic neurons in SNpc region of midbrain. Neuronal apoptosis involves transcriptional activation of pro-apoptotic genes in various neurodegenerative diseases. Increasing evidence suggests that FasL plays an important role in apoptotic cell death. The present study was aimed in understanding the role and regulation of FasL in PD. Using 6-OHDA treated neuronal PC12 as model we found significant up regulation of FasL both in transcript and protein level. siRNA mediated knockdown of FasL significantly protects neuronal cell in PD model indicating its necessary role in PD relevant neurodegeneration. We reported that transcription factor FoxO3a is activated in PD and FoxO under certain situation may regulate FasL. Thus, we intend to investigate whether FasL is regulated by FoxO in PD model. We could successfully show that siRNA mediated down regulation of FoxO3a blocks 6-OHDA induced upregulation of FasL. We also found a reduction of microRNA21 in PD model. We found that Fox negatively regulates mir 21, which in turn negatively regulates Fas L. In summary, our result indicates that FasL plays necessary role and FoxO-miR21-FasL axis is activated in PD related neurodegeneration.

Association of Ants with invasive Mealybugs (*Phenacoccus solenopsis* Tinsley) in Ashwagandha (*Withania somnifera* L.) plant

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The association between ants and mealybugs (*P. solenopsis* Tinsley) plays a critical role in the pest proliferation and plant damage. This study, conducted in biodiversity garden and entomology laboratory of University of Kalyani, focuses on black ants (Formicidae) and their interactions with mealybugs, particularly in transferring mealybug crawlers because they are sluggish in nature (many times covered entire life cycle). Mealybugs (Pseudococcidae) are soft-bodied, sap-sucking insects with waxy secretions, and their morphology facilitates their movement and attachment to plant hosts. Their limited mobility makes them reliant on external factors, such as ants, for dispersion. The investigation observes that black ants frequently visit infested Ashwagandha plants (*W. somnifera* L.), attracted mainly to the honeydew secreted by mealybugs, which is rich in sugars. Ants protect mealybugs from predators and parasites in exchange for this sugary exudate, forming a mutualistic relationship. The number of ants visiting plants and the frequency of crawlers of mealybugs transfer per ant are also analyzed to understand the extent of mealybug dispersal facilitated by ants. The negative impacts on plants include stunted growth, yellowing, and in severe cases, plant death due to excessive sap extraction. This study highlights the critical role ants play in mealybug survival and distribution, contributing to the agricultural significance of this pest-ant association and the need for effective pest management strategies.

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Presenting author*

Leishmania GP63 targets the macrophage miR-122–hepcidin pathway to alter Nramp1 levels for efficient iron acquisition

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Natural resistance associated macrophage protein 1 (Nramp1), a macrophage phagolysosomal iron transporter, is critical for resistance against intracellular pathogens like Leishmania. We previously observed a significant downregulation of Nramp1 in L. major infected macrophages, accompanied by a substantial increase in phagolysosomal iron levels. This rise in iron was strongly correlated with high parasite burden, suggesting Nramp1 plays key role in regulating iron availability to control Leishmania survival. In our follow-up study, we observed that Nramp1 downregulation also occurs in uninfected macrophages treated with Leishmania conditioned medium (LmCM), resulting in elevated phagolysosomal iron levels. These intriguing data indicated a possible involvement of Leishmania secretory factor in mediating Nramp1 downregulation. Furthermore, heat and trypsin treatments of the LmCM abolished this effect, indicating that the secretory factor is likely a protein secreted by the parasite. Since GP63 is abundant protein in the Leishmania secretome, we treated LmCM with its inhibitors, EDTA and 1,10-phen, and found that the treated LmCM failed to downregulate Nramp1, suggesting that GP63 may be responsible for the downregulation of Nramp1. Further using LmGP63-/- strain, we confirmed that GP63 drives Nramp1 downregulation. We also found that GP63 promotes Nramp1 degradation via the ubiquitin-proteasome pathway by upregulating hepcidin, linked to GP63-mediated DICER1 downregulation, which affects Pre-miRNA-122, a negative regulator of hepcidin. In vivo, BALB/c mice infected with LmWT/LmCas9 strains showed Nramp1 downregulation, while LmGP63-/- infections did not affect Nramp1, hepcidin, or Dicer1 levels. These findings reveal a novel mechanism by which Leishmania GP63 downregulates Nramp1, enhancing the parasite's survival within macrophages.

Unravelling mungbean yellow mosaic India virus (MYMIV) and its satellite complexes: 3D structural modelling and functional insights into viral pathogenesis

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Mungbean yellow mosaic India virus (MYMIV) is a serious pathogen affecting legume crops, causing significant yield losses. The DNA and DNA B of MYMIV, along with its satellite complexes, uses some complex mechanisms to infect host plants and by-pass their immune responses. This study focuses on 3D structural modelling of MYMIV proteins and associated satellite molecules to gain insights into their role in viral pathogenesis. Computational tools such as Protein Homology/analogy Recognition Engine v. 2.0 (Phyre 2.0); PSI-PRED; InterPro; I-TASSER, Alfafold etc. were employed to model the 3D structures of key viral proteins responsible for replication, movement, and pathogenicity, followed by functional domain analysis. The study further explored interactions between MYMIV proteins and host factors, as well as the role of satellites in modulating viral infection. Structural modelling revealed essential features of MYMIV proteins, including conserved motifs crucial for viral replication and manipulation of host defences. The satellite molecules were found to play a significant role in enhancing viral pathogenicity, possibly contributing to its ability to overcome host immune responses. This comprehensive structural and functional analysis of MYMIV and its satellite complexes has provided new insights into the molecular mechanisms governing viral infection. These findings highlight potential targets for developing resistant legume varieties and offer a deeper understanding regarding viral interactions with its host to drive disease progression. The research was aimed to develop sustainable management strategies for controlling MYMIV in affected black gram.

CUEDC2 down-regulation: A strategy to enable endocrine therapy in HR-negative breast cancer

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The protein CUEDC2 has been reported to degrade the hormone receptors for estrogen (ER) and progesterone (PR) in breast cancer. Breast cancer management is largely guided by hormone receptor (HR) status, with endocrine therapy commonly used to target HR-positive (HR+) tumors. CUEDC2 is over-expressed in hormone receptor-negative (HR-) breast cancers, reducing endocrine therapy efficacy. This study investigates the role of elevated CUEDC2 expression in breast cancer patient survival and explores CUEDC2 downregulation as a potential therapeutic strategy. Breast cancer tissue analysis revealed poorer overall survival in patients with high CUEDC2 expression. TCGA data and multivariate Cox regression confirmed clinicopathological associations. Targeting CUEDC2 stably in MDA-MB-231 cells restored ERα functionality, which was validated by qPCR, ChIP qPCR, Western blot, and luciferase assays. CUEDC2 transient knockdown combined with Tamoxifen reduced cell proliferation and migration in colony formation and scratch wound healing assays. Initially we developed a library of 95 FDA approved FDA-approved small molecule inhibitors (SMI). Following that, we used protein structure prediction and computational docking to identify one SMI candidate that specifically targets CUEDC2's ubiquitin-binding motif. The binding of the SMI to the CUE domain of CUEDC2 might in turn be effective to reduce Erα degradation ultimately restoring the endocrine signaling, which could then be used to our advantage by using a combinatorial approach of SMI and endocrine therapeutic. Through our research, we aim to highlight and explore the potential therapeutic strategy of targeting CUEDC2 to enhance the effectiveness of hormone therapy in breast cancer.

A low-cost immersion culture system for *in vitro* propagation of *Limonium* in a mesh raft with a wire stand

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To reach sustainable development goals during drastic global climate changes, it is a major task to find out the suitable plant species that can tolerate harsh climatic conditions like salts and droughts. The florist plant *Limonium* originated in the Mediterranean region and can be suitable to grow in salt marshes and agricultural drought conditions, especially in the districts of South 24 Parganas, Midnapore, Birbhum, Bankura, and Purulia. As the *Limonium* plants are recretohalophytes, they can also be cultivated in other districts of the state. Though *Limonium* has huge potential, the availability of planting materials is very scarce in our state because most of the cultivated *Limonium*s are heterozygous and propagated mainly through micropropagation. High production costs are the major constraint for the popularization of this technology. Agar is one of the costliest components in the plant culture medium. To reduce the cost and labor involvement, the current protocol employs an immersed liquid culture medium on a flexible aluminium mesh raft with a wire stand to facilitate shoot organogenesis from root explants in a half-strength Murashige and Skoog's (1962) basal medium (MS) supplemented with 1.6µM NAA and 1.1µM BA. A full-strength liquid MS medium that contains 0.44µM BA and 1.07µM NAA was standardized for shoot multiplication and simultaneous root formation from cultured shoots. The protocol produced an average of 4–5 rooted plants per shoot, which were further hardened in controlled greenhouse conditions. The true-to-type nature of the regenerated plants was confirmed by ISSR analysis.

Protein structure modulation by microplastic – a new route of neurodegeneration

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Being nearly invisible, the power impact of microplastics is inversely proportional to their size. By 2025, it is predicted that the amount of plastic waste generated will reach about 250 million metric tons, further taxing the mechanisms to manage plastic waste. Studies have shown that microplastics can enter the human body by ingestion, inhalation, and dermal contact, thereby establishing an intracellular crosstalk, emanating from which are various pathophysiological conditions. This study aims to understand the interaction of Terephthalic acid with Serum protein, emphasizing its ability to induce any conformational change in the hierarchy of protein micro-environment and biophysical characterization of the protein-ligand complex, delving into its thermodynamic, hydrodynamic, and calorimetric properties. UV–Visible and Fluorescence spectroscopic studies performed agreed with the in-silico analysis, which reported Van der Waal's, hydrogen bonding and hydrophobic force of attraction on the spontaneous formation of a ground-state complex with BSA and HSA. Being the most abundant and investigated serum protein, the molecular information regarding the type of interaction, binding site, binding energy, affinity, change in the microenvironment and polarity, binding kinetics, and dynamics. Moreover, further analysis of the thermal stability and visco-elasticity of the complex will provide insight into the degree of toxicity in humans. Additionally, this study will also shed light on the mechanism of protein modification leading to aggregation paving the way for a novel approach in the determination of its ability to cross the blood-brain barrier and associated neurodegeneration which has not been reported yet.

Comparative molecular diagnostics and treatment strategies for polycystic ovarian syndrome (PCOS)

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Polycystic Ovarian Syndrome (PCOS) is a prevalent endocrine disorder among women of reproductive age, marked by hormonal imbalances, irregular menstruation, and polycystic ovaries. Despite its widespread occurrence, diagnosing and treating PCOS remains complex due to its diverse manifestations. This study compares molecular diagnostic methods and treatment strategies to enhance personalized management of PCOS. Advances in molecular diagnostics, including genetic testing, hormone assays, and biomarker analysis (such as anti-Müllerian hormone and insulin resistance markers), enable earlier and more precise diagnoses than traditional symptom-based approaches. Key diagnostic markers like FSHR and INS gene variants, identified through molecular techniques, shed light on the genetic and metabolic aspects of PCOS. Treatment approaches for PCOS are equally varied, ranging from lifestyle modifications and hormonal treatments to insulin-sensitizing medications like metformin. The analysis reveals that personalized treatments, informed by molecular diagnostics, are more effective in addressing PCOS's underlying causes, such as hyperandrogenism and insulin resistance. In conclusion, molecular diagnostics allow for more accurate identification of PCOS subtypes, enabling customized treatment plans. This integration of diagnostics with individualized therapies can improve patient outcomes and enhance the quality of life for women with PCOS, providing a pathway for more effective management.

Potential antibiofilm effect of biogenic ZnO nanoparticles using catharanthus roseus flower extract

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The incompetencies of antibacterials can be evaded by ZnO nanoparticles (NPs) as it can deliver higher bactericidal potential alongside being economical, biocompatible, and eco-friendly. The current study pivots around using ethnobotanically important yet underutilized C. roseus flowers for the biogenic synthesis of ZnO NPs and displays them as a potential antibiofilm agent. The producibility of the NPs was characterized via ultraviolet-visible spectroscopy, X-ray diffraction, Fourier transform infrared (FTIR), energy dispersive X-ray analysis, field emission-scanning electron microscopy (FE-SEM) and zeta potential analysis. Meanwhile, the phytocompounds and phyto-elements were identified using Gas Chromatography Mass Spectrometry, X-ray fluorescence and FTIR analysis. These were screened for in-silico toxicity using SWISSADME, ProToX-3 and BeeTox web tools. In vitro, antibacterial studies against S. aureus ATCC 23235 and P. aeruginosa ATCC 10145 showcased repressions in cell's potential and growth; and inhibition of initial adhesion of cells. Additionally, the antibiofilm study included a crystal-violet assay, cell revival study, viability analysis using flow cytometry, FTIR analysis of extracellular polymeric substances of biofilm and morphological alterations detected using SEM. The intricacies of biofilm-NP interaction have also been studied and verified over the different experimental setups. Therefore, the ease of synthesis of ZnO NPs from C. roseus flower extract delivers viable antibiofilm activity and can be propelled for diverse applications in biomedical sciences.

Medi-guardian: A multifunctional biomedical box for medication adherence, patient monitoring, and remote family care

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To help with medication adherence and patient monitoring, we are creating a biological box. This device maintains a current pharmaceutical datasheet including previous intake, dosage, and regimen. It features a voice alarm system that reminds the user to take their medication at the appropriate times, as well as a camera module that records brief videos of drug administration. The device will play voice reminders every five minutes until the medication is taken. It notifies authorized family members via email if a medication is missed. Additionally, picture analysis combined with AI and machine learning algorithms can be used to identify the person giving the drug. The system notifies the registered email account if the user is a nurse, family member, or other authorized person. An unauthorized individual or intruder is not allowed to administer medication. Additionally, we created a website that allows patients and physicians to log in. Doctors may monitor patient data, add and remove medications, and manage prescriptions. Patients can examine their prescription schedule and make changes to their blood sugar readings by logging in. This comprehensive solution aims to improve medication adherence and enable remote patient monitoring for timely support.

Beta vulgaris extract ameliorates diabetic peripheral neuropathy by enhancing nerve function and glycemic control in diabetic rats

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Diabetic peripheral neuropathy (DPN) is a common and severe complication affecting 35% to 45% of type 2 diabetic patients. While recent therapy mostly focuses on the management of hyperglycemia, no effective therapies exist for DPN itself. Attributed to their natural origin and minimal adverse effects, herbal medicines play a significant role in diabetes care. Beta vulgaris (BV) has antidiabetic properties, however its impact on DPN remains unexplored. The present study aims to elucidate the effects of BV on DPN progression in animals. Chemical examination of the aqueous extracts of BV was evaluated with HPLC and AAS, followed by the evaluation of behavioral parameters (somatomotor activity and pain threshold), biochemical parameters (blood glucose, insulin, glycosylated hemoglobin (HbA1c)), and nerve conduction velocity (NCV) in diabetic rat models. BV was found to contain significant amounts of chlorogenic acid, gallic acid, and Vitamin C. Behavioral studies revealed prominent improvement in somatomotor activity and pain threshold in BV-treated DPN rats. The test drug significantly lowered blood glucose and HbA1C levels and improved insulin level following therapy, confirming their effectiveness in glycemic control. NCV, a measure of neuropathy, was found to be nearly 39 m/sec in sciatic nerve of normal rats. It was slowed down by 15.3% and 56% in diabetic animals within 12 week and 24 week, respectively. The test drug enhanced NCV thereby restoring nerve function and preventing DPN. The present study thus highlights the role of BV in ameliorating behavioral, biochemical, and nerve conduction parameters, suggesting its potential role in preventing DPN progression.

AI-assisted modelling of clinical and genetic data for early diagnosis of neurodegenerative disorders

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Neurodegenerative disorders are characterized by progressive loss of neuronal function, often resulting in severe disability over time. Early diagnosis is essential for effective management and improving patient outcomes. This study presents an Artificial Intelligence (AI) and machine learning (ML)-based approach for early diagnosis of neurodegenerative disorders by integrating clinical, genetic, and imaging data. We utilized large-scale clinical datasets, such as UK Biobank, dbGaP, and the European Genome-Phenome Archive (EGA), combined with genetic and transcriptomic information, as well as neuroimaging data, including functional MRI (fMRI) images. Statistical modelling and ML algorithms, such as random forests and neural networks, were employed to identify key clinical parameters and biomarkers associated with different neurodegenerative conditions. Natural language processing (NLP) was applied to extract relevant information from unstructured clinical records, while survival analysis was incorporated to predict disease progression and patient outcomes. The combination of clinical data, genetic information, and fMRI features allowed for a comprehensive analysis, improving the accuracy of early diagnosis. The model was tested across multiple neurodegenerative disorders like Alzheimer's disease, Spinocerebellar Ataxia demonstrating promising results in predicting disease onset and progression. This AI-driven tool can assist healthcare providers in identifying high-risk individuals, understanding disease trajectories, and offering personalized interventions, ultimately contributing to better patient care and outcomes for individuals with neurodegenerative disorders.

Understanding rhabdomyosarcoma: Advances in research, clinical perspectives and outcomes

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Rhabdomyosarcoma is the most common soft tissue sarcoma (~7%) in paediatric patients, originating from high-grade malignant neoplasm. The two primary RMS subtypes-ARMS and ERMS-differ in molecular mechanisms and present unique clinical challenges. Advances in clinical and basic research have gradually enhanced the understanding of RMS pathophysiology, leading to optimized care. Effective treatment requires controlling both the primary tumor, which can occur in diverse anatomic locations, and potential systemic spread. Current risk stratification for RMS involves clinical, pathological, and molecular factors to guide multifaceted therapy, typically combining chemotherapy with surgery, radiotherapy, or both. However, relapse in RMS poses significant therapeutic challenges, with recurrence rates reaching up to onethird for localized cases and over one-third for metastatic cases, usually within 3 years of initial treatment. Several factors including primary tumor characteristics, initial treatment specifics, and relapse features impact post-relapse prognosis. Although there is no standard treatment for relapsed RMS currently, key principles include biopsy confirmation, prognosis assessment, and determining options for local control. Patients with favourable factors, like certain RMS subtypes or those who have not received cyclophosphamide, have the highest likelihood of achieving a cure with multiagent chemotherapy. However, most patients fall outside this category and often face poor outcomes. This study explores our current understanding of RMS, including susceptibility factors, mechanisms, advances in diagnostics and clinical care, as well as the challenges presented by relapse.

Formulation and evaluation of oral fast dissolving films of diclofenac sodium

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Diclofenac Sodium (Diclofenac Na) is a widely used NSAID effective in treating pain and inflammation, but its conventional oral administration can lead to gastrointestinal side effects and poor patient compliance, especially in those with difficulty swallowing tablets. Incorporating Diclofenac Na into oral fast-dissolving films (OFDFs) offers a promising alternative by enhancing its ADME profile through rapid disintegration and immediate drug release. This study developed and characterized OFDFs using hydroxypropyl methylcellulose as the polymer and propylene glycol as the plasticizer. The OFDFs exhibited uniform thickness (0.22 to 0.41 mm) and weight (24.14 to 57.55 mg), ensuring reliable production. Surface pH (6.5 to 6.9) compatibility minimized oral mucosa irritation. High folding endurance (83 to 217 folds) and significant elongation percentage (15% to 58%) demonstrated mechanical strength and flexibility. Controlled moisture content (4% to 8%) maintained stability, while rapid disintegration time (15.33 to 37 seconds) facilitated quick drug release, crucial for patients with swallowing difficulties. Content uniformity (91.67% to 98.15%) and in-vitro dissolution showed effective drug distribution and release, with up to 95.61% of Diclofenac Na released in the best formulation. FTIR confirmed chemical stability, SEM indicated smooth morphology, and DSC confirmed appropriate thermal properties. The OFDFs meet the criteria for rapid disintegration, effective drug release, and robustness, presenting a promising alternative to conventional dosage forms and improving patient compliance and therapeutic outcomes. Further research, including in-vivo studies and large-scale production, is supported to explore their full potential.

Elucidation of antibiofilm activities of extracellular α-amylase from *Bacillus subtilis* SM-RRR 2023

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Biofilm being a three-dimensional microbial structure is primarily supported by extracellular polymeric substances (EPS). The biofilm bound sessile cells escape various antibiotics leading to the development of antibiotic resistance, a skyrocketing crisis of tomorrow. These biofilm-bound recalcitrant cells of pathogenic bacteria give rise to several chronic infections. In order to remove the biofilm, some alternative strategy may be adopted and amylase may be used as potent antibiofilm agent. With that aim, we have isolated a bacterial strain from domestic effluent and identified as *Bacillus subtilis* SM-RRR-23 followed by the determination of its growth parameters for maximum production of extracellular α-amylase. The partially purified enzyme was characterized and the minimum inhibitory concentration (MIC), minimum biofilm eradication concentration (MBEC), and cell behavior after treatment against two nosocomial pathogens namely Gram-positive *Staphylococcus aureus* ATCC 23235 and Gram-negative *Pseudomonas aeruginosa* ATCC 10145 were determined. The EPS matrix was found to be disintegrated by the enzyme. The obtained *in vitro* data was further validated through Response Surface Methodology (RSM) and Artificial Neural Network (ANN) analysis.

Molecular characterization and identification of a leaf curl virus infecting multivitamin *(Sauropus androgynus* L. Merr) plant

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Sauropus androgynus L. Merr commonly known as Katuk or sweet leaf which is a perennial shrub native to South-East Asian countries. This plant is highly valued for its culinary uses and traditional medicinal properties and is often referred to as the multivitamin plant due to its rich nutritional content, including vitamins C, A, E, and K. Except for a few reports from Thailand, no reports have been noted of this plant being infected by *Begomovirus*. The hallmark disease symptoms of these virus-infected leaf tissues are upward leaf curling and stunted plant growth. From Narendrapur region of South 24 Parganas district of West Bengal, we found *S. androgynus* plants exhibiting leaf-curling symptoms. This prompted an investigation to determine whether the cause is a virus infection or another physiological condition. In this regard, we aimed to isolate the viral DNA from infected *S. androgynus* plants, followed by cloning the viral DNA into a suitable vector for further DNA sequencing and other molecular biology, genomics applications. We cloned the rolling circle amplified restriction digested viral DNA fragments into the pET28a vector. The cloned viral DNA was subsequently sequenced which showed similarities to *Synedrella leaf curl virus*, along with a *Croton yellow vein mosaic alpha satellite virus*. In future, functional studies can be conducted to understand the viral pathogenesis and virulence of the virus by developing an *Agro-infectious* clone.

MicroRNA mediated regulation of hypertriglyceridemia in active visceral Leishmaniasis

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Hypertriglyceridemia is a risk factor for many diseases including several cardiovascular and metabolic disorders. Liver is the primary organ that gets infected in the early phase of *Leishmania donovani* infection. Recently it has been found that hypertriglyceridemia can be a promising diagnostic indicator for active Visceral Leishmanisis (VL) cases. There is a positive correlation between the triglyceride level in serum and severity of VL. Several studies shown that microRNAs can play very crucial role in the immune-regulation during host-pathogen interaction in VL. It has been shown that mice hepatic tissue can secret miR-30c, which can coordinately, reduces lipoprotein secretion, thereby regulating hepatic and plasma lipid concentrations. So, raising miR-30c levels may be useful to regulate the hypertriglyceridemia and severity of the VL cases. It also been shown that miR-33a and -b can regulate hypertriglyceridemia and suggest that inhibitors may be useful in the treatment of this HDL and triglyceride disorders. In this study we have identified some important microRNA molecules which are associated with hypertriglyceridemia and severity of VL in infected mice compared to un-infected mice. As there is no approved vaccine against VL and the current chemotherapy is facing many shortcomings, this study can reveal some important microRNAs which may be considered for future chemotherapeutic development to treat the deadly disease.

Antibiotic resistance (ABR) profiling and phenotyping of *Aeromonas* species isolated from Indian Major Carps (IMCs) in West Bengal

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Aeromonas species, a gram-negative, oxidase-positive, facultative anaerobic, non-spore-forming, opportunistic rods. *Aeromonas* is a pathogenic bacterium commonly associated with fish infections, capable of transmitting antibiotic resistance to other bacteria in aquatic ecosystems and to humans through the food chain. Most of them produce numbers of virulence factors, such as hemolysins, aerolysins, adhesins, enterotoxins, phospholipase and lipase. The increasing prevalence of antibiotic resistance (ABR) in aquatic environments poses a significant threat to public health and aquaculture industries. This study focuses on the antibiotic resistance profiling and phenotyping of *Aeromonas* species isolated from Indian Major Carps (IMCs) in West Bengal. Fish samples were collected from various aquaculture farms in West Bengal, and *Aeromonas* species were isolated using selective Rimler Shotts media. Phenotypic identification was performed using biochemical tests, followed by molecular confirmation through 16S rRNA gene sequencing. The antibiotic resistance profile of the isolates was determined using the disc diffusion method against a panel of commonly used antibiotics, including ampicillin, tetracycline, ciprofloxacin, and chloramphenicol. Results indicated that a significant proportion of *Aeromonas* isolates exhibited multi-drug resistance (MDR), with high resistance observed against β-lactams and tetracyclines. Phenotyping revealed the presence of both *Aeromonas hydrophila* and *Aeromonas veronii*, two species commonly associated with fish infections. Furthermore, molecular screening detected genes such as *blaTEM* (β-lactam resistance) and *tetA* (tetracycline resistance), confirming the genetic basis for antibiotic resistance in these isolates.

This study highlights the growing concern of antibiotic resistance in aquaculture, emphasizing the need for regular monitoring and judicious use of antibiotics in fish farming practices. The findings are crucial for developing strategies to mitigate the spread of ABR in aquatic environments, ensuring the sustainability of aquaculture in West Bengal.

Isolation, identification and molecular characterization of *Vibrio parahaemolyticus* isolated from Indian major carps (IMCs) in West Bengal, India

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Indian Major Carps (IMCs) are an inseparable part of our daily lives and major source of animal protein, especially in the regions where rice is the staple diet. IMCs include Katla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus cirrhosus*). Along with these staple fishes comes *Vibrio parahaemolyticus*, a halophilic enterobacter which is gram negative, opportunistic bacilli. *Vibrio* species are responsible for a number of gut infections like bacterial gastroenteritis and septicaemia. *V. parahaemolyticus* strains contain a number of major virulent genes like tdh, trh, T3SS1, T3SS2, etc., which are the prime causes of the clinical complications. All the virulence factors (or genes) are regulated by the toxR gene (or operon), which is common to all species of *Vibrio.* In recent years, gut infections due to *Vibrio* species like food poisoning, have remarkably increased due to consumption of undercooked fishes, raw or undercooked sea-foods, shellfishes, oysters, frozen marine as well as freshwater fishes, etc. This study aims to isolate, identify, and molecularly characterize *V. parahaemolyticus* from Indian Major Carps (IMCs) in West Bengal, India. Fish samples were collected from various aquaculture farms, and bacterial isolates were cultured and identified using biochemical and molecular methods, including Polymerase Chain Reaction (PCR). The presence of virulence genes such as *tdh* and *trh* was also confirmed. The findings highlight the potential health risks associated with consuming contaminated IMCs and emphasize the need for stringent monitoring in aquaculture practices.

Therapeutic potential of *Phyllanthus embelica* phytochemicals in gallstone disease: 5 lipoxygenase inhibition and molecular dynamics insights

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Gallstone disease, a common disorder characterized by the formation of stones in the gallbladder or biliary tract, frequently causes pain and inflammation. While surgery is the primary treatment, pharmacological options like Zileuton, a 5-lipoxygenase (5-LOX) inhibitor, provides significant improvement in patient but has severe harmful effects. Given the Crucial role of 5-LOX in the inflammatory processes driving gallstone disease, inhibiting this enzyme represents a promising therapeutic target. This study explores the potential of phytochemicals from Phyllanthus embelica (Indian gooseberry) in preventing gallstone disease. Compounds from the leaves, fruits, and seeds of Phyllanthus embelica were sourced from the Indian Medicinal Plants, Phytochemistry, and Therapeutics (IMPPAT) database. After ADMET profiling to evaluate pharmacokinetic properties, virtual screening using AutoDock Vina identified several compounds with superior binding affinities for 5-LOX compared to Zileuton. Detailed interaction studies using LigPlot and PLIP revealed robust hydrogen bonding between the phytocompounds and 5-LOX, indicating strong inhibition potential. Molecular dynamics (MD) simulations performed using GROMACS and MM-PBSA free energy calculations confirmed the stability of these 5-LOX- phytocompound complexes. The results suggest that Phyllanthus embelica phytochemicals may serve as natural inhibitors of 5-LOX, offering a safer and more effective alternative to existing pharmacological treatments for gallstone disease. This study highlights the potential of plant-based therapeutic strategies. It emphasizes the need for further in vitro and clinical studies to validate the efficacy of Phyllanthus embelica-derived compounds in preventing and treating gallstone disease.

Exploring the antibiofilm potential of green zinc oxide quantum dots from *Amaranthus viridis* against *P. aeruginosa*

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The adverse effects and resistance of antibiotics are ever increasing with each passing day, so newer techniques need to be developed. The biofilms, which are matrix-enclosed aggregates, formed by Gram-positive and Gram-negative bacteria. *P.aeruginosa* and *S.aureus* cause a majority of nosocomial infections affecting above 2 million people annually. However, the use of phytocompounds for treating biofilm-associated chronic illnesses hasn't received much research. Though, the bioactive compounds of some plants may serve as good antimicrobial and antibiofilm agents. The GC-MS study of the ethanolic extract of the leaf of *A.viridis* has shown the presence of lots of phytochemicals that strongly contribute to the medicinal properties of that plant. In this report, we have chosen a phyto-extract from *A.viridis* against *P.aeruginosa* to check the anti-biofilm activity assay of biogenic Zinc Quantum Dots. Green synthesized ZnO-QD showed absorption maxima at 410nm confirming quantification. We have checked the anti-biofilm and anti-quorum sensing activities by performing various desired assay against biofilm formed by bacteria. Although the antibiofilm activity of the phytoextract was found to be higher than that of individual phytocompounds at a concentration of 2 µg/mL while biogenic ZnO-QDs showed 9 µg/mL, much higher than that of phyto-extract for *P.aeruginosa*. SEM images were also examined in this process which showed active result. Further research was conducted into molecular docking and active substances that disrupt the activity of QS sensing proteins by binding to them. This present study focuses on the efficacy of biogenic ZnO-QDs against *P. aeruginosa* in comparison to the effect of phytoextract.

Unlocking the Antidiabetic Potential of *Raphanus sativus* Leaves: A triad of in-vitro, in-vivo, and in-silico studies targeting L6 myoblasts

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Raphanus sativus, a vegetable belonging from the Brassicaceae family, is typically grown as an annual plant with an enlarged taproot. In Yemenite traditional medicine, its juice is used to help dissolve kidney stones. In Unani, Greco-Arab, and Indian-folk medicine, it's commonly used as a home-remedy for treating a range of conditions, including jaundice, gallstones, liver disorders, rectal problems, and other gastrointestinal discomforts. This study investigates that the leaf extract of *Raphanus sativus* contains strong antioxidant activity by inhibiting DPPH, ABTS, H2O2, and superoxide radicals. Phytochemical analysis using HPTLC and GC-MS identified and quantified various bioactive compounds. *In-vitro* studies using L6 myoblasts revealed a significant increase in glucose uptake, reaching 79.63% at 100 µg/ml. The extract also reduced lipopolysaccharide-induced Protein Kinase C (PKC) levels by 56.2%, highlighting its potential to alleviate hyperglycemia-associated complications. *In-vivo* experiments on Streptozotocin-Nicotinamide-induced diabetic rats treated with 400 mg/kg body-weight of the extract showed a significant reduction in blood glucose ($p < 0.001$), comparable to standard drug metformin. Additionally, lipid profiles, body weight, serum creatinine, and liver enzymes improved. *In-silico* analysis of the identified compounds was performed using the GLUT-4 protein (PDB ID: 7WSM), which is prevalent in skeletal muscles. ADMET analysis assessed the toxicity profiles of the phytocompounds, and molecular dynamics simulation evaluated the stability of the top docked compound, gamma-sitosterol.

The study concludes that gamma-sitosterol from *Raphanus sativus* leaves may enhance glucose uptake in skeletal muscles by acting through GLUT-4 transporter under hyperglycemic conditions, offering a promising therapeutic approach for diabetes management.

Evaluation of plant extracts from *Datura metel* L. and *Kalanchoe pinnata* L. for their antibacterial properties against some selected pathogens

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Phytochemicals, the bioactive compounds found in plants are gaining attention for their potential therapeutic applications from various aspects. In recent years antibiotic resistance has become more critical and serious which prompts the search for other types of antimicrobial compounds. This study aims at examining the effectiveness of plant extracts from *Datura metel* and *Kalanchoe pinnata* against a number of Pathogenic bacteria. Phytochemicals from both plants were extracted using various solvents and the results obtained by phytochemical analysis. To assess the antibacterial activity to the ethnobotanicals, the agar well diffusion method was used, targeting pathogenic bacteria such as *Escherichia coli*, *Salmonella typhi*, *Bacillus subtilis*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. Some of the screened extracts have shown very promising results in terms of antibacterial properties and the study is believed to be providing significant data on the potential of the plant as a source of broad-spectrum antibiotics. Based on the research outcome it is concluded that *Datura metel* L. and *Kalanchoe pinnata* L. have active phytochemical constituents that can be recommended as possible sources of potent antimicrobials. The potential synergistic effects of these plant extracts when used in combination with conventional antibiotics could enhance their efficacy and help in reducing the global increase in antibiotic-resistant bacterial infections. This study brings vital information in the form of plant-based extracts towards the discovery of new antibacterial treatments. It is suggested that subsequent research be dedicated to identifying and describing the individual components of the test extracts in question that might afford such antibacterial properties.

Bio-remediation of heavy metals from wastewater by using cross-linking of biochar and chitosan nanoparticles

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Bioremediation, a term describes the mutual and sustainable approach to remove of heavy metals from industrial wastewater, utilizing natural materials for detoxification of polluted water. In this study, the cross-linking of biochar and chitosan nanoparticles was explored as a potential method for enhancing the efficiency of heavy metal adsorption from wastewater. Biochar, a carbon-rich material derived from biomass, has a porous structure and high surface area that facilitates the adsorption of pollutants. Along with Chitosan, a biopolymer derived from chitin, is known for its metal-binding properties due to presence of amino, hydroxyl functional groups. The combination of biochar and chitosan nanoparticles aims to create a hybrid material with improved mechanical strength, stability, and adsorption capacity for the effective removal of HM such as Pb, cd, and Hg from wastewater. The cross-linked biochar-chitosan composite was synthesized and characterized to understand its physicochemical properties, including surface morphology, functional groups, and thermal stability. Batch experiments were conducted to evaluate the adsorption efficiency of the composite under various conditions, such as pH, contact time, initial metal concentration, and temperature. The results demonstrated that the biochar-chitosan composite significantly enhanced the adsorption of heavy metals compared to biochar or chitosan alone. The adsorption process was found to follow the process adheres to pseudo-second-order kinetics indicating monolayer adsorption on a homogenous surface. This study suggests that the crosslinking of biochar and chitosan nanoparticles offers promising and cost-effective for the bioremediation. Lastly, it provides recommendations for future research and the development.

Investigation and in-depth analysis of antibiotic resistance *Bacillus species* and its implication in food microbiology

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The increasing prevalence of antibiotic-resistant bacteria poses a significant threat to public health, particularly in food microbiology. *Bacillus sp.* is commonly found in soil and food and are known for their ability to produce spores, which can survive extreme conditions, including improper food handling and processing. The primary objective of this research was to identify and characterize the *Bacillus sp.* present in food waste samples in Kolkata, India and to assess their resistance to commonly used antibiotics. Food waste samples were collected from various hotels and analyzed for the presence of *Bacillus sp.* using standard microbiological techniques. The isolated strains were subjected to antibiotic susceptibility testing using the disk diffusion method against a panel of antibiotics like ampicillin, tetracycline, and erythromycin etc. Molecular techniques, including polymerase chain reaction (PCR) and sequencing, were employed to identify antibiotic resistance genes within the isolated *Bacillus* strains. The results revealed a significant prevalence of antibiotic-resistant *Bacillus sp.* in the food waste samples, with resistance observed against multiple antibiotics, including ampicillin, tetracycline, and erythromycin. The presence of antibiotic resistance genes highlights the potential risk of these bacteria spreading through the food chain, posing challenges to food safety and public health. This study underscores the need for stringent food waste management practices and increased surveillance of antibiotic-resistant bacteria in the food industry to mitigate the risks associated with foodborne pathogens.

Unveiling the power of guava: A comparative phytochemical and antimicrobial study of flowers, fruits, and leaves

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The Guava Tree is scientifically referred to as *Psidium guajava* the tree has been deemed to have a medicinal health symbolic value keyed to its fruits, leaves, and flowers sources of various bioactive compounds. This study looks at the phytochemistry and antimicrobial effects of guava flowers and contrasts these with those of guava fruits and leaves. The purpose is to compare and contrast the different chemical compositions and pharmaceutical efficacies of the various plant organs and to pinpoint the fight against microbial organisms as a key area of applicability. However, this research is a comparative study of the flavonoids, phenolic, and tannin contents of the three plant parts to determine the concentration and variety of the phytochemicals.

Antimicrobial activity is tested through in vitro growth-inhibition assays against reference bacterial strains intending to compare the size of the inhibition zones. Increased phytochemical activity is consequent with enhanced antimicrobial efficacy, especially towards the Gram-positive and Gram-negative microbes. Yet the fruits show better anti-fungal activity probably due to different phytochemical content and the nature of the leaves. The study also emphasizes the uses of guava flowers in medicinal value, this is because the flowers may hold potential natural antimicrobial resources. This paper adds to the existing knowledge of the treatment potential of the plant by comparing the phytochemical and antimicrobial compounds present in guava flowers, fruits, and leaves, and their uses in enhancing the utilization of the plant in herbal medicine and pharmacological technology.

Identification and molecular analysis of the role of industrial waste degrading bacteria, isolated from Kolkata, India

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Industrial waste, often rich in hazardous chemicals, poses serious environmental threats, particularly to water bodies and soil ecosystems. This study focuses on the identification and molecular analysis of bacteria capable of degrading industrial waste, aiming to explore their potential for bioremediation. Bioremediation, a promising eco-friendly approach, utilizes microorganisms to detoxify pollutants, making the identification of effective waste-degrading bacteria crucial for sustainable waste management. Samples were collected from industrial waste-contaminated sites at Kolkata, India, and bacterial strains were isolated using selective enrichment techniques. Molecular identification was carried out through 16S rRNA gene sequencing, revealing bacterial genera such as *Pseudomonas, Bacillus, and Acinetobacter*, known for their strong waste-degrading capabilities. Further molecular analysis identified key catabolic genes, including those responsible for the breakdown of hydrocarbons, heavy metals, and toxic dyes. Functional studies showed that these bacteria could degrade a range of industrial pollutants, including phenolic compounds, heavy metals, and petrochemical waste, under both aerobic and anaerobic conditions. The presence of specific genes such as alkB (for alkane degradation) and merA (for mercury resistance) indicated the bacteria's potential in bioremediation processes. The findings suggest that these bacterial strains are promising candidates for large-scale bioremediation of industrial waste. Their ability to degrade a variety of pollutants highlights their importance in developing sustainable strategies for waste management. Future studies may focus on optimizing the environmental conditions for enhanced bacterial activity and exploring the application of these bacteria in bioreactors and wastewater treatment plants.

AAA+ ATPase ATAD5: Implications for oncogenesis and therapeutic targeting

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ATPase Family, AAA+ Domain-Containing 5 or ATAD5, a key regulator in DNA replication and repair, has emerged as a significant biomarker in cancer research. Despite extensive studies on DNA repair mechanisms, the role of ATAD5 in cancer progression and patient outcomes still remains underexplored. Our study addresses these research gaps by investigating the mRNA expression patterns, mutation landscapes, protein interactions, and survival outcomes of ATAD5 across various cancers. Our analysis, leveraging multiple data repositories, revealed that ATAD5 is highly expressed in most of the cancers and the top five cancers with high fold change in expression are Thymic Carcinoma, Diffuse Large B-Cell Lymphoma, Cholangiocarcinoma, Sarcoma, and Stomach Adenocarcinoma. Elevated ATAD5 expression in these cancers is associated with poorer survival outcomes, highlighting its potential as a prognostic biomarker. Furthermore, we examined copy number amplifications and identified key potential mutation sites within the ATPase domain that have potential in contributing tumorigenesis. Additionally, protein-protein interaction (PPI) analysis highlighted interactions of ATAD5 with other proteins involved in DNA replication and repair pathways. Notably, ATAD5 is found to interact with WDR48, RFC4, RFC5, RFC1, RFC3, RFC2, BRD4, PCNA, WDHD1, and RAD17, which are critical components of the replication machinery and genome stability. Detailed pathway analysis indicated that ATAD5 has a pivotal role in oncogenesis through multiple signaling pathways. These findings highlight ATAD5 as a potential biomarker for prognosis and a novel target for therapeutic intervention in cancers.

In silico therapeutic development targeting dosS of *Mycobacterium tuberculosis*: An approach to overcome drug-resistance mechanism

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Tuberculosis (TB) is the 13th largest cause of death, worldwide. The causative agent *Mycobacterium tuberculosis (Mtb)*, has been known to transform into its multi-drug-resistant non-replicating persistence state (NPR), mediated by DosS, a sensor histidine kinase. DosS accommodates two characteristic GAF domains that potentially detect oxygen tension. B-type heme is definitively rooted in a hydrophobic cavity of the first GAF domain (GAF-A), positioned at near-right angle to the β-sheet of GAF. Wild type GAF-A is essentially composed of a five-stranded antiparallel β-sheet flanked by four α-helices. UV−visible spectroscopy studies by Zheng et al. showed HC106A (a novel chemical inhibitor of DosS) directly targets the sensor kinase heme present in the GAF-A domain, indicating that binding of HC106A supposedly locks the DosS into an inactive state. To affirm HC106A targets the DosS of *Mtb*, this group generated two mutants (E87L and G117L) and treated them with HC106A and observed their respective profiles. Overall, studies which include several structural analogues of the HC106A series have provided proven efficacy. In our study, aided by extensive all-atom molecular dynamics simulation for 150 ns, we observed the conformational changes in the wild type and mutants, following which we docked a library of 20 structural analogues and HC106A, itself, upon the three receptor proteins. Further, we studied the alterations in interaction patterns and binding affinities of these receptors and respective inhibitors in wild type alongside their effects in mutant condition. Our study would thus provide insights into developing novel therapeutic approaches for multi-drug-resistant TB.

Bioinformatical characterization of *Cellulose Synthase like* (CSL) proteins in two cultivated jute species

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Jute fiber, which is referred to as the "golden fiber," holds the position as the second most important fiber crop after cotton. Jute plants belong to genus *Corchorus* and the two main cultivated jute species under *C. capsularis* and *C. olitorius*. The fibre of jute is collected from the bast region of the stem. The environmentally friendly jute fibre can be utilized to minimize the use of synthetic fibres which produces greenhouse gases. The fibre of jute mainly consists of some chemical compounds which are cellulose, hemicellulose and lignin, and some other small quantities pectin and fats/wax. Cellulose is a component which provides the strength of the fibre. The quality of the jute fibre decreases due to low cellulose content. In this study, *Cellulose Synthase Like* (*CSL*) proteins which are involved in the cellulose biosynthesis pathway of jute were bioinformatically characterized. A total of 8 *CSL* proteins of *C. olitorius* and 8 *CSL* proteins of *C. capsularis*, were retrieved from the previously published Gene ids. The physico-chemical properties and three-dimension (3D) structure of the 16 different *CSL* proteins were predicted, where variations are observed among the selected *CSL* proteins of the two jute species. To understand the evolution relationships, the phylogenetic tree of *CSL* proteins was constructed with a total of 40 species including the selected *CSL* proteins of the jute species with the homologous *CSL* proteins of Rice, *Arabidopsis thaliana*, and other the fibre crops. This study of *CSL* proteins gives helpful information for future genetic manipulation of cellulose biosynthesis pathway of jute to develop better quality jute fibre with enhanced cellulose content.

Accelerating targeted therapeutic development: Advanced machine learning for the discovery of novel MMP-1 Inhibitors in disease treatment

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Matrix metalloproteinase-1 (MMP-1) plays an important role in the degradation of collagen within the extracellular matrix, contributing to pathological conditions such as cancer metastasis, arthritis, and fibrosis. Despite extensive efforts to target MMP-1, the development of selective and potent inhibitors has been hindered by challenges in achieving specificity and minimizing off-target effects. To address these challenges, we propose a machine learning (ML)-driven computational framework for the discovery of novel MMP-1 inhibitors. Our approach leverages advanced molecular descriptors, including structural, functional, and physicochemical features of known inhibitors, to train robust ML models capable of predicting inhibitory potential with high accuracy. We employed Random Forest classification algorithms trained on large, curated datasets of both MMP-1 inhibitors and inactive compounds. This data-driven model was integrated with high-throughput virtual screening, enabling the rapid identification of potential inhibitors from vast chemical libraries. Top candidates were further validated through molecular docking simulations to assess their binding affinity and interaction dynamics within the MMP-1 active site. The advantages of this ML approach are multifold: it significantly accelerates the drug discovery process, enhances predictive accuracy by learning from diverse chemical spaces, and reduces the costs and time associated with traditional experimental methods. This framework not only offers a powerful tool for identifying novel MMP-1 inhibitors but also serves as a template for applying ML to the discovery of inhibitors for other challenging biological targets. The findings of this study open new avenues for therapeutic interventions in MMP-1-associated diseases.

A comparative study among coffee arabica, green coffee and a commercial coffee powder based on their antioxidant and antimicrobial property

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The highlands of Ethiopia are home to the coffee plant *Coffea arabica*, or Arabica coffee. Arabica coffee plants thrive at high elevations and require a specific climate in order to produce their delicate, nuanced beans. A commercial coffee powder can be easily dissolved in hot water. Green coffee is also rich in chlorogenic acids which have several potential health benefits; including weight loss properties and serving as an antioxidant. As for the antibacterial and anti-oxidant activity of the other three extracts ethanolic extract turned out to be better compared to water extract. Aqueous extract was found effective against Gram +ve bacteria, but less effective on Gram -ve bacteria while Ethanol showed no inhibition activity in both Gram positive and Gram-negative type. Methanol extracts was tested against seven isolates of pathogenic bacteria using Filter disc diffusion method. It was found effective against *Escherichia coli* and *Staphylococcus aureus* then other above tested organisms. Both ethanolic and aqueous extracts were tested on *E. coli* and *S. aureus* which should least zones of inhibitions. Water extract obtained from coffee powder at a concentration of 50% (v/v) was able to inhibit all the Gram-positive bacteria solutions, while that obtained from the concentration of 100% (v/v) had higher inhibition activity towards all the pathogenic bacteria used in this study.

ABSTRACTS OF THE

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Presenting author*

Finding the antagonist molecule of HIV-1 reverse transcriptase through e-pharmacophore modelling approach

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Human immunodeficiency virus (HIV) remains a formidable global health challenge, particularly HIV-1, which exhibits high virulence and infectivity. This study explores the molecular mechanisms of HIV transmission, emphasizing its structural components, including the conical capsid and glycoprotein spikes, that facilitate viral entry via CD4 receptors and chemokine coreceptors. Antiretroviral therapies (ART), including non-nucleoside reverse transcriptase inhibitors (NNRTIs) such as Efavirenz, target key stages of the viral replication cycle. However, drug resistance and toxicity, particularly neurotoxicity associated with Efavirenz, limit therapeutic efficacy. To address these challenges, we employed Computer-Aided Drug Discovery (CADD) techniques, leveraging structure-based and ligand-based pharmacophore modelling to screen potential drug candidates. In-silico approaches, including ADME profiling and virtual screening, allow for rapid identification of lead compounds with optimized pharmacokinetic and pharmacodynamic properties. This study underscores the potential of computational methods to streamline HIV drug development, offering precise targeting of viral mechanisms while minimizing resource expenditure. Future research is directed toward refining these models to test and trial for alternating target antagonist, with negligible toxicity.

Production of bioplastic from soil bacteria to combat environmental issues

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Petroleum-based plastic being non-biodegradable cause major threats to our environment affecting marine life and causing serious health problem. PHB (Polyhydroxybutyrate) is a biodegradable bioplastic with physical properties similar to conventional plastics, produced by certain bacteria under stress. Some major examples of PHB producers being *Ralstonia eutropha*, Alcaligenes latus, Aeromonas hydrophila, and Bacillus megaterium. In this research we have focused on screening and optimization of bioplastic producing bacteria from soil. Initially a total of 13 isolates (designated as S1 to S13) found to produce PHB. Further screening and optimization by using various carbon source (dextrose, maltose and sucrose), various nitrogen source (Peptone, di-ammonium hydrogen phosphate and glycine) ,pH (range from 5 to 7) and temperature (range from 20°C to 50°C) revealed that 6 strains were potent PHB producers. PHB production is optimal at neutral pH, moderate temperature, with maltose as the carbon source and peptone as the nitrogen source. From the Gram staining result, we found that all the six potent ones were Gram positive rods. Biochemical tests like catalase, oxidase and IMViC tests were done to get information about the metabolic activities of PHB producers. UV-Vis spectrophotometer analysis and FTIR (Fourier Transform Infrared) spectroscopy analysis were conducted to get characteristic structure of the molecule. DNA extraction from four strains showed molecular weight-based separation in agarose gel. One of many reasons to do this project is because PHB degradation is crucial for maintaining the carbon cycle in the ecosystem. Our research promises to eliminate plastics in near future.

Respiratory problems among male conch shell artisans engaged at unorganised sectors in West Bengal: A multi parameter assessment study

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The conch shell industry, a captivating fusion of artistry and cultural tradition, stands out across West Bengal for its exquisite craftsmanship. This informal sector exposes workers to substantial occupational hazards, primarily from the dust composed of calcium carbonate. The impact of conch shell dust on respiratory function of the workers remains an undermined issue due to the limited research. This study primarily assessed the respiratory health of conch shell workers and investigate potential inflammatory responses due to long-term exposure to conch shell dust. A sample of 200 male conch shell workers were surveyed using the standardized questionnaires to assess sociodemographic and general health parameters of the exposed group. Spirometry was performed on a subset of population to assess different lung function parameters. Sputum cell viability was measured via trypan blue staining and oxidative stress markers were also evaluated. Red blood cells were analysed for eryptosis to understand further cellular stress responses. Results indicated a significant reduction in pulmonary function ($p < 0.0001$) among conch shell workers compared to the unexposed control group. The number of viable cells were decreased in the sputum sample of exposed workers and the markers of oxidative stress were elevated. RBC analysis also suggested increased eryptosis among the workers. The findings suggest that chronic exposure to conch shell dust is strongly associated with compromised lung function and increased oxidative stress among artisans. Interventions such as providing appropriate masks, improving workplace ventilation could mitigate the adverse health effects on workers in this industry.

Delineating identity through dermal inscriptions: A forensic investigation into tribal tattoos as markers of regional origin, sociodemographic affiliation, marital status, age, thematic choice, and cognitive processes

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Tattoos have long been a form of cultural expression among indigenous communities, such as the Santhal tribe, carrying deep-rooted meanings and serving as unique identifiers. This research explores the potential of tribal tattoos as reliable markers for forensic identification, particularly in criminal investigations and the search for missing persons. By integrating ethnographic fieldwork with forensic analysis, we demonstrate how the distinctiveness of these tattoos, shaped by rich cultural narratives can enhance identification accuracy. The findings highlight the significance of culturally informed approaches in forensic science, promoting the integration of anthropological insights to refine identification techniques. This research underscores the importance of honouring indigenous knowledge systems in forensic practice and advocates for culturally sensitive methodologies to elevate the standards of forensic identification in diverse populations,

Enhancing forensic science through advanced artificial intelligence integration

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Forensic science stands as a highly technology-intensive field, especially given the increasing complexity of crimes. It demands advanced methods to apprehend and uncover the truth about crime scenes. From securing the crime scene to identifying evidence and potential witnesses to performing an autopsy, these are critical areas of forensic science that can significantly benefit from cognitive technology. Artificial Intelligence (AI) has the potential to revolutionize the forensic landscape by offering new approaches for collecting, analyzing, and interpreting data. Machine learning algorithms can rapidly process large amounts of data, identifying patterns that may be imperceptible to humans. For example, facial recognition and biometric analysis can accurately identify suspects or link individuals to crime scenes. Natural Language Processing (NLP) can effectively analyze witness statements and extract relevant information from large textual databases. AI-powered tools, such as digital forensics, can efficiently trace cybercrimes and analyze data from electronic devices. Automated image analysis using AI can vastly improve surveillance footage, identifying small details often overlooked by human analysis. AI can also expedite DNA analysis, providing faster and more precise results, crucial in time-sensitive cases. To implement these advancements, forensic labs must utilize high-performance computing systems, robust data encryption to secure sensitive information, and advanced AI frameworks. This abstract firmly presents the concept of integrating AI into forensic science.

Assessment of heavy menstrual bleeding using self-perceived pictorial blood assessment chart (PBAC) among adult Bengalee women in Kolkata, West Bengal, India

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Heavy menstrual bleeding, or menorrhagia, significantly impacts on the quality of life for women. However, the assessment of Heavy Menstrual Bleeding (HMB) is complicated due to the lack of standardized tool. The Pictorial Blood Loss Assessment Chart (PBAC) method provides a semi-quantitative tool for self-evaluation and estimating HMB severity. Therefore, this study aims to assess self-perceived menstrual blood loss using the PBAC method and identify contributing factors. Seventy unmarried women, aged 18 years and above, using sanitary pads, participated in this one-month survey. Results showed the mean age at menarche was 11.70 ± 0.180 years. A prevailing range of participants had a menstrual cycle length of 21 to 35 days with a flow length of 4 to 5 days. PBAC scores ranged from 18 to 330 (median: 51). 37.1% had PBAC scores >100, indicating HMB. Statistically significant correlations between PBAC scores and menarchal age ($p<0.05$) and also flow length ($p<0.001$) were noted. The PBAC method can serve as a valuable indicator for assessing heavy menstrual bleeding, enabling early or timely medical intervention, and mitigating menorrhagia-related risks. The implementation of this method by healthcare providers will refine diagnostic and treatment strategies.

Phytocompounds from *Caesalpinia bonduc* as potential anti-stroke agents: A molecular docking and dynamics approach targeting tPA

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Thrombotic stroke is a major global health issue, causing significant mortality and long-term disability. It results from blood clots in cerebral arteries, blocking blood flow and damaging brain cells. Although antithrombotic therapies have improved, challenges remain due to patient eligibility, limited accessibility, and bleeding risks. Human tissue-type plasminogen activator (tPA), a key protein in fibrinolysis, plays a crucial role in dissolving these clots. However, current treatments' limitations call for exploring new, effective alternatives. This study explored phytocompounds from *Caesalpinia bonduc* as potential anti-stroke agents using the Indian Medicinal Plants, Phytochemistry, and Therapeutics (IMPPAT 2.0) database. The selected compounds were screened through ADMET screening, and high-throughput virtual screening against human tPA was performed using AutoDock Vina. Compounds with superior docking scores were further analysed via ten ns molecular dynamics simulations using GROMACS, and the binding free energies of the protein-ligand complexes were calculated using the MM-PBSA method. RMSD and RMSF analyses evaluated the structural stability of these complexes. The results showed that α-Caesalpin exhibited a higher binding affinity for tPA compared to several marketed drugs, such as Iloprost and Dexibuprofen, highlighting its potential as a plant-based alternative for thrombotic stroke treatment. The molecular dynamics simulations further confirmed the stability of the phytocompound-tPA interactions, with binding free energies supporting similar or better efficacy than existing synthetic drugs. These findings suggest *Caesalpinia bonduc* as a promising candidate for future in vitro and clinical studies, potentially offering safer and more effective anti-stroke therapies and instilling optimism about the future of stroke treatment.

The physiological impacts of occupational heat exposure on male harvesters: Implications of climate change scenarios

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Climate change heightens global temperatures pose significant occupational health risks for harvesters exposed to extreme heat. This study examines the physiological impacts of occupational heat exposure and health conditions of harvesters during harvesting operations. Ninety-six healthy, adult (aged between 20-55 years old) male harvesters were selected randomly from West Bengal, India and grouped into two groups according to age. Hourly WBGT was measured by a globe thermometer, sling psychrometer and anemometer were used to measure airspeed. HOTHAPS questionnaire was used to evaluate subjective responses of occupational heat as 71.42% of group-1 and 66.66% of group-2 respondents complained about heat exhaustion. Harvesters' (group-1 and group-2) hourly productivity was measured and negatively correlated (r) with mean hourly WBGT (-0.9987 and -0.9984; $p<0.05$), respectively. Pre-working blood pressure and post-working blood pressure were measured by sphygmomanometer and results showed that there were only systolic blood pressure changes significantly in both groups (t-values: 22.754 and 29.401; $p<0.05$). Pre-working and post-working aural canal temperatures were recorded by "ear thermometer" and showed significant differences in both groups (t-values: 19.771 and 12.037, $p<0.05$), though remaining below 38.5°C, indicating heat strain within physiologically manageable limits. Spot urine was collected and measured pre-working urine specific gravity (USG) of group-1 and group-2 workers and the results were 1.010 and 1.011, respectively, whereas post-working USG of group-1 and group-2 were 1.019 and 1.020, respectively. There were significantly increased USG of both groups (t-value: 19.693 and 12.257; $p<0.05$), indicating dehydration risk. Rising temperatures augment harvesters' heat-related health risks and dehydration during work.

Ergonomic analysis of work-related musculoskeletal disorders of male power loom workers in Santipur, Nadia, West Bengal

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The power loom industry is a significant contributor to India's textile sector. However, this industry is fraught with ergonomic and environmental challenges that adversely affect the health of the workers. The objective of the study was to assess the work-related musculoskeletal disorders of the power loom workers. The study was conducted among 30-35 power loom workers, aged 20 to 50. Different questionnaires, including the Modified Nordic Questionnaire, Oswestry Questionnaire, and BPD Rating Scale, were utilized to gather information about pain experienced in different body regions among workers. The analysis of working postures of the workers were conducted using several tools, such as OWAS, REBA, RULA and Roger Muscle fatigue analysis. Mental health status of the workers was assessed by different tests like Ruler Drop, Letter Cancellation, memory recall, audio reaction time, visual reaction time. The results revealed a high prevalence of work-related musculoskeletal disorders (WRMSDs), particularly among workers in static and awkward postures. Workers generally suffering from upper & lower back pain with few of the aged workers suffering from knee pain. The postural analysis indicated that the majority of the working positions adopted by the workers are improper. The power loom industry contributes to economic growth and employment in West Bengal. The high prevalence of work-related musculoskeletal disorders suggests that current working conditions may be contributing to long-term health issues. This is especially concerning as the health issues can lead to reduced productivity, increased absenteeism, all of which can negatively impact the industry's overall efficiency and profitability.

Development and analysis of a novel dietary fiber rich food supplement: Concerning the issue of geriatric constipation

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Aging is an inevitable biological process that leads to several physiological changes in the human body. Elderly persons often experience several gastrointestinal problems, among which constipation is quite common. Although constipation has multifactorial etiology; but daily consumption of adequate dietary fiber helps in its prevention. Concerning the issue, the study aimed to develop a novel dietary fiber rich food supplement for the elderly persons and analysis its physio-chemical and other properties. The supplement was developed using several edible food items and processing techniques. Analysis of physio-chemical and other important properties were carried out using standard tools and procedures. The results indicated the supplement is rich in dietary fiber, with beneficial physio-chemical properties, able to meet the daily requirement and may be effective in the prevention of constipation, especially in reference to elder persons.

Respiratory impairments lead to increase oxidative stress among marble cutting workers engaged in unorganized sector in West Bengal, District: North 24 Parganas

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Marble industry is one of the important unorganized sector in India. Dust pollution in marble industry has various adverse health effects to the workers especially those are involved in the cutting of the marbles. Prolonged exposure to large amount of respirable dust particles containing calcium carbonate and silica, has a potential to create different types of diseases among the workers. Most of the marble cutting workers are complained about phlegm, shortness of breath, breathlessness and nasal allergy. The objective of this study is to assess the prevalence of respiratory problems among the marble cutting workers and to assess the sputum cytology for identification of the lung inflammation. Another objective of this study is to evaluate the different oxidative stress biomarkers levels between sample and control group. A total number of 40 marble cutting workers of age group between 20-45 years having minimum 3 years working experience were randomly selected for this study from West Bengal. Workers who have chronic diseases were excluded from this study. Pulmonary function test parameters were significantly compromised ($p<0.01$) among the workers compared to the unexposed controls. Sputum cell cytology revealed that the number of viable cell count is significantly lower among exposed group compared to the control group. This study suggests that lung function capacities exhibited a significant decline & oxidative stress biomarkers such as catalase and Malondialdehyde (MDA) showed negative and positive correlation with the working experience respectively. Use of face mask will minimize the inhalation of marble dust for this marble cutting workers.

Prevalence of abnormal eating behavior and related psychological factors of female college students (18-23 years)

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Eating disorders (ED) are defined as serious psychological disorders identified as abnormal eating behaviors and distorted self-perception regarding body appearance. A total of 125 female college students aged 18-23 years, from various discipline and located in Nadia district were selected for this study. Individual chronotype, chrononutritional profile, eating behavior, depression, anxiety and stress levels, and their EAT-40 score were assessed. Individuals' nutrients intake was analyzed by using the 24-hour dietary recall method. Physical parameters (height, weight, waist-hip ratio, body mass index, body fat percentage) were assessed. One Way ANOVA test ($p<0.05$) was used for statistical test analysis and for assessment of relationship between BMI and morning latency, evening latency, physical activity and nutrients intake Pearson's correlation was performed. 36% subjects showed borderline eating disorder tendencies, 13.60% had eating disorders and 50.40% showed normal eating behavior. The analysis showed significant differences in eating attitudes, nutrients intake (energy, fat, carbohydrate, and iron), and level of stress, depression and anxiety among all three study groups (normal, borderline and eating disorder identified). There was significant difference found in eating attitudes($p<0.05$), nutrient intake (energy, fat, carbohydrate, iron), and psychological factors across the three groups. The study found that there was a negative correlation between individual groups BMI and their morning latency ($r=-0.05878$, -0.48005 and -0.21866; $p<0.05$). These results shows that college students often have unhealthy eating habits linked to psychological disorders. This highlights the importance of early detection and treatment of eating disorders, meanwhile promoting awareness and nutrition education among them.

Anti-Arthritic Potential of Methanolic Extract of Purified Roots of *Plumbago zeylanica*-An In Vivo Study

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The purified roots of *Plumbago zeylanica* have traditionally been used to mitigate various painful inflammatory and rheumatic diseases. In our preliminary in vitro studies, the methanolic extract of the purified root (PZME) was found to have the highest anti-inflammatory activity. Hence, the present study investigated the pharmacological activities of PZME in Freund's complete adjuvant (FCA)-induced arthritis in Wistar rats. Rheumatoid arthritis was induced in the rats by administering FCA in the right paw on day 0, and treatment of prednisolone and PZME was given from day 1 to 28. The various arthritis parameters (paw volume, joint diameter, grid crossing, gait analysis, weight-bearing, and muscle relaxation) were evaluated by various standard methods. The serum samples were analysed by western blot analysis to estimate COX-2 while the serum oxidative stress parameters (lipid peroxidation and catalase activity) were estimated by standard methods. The tibiotarsal joints were subjected to microscopic studies to evaluate histological findings. Further, LC-MS study of PZME was conducted to identify bioactive compounds, Results revealed that FCA administration caused a significant alteration in the arthritis parameters, oxidative stress parameters and COX-II expression in serum, and histology of the tibiotarsal joint which were significantly attenuated by PZME treatment. The results were comparable with prednisolone, a standard drug. Hence, the study suggests the preventive effect of the purified root of *P. zeylanica* in rheumatoid arthritis. The effects may be attributed to the presence of anti-inflammatory and antioxidant phytoconstituents in PZME. Further, the study validates the traditional use of purified roots in rheumatic diseases.

Anthropometric variation between orphan and non-orphan children: A socio-nutritional approach

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Anthropometric data, nutritional status, physiological parameters and socio-economic condition of orphan children are unaddressed in Indian context. The present study was aimed to evaluate the anthropometric parameters. of orphan children of Kolkata and its suburban regions, belonging to the age group of 8-12years and to compare the data with their non-orphan counterparts. Only orphan and non-orphan boys are selected as subject. The number of the orphan boys is 85 and non-orphan boys are 160 accordingly. Significant difference was found in body weight ($p<0.05$), body height ($p<0.001$), and weight for age ($p<0.001$) parameters between orphan and non-orphan groups. Body mass index (BMI) of orphan group was much lower i.e.15.48kg/m^2 than their non-orphan counterparts 20.01kg/m^2. 90% orphan boys were found to be suffering from growth stunting which has been calculated by the formula of (Height of the child/Height of a normal child at same age) × 100. Data of calf, biceps, triceps, abdomen and sub scapular skin folds were significantly ($p<0.001$) lower in orphan children. Therefore, to maintain the proper nutritional status of non-orphan and orphan children in physiological and social dimension, the present study suggests a balanced and nutrient dense food for both the group of boys which also works as Nutraceuticals to some extent and helps to prevent some common noncommunicable disease such as childhood obesity, chronic respiratory disorders etc.

Federated learning based privacy preserving real time digital forensic

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Abstract: Federated Learning (FL) is a machine learning paradigm that is especially useful in digital forensics since it improves data confidentiality and privacy. Sensitive data frequently needs to be consolidated for examination in typical forensic investigations, which raises questions regarding data breaches and privacy issues. By enabling models to be trained across decentralized data sources without requiring the transfer of sensitive data to a central server, FL reduces these vulnerabilities. FL can be used in digital forensics to securely examine dispersed datasets from various sources, including enterprises, cloud services, and law enforcement agencies. Without exchanging raw data, investigators can work together to create models that identify anomalies, malware, or fraudulent activity on several platforms. Through group learning, this method not only protects the confidentiality of sensitive data but also makes it possible to gain deeper understanding. The model gains strength and efficiency from the contributions of several entities, increasing the precision of forensic examinations. Furthermore, FL enables real-time upgrades, which facilitates adaptation to new threats and changing digital environments. Federated Learning is a major development in digital forensic techniques that allows for safe, private collaboration while harnessing the combined knowledge of several data sources. This invention has the potential to revolutionize the practice of forensic investigations by encouraging increased institutional collaboration and guaranteeing the confidentiality and integrity of data.

Impact of water, hygiene and sanitation (WASH practice) on the growth of children aged 1 to 5 years

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Ensuring adequate WASH (Water, Sanitation, and Hygiene) practices is crucial for child health, particularly in the formative years of ages 1 to 5. This study aims to explore the impact of WASH practices on the growth outcome of children aged 1 to 5 years. A systematic search strategy was developed and conducted using relevant keywords related to sanitation, hygiene, growth outcomes, and children aged 1 to 5 years. The databases like Google Scholar and Pub Med central were thoroughly explored to identify the relevant studies. PRISMA checklist was utilized to report and select the studies. Studies were included based on the impact of sanitation, hygiene practices, and growth outcomes in terms of nutritional deviation. The study's insights offer strong testimony that water, sanitation and hygiene are critical factors in enhancing children's developmental outcome. Improved access to clean water, sanitation facilities, and hygienic practices are associated with better nutritional status and reduced risk of infectious diseases, contributing to overall growth and development in young children. Prioritizing WASH interventions is essential in order to support the best possible nutrition and growth among children aged 1 to 5 years. Effective interventions are crucial to support the growth of young children's. However, to optimize the child health and wellbeing Additional research is necessary.

Implication of socioeconomic status on the risk of diabetes on Bengali young adults in the southern region in West Bengal

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Conventionally, diabetes was perceived as a disease of older people. However, recent research findings indicates that, the attributes of the disease remain presents long before the full flown appearance of the disease. Diabetes is a multifactorial disease and interplay of different risk factors, behavioral and sociodemographic, are associated with the progression of the disease. An attempt has therefore been taken to study the relationship between socioeconomic status (SES) and possible risk factors of diabetes. Information regarding the sociodemographic variables was collected and socioeconomic status was computed. The risk of diabetes was identified with the help of select anthropometric parameters and diabetes risk score. Among 451 participants, 67% was female and 50% of females and around 70% of males belonged to upper-lower socioeconomic class in the study. A significant ($P< 0.05$) difference was found in the risk of developing diabetes among the categories of SES and the individuals at upper-middle socioeconomic class had the greater risk of diabetes.

Paradigm of protein intake from plant and animal sources among young adult urban females in West Bengal

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Protein is a macronutrient essential for growth of tissues, immunity, synthesis for vital body components like enzymes and hormones, act as a source of energy and is crucial to carry out the proper metabolic functions of the body. Lack of adequate protein can show detrimental structural and functional effects in the body augmenting mortality and morbidity. Besides other nutrients, quality protein intake in right amounts is recommended referring to specific age, life stage, and sex to maintain proper nutritional status. However dual burden of malnutrition in India is still a serious concern for all age groups, including young adult females being at a greater risk. Against this background, the present work aims to assess the paradigm of protein preferences and its intake among the young adult females residing in urban areas of Kolkata, West Bengal. The study was conducted on 99 collegiate females aged between 18 to 25 years. Their background information was collected, anthropometric measurements and dietary information were taken. Comparisons of the average protein intake was done with the recommendation. Daily average protein intake was found to be insignificantly lower than the recommended value. Double burden of malnutrition was evident in the present study. More than 50% of the protein intake were from plant sources. Moreover, cereals were contributing as the major protein source irrespective of the nutritional status of the participants.

mTOR inhibition using Torin1 resulted in increased stability of Wee1, an oncoprotein in various cancers: A possible reason for the ineffectiveness of mTOR inhibitors in clinics

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mTOR, a crucial regulator of cellular processes, is frequently disrupted in cancer. While its inhibition has been explored as a potential therapeutic strategy, clinical outcomes have been inconsistent. The underlying molecular mechanisms remain unclear. Wee1, a cell-cycle checkpoint kinase often overexpressed in tumors, has emerged as a promising target due to its potential role in chemoresistance. Our study investigated the interplay between mTOR and Wee1. We discovered that inhibiting mTOR with Torin1 led to increased Wee1 protein levels. This regulation occurs at the translational level, not at the transcriptional level. We linked this effect to reduced proteasomal degradation, as evidenced by increased Wee1 levels with the proteasome inhibitor MG132. Additionally, we observed decreased βTrCP-1, a ubiquitin ligase that targets Wee1 for degradation. Interestingly, Torin1 decreased the sensitivity of Bortezomib, an anticancer drug. Furthermore, we found that Wee1 knockdown increased sensitivity to Torin1. These findings suggest that mTOR inhibition can elevate Wee1 expression by interfering with proteasomal degradation. Interestingly, this mechanism might contribute to the reduced effectiveness of mTOR inhibitors in certain cancers, as it could potentially counteract their anti-tumor effects by increasing the oncoprotein Wee1. Our study proposes a potential strategy to enhance the clinical efficacy of mTOR inhibitors.

Downregulation of S6K1 activity is associated with increased sensitivity to protein synthesis perturbations in multiple myeloma

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Protein synthesis plays a crucial role in multiple myeloma. These cells require increased translation to survive and proliferate. Understanding the mechanisms of protein synthesis in multiple myeloma is essential for developing targeted therapies. Several treatments for multiple myeloma focus on targeting specific steps in protein synthesis or interfering with the signaling pathways that regulate it. S6K1 signaling is critical for rDNA transcription and ribosome biogenesis. However, researchers have not yet thoroughly examined the sensitivity of multiple myeloma cells to various protein synthesis disruptions compared to other cancers. The role of S6K1 signaling in how multiple myeloma cells respond to disturbances in protein homeostasis also remains unclear. Furthermore, the therapeutic potential of Torin1, an S6K1 inhibitor, has not been fully explored in multiple myeloma. In this study, we investigated the sensitivity of RPMI-8226 cells to Bortezomib, Azacitidine, and Cycloheximide treatments, comparing them with HeLa and HepG2 cells. We also explored the role of S6K1 signaling under these conditions and assessed the therapeutic potential of Torin1. Our findings reveal that RPMI-8226 cells are highly sensitive to protein synthesis disruptions, leading to a significant decrease in S6K1 signaling. Additionally, Torin1 treatment induces apoptosis in RPMI-8226 cells. Overall, we establish a molecular link between S6K1 signaling, protein synthesis perturbations, and multiple myeloma.

A comparative study between different motor ability among field hockey players according to their different playing position

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ifferent skill-based motor fitness components such as speed, flexibility, power have a significant role in enhancing the team performance. Fast moving games like field hockey also seek the skills including sprinting, dribbling, tactical movements in the players. Field hockey also involves positional playing in which each player performs specific role. Against this context, the current study has been carried out to assess the motor fitness status of field hockey players, further based on different playing positions, residing in and around North 24 Parganas, receiving training in field hockey for at least 2 hours and 5 days in a week. Specific standard fitness tests were carried out. It was found that individuals in different positions differ in respect of the test parameters.

A Study on oxidative stress and hematological profile among carpentry site worker of West Bengal, India

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Carpentry site was known with several occupational hazards. There were with a large extent of chemical and biological hazards which toxic to human body which might be answerable for debased of enzymatic or non-enzymatic antioxidant of human system. In this study we were evaluated the blood plasma level of oxidative stress enzyme, SGOT and SGPT, hemoglobin, mean corpuscular hemoglobin, RBC, Ca^{2+}. This study was put through by 262 numbers of male exposed subjects from carpentry industry and 155 non-exposed. The exposed group was divided in to Group A, having less than 10 years of work experience and Group B, having less than 10 years of work experience. Physical parameter and oxidative stress biomarker like catalase (CAT), superoxide dismutase (SOD), reduce glutathione (GSH), glutathione reductase (GR), glutathione peroxidase (GPx), glutathione-s-transferase (GST) activity and concentration of malondialdehyde (MDA) were measured. Serum SGOT, SGPT, haemoglobin, total count of RBC, MCH, and serum calcium level were measured in blood plasma. It was observed that plasma level of all oxidative stress biomarkers except malondialdehyde and other parameter were lowered in exposed group than controlled group. This study was identified that work site of carpenters was brimming with toxic hazards which were diminished the level of enzymatic and non-enzymatic antioxidant and other parameters of blood. Carpenter should be avoiding exogenous free radical and UV rays. Carpenter should habituate with use personal protective measures like proper cloth, mask, gloves and sunglass.

A study on nutritional status of children aged 9y from North 24 Parganas

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Abstract: Nutritional status is the balance between nutrient intake and its expenditure for various physiological processes. A balanced nutrition contains foods in adequate amount and proportions important for a child's growth and development. Imbalance in nutritional status can manifest in various forms of malnutrition. This is very common in developing countries and has become a worldwide phenomenon. Though the number of malnourished children has declined steadily but still a significant number is under malnutrition. Globally around 22.3% under age 5 has stunted growth, 6.8% wasted and 5.6% are overweight. In this backdrop, a study has been undertaken among the economically weaker sections of the society, to assess the nutritional status of children from Barasat, North 24 Parganas. The nutritional status was assessed by measuring their anthropometric parameters and collecting dietary information. It was found that around 3% boys had malnutrition and 4% girls had severe malnutrition. As children are the future of the nation any deviation in their health is a grave concern. Though much effort has been made towards curbing malnutrition more thorough interventions are required to tackle the situation.

The association of TMPRSS6 polymorphism rs2413450 and rs4820268 with iron and haematocrit parameters among Women of Reproductive age group in rural population of Nadia district, West Bengal

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Despite being a prevalent condition, underlying mechanisms and genetic factors contributing to Iron deficiency anemia (IDA) remain incompletely understood. This study revealed that in spite of having plenty consumption of iron enriched food, women from Kalyani, West Bengal Population were suffering from anemia. To check whether it is by nature iron refractory, an association of TMPRSS6 gene mutation were screened. Among 66% of anaemic population 33.6% was mild anaemic, 30.3% was moderate and 2.9% was suffering from severe anemia. Associations of haematological parameters like RBC, MCHC, RDW-CV, Hb, Hct, MCV, MCH with hepcidin was found among the different anaemic groups. Amplification refractory mutation system-polymerase chain reaction of rs4820268 and rs2413450 was confirmed by Sanger sequencing. Heterozygote mutant allele genotype (GA) of rs4820268 shows no association with hepcidin, ferritin, transferrin and Hb level. Heterozygote mutant allele genotype (GA) of rs2413450 was associated with higher hepcidin, low ferritin, and higher transferrin level. On the other hand, a lower Hb, ferritin and hepcidin level were detected within homozygote major allele GG genotype of rs2413450. No correlation of rs4820268 with haematological parameters, and the occurrence of being anaemic in spite of having normal GG genotype for both the alleles in this population indicated that, may be these alleles can have different effect on all the haematological parameters against the different genetic background in this population, and heterogeneity in genetic makeup and environmental disparities between population may play a crucial role in the distribution of allele frequencies followed by their association with haematological parameters.

Detection of evolutionary dynamics and molecular parallels of chloramphenicol resistance genes via advanced phylogenetic analysis

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BACKGROUNDS: Chloramphenicol is a potent antibiotic inhibiting protein synthesis via the peptidyltransferase of the 50S ribosomal subunit. Resistance mechanisms have been observed in the following conditions which include enzymatic inactivation by chloramphenicol acetyltransferases (CAT), acquired chloramphenicol resistance Plasmid (genes) and acquired chloramphenicol resistance single genes based on the mechanism of Efflux. OBJECTIVE- This study aims to determine the evolutionary relationship of major classes of antibiotic resistance genes by investigating the evolutionary dynamics and molecular similarities of chloramphenicol resistance genes, focusing on catA and catB variants, as well as other systems like phosphotransferases, target site mutations, permeability barriers, and efflux systems (cmlA and floR). Method: The analysis has been conducted by various phylogenetic software tools namely MEGA, CLUSTAL-W,1 i-TOL2 CLUSTAL OMEGA. The phylogenetic analysis of antibiotic-resistant genes within the scope of MEGA software, exclusively on the acquired chloramphenicol resistance mediated through inactivating enzymes, iTol, which is a tool for customize tree visualization, to prune and collapse symmetric branches, re-root nodes and color-code branches to aid navigation. The analysis of the acquired resistance genes could be performed with both overall and pairwise alignment because of the utilization of Clustal W and Clustal Omega softwares. RESULT: Analysis show genetic and molecular similarity between antibiotic resistance genes. These similarities are emphasized by different phylogenetic parameters. Conclusion: This research will hopefully facilitate future computational biology work on antibiotic resistance. It also proposes that synthesizing new molecules to improve the management of antibiotic resistance needs to be prepared.

Modulation of toll like receptors (TLRs) and Interferons (IFNs) by glycyrrhizin from Glycyrrhiza glabra in Japanese Encephalits virus infected chick embryo model

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Japanese Encephalitis Virus (JEV) is a mosquito-borne virus belonging to the genus Flavivirus prevalent in Asia and certain parts of the Western Pacific. Due to lack of a particular antiviral treatment and the limitations of current vaccination strategy, Japanese encephalitis (JE) has become a public health concern, necessitating the development of novel therapeutic approaches. The present work focuses on glycyrrhizin's immunomodulatory role, examining how it affects various signaling pathways involved in viral recognition and immune response. Through molecular docking, glycyrrhizin was shown to bind effectively to the NS5 protein of JEV, a key component in viral replication. The pre-treatment led to a significant reduction in JEV viral load in brain and chorioallantoic membrane tissues, likely through modulation of Toll-like receptors (TLR3, TLR4, TLR7, TLR8) and interferon pathways. Additionally, glycyrrhizin increased interleukin levels (IL-4, IL-10), suggesting it helps to activate antiviral responses while managing inflammation indicating a reinforced antiviral state and reduced inflammation. These findings highlight glycyrrhizin's potential as a natural antiviral agent against JEV through targeted immune pathway regulation.

Development of RADI-SO-SCAN: A novel breast scanning modality

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RADI-SO-SCAN is a cutting-edge breast imaging device developed to significantly improve diagnostic precision and facilitate early breast cancer detection. This unique technology integrates ultrasound and soft X-ray imaging within a single, advanced system powered by AI algorithms and fusion technology. By combining these two imaging modalities, RADI-SO-SCAN enables detailed visualization of soft tissue while accurately detecting early calcifications, key indicators of potential malignancies. This device generates high-resolution 3D (Hybrid) images that reduce false positives and negatives, enhancing diagnostic confidence for both patients and healthcare professionals, which supports more effective treatment planning.

RADI-SO-SCAN is designed for versatile applications across breast cancer screening centers, diagnostic clinics, and mobile healthcare units, especially in underserved areas. Its compact and portable design even allows for home-based screening, making it accessible to rural and remote populations. As healthcare shifts toward precision diagnostics, RADI-SO-SCAN aligns with advancements in multimodal imaging and AI-driven insights.

Digital breadcrumbs: How metadata on the dark web leads to hidden criminal networks

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Dark web, a hidden segment of the internet accessible only through specialized software, has become a hub for illicit activities, fostering complex criminal networks that are challenging to detect and dismantle. While the internet we commonly use comprises only 5% of the total web, the remaining 95% is largely hidden within the deep and dark web. This study explores the potential of metadata as a tool to uncover hidden criminal networks on the dark web. Metadata, often referred to as "data about data," includes details like timestamps, IP addresses, file-sizes, and transaction information, which can reveal interaction patterns and user behavior without exposing actual communication content. Through metadata analysis, investigators can identify connections between isolated events, map relationships, and pinpoint key actors on dark web marketplaces, hacking forums, and other covert platforms. This review examines cases where metadata analysis led to breakthroughs in investigations, highlights advanced techniques for extracting and interpreting metadata, and discusses ethical and legal challenges of metadata analysis on the dark web. Additionally, it explores limitations and evasion tactics criminals use to avoid detection, providing a balanced view of metadata's effectiveness and reliability in digital forensics. The findings underline metadata's role as digital breadcrumbs that expose the structure and participants within dark web criminal networks, offering law enforcement and forensic analysts new ways to combat cybercrime and enhance security.

An approach based on systemic biology to comprehend the impact of several mentha phytochemicals on human breast cancer

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Mint (Mentha spp.), a perennial herb belonging to the Lamiaceae family, is well-recognized for its medicinal benefits and refreshing fragrance. Traditional cancer treatments, including surgery, chemotherapy, and radiation, frequently lead to significant side effects, drug resistance, and diminished quality of life. Phytochemicals extracted from mint present a promising alternative, offering potential anti-cancer effects that could mitigate these challenges while improving cancer cell targeting. This research focuses on identifying potent mint-derived phytochemicals that inhibit several key human breast cancer genes. By leveraging bioinformatics and systems biology, we have analyzed the phytochemicals and metabolites for their drug-likeness, bioavailability, and toxicity to select non-toxic compounds for breast cancer gene targeting. Gene enrichment analysis was conducted to correlate breast cancer with specific genes, identifying overexpressed HUB genes implicated in the disease. In the future, cell proliferation linked to breast cancer prognosis could be effectively addressed by targeting these HUB genes using phytochemicals, offering a more tailored therapeutic approach.

ABSTRACTS OF THE

SUBJECT AREA:

ENVIRONMENTAL SCIENCES INCLUDING CLIMATE CHANGE

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Presenting author*

Kitchen waste: gruel and rotten fruits are natural sources for fungal medium preparation and fungi isolation for mycoremediation of dye

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Kitchen waste plays an important part of the whole waste because it is a regular problem, so it has been obtaining more attention currently. Gruel or rice water is an important liquid waste material in kitchen waste. Our aim was to explore the growth of fungi from natural sources like plants or kitchen waste like rotten fruits on rice water or gruel-based mediums and used in mycoremediation. Rotten fruits like apples, guavas, and pomegranates were placed on the autoclaved solid gruel-based medium for the isolation of fungi. Aspergillus niger was isolated. The endophytic fungus Rhizopus sp. was also isolated from the plant bakul, Mimusops elengi, on gruel-based medium. Both fungi were tested to have the ability of the azo dye (congo red) degradation by qualitatively and quantitatively. The lignolytic enzymes involved in dye degradation—laccase, lignin peroxidase, and manganese peroxidase—were assayed using decolorization of the dyes like bromophenol blue, methylene blue, and phenol red, respectively. A phytotoxicity assay was also done with Rhizopus sp. treated with 0.05% congo red on okra seeds. Percentage of congo red degradation was 90.44 ±0.471 by Aspergillus niger, 95.42 ± 0.144 by Rhizopus sp., 96.89 ± 0.01 for acidic pH, and 81.28 ± 0.108 for basic pH by Rhizopus sp. This data showed that Rhizopus sp. was more effective for congo red decolonization than Aspergillus niger. Kitchen waste like gruel-based medium acts as a natural ingredient of cost-effective fungal medium, and rotten fruits are stores of fungi that can be used in bioremediation of azo dyes.

Analysis of common airshed of atmospheric PM_{10} in Kolkata and Howrah

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The seasonal common airshed of atmospheric pollutants in Kolkata and Howrah cities has been estimated using daily atmospheric PM_{10} concentrations at different Continuous Ambient Air Quality Monitoring Stations (CAAQMS) locations during 2023 and the 72h air parcel back trajectory analysis with the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT: Version 4) model. The daily PM_{10} concentration data of selected CAAQMS locations (i.e. Belur math, Ghusuri, Padmapukur, Bidhannagar, Ballygunge, Fort William, Rabindra Bharati University, Jadavpur, Rabindra Sarobar, Victoria Memorial) were collected from the Central Pollution Control Board. This study analyzes the temporal variation of the atmospheric PM_{10} concentrations at the selected CAAQMS sites. The HYSPLIT model suggests that the wind to both cities were southerly in summer and northerly and north westerly in winter. The seasonal airshed or potential area of sources of atmospheric PM_{10} in both cities were estimated through PSCF (Potential Source Contribution Function). The result of the PSCF analysis suggests that the parts of north NW districts of West Bengal (e.g. Howrah, Bankura, Purba Burdwan, Paschim Burdwan, Birbhum, Hooghly) and nearby states Jharkhand and Bihar are influencing the concentrations of atmospheric PM_{10} of both cities in winter. Also, the influence from part of the neighbouring Bangladesh was also estimated. This study can support the policymakers to implement inter-regional and international collaboration to efficiently and sustainably manage air pollution in Kolkata and Howrah cities.

A comparative study on mangrove self-restoration at Indian Sundarbans and Bhitarkanika after severe cyclonic events - a remote sensing-based approach

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As the Bay of Bengal responds to the global warming phenomenon, incidences of cyclonic events are on the rise like never before. The Indian Sundarbans at the terminal fringes of West Bengal and Bhitarkanika, Odisha are constantly exposed to various catastrophic cyclones, resulting in extensive damage to these fragile ecoregions that results in loss of habitat and biodiversity. Recent cyclones that traversed Bhitarkanika Mangroves are Phalin (2013), Hudhud (2014), Fani (2019), Yas (2021) and Sundarbans mangrove faced destruction by Aila (2009), Bulbul (2019), Amphan (2020), Yass (2021), Jawad (2021) and many more. Despite the frequent occurrence of these natural disasters, mangrove forests are particularly adept at maintaining their existence, and can overcome the damage of natural disasters in a short period of time. However, the frequent occurrence of cyclones reduces the chances of significant self-restoration. In this present work we have studied the impact of cyclones since 2009 and how these impacts have been dealt with in the following years. Here we propose a new and robust mangrove monitoring index to envisage the restoration of mangroves in different locations which we put forward as a more accurate descriptor of mangrove vegetation changes at temporal scale. To validate our formula and model we use satellite derived imagery from both these mangrove habitats and document the self- restoration potential of natural mangrove vegetations over time.

Exploring the invisible pathways: How aerosols travel and deposit in upper respiratory tract

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Aerosols—tiny airborne particles—are a double-edged sword. They can deliver medication deep into our lungs, or carry harmful pollutants that compromise our health. But how do these microscopic particles navigate the intricate pathways of our respiratory system? While current models provide valuable insights, they often rely on oversimplified anatomical representations, missing crucial details about aerosol deposition in the lungs. In this study, we present advanced computational simulations that trace aerosol behaviour from the nostrils to the first bronchi, offering a more comprehensive understanding of aerosol dynamics in the human respiratory tract. Using the adult male Mesh-type Reference Computational Phantom integrated with Computational Fluid-Particle Dynamics, we simulate aerosol transport through realistic respiratory geometries. Our process involves creating detailed 3D meshes of the respiratory system, capturing nasal and airway features, and performing grid-independence tests to ensure reliable accuracy. The airflow is modelled by solving the unsteady Navier-Stokes equations, while particle transport is governed by particle motion equations, allowing us to account for key deposition mechanisms such as inertial impaction, Brownian motion, and gravitational settling. Our results uncover the complex deposition patterns of aerosols in regions like the nasal passages, trachea, and bronchial tubes, highlighting how particles of different sizes behave under varying airflow conditions. These findings could revolutionize how we optimize drug delivery and protect ourselves from pollutants, providing a more accurate and personalized approach to respiratory health.

Presence of antibiotic resistant *Mycobacterium fortuitum* in bathing pond water of North 24 Parganas District, West Bengal: A preliminary report

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Mycobacterium fortuitum is a nontuberculous mycobacterium, found worldwide in water and soil, can cause health risks like extensive pulmonary infections, localized skin lesions, and disseminated disease in immunocompromised patients. Recent rate of *M. fortuitum* infection along with concern over antibiotic resistance is increasing globally. The current report identifies the potential public health risks associated with *M. fortuitum* found in non-potable water. Preliminary study found antibiotic-resistant *Mycobacterium fortuitum* in bathing ponds of the areas around North 24 Parganas district, West Bengal. Water samples were collected from ten sites used by local villagers. Microbiological and molecular techniques were used to isolate and identify the *M. fortuitum* strains. Antibiotic susceptibility test was performed by broth microdilution method as per CLSI guidelines. The results indicated a significant prevalence of antibiotic-resistant *M. fortuitum* against major antibiotics including Rifampicin (100%), Cefoxitin (80%), Levofloxacin (80%), Moxifloxacin (80%), Doxycycline (60%), Azithromycin (100%) and Erythromycin (100%) among the six isolates. The findings raise concern due to the potential exposure of vulnerable rural populations to resistant strains. Some factors that may contribute to drug resistance include anthropogenic pollutions, accumulation of waste from animal husbandry runoff and the discharge of untreated sewage into the water bodies. This study emphasizes the urgent need for monitoring and controlling antibiotic use in both clinical and agricultural settings to reduce the spread of resistance, raise public awareness campaigns regarding the risks of using contaminated water and development of effective water quality management strategies for aquatic environments in this region. Proper documentation and remedial policies will contribute to achieve the Sustainable Development Goals of the UNO.

Surface and ground water quality assessment in a selected meander stretch of the Adi Ganga River using multivariate statistical analysis, WQI and GIS

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Rivers are essential to the life of a nation and its economic prosperity. Rivers are increasingly vulnerable to pollution due to unsustainable urbanization, industrialization and development. The ancient Adi Ganga waterway is no exception. Unrestricted garbage disposal also deteriorates water cleanliness, which could harm the nearby groundwater. In the present study, a total of 27 water samples (13 groundwater and 14 surface water) were gathered from the study area and analyzed for various physicochemical parameters anion and cation to evaluate the water quality.The water quality index ranged from 103.16 – 200.62 for surface water and 30.58 – 71.35 for ground water indicated that these are severely and marginally threatened, respectively. CDOM (Chromophoric dissolved organic matter) analysis using excitation-emission matrix spectroscopy detected protein-like fluorescence peaks, indicating the presence of microbial as well as organic substances. Multivariate statistical analysis (PCA, HCA, Pearson Correlation) of water quality were performed. Also, the LULC change detection analysis (2008-2013) and transition matrix clearly revealed the diminishing of water bodies and vegetation due to rapid urban growth, which may also have an impact on the water quality. Thus, urbanization severely impacts the water quality, threatening nearby groundwater in the study area. Effective waste management and conservation strategies are crucial to mitigate these effects.

Comparative study on the effects of idol immersions on the water quality of River Ganga at Ghats of six Municipal Zones of North Twenty Four Parganas, West Bengal

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River Ganga is one of the most significant rivers of Asia and India from ecological, geographical and anthropogenic perspectives. Religious activities in India are much dependent on natural freshwater bodies and thus practices of various idol immersions are also invariably associated with those. Durga puja, being the greatest festivity of West Bengal, India, imparts a pivotal role in modifying the quality of the river at its lower basin, after the immersion rituals. The stretch of river Ganga corresponding to the district of North Twenty Four Parganas is very significant in regulation of the water-quality of the river at Kolkata and lower basin. This study attempted to find out the variations in the limnological parameters such as temperature, pH, conductance, Total Dissolved Solids (TDS), salinity, Dissolved Oxygen (D.O.), free carbon dioxide etc. along with the levels of heavy metals like Lead (Pb) and Chromium (Cr). Surface-water samples were collected after the idol immersions (October, 2023), from six ghats of Ganga corresponding to six municipal areas- Halisahar, Naihati, Bhatpara (north) and Panihati, Kamarhati, Baranagar (south). Levels of all the parameters were compared with that of a non-immersion season (August, 2024). Ghat specific variations in the parameters were observed where increase in the levels of Lead (Pb) after the immersion was most notable. Paints, varnishes, water colors, clay, bamboo, husk, clothes, paddy straw, metals etc. from the idols along with miscellaneous types of solid wastes are disposed into the water resulting in the adverse changes of the water quality and ecosystem health. Implementation of the environmental laws and regulatory guidelines should be done by the urban local bodies, along with policy refinements for addressing this post-festival pollution stress.

Receptor modeling-based source apportionment of ambient particulate matter in Howrah City

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Air pollution source apportionment through receptor modeling is used to estimate the contribution of various pollution sources to ambient particulate matter (PM_{10} and $PM_{2.5}$) concentrations at any receptor sites. The model assumes that any particulate emission from a given source remain unchanged in the atmosphere before it reaches the receptor location. The chemical and physical properties of ambient PM_{10} and $PM_{2.5}$ at the five receptor (Benaras road, Baltikuri, Jagachha, Sarat Sadan and one background in upwind direction outside HMC area) sites in the Howrah City were measured and analyzed with key source profile of air pollution identified area e.g. transport tail-pipe emissions, dust, biomass and coal combustion (from households, roadside eateries, and industries), industrial emissions, and refuse burning following the principle of mass conservation. Dust was estimated as the dominant source to the ambient PM_{10} concentrations, accounting for an average of 35% across all seasons with the highest contribution of 43% in summer. Tail pipe emissions from the transport sector was estimated as the major source of ambient $PM_{2.5}$ (contributing 28% on average), during summer. Biomass and coal burning attributed to 25% of ambient $PM_{2.5}$ concentration during summer. Industrial activities were another consistent contributor to air pollution, accounting for 15% ($PM_{2.5}$) and 13% (PM_{10}). Other sources, such as refuse burning and secondary particulates, were estimated to have minor contributions to the ambient $PM_{2.5}$ concentrations.

Interactive web application for analyzing light pollution in Darjeeling using remote sensing and Google Earth Engine

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Light pollution has emerged as a critical environmental challenge, significantly impacting human health, ecosystem stability, and astronomical observations. While this issue demands global attention, research gaps persist, particularly in ecologically sensitive regions like the Darjeeling district in the Himalayan foothills. This study employs Visible Infrared Imaging Radiometer Suite (VIIRS) satellite imagery and Google Earth Engine (GEE) to analyze light pollution patterns in Darjeeling from 2012 to 2024. We developed an innovative interactive web application through GEE, enabling users to visualize spatial distributions, track historical changes, and identify areas of significant light intensity variations. Our analysis reveals concerning concentrations of light pollution across Darjeeling, with a strong correlation between urban expansion and increasing light intensity. These findings demonstrate how rapid urbanization threatens local biodiversity and diminishes night sky visibility. The study also uncovers potential implications for human health and ecosystem functioning, highlighting the urgency for targeted policy interventions. The interactive platform we developed serves as a dynamic tool for monitoring and analyzing light pollution trends, offering valuable insights for various stakeholders. By illuminating the complex relationship between urban development and light pollution, our research provides essential data for urban planners, policymakers, and environmental researchers. These findings can inform evidence-based strategies to promote sustainable urban growth while minimizing the adverse effects of artificial lighting on both human communities and natural ecosystems. This comprehensive analysis establishes a foundation for future research and policy development in managing light pollution within environmentally sensitive regions.

Exploring water footprint and sustainable approaches for water security in the Raniganj Block, Paschim Bardhaman, West Bengal, India: Advancing SDGs through agricultural resilience, water security, and responsible mining

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The Water Footprint (WF), introduced in 2002, underscores the urgent need for sustainable freshwater management, aligning with the United Nations' Sustainable Development Goals (SDGs). Agriculture, vital for global food security, depends heavily on freshwater resources, particularly in regions like the Raniganj block in Paschim Bardhaman, West Bengal, India, where coal mining has contaminated water, disrupted agriculture, and caused land subsidence. This study, conducted from 2021 to 2024, evaluates the WF of the region's agricultural practices and examines the region's reliance on limited water supplies and recurring midsummer shortages, exacerbated by inefficient water management. The study uses survey data analyzed through MS Excel and highlights paddy as having the highest WF among others. It proposes strategies to address the crisis, including exploring alternative freshwater sources, adopting green water-purification techniques, and developing ecologically sound policies. It emphasizes the need for a comprehensive water management plan and advocates for future research incorporating life cycle analysis, Indigenous knowledge, and collaborative stakeholder involvement. The study supports SDG 6 (Clean Water and Sanitation) by addressing water scarcity, and SDG 2 (Zero Hunger) by ensuring water availability for agriculture. It advances SDG 12 (Responsible Consumption and Production) by optimizing water use, and SDG 13 (Climate Action) by enhancing resilience to water challenges. Furthermore, SDG 15 (Life on Land) is supported by fostering ecological balance, while SDG 17 (Partnerships for the Goals) is promoted through collaboration for sustainable water management. Ultimately, the study offers a pathway toward water security, sustainable agriculture, and responsible mining through innovative solutions.

Hourly forecasting of PM2.5 using different missing value imputation techniques - A comparative study

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Due to rapid environmental degradation, it becomes important to forecast the trend of urban air pollution effectively for a sustainable development and better decision making. But, high resolution air pollution data collected through sensors often contains missing entities, which need to be filled up for the forecasting models to remain functional and provide accurate predictions. In view of present context, the study attempts to explore univariate missing value imputation techniques for effective forecasting of urban air pollution. In addition, a comparative study has been performed. These experiments have been carried out by considering hourly concentration of PM2.5 at three different air pollution monitoring stations (viz., Ballygunge, Bidhannagar, and Victoria) of Kolkata, West Bengal during January-December, 2023. These datasets have been collected from the website of the Central Pollution Control Board. For the computation of missing entities, seven well-known methods (viz., Forward fill, Backward fill, Replace with mean value, Replace with rolling mean, Linear interpolation, Cubic spline interpolation and KNN imputation) have been utilized in this study. Consequently, sequential forecasting methods e.g., MLP, single layer LSTM , and LSTM in combination with MLP have been used for monitoring the hourly pollution trends. The performance of the proposed models has been compared in terms of MSE values and it has been found that no single method is suitable in general. Overall MLP performs well for any type of imputation technique and linear interpolation, spline interpolation and backward fill methods are found to well-perform respectively for the three different datasets.

Simple scalable transformation of waste laser tonner into magnetic black pigments by pyrolysis and its application in magnetic leather finishing

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Management of e-waste is one of the major challenges towards rapid urbanization. Extensive use of laser printers has resulted in the generation of huge waste toner powder (WTP) (~6000 tons/year). WTP contains about 7.0%, polyacrylate, 56.0% polystyrene, 1.0% SiO_2, and 38.0% Fe_3O_4. The presence of Fe_3O_4 makes it magnetic. Because of its engineering and chemical endurance, it has limited (20-30%) recycling options. Hence most of it is dumped in landfills. Recently WHO had classified WTP as class 2B carcinogen. Reutilization of WTP by converting them into valuable materials is an excellent idea for the protection of the environment. Here, we propose a simple scalable conversion of WTP into the carbon/Fe_3O_4 material by controlled pyrolysis and subsequently its application as a black magnetic leather finish. The recovered WTP was carefully pyrolyzed at 600 °C under vacuum conditions; and was milled and sieved. Developed MC was characterized before and after pyrolysis using various analytical tools. Presence of Fe_3O_4 was confirmed by XRD and Mössbauer studies in native and pyrolyzed WTP. FE-SEM revealed that the appearance of WTP changes from rough and uneven to even and spherical after pyrolysis. Fe_3O_4 nanoparticles (~80 nm) were recognized by TEM analysis in both the original and modified WTP. VSM analysis revealed that pyrolysis doubled the magnetic saturation of the material. Substantial magnetic properties are imparted to leather that has been finished with native and treated WTP using blend formulation. Coated leather also demonstrated good abrasion resistance, rub-fastness, and flexing endurance in both dry and wet conditions.

Clean fuel use, political representation and forest cover: Evidence from rural India

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This study illustrates the persistent reliance of solid cooking fuels practice in rural areas that poses significant health hazards due to indoor air pollution which also becomes an emerging development issue specially for rural India. Despite Government intervention programme like the Pradhan Mantri Ujjwala Yojana (PMUY) aiming to promote clean cooking fuels among disadvantaged & needy households such as the ST community, the transition from traditional solid fuels remains uneven. Using data from the Mission Antyodaya survey for 2020, encompassing 484107 village-level observations, this paper highlights the critical role of forest cover in shaping household fuel choices across rural regions in India. By integrating forest cover data from the SHRUG database, we uncover extensive forest cover becomes an obstacle in promoting targeted intervention programme namely, PMUY and significantly lowers household's cooking fuel choice. Our findings remain robust even when accounting for varying levels of village development proxied by nightlights and supply-side constraints, such as the reach of LPG distribution networks proxied by the terrain ruggedness index, elevation and length of earliest completed new roads and upgraded roads across sub-district level. As these supply side constraints do not offset the barriers of clean fuel use we shed light on complex dynamics influencing clean fuel use accounting for ST population who are declared as targeted beneficiary of PMUY. To further explore this scenario, our study focusses the patterns of clean fuel use and PMUY provision in "Scheduled Areas" which was declared by the Indian Parliament in fifth schedule of India's Constitution following the post-independence period where majority of population constitutes Scheduled Tribes and mostly rely on forest products to earn their livelihood. We use several electoral mechanisms to identify the impact of political mandates on clean fuel use. Our results indicate empowered elected representatives to advocate for better stewardship of forest resources which hinders clean cooking fuel use among marginalized communities, ST and these electoral quotas have no significant influence on PMUY utilization in Scheduled villages where ST populations are a majority. This finding reveals the relationship between forest availability, political representation, and access to clean cooking fuel benefits.

Analysis of spatiotemporal trends in climatic variables in the coastal plain of West Bengal

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A comprehensive understanding of the climatic variables that are present in any agroecological zone is essential to the production and management of sustainable agricultural output. Consequently, it is essential for studies involving the analysis of climatic variables to have been undertaken in developing nations such as India. In the current study, an attempt is made to analyze the spatiotemporal trends of two climatic variables, namely rainfall and temperature on large scale since the highly localised climate conditions can be of critical importance for agricultural applications. The significance of the study pertains to the attainment of SDG 13, as it focuses on identifying climatic patterns and trends, which may facilitate appropriate climate actions as required. This study has been conducted in the southern region of Purba Medinipur District, located in the Coastal Plain of West Bengal, due to its vulnerability to severe cyclones in recent years. Data for rainfall (R), maximum temperature (Tmax), and minimum temperature (Tmin) were collected in time-series gridded format from the Indian Meteorological Department (IMD) for the period of 1951-2024. The analysis of the data was carried out using the more advanced statistical methods, which included the Mann-Kendal Test, Sen's Slope Test, and the Coefficient of Variation (CV). The findings reveal that temperature and rainfall irregularities are rising, which may have implications on agricultural production in the future, particularly for farmers who are smallholders. Therefore, agricultural scientists and policymakers may come up with necessary steps to address these climatic adversities considering the findings of the present study.

Simulation of future rice production under downscaled climate change scenarios over south Bengal

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Rice productivity is expected to decline many folds under the influence of global warming and climate change. The focus of this study is to investigate how the productivities of Kharif rice are changing under different climate change conditions from the CMIP6 SSP scenarios over a location of the New Alluvial zone of West Bengal. Whole assessment was performed using a crop simulation model known as the Decision Support System for Agro-technology Transfer (DSSAT). Firstly, the model was calibrated using the 2020 field experimental data and validated with the 2021 data. The values of several statistical indices as calculated between the observed variables and simulated variables indicates that the crop model could reproduce the observed parameters with a high reliability in terms of lower errors and high agreement. Then it has been used in investigating the future rice productivity as influenced by future climatic conditions as simulated by several CMIP6 SSP scenarios. The yield simulations under these future climate conditions suggest a potential decline in rice productivity. The CERES-Rice model, when run under different SSPs scenarios with downscaling, indicated a clear declining trend of future rice yields by approximately 10% to 20% by 2050, and further declining up to 30% by the end of the century irrespective of considered varieties and SSPs. The study also emphasizes incorporation of different agronomic adaptation strategies like altering dates of sowing and application of suitable doses of fertilizer may reduce yield loss in a marginal rate.

Climate crisis and gender discrimination: A crucial scenario of injustice

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Climate change and gender inequality cross paths, as impacts of climatic change often complement existing socio-economic, cultural and political inequalities. As an economic system essentially propelled by motives of making profits, Capitalism, has been an avid applauder for innovation, competition and economic development. Yet it is also criticized for serving as catalyst to social injustice and disparity. In this capitalist framework where social injustice is not just inherent but also a complex phenomenon, unequal access to resources, systematic deprivation, impoverishment become rampant and clash of conflicting interests often favour the affluents and marginalize underprivileged. It also leads to ecological downturn, environmental damages affecting women the most across the world. Countries attributing the least to global greenhouse gas emissions, often endure severe impacts of climate crisis. Low-income nations with relatively small carbon footprints, face some of the worst aftermaths, such as rising sea levels, extreme weather upheaval, droughts, floods etc. Ecological calamity affects natural wealth and economic growth of women as scarcity of resources increases their workload, exposure to unsafe and unhealthy environment and time spent away from education or employment. Climatic disaster frequently forces communities to migrate, placing women and girl children at a higher risk of gender-biases and the violence that follows like rape, molestation, exploitations, especially in interim shelters and refugee camps. This paper will discuss, from a gender-sensitive approach, the environmental challenges faced by women in neo-normal era, and attempts to overcome the same, towards contributing to women empowerment and combating climate crisis for a sustainable future.

Promoting climate resilience among youth through sustainable practices

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Climate crisis, over the recent years, has become one of the alarming issues, with far-reaching consequences of the mother earth and its inhabitants. Hence, the need for immediate and effective discussions on the strategies to solve this critical problem or at least mitigating its effects has been felt more and more nowadays. As the next generation has a crucial role to play in addressing such global challenge, promoting climate resilience among youth through sustainable practices, education and community engagement is urgently needed. Empowering young people to take action can foster a culture of sustainability, drive positive change and ensure a resilient future for all. The present study strives to highlight effective strategies, successful initiatives and innovative solutions to inspire and support the development of climate-literate, engaged and active youth leaders. Various environmental awareness programs, workshops, seminars and webinars need to be held in different academic institutions to spread mass consciousness regarding the nature and consequences of climate change at global level. Youth-led initiatives like eco-friendly products (such as '*From Trash to Treasure'*) may be considered as effective weapon to fight against climate change besides generating employment and economy earning. Besides, technical training, sustainable agriculture and food system, increase usage of renewable energies, social media campaigns, climate app and tools or more new invention by youth can resist climate changes and promote sustainable climatic resilience in near future.

ABSTRACTS OF THE

SUBJECT AREA:

AGRICULTURE, HORTICULTURE, FISHERIES AND VETERINARY SCIENCES

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Mass multiplication and optimization of media components for chitinase production by native rhizospheric bacteria for their antifungal activity

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Many potentially beneficial strains did not make it to the commercial market; possibly due to unavailability of proper formulation. It is also evident that not much effort has been carried out to synthesize a carrier with predefined superior characteristics for agricultural and environmental purposes, presumably because of the high cost. Furthermore, fungal cell wall is made up of chitin. Chitinase producing microbes are promising candidate for the management of plant pathogenic fungi. Hence, in this study, an attempt was made to develop a low cost media which can augment chitinase production. Nutrient sources like sugarcane molasses, groundnut cake, Baker's yeast and shrimp shell chitin were used for mass production of native rhizospheric bacteria, *Pseudomonas aeruginosa* GP8. The individual components were optimized through response surface methodology and central composite design to alleviate the chitinase activity. Quadratic model was selected with adjusted R^2 value of 0.8798 and predicted R^2 value of 0.8217. The optimized media having components like sugarcane molasses (1 %), groundnut cake (20 %), Baker's yeast extract (0.25 %) and shrimp shell chitin (0.5 %) showed highest chitinase production (3.000 EU/ml). Further, the optimized media showed mycelial inhibition of *Sclerotium rolfsii* (65.19 %) and *Rhizoctonia solani* (45.93 %), and an increase in secondary metabolites production. Therefore, this bioformulation may be used to ameliorate the chitinase production of biocontrol agents to mitigate phytopathogenic fungi and that too with less cost.

Management strategy for post-harvest disease of fruit crops with manipulation of bio-inoculant: the yeasts

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Post-harvest diseases cause national loss of 30-40% in fruit crops like mango and banana. The studies were conducted for efficient management against the post-harvest loss caused by fungal pathogen particularly the *Colletotrichum* spp, utilizing yeast-based bio-control agents isolated from phylloplane and fructo-plane of fruit crops. The two bio-control yeast isolates: *Meyerozyma* sp. and *Candida* sp., were evaluated along with a chemical fungicide as a comparative study. Dual culture techniques and *in vivo* assessment on ripe fruit were tested with natural antifungal products like safflower, flaxseed and sesame oils. A novel oil-based liquid formulation of yeasts was tested and were recorded as an effective tool to enhance efficacy against post-harvest disease of bananas and mangoes followed by assessment of shelf life, and spoilage rates, alongside monitoring viable yeast populations in storage. The morphological and cultural characteristics of the different biocontrol yeast isolates were examined in detail. Among the fifteen bio-control yeasts, the isolate YDP27 was observed as the most effective followed by YDP41. Both the isolates along with carrier materials, were standardized for shelf life and disease reduction. In *in-vivo* tests, formulations S1 (Safflower oil + YDP27) and S3 (Flaxseed oil + YDP27) effectively reduced disease spread and extended shelf life by 2-3 days. To successfully commercialize the biocontrol agent, a minimum population of 6 Log_{10} CFU/ml must be sustained for six months. The two yeast isolates met this requirement, and fruits treated with these yeast formulations even after 180 days of storage showed marketable acceptability of fruits.

Nexus between livelihood diversification and socio-demographic predictors among tribal households in Paschim Medinipur district of West Bengal: A cross-sectional study

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Livelihood diversification is the most common and suitable strategy among marginalized and vulnerable social groups especially among Scheduled Tribe in West Bengal. This occurs due to limited access to resources and relies on primitive agriculture, farming, livestock, and daily wages, which triggered the diversification of their livelihood. Therefore, we aimed to investigate the determinants and associations of livelihood diversification in the Paschim Medinipur district of West Bengal. A multistage cluster random sampling method was used to collect data from 450 scheduled tribe households through a structured questionnaire. Descriptive statistics, chi-square test and Simpson Index of Diversity (SID) were applied for preliminary analyses of livelihood diversification. Furthermore, a censored regression model (CRM) or Tobit model was employed to identify the factors influencing and predicting the household's decision to livelihood diversification. The results showed that 30.44% of households engaged in agriculture, 26.44% off-farm, 22.67% non-farm and 12% engaged in other combined livelihoods with a SID value 0.733. CRM model revealed that households with a combination of livelihood (0.472, $p<0.05$), tribal groups (0.123, $p<0.05$), households having agricultural land (0.128, $p<0.05$), households with migrant members (0.183, $p<0.05$), household wealth index status (0.073, $p<0.05$), availed Self-Help Group (SHG) assistance (0.178, $p<0.05$) and participation in MGNREGA (0.175, $p<0.05$) are positively associated with and significantly predicted diversification of livelihood. Therefore, the result of this study can be integrated into community-based policies, such as ensuring MGNREGA, agricultural incentives, and welfare schemes for sustainable and inclusive development for tribal communities in the Paschim Medinipur district of West Bengal.

Decontamination magnitudes of thermal impacts, and different water-based techniques for removing pesticide residues from regularly consumed veggies and food safety analysis

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Fruits and vegetables are essential for human nutrition and good health. Unfortunately, there are significantly more pesticide residues in these commonly consumed food products due to the careless application of pesticides. Various decontamination processes with varied levels of pesticide residue reduction are the simplest approaches to eliminate these pollutants from food. In controlled field and tunnel settings, the effects of several heat and water treatment techniques in a variety of fruits and vegetables were studied. Boiling, as well as washing in chlorinated, detergenated, alkalinized, and ozonized water, were used to investigate eleven plant protection products-sprayed cabbage, cauliflower, brinjal, and tomatoes. The amount of decontamination varied depending on the pesticide, product, and processing technique used, ranging from 0.03 to 1.66 mg/kg. The toxicant removal efficiency of washing in ozonated water was higher than washing in chlorinated water. High boiling temperatures dramatically lowered the concentration of most compounds (up to 97%), while there were a few exceptions. Thermal treatment proved to be the most effective technological solution for getting rid of pesticide residues from different commodities. It is possible to remove pesticide residues from other commodities fast and easily using the water washing and heat decontamination procedures that have been proven.

Optimizing integrated nutrient management practices for sustainable rice-based cropping system in lower Indo-Gangetic Plains

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Modern agriculture aims to enhance productivity while curbing fertilizer use and minimising environmental impact. A study was conducted in a long-term field experiment at the Central Research Farm, Gayeshpur (22°58´N, 88°29´E), to evaluate the direct and residual effects of INM under rice (*Oryza sativa* L. cv. IET 4786) - rapeseed (*Brassica napus* L. cv. B-9) cropping system. In kharif rice, a randomized block design with three replications and nine treatments resulted in significant changes in soil physicochemical properties. In succeeding rapeseed, a two-factor randomized block design was used and comparable results were observed. Application of sub-optimal doses of fertilizer combined with organic manures (FYM/green manure) and biofertilizers maintained higher levels of nitrogen, phosphorus, and potassium in soil during kharif and left a significantly higher residual fertility support to rapeseed compared to control and sole inorganic treatment. Application of (50% NP + 100% K) of soil test-based fertilizer with green manuring, *Azospirillum* sp., and Phosphobacteria (*Pseudomonas* sp.) resulted in the highest grain yield, crude protein content and nutrient uptake in both rice and rapeseed. The same treatment recorded the highest rice equivalent yield (5376.5 kg ha^{-1}). The control and sole organic treatment reported higher internal utilization efficiency of nutrients compared to other treatments. Grain yield was significantly correlated with N, P, and K concentrations in grain and straw in both crops. This INM strategy is optimal for achieving high yields while minimizing the use of chemical fertilizers in rice-based cropping systems, particularly in the new alluvial zones of the lower Indo-Gangetic plains.

Characterization and management of *Fusarium* head blight, an emerging disease of wheat in West Bengal

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Wheat (*Triticum* sp.) is an important cereal crop globally. Recent times, Fusarium head blight (FHB) poses significant threats to wheat cultivation. A study was conducted in the Plant Pathology laboratory and District Seed Farm of BCKV to characterize the pathogen and finding the effective management practices. Initially, pathogen was isolated in potato dextrose agar media (PDA) from collected disease samples. Morphological and molecular studies confirmed the pathogen as *Fusarium equiseti*. Several cultural studies were conducted to unravel the different vital characteristics of the pathogen, and it was observed that oatmeal agar media supported the highest mycelial growth, and spore concentration. Growth rate of *F.equiseti* was maximum at 20°C, whereas conidia size was maximum at 25°C. Gene expression studies was also conducted to observe the effect of different carbon sources on trichothecene toxin gene expression, it was revealed that trichothecene gene expression was higher in dextrose containing broth compared to starch and sucrose. To address the management aspects, initially efficacy of fungicides and bioagents were tested under *in vitro* condition and it was observed that Propiconazole 25% EC and Azoxystrobin 18.2% + Difenoconazole 11.4% SC effectively inhibited the growth of *F.equiseti*. Among bio-agents tested *Bacillus subtilis* (BRB-88) emerged as a potent antagonist. In field experiments, fifteen wheat genotypes were screened, and it was observed that most of the lines were moderately susceptible to FHB. Azoxystrobin 18.2%+Difenoconazole 11.4% SC (sprayed at 50% anthesis stage and 10 days after 1st spray) was more effective to manage the disease.

Effect of nano urea in rice hybrids (*Oryza sativa* L.) during *Kharif* season under New Alluvial Zone of West Bengal

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A field experiment was conducted during the kharif season of 2023 at Central Research Farm, Gayeshpur, B.C.K.V., Nadia, West Bengal, to evaluate the effect of nano urea on rice hybrids (Oryza sativa L.) in the New Alluvial Zone of West Bengal. The split-plot design comprised three rice hybrids (V1: CHR 846, V2: PAN 2423, V3: GMS 2264) in main plots and four fertilizer treatments (F_1: recommended dose, F_2: 75% nitrogen + nano urea spray @ 2 ml/l at 42 DAT, F_3: 75% nitrogen + nano urea spray @ 4 ml/l at 42 DAT, and F_4: 50% nitrogen + two nano urea sprays at 21 and 42 DAT) in sub plots. Results indicated that the CHR 846 variety exhibited the highest grain yield (5.89 t/ha), straw yield (6.55 t/ha), and harvest index (47.53), along with superior yield attributes such as panicle count and filled grains per panicle. Among the fertilizer treatments, F_1 (recommended dose) resulted in significantly higher grain (5.76 t/ha) and straw yields (6.74 t/ha), which were at par with F_3 (75% nitrogen + 4 ml/l nano urea spray). The lowest yields were observed in F_4 (50% nitrogen + two nano urea sprays). Additionally, the F_1 treatment provided the highest net return (Rs. 73,179) and benefit-cost ratio (2.15), whereas F_4 had the lowest economic returns. Thus, the study suggests that CHR 846, combined with the recommended fertilizer dose of 90:45:45 ($N:P_2O_5:K_2O$) kg/ha, offers optimal productivity and profitability for rice cultivation in the New Alluvial Zone of West Bengal.

Development of liquid bioformulations of phosphate solubilizing *Enterobacter* sp. (AJ14) for acid soils

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Phosphate-solubilizing bacteria (PSB) enhance phosphorus (P) use efficiency in acid soils through the production of organic acids. However, the short shelf life of carrier-based PSB biofertilizers limits their popularity among farmers. In this study, we developed and tested various liquid bioformulations using the PSB strain *Enterobacter* sp. (AJ14), isolated from an acid soil of West Bengal. The bioformulations were evaluated for their shelf life and effectiveness over eight months. Seven formulations were tested: F1 (Pikovskaya broth), F2 (isotonic phosphate buffer, IPB), F3 (IPB + 0.5% PVP), F4 (IPB + 0.5% PEG), F5 (soybean oil + 2.5% Tween 20), F6 (coconut oil + 2.5% Tween 20), and F7 (charcoal-based).The F1 could only maintain *Enterobacter* viability for four months, while the other formulations preserved populations significantly longer. Buffer-based (F2–F4) and emulsion-based formulations (F5 and F6) sustained populations >5×10^8 CFU/mL, significantly higher than solid carrier formulation F7 (1×10^7 CFU/mL). Though buffer formulations F3 and F4 maintained the highest *Enterobacter* populations after eight months, emulsion-based formulations exhibited less reduction of cell count from their initial population. Among all, F3 maintained the highest cell population (2.7×10^9 CFU/mL), followed by F4 (1.27×10^9 CFU/mL), F5 (1.0×10^9 CFU/mL), and F6 (0.63×10^9 CFU/mL). All these four formulations retained the P- and K-solubilizing efficiency of *Enterobacter* sp. (AJ14). These liquid formulations offer a promising alternative to soil carrier-based formulations as biofertilizers for acid soils in West Bengal.

Assessing coastal salinity: Fusing remote sensing and EM data for sustainable land use in the Indian Sundarbans

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The Indian Sundarbans, part of the world's largest mangrove delta, faces severe agricultural challenges due to seasonal soil salinity, poor drainage, freshwater scarcity, and frequent tropical cyclones. Salinity fluctuates seasonally, with low levels during monsoon due to freshwater influx and peaks during summer from capillary upwelling. Despite abundant water bodies, saline water limits irrigation options, posing significant obstacles to crop production. This study aims to assess soil salinity through an Electromagnetic (EM) survey and satellite remote sensing, conducted over four years in Gosaba C.D. Block. The survey utilized DualEM- 1HS to record apparent electrical conductivity (ECa) at multiple soil depths. The data were spatially analyzed using ordinary kriging, and Sentinel-2 satellite imagery was processed to generate spectral indices. K-means clustering effectively categorized land based on ECa data, providing insights into spatial and temporal soil conductivity variations. The correlation matrix guided the selection of salinity indices for stepwise regression models, which, despite some biases, showed strong correlations between observed and simulated ECa values. This study explores the potential of these advanced technologies to enhance agricultural productivity in the Sundarbans by providing a comprehensive understanding of soil salinity dynamics and enabling the development of targeted management strategies.

Inheritance of host plant resistance against viral diseases and role of defense related biochemical traits in Okra

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The Bhindi yellow vein mosaic virus (BYVMV) and Okra enation leaf curl virus (OELCV) are the two most complicated biotic constraints limiting okra production across the country. Constant evolution of begomo viruses through mutation and recombination leads to the breakdown of resistance in many varieties. Comprehending the inheritance of disease resistance and the role of biochemical components regulating plant defense mechanism is crucial for framing an efficient resistance breeding strategy. The present study evaluated six generations, P_1, P_2, F_1, F_2, BC_1, and BC_2 of two contrasting cross combinations involving Tolerant × Tolerant and Tolerant × Susceptible for BYVMV and OELCV diseases separately during the *Kharif* season. Relationship between the disease severity and the proximate compositions along with enzymatic activities were studied. Generations from two crosses demonstrated incredibly high AUDPCs for susceptible reaction. The inheritance study through χ^2 test indicated that the host plant resistance to both diseases were governed by two duplicate dominant genes in Tolerant × Tolerant combination and two duplicate recessive genes in Tolerant × Susceptible combination. The scaling test based on six parametric model also emphasized the presence of duplicate epistasis for the disease parameters. The enzymatic activities (Peroxidase, Polyphenol oxidase and phenylalanine ammonia-lyase) and proximate compositions (ascorbic acid, phenol, protein, total chlorophyll) in okra leaf exhibited significant, negative, correlation with percent disease index of OELCV and BYVMV over the growth stages and proved to be potential selection indices. The study recommends modified bulk breeding approach with delayed selection after attaining homozygosity for maximum heterozygous loci.

Temperature sensitivity of soil nitrogen in long-term fertilization for climate-resilient nutrient management

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Quantitative data on soil nitrogen (N) mineralization under long-term nutrient management is crucial for understanding N availability and loss. The temperature sensitivity (Q_{10}) of soil nitrogen mineralization (Nmin) affects the interaction between soil productivity and climate warming, yet information on how fertilization impacts Q_{10} and Nmin in long-term fertility experiments (LTFEs) is limited. A laboratory incubation study was conducted at four temperatures (10°C, 20°C, 30°C, and 40°C) and two moisture regimes (100% and 80% field capacity), using surface soils (0-15 cm) from LTFEs at Pantnagar, Sabour, Udaipur, and Raipur across diverse soil and agro-climatic zones. Treatments included a non-fertilized control, chemical fertilization with various NPK grades, and integrated nutrient management (INM). The study found higher Q_{10} in control treatments, followed by chemical fertilization and INM, with a decline in mean Q_{10} as moisture increased. Activation energy (Ea) showed a negative correlation with substrate quality index (Q), supporting the carbon quality-temperature (CQT) hypothesis for N mineralization. The simulated Q represents the labile fraction of organic nitrogen (e.g., amino acids and sugars), which is more resilient to temperature changes. Long-term application of farmyard manure (FYM) or organic sources with chemical fertilization reduces Nmin temperature sensitivity, thereby minimizing N loss and enhancing yield potential in warming climates.

Novel boron application technology for improving quality of tomato (*Solanum lycopersicum* L.) and cauliflower (*Brassica oleracea* var. botrytis L.)

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Tomato (*Solanum lycopersicum* L.) and cauliflower (*Brassica oleracea* var. botrytis L.), which are excellent vegetables to provide important nutrients and bioactive compounds for human health benefits, are sensitive to boron. Influence of boron application for improving physical, biochemical, bioactive and nutritional attributes of tomato and cauliflower, by synchronising boron requirements of the crops is not reported yet. This study critically evaluated influence of five boron application treatments with seven tomato genotypes on 28 fruit quality attributes and with seven cauliflower genotypes on 20 curd quality attributes. In-depth evaluation showed that boron directly influenced fruit pericarp thickness, pH, phenol, Zn, Cu and B content. In the case of tomato, boron application (2.0 kg ha^{-1}) to soil at planting plus foliar spray (0.125 kg ha^{-1}) at pre-flowering stage was the best, which improved fruit quality by improving physical (6.1-33.1%), biochemical (7.8-49.0%), bioactive/antioxidant (16.7-207.5%) attributes and mineral nutrients (9.6-146.8%) content. This led to improve fruit quality indices for both fresh consumption and processing by about 31.0%. For cauliflower, B application (2.0 kg ha^{-1}) to soil as basal at planting plus foliar spray (0.125 kg ha^{-1}) before curd initiation was the best to improve curd quality by increasing physical (11.2-29.1%), bioactive/antioxidant (15.8-18.5%) attributes and mineral nutrients (7.0-52.0%) content. The study suggests cultivation of the promising genotypes of tomato and cauliflower with good boron management technology for producing superior quality fruit and curd, respectively, in intensive vegetable growing regions.

Assessment of global warming potential, carbon balance and farm energetics from varied field experiments: A pathway towards eco-friendly crop management and net-zero goal

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Global pursuit of sustainable production systems extends beyond a mere focus on heightened productivity; it necessitates a comprehensive comprehension of farm-level energy dynamics and the ensuing environmental ramifications. Moreover, the escalating patterns observed in C emission and Global Warming Potential (GWP) are intricately linked to the adoption of energy-intensive agricultural methodologies. Indian agriculture exclusively provides 22.50% total country's GHGs emission and rice cultivation solely contributes 10.1% of total agricultural emission. Energy fluxes, GWP and C balance were estimated by considering the inputs, their quantity and management practices using FAO and IPCC guidelines. Results from a long term (8 years) field experiment on application of organic and natural inputs on rice-based cropping system showed almost 82% reduction of GHGs under fully organic input along with higher C stock as compared to conventional practices. Results from another experiment related to nutrient omission on rice revealed that rational uses of inorganic fertilizer (recommended by Nutrient Expert©) accounted low GWP (1075 kg CO_2e/kg rice) over recommended dose (1350 kg CO_2e/kg rice) without compromising the productivity. Maximum net energy gain (78046 MJ/ha) and energy use efficiency (4.24) were accounted from similar recommendation. In another study, rice cultivation under non-puddled condition with alternate wetting drying resulted in less CH_4 emission and left less water footprint over conventional practice. Aforesaid findings concluded that judicious application of farm resources along with low energy intensive practices are earnestly needed to meet the sustainable approaches towards net zero goal.

Arko Provo (WBSH-2021): First sunflower hybrid developed in West Bengal notified for cultivation

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Sunflower hybrid Arko Provo (WBSH-2021) was developed at Pulses & Oilseed Research Station (PORS), Berhampore, West Bengal during the period 2003-2008 through crossing between male sterile line CMS 7-1 A with restorer line RHA 6D-1. The parental materials were collected from ICAR- Indian Institute of Oilseed Research, Hyderabad. Based on performance in the AICRIP (Sunflower) trial during 2013-14 (Initial hybrid trial) and 2014-15 (Advanced hybrid trial), WBSH -2021 was found superior to DRSH-1 and KBSH-44 (National check). WBSH-2021 (Arko Provo) had the distinction of attaining 2246 kg/ha. seed yield whereas, DRSH-1 and KBSH-44 (National check) recorded 1943 and 2106 kg/ha seed yield respectively under national trial. WBSH-2021 (Arko Provo) also recorded significantly lower plant height (124 cm) and early maturity (119 days) than national check variety DRSH-1 and KBSH-44. Superior performance of Arko Provo (WBSH-2021) in the coordinated and multilocation trials over the years, led to notification by central variety release committee (CVRC) for release in West Bengal [Notification No. S.O.4065 (E) New Delhi, 31.08.2022]. Molecular markers clearly distinguish the hybrid Arko Provo (WBSH-2021) from other check hybrids where ORS-379 and ORS-1159 were specific for Arko Provo (WBSH-2021).

Unravelling seeds of uncertainty in a selected area of West Bengal using FCM and ML tools

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The high degree of uncertainty makes it challenging for farmers to plan ahead. The effects of uncertainty associated with climate change on farming outcomes vary based on geographical location and specific agricultural practices, as agriculture is influenced by a complex interplay of social, ecological, and economic factors. By adopting a holistic approach that considers all these factors, we can better understand how farmers interact to shape the intricate connections between uncertainty and other variables. This study was conducted in three purposefully selected villages of Kastadanga-I gram panchayat, Haringhata block, Nadia district, West Bengal. The study was carried out on 90 randomly selected respondents and data were collected through a structured interview schedule. The study assessed intra and inter level interactions among and between a set of exogenous variables and consequence variables using fuzzy-logic cognitive mapping and machine learning algorithms like stepwise regression analysis, canonical covariate analysis, and artificial neural network, elucidating their effects on the perceived uncertainty of farmers. The findings indicate that factors such as functional education, family size, on-farm income, savings, livestock count and soil and biodiversity conservation perception among other independent variables significantly impact farmers' level of perceived uncertainty. The research advocates for substantial micro-level socio-ecological strategies to promote resilient farming practices as well as to increase farm income.

Compositional changes in fresh and processed products in crosses between standard tomato and cherry tomato involving varied fruit colours

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Genetic enhancement of tomato for improved processing quality needs to be pursued for ensuring antioxidant retention in processed product. In processing tomato breeding, improvement of fresh fruit quality is an important objective. These quality attributes are highly variable and changes with the genotypes, growing conditions and processing methods. We have assessed compositional changes of double cross tomato hybrids developed by involving four single cross hybrid genotypes and crosses between two purple tomato and three cherry tomato genotypes in fresh and processed form. The present investigation amply demonstrated significant variation in different quality characters in the hybrids suggesting that lycopene, β-carotene, ascorbic acid, anthocyanin, titratable acidity and TSS of tomato mostly depends on both genetic factors. Lycopene content in the processed product increased substantially (321.11%) in purple × cherry hybrid tomatoes after heating due to rise in extractability of lycopene and Bidhan Purple × Cherry yellow big fruit (20.33 mg/100 g) reported maximum lycopene content. Anthocyanin content in the processed product decreased considerably by 86.28% in purple × cherry hybrids and 87.65% in purple tomato genotypes thereby hybrids retained more anthocyanin than parents when exposed to heat. Except TSS and lycopene content, other biochemical compositions were found to decrease after processing. Suitable thermal method needs to be standardized for preparation of different processed products with the retention of adequate level of lycopene, ascorbic acid and other anti-oxidants. Involvement of multi-parents in the development of hybrids could provide a useful germplasm source with diverse allelic combinations for developing superior tomato products.

Mental modeling of human elephant conflict using fuzzy cognitive mapping and decision ecology for conflict resolution

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Human elephant conflict (HEC) causes a significant challenge, with severe occurrences documented in Asian and African countries. It hampers economic growth by disrupting agricultural activities and local economies, while also contributing to ecological imbalance. HEC is widespread in southern part of West Bengal in India, and the conflict is especially severe in several villages of Bankura district. This study was executed to understand the complex phenomenon of HEC, and develop the effective mitigation strategies for sustainable coexistence. Nine villages from three gram panchayats at Barjora block of Bankura district in West Bengal were chosen deliberately. After finding the key informant, additional respondents were found using snowball sampling. Data was collected through direct individual interviews with 37 respondents, and analysis was conducted using 'Mental Modeler'. In this study, fuzzy cognitive mapping was employed to construct stakeholders' mental models, revealing areas of both shared interests and conflicts related to HEC. A shared mental map was developed by amalgamating individual cognitive maps. We performed three scenario analyses considering various hypothetical scenarios for suggesting better decision-making in the context of HEC in Bankura district. The findings highlighted noteworthy elements like crop damage, elephant attack, corridor breakage, habitat loss, human death or injury, aggressiveness of elephants, and food availability within forest area etc.; and mitigation strategies were proposed by scrutinizing the results of scenario analysis.

Utilization of sensor-based technology for low-cost meteorological information delineate system

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In the context of modern agriculture, effective farm management is increasingly reliant on accurate meteorological data. Accurate meteorological data is essential for effective farm management, yet traditional measuring systems can be prohibitively expensive for many farmers. This study presents the development of a low-cost measuring system aimed at studying and analyzing key meteorological parameters for agricultural purposes. The system utilizes various sensors, including DHT11, DHT22, BME680, and soil moisture sensors, to collect real-time data on temperature, humidity, air quality, and soil conditions. Data collected from these sensors is processed using machine learning and artificial intelligence techniques to extract valuable insights that can aid in decision-making for farmers. The system's affordability makes it accessible to a broader range of users, thus enhancing its potential impact on sustainable agriculture. Our findings demonstrate that the proposed low-cost system not only significantly reduces the financial burden associated with traditional meteorological equipment but also provides farmers with predictive analytics that improve resource management and crop yield. By empowering farmers with accurate data and analytical tools, this research contributes to the advancement of precision agriculture and promotes sustainable farming practices. Overall, this study highlights the importance of integrating innovative technology into agriculture, aiming to bridge the gap between data accessibility and practical application in farm management.

Trichoderma improves nutrient uptake and yield of tomato (*Solanum lycopersicum*) in Red and Laterite soils of eastern India

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Soils of Red and Laterite zone of West Bengal are poor in fertility and farmers are forced to apply huge amount of inorganic fertilizer for higher produce, resulting into degradation of soil health and decline in crop production. An experiment was conducted to find out the influence of different levels of inorganic fertilizer and biofertilizer on nutrient uptake, crop growth and productivity of tomato in red and laterite soils of Jhargram. Nutrient uptake, crop growth and yield were found to vary significantly under various treatments. Liming and application of vermicompost increased nutrient (N, P and K) uptake significantly. Effect of Trichoderma inoculation and boron application was also visible on crop growth and yield. NPK uptake was found to vary from 90.1 to 155.2 kg ha^{-1}, 9.1 to 25.7 kg ha^{-1} and 60.1 to 90.5 kg ha^{-1} respectively and was highest under plots when boron and lime was applied alongside vermicompost, inorganic and *Trichoderma* (L_1N_6). Similar trend was noticed for crop growth and yield. Plant dry matter accumulation was found to vary from 22.8 to 58.4 and 43.3 to 166.1 gm m^{-2} at 30 DAE and 60 DAE respectively. Tomato yield varied from 8.4 to 22.0 t ha^{-1} and highest yield was recorded under L_1N_6 treatment. It was concluded that application of boron and *Trichoderma* significantly enhanced nutrient uptake thereby tomato yield in soils amended with lime and vermicompost; and may be recommended for this zone.

Priming with PEG-6000 positively influenced seedling development of carrot

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The present investigation was conducted with three carrot genotypes like Carrot Florence, Deb Kuroda-1, and Deb Kuroda-3. The priming was done with varying concentrations and durations of PEG-6000, which were 0.1 MPa for 24 hours, 0.1 MPa for 48 hours, 0.25 MPa for 24 hours, 0.25 MPa for 48 hours, 0.40 MPa for 24 hours, 0.40 MPa for 48 hours, and non-primed seeds in order to improve germination and vigour. A pre-sowing procedure called 'seed priming' creates a physiological state that facilitates more effective seed germination. The experiment was conducted in the Department of Seed Science and Technology's seed testing laboratory in Mohanpur, Nadia, West Bengal, India. The results of the experiment showed that seeds soaked in 0.25 MPa PEG-6000 for 48 hours outperformed seeds treated with other priming concentrations and durations due to their significantly higher potential, as measured by treatments over genotypes. In the case of genotypes over treatments, the best genotype was recorded Deb Kuroda-3. For seed quality parameters such as germination energy (47.273), seedling vigour Index-I (639.032), and germination index (5.503), seeds soaked in 0.25 MPa PEG-6000 for 48 hours demonstrated the significantly best performance. But highest germination percentage was observed in PEG-6000 @ 0.1 MPa for 48 hours which was non-significant with PEG-6000 @ 0.25 MPa for 48 hours. Therefore, when treating carrot seed, PEG-6000 @ 0.25 Mpa pre-sowing treatment for 48 hours is recommended for better seedling establishment.

Performance of tossa jute (*Corchorus olitorius* L.) under various weed management practices

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An experiment was carried out during pre-*Kharif* season of 2023 at Teaching Farm, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal with the objectives: i) to study the effect of grasses, sedges and broad leaf weeds as influenced by different treatment combinations on growth and development, yield viz. overall performance of jute crop. ii) to find out the efficient weed control measure to suppress the weeds within the critical period of jute crop-weed competition. iii) to find out the economics of different weed control measures. Experiment was conducted in randomized block design with 9 treatments viz. T_1: PoE spray of Quizalfop ethyl 10% EC @ 38 g ha^{-1} at 15 DAE + one hand weeding at 25 DAE; T_2: Pre-emergence spraying of Pendimethalin 35% EC @ 525 g ha^{-1} at 48 hrs of sowing+ one hand weeding at 15 DAE; T_3: Jute + Moong intercropping (1:1); T_4: Jute + Red amaranthus intercropping , broadcasting of red amaranthus seed @ 10 kg ha^{-1} in inter-row space of jute; T_5: Mulching with rice straw @ 7.5 t ha^{-1} + one hand weeding at 15 DAE; T_6: Nail weeder at 10 DAE , soil moisture must be at FC + scrapper at 21 DAE; T_7: Control; T_8: Two hand weeding at 15 DAE and 35 DAE and T_9: Pretilachlor 50% EC @ 900 g ha^{-1} at 48 hrs of sowing + one hand weeding at 15 DAE were replicated thrice. In total 27 no. of plots were laid down with 20 m^2 gross plot size area receiving recommended dose of fertilizer (80:40:40 N: P_2O_5: K_2O kg ha^{-1}) with a seed rate of 5 kg ha^{-1} of the variety JRO-204 (Suren). Other standard cultivation practices were followed as per recommendation. The primary requirement for future jute researchers is to prioritise the search for alternative ways, such as the combination of physical, mechanical, and cultural means of weed control, to replace the excessive use of chemical herbicides. Thus, a potential ecological and economical option to achieve optimal fibre quality and sustainable increase in factor productivity is to prevent weed population growth through mulching or intercropping, thereby avoiding competition with crops during the early stages of crop growth up to 45 DAS. From the analyzed data it can be concluded that hand weeding twice at 15 DAE and 35 DAE (T_8) showed best result in all aspects in terms of least weed population (weed count of grasses, sedges and broadleaf), lower dry weight of weed at 15 days intervals from 15-45 DAS was followed by T_9 treatment (Pretilachlor 50% EC @ 900 g/ha at 48 hrs of sowing and irrigation + one hand weeding at 15 DAE) in suppression of weeds. Treatment T_8 recorded the best performance (fibre and stick yield of 3.14 and 2.87 t ha^{-1}, respectively), which was statistically at par with the treatment T_9. T_4 (jute + red amaranthus) treatment also recorded lesser weed count and dry weight. In terms of yield parameter, jute and red amaranthus recorded comparatively higher total yield. T_4 registered the highest benefit cost ratio (2.33) among all the treatments; followed by T_3 (2.14). So, it can be concluded that, for the findings of efficient weed management practice, T_4 (Jute + Red amaranthus intercropping) is the best weed management practice both economically and environmentally

LCC-based top dressing and organic manure for improvement of growth, yield and quality of GI-tagged Gobindabhog rice

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The field experiment replicated thrice in a split-plot design was conducted to find out the effect of organic manure at 20 kg N ha^{-1} (cowdung manure, vermicompost and poultry manure) as basal, and leaf colour chart (LCC)-based N top dressing (no top dressing, neem-coated urea, nano urea and mustard cake) on Gobindabhog rice (Geographical Indication No. 531) at Bidhan Chandra Krishi Viswavidyalaya, Jaguli, Nadia, West Bengal during *kharif* season of 2023. Vermicompost at 20 kg N ha^{-1} applied basally resulted in highest total chlorophyll content (2.63 mg g^{-1}) at 42 DAT, maximum tiller production (346.6 m^{-2}) at 63 DAT, LAI (4.90) at 84 DAT, grain yield (2.67 t ha^{-1}) and better residual nutrient status (+2.6% N and +8.3% P) in soil. But poultry manure had favourable effect toward moderate yield (2.54 t ha^{-1}), better lodging resistance (score 2.0) and protein content (7.4%). Among LCC-based top dressing (score <3) methods, mustard cake at 15 kg N ha^{-1} twice recorded better growth attributes, chlorophyll content in leaf (2.52 mg g^{-1}) at 84 DAT, maximum grain yield (2.79 t ha^{-1}), and better soil P status (+14.2%). The foliar spray of nano urea (4% N) at 1.25 litre ha^{-1} thrice was not found sufficient to provide the desired yield of Gobindabhog rice. The significant positive correlation between grain yield with LAI (r= 0.793**), total chlorophyll content (r=0.610*) and SPAD value (r= 0.654*) at 84 DAT indicated that greater photosynthetic area and chlorophyll content at pre-heading stage favoured the grain yield of tall-*indica* rice.

Mango plantation nutrients feeding device (MPNFD)

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Mango farming has relied on periodic assessments of soil and plant health to determine fertilization schedules. This process can be labour-intensive, inaccurate, and static, not accounting for the changing needs of the plant or environmental conditions. The invention of the Mango plantation nutrients feeding device (MPNFD) a smart device for optimizing mango nutrient supply with AI and biofertilizer integration that can manage nutrient supply and overcome these inefficiencies. The gadget has a sleek and small design, integrated solar panels for sustainable energy generation, and is easily portable for deployment in orchards of any size. AI algorithms analyse soil, plant health, and ambient parameters in real-time to optimise nutrient levels for mango plants. The instrument has a compartment for biofertilizer cartridges with beneficial bacteria such as *Azotobacter, Azospirillum*, and VAM, ensuring a balanced nutrient supply. Integrated sensors track soil moisture, nutrient levels, and plant health, offering farmers with real-time data and insights through a mobile app or dashboard. It uses AI to provide personalised suggestions for irrigation schedules, fertiliser rates, and pest management tactics based on each orchard's circumstances data analysis provides useful insights for educated decision-making and sustainable techniques. It is a step towards a more resource-efficient, eco-friendly, and productive agricultural future. The "Mango Plantation Nutrients Feeding Device " provides a scalable economic and adaptable solution for optimising mango orchard management and enhancing mango farming sustainability.

Anthracnose of lucky bamboo: Morphological and cultural characterization

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Ornamental plants are economically important and widely cultivated due to high demand in international and domestic markets. At least 100 genera, 500 species, and over 1000 cultivars are produced as foliage plants, with 40 genera native to Asia. Among these, lucky bamboo is a prominent ornamental, but it is susceptible to over 20 fungal, viral, and bacterial diseases. Anthracnose, caused by *Gloeosporium leguminum*, has emerged as a significant threat to nurseries in West Bengal. The pathogen was identified through symptom analysis, micrometric observation, and spore cluster analysis. To study the effects of temperature and nutrient media on colony morphology, radial growth, and dry mycelial production, *Gloeosporium leguminum* was incubated at three temperatures (21°C, 24°C, 28°C) and grown on four media (PDA, CDA, MEA, OMA). The experiment revealed distinct differences in colony morphology, including colour, texture, and growth patterns, depending on the medium and temperature. MEA was the most effective for rapid growth, OMA at 28°C promoted better sporulation, and PDB supported the highest mycelial biomass production. These findings highlight the importance of both temperature and media in pathogen growth.

A two-stage system for categorization of cat fishes using image processing techniques

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To recognize different types of fish, that have similar features, is very hard by seeing the images; therefore, to overcome such type of overhead for common people this application will be helpful. This study categorizes similar kinds of fish species based on their texture, gradient orientation, and regions to distinguish between fish images with analogous features. By employing methods such as feature extraction, Histogram of Oriented Gradients (HOG), Local Binary Pattern (LBP), Region Property analysis, Gray-Level Co-occurrence Matrix (GCLM), and Multi-Stage classification, the application aims to streamline the recognition process for common individuals dealing with similar-looking fish species. The traditional machine learning method Support Vector Machines (SVM) approach is found to be effective as well as exhibit varied accuracies. Further, the multi-stage approach stands to be fruitful in solving discrimination in similar-shaped fishes.

Response of black-husked aromatic rice cultivars to LCC-based N top dressing in Lower *Gangetic* Plains

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A field experiment was conducted at Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya, Jaguli, Nadia, West Bengal during *kharif* season of 2023. The experiment replicated thrice was laid out in a split-plot design comprising 3 black-husked aromatic rice cultivars (Kalojira, Kalonunia, NC 365) in main plots, and 4 LCC-based N top dressing (control, neem-coated urea @ 15 kg N ha^{-1}, nano urea @ 4 ml l^{-1}, mustard cake @ 15 kg N ha^{-1}) in sub-plots. NC 365 recorded maximum plant height at harvest (154.1 cm), LAI at 84 DAT (4.90), and it produced the highest grain yield (2.80 t ha^{-1}) that was 10.2% and 20.6% greater over Kalojira and Kalonunia, respectively. The crop top dressed with mustard cake twice based on LCC (score <3) at 21 and 42 DAT showed higher LAI (5.27), DM production (422.1 g m^{-2}), maximum grain yield (2.71 t ha^{-1}), protein content (7.2%) and aroma (score 1.7). Two chemical fertilizer-based top dressing (neem-coated urea and nano urea) recorded less aroma (score 1.4 and 1.6) in kernels. NC 365 lodged completely (score 6.0) at hard dough stage, while other two cultivars showed slight lodging habit (>3.0), and top dressing with neem-coated urea resulted in less lodging tendency of the cultivars compared to other N sources used in the study. NC 365 can be recommended for cultivation in lower *gangetic* plains of West Bengal due to its higher yield, medium-slender kernel and better aroma (score 1.8).

Analysis of furrow profiles using a furrow profile analyser and image-based digitization for enhanced soil disturbance assessment

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The performance of inverted T-type and double disc (DD) furrow openers under simulated zero-tillage conditions of a soil bin setup was assessed focusing on draft requirements and soil disturbance by the two furrow makers. The objectives include the development of a furrow profile analyser to study furrow silhouette, digitisation of profiles created by the two openers by image processing, and assessment of draft requirements under varying operational conditions. The development of furrow profile analyser portraited the cross-sectional furrow profiles and their digitisation enabled measurement of profile parameters such as disturbed area, furrow width, furrow depth and their nexus soil Disturbance Index (DI), calculated as the area of the disturbed groove divided by the maximum effective operating depth. The digitisation of furrow profiles demonstrated a V-shaped and U-shaped profile for the inverted-T and DD type openers. Results unveiled the DI for the inverted T-type opener consistently superseded that of its counterpart across all operational settings and interactions. The draft requirement for the inverted T-type furrow opener significantly increased with higher speeds and deeper sowing depth, ranging from 152N at 0.5 kmh^{-1} to 785N at 2 kmh^{-1}. In contrast, the double disc opener demonstrated reduced draft force owing to its smaller contact surface area, resulting in minimal soil disturbance. Hence, this study highlighted the significance of optimizing furrow opener design, as the findings revealed the DD opener not only required less draft but also minimized soil disturbance, contributing to improved soil health and micro-climate in zero-tillage systems.

Genotype screening of faba bean (*Vicia faba* L.) in field condition for leaf miner and pod borer resistance

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Legumes, a valuable plant source of protein, are essential for global dietary needs. Faba bean, a protein-rich legume (30%), is used for human consumption and animal feed. However, its productivity and marketability in West Bengal have declined due to leaf miner and pod borer infestations. Farmers typically use chemical insecticides to control pests, but these have negative impacts such as environmental pollution, destruction of natural enemies, insect resistance, and changes in pest dynamics. To address these issues, host plant resistance is promoted as part of an integrated pest management strategy to control pests while reducing insecticide use. A field experiment was conducted at AB Block Farm, Bidhan Chandra Krishi Viswavidyalaya (Nov 2019 – March 2020), to identify faba bean genotypes resistant to leaf miner and pod borer. Forty-four genotypes were evaluated for plant growth, seed yield, leaf mining percentage, and pod damage. Six genotypes (*FLIP15-159FB, FLIP15-197FB, L-2013-014, L-2013-060 (S4), L-2013-092 (S4), and L-2014-137*) showed high resistance to leaf miner, while nine genotypes (*Ahmednagar Local, Bangla Gangachar, EC-25085, FLIP15-196FB, FLIP15-197FB, Gazipur Local, HB-15, HB-90, and L-2013-060*) demonstrated strong resistance to pod borer. If these genotypes perform consistently across different locations, they could be used to develop pest-resistant faba bean varieties.

Genetic variability studies of grain physical traits, hydration properties and starch content in mung bean

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Mung bean [*Vigna radiata* (L.) Wilczek] is a nutritionally and industrially important pulse crop in India. Along with other nutritional components, it consists of high percentage of starch (25-48%) as well as amylose (16-45%). Grain physical parameter and hydration status are important for improvement of grain and cooking quality and improving industrial applicability. In this context, present study was conducted with 100 mung bean genotypes to identify high amylose and starch content in seed. In addition, attempt to detect the sequence polymorphisms in *GBSS* gene homolog between the high and low amylose containing mung bean was also contemplated. Results revealed that the yield attributing parameters showed substantial variation with inconsistent performance revealing the influence of environment. Amylose and starch showed a significant positive correlation. Traits such as swelling capacity, swelling index, hydration capacity, and hydration index also demonstrated positive correlations. Key components contributing the most to genetic divergence included pods per plant, clusters per plant, pods per cluster, soaked seed density, as well as swelling and hydration capacity. MGG 348, SML 1082 and BCM 20-50 were detected as high amylose containing genotypes whereas MH 1142, BCM 20-50 and BCM 21-07 were promising high starch containing genotypes. The analysis of allelic variation in *GBSS* gene homologs among selected mung bean genotypes revealed non-synonymous SNPs only in the high-amylose genotype IPM-2-3. Further validation with a larger panel is needed to confirm these findings. The findings will facilitate development of functional marker for rapid screening of starch and amylose content in mung bean.

Impact of DAESI course on knowledge level of input dealers in some selected areas of West Bengal

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The Diploma in Agricultural Extension Services for Input Dealers (DAESI) program aims to provide scientific knowledge and skills to input dealers to serve village community. The study was conducted in the Birbhum and Purba Bardhaman focusing on the knowledge of DAESI input dealers compared to non-DAESI. The research involved 240 agricultural input dealers, with 120 holding DAESI diplomas and 120 non-DAESI. The objectives were to study socio-economic profile of DAESI and non-DAESI dealers; to find the knowledge level of DAESI and non-DEASI dealers on different agricultural aspects; A score of dependent variables i.e. Impact of DAESI program in terms of knowledge and 20 independent variables have been executed to study their multilevel interaction to predict and isolate the dominant for both DAESI and non-DAESI respondents. Statistical analysis like coefficient of correlation, stepwise was done Findings revealed that DAESI dealers exhibited higher knowledge levels compared to non-DAESI. The research highlighted that for DAESI dealers, there is a significant correlation between knowledge level and different independent variables like education, business experience, and risk orientation, mass media exposer, cosmo politeness. From stepwise regression analysis it has been found that out of 20 independent variables 11 variables exert more than 65% of total effects on knowledge level of DAESI dealers.

ABSTRACTS OF THE

SUBJECT AREA:

APPLICATIONS OF EMERGING TECHNOLOGIES INCLUDING AI/ML IN SUSTAINABLE DEVELOPMENT (FOCAL THEME)

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Presenting author*

Federated quantum neural network for privacy-preserving classification of retinal images

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Diabetic Retinopathy (DR) is one of the leading causes of blindness, and detecting it in its mild stages is crucial for preventing severe damage. Microaneurysms (MA) are the earliest sign of DR. Identifying MA as early DR sign is a challenging job due to its minute size, shape and complicated nature. Traditional Convolutional Neural Networks (CNNs) are commonly used for medical image analysis, but they require large datasets and computational resources. In contrast, QNN can handle complex data with fewer learnable parameters, offering better generalization and computational efficiency. We propose the federated learning based approach that combines Quantum Neural Networks (QNN) to tackle the challenges of early Diabetic Retinopathy (DR) detection from retinal fundus images. In federated learning, local models are trained on different devices and then aggregated into a global model, preserving the privacy of sensitive medical data while improving the model's generalization power. The system preprocessed the images by extracting small patches from affected and healthy regions. Quantum state preparation involves encoding these patches into qubits. We fed these qubits into a Parameterized Quantum Circuit (PQC). The PQC parameters update during quantum circuit learning. The proposed method gives above 95% accuracy in different experiments. It shows promising accuracy, precision, and recall while detecting mild DR. It is a robust, lightweight solution for privacy-preserving medical image diagnosis. We also compared the system with classical and non-federated methods. The system integrates quantum computing with federated learning to build a structured, secure, scalable healthcare system.

A study on artificial intelligence and its fostering role in enhancing emotional intelligence among the autistic individuals

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Autism Spectrum Disorder (ASD) is alarmingly spreading around the world. Autism is a neurodevelopmental disorder characterized by restricted and repetitive behaviour, trouble with social interaction and communication, and other symptoms. According to a 2021 study published in the Indian Journal of Pediatrics, almost 1 in 68 Indian children suffers from autism. As the illness is often underdiagnosed and underreported, accurate estimates of its true prevalence are hard to come by. The diagnostic method for ASD has undergone a significant transformation with the blessings of artificial intelligence. An artificial intelligence system is a useful tool for individuals with autism and learning difficulties of various ages. This paper will highlight how Artificial Intelligence can be an instrumental tool in diagnosing the Autistic symptoms at an early stage, analysing the different tools of Artificial Intelligence which can enhance emotional intelligence among the Autistic individuals and finding the gap in the treatment of Autistic Individuals based on Artificial Intelligence in context of abroad and India.

Ancient knowledge meet modern technology to address human-animal conflicts in West Bengal: A narrative review

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Human-animal conflict (HAC) takes place when humans aggressively pursue activities extending their spheres of control thus disturbing the natural ecosystems leading to destruction of crops, loss of domestic animals, property damage in some instances, infliction of injuries to or deaths of people. In the state of West Bengal, these conflicts are more Tribal centered particularly affecting forest-based tribal communities that directly rely on the forests for their subsistence. Through this narrative review, this paper seeks to identify the scope of HAC Management of Indigenous Knowledge and Modern Technology in eight districts of biodiversity hotspots in the state of West Bengal. This study systematically analyzes 25 research articles available in academic repositories such as Google Scholar, and Research Gate to understand the application of both traditional and modern methods of conflict resolution in given case scenarios. In addition, Indigenous People have been conservatively confined to animal behavioral practices that have employed ethical respect in the preservation of cultural practices. In addition, modern-day apparatus like GPS devices and early warning systems are helpful and provide new strategies that do work but still, they are rarely effective when used alone. The findings imply that the most appropriate solutions to human-wildlife conflicts are achieved by combining strategies that involve eliminating the use of modern technology in favor of the time-tested ideas of the Indigenous people. This hybrid approach not only enhances conflict resolution but also promotes the conservation of wildlife and its cultural diversity without threatening the indigenous people, hence working towards a more just and equitable relationship between man and nature in West Bengal.

Human movement replication system using robots for advanced remote intervention in industrial works

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The "Human Movement Replication System" is designed to replicate exact human movement into more accurate actions in robots using computer vision and robotics technology. MediaPipe Pose ML models capture real-time body movements that recognize landmarks such as shoulders, elbows, wrists, etc. These landmarks and their detected positions determine the joint angles and relative position, which are sent to a powerful microcontroller. The microcontroller controls the servo actuators/servos to execute the detected movements in a robotic arm. Features include smooth transitions between movements using interpolation methods from NumPy, giving a fluid, natural response. Managing live video feeds with OpenCV ensures high responsiveness and real-time interaction. Face recognition adds a security layer, allowing only authorized users to access and control the system. Additionally, users can remotely operate the system over a secure, encrypted network connection. The system has numerous applications, including human-robot interaction, assistive technology, industrial automation, and remote control. Its modular design supports adaptability for various applications, making it a versatile platform for extending robotics capabilities. It bridges the gap between human gestures and robotic systems, opening doors for intuitive and efficient control in many scenarios. (COPYRIGHTED Diary_No.-11081/2024-CO/L; 18/6/2024).

Forecasting employment trends in India's IT sector: Leveraging advanced predictive models for sustainable workforce development

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The rapid changes in technology and market conditions within the Information Technology (IT) industry in India have resulted in unstable employment patterns, making it challenging to generate accurate workforce projections. Such fluctuations in labor activities within the IT sector often render traditional approaches to workforce management planning inadequate. Increasing conflicts between advanced regions are fueled by robotic process automation, AI, and tech advancements, highlighting a growing labor market imbalance. There exists a gap in the current research, and this analysis aims to address it through employment forecasting based on historical employment statistics from governmental and non-governmental sources, as well as the operational benefits of major information technology (IT) corporations. The utilization of several advanced forecasting models, such as ARIMA, SARIMA, and LSTM, facilitates the interpretation of stock market fluctuations and other economic indicators in relation to employment in various subsectors of the IT industry. This is particularly relevant at the present juncture, as the industry is undergoing significant transformations in job roles, skills, and expertise as a consequence of automation and artificial intelligence. This analysis aims to enable policymakers, educational institutions, and businesses to implement and sustain workforce development that aligns with prevailing and emerging trends. This research, therefore, seeks to support the cultivation of a more competent labor force to address the technological requirements of the future and contribute to sustainable development initiatives such as SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), with a primary focus on advancing India's IT industry and economy.

Evaluating the best deep learning architectures for medical image segmentation

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Medical image segmentation plays a vital role in modern healthcare by enabling precise diagnosis and treatment planning. This study aims to explore the strengths and limitations of traditional convolutional models, such as U-Net variants, alongside transformer-based architectures and the Segment Anything Model (SAM). The analysis compares various deep learning architectures, including U-Net, V - Net, U-Net++, U-Net 3+, TransUNet, UNETR, Swin UNETR, and SAM in segmenting of medical images. The models are evaluated using standard metrics such as Dice Similarity Coefficient, Jaccard Index, sensitivity, and specificity. Additionally, computational aspects such as the number of parameters, training and inference time, and architectural complexity are considered. The datasets used in this study include the ISIC Skin Lesion Image Segmentation dataset for 2D data and the BTCV dataset for 3D segmentation tasks. While transformer-based models, incorporating attention mechanisms and multi-scale feature extraction, along with SAM, tend to outperform in terms of segmentation accuracy, they also come with increased computational costs. Convolutional models offer a favourable balance of efficiency and accuracy, making them suitable for limited computational resources. It serves as a practical guide for researchers and clinicians to select the most appropriate model for specific medical image analysis tasks, taking into consideration both segmentation quality and resource constraints. The study also helps to work in developing optimized hybrid models for more robust medical image segmentation.

Artificial intelligence for sustainable development: A framework for business ecosystem transformation in marketing

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The primary proposition of this work is that consumers buy expectations of benefits and specific problem-solving abilities rather than product features. By looking at how to create a sustainable value proposition that allows suppliers to show prospective clients the life cycle value that arises from the economic, environmental, and social consequences of AI, this work seeks to integrate various viewpoints. The term artificial intelligence (AI) describes the result of using computers to realize human minds. It is showing up more and more in our day-to-day lives. Machine learning (ML) is a branch of Artificial intelligence (AI) that facilitates autonomous machines and transform and enhance business processes in the contemporary cognitive and intelligence eras to advance sustainable development (SD). AI can learn automatically and acquire information from large amounts of data, and then utilize that knowledge to assist humans in achieving their technical and practical objectives. AI is a machine-based system capable of making predictions, recommendations, or judgments that influence real or virtual surroundings in response to a given set of human-defined objectives. It perceives actual and virtual worlds through the use of both machine and human inputs. This conceptual approach asserts that resource design affects marketing. "Sustainable marketing involves strategically creating, communicating, delivering, and exchanging products or services in a way that adds value through consumer behaviors, business practices, and the marketplace. At the same time, it aims to reduce environmental harm and ethically and equitably improve quality of life."

A study on gender inequality and sustainable development: Measuring feminist progress in working organization

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Gender inequality in organizational leadership has been shamefully ignored even though it has been a topic of social study and action for decades in many fields. Over time, there has been a rise in the proportion of highly educated women with technical skills in the workforce worldwide. On the other side, gender discrimination at work has impeded women's advancement into jobs that are more prestigious for men. Discrimination, occupational segregation, and compensation differences based on gender are just a few examples of how gender inequality in the workplace presents itself. Working women have long battled against both the separation of men and women into genders and horizontal segregation. Women's presence on management teams is frequently associated with greater social involvement and participative leadership philosophies. Women's influence at cooperative firms, which have unique organizational and purpose qualities, is examined to see how it affects productivity and performance. One advantage of female leadership is increased efforts to promote work-family balance, essential for national progress and raising family living standards. Measuring feminist progress has long been challenging because international and national governance approach political and economic issues differently. This research will concentrate on the perspectives of gender equality and feminist progress. In this assessment, the Sustainable Development Goals (SDGs) are the expected successor to every country due to their assurance to gender mainstreaming, as well as their relatively strong analysis and attention to intersectionality and key feminist issues.

Real-time Parkinson's disease screening through gait and keystroke pattern analysis

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Diagnosing Parkinson's disease (PD) is challenging due to its wide range of symptoms, which can introduce bias, particularly if the doctors are less experienced. Additionally, there is no direct test for Parkinson's due to subtle early symptoms (often overlooked), a lack of specific biomarkers, and overlapping symptoms with other disorders. This study focuses on sensor technology to collect extensive datasets from patients during various motor activities, such as walking and typing. We propose a bootstrap-based homogeneous ensemble classification model designed to rapidly identify PD patients within a two-minute timeframe in a home environment with greater accuracy. The model's validity was assessed using multiple datasets and a robust, realistic evaluation protocol. We considered three unique conditions—Serial Seven Test, Rhythmic Auditory Stimulation, and treadmill walking—to validate walking-based PD indicators. Additionally, three models were developed to analyze daily keystroke patterns across three user groups (healthy individuals, de novo patients, and early-stage PD patients), with evaluations conducted under various text input scenarios, including 15 fixed and free-text typing tasks. Separate models were built for gait and keystroke analysis. Gait analysis used Vertical Ground Reaction Force data, while keystroke analysis incorporated various timing features. The proposed methodology demonstrated strong performance, with Area Under Curve values ranging from 78% to 86%, suggesting the potential effectiveness of our approach for identifying PD indicators. This approach has the potential to facilitate affordable, accurate, and timely screening. Furthermore, it may contribute to sustainable healthcare systems and promote global health equity by increasing accessibility to early diagnostic tools.

Application of geospatial technology in the assessment of forest fragmentation in Rajaji National Park, Uttarakhand

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Satellite remote sensing data provides specific and accurate need-based information about forest cover, vegetation type, and land use changes to facilitate various conservation programs in accessible and inaccessible terrains. The geospatial landscape characterization of satellite maps of Rajaji National Park (RNP), Uttarakhand, using ERDAS Imagine 2014, Arc Map 10.1, IDRISI Taiga, FRAGSTAT 4.2 exhibited Forest as the largest patch (84%) among the four land-use classes namely; Forest, Scrub, Water channels, and Non-Forest. The Land Use Land Cover (LULC) changes for 20 years from 1995 to 2015 depicted 212% increase in area under Scrub and 15% decrease in area under Forest. Areas under Water increased by 32% while area under Non-Forest decreased 38%. However, the patchiness of the landscape impacted the qualitative indices such as Shannon's diversity index, contiguity, connect and fractal dimensions of the Park landscape and reduced its value for biodiversity conservation, mitigation of climate change and sustainable development. Despite several management practices the invasive attribute of the Scrub resulted in the fragmentation of the forests at RNP due to the presence of an invasive species (Lantana camara). This geospatial assessment approach of landscape changes was cost-effective, time-saving, safe and effective for both quantitative and qualitative analysis of land use patterns of large protected areas.

India's growing electronic footprint prediction: A machine learning approach

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This study focuses on a comparative study on global e-waste generation and Indian e-waste generation and investigating past and future trends using Auto ARIMA, LGBM Regressor, XGB Regressor, and Random Forest Regressor, Time GPT models, commonly used in time series analysis and forecasting the e-waste generation up to financial year 2031-2032. In this study it is observed that for all the cases the values of error matrices (such as MAE, MAPE, RMSE etc) of XGB Regressor is lowest among all the models. So, we choose this model for forecasting the e-waste generation. The study predicts that the E-waste generation in global and Indian perspective will rise up to 84.47 MT & 7.269 MT respectively and the percentage generation of E-waste for India will rise from 6.61% at 2022 to 8.61% at 2032 of global e-waste, whereas USA will decrease their e-waste generation from 11.45% at 2019 to 9.72% at 2032 and there is a high possibility that India may enhance their position from 3rd place to 2nd place in near future. If we compare 5 continents it is observed that currently Asia will contribute the highest percentage of e-waste (48.62%), and it will increase up to 53.36% on 2032, whereas Europe, America and Oceania will decrease their contribution and for Africa it follows almost a constant pattern.

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