National Seminar on

'SDGs: Science and Technology Innovation'

Organized on the occasion of the

26th Odisha Bigyan 'O' Paribesh Congress
&
1st International Conference on
'Sustainable Green Frontiers'

November 28-30, 2025

Advisor

Dr. Jaya Krushna Panigrahi
Working President, OES

Organised by

Orissa Environmental Society
Bhubaneswar
www.odishaenvironment.org

KIIT Deemed to be University
Bhubaneswar
www.kiit.ac.in

Odisha Bigyan 'O' Paribesh Congress (OBPC)

History of 26 Years Journey

Background

The Odisha Bigyan 'O' Paribesh Congress (earlier Orissa Bigyan Congress) had its genesis in the year 1997 to create and foster an apt platform for the scientific community of the State for reflecting and deliberating upon the advances of science and technology in diverse frontiers. Since then, it has been organized as an annual event in reputed universities/ institutions of Odisha with the objective of bringing to a common forum the scientists, academics, technologists and environmentalists of the State as well as from other parts of the country for sharing their experiences and innovations. At the beginning, it was organized under the banner of the Orissa Environmental Society (OES) and the Indian Science Congress Association – Bhubaneswar Chapter (ISCABC), which was opened under the auspices of the OES in 1996. On the occasion of the Congress, a national seminar is being organized on a theme of current significance. Noted scientists and academics of the State are also felicitated during the Congress for their lifetime contributions, while young researchers are awarded prizes for best oral and poster presentations. This year being the Silver Jubilee Year, the theme has been purposefully kept as 'Science Fostering Holistic Development of the Nation' to focus on the contribution of science and technology in national development, in the light of the advancements in research fields. The 26th session of the Congress is organized under the joint auspices of the Orissa Environmental Society, Bhubaneswar and the KIIT Deemed to be University, Bhubaneswar, Odisha.

NB: The Congress couldn't be organized in the years 2007, 2015 and 2020 for various reasons. As the then convener was indisposed off, the 2007 session was abandoned, while in 2015 the ISCABC was shifted to KIIT University for which some dislocation occurred and the Congress couldn't be held. In 2020, grave circumstances during the Covid pandemic resulted in the non-organization of the OBPC.

Sl. No.	Year	Theme	Venue
01	1st Orissa Bigyan Congress, 14-16 Nov, 1997	Science & Technology in Independent India: Retrospect & Prospect	Regional Science Centre, Bhubaneswar
02	2nd OBC, 13-15 Nov, 1998	New Biosciences: Opportunities and Challenges as We Move into the Next Millennium	Regional Science Centre, Bhubaneswar
03	3rd OBC, 4-5 June, 1999	Indian Science into the Next Millennium	Regional Science Centre, Bhubaneswar
04	4th OBC, 30-31 Dec, 2000	Pollution and Its Prevention in Next 25 Years	Dalmia Institute of Scientific and Industrial Research (DISIR), Rajgangpur, Sundargarh
05	5th OBC, 2001	Health care, Education and Information Technology	Regional Science Centre, Bhubaneswar
06	6th OBC, 2002	Frontier Science and Cutting-Edge Technology	Berhampur University, Berhampur
07	7th OBC, 2003	Science in the Twenty First Century: Quest for Excellence	Dept. of Botany, Utkal University, Bhubaneswar
08	8th OBC, 11-12 Dec, 2004	Health Technology as Fulcrum of Development for the Nation	Regional Plant Resource Centre, Bhubaneswar
09	9th OBC, 11-12 Dec, 2005	Integrated Rural Development: Science and Technology	The Institution of Engineering (India), Orissa State Centre, Bhubaneswar
10	10th OBC, 04-05 Nov, 2006	Planet Earth	Orissa University of Agriculture and Technology, Bhubaneswar
11	11th OBC, 23-24 Dec, 2008	Science Education and Attraction of Talent for Excellence in Research	KIIT University, Bhubaneswar
12	12th OBC, 2009	Science and Technology Challenges of 21st Century – National Perspective	Regional Museum of natural History, Bhubaneswar, Odisha
13	13th OBC, 09-11 Dec, 2010	New Frontiers in Life Sciences	Regional Museum of natural History, Bhubaneswar, Odisha

14	14th OBC, 12-14 Nov, 2011	Interdisciplinary Science – Key to Novel Innovations	Orissa University of Agriculture and Technology, Bhubaneswar, Odisha
15	15th OBC, 18-19 Oct, 2012	Science for Shaping the Future of India	Dept. of Geology, Utkal University, Bhubaneswar
16	16th OBC, 23-24 Nov, 2013	Innovations in Science & Technology for Inclusive Development	Institute of Physics, Bhubaneswar
17	17th OBC, 05-06 Dec, 2014	Science & Technology for Human Development	ITER, SOA University, Jagamara, Bhubaneswar
18	18th OBPC, 03-04 Dec, 2016	Forestry and Agriculture for Sustainable Future	Orissa University of Agriculture and Technology, Bhubaneswar
19	19th OBPC, 25-26 Nov, 2017	Science & Technology for Environmental Security	Convention Centre, KIIT University, Bhubaneswar
20	20th OBPC, Nov 17-18, 2018	Science for Society	NISER Bhubaneswar, Jatni, Khordha, Odisha
21	21st OBPC, 23-24 Nov, 2019	Harnessing Science & Technology for a Better Future	ITER, SOA University, Bhubaneswar
22	22nd OBPC, 20-21 Nov, 2021	Overcoming the Challenges: Role of Science & Technology	Convention Centre, Ravenshaw University, Cuttack, Odisha
23	23rd OBPC, 26-27 Nov, 2022	Science & Technology in Combating Climate Change	Biju Patnaik Auditorium, Sambalpur University, Jyoti Vihar, Burla, Odisha
24	24th OBPC, 18-19, Dec, 2023	Environmental Challenges Role of Science and Technology	New Conference Hall, Berhampur University, Berhampur, Odisha
25	25th OBPC, 29-30 Nov, 2024	Fostering Science for Holistic Development	IMMT Auditorium, CSIR-Institute of Minerals & Materials Technology, Bhubaneswar
26	26th OBPC, 28-30 Nov, 2025	'SDGs: Science and Technology Innovation'	KIIT Deemed to be University, Bhubaneswar

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
(Established U/S 3 of UGC Act, 1956)
Bhubaneswar, Odisha, India

Bhubaneswar, the 24th November, 2025

Message

I am immensely delighted to learn that the 26th Odisha Bigyan 'O' Paribesh Congress & 1st International Conference on 'Sustainable Green Frontiers' is being organized by the Department of Chemistry, School of Applied Sciences, KIIT-DU, in collaboration with the Orissa Environmental Society, Bhubaneswar from 28th to 30th November 2025. I am also glad to know that a souvenir booklet will be unveiled on this momentous occasion. I hope this souvenir will be exceptionally helpful for scores of inquisitive students and researchers for their instant reference.

Revolving around the theme "SDGs: Science & Technology Innovations", the conference will generate a thrilling experience to witness some insightful, enlightening and thought-provoking sessions with an array of distinguished professors and scientists from across the globe. Needless to say that, their encouragement and blessings will greatly inspire our students and budding researchers.

Odisha Bigyan 'O' Paribesh Congress (OPBC) has created a marvelous platform for the scientific community of Odisha to deliberate on emerging frontiers in science and technology. It has successfully brought together scientists, researchers, students, environmentalists, and policymakers to discuss scientific advancements, environmental challenges, and sustainable solutions on a common platform year after year.

On the other hand, Sustainable Green Frontiers 2025, an international conference launching for the first time, biennially unites together researchers, scientists, technologists, policymakers, and academicians to exchange ideas, showcase innovations, and develop solutions for sustainability, renewable energy, biodiversity, clean technologies, and human well-being.

I congratulate the members of the Organizing Committee for their laudable endeavour to host such an event of immense significance as well as scientific, technological and environmental relevance.

I also wish the 26th Odisha Bigyan 'O' Paribesh Congress & 1st International Conference on 'Sustainable Green Frontiers' an astounding success.

24.11.25

(Dr. Achyuta Samnata)
Founder, KIIT & KISS
Former Member of Parliament (RS & LS)

'A' Category as per notification of Ministry of HRD, Govt. of India | 'Tier1' Accreditation (Washington Accord) by NBA for Engineering Streams | Accredited by NAAC in 'A Grade' | Accredited by IET, U.K. (B.Tech. Programme)

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Orissa Environmental Society

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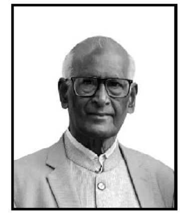

Message

I am happy that the internationally accredited vibrant KIIT Deemed to be University is co-partnering the Orissa Environmental Society to hold the 26th session of the 'Odisha Bigyan 'O' Paribesh Congress' and the first ever 'International Conference on Sustainable Development' during November 28-30, 2025, on the theme 'Sustainable Development Goals (SDGs): Science and Technology Innovations'.

The United Nations (UN) Headquarters in New York had organised the 'Millennium Summit' way back through 6th to 8th September 2000, with a view to redefining its role in the 21st century. The Summit came out with the Millennium Declaration. The declaration identified six fundamental values, namely Freedom, Equality, Solidarity, Tolerance, Respect for Nature, and Shared Responsibility, that are central to international cooperation. It had eight Millennium Development Goals (MDGs). The Paris Climate Accord 2015 sets the target to limit the global temperature rise to 1.5 degree centigrade by the end of 21^{st} century.

Following the conclusion of the MDG timeline in 2015, the UN Sustainable Development Summit, adopted a new and expanded development framework, the 17 Sustainable Development Goals (SDGs), with a more comprehensive and inclusive vision. The target year for achieving SDGs is 2030. The SDGs serve as a roadmap for building a more equitable, sustainable, and peaceful world for current and future generations.

The NITI Aayog acts as the central coordinating body to facilitate SDG implementation across sectors and states, in India. For the first time, India ranks among top 100 in SDG Index at 99 in 2025 with a score of 67 out of 100. India's decade-long journey with the SDGs shows meaningful progress in key social and infrastructure indicators.

Happily, many distinguished scientists, scholars and luminaries from across the country and abroad are participating in the event for presentation and interaction. A proceedings volume incorporating deliberations and recommendations would be brought out at the end, hopefully.

I thank the organisers profusely for this noble endeavour, and wish the 26th OBPC and the International conference a grand success and productive.

Dr. Sundara Narayana Patro
President

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
(Established U/S 3 of UGC Act, 1956)
Bhubaneswar, Odisha, India

Message

It gives me immense pleasure to extend my warm greetings to all the distinguished delegates, researchers, academicians, industry experts and students participating in the ***6th Odisha Bigyan 'O' Paribesh Congress*** and ***1st International Conference on "Sustainable Green Frontiers".*** This combined event stands as a testament to our institution's commitment to scientific advancement and environmental stewardship.

The themes of this Congress and Conference align closely with Hon'ble Founder Dr. Achyuta Samanta's belief that knowledge must serve society and contribute to a sustainable and harmonious future. At a time when climate challenges are accelerating and ecological systems are under increasing strain, this platform for meaningful dialogue and collaborative innovation is both timely and essential. I am confident that the insights, discussions, and research shared here will spark new perspectives and foster transformative solutions for a greener tomorrow.

I also take this opportunity to express my sincere appreciation to the organisers and all contributors for their efforts in shaping this significant event. I wish the Congress and the Conference great success and look forward to the impactful outcomes that will emerge from your deliberations. May this gathering strengthen our collective resolve to build a more sustainable, resilient and environmentally responsible future for generations to come.

(Prof. Saranjit Singh)
Vice Chancellor

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
(Established U/S 3 of UGC Act, 1956)
Bhubaneswar, Odisha, India

Message

I am delighted to extend my warm greetings to all delegates, researchers, academicians, and participants attending the 26th Odisha Bigyan ‘O’ Paribesh Congress and the 1st International Conference on ‘Sustainable Green Frontiers’, jointly organized by the Odisha Bigyan ‘O’ Paribesh Congress (OBPC) and KIIT University from 28th to 30th November 2025.

This conference, centred around the focal theme “SDGs: Science and Technology Innovations,” provides a timely and vital platform for exchanging ideas, presenting research, and exploring solutions that support global sustainable development. In an era marked by rapid technological advancements and complex environmental challenges, such collaborative academic endeavours play a crucial role in shaping a greener, more resilient, and inclusive future.

KIIT University is proud to host and to be a partner in this significant initiative, reaffirming our commitment to research-driven progress and community-centric development. I am confident that the deliberations, interactions, and knowledge-sharing during this conference will inspire innovative approaches and strengthen the collective resolution to advance the Sustainable Development Goals.

I congratulate the organizers and contributors to the Souvenir, and I wish the conference grand success.

Dr. Jnyana Ranjan Mohanty

(Registrar)

Orissa Environmental Society

ND-4, VIP Area, IRC Village, Bhubaneswar - 751015

Message

I am delighted that the Orissa Environmental Society and the KIIT Deemed to be University are organizing jointly the 26th Odisha Bigyan ‘O’ Paribesh Congress (OBPC) and the 1st International Conference on ‘Sustainable Green Frontiers’ from 28-30 November 2025 on the theme ‘SDGs: Science & Technology Innovations.’ It is indeed an honour that the OBPC is being hosted for the third time at the prestigious KIIT University.

Science, technology, and innovation (STI) are key drivers of the Sustainable Development Goals. At a time of global challenges - climate change, food insecurity, health risks, and widening inequalities - innovative scientific solutions are essential for building resilient and inclusive societies. Advances in renewable energy, digital technologies, biotechnology, and smart infrastructure are accelerating progress across sectors and improving quality of life.

To maximize the impact of STI, accessibility and equity are crucial. Reducing the digital divide, strengthening inclusive research ecosystems, and ensuring ethical innovation must remain priorities. Collaboration among governments, academia, industry, and civil society is vital for knowledge sharing and for translating scientific advancements into meaningful outcomes. Aligning STI efforts with the SDGs will help create a future where sustainability and prosperity reinforce each other.

I extend my best wishes for a successful conference filled with insightful discussions, productive collaborations, and impactful presentations. May the deliberations inspire new ideas, strengthen partnerships, and lead to actions that benefit both people and the planet. I congratulate all participating scientists, academics, researchers, and students, and wish the twin events grand success.

(Dr. Jaya Krushna Panigrahi)
Working President

Felicitation to Distinguished Scientists
On the Occasion of the Orissa Bigyan 'O' Paribesh Congress (OBPC)

No. of OBC (Year)/Venue	Distinguished Scientists Felicitated
6th (2002) Berhampur University, Berhampur	**1. Dr. Kota Harinarayana,** Aeronautical Engineer, Hindusthan Aeronautics, Bangalore. **2. Dr. Bibhuti Bhusan Deo,** Former VC, Berhmapur University **3. Dr.Prafulla Chandra Tripathy,** Former Parija Prof. of Botany, Utkal Univ.c **4. Dr. Chandi Charan Das,** Former Prof. of Zoology, Berhampur Univ.
7th (2003) Utkal Univ. Bhubaneswar	**1. Dr. Ajit Kumar Pattnaik,** Chief Executive, Chilika Development Authority, BBSR
8th (2004) RPRC, Bhubaneswar	**2. Dr. Sarat Chadra Misra,** Orchidologist (Former Chief Engineer - R&B)
9th (2005) Institution of Engineers (India), BBSR	**1. Dr. Gokulananda Mohapatra,** Former Prof. of Chemistry & Popular Science Writer **2. Dr. Radhanath Rath,** Former Prof. of Psychology, Utkal Univ. **3. Dr. Gadadhara Mishra,** Former Prof. of Botany, Utkal Univ.
10th (2006) OUAT, Bhubaneswar	**1. Dr. Basant Kumar Behura,** Former Prof. of Zoology, Utkal Univ. **2. Dr. Iswar Chadra Mahapatra,** Former VC, OUAT. **3. Dr. Khageswar Pradhan,** Former VC, OUAT. **4. Dr Prafulla Kumar Jena,** Former Director, RRL, Bhubaneswar **5. Dr. Sanatan Rath,** Former Prof. of Med. (Neurology), SCB Medical College, Ctc.
11th (2008) KIIT University, Bhubaneswar	**1. Padmabhusan Dr. Trilochan Pradhan,** Former VC, Utkal Univ. **2. Dr. Susil Kumar Sinha,** Former Prof. of Botany, OUAT.
12th (2009) Regional Museum of Natural History Bhubaneswar	**1. Prof. Basudev Kar** Former Principal & Superintendent, SCB Medical College **2. Prof. Madhab Chandra Dash** Former Vice-Chancellor, Sambalpur Univ. **3. Prof. Surjyo Narayan Behera** Former Vice-Chancellor, Berhampur Univ.

13th (2010) RMNH, Bhubaneswar	**1. Prof. Satyananda Acharya** Former Vice-Chancellor, Utkal University **2. Prof. Nimai Charan Panda** Former Principal, SCB Medical College **3. Prof. Siva Prasad Mishra** Former Director, Institute of Physics
14th (2011) OUAT, Bhubaneswar	**1. Dr. Bishnu Prasad Das** Former EIC, Water Resources (Odisha) **2. Prof. (Dr.) Rabindranath Sahoo** Former Prof. in Neurology, SCB Medical College **3. Prof. Bimbadhar Nayak** Former Prof. in Chemistry, IIT, Kharagpur **4. Prof. Debi Prasad Ray** Vice Chancellor, OUAT, Bhubaneswar **5. Dr. Achyuta Samanta** Founder of KIIT & KISS, Bhubaneswar
15th (2012) Dept. of Geology, Utkal University	**1. Prof. Priyambada Mohanty Hejmadi** Former Vice-Chancellor, Sambalpur Univ. **2. Prof. Somnath Mishra** Former Principal, NIT, Rourkela **3. Prof. Premananda Das** Former Chief Executive, RPRC, BBSR **4. Prof Gopabandhu Behera** Former Head, Dept. of Chemistry, Sambalpur University
16th (2013) Institute of Physics, Bhubaneswar	**1. Prof. Amulya Kumar Panda** Former Principal, Ravenshaw College **2. Prof. Banchhanidhi Mishra** Former Head, Dept. of Botany, Berhampur Univ. **3. Prof. Padma Lochan Nayak** Former Head, Dept. of Chem., Ravenshaw College **4. Prof. Pradipta Kishore Dash** Director (R&D), ITER, SOA Univ., BBSR **5. Prof Swadheenananda Pattanayak** Former Head, Dept. of Math, Sambalpur University
17th (2014) ITER, SOA University, Bhubaneswar	**1. Prof. Bhabendra Kumar Patnaik** Former Vice Chancellor, Berhampur University **2. Prof. Sadananda Torasia** Former Director, Sc. & Tech. Dept., Odisha **3. Prof. Chandra Sekhar Sarangi** Former VC, Sri Jagannath Sanskrit University **4. Prof. Bhaskar Dash** Former Prof. and Head of Chemistry, Utkal University **5. Prof. Gokulananada Das** Former Vice Chancellor, Utkal University

18th (2016) OUAT, Bhubaneswar	**1. Prof. Uma Charan Mohanty** Former President, Odisha Bigyan Academy **2. Prof. Uday Chand Biswal** Former Vice Chancellor, Sambalpur University **3. Prof. Surendranath Pasupalak** Vice Chancellor, OUAT **4. Dr. Trilochan Mohapatra** Secretary, DARE & DG, ICAR
19th (2017) KIIT University, Bhubaneswar	**1. Prof. Damodar Acharya** Former Chairman, AICTE & Former VC, BPUT **2. Prof. Ch. Rajendra Praharaj** Former Emeritus Professor, Institute of Physics, BBSR **3. Prof. Dhruba Raj Naik** Former Vice Chancellor, Sambalpur University **4. Padma Shri Prof. Subrat Kumar Acharya** Former Dean, AIIMS New Delhi
20th (2018) NISER, Bhubaneswar	**1. Prof. Mahendra Kumar Mahanti** Former Dean, School of Physical Sciences, NEHU, Shillong **2. Prof. Rabindranath Nayak** Former Professor, Dept. of Microbiology, IISc, Bangalore **3. Prof. Sudarsan Nanda** Prof. of Eminence & Research Chair KIIT University, Bhubaneswar **4. Prof. Sudhakar Panda** Director, NISER & Institute of Physics (IOP), BBSR
21st (2019) SOADU, Bhubaneswar	**1. Prof. Ashok Kumar Tripathy** Power Systems Engineer **2. Prof. Niranjan Barik** Former Professor of Physics, Utkal University **3. Prof. Santosh Kumar Kar** Professor, School of Biotechnology, KIIT University **4. Prof. Amit Banerjee** Vice-Chancellor, Siksha 'O' Anusandhan University
22nd (2021) Ravenshaw University, Cuttack	**1. Prof. Krishna Chandra Sahu** Former Prof., IIT Bombay **2. Prof. Ganapati Panda** Former Deputy Director, IIT Bhubaneswar **3. Prof. Sanjay Kumar Nayak** Vice-Chancellor, Ravenshaw University **4. Padma Shri Dr. Ajay Parida** Director, Institute of Life Sciences, Bhubaneswar **5. Dr. Sanghamitra Pati** Director, ICMR-RMRC, Bhubaneswar

23rd (2022)
Sambalpur University, Burla

1. **Prof. Pravat Kumar Mohapatra**
   Former Prof., School of Life Sciences, Sambalpur Univ.
2. **Prof. Pramod Chandra Mishra**
   Former Prof., Dept. of Environmental Sciences, SU
3. **Dr. Chita Ranjan Mishra**
   Former DGM, NALCO and Science Communicator
4. **Prof. Hrushikesh Sahoo**
   Former Prof., Dept. of Geology, Utkal University
5. **Prof. Shankar Prasad Pati**
   Former Prof., School of Physics, Sambalpur University

24th (2023)
Berhampur University, Berhampur

1. **Prof. Ashok Kumar Mahapatra**
   Former Director, AIIMS Bhubaneswar
2. **Prof. Sunil Kumar Sarangi**
   Former Director, NIT, Rourkela
3. **Prof. Malay Kumar Mishra**
   Former HoD of Botany, Berhampur University
4. **Prof. Gouri Shankar Tripathy**
   Former HoD of Physics, Berhampur University

25th (2024)
CSIR-Institute of Minerals & Materials Technology, Bhubaneswar

1. **Prof. Omkar Nath Mohanty**
   Former VC, BPUT, Rourkela
2. **Prof. Kulamani Parida**
   Director N&N Centre, SOA University
3. **Prof. Lala Behari Sukla**
   B&B Res. Centre, SOA University
4. **Prof. Chinmoy Bijoy Kumar Mohanty**
   Former DMET, Odisha & Pro-VC, KIIT, University
5. **Prof. Rama Chandra Mohanty**
   Former HoD of Botany, Utkal University

26th (2025)
KIIT Deemed to be University
Bhubaneswar

1. **Prof. Aditya Prasad Dash**
   Former VC, Central University of Tamil Nadu
2. **Prof. Lambodar Prasad Singh**
   Former Professor of Physics, Utkal University
3. **Prof. Binod Chandra Choudhury**
   Former Professor, Wildlife Institute of India, Dehradun
4. **Dr. Binay Kumar Das**
   DG (ECS), DRDO, Bangaluru
5. **Dr. Jayakrushna Panigrahi**
   Former Convenor, ISCA-Bhubaneswar Chapter

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KIIT Deemed to be University

Bhubaneswar, Odisha

www.kiit.ac.in

From a modest beginning in 1997, Kalinga Institute of Industrial Technology (KIIT) has evolved into a multi-disciplinary university, respected worldwide for its culture of educational excellence. The excellent academic ambience, quality faculty, adherence to strict academic rigor and plethora of other academic activities led to the grant of Deemed to be University status under Section 3 ofUGC Act 1956 to the Institute by the Ministry of HRD, Govt. of India in the year 2004, within just six years of its inception. KIIT, though a very young institution, has performed incredibly well in the rankings conducted by various national and international associations. Today, KIIT offers professional education to around 40,000 students from across India and overseas. This includes over 2,000 international students from 65 countries. The alumni ofKIIT, over a lakh of them, have made their mark in their respective careers in academics, corporate organizations, civil services and enterprises. KIIT has now grown to incomprehensible propositions and is spread over a vast 36-square-kilometre academic township. Its 30 lush green campuses employ over 3,000 eminent faculty and researchers and 15,000 staff members. KIIT and KISS together is a family of over a lakh people. The campus houses a 2,600- bedded super speciality hospital (KIMS), a multi-storey central library, a central research facility, a 22-storey research and innovation wing, auditoriums - the largest one with 5,000 seating capacity, 18 sports complexes, many international standard stadiums covering all sports, 30 food courts, and a rose garden. The institution takes pride in being the greenest campus in India.

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Orissa Environmental Society

(Profile and brief history of the organization, its objects and activities)

Regn No. 100/19 of 1982- 1983, dated 25th Oct. 1982, Regd. under the S.R.Act 1860,
Regn. No. II/ 21022/ 70 (084)/ 2003–FCRA- III, dated 17.11.2003 under FC®Act, 1976.
Website:www.orissaenvironment.com,
Email:oesbbsr1@rediffmail.com, oesbbsr@gmail.com

Orissa Environmental Society was founded in the year 1982 as a state level non-profit organisation, with the prime objective of promoting awareness towards the conservation of wildlife and biodiversity habitats, protection of environment and eco-development. The Society's activities include study, research, documentation, publication, education, awareness promotion, lobby, liaison, persuasion, mass mobilisation campaign, conference, seminar, workshop, colloquium, issue based discussion and consultation, public meeting, etc. It was registered at Phulbani in 1982 under the Societies Registration Act 1860 and now has its headquarters in Bhubaneswar

The approach of the Society has been to sensitise people on environmental issues and influence government policies by way of interaction. This Society is a non-profit making State level voluntary organisation functioning for the four decades and contributing significantly for eco-development, habitat promotion and environmental management in the State of Odisha.. It has been carrying out sustainable activities through the years since 1982 for achieving its objectives, and has established itself as a reputed state level apex organisation in matters regarding natural habitat, wildlife and environment.

The Government of Odisha was pleased to award a piece of land free of premium to the Society, in recognition of its selfless services for the cause of nature conservation. It is now having its own building and infrastructure and self-sustaining. As on today, it has about 800 life members on its roll drawn from various walks of life, such as academics, engineers, doctors, architects, planners, economists, development managers, bureaucrats, forest managers and persons interested in biodiversity, natural resources and environment conservation. Some reputed institutions are also the institutional members of the Society. A few achievements are cited to elucidate the Society's commitment for the cause of the environment:

- Submitted a memorandum to Government of Odisha (Orissa) in 1982 for creation of the Department of Environment in the State.
- A research study on the problem of fluoride pollution in Angul (an industrial pollution hot-spot area identified by the Central Pollution Control Board) area

due to industrial activities led to implementation of the fluoride-free water supply project to 11 villages by Orissa Environment Programme (Indo-Norwegian Cooperation) in 2000-2001.

- Launched an intensive campaign leading to the creation of the eighth biosphere reserve of the country in the Similipal Forest of the Mayurbhanj District by the Government of India in 1994.
- Sustained campaign is going on towards protection and conservation of the epic fame Mahendragiri hill complex. Efforts are made to impress upon appropriate authorities in order to recognize this hill forest ecosystem studded with rare biodiversity and archaeological monuments as an Entity of Incomparable Value (EIV) and raise the status to a Biosphere Reserve and also to include in the list of Heritage Site.
- Preparation of a comprehensive document and sustained efforts in highlighting eco-degradation of the Chilika Lake, the largest brackish water lagoon in Asia provided input that helped creation of the Chilika Development Authority by the Government of Orissa to conserve it through eco-restoration activities.
- Plays proactive role through participation in formulation of the National Environment Policy, Odisha State Action Plan for Climate Change and such other national, and local issues.
- Conducts environment impact studies and suggests for appropriate environment management strategies for development projects.
- The members of the Society comprising the pool of experts on various disciplines of science in the field of environment and natural resources lend their ungrudging support to government and non-government organizations, academic and research institutions through consultation, participation, advices.
- Collaborates, supports and associates with other organizations and institutions in conducting programmes and activities similar to the aims and objectives of the Society.
- Played the pivotal role in opening of the Bhubaneswar Chapter of the Indian Science Congress Association. With a view to promoting scientific temper the Chapter with the cooperation of the Society has been doing excellent work including holding of a state level Science Congress regularly every year since its inception in 1996. Scientists are also felicitated for their life time contributions in various disciplines of science.
- In collaboration with the Indian Science Congress Association Bhubaneswar Chapter regularly holds discussions on "Current Issues on Science &

Environment" regularly on the first Sunday of every month. An expert on the subject is often invited.

- Celebration of World Environment Day, National Science Day, Wildlife Week, and participation in National Environment Awareness Campaign are some of the regular programmes of the Society since inception.
- Confers the "Environmentalist of the Year" and 'Lifetime Achievement' awards on the occasion of World Environment Day celebration and Society's Foundation Day respectively to deserving persons for lifetime achievement in the field of environment and natural resource conservation, initiated since 2010.
- To its credit, it has more than 30 publications on matters related to environment and natural resources.
- Received Nagar Bandhu Samman Award in 2008 for initiating collaborative action through the Bhubaneswar Municipal Corporation in 2009 to raise environment awareness in all the wards of the Corporation.
- It is represented in various committees, in the state as well as national and international levels in matters relating to the environment and the natural resources management, such as Similipal Biosphere Reserve Research Committee, Similipal Biosphere Reserve Expert Committee, Technical Committee on Similipal Biosphere Reserve, State Wildlife Board, State Coastal Regulation Zone Identification Committee, National Environment Awareness Campaign Screening Committee, State level Committee on Environmental Management of Irrigation Projects, World Bank India Country Assistance Evaluation and Country Assistance Strategy Consultations on Environment, Expert Committee for the preparation of the Regional Environmental Management Plan (REMP) based on Carrying Capacity Study (CCS) for Angul-Talcher and Meramundali Region in Odisha State nominated by the State Pollution Control Board, Odisha, etc.

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Abstract (Oral & Poster)

Editorial.....

SDGs: Science and Technology Innovations

Comprising of 17 Goals and 169 associated Targets, the Sustainable Development Goals (SDGs) are the most wide-ranging and ambitious global goals in history that seek to integrate the social, economic, and environmental dimensions of development. At the heart of the SDGs lies the principle of universality-the resolve to ‘Leave No One Behind’. Moreover, the idea of inclusion, and the awareness that it is no longer sufficient to focus only on economic growth but on building more equal societies, threads the Goals. SDGs, the global initiative adopted in 2015 by the United Nations, place the onus on countries to monitor and review at their level the implementation of the Goals and Targets between 2016 and 2030.

Science, Technology, and Innovation (STI) are crucial for achieving the Sustainable Development Goals (SDGs) by addressing complex challenges and fostering sustainable practices across various sectors. STI can drive economic growth, improve human well-being, and protect the environment, contributing to all the 17 SDGs. By harnessing the power of STI, countries can accelerate progress towards the SDGs and build a more sustainable and prosperous future for all. India is deeply involved in achieving the SDGs and has made a substantial progress in several key goals, particularly in areas like poverty reduction, access to clean water and sanitation, affordable energy, and sustainable infrastructure. However, the challenges confronting us have multiplied in the face of global warming, climate change, pollution, depletion of biodiversity and other environmental challenges, and the consequential disasters they bring upon. In such a scenario, our scientists need to come together and provide groundbreaking solutions for SGDs within the timeframe.

Policies for STI seek to foster the production, dissemination and use of knowledge. Each STI policy usually comprises a set of strategies and actions designed to improve the performance of the STI system. STI policy has the potential to set the pace and direction of scientific production, technological learning and innovation. Accelerated development of science and technology and the pervasive use of new technologies in all human activities has made the role of STI policy relevant. Today's "knowledge economy/society" requires new skills, new understanding and education and greater flexibility in our governance system to improve adaptability to a constantly evolving environment. Shaping management tools and instruments to address problems that impact the public agenda form the core to designing public policies. STI systems can contribute to public policy to address these problems. Therefore, a thorough understanding of each of the STI domains and areas to articulate the corresponding actions is necessary for arriving at a systemic solution.

Physical sciences are critical for achieving the Sustainable Development Goals (SDGs) by providing the fundamental knowledge and technologies needed for challenges like climate change, energy, and resource management. Physics, chemistry, and earth sciences offer solutions such as efficient energy devices, renewable energy technologies, and pollution control, which are directly relevant to multiple SDGs including clean energy, climate action, and responsible consumption and production. Physics provides insights into climate change processes and helps develop solutions like renewable energy technologies and efficient energy devices which constitute a part of Climate Action. Climate and weather science are crucial for understanding impacts and implementing mitigation and adaptation strategies. Research in physics and chemistry is essential for developing and improving renewable energy sources like solar and wind power, and for creating more efficient energy storage and distribution systems for making clean and affordable energy. New technologies and innovation that drive economic growth, create jobs, and build resilient infrastructure. Chemistry and earth sciences can contribute to water purification, resource management, and understanding water cycles. Earth and ocean sciences provide the knowledge to monitor and protect marine and terrestrial ecosystems, manage natural resources, and understand the impacts of climate change on biodiversity. Environmental chemistry also plays a role in understanding and mitigating pollution that impacts health. Thus, physical science plays a vital role in advancing technology and addressing global challenges across various sectors, developing innovative solutions, including smart materials, nanomaterials, and eco-friendly polymers.

Life sciences contribute to achieving the United Nations' Sustainable Development Goals (SDGs) by addressing challenges in health, food security, clean water, and sustainable ecosystems. For example, life science research helps develop disease treatments, improve crop yields through biotechnology, and enable new solutions for clean energy and water management (SDGs 6, 7). Furthermore, it is crucial for preserving biodiversity and developing scientific literacy for better policymaking. Biotechnology and modern farming techniques can increase crop yields, improve food security, and reduce world hunger. With ongoing efforts in vaccine development, disease treatment, and ensuring access to medicines and healthcare, good health and well-being is being taken care of. Microbial research and other life science technologies can help in decontaminating water supplies and improving sanitation systems. Research in life sciences is essential for understanding and preserving terrestrial ecosystems, conserving biodiversity, and combating diseases that threaten wildlife. The field of microbiology, for instance, is relevant to almost every SDG, from human health and food production to energy and waste management.

A new scientific paradigm, which utilizes data science models and pervades through almost all disciplines, is emerging to aid the achievement of SGDs. This paradigm leverages on the wealth of scientific knowledge for improving the effectiveness of data science models in enabling scientific discovery. The overarching vision is to introduce scientific consistency as an essential component for learning generalizable models and by producing scientifically interpretable models. Data-driven science has started to gain prominence in a number of scientific disciplines such as turbulence modelling, material discovery, quantum chemistry, bio-medical science, bio-marker discovery, climate science, and hydrology. Data Science is driving AI solutions which have pervaded into almost all disciplines alike and can be easily aligned to be applied for achieving SGDs.

STI, therefore is the backbone for achieving SGDs and the world must prepare a stage where STI can be leveraged through education, research, policy, practice and governance to skill and equip all sectors of society with the power to negate the effect of climate change and make the world sustainable for our future generation.

Prof. Sandeep Narayan Kundu

Prof. Tapan Kumar Bastia

LIFE SCIENCES
Abstracts (Oral)

Characterization of ecoraces of *Antheraea mylitta* Drury found in Odisha through Cyt b DNA barcoding marker

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ABSTRACT

Tropical Tasar silkworm, *Antheraea mylitta* Drury plays a very crucial role in the economic development of the country employing around 9.76 million people in rural and semi-urban areas. Since the population of this species has spread over many states with varying environmental factors, the population has been isolated into many pockets, specifically adapted to that niche, and are called as “ecoraces”. Even though phenotypically these ecoraces may look similar to some level but the intra-generic genotypic variability between them is correlated to the economically important yield traits of their cocoons. The mitogenome is a crucial source for molecular barcoding and phylogeny research. The purpose of our study was to evaluate the effectiveness of cytochrome b (Cyt b) gene of mitochondrial genome as a potential DNA barcoding marker for identification of these ecoraces as to are they really ecoraces, and attempts to establish the first country report of DNA barcode reference library of this silkworm species. After the PCR amplification, a <“450 bp amplicon of Cyt b gene was amplified. This Cyt-b was tested for an appropriate DNA Barcoding marker for *A. mylitta* Drury ecoraces identification. Our study is the first study to compare the relative genetic distance and relation among the ecoraces of *A. mylitta* Drury in Odisha.

Keywords: Cyt b, DNA Barcoding, Ecorace, Ecozone

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Effect of pre-sowing treatments on germination and nursery performance in *Tectona grandis* linn.

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ABSTRACT

Teak (*Tectona grandis* L.f.), is a tropical hardwood species of the family *Lamiaceae*, holds immense commercial and ecological significance due to its durable, termite-resistant, and aesthetically appealing timber. Despite its value, seedling propagation in teak is often constrained by low and erratic germination caused by hard seed coats and inherent dormancy. This study was undertaken to evaluate the impact of different pre-sowing treatments on the germination behaviour and seedling performance of teak under nursery conditions.The experiment was conducted in the nursery of the College of Forestry, OUAT, Bhubaneswar, using a Completely Randomized Design (CRD) with 9 treatments and 3 replications in the year 2025. Pre-sowing treatments included mechanical scarification followed by various chemical, biological, and physical treatments—namely H2SO4, HCl, cow dung, cow urine, hot water, normal water, and gibberellic acid (GA3). Results revealed significant variation among treatments. The highest germination percentage (51.66%), peak value (0.271), and germination value (0.069) were observed in seeds treated with mechanical scarification followed by GA3. However, the highest seedling vigour index (SVI) was recorded in the HCL treatment (990), while the control recorded the highest seedling quality index (SQI) of (8.7). This research underscores the importance of targeted pre-sowing treatments in improving teak seed germination and seedling vigour. Among the treatments, GA3 and HCl treatments emerged as the most promising for enhancing nursery success, offering valuable insights for forestry professionals and plantation managers engaged in teak propagation.

Keywords: Teak, Germination, pre-sowing treatments, nursery performance.

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Ethnomedicinal exploration, phytochemical screening and antimicrobial activity of *Boerhavia diffusa* L.: A multipotential medicinal plant

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ABSTRACT

Boerhavia diffusa L. (family: Nyctanginaceae) is a medicinal herb commonly known as Purunee in Odia, Gadhapurni in Sambalpuri, and also consumed as leafy vegetables. The plant is enriched with anti-inflammatory, antibacterial, antioxidant, and immunomodulatory properties. The secondary metabolites present in the plants can act as effective pharmaceutical compounds. The exploration of phytochemicals in different parts of *B. diffusa* with both the aqueous and ethanol extract will create awareness, along with the suitable solvent and method for extraction of pharmaceutical compounds. Hence, the present study focuses on phytochemical analysis of *B. diffusa* leaves, stems, and roots. In the antimicrobial test, the *B. diffusa* root ethanol extract inhibited the growth of *Pseudomonas aeruginosa* and *Staphylococcus aureus* with zones of inhibition of about 8.3 ± 0.6 mm and 20.7 ± 0.6 mm at 200 µg concentration, respectively. *B. diffusa* is highly nutritious, and the maceration and decoction extracts were similar except for the chloroform extract that was found to be weak.

Keywords: *Boerhavia diffusa* L., ethnomedicine, phytochemicals, antimicrobial activity.

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Therapeutic Use of Curry Leaves and Bael Leaves in Inducing Estrous in Binjharpuri Cattle of Odisha

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ABSTRACT

This study investigates the efficacy of herbal feed additives, specifically curry leaves (*Murraya koenigii*) and bael leaves (*Aegle marmelos*), combined with an area-specific mineral mixture (ASMM) in improving reproductive performance in anestrous Binjharpuri cattle, an indigenous breed from Odisha, India. Sixty anestrous animals (30 heifers and 30 cows) were randomly assigned to five treatment groups: a control group following farmers' standard practices without supplementation, a group receiving ASMM alone (50 g/day/animal), and three groups supplemented with ASMM combined with curry leaves (100 g/day/animal), bael leaves (100 g/day/animal), or both. Over a 60-day experimental period, blood samples were analyzed for hematological, biochemical, hormonal, and mineral profiles. Results indicated significant improvements in hemoglobin, total erythrocyte count (TEC), and packed cell volume (PCV) in heifers supplemented with ASMM alone ($P<0.05$). Serum mineral concentrations (calcium, phosphorus, iron, copper, zinc, manganese) increased significantly in all supplemented groups ($P<0.01$). Estrus induction was highest (83.33%) in the group receiving ASMM with both curry and bael leaves, achieving a conception rate of 66.66% in both heifers and cows, compared to 0% in the control group. The synergistic effect of herbal and mineral supplementation is justifying the *in vitro* laboratory analysis of high phytochemicals and potent antioxidant activity of both the plants by different qualitative and quantitative analytical tests of plant extracts. It offers a promising, cost-effective strategy for addressing anestrous conditions and enhancing fertility in indigenous cattle breeds in nutrient-deficient regions.

Keywords: Binjharpuri cattle, herbal feed additives, estrus induction

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Identification of Natural Anti-Arthritic Compounds from Indian Medicinal Plants using Virtual Screening Approaches

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ABSTRACT

Arthritis is an autoimmune disease characterize by persistent joint inflammation and progressive degeneration, affecting a large segment of both the global and Indian populations. Due to the limitations and adverse effects associated with conventional therapies, there is a growing interest in exploring safer, plant-based alternatives. The present study focuses on identifying potential anti-arthritic compounds from Indian medicinal plants using virtual screening approaches. Medicinal plants traditionally used for arthritis treatment were selected from the IMPPAT and ZINC databases, and their bioactive phytochemicals were retrieved and prepared as ligands. Cadherin-11, a key protein implicated in synovial inflammation and joint destruction in rheumatoid arthritis, was chosen as the target for molecular docking studies. Docking analyses were carried out using AutoDock 4.2 to evaluate the interactions between the ligands and the target protein, assessing their binding affinities and inhibitory potentials. Among the screened compounds, Amiloride, OLT1177, BAPTA-AM, cinnamic acid, and resveratrol exhibited favorable binding energies of -5.3, -4.7, -6.8, -6.2, and -6.7 kcal/mol, respectively, along with reported anti-inflammatory properties. These findings highlight their promise as potential lead molecules for anti-arthritic drug development. Overall, the study emphasizes the importance of integrating traditional medicinal knowledge with modern computational tools to accelerate the discovery of novel phototherapeutics for arthritis management.

Keywords: Anti-arthritis, IMPPAT database, Molecular docking, Phytotherapeutics.

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Floristic inventory of wild edible mushrooms with reference to their ethnotherapeutic potential in Western Odisha, India

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ABSTRACT

Wild edible mushrooms (WEM) are utilised in traditional remedies all over the world and are economically significant. The Western Odisha is home to a wide variety of edible mushrooms that are harvested by rural residents for both food and livelihood generation. In an attempt for the first comprehensive study on the variety and traditional applications of mushrooms in western Odisha extensive surveys were undertaken from 2017 to 2024 to document the ethnomycological diversity and socio-economic significance of the value chain for wild edible mushrooms. The results identifying the gender, type of mushroom species, medicinal uses, and marketing of mushrooms were reported by a total of 750 informants from the study area. As a result of the floristic inventory in the study area 175 different species of mushrooms were collected and taxonomically identified by following the available literature of which 97 were new records for Odisha. Russulaceae was the most dominant family with 25 species followed by Agaricaceae (18 species). The most edible and medicinally significant fungi were found to be *Sparassis crispa, Pleurotus* sp., *Laetiporus sulphureus, Lentinus edodes, L. squarrosulus, Pleurotus ostreatus, P. pulmonarius, Pycnoporus cinnabarinus, Microporus xanthopus, Russula cyanoxantha, Schizophyllum commune, Trametes gibbosa, T. versicolor, Lycoperdon perlatum, L. sajor-caju*. Of all the macro-fungal species, morels were the most expensive and crucial in terms of medicine being widely used to treat common illnesses and primary health disorders by the local tribes. The collection and sale of wild edible mushrooms for food and medicine contributes in the socio-economic advancement, alternative employment, and food security of the rural folks in the study area. It is expected that further studies could isolate novel pharmaceutically potential bioactive substances from these mushrooms, which are now used by rural inhabitants as a source of food and medicines.

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Efficacy of *Carum copticum* extract as a green pesticide against the cosmopolitan beetle, *Tribolium castaneum*

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ABSTRACT

Groundnuts and rice grains are both are susceptible to attack by numerous insect pests. *TrIbolium castaneum* (Coleoptera), is a significant major pest that infests unshelled nuts and broken rice grains. Synthetic chemical pesticides cause consumers serious health issues. The current investigation sought to extract phytochemicals from *Carum copticum* by Soxhlet extractor using methanol as organic solvent and evaluate its ability to combat the major pest *Tribolium castaneum.* Mass spectroscopy and gas chromatography (GCMS) were used to identify the major bioactive chemicals in *Carum copticum*, and there were Thymol (C10H14O), Benzene 1-methyl ($C_{10}H_{14}$),7-Oxabicycloheptane ($C_{10}H_{18}O$), 1-Pentene4-methyl (C_6H_{12}) and Octane (C_8H_{18}). *Tribolium castaneum,* was exposed to three distinct concentrations of the plant's crude and fractions of extract of organic solvents extract (hexane, ethyl acetate, and methanol). All concentrations caused substantial mortality of its eggs and grownups. The methanol fraction and crude extract showed significant adulticidal effects after 10 days of treatment, with 87.11 ± 2.21% and 70.10 ± 2.52%, respectively. A sex ratio imbalance, an extension or reduction of the developmental phases, decreased fecundity, and limited fertility were further manifestations of the biological action of *Carum copticum* extracts on the insects . In comparison to the control, the hexane fraction produced fecundity averages of 55.33 ± 2.01 eggs, and elevated levels of the fraction of ethyl acetate produced 41 ± 0.25 eggs, or a rate at which the spawning of rate at which the spawning of52.93% and 63.25%, respectively This study shows that the efficacy of *Carum copticum* is due to the active chemicals present in the extract that can be employed as a biocontrol agent against the major pest *Tribolium castaneum* infection.

Keywords: *Tribolium castaneum*, Groundnut, Rice grains, Biocontrol, GC-MS

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Effect of *Moringa oleifera* leaf powder as feed additive on the histomorphology and histochemistry of intestine in broiler chicken

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ABSTRACT

Poultry meat is a good source of protein, vitamin B complex, bioactive components (taurine and glutathione) and low in fat and cholesterol. Commercial feed additives have many side effects like antibiotic resistance in the food chain. *Moringa oleifera* leaf powder (MOLP), a natural feed additive is economic, easily available rich in vitamins, minerals and other bioactive compounds can be a safe alternative for the commercial feed additive with minimal side effect. Thus it can enhance the meat quality in broilers. The present study was designed to assess the beneficial potential of moringa leaf powder on the histomorphology of intestine as it is the site of assimilation of nutrients and ultimately contribute to meat production. For the research work, a total of 36 numbers of day old Vanaraja chicks of either sex were procured from Central Poultry Development Organization, Bhubaneswar and reared in the Department of Veterinary Anatomy and histology, C.V.Sc. & A.H, Bhubaneswar. They were divided into two groups with 18 numbers of birds in each. The Group-I Vanaraja chicks were fed with basal diet. The birds in Group-II were fed with basal diet and MOLP @ 3g/kg feed upto 28 days and Basal diet with MOLP @ 9g/kg feed upto 42 days of age. After that the birds were sacrificed by decapitation, the abdominal cavity of the birds

was cut open and the whole intestine was dissected out. Tissues from duodenum, jejunum, ileum, caecum and colo-rectum were collected in 10% BNF and processed routinely for histomorphological and histochemical study. The intestine showed higher villi height and crypt depth, thicker tunica muscularis, increased frequency of intestinal glands as well as lympho-glandular complex in Group-II than Group-I. Thus it can be concluded that MOLP has a positive influence on the histoarchitecture of intestine, thus better digestive physiology and can contribute to production of better quality lean meat.

Keywords: *Moringa oleifera*, Vanaraja chick, intestine, histomorphology, villi

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Plant growth and nodulation of three leguminous intercrops under *Gmelina arborea* based agroforestry systems

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ABSTRACT

A field study was conducted to assess the plant growth and nodulation of leguminous intercrops within *Gmelina arborea* based agroforestry systems under central Indian condition. The experiment comprised eight treatments, including sole and intercropping combinations of *G. arborea* (6-year old) with arhar, cowpea, and greengram. Tree height in the first year of experimentation ranged from 4.02 to 4.72 m and increased to 5.04 -5.84 m range in the second year of experimentation (7-year old tree). The intercropping system of *G. arborea* with greengram recorded the tallest trees, statistically comparable to the *G. arborea* + cowpea system, while the sole *G. arborea* plot produced the minimum height. Diameter at breast height (DBH) of 6-year old trees varied from 7.22 to 9.02 cm, with the highest under *G. arborea* with greengram, at par with *G. arborea* + cowpea system. A similar trend persisted at 7-year of age, with DBH ranging from 8.34 to 10.54 cm. Among pulse crops, plant height at 30, 60 days after sowing and at

harvest ranged from 48.3 to 104.7 cm. Sole arhar attained the greatest height, whereas greengram intercropped with *G. arborea* recorded the least. Nodule count in the first year of trial varied between 9.5 and 17.1 per plant across treatments, with greengram sole showing the maximum and arhar with trees the minimum. The second year of experimentation reflected a similar pattern, with mean nodule numbers ranging from 9.4 to 17.4. Dried nodule weight increased with crop age, ranging from 0.097 to 0.131 g plant{ ^{1} in the first year and 0.075 to 0.168 g plant{ ^{1} in the second year. Greengram in open conditions exhibited the highest total nodule dry matter per hectare (35.9 kg ha{ ^{1}), while arhar intercropped with trees had the lowest (19.5 kg ha{ ^{1}). Overall, the integration of pulse crops, particularly greengram and cowpea, enhanced *G. arborea* growth without significantly reducing crop nodulation, demonstrating the compatibility of these species in agroforestry systems.

Keywords:*Gmelina arborea,* greengram, cowpea, arhar, DBH, nodule.

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Phytochemical Characterization and Bioactivity Screening of a Mangrove Plant *Xylocarpus granatum* Fruit Extracts

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ABSTRACT

Oxidative stress, glycation and inflammation play an important role in manifesting of diabetes and vascular complications. Therefore, medicinal plants having antioxidant, antidiabetic, anti-inflammation, and antiglycation activity may be important in the treatment of diabetes and its associated complications. In recent times, mangrove plants have shown tremendous potential in treatment of various human ailments. Several mangrove plants have also been studied for their unique phytochemicals which play important role in therapeutic interventions. In this context, the present study is aimed at evaluation of antioxidant, antidiabetic, anti-inflammatory, antiglycation potential of *Xylocarpus granatum* fruits available in Mahanadi mangrove delta forest, Odisha. The extraction was carried out using aqueous solvent by maceration technique. The qualitative phytochemical screening exhibited presence of phenols, tannins, saponins, glycosides, terpenoids and flavonoids, whereas the quantitative study revealed the total phenol content of 40 µg/g of GAE. The GC-MS analysis of fruit extract showed 11 peaks on the basis of their different retention time. However, only 08 compounds could be identified such as Ribitol,1,3:2,4 di-O-benzylidene; Permethyl 6''-O-arabinosylisoorientin; 9-O-methyl-4,5-deoxymaytansinol; Ethyl ester decanioc acid; 2,3-epoxyhexanol; Eicosanoic acid, ethyl ester; Quadrigeneine B, 10-Benzyl-7-chloro-3-[4-(trifluromethyl) phenyl]- 3,4-dihydro-1,9-acridinedione. The fruit extracts of these three mangrove plants are evaluated for their antioxidant, antidiabetic, anti-inflammatory, antiglycation potential using *in vitro* assay methods. The *in vitro* antioxidant screening revealed the antioxidant potential of fruit extract with IC_{50} values of 65.71, 45.93 and 41.19 µg/ml respectively for DPPH, ABTS and superoxide scavenging assay. The antidiabetic study revealed that the fruit extract could inhibit á-amylase enzyme with IC_{50} values of 60.33 µg/ml. The antiglycation study revealed that the fruit extract could inhibit Fructosamine and Congo red binding with IC_{50} values of 53.77 and 49.61 µg/ml respectively against the standard drug with IC_{50} values 49.68 and 50.47 µg/ml respectively. The protein denaturation study and RBC membrane stabilization study also revealed that the extract exhibited anti-inflammatory potential with IC_{50} values at 41.81 and 50.05 µg/ml respectively. The findings of the present study might open a new arena of research in traditional herbal medicine with mangrove plants which could be utilized in treatment of diabetes due to its antiglycation, anti-inflammatory and antioxidant properties.

Keywords: Mangrove; antidiabetic; antioxidant; antiglycation; anti-inflammatory

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Anti-bacterial, Anti-viral and Anti- cancer efficacy of *Nymphaea caerulea*

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ABSTRACT

Background and Aim: Multiple antibiotic resistances make illnesses complex to cure and raise morbidity and mortality globally, making multidrug-resistant bacterial diseases serious challenges to global health. Along with these, the ageing of the population, increased exposure to alcohol, tobacco, obesity, and pollution, in lower-income nations, are all contributing factors to the rising burden of cancer, which is another major and expanding global health concern alongside infectious diseases. The rich phytochemical composition of *Nymphaea caerulea* (Blue lotus), includes flavonoids, glycosides, and phenolic acids, is responsible for its many biological actions, which include anti-inflammatory, antioxidant, antibacterial, and anti-cancer qualities. Therefore, in this article we have explored the antibacterial, antiviral and anticancer activities of ethanolic extract of *Nymphaea caerulea*.

Methods: The antibacterial and antiviral study was done with 14th day old fertilized chick embryo model. Several experimental sets were prepared and relative fold change in gene expression of several cytokines were studied which are responsible for pathogenicity, inflammation and tissue damage. The gross morbid anatomical changes of the embryo were studied. Anti-cancer activity of the extract was studied on acute myeloid leukemia cell line, THP-1 along with a control of normal human embryonic kidney (HEK 293) cell line. Cyto-toxicity study with MTT assay, cytopathic study, cytokine gene expression changes together with apoptotic markers were also studied.

Results: Blue lotus extract was found to be remarkable immune-modulator agent as it suppressed pro inflammatory cytokine genes IL-8, IL-1â and IL-6 maintaining the immune homeostasis and triggered the IFN-ã gene expression that stimulated the host immunity in case of bacterial and viral infections. The extract also reduced the haemorrhages in the embryos when infected with *E. coli*. The flower extract is capable of inducing apoptosis in AML cell line and it can balance cytokine alterations in such disease.

Conclusions: Ethanol extract of *N. caerulea* showed promising antimicrobial and anticancer activities.

Keywords: *Nymphaea caerulea*, anti-bacterial agent, anti-viral activity, anti- cancer activity

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Developing Climate-Resilient Rice: Integrating Submergence Tolerance, Bacterial Blight Resistance, and Yield Traits in Swarna through Gene Pyramiding and Marker-Assisted Selection

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ABSTRACT

Swarna, a widely cultivated rice variety in Eastern India, is highly vulnerable to climate-induced stresses such as submergence and bacterial blight (BLB) caused by *Xanthomonas oryzae* pv. *oryzae*, resulting in severe yield losses. The present study aimed to improve Swarna's resilience and productivity by pyramiding multiple stress-tolerance and yield-enhancing genes through marker-assisted backcross breeding (MABB). Genomic DNA extracted from 15-day-old seedlings via the CTAB method was screened using gene-specific markers linked to yield-related QTLs (*Gn1a*, *GW2*, *gw5*, *OsSPL14*, *SCM2*). Seven target genes/QTLs (*Sub1A*, *GW2*, *OsSPL14*, *SCM2*, *xa5*, *xa13*, *Xa21*) were introgressed from three donor parents—Swarna Sub1, Swarna MAS, and Swarna-Habataki—into the Swarna background. Advanced backcross generations were subjected to foreground and background selection to identify lines carrying all desired alleles. The resulting pyramided lines exhibited markedly reduced lesion lengths upon *Xoo* infection, indicating enhanced BLB resistance, and demonstrated robust recovery following complete submergence stress. Agronomic evaluation revealed improved culm strength, panicle weight, and grain yield. The elite line SSBY-69-840 achieved a yield of 7.52 t ha{ ^{1}, representing an 18% increase over the original Swarna and a 6.8% gain over other high-yielding resistant lines. This study highlights the successful integration of submergence tolerance, disease resistance, and yield-related traits through gene pyramiding and marker-assisted breeding, providing a resilient and high-performing rice genotype suited for climate-vulnerable regions.

Keywords:Gene pyramiding, Marker-assisted breeding, Submergence tolerance, Bacterial blight resistance, QTLs, Swarna rice.

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Radio-tolerant novel bacterial consortium for the biodegradation of hexamine

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ABSTRACT

Biofilm-based bioremediation of emerging organic pollutants on a large industrial scale is an economically viable, ecofriendly and stable technology for prolonged uses. Biofilm provide, well establish cellular network, metabolic exchanges, and adaptability towards environmental fluctuation. Biofilm facilitate rapid absorption and degradation of the pollutants compare to suspended culture. Tailor-made, strong biofilm forming bacterial consortium was developed using six well characterized bacterial isolates from the hexamine and formaldehyde containing industrial effluent. The extent of hexamine removal was assessed (based on hexamine, formaldehyde and COD removal efficiency) in biofilm setup after low doses of ^{60}Co irradiation, revealing the consortium to be radio tolerant recovering their efficiency within 96 hours of post irradiation. The immobilized system, showed 94.6%, 86% and 52.5% reduction in hexamine, formaldehyde and COD after 3.75Gy of ^{60}Co irradiation and 92.2%, 84.2% and 52.57% reduction in hexamine, formaldehyde and COD after 5.25 Gy of ^{60}Co irradiation, when starting with an initial 51.6 mg/L hexamine, 39.1 mg/L formaldehyde and COD 13359 mg/L. In suspended condition, the consortium could recover their efficiency within 192 hours post irradiation showing 90.6%, 71.6% and 32.43% reduction in hexamine, formaldehyde and COD after 3.75Gy ^{60}Co irradiation while 91.6%, 72% and 31.9 % reduction in hexamine, formaldehyde and COD after 5.25 Gy ^{60}Co irradiation, when starting with an initial concentration of 52.2 mg/L hexamine, 39.9 mg/L formaldehyde and COD 13037 mg/L. In immobilized condition the consortium could recover hexamine removal efficiency within 24 hours post irradiation following both 3.75Gy and 5.25 Gy of ^{60}Co . In this study we report the hexamine removing ability of *Brucella pseudintermedia*. In this study we report the hexamine removing ability of *Brucella pseudintermedia* and *Ochrobactrum sp.*

Keywords: Hexamine, Ammonia, Formaldehyde, Bioremediation, Biofilm

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In Silico analysis of Structure and Function of Key Enzymes across different Organisms and Study of Evolutionary Relationship

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ABSTRACT

Cytochrome c is a small protein found in mitochondria that helps cells produce energy and control programmed cell death (apoptosis). It is highly conserved across vertebrate species, making it an ideal protein to study how evolution shapes important cellular functions. This project utilises computer-based bioinformatics tools, AI-driven modelling, and molecular simulations to investigate the structure, function, and environmental adaptation of Cytochrome c. This study investigates the evolutionary conservation and functional versatility of Cytochrome c across diverse species, from microorganisms to humans. Highly conserved regions, especially the heme-binding motif, were identified, alongside subtle species-specific variations suggesting functional adaptations. Structural analyses revealed differences in active sites and potential interactions with small molecules. These insights highlight Cytochrome c's key roles in energy metabolism, apoptosis, and stress response. This study helps us understand how Cytochrome c evolved to maintain energy production and respond to environmental stress. It also highlights its role in oxidative stress management, apoptosis, and potential use in bioengineering organisms for environmental resilience. This research provides a clear example of how computational tools can reveal the connection between protein evolution, structure, and environmental adaptation and provides new avenues in drug discovery, enzyme engineering and green biotechnology.

Keywords: Enzyme, NCBI, Phylogenetic Analysis, Sequence Alignment, Molecular Docking.

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Plant Growth–Promoting and Zinc-Solubilising Rhizobacteria: Dual Role in Enhancing Zinc Availability and Crop Productivity

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ABSTRACT:

The soils across all districts of Odisha exhibit zinc deficiency. To sustain and enhance crop production and productivity, the application of zinc-solubilising bacteria (ZnSB) as bioinoculants is therefore essential for improving zinc availability and uptake by plants. The present study investigates the in vitro zinc (Zn) solubilization potential and plant growth–promoting (PGP) effects of native rhizobacterial isolates obtained from agricultural soils of Odisha, India, and evaluates their biofertilization potential in rice crop cultivation. A total of 55 rhizospheric soil samples with pH d" 5.0 were collected from five districts - Balasore, Cuttack and Khordha. One efficient zinc-solubilising bacterial isolate from each district was selected and assessed for its ability to solubilise insoluble zinc compounds under laboratory conditions. Among the isolates, *Priestia aryabhattai*, *Alcaligenes faecalis* and *Bacillus subtilis* exhibited the highest Zn solubilization efficiency, releasing significantly higher concentrations of soluble Zn after eight days of incubation. The overall solubilization trend for all isolates followed the order ZnCOƒ > ZnO > Znƒ (PO„), . The three isolates could produce indole acetic acid in broth cultures and siderophores on CAS agar medium. All three bacteria demonstrated superior zinc-solubilising and growth-promoting capabilities, indicating their potential use as bioinoculants to enhance Zn bioavailability and crop productivity in Zn-deficient soils.

Keywords: Zinc-solubilising bacteria (ZnSB); *Priestia aryabhattai*; *Alcaligenes faecalis*; *Bacillus subtilis*; *Vigna radiata*; Zinc deficiency; Rice; Odisha soils.

Integrated Morphometric Variability, Structural Characterisation and Tissue Biochemical Composition of *Sepiella inermis* (Ferussac & Orbigny, 1848) along the Balasore Coast, Bay of Bengal

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ABSTRACT:

The spineless cuttlefish *Sepiella inermis* is an ecologically and commercially important cephalopod along the Indian coast, yet limited information exists on its morphometric and biochemical traits. This study analysed 221 specimens (132 males and 79 females) collected from the Balasore coast, Odisha, to examine morphometric relationships exhibited by allometric growth in both sexes, with strong positive correlations between dorsal mantle length and body weight (r = 0.81 in males; r = 0.79 in females). Principal Components Analysis (PCA) explained 91% of total variance, confirming sexual dimorphism and size differentiation. Structural characterisation using Fourier Transform Infrared Spectroscopy (FTIR) confirmed the presence of characteristic aragonite bands at 1444, 1081, 852, and 712 cm{ ^{1} along with O–H and N–H stretching vibrations, indicating the coexistence of organic and inorganic components. Scanning Electron Microscopy (SEM) revealed a porous lamellar microstructure with interconnected macropores and compact particulate fragments, again characteristic of aragonite frameworks. Biochemical assays revealed significantly higher protein content in muscle (16.36 ± 1.10 mg g{ ^{1}) compared to skin (10.16 ± 0.51 mg g{ ^{1}), while skin contained greater carbohydrate (8.83 ± 0.68 mg g{ ^{1}) and lipid (1.59 ± 0.11 mg g{ ^{1}) levels. The results demonstrate that *S. inermis* exhibits distinct morphometric and biochemical patterns linked to growth and sex, underscoring its nutritional value and ecological significance. This study provides essential baseline data for sustainable management and value-added utilisation of *S. inermis* in the Bay of Bengal region.

Keywords: *Sepiella inermis*, morphometry, FTIR, SEM, biochemical composition, length-weight relationship

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Repurposing of an FDA-Approved Drug Against Fluconazole-Resistant *Candida albicans*: An In Vitro and In Vivo Experimental Approach

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ABSTRACT:

An inhibitory study of the repurposed FDA-authorised drug compound was done on *Candida albicans*, a primary potent fungal pathogen that causes both superficial and invasive infections, mostly in immunocompromised individuals. In vitro investigations employed minimum inhibitory concentration and minimum fungicidal concentration assays to determine the antifungal susceptibility of the *C. albicans* strain SC5314. Scanning electron microscopic observations revealed significant ultrastructural disruptions in treated fungal cells, including cell wall compromise and morphological irregularities. And when it was administered in a murine model of candidiasis, the compound led to notable reductions in fungal burden and tissue pathology, as confirmed by histological analysis. Notably, antifungal resistance to fluconazole, a mainstay therapy for candidiasis, has emerged worldwide, with documented resistance rates for *C. albicans* varying by geographic region and clinical setting, ranging from less than 2% up to 23% and higher under certain conditions, such as low pH or repeated exposure. In direct comparative assays, the repurposed FDA-approved agent demonstrated greater inhibition of *C. albicans* growth than fluconazole at equivalent concentrations, suggesting superior antifungal potency against resistant clinical isolates. These findings indicate the strong potential of repurposed FDA-approved therapeutics as alternative agents in the treatment of resistant candidiasis, underpinning the need for further mechanistic elucidation and clinical validation.

Keywords: *Candida albicans*, Drug Repurposing, MIC, MBC, SEM, Antifungal Resistance.

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Exploration of Microbial Community Dynamics Influencing Soil Quality in a Chrono-sequence of Red Mud Spoil for Agro-Ecosystem Sustainability

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ABSTRACT

Red mud is the major by-product of bauxite refining process, which poses significant environmental challenges due to extremely high alkalinity, elevated salinity and heavy metal toxicity. Such characteristics render red mud disposed sites hostile to microbial colonization and vegetation establishment. The review dealt with the influence of red mud on microbial community dynamics reflecting the relative distribution of microbial population and its impacts on soil quality status. Several soil quality biomarkers have been utilized for the exploration of microbial community structure that provide insights into ecological implications of red mud contamination. The physico-chemical (pH, texture, hydrological regimes and heavy metal content), microbiological (microbial biomass and diversity indices) and biochemical indicators (enzyme activities and functional diversity) are considered as sensitive biomarkers essential for monitoring soil health and elucidate functional status of red mud spoil. The shift in microbial community structure in red mud spoil has been addressed using advanced analytical and molecular techniques such as phospholipid fatty acid analysis (PLFA) and community level physiological profiling (CLPP). Furthermore, the high-throughput sequencing and metagenomic analysis provided comprehensive insights into the taxonomic and functional alterations in microbiome associated with long-term weathering of red mud spoil. The red mud induced shift in microbial community structure with relative abundance of pioneer metal-tolerant alkaliphiles followed by gradual amelioration of other heterotrophic microbial communities through natural weathering, with notable decline in extremophiles reflect sign of red mud spoil genesis promoting ecological restoration. Long-term weathering

exhibited slow ecological self-recovery, aggregate stability, enhanced water holding capacity, nutrient availability and biodiversity, which are critical in restoring other ecological services such as carbon sequestration and nutrient recycling. Overall, the review provided an insight into ecological consequences of red mud on microbial community dynamics, which pave the way of greater understanding in the direction of improving soil quality and promoting ecological rehabilitation and sustainable development of bauxite residue disposal areas (BRDAs).

Keywords: Microbial community dynamics, red mud, ecological restoration, soil quality.

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Assessing the Antimicrobial Activities Synthetically Derived Lawsone Based 2-Aryl-3-nitro-2*H*-Chromenes

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ABSTRACT:

We have designed a clean and facile *one-pot* protocol for the synthesis of new lawsone-based 3-Nitro-2*H*-chromene derivatives in good to excellent yields (80-92%) at room temperature. All the synthesized compounds were screened with different bases and solvents and also characterized by ^{1}H NMR, ^{13}C NMR, and HRMS. Following that, the compounds were tested for their *in vitro* anti-bacterial studies against two pathogenic bacterial strains, *E. coli* (PDBID: 1KZN) and *S. aureus* (PDBID: 3G75). Among the tested compounds, 3p with 6,8-dichloro and -OMe appended phenyl group exhibited the highest bacterial inhibition potency with MIC value of 6.25 ìg/mL against *E. coli* and 12.5 ìg/mL against *S. aureus,* respectively. Additionally, *in-silico* molecular docking results also revealed that 3p have excellent binding affinity energy of -9.3 Kcal/mol and -8.2 Kcal/mol against *E. coli* and *S. aureus.* Consequently, the results of *in vitro* and *in-silico* assays discovered the capabilities of these compounds as active oral anti-bacterial drugs.

Keywords: Lawsone; Molecular Docking; 2*H*-chromene; Biological activities.

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Multi-Omics Approaches in Sustainable Oral Health Research on Probiotics and Functional Foods Against *Streptococcus mutans* Biofilm Formation

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ABSTRACT

Sustainability in oral health care is evolving beyond eco-friendly clinical practices to embrace molecular-level precision driven by multi-omics technologies. The integration of genomics, transcriptomics, proteomics, and metabolomics enables a comprehensive understanding of the complex interactions between the oral microbiome, host tissues, and environmental factors. This approach provides insights into microbial ecology, gene regulation, and metabolic adaptations influencing oral diseases such as caries and periodontitis. Targeted suppression of key virulence genes in *S. mutans* represents a novel, sustainable, and non-antibiotic approach to manage oral biofilm-related diseases. Moreover, metagenomic analyses capture community-level shifts, highlighting synergistic effects of probiotic strains and bioactive food components in reshaping oral microbiota ecology. Multi-omics facilitates the identification of natural and eco-friendly bioactive agents such as functional food, probiotics, and biodegradable nanomaterials that can replace conventional synthetic antimicrobials promoting targeted modulation of the oral microbiome without disturbing ecological balance, aligning clinical innovation with environmental responsibility, green biotherapeutics, biomaterials with enhanced biocompatibility and reduced environmental footprint that serves as a bridge between high-throughput biological discovery and eco-conscious oral healthcare, defining the future frontier of sustainable dentistry.

Keywords: Oral biofilm, *Streptococcus mutans*, functional foods, multi-omics, Oral Bio-film.

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In silico analysis of phytochemicals of *Ricinus communis L.* for diabetic wound healing

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ABSTRACT

Excessive inflammation, reduced angiogenesis, impaired keratinocyte migration, and reduced fibroblast proliferation are the hallmarks of diabetic wounds. Prolonged hyperglycemia impairs appropriate blood circulation and destroys the vascular system. Diabetic wounds are aggravated by oxidative stress, leading to treatment failure, increased morbidity, and ultimately, costly treatment. *Ricinus communis* L.(castor) is used for wound healing due to its antimicrobial and anti-inflammatory properties, supported by compounds like tannins and flavonoids. *R. communis leaves* were extracted with 100% ethanol using a Soxhlet extractor at 40°C after being shade-dried and ground. The concentrated acetonic extract of *R. communis* was analysed for phytocompounds using FTIR, UV-Vis Spectrophotometer, and GC-MS. The discovered phytocompounds were subjected to molecular docking to investigate their binding interactions with proteins involved in delaying diabetic wounds. The UV vis analysis showed notable peaks at 441.75 nm, 449.10 nm, and 451.55 nm, with absorbance values exceeding 3.2 AU, corresponding to n’!ð* transitions, showing the presence of anti-inflammatory phytocompounds. The FTIR spectroscopy spectrum exhibited a broad and intense absorption band at 3355 cm{ ¹, indicating the presence of O–H stretching vibrations. Also, peaks are observed at 2920 cm{ ¹ and 2851 cm{ ¹ correspond to C–H stretching of aliphatic –CH, and –CHƒ groups. Among all the 32 GC-MS compounds, 5 potential phytocompounds were retrieved by using pubchem database. Molecular docking of diabetic wound healing protein like MMP-8 was docked with 5 no. of phytochemicals of *R. communis*

using PyRx software. Ligand 1-CYCLOHEXYLHEPTENE interacts with MMP-8 at LEU^{193}, VAL^{194}, LEU^{160} by alkyl bond and HIS^{197}, TYR^{219} BY Pi-alkyl bond with lowest binding energy and considered to be a stable complex. So,1-CYCLOHEXYLHEPTENE may be a phytocompounds that can heal diabetic wounds. Thus, the acetonic extract of leaves of *R. communis* may serve as a source for the development of a newer drug for diabetic wounds. However, in vivo research is still needed to determine its efficacy in diabetic wound healing.

Keywords: castor oil, diabetic wound healing proteins, antioxidant, anti-inflammatory.

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Ecological Assessment of Spider Diversity in Aquatic and Residential Areas in Cuttack, Odisha

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ABSTRACT

The present study was undertaken to evaluate the diversity, distribution, and ecological significance of spiders in selected habitats. Spiders, belonging to the order Araneae, are important bioindicators and biological control agents that maintain ecological balance by regulating insect populations. Despite their ecological importance, very limited studies have been conducted on spider fauna in Odisha, particularly in Cuttack district. The investigation was carried out between January and March 2025 in two contrasting habitats: the aquatic site (Naraj, Mahanadi River View) and the residential site (Jobra, Ravenshaw University Campus). Sampling was conducted using multiple standard methods such as active visual search, vegetation beating, net sweeping, hand picking, and pitfall trapping. Collected specimens were preserved in 70% ethanol and examined under a stereo zoom microscope for taxonomic identification using standard keys. A total of 34 genera belonging to 15 families were recorded during the study. The dominant families included Salticidae (jumping spiders), Lycosidae (wolf spiders), and Araneidae (orb weavers), which were widely distributed across both habitats. Habitat-specific differences in species composition and abundance were noted, reflecting the influence of vegetation structure, humidity, and prey availability on spider assemblages. Spiders were categorised into distinct ecological guilds such as orb weavers, ambushers, stalkers, ground runners, and space-web builders, based on their foraging strategies and web architecture. The diversity index revealed that the aquatic habitat supported a higher number of orb weavers and sheet-web builders due to its dense vegetation and high moisture, whereas the residential habitat favoured ground runners and ambushers adapted to open and disturbed conditions. The findings emphasise that environmental heterogeneity plays a key role in shaping spider communities. This study provides the first comprehensive baseline data on spider diversity from Cuttack district, Odisha. It highlights the ecological significance of spiders as potential indicators of habitat quality and environmental health. Further long-term studies are recommended to monitor seasonal variations and the impact of anthropogenic activities on spider populations, contributing to biodiversity conservation and sustainable ecosystem management in the region.

Keywords: Spider diversity, Odisha, Araneae, Orb weavers, Biodiversity conservation.

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Zingerone as a Green Antifungal Agent: Targeting *Candida* Species for Sustainable Health Solutions

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ABSTRACT

Candida (*C.*) species are opportunistic fungal pathogens that infect immunocompromised people, especially *C. albicans*. Alternative antifungal drugs are in greater demand as a result of the growth in antifungal resistance. It has been claimed that gingerone, a strong ketone extracted from ginger and a structural analogue of curcumin, has antibacterial qualities. Its effectiveness against *Candida* species is still unknown. This study intends to test the antifungal potential of zingerone against different *Candida* species. A dilution series of zingerone in dimethyl sulfoxide (DMSO) was prepared for the microbroth dilution test, and it was then incubated with fungal cells in a 96-well microtiter plate at 37°C. The half-maximal inhibitory concentration (IC50) was determined by measuring the optical density (OD) at 24 and 48 hours. Using the resazurin assay, which measures fluorescence intensity to gauge metabolic activity, the effect of zingerone on *C. albicans* biofilm formation was ascertained. Zingerone's moderate antifungal activity was shown by its IC50 values against *C. albicans*, which were 2891 ìg/mL at 24 hours and 1149 ìg/mL at 48 hours. Remarkably, an IC50 value of 367.9 ìg/mL was found by biofilm inhibition analysis, indicating efficacy in biofilm elimination. According to the findings, zingerone may have significant antifungal activity against *C. albicans* when used alone.

Keywords: Zingerone, antifungal resistance, biofilm inhibition, resazurin assay, IC50

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Ethnobotany and Traditional Plant Knowledge: A Green Pathway Toward Sustainable Development

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ABSTACT

In a world striving for sustainability, the ancient wisdom of plants offers valuable insights into modern environmental and social challenges. Ethnobotany, the scientific study of traditional knowledge and cultural practices related to plant use, serves as a vital bridge between ancient wisdom and modern sustainability. Across India — particularly in indigenous communities — plants have long been revered not merely as biological resources but as sacred allies in health, livelihood, and spirituality. This deep-rooted relationship demonstrates how local knowledge systems contribute to sustainable development, biodiversity conservation, and ecological resilience. Traditional plant-based remedies, agricultural methods, and conservation ethics have guided communities for centuries, ensuring a balance between human needs and natural harmony. However, globalization, urbanization, and the loss of indigenous knowledge now threaten these fragile connections. Documenting and integrating ethnobotanical insights into modern science can unveil novel medicinal compounds, promote climate-resilient crops, and encourage community-led conservation. Preserving ethnobotanical traditions is not just cultural nostalgia — it is a scientific and ethical necessity for a sustainable future. Indigenous communities have long practiced sustainable harvesting, soil regeneration, and biodiversity conservation through deep-rooted cultural traditions and plant-based rituals. By documenting and integrating this traditional plant knowledge with modern scientific research, we can develop eco-friendly alternatives for food, medicine, and resource management. Plants used in traditional healing systems often exhibit pharmacological properties that inspire modern therapeutics. Thus, ethnobotany is not merely a study of plants but a living philosophy of coexistence — one that reminds humanity of its shared responsibility to protect nature's wisdom while nurturing a greener, more inclusive future.

Keywords: Ethnobotany, Traditional knowledge, Biodiversity conservation, Sustainability, Cultural heritage, SDGs

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Extremophile–Plant Interactions in Extraterrestrial Agroecosystem Design: A Conceptual Review of Mechanisms and Applications

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ABSTRACT

Extremophile–plant symbioses represent an emerging approach to developing resilient, low-input agroecosystems capable of sustaining productivity in degraded, resource-limited, and climate-stressed environments. Extremophiles including halotolerant bacteria, thermophilic fungi, desiccation-tolerant microalgae, and radiation-resistant archaea exhibit distinctive genomic and metabolic adaptations that enable survival under salinity, heat, drought, nutrient scarcity, and high UV radiation. When functioning as endophytes or rhizospheric partners, these microorganisms enhance plant resilience through osmoprotectant synthesis, biofilm-mediated water retention, phytohormone regulation, nutrient solubilization, and antioxidant defense activation. Integrating advances in microbial ecology, synthetic biology, and planetary agriculture, extremophile–plant partnerships offer scalable biotechnological strategies for regenerative agriculture aligned with the Sustainable Development Goals, particularly Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), and Climate Action (SDG 13). Tailored extremophile consortia can improve crop performance across distinct abiotic stress regimes: halophilic bacteria reduce sodium toxicity and promote potassium balance in saline soils; metallophilic microbes mobilize micronutrients in mining-affected regions; and xerotolerant fungal endophytes enhance stomatal control and lower evapotranspiration in arid zones. Collectively, these mechanisms diminish reliance on chemical fertilizers and irrigation, thereby reducing emissions, conserving water, and mitigating eutrophication. The resilience of extremophiles under Martian-analog conditions marked by radiation, desiccation, and perchlorate-rich regolith also positions them as biological candidates for closed-loop agroecosystems in extraterrestrial habitats. Extremophile-assisted cultivation systems could facilitate nutrient recycling, biogenic soil formation, and greenhouse stability within space habitats. To operationalise this concept, a modular "symbiome-based" agroecosystem is proposed, integrating (1) extremophile bioinoculants optimized for local stressors, (2) soil conditioners derived from microbial biopolymers, (3) decentralized bioreactors for inoculum production, and (4) AI-based monitoring of plant–microbe systems. By decentralizing production and lowering ecological input footprints, extremophile–plant systems contribute to circular bioeconomy models, ecological restoration, and climate adaptation. Ultimately, these symbioses may offer a biologically robust and scalable pathway for transforming marginal lands into productive ecosystems, possibly supporting food security on Earth and sustainable life-support systems in future extraterrestrial settlements.

Keywords: Extremophiles, Symbioses, Resilience, Agroecosystems, Regenerative agriculture, Extraterrestrial habitats.

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Assessment of Age-Specific Incidence and Clinical Characteristics of Endometriosis in Women of Reproductive Age: A Cross-Sectional Case Study.

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ABSTRACT

Women of reproductive age who suffer from endometriosis, a persistent gynaecological illness, experience severe menstrual pain, pelvic discomfort, and a reduced quality of life. Despite its prevalence, there are still significant obstacles, such as delayed diagnosis and low awareness. Early detection and prompt management depend on an understanding of age-specific patterns and clinical manifestations. This study reveals systematic data collection and analysis to ascertain the prevalence of endometriosis symptoms and related traits in the reproductive age population across various age groups. From October 2025, women of reproductive age participated in a cross-sectional online questionnaire study. Menstrual characteristics (age at menarche, cycle regularity, flow intensity, and severity of dysmenorrhea), clinical symptoms (pelvic pain, dyspareunia, gastrointestinal and urinary symptoms), lifestyle factors (physical activity, dietary patterns, smoking, and alcohol consumption), reproductive history, family history, and healthcare-seeking behaviour were all recorded by the structured questionnaire. For comparative analysis, respondents were divided into three age groups: 18–25 years, 26–35 years, and >35 years. A total of seventy-two valid responses were gathered. The age distribution showed that 76.4% of the respondents were between the ages of 18 and 25, 19.4% were between the ages of 26 and 35, and 4.2% were older than 35. 43.1% of respondents reported considerable pain, and 31.9% reported severe dysmenorrhea that interfered with everyday activities. In 26.4% of respondents, heavy menstrual flow was seen. Of the respondents, 8.3% reported having pelvic discomfort frequently, while 29.2% reported having it occasionally outside of their periods. 63% of women reported experiencing gastrointestinal problems during their periods, primarily bloating. Seventy-eight percent of those surveyed were sedentary to moderately active. In 18.1% of patients, there was a family history of endometriosis or similar gynaecological problems. Remarkably, 38.9% of respondents said that neither family members nor medical professionals took their initial problems seriously. 73.6% of responders had regular 27–35 days cycles, and the mean age of menarche was 12.7 years. The need for increased awareness and screening in this age group is highlighted by the prevalence of substantial dysmenorrhea and related symptoms in younger women (18–25 years old). The survey effectively recorded symptom patterns and age-specific distribution, indicating a considerable burden of endometriosis-related symptoms, especially among young women aged 18 to 25. To enable earlier diagnosis and intervention, the data highlights the critical need for increased awareness among the public and healthcare professionals.

Keywords: Endometriosis, dysmenorrhea, reproductive age, age-specific incidence, menstrual disorders, cross-sectional survey, diagnostic delay.

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Addressing Hidden Hunger: The Role of Biofortification in Improving Human Nutrition

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ABSTRACT

Micronutrients are essential for plant growth and development, supporting numerous physiological and biochemical functions. Their significance extends to humans, where elements such as zinc (Zn), iron (Fe), iodine (I), calcium (Ca), and phosphorus (P) are vital for growth, immune performance, and cognitive development in children. However, a large proportion of the global population, especially in developing nations suffers from deficiencies of these nutrients, largely due to dependence on staple foods such as wheat, rice, and maize. These crops naturally contain low concentrations and poor bioavailability of Zn and Fe. In many Asian countries, for example, wheat and rice provide more than 70% of daily calories, yet modern high-yield cultivars possess lower micronutrient levels than traditional varieties. According to the World Health Organization, deficiencies of Fe and Zn are among the most widespread, affecting nearly two billion people worldwide. Biofortification has emerged as a sustainable and cost-effective approach to address these "hidden hunger" challenges by improving the nutritional quality of staple crops. It includes agronomic methods such as optimized fertilizer use, conventional breeding for nutrient-rich genotypes, and transgenic techniques aimed at enhancing micronutrient content. In recent years, omics-based approaches such as genomics and metabolomics have further advanced biofortification by revealing molecular mechanisms of nutrient uptake and storage. Successful examples include golden rice enriched with vitamin A and iron-biofortified beans, which have improved nutritional outcomes without altering consumer habits or increasing production costs. Despite ongoing challenges related to regulation and public acceptance, biofortification remains one of the most practical, sustainable, and long-term strategies to combat global micronutrient deficiencies and strengthen food and nutritional security.

Keywords: Micronutrients, Golden Rice, Hidden Hunger, Deficiency, Biofortification, Transgenic.

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Polystyrene microplastics disrupt cardiac energy metabolism: impairment of carbohydrate, protein and lipid pathways in Wistar rats

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ABSTRACT

Microplastic pollution has emerged as a significant environmental and health concern, with polystyrene microplastics (PS-MPs) being among the most prevalent. Growing evidence suggests that microplastics can translocate across biological barriers and accumulate in vital organs, including the heart, where they may interfere with cellular functions. Since energy metabolism is fundamental to cardiac physiology, disruptions in carbohydrate, protein, and lipid pathways may compromise cardiac performance. However, the metabolic impact of PS-MPs on cardiac tissue remains underexplored to date. The present study aimed to assess the effect of PS-MPs on specific energy metabolism pathways in the cardiac tissue of Wistar rats. Adult male Wistar rats were exposed orally through gavage to certain concentrations of PS-MPs for a sub-chronic duration. After exposure, Cardiac tissues were sacrificed, isolated and analysed for key biochemical markers associated with carbohydrate metabolism (glycogen, pyruvate content, glycolytic enzyme activity, Pyruvate dehydrogenase activity and some TCA cycle enzyme activities), protein metabolism (total protein content, free amino nitrogen content, protease activity and cathepsin activity), lipid metabolism (Lipid profile and Fatty acid synthase activity) and key oxidative stress markers. Enzymatic assays and other metabolic markers were performed to evaluate metabolic disruption and tissue integrity. Exposure to PS-MPs significantly reduced glycolytic and TCA cycle enzyme activities, indicating impaired carbohydrate utilisation. Protease activity and free amino nitrogen content were elevated, suggesting enhanced protein breakdown. Lipid metabolism

was altered, with disturbances in lipid profile and fatty acid synthase activity. These metabolic disruptions were accompanied by increased oxidative stress markers, which may indicate metabolic disorders.PS-MP exposure disrupts cardiac energy metabolism by impairing carbohydrate utilization, promoting protein catabolism, and disturbing lipid oxidation, ultimately compromising myocardial bioenergetics. These findings highlight the potential cardiovascular risks posed by chronic microplastic exposure. Future research should investigate the molecular mechanisms underlying the metabolic dysregulation in cardiac tissue induced by PS-MPs, with an emphasis on histopathological alterations, mitochondrial dysfunction, electrocardiography with heart rate variability analysis, and possible therapeutic interventions to mitigate cardiovascular toxicity.

Keywords: Polystyrene microplastics (PS-MPs), Wistar rats, cardiac metabolism, metabolic disruptions and oxidative stress, energy pathways

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Sustainable Pest Management through Natural Fertilisers from Plants

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ABSTRACT

The increasing demand for sustainable agricultural practices has led to a shift towards eco-friendly alternatives for pest management. This study explores the potential of natural fertilizers derived from plants as a viable solution for sustainable pest management. Plant-based fertilizers, rich in bioactive compounds, can enhance soil health, promote beneficial microbial growth, and induce systemic resistance in plants, thereby reducing the reliance on synthetic pesticides. A comprehensive review of existing literature reveals that various plant species, such as neem (Azadirachta indica), garlic (Allium sativum), and marigold (Tagetes spp.), possess insecticidal and fungicidal properties, making them ideal candidates for natural fertilizer production. These plant-based fertilizers can be formulated through various methods, including composting, vermicomposting, and extraction of bioactive compounds. The use of natural fertilizers from plants offers several benefits, including reduced environmental pollution, improved soil health, and increased crop yields. Moreover, these fertilizers can also contribute to the development of pest-resistant crop varieties, reducing the economic burden on farmers. However, the efficacy of these fertilizers depends on factors such as plant species, formulation methods, and application rates. This study highlights the potential of natural fertilizers from plants as a sustainable solution for pest management. Further research is needed to standardize the production and application protocols for these fertilizers, ensuring their widespread adoption in agricultural practices. By promoting the use of plant-based fertilizers, we can reduce our reliance on synthetic pesticides, mitigate environmental hazards, and ensure a more sustainable future for agriculture.

Keywords: Sustainable agriculture, natural fertilizers, plant-based pesticides, eco-friendly pest management

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Unravelling the Genomic Landscape of HPV-Linked Cervical Cancer among Women of Tripura, Northeast India

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ABSTRACT

Cervical cancer remains a major global health challenge, predominantly driven by Human Papillomavirus (HPV) infection. Among the women of Tripura, Northeast India, the molecular basis and genotype distribution of HPV-linked cervical cancer have not been thoroughly characterised. This study aimed to investigate the prevalence of HPV genotypes, associated cytological abnormalities, and host genetic variants contributing to cervical carcinogenesis in the Tripura population. Cervical samples collected from gynecological outpatients were cytologically screened and subjected to HPV detection using PCR following ethical guidelines.Epidemiological determinants and HPV infection rates across cytological grades were analyzed via logistic regression. Furthermore, a genome-wide association study (GWAS) was performed using the Illumina Infinium HumanExome-12 BeadChip platform on 12 cervical cancer patients and 12 control subjects to identify potential susceptibility loci. HPV infection was detected in 90% of participants, with 68.83% showing normal cytology and 37.17% displaying cytological abnormalities. Notably, 94.37% of women with abnormal cytology were HPV-positive, and 42.25% of these cases progressed to cervical cancer. Age (p-trend = 0.017) and parity were identified as major correlates of HPV infection. GWAS analysis revealed three significant variants—rs799852, rs605059, and rs4608—potentially associated with increased cervical cancer risk.The study highlights a high prevalence of HPV16 infection and its strong association with cytological alterations among women in Tripura. Advancing age and parity emerged as independent predictors of HPV infection. The rs605059 variant identified in this population shows functional associations with ovarian and endometrial pathologies, ð its broader relevance in ð< cancers. These genomic insights emphasize the need for region-specific screening and genetic risk assessment strategies to combat HPV-associated cervical cancer.

Keywords: HPV, Cervical Cancer, Cytology, GWAS, Genetic Variants, Tripura.

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Assessment of Phytotoxic Effects of Synthetic Dyes on Seed Germination and Early Seedling Growth of Selected Crop Species

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ABSTRACT

Synthetic dyes are common and critical pollutants of agricultural soils and waters due to their current and past uses in textiles or allied industries. The purpose of this investigation is to study the phytotoxic effects of two synthetic dyes, methylene blue (MB) and crystal violet (CV), on seed germination and initial seedling development in three crop species: Brassica juncea, Vigna radiata, and Pennisetum glaucum. Seeds were germinated on Petri dishes filled with MB or CV solutions of different concentrations, with distilled water as the control treatment. After 10 days, germination percentage, length of the root and shoot, and seedling vigor index were determined. A concentration-dependent reduction in germination and seedling development was found, with roots more sensitive to dye toxicity than shoots. The crop species affected the level of sensitivity to dye concentration, with mustard being the most affected followed by either moong or millet. These findings indicate the potential ecological danger of using dissembled water contaminated by dyes on agricultural production and emphasize the necessity for accurate remediation and management.

Keywords: Synthetic dyes, Methylene blue, Crystal violet, Phytotoxicity, Germination inhibition

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Effect of Endometriosis on IVF outcome: A retrospective analysis

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ABSTRACT

Endometriosis is a leading cause of infertility. In vitro fertilisation (IVF) carries the best outcome in infertility patients with endometriosis. Due to unclear etiology and multifactorial pathogenesis, the disease is proposed to affect reproductive physiology through various mechanisms. Existing literature provides conflicting results regarding the effect of endometriosis on IVF laboratory parameters and pregnancy outcome. In addition, there is a paucity of data in Indian females in this context. The present study was conducted to analyse the effect of endometriosis on embryological parameters in a tertiary care fertility centre. To compare the fertilisation rate, Grade I embryo formation and pregnancy rate in patients with and without endometriosis undergoing an autologous IVF cycle. Patients undergoing IVF cycles from January 2021 to December 2024 in a tertiary care centre were enrolled for the study. Data regarding the key embryological parameters such as total number of oocytes retrieved, fertilisation rate, Grade I embryos, and pregnancy rate were collected from the embryology lab records. Data entered and calculated in Microsoft Excel. A p-value of less than 0.05 was considered significant. During the above-mentioned period, 201 autologous IVF cycles were conducted. Among these, 22 patients had endometriosis (group I), and 24 had either tubal or unexplained infertility (group-II). Couples with male factor, poly-cystic ovary syndrome and oocyte donation cycles were excluded from the study. In group-I patients with endometriosis, a total of 214 oocytes were retrieved out of which 170 fertilized (79.4%). Eighty grade I embryos were formed on day-3 post retrieval (47.05%). Nine patients had positive serum â-hCG (40.90%). In comparison, in group -II patients without endometriosis,358 oocytes were retrieved, out of which 276 (77.09%) were fertilised. Number of Grade I embryos was 139 (50.36%,). Fifteen patients conceived after embryo transfer (62.5%). The oocyte fertilization rate, grade-1 embryo formation rate and pregnancy rate were found to be similar in patient with and without endometriosis ($p > 0.05$). The current study demonstrates no adverse effect of endometriosis on IVF outcome.

IVF Indications	Group	No. of Oocytes (average)	Fertilisation rate (%)	GradeI embryo (%)	βhCG
Endometriosis (n=22)	I	214 (9.72)	170 (79.04%)	80 (47.05%)	9 (40.90%)
Tubal and unexplained (n=24)	II	358(14.91)	276(77.09%)	139(50.36%)	15(62.5%)

Keywords: Endometriosis, in-vitro fertilisation (IVF), Embryo quality, Fertilisation rate, Pregnancy outcome, Oocyte retrieval, Assisted reproductive technology (ART)

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Sustainable Pest Management through Natural Fertilisers from Plants

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ABSTRACT

The increasing demand for sustainable agricultural practices has led to a shift towards eco-friendly alternatives for pest management. This study explores the potential of natural fertilizers derived from plants as a viable solution for sustainable pest management. Plant-based fertilizers, rich in bioactive compounds, can enhance soil health, promote beneficial microbial growth, and induce systemic resistance in plants, thereby reducing the reliance on synthetic pesticides. A comprehensive review of existing literature reveals that various plant species, such as neem (Azadirachta indica), garlic (Allium sativum), and marigold (Tagetes spp.), possess insecticidal and fungicidal properties, making them ideal candidates for natural fertilizer production. These plant-based fertilizers can be formulated through various methods, including composting, vermicomposting, and extraction of bioactive compounds. The use of natural fertilizers from plants offers several benefits, including reduced environmental pollution, improved soil health, and increased crop yields. Moreover, these fertilizers can also contribute to the development of pest-resistant crop varieties, reducing the economic burden on farmers. However, the efficacy of these fertilizers depends on factors such as plant species, formulation methods, and application rates. This study highlights the potential of natural fertilizers from plants as a sustainable solution for pest management. Further research is needed to standardize the production and application protocols for these fertilizers, ensuring their widespread adoption in agricultural practices. By promoting the use of plant-based fertilizers, we can reduce our reliance on synthetic pesticides, mitigate environmental hazards, and ensure a more sustainable future for agriculture.

Keywords: Sustainable agriculture, natural fertilizers, plant-based pesticides, eco-friendly pest management

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Fluoride and Thyroid Histopathology: Dose-Dependent Effects

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ABSTRACT

Fluoride, a common environmental contaminant, exerts profound dose- and duration-dependent histopathological effects on the thyroid gland, primarily through direct cytotoxicity, oxidative stress, and interference with iodine metabolism. At optimal levels (<1.5 mg/L in water), fluoride poses minimal structural risk, preserving normal follicular architecture with cuboidal epithelium, homogeneous colloid, and intact vascular supply. However, chronic exposure to moderate (1.5–4 mg/L) and high (>4 mg/L) fluoride concentrations, prevalent in fluorosis-endemic regions (e.g., India, China, Ethiopia), induces progressive histopathological alterations. Light microscopy of thyroid tissues from fluoride-exposed rodents and human cohorts reveals initial adaptive changes: follicular hyperplasia, increased epithelial height, colloid vacuolization, and vascular congestion at 1.5–3 mg/L. As exposure escalates (>4 mg/L), degenerative lesions predominate—follicular atrophy, epithelial flattening or desquamation, reduced colloid density, and interstitial fibrosis. Parafollicular cell hyperplasia and lymphocytic infiltration suggest chronic inflammation. Severe cases (>10 mg/L) exhibit cystic degeneration, hemorrhage, and sclerosing thyroiditis-like patterns. Ultrastructural analysis via transmission electron microscopy (TEM) demonstrates subcellular damage: mitochondrial cristolysis and swelling, rough endoplasmic reticulum (RER) fragmentation, Golgi apparatus dilation, and lysosome proliferation in thyrocytes, reflecting impaired protein synthesis and cellular homeostasis. Nuclear chromatin condensation and apoptotic body formation confirm programmed cell death. Scanning electron microscopy (SEM) further reveals disrupted follicular luminal surfaces and microvillar loss. Epidemiological studies report a significant association between water fluoride >4 mg/L and goiter prevalence, with

histopathological confirmation in surgical specimens showing diffuse colloidal goiter and nodular transformations. Iodine deficiency exacerbates fluoride-induced histopathology, while co-administration of iodide or antioxidants (ascorbic acid, N-acetylcysteine) attenuates epithelial damage and restores follicular integrity in animal models. In summary, fluoride induces a histopathological continuum in the thyroid—from compensatory hyperplasia to irreversible atrophy and fibrosis—driven by iodination defects and oxidative injury. These structural alterations underscore the need for stringent fluoride exposure limits, especially in iodine-deficient populations, to safeguard thyroid morphology and function.

Keywords: Atrophy, Colloid, Hyperplasia, Thyroid Follicular Cells

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Phenological Behaviour and Productivity of Mustard [Brassica juncea (L.) Czern and Coss.] under Varying Sowing Dates and Crop Geometry

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ABSTRACT

During the Rabi season of 2023-24. The study, titled "" aimed to determine the optimal sowing time for mustard by establishing the relationship between crop phenology, weather patterns, and its impact on yield and yield-attributing characteristics. The findings sought to provide valuable insights into the best agronomic practices and sowing schedules, thereby enhancing mustard production in the region under prevailing climatic conditions. The experiment was conducted in split plot design with 3 replications along with four different dates of sowing in main plot i.e. D_1(10th November), D_2 (24th November), D_3(8th December) & D_4(22nd December) and three different crop geometry in sub plot i.e. S_1 (30 cm x 15 cm), S_2 (45 cm x 15 cm) & S_3 (30cm x 30cm). The results of the experiment revealed that all the yield-attributing characters of mustard were significantly highest under the first sowing date (D_1), i.e., the 45th Standard Meteorological Week (SMW), followed by the second sowing date (D_2), i.e., the 47th SMW. However, beyond these sowing dates, there was a noticeable decline in growth parameters, yield attributes, and seed yield due to unfavourable climatic conditions that affected the growth and development of mustard, particularly at the later stages. The highest seed yield (1082.9 kg ha{ ^{1}) was recorded under early sowing on 10th November (45th SMW), followed by the second sowing on 24th November, which yielded 822.1 kg ha{ ^{1}. Among the different crop geometries, the yield-attributing characters were significantly highest in the 30 cm × 30 cm spacing (S_3), followed by 30 cm × 15 cm spacing (S_1). Despite this, the highest seed yield (857.50 kg ha{ ^{1}) was observed under the spacing of 30 cm × 15 cm due to a higher plant population (22 plants/m^2) per unit area compared to the wider spacing (11 plants/m^2). The highest seed yield (1151 kg ha{ ^{1}) was achieved in the combination of D1S1, which was

statistically similar to D1S3, with a seed yield of 1145.33 kg ha{ ^{1}. When comparing the two spacing, S_3 (30 cm × 30 cm) proved to be more remunerative due to its lower input requirements (particularly seed), making it a more cost-effective option, despite the slightly lower seed yield than S_1. The agro-meteorological indices indicated that the first sowing date (D1), i.e., the 45th Standard Meteorological Week (SMW), accumulated higher Growing Degree Days (GDD), Helio-thermal Unit (HTU), Photo-thermal Unit (PTU), and Heat Use Efficiency (HUE), with values of 1831.92°C days, 13225.15°C hours, 20171.47°C hours, and 0.60 kg ha{ ^{1} °C{ ^{1} days, respectively. A correlation study between the agro-meteorological indices and the yield across different sowing dates revealed a highly positive correlation between yield and HUE (r = 0.9928), GDD (r = 0.976), HTU (r = 0.977), and PTU (r = 0.957). Based on the findings of the study, it can be concluded that sowing mustard during the first fortnight of November, combined with a wider spacing, results in higher productivity under the prevailing agro-climatic conditions of Odisha. This combination optimizes growth and yield, making it the most suitable agronomic practice for enhancing mustard production in the region.

Keywords: Mustard, Sowing date, Yield-attributing characters, Crop geometry

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Ficus geniculata: A nutritious wild leafy vegetable

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ABSTRACT

Ficus geniculata, an underexplored Moraceae leafy vegetable, is traditionally consumed and used ethnomedicinally in tropical Asia, yet comprehensive nutritional data remain scarce. This study examined the proximate composition and mineral content of *F. geniculata* leaves collected from Sundargarh, Odisha, to elucidate its potential as a nutritious wild edible resource. Leaves were dried at 50°C, milled, and subjected to standard analyses: carbohydrates by Anthrone, protein by Lowry’s method, fat by Soxhlet extraction, with mineral profiles determined via ICP-OES. Results showed substantial macronutrient content, with carbohydrates at 60.09 g per 100 g, protein at 18.23 g per 100 g, and fat at 2.06 g per 100 g on a dry weight basis, highlighting an energy-dense profile suitable for diverse dietary applications. Mineral analysis revealed pronounced levels of essential micronutrients, notably calcium at 2.48654 g per 100 g, magnesium at 0.552416 g per 100 g, iron at 0.049858 g per 100 g, and zinc at 0.008274 g per 100 g, underscoring the leaf’s significant contribution to daily micronutrient requirements for rural and tribal populations. Collectively, the data position *F. geniculata* leaves as a nutritionally valuable wild edible resource with potential implications for food and health security, particularly in settings grappling with malnutrition and micronutrient deficiencies. The findings support the plant’s integration into local diets as a sustainable dietary option and highlight its relevance for biodiversity-based nutrition strategies. To maximize health benefits and practical applications, the study recommends further research into bioavailability, toxicity assessments, pharmacological validation, and the development of value-added products to facilitate community adoption and contribute to sustainable development goals focused on health, nutrition, and sustainable agriculture.

Keywords: *Ficus geniculata*, Leafy vegetable

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Impacts of forest fire on Diversity and Population of Medicinal plants

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ABSTRACT

Forest fires are increasingly recognized as one of the most critical disturbances threatening biodiversity, particularly affecting understorey vegetation and medicinal plant populations in tropical forest ecosystems. The present study assessed the quantitative impact of recurrent forest fires on the population density of nine key medicinal plant species (*Asparagus racemosus*, *Celastrus paniculatus*, *Cissampelos pareira*, *Curculigo orchioides*, *Dioscorea bulbifera*, *Hemidesmus indicus*, *Osbeckia stellata*, *Rauvolfia serpentina*, and *Rotheca serrata*) across the study areas over three years (2021–2024). Population data were collected through a quadrant study, and interannual variations were analysed to assess trends in abundance and decline. Results revealed a consistent reduction in population density across all species. Species such as *Rotheca serrata* and *Celastrus paniculatus* showed the greatest sensitivity to fire, while *Dioscorea bulbifera* and *Curculigo orchioides* displayed comparatively higher resilience. The study concludes that recurrent forest fires pose a significant threat to the survival and regeneration of medicinal plants, leading to long-term depletion of forest genetic resources and undermining traditional healthcare practices dependent on these species. Immediate conservation interventions, including fire management, assisted regeneration, and community-based monitoring, are essential to preserve medicinal plant diversity and ecological integrity in fire-prone tropical forests.

Keywords: Biodiversity loss, Bonai Forest Division, conservation management, population decline

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Sustainable Neurodiagnostics: Gut Microbiome and Metabolomics for Early Strok Detection

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ABSTRACT

The increasing global burden of stroke presents a major challenge to sustainable healthcare systems, particularly in resource-limited regions. Traditional neurodiagnostic methods rely heavily on imaging and clinical evaluations that detect stroke after irreversible neuronal damage has occurred. This proposal introduces a sustainable, science-driven diagnostic innovation that integrates gut microbiome profiling and metabolomics for the early, non-invasive detection of stroke, aligning directly with the United Nations Sustainable Development Goals (SDGs) — notably SDG 3 (Good Health and Well-being) and SDG 9 (Industry, Innovation, and Infrastructure). Recent advances in neurobiology reveal that the gut–brain axis plays a pivotal role in cerebrovascular health. Alterations in gut microbial diversity and metabolite composition—particularly involving short-chain fatty acids, trimethylamine-N-oxide (TMAO), and bile acid pathways—have been associated with systemic inflammation, endothelial dysfunction, and increased stroke susceptibility. By applying targeted and untargeted metabolomic approaches (LC–MS, GC–MS, NMR), we can identify and quantify metabolite-based biomarkers indicative of early neurovascular stress. This research aims to establish a neuro-metabolomic biosignature panel that combines gut microbial data with circulating metabolic profiles using machine learning and systems biology tools. The resulting diagnostic model offers a sustainable and cost-effective solution that reduces dependence on high-cost imaging infrastructure and promotes equitable access to healthcare innovations in both urban and rural communities. Furthermore, the integration of lab-on-a-chip biosensors and portable microfluidic systems enhances field applicability, supporting large-scale screening initiatives within a circular, low-resource diagnostic ecosystem. By fostering cross-disciplinary collaboration among neuroscientists, microbiologists, and data

scientists, this framework promotes green innovation in biomedical technology, contributing to a resilient, inclusive, and sustainable healthcare frontier. Ultimately, this study proposes a paradigm shift from reactive to preventive neurology, emphasizing sustainability through scientific innovation. The convergence of microbiome science, metabolomics, and artificial intelligence presents an opportunity to build a green, data-driven diagnostic future.

Keywords: Sustainable neurodiagnostics, gut–brain axis, gut microbiome, metabolomics, stroke biomarkers,

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Dissecting Genetic Determinants of Grain Dimension and Weight through GWAS in Aromatic Rice Germplasm

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ABSTRACT

Oryza sativa L. (rice) feeds over half of the global population and contributes about 21 % of the world's total caloric intake. Among the various traits influencing productivity and market acceptance, grain size, grain length, grain width, and thousand-grain weight are key determinants. In aromatic rice varieties, grain dimensions directly influence cooking behavior, texture, and consumer preference, making these traits dual targets for both yield improvement and quality enhancement. Grain dimension traits—including area, length, breadth, length-to-breadth ratio, and test weight—are critical determinants of yield, grain quality, and consumer acceptance in rice. Despite their agronomic importance, these traits remain understudied in aromatic rice germplasm. This study conducted a genome-wide association study (GWAS) using 143 aromatic rice accessions genotyped with 1009 SNP markers and phenotyped across three consecutive seasons (2022–2024) to elucidate the genetic architecture of grain dimension traits. GWAS analysis identified 36 significant marker–trait associations (MTAs) across five traits, with 17 MTAs from 13 unique markers showing statistically significant allelic effects that explained 7.1–10% of phenotypic variance. The identified loci were distributed across 12 chromosomes, with notable clustering on chromosomes 3, 5, 8, and 9. Four pleiotropic loci (M406, M548, M665, and M714) exhibited effects on multiple traits, reflecting both favorable and unfavorable genetic trade-offs. Marker-assisted donor identification revealed APA-81 and APA-83 as promising donors for long-slender aromatic rice improvement, while APA-41, APA-45, APA-93, and APA-126 were identified as donors for short-bold types. The systematic identification of 225 putative candidate genes through genome-wide ±200 kb flanking window annotation represents a crucial step toward narrowing the genetic basis of grain dimension and weight traits from chromosomal regions to specific functional loci.

The differential distribution of candidate genes across traits—from five genes for grain area to 182 for test weight—reflects the varying biological complexity underlying trait control. While grain dimension traits are typically governed by a few masters regulatory genes, test weight involves more intricate metabolic and developmental processes. These results not only enrich the genetic toolbox for rice improvement but also underscore the utility of GWAS in capturing natural variation within diverse germplasm. Future research should focus on the functional validation of candidate genes and the deployment of identified markers in marker-assisted selection to accelerate the development of high-quality aromatic rice cultivars.

Keywords: Aromatic rice, genome-wide association study, grain dimension, marker-trait associations, candidate genes, allelic variation, marker-assisted selection.

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Characterization of selected marine cyanobacteria as a source of compounds with antioxidant activity

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ABSTRACT

Cyanobacteria are now being recognized as a valuable source of new and safe bioactive compounds. Although many studies have explored their antioxidant potential in freshwater and soil habitats, much less is known about those from marine environments. In this study, two marine cyanobacterial strains *Oscillatoria boryana* (SB 15) and *Oscillatoria pseudogeminata* (SB 20) were investigated for their enzymatic and non-enzymatic antioxidant activities, as well as their phytochemical composition. The species were identified using both morphological and molecular methods. Their pigment content, including chlorophyll, carotenoids, and phycobiliproteins, was measured. Antioxidant activity was evaluated using DPPH and ABTS free radical scavenging assays. The IC… € values obtained were 260.21 ± 0.94 µg/mL for *O. boryana* and 362.03 ± 0.78 µg/mL for *O. pseudogeminata*, indicating that *O. boryana* had stronger antioxidant potential. The FRAP assay showed that *Oscillatoria boryana* had strong reducing (antioxidant) activity. The methanol extracts of both species contained notable amounts of phenols, flavonoids, tannins, and terpenes compounds known for their antioxidant properties. Both cyanobacteria also showed significant levels of the antioxidant enzymes Superoxide Dismutase (SOD) and Catalase (CAT). FTIR analysis revealed that both species shared similar functional groups, including amines, alcohols, aldehydes, amides, alkynes, alkanes, aromatic rings, nitro compounds, aryls, and halides. In the GC–MS analysis, *O. boryana* was found to contain compounds such as aromatic carboxylic acids, flavonoids, fatty acids, terpenes, and monounsaturated fatty acids. On the other hand, *O. pseudogeminata* showed the presence of organic alcohols, propionates, and aliphatic alcohols. Overall, the findings suggest that both cyanobacterial species naturally produce antioxidant compounds. These results highlight their potential as promising natural sources of antioxidants,

which could be further explored for use in the food, pharmaceutical, and cosmetic industries.

Keywords: Bioactive compounds, Catalase, Molecular identification, Phytochemicals, Radical scavenging, Superoxide dismutase

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Vinegar - From Taste Enhancer to Health Enhancer

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ABSTRACT

Vinegar is a mixture of acetic acid and water made by a two-step fermentation process, with yeast converting sugar to alcohol (ethanol) and ethanol being oxidized to acetic acid by acetic acid bacteria (Acetobacter). Organic acids like acetic acid, maleic acid, citric acid, naturally occurring compounds of plants and animals, and produced by various beneficial microorganisms, play an important role in enhancing food flavour, preserving nutritional quality, and extending the shelf life of food products and extended food safety. Vinegar's scientific importance lies in its diverse health benefits, including antioxidant properties and potential roles in disease prevention and management. These benefits are largely attributed to its bioactive compounds, such as acetic acid and various polyphenols, which contribute to its therapeutic effects. Additionally, the consumption of vinegar has been linked to improved metabolic functions, helping in the management of conditions like diabetes and obesity. Research indicates that vinegar's bioactive components, particularly acetic acid, can enhance insulin sensitivity and aid in weight management, thereby supporting diabetes control and obesity prevention. Innovation and development in vinegar includes *Cider Vinegar,* which derived from fruit juices, as it includes the natural goodness and nutrients from food as well as benefits of vinegar. In the present study

we have used UV Visible absorption spectra to analyse vinegar in different concentration was analysed which indicates a broad peak near 230-235 nm which conforms the presence of acetic acid. In this experiment the percentage of acetic acid in vinegar was determined by using titration with a standardized sodium hydroxide, NaOH solution & by using pH metric titration. After completing both experiments. From both the experiments we determined the acetic acid in white vinegar is 6-7%,in apple cider vinegar is 4-5%, in chili vinegar it's 4-5% and in red wine vinegar it's 6-6.5%. The findings from experiment show a low percentage of acetic acid in the vinegar which prove it is a weak acid. Since the vinegar is a weak acid, a rather low amount Of NaOH is needed to neutralize it. The food industry is developing intensively, and products that, with their characteristics, enrich the food taste and aroma are widely used in the culinary arts. Vinegar contains various nutrients and bioactive components, which are brewed by liquid-state and solid-state fermentation techniques. Nutrients in vinegar include amino acids, sugars, vitamins, and minerals. The functions of these nutrients were providence energy, regulation of cell metabolism regulation, immunoregulation, antioxidation, anticoagulation and improvement of brain development. Additionally, cider vinegar has been reported to have the potential to balance pH levels in the body if taken regularly.

Keywords: Vinegar, Cider Vinegar acetic acid, apple cider vinegar

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Mapping Human Vulnerability to Extreme Heat: Spatial Pattern of Exposure, Sensitivity, and Adaptive Capacity in Odisha

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ABSTRACT:

Heatwaves have emerged as one of the most serious climate-induced hazards in recent decades, with disproportionate impacts on human health, livelihoods, and well-being, particularly in developing states like Odisha. Odisha, characterized by distinct climatic conditions and socio-economic heterogeneity, frequently experiences extreme heat events that pose serious risks to vulnerable population groups. This study aims to analyze the spatial variability of heat-related human vulnerability across 30 districts of Odisha using the vulnerability framework. The study employs a multi-criteria geospatial approach integrating indicators of exposure, sensitivity, and adaptive capacity. All indicators were normalized using min–max scaling and aggregated into a composite vulnerability index. Spatial mapping and cluster analysis revealed distinct regional disparities in the vulnerability patterns. The western and southern inland districts exhibit very high vulnerability due to recurrent heatwave exposure coupled with socio-economic disadvantages and limited adaptive infrastructure. Conversely, coastal districts, despite higher exposure levels, show relatively lower overall vulnerability owing to better health infrastructure and literacy rates. The study further employs correlation analysis across different weighting schemes to check the stability of spatial patterns and methodological bias. The study highlights the significance of district-scale vulnerability mapping for developing evidence-based heat action plans and climate-resilient policies. It advocates for targeted adaptation strategies focusing on the most sensitive and poorly adaptive regions. The integration of geospatial analysis with the vulnerability framework offers a replicable approach for assessing localized heat risk in data-scarce regions.

Keywords: Heatwaves, Heat stress, Heat vulnerability index, climate change

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Assessing antioxidant efficacy of *Ricinus communis, Leucaena leucocephala,* and *Mangifera indica* for reducing oxidative stress in diabetic wounds

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ABSTRACT

Diabetic wounds that do not heal quickly develop ulcers, which are a major complication in diabetic people and cause significant morbidity. The primary reasons of diabetic wound healing delay are chronic oxidative stress and an imbalance between antioxidant defences and reactive oxygen species (ROS), which hamper normal tissue repair. Because of their ability to control oxidative stress, plant-based antioxidants can be investigated as possible botanical options. The leaf extracts of *Ricinus communis, Leucaena leucocephala,* and *Mangifera indica*, were explored for their radical scavenging activities through DPPH and ABTS assays at concentrations of 250/ µg/mL and 1.5/ mg/mL, respectively. Seven different solvents were employed (methanol, ethanol, aqueous ethanol, n-hexane, acetone, ethyl acetate, and chloroform) to maximize extraction of bioactive antioxidant compounds. The antioxidant efficiency of each extract differed according to the plant type and the solvent utilized. *Ricinus communis* acetonic leaf extract achieved 86.05%/ ±/ 0.26 DPPH inhibition (IC50: 79.83/ µg/mL/ ±/ 1.98) and 94.65%/ ±/ 0.17 ABTS inhibition (IC50: 454.62/ µg/mL/ ±/ 1.35), indicating strong but moderate radical neutralization when compared to the other solvents. *Leucaena leucocephala* methanolic extract exhibited 79.88%/ ±/ 0.49 DPPH inhibition (IC50: 247.26/ µg/mL/ ±/ 2.11) and 70.89%/ ±/ 0.51 ABTS inhibition (IC50: 505/ ±/ 1.51/ µg/mL), showing best antioxidant activity among all its solvents. *Mangifera indica*'s aqueous ethanolic extract displayed the highest antioxidant capacity, with 94.49%/ ±/ 0.37 DPPH inhibition (IC50: 52.45/ µg/mL/ ±/ 0.25) and 94.98%/ ±/ 0.89 ABTS inhibition (IC50: 325/ ±/ 2.51/ µg/mL) among all its solvents. The comparative assessment showed that although all three species have substantial antioxidant capabilities, *Mangifera indica*'s aqueous ethanolic extract displayed the highest antioxidant capacity most notably in both the DPPH and ABTS tests. The leaves of *Mangifera indica* showed the highest radical scavenging activity and lowest IC50 value compared to leaves of *Ricinus communis* and *Leucaena leucocephala*. This makes leaves of *Mangifera indica* the most effective antioxidant source for reducing oxidative stress, which can act against delayed wound healing in diabetics. So, leaves of *Mangifera indica* can be used to develop drugs for healing diabetic wounds. To fully utilize its therapeutic potential in the context of diabetic wound care, more research into its phytochemical profile and mechanistic impact is necessary.

Keywords: *Ricinus communis, Leucaena leucocephala, Mangifera indica*, antioxidant activity, diabetic wound

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Pterocarpus as a therapeutic candidate for Type II diabetes: A comprehensive analysis combining computational predictions and in-vitro experimental validation

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ABSTRACT

Diabetes mellitus (DM) is defined as chronic hyperglycemia caused by abnormalities in insulin secretion or action, or both, as well as impaired carbohydrate, lipid, and protein metabolism. Type I and Type II diabetes mellitus are classified as insulin-dependent and non-insulin-dependent, respectively. The global prevalence of diabetes is estimated to rise by 6% per year, with India, China, and the United States having the highest numbers of people with type II diabetes by 2025. This type of diabetes, which accounts for 90-95% of all cases, is caused by a complicated cause that includes insulin resistance and faulty insulin production, resulting in hyperglycemia. The effectiveness of current type II diabetes medications is limited, and many have major side effects. The World Health Organization (WHO) has identified a deficit in the scientific evaluation of traditional plant medicines, despite their extensive use worldwide. Computer-aided drug design (CADD) is a commonly used word in this sector. The expensive and time-consuming experimental methods of high-throughput screening have been replaced with high-throughput virtual screening (HTVS), sometimes referred to as in-silico virtual screening. The biological components, antioxidant capacity, and in vitro and silico antidiabetic activities of *Pterocarpus marsupium*, *Pterocarpus santalinus*, and *Pterocarpus indicus* were examined in this study. The á-glucosidase enzyme inhibition experiments were used to evaluate the antidiabetic potential. The crude extract showed the strongest inhibition

(IC50=39.28 mg mL-1), indicating that it may be used to control postprandial hyperglycemia. Molecular docking and dynamics simulations were used in in silico investigations to clarify the interactions between isolated chemicals and á-amylase enzymes. The compounds (Liquiritigenin, Pterostilbene, Genistein, and Acarbose) showed encouraging binding affinities with the target enzymes 3wh5, 5ayb, and 5ayi. Liquiritigenin exhibits the greatest expected inhibitory effect when compared to the control drugs, with a docking score of -5.999 kcal/mol. Because the plant extract inhibits the enzymes that break down carbohydrates, it may be used as a supplemental treatment for type 2 diabetes-related hyperglycemia.To identify possible antidiabetic components derived from the hypoglycemic characteristics of *P. marsupium*, *P. santalinus*, and *P. indicus*, a study used in-silico methodologies.

Keywords: Anti-diabetic, á-glucosidase, Computer-aided drug design, Diabetes mellitus, hyperglycemia, Molecular docking simulation.

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Enumeration of host plants of the Red Weaver Ant (*Oecophylla smaragdina*): a beneficial forest insect and a key prey of the Indian Pangolin

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ABSTRACT

The Red Weaver Ant (*Oecophylla smaragdina*) is an ecologically significant eusocial insect known for constructing leaf nests using larval silk. It forms mutualistic associations with a variety of host plants, including trees, shrubs, and climbers, which provide shelter, food, and protection. In return, the ants defend their host plants from herbivores and insect pests such as stem borers, aphids, caterpillars, and mealybugs, thereby enhancing plant fitness and contributing to overall ecosystem stability. Moreover, Red Weaver Ants (RWA) serve as an important prey species for the Indian pangolin (*Manis crassicaudata*), a nocturnal insectivore dependent on ants and termites. Therefore, documentation of host plants of RWA is an important ecological study. Hence, to document the diversity of host plants associated with *O. smaragdina*, a survey was conducted between 2022 and 2025 across two forest divisions (Bonai Forest Division and Rourkela Forest Division) of the Sundargarh district, Odisha, India, A total of 30 host plant species were identified, representing 27 genera and 17 families by the authors followed by published flora books. A field data book was maintained for the enumerated host plant species. The results revealed that the family Fabaceae accounted for the highest proportion of host species (13.34%), followed by Apocynaceae (10%), Ebenaceae (10%), and Lecythidaceae (10%). While *O. smaragdina* is an indicator of a healthy forest ecosystem, recent observations reveal its nesting on invasive species such as *Terminalia catappa*, which may threaten native plant diversity and disrupt ecological balance. Present study highlights the ecological significance of RWA, their diverse host plant associations, and their role in supporting the trophic needs of the Indian pangolin. The findings provide a base line data for developing effective management and conservation strategies for *O. smaragdina*, its host plants, and the habitat they sustain.

Keywords: Conservation, diversity, ecosystem balance, eusocial insect, invasive species.

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Aberrant Oncogenic Signalling Driven by p53 Gene Mutations in Glioma Cells

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ABSTRACT

Glioma represents one of the most aggressive and lethal tumors of the central nervous system, characterized by extensive genetic and molecular heterogeneity. Among the various genetic alterations implicated in gliomagenesis, mutations in the p53 tumor suppressor gene play a pivotal role in disrupting normal cell-cycle regulation and apoptotic control. The present study focuses on understanding how p53 gene mutations contribute to aberrant oncogenic signaling in glioma cells. **Mutational inactivation of p53 leads to the loss of its regulatory function over key signaling cascades such as PI3K/AKT/mTOR, MAPK/ERK, and MDM2 feedback pathways, thereby promoting uncontrolled proliferation, survival, and resistance to cell death.** By integrating molecular analysis, mutational profiling, and pathway mapping, this investigation elucidates the mechanistic links between p53 dysfunction and the activation of oncogenic networks. The findings highlight that altered p53 signaling not only serves as a molecular hallmark of glioma progression but also presents potential therapeutic targets for precision medicine approaches. Understanding these aberrant signaling mechanisms may pave the way for improved prognostic markers and targeted treatment strategies in glioma management.

Keywords: Glioma , p53, MDM2, AKT

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Comparative study on diversity and distribution of *Dendrobium* Swartz (Orchidaceae) species in India and their significance

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ABSTRACT

Orchids represent one of the largest and most diverse families of flowering plants, celebrated for their vibrant colours, intricate forms, and captivating fragrances. Within the Orchidaceae, *Dendrobium* Swartz is among the three largest genera, comprising approximately 129 species reported from India. In Odisha, around 14 *Dendrobium* species have been documented, including two endemic species (*D. herbaceum* and *D. regium*) to the state. India overall hosts 23 endemic *Dendrobium* species. Most *Dendrobium* species are epiphytic, though a few exhibits lithophytic habits, thriving across diverse habitats ranging from high-altitude forests to lowland regions. Their striking and often large flowers attract a wide array of pollinators such as bees, butterflies, moths, and bats, ensuring successful reproduction. Traditionally, various *Dendrobium* species have been used in the treatment of multiple ailments. Some are valued as blood purifiers and consumed as herbal teas. For instance, a paste of *D. amoenum* is applied to reduce inflammation and treat dislocated bones, while pseudobulbs of *D. crepidatum* are used for bone fractures, and roots of *D. fimbriatum* are employed in managing liver disorders. Pharmacological studies have demonstrated that *Dendrobium* species possess diverse bioactivities, including antimicrobial, anti-aging, antidiabetic, anticancer, and anti-metastatic properties. Beyond their medicinal potential, *Dendrobium* orchids contribute significantly to local livelihoods due to their ornamental value, with species such as *D. amoenum*, *D. fimbriatum*, and *D. nobile* being highly prized in the floriculture market. Continued exploration and advanced research are essential to fully uncover the ethnobotanical and pharmacological potential of *Dendrobium* species in India, particularly within the diverse ecosystems of Odisha state.

Keywords: Conservation, endemic, ethnomedicinal, livelihood, pharmacological.

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Phytochemical profiling, antioxidant activity and antibacterial potential of selected grass species of Odisha, India

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ABSTRACT

Grasses are among the most abundant yet underexplored plant groups, playing vital ecological, nutritional, and medicinal roles belonging to the family Poaceae. Despite their widespread distribution and traditional uses in ethnomedicine, limited scientific data exist on their bioactive compounds and bioactivity. Amid growing global health challenges, the search for novel plant-based therapeutic agents has intensified, positioning grasses as a promising and less studied reservoir of healing potential. Therefore, keeping this in view, nine common grasses were selected for the screening of bioactive compounds and studying their bioactivity. *Chloris barbata*, *Dactylocteniumaegyptium*, *Digitaria ciliaris*, *Dinebra chinensis*, *Echinochloacolona*, *Paspalum scrobiculatum*, *Setaria pumila*, *Sporobolus diandrus*, and *Urochloadistachyos*were collected from the Mahanadi River areas of Cuttack and Nayagarh, Odisha. Herbarium specimens were prepared, identified, and submitted to the Herbarium unit, Ambika Prasad Research Foundation, Odisha. Plant parts were subjected to extraction followed by phytochemical screening, quantification of total phenol, tannin, flavonoids and saponin. Antioxidant and antibacterial activity were carried out using standard methods. Qualitative phytochemical screening revealed the presence of tannins, saponins, alkaloids, and reducing sugars, particularly in ethanolic and aqueous extracts, while terpenoids, phenolics, steroids, and flavonoids were generally scarce in the used extracts. Quantitative analysis showed variation in bioactive content, with *Urochloa distachyos* showing exceptionally high flavonoid content (8.29 mg/100g) and *Chloris barbata* with the highest saponin concentration (30.29%). Thin Layer Chromatography -2,2-Diphenyl-1-Picrylhydrazyl (TLC-DPPH) based analysis confirmed the presence of multiple antioxidant-active spots, especially in *Dinebra chinensis* and *Paspalum scrobiculatum*. Antibacterial assays against *Escherichia coli* revealed significant

inhibitory activity in *Paspalum scrobiculatum*, *Setaria pumila*, and *Urochloa distachyos,* with the lowest Minimum Inhibitory Concentration (MIC) value of 12.5 mg/mL. These findings highlight the potential of these underexplored grasses of Odisha as promising sources of natural antioxidants and antibacterial agents for future pharmacological applications. In addition, they can be suitable grass species for grassland restoration and wildlife habitat management.

Keywords: Bioactive compounds, conservation, drug formulation, wildlife habitat management

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Diversity and temporal dynamics of major insect pollinators association with important trees in east coast of India

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ABSTRACT

Insect pollinators and trees play crucial roles in sustaining ecosystem productivity and stability. A field investigation conducted in 2024 examined the association between major insect pollinators and 15 important tree species under east coastal Odisha conditions in eastern India. The studied species included *Mangifera indica*, *Gliricidia sepium*, *Moringa oleifera*, *Litchi chinensis*, *Cinnamomum zeylanicum*, *Pongamia pinnata*, *Peltophorum ferrugineum*, *Lagerstroemia speciosa*, *Caesalpinia coriaria*, *Tectona grandis*, *Santalum album*, *Ziziphus mauritiana*, *Alstonia scholaris*, *Sapindus mukorossi* and *Anacardium occidentale*. The study assessed pollinator diversity and temporal activity patterns associated with these flowering trees. Results revealed a rich assemblage of insect pollinators belonging to several functional groups, including bees, flies, butterflies, moths, wasps, and beetles. *Ziziphus mauritiana* supported the highest pollinator species richness (12 species), followed by *Pongamia pinnata* and *Santalum album* (Flowering 2) with 11 species each, while *Gliricidia sepium* recorded the lowest (5 species). Pollinator individuals varied across flowering phases and tree species. Mid-flowering recorded the highest activity (20.14 individuals/5 min/m^2), followed by early (12.89) and late phases (8.42). Among species, *Ziziphus mauritiana* showed maximum numbers (20.83/5 min/m^2), while *Caesalpinia coriaria* had the lowest (7.67/5 min/m^2). Pollinator activity varied significantly throughout the day, with peak visitation observed between 09:00–11:00 hours, averaging 8.51 number of species per 5 min/m^2. Diversity indices reflected considerable variation among tree species. Simpson’s Index ranged from 0.07 to 0.16, while Simpson’s Diversity Index (0.84–0.93) and Reciprocal Index (6.19–14.61) indicated moderate to high diversity. *Santalum album* (Flowering 2), *Ziziphus mauritiana*, and *Pongamia pinnata* supported the most diverse pollinator communities. Evenness values (0.26–0.67) demonstrated variable distribution patterns, with *Ziziphus mauritiana* showing the most balanced pollinator community. Among pollinator species, *Apis cerana indica* exhibited the widest association, visiting 12 tree species, followed by *Apis dorsata* and *Eristalinus* sp. (11 species each). Several taxa, including *Megachile disjuncta*, *Coelioxys* sp., *Polistes watti*, *Papilio polytes*, and *Eristalis tenax*, were linked to single host trees.

Keywords: Insect pollinators, tree species, diversity index, *Apis* spp, Ber, Karanj, Sandal, association

Development and Evaluation of Chicken Feather Protein Hydrolysates as a Cost-Effective and an Alternative Nutrient Source for Microbial Cultivation

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ABSTRACT

To reduce the production cost of microbial growth media, various natural resources such as agricultural by-products, plant materials, sugars, and animal-derived wastes have been increasingly explored as nutrient alternatives. In this study, **Chicken Feather Protein Hydrolysate (CFPH)** was produced through both alkaline and acid hydrolysis of raw chicken feathers and subsequently evaluated as a cost-effective component for bacterial culture media. The efficacy of the CFPH-based media was assessed using *Escherichia coli* as a model organism, with **Nutrient broth (NB)** serving as the commercial control medium. Several experimental media were formulated by varying the ratios of CFPH with yeast extract and beef extract. For growth kinetics analysis, 1 mL of actively growing *E. coli* broth culture was inoculated into each test medium. Optical density (OD) at 600 nm was recorded immediately after inoculation and at 4h intervals over a 22h incubation period. The growth profiles demonstrated that *E. coli* exhibited comparable or enhanced growth in CFPH-yeast and CFPH-beef formulations relative to the standard NB medium. Notably, even CFPH alone supported substantial bacterial growth, indicating its nutritional adequacy as a basal medium. Further validation was carried out using six bacterial species: *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Salmonella typhimurium*, *Leuconostoc mesenteroides*, and *Listeria innocua* via the streak plate method. All strains showed robust colony formation on CFPH-based agar, with growth characteristics nearly equivalent to those observed on nutrient agar. Overall, the findings highlight the **potential of CFPH as a sustainable and economical substitute** for conventional peptone-based media in microbial cultivation. The valorisation of chicken feather waste into nutrient-rich hydrolysates not only mitigates environmental pollution but also

contributes to the principles of the circular bioeconomy by converting low-value waste into a high-value biotechnological resource applicable to the **biotechnology, pharmaceutical, agricultural, and food sectors**.

Keywords: **Chicken Feather Protein Hydrolysate (CFPH), Chicken Feather waste,** cost-effective, NB medium, culture media.

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Synthesis of Membranotropic Phyto-conjugate for Efficient Delivery of antimicrobials into Drug Resistant Bacteria

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ABSTRACT

Antibiotics have been the most effective way to treat bacterial infections for nearly a century. However, bacterial pathogens rapidly exhibited their tendency to acquire and spread mechanisms that enable them to resist the effects of antimicrobials. Antibiotic resistance, one of the world's biggest public health threats, could render many antibiotic classes ineffective soon. Poor membrane permeability of antimicrobial agents is a key rate-limiting step towards the design of successful chemotherapeutics. Membrane physical parameters such as lipid composition, charge and fluidity are the major determinants of drug interaction and permeability. Phytochemicals from the chloroform-ethanol extract of *Gymnema Sylvestre* induce flip-flop in phospholipid analogues in Large Unilamellar Vesicles (LUVs) prepared from the bacteria. As this fraction also exhibited anti-microbial activity on several bacteria, it was hypothesised that flip-flop inducing terpenoids might alter the membrane organisation that leads to its anti-bacterial activity. We have synthesised a phytochemical named *Gymnema* Saponin (GS) from *Gymnema sylvestre* using solvent extraction procedure, which shows antibacterial

activity against both gram-positive and gram-negative bacteria. It was hypothesised that flip-flop inducing terpenoids might alter the membrane organisation that leads to its enhanced permeability and thereby it show anti-bacterial activity. That means GS can enhance the bacterial membrane permeability. Thus, the phyto-conjugate formulation of GS will provide effective therapeutics against clinically isolated multidrug-resistant (MDR) bacteria. The antimicrobials that target the bacterial cell membrane but have poor membrane permeability can penetrate the membrane easily due to the flippase-inducing fraction of *Gymnema sylvestre* followed by bacterial cell lysis. We synthesised phyto-conjugates using the GS; the phytochemical isolated from our lab in combination with antibiotics such as Sulfamethoxazole and Ampicillin, which show enhanced antibacterial activity against drug-resistant bacteria. It enhances the membrane permeability of the antibiotics when it is combined with the phytochemical.

Keywords: Phyto-conjugate, drug resistance, *Gymnema* saponin

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Phytochemicals from *N. arbortristis* induce drug resistance in antibiotic-sensitive *S. aureus*

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ABSTRACT

Antibiotic Resistance in *S. aureus* develops by the mechanism of aminoacylation of membrane lipids. Leaf extract of *Nyctanthes arbortristis*, an important herbal healer widely distributed across the Indian subcontinent, induces dose-dependent and time-dependent increase in amino-PL (amino-PG and amino-CL) content in the plasma membrane of *S. aureus,* which induces its resistance against the current generation of cationic antimicrobials such as collistin and daptomycin. However, the specific phytochemical component(s) responsible for lipid amino-acylation in *S. aureus*, their characterisation and effect on drug resistance mechanism in *S. aureus* need to be investigated. In contrast to many other phytochemical extracts that exhibit growth-inhibitory activity on *S. aureus*, we observed growth-enhancing effects of MENA (Methanol extracted fraction of *Nyctanthes arbortristis*) on methicillin-sensitive *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA). The MSSA strains exhibited more growth compared to MRSA in the presence of MENA, indicating that MENA exhibits a higher growth-enhancing effect on MSSA. The *S. aureus* strains develop resistance against multiple antibiotics when treated with MENA. MENA also enhances lipid aminoacylation in *S. aureus*. Lipid aminacylation is a key regulatory factor that increases the plasma membrane charge and inhibits the binding of cationic antimicrobial peptides. CENA (Chloroform extracted fraction of *Nyctanthes arbortristis*) has an inhibitory factor for lipid aminoacylation. The resistance factor from *N. arbortristis* responsible for drug resistance in *S. aureus* needs to be investigated further.

Keywords: Aminoacylation, Drug resistance, MENA, CENA.

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contributes to the principles of the circular bioeconomy by converting low-value waste into a high-value biotechnological resource applicable to the **biotechnology, pharmaceutical, agricultural, and food sectors**.

Keywords: Chicken Feather Protein Hydrolysate (CFPH), Chicken Feather waste, cost-effective, NB medium, culture media.

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Synthesis of Membranotropic Phyto-conjugate for Efficient Delivery of antimicrobials into Drug Resistant Bacteria

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ABSTRACT

Antibiotics have been the most effective way to treat bacterial infections for nearly a century. However, bacterial pathogens rapidly exhibited their tendency to acquire and spread mechanisms that enable them to resist the effects of antimicrobials. Antibiotic resistance, one of the world's biggest public health threats, could render many antibiotic classes ineffective soon. Poor membrane permeability of antimicrobial agents is a key rate-limiting step towards the design of successful chemotherapeutics. Membrane physical parameters such as lipid composition, charge and fluidity are the major determinants of drug interaction and permeability. Phytochemicals from the chloroform-ethanol extract of *Gymnema Sylvestre* induce flip-flop in phospholipid analogues in Large Unilamellar Vesicles (LUVs) prepared from the bacteria. As this fraction also exhibited anti-microbial activity on several bacteria, it was hypothesised that flip-flop inducing terpenoids might alter the membrane organisation that leads to its anti-bacterial activity. We have synthesised a phytochemical named *Gymnema* Saponin (GS) from *Gymnema sylvestre* using solvent extraction procedure, which shows antibacterial

activity against both gram-positive and gram-negative bacteria. It was hypothesised that flip-flop inducing terpenoids might alter the membrane organisation that leads to its enhanced permeability and thereby it show anti-bacterial activity. That means GS can enhance the bacterial membrane permeability. Thus, the phyto-conjugate formulation of GS will provide effective therapeutics against clinically isolated multidrug-resistant (MDR) bacteria. The antimicrobials that target the bacterial cell membrane but have poor membrane permeability can penetrate the membrane easily due to the flippase-inducing fraction of *Gymnema sylvestre* followed by bacterial cell lysis. We synthesised phyto-conjugates using the GS; the phytochemical isolated from our lab in combination with antibiotics such as Sulfamethoxazole and Ampicillin, which show enhanced antibacterial activity against drug-resistant bacteria. It enhances the membrane permeability of the antibiotics when it is combined with the phytochemical.

Keywords: Phyto-conjugate, drug resistance, *Gymnema* saponin

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Phytochemicals from *N. arbortristis* induce drug resistance in antibiotic-sensitive *S. aureus*

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ABSTRACT

Antibiotic Resistance in *S. aureus* develops by the mechanism of aminoacylation of membrane lipids. Leaf extract of *Nyctanthes arbortristis*, an important herbal healer widely distributed across the Indian subcontinent, induces dose-dependent and time-dependent increase in amino-PL (amino-PG and amino-CL) content in the plasma membrane of *S. aureus,* which induces its resistance against the current generation of cationic antimicrobials such as collistin and daptomycin. However, the specific phytochemical component(s) responsible for lipid amino-acylation in *S. aureus*, their characterisation and effect on drug resistance mechanism in *S. aureus* need to be investigated. In contrast to many other phytochemical extracts that exhibit growth-inhibitory activity on *S. aureus*, we observed growth-enhancing effects of MENA (Methanol extracted fraction of *Nyctanthes arbortristis*) on methicillin-sensitive *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA). The MSSA strains exhibited more growth compared to MRSA in the presence of MENA, indicating that MENA exhibits a higher growth-enhancing effect on MSSA. The *S. aureus* strains develop resistance against multiple antibiotics when treated with MENA. MENA also enhances lipid aminoacylation in *S. aureus*. Lipid aminacylation is a key regulatory factor that increases the plasma membrane charge and inhibits the binding of cationic antimicrobial peptides. CENA (Chloroform extracted fraction of *Nyctanthes arbortristis*) has an inhibitory factor for lipid aminoacylation. The resistance factor from *N. arbortristis* responsible for drug resistance in *S. aureus* needs to be investigated further.

Keywords: Aminoacylation, Drug resistance, MENA, CENA.

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PHYSICAL SCIENCES
Abstracts (Oral)

Adulteration Detection In Mutton By FT-NIR

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ABSTRACT

Near infrared reflectance spectroscopy (NIRS) has been developed as a rapid tool for estimation of chemical composition and meat speciation studies and also a great potential for online analysis of foods. The principle of the method is the absorption or reflection of different wavelengths of incident radiation, which depends on the chemical composition of the analyzed sample. The unique nature of NIR spectroscopy include rapid, non-destructive, environmentally friendly, no chemical is required for sample preparation. Current study was proposed to detection of beef adulteration in mutton by using Fourier transform near infrared spectroscopy (FT-NIR) at 700-2500 nm wavelength for spectral acquisition. A total of 22 trials were conducted each of which containing 7 classes with different ratios of mutton and beef viz., 100:0, 0:100, 90:10, 80:20, 70:30, 60:40 and 50:50. Mutton samples were adulterated with beef approximate 10 per cent increment up to 50 per cent according to weight. A total of 924 spectra were collected and each sample scanned at 6 times and it was collected over 12500-4000 cm^{-1} at room temperature (25±1^{0}C) and 132 spectra were recorded in each class level. The absorptions measured by NIR spectroscopy correspond mostly to overtone and combinations of vibrational modes involving C-H, O-H and N-H chemical bonds in the NIR wavelengths produces spectra which are unique to a sample acting as a "finger print". Mahalanobis distance method was used for removing of spectral outliers and those samples should be excluded from the data. To eliminate the interference using pre-processing methods such as Vector Normalization using Standard Normal Variate (SNV) +1st derivative and Multiplicative Scatter Correction (MSC)+2nd derivative which were used for current study. A total of 17 Savitzky-Golay smoothing points were used for the purpose of smoothing the data and baseline correction. Calibration model set for R^2, RMSEV, RPD were obtained. It could be concluded that, the current study was performed combination of near infrared spectroscopy technology with partial least square regression and multivariate statistical analysis was great potential tool than conventional methods to identified 10% beef adulteration in mutton.

Keywords: FT-NIR, Mutton and PLS.

Ultrasonic Extraction as a Green Technology for Sustainable Rice Bran Oil Production

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ABSTRACT

Rice bran, an important by-product of the milling process, is particularly rich in oil (18–23%) and valuable bioactive compounds such as ã-oryzanol, tocopherols, and phytosterols. Ultrasonic-assisted extraction (UAE) using water as a sustainable alternative to inorganic solvents and chemical free green technology was investigated for rice bran oil extraction. Freshly stabilized rice bran was subjected to ultrasonic treatment using a probe sonicator (350 W sonication power). Process parameters, including solid-to-liquid ratio (1:10–2:10 w/v), sonication time (15–35 min), and sonication temperature (40–60 °C), were optimized through Response Surface Methodology (Box–Behnken Design). The extracted rice bran oil was analyzed for oil yield, free fatty acid (FFA), peroxide value (PV), iodine value (IV), ã-oryzanol content, and color values. The oil obtained through the optimized UAE condition was compared with conventional Soxhlet extraction, cold pressing, and a commercial refined rice bran oil. The optimized UAE condition yield 16.92 ± 0.38% oil, which had a higher recovery than the Soxhlet extraction (15.46 ± 0.88%). The ultrasonic-extracted rice bran oil (URBO) demonstrated lower FFA content (4.16%) than Soxhlet oil (7.46%) and cold-pressed oil (6.25%). URBO exhibited a slightly higher but acceptable peroxide value (3.73 meq O, /kg), a higher iodine value (96.74 g I, /100 g oil), and an enriched ã-oryzanol content (1.64%) compared to conventional solvent-extracted oil. URBO exhibited improved color characteristics and a lighter appearance. These findings demonstrate that UAE enhances oil recovery and bioactive compound retention while reducing dependence on organic solvents, positioning it as an efficient, eco-friendly, green and nutritionally superior rice bran oil.

Keywords: Rice bran oil, Ultrasonic-assisted extraction, Optimization, Free fatty acids, Peroxide value, ã-Oryzanol

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Sustainable fluorescent Graphitic Carbon Quantum Dots derived from Liquorice for Selective Iron Sensing and Membrane Targeted Antibacterial Activity

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ABSTRACT

Establishing a clear structure–function correlation is fundamental for advancing the performance and application scope of Graphitic Carbon Quantum Dots (GCQDs). In particular, systematic modulation of the core structure and surface chemistry is critical for achieving desirable physicochemical and functional properties. In this study, GCQDs were synthesised via a green, hydrothermal route using *Glycyrrhiza glabra* (liquorice) as a natural carbon precursor, capitalising on its phytochemical richness. The resulting nanostructures possessed abundant surface functionalities, including –OH, –COOH, and –NH, groups. Comprehensive spectroscopic and microscopic analyses were conducted to elucidate the structural, morphological, and surface features, thereby establishing robust structure–function relationships relevant to sensing and biomedical applications. Photoluminescence characterisation revealed a pronounced Stokes shift of 87 nm, demonstrating favourable excitation–emission separation for fluorescence-based sensing and bioimaging. The GCQDs demonstrated high selectivity and sensitivity toward Fe^{3}z ions. Cytotoxicity and biocompatibility were evaluated in Drosophila melanogaster larvae at the single-organism level, allowing assessment of genotype-specific gut responses. Antimicrobial investigations showed significant inhibition against both Gram-positive and Gram-negative bacteria, with markedly stronger activity toward Gram-positive strains, attributed to their simpler cell wall architecture and enhanced interaction with surface-amine-rich GCQDs, leading to oxidative stress-mediated cellular damage. Biofilm inhibition studies further confirmed superior disruption in *Staphylococcus aureus*

compared to *Escherichia coli*, underscoring enhanced effectiveness against Gram-positive pathogens. Collectively, these findings emphasise the multifunctionality of biomass-derived GCQDs and provide a rational framework for tailoring their structural attributes to achieve targeted sensing, antimicrobial, and bioimaging performances.

Keywords: Liquorice, Graphitic Carbon quantum dots, Fluorescent, Antimicrobial Study, Metal ions Sensing, Anti-counterfeiting.

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Optimization and Scale-Up of a Biofilm-Based Sulfate-Reducing Bioreactor for Industrial Wastewater Treatment

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ABSTRACT

Sulfate-reducing bacteria (SRB) exhibit high efficacy in the bioremediation of sulfate-enriched industrial wastewater by catalyzing the reduction of sulfate (SO_4^{2-}) ions into less toxic end products such as hydrogen sulfide or elemental sulfur. A previously developed biofilm-based bioreactor system demonstrated a sulfate reduction concentration from 1600 mg/l to environmentally compliant discharge levels within 3.5 hours under ambient operational conditions, achieving a working capacity of 1.51 m^3/day using a 220-liter bioreactor. Among various reactor configurations, the single-unit bioreactor exhibited superior performance for continuous operation. Process optimization was conducted using Response Surface Methodology (RSM), which identified the optimal parameters at an initial sulfate concentration of 1250 mg/l and a flow rate of 1.8 L/h. Despite effective sulfate removal, the use of a modified DSMZ 641 growth medium elevated the Chemical Oxygen Demand (COD), thereby constraining its scalability for large-scale applications. Medium composition optimization was performed using a "one-variable-at-a-time" approach to evaluate the impact of individual parameters on sulfate reduction efficiency. The microbial consortium achieved sulfate removal efficiencies of 70% in suspended culture and 78% in immobilized biofilm systems at initial sulfate concentrations ranging between 2000 and 3000 mg/L within a 50 mL working volume. Upon scale-up to a 9-liter vertical biofilm reactor operating in batch mode, sulfate reductions of 76% (with optimized medium) and 74% (with modified DSMZ 641 medium) were obtained within 4 hours. RSM optimization further determined the ideal nutrient concentrations as follows: 6 mL/L lactic acid as the carbon source, 500 mg/L yeast extract and ammonium chloride as nitrogen sources, and 750 mg/L potassium phosphate as the phosphate source. Lower COD:(SO_4^{2-})ratios facilitated rapid sulfate reduction kinetics, whereas higher ratios resulted in slower but efficient sulfate removal. To mitigate elevated COD levels, a two-step treatment process incorporating an activated charcoal adsorption column was implemented. Additionally, biofilm modification techniques were employed to enhance biodegradation performance and overall system efficiency.

Keywords: Sulfate-reducing bacteria, Industrial wastewater treatment, Biofilm bioreactor, Bioremediation, Response Surface Methodology, Chemical Oxygen Demand

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Diatoms as natural sources for urban water body pathogenic bacterial remediation

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ABSTRACT

Background and Aim: Diatoms, a major frontier in biotechnology for developing sustainable and green solutions across various industries, are important for water body purification. This potential is rooted in their unique ability for high-efficiency photosynthesis, porous silica cell walls called frustules, and their ability to produce valuable bioactive compounds. These bioactive compounds often show antimicrobial activities. Diatoms are sensitive to environmental changes and play a major role in aquatic ecosystems, making them useful bio-indicators and tools for bioremediation. By analyzing the species composition in a water body, scientists can assess water quality and ecosystem health. In this study we observed antimicrobial activities of some common diatoms present in ponds of the metropolitan city of Kolkata against pathogenic bacterial species.

Methods: Diatoms present in the six ponds of Kolkata were screened throughout different seasons and recorded. For this study, we selected diatoms of one pond among these six ponds in which maximum number of diatoms were present throughout the seasons. Again, we included the diatom species of that pond in maximal seasonal occurrence. We separated the diatom species by standard procedures and finally one suspension was made for the study. Pathogenic bacterial species *Staphylococcus aureus* and *Escherichia coli* were inoculated in *Gallus gallus* embryo to produce infections and after one hour were challenged with diatom suspensions. Control experiments were also done as normal control, bacterial infection control and diatom control.

Results: The morbid anatomy of the embryos were normal in the challenged sets with diatoms, while extensive hemorrhages, necrosis were present in infection controls. Diatom and normal controls were normal. When

we studied cytokine gene expressions then we observed a balance between pro-inflammatory cytokines and anti-inflammatory cytokines in all challenged sets with diatoms while in control infection experiments this balance was not maintained.

Conclusion: Diatoms are a sustainable, vegetarian source of omega-3 polyunsaturated fatty acids (PUFAs) like EPA and DHA, which are crucial for human health. This pigment found in diatoms has strong antioxidants, anti- microbial, anti-inflammatory, and anti-cancer properties. There are many similar bioactive agents present in diatoms which are capable of anti-microbial and anti-inflammatory activities. Thus, we should optimize use of diatoms in urban water systems for betterment of human health.

Keywords: Diatoms, Pathogenic bacteria, Bioremediation.

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Development of an effective bioremedial system for ammonia containing wastewater treatment

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ABSTRACT

Ammonia (NH_3) is a major pollutant commonly discharged into aquatic environments from domestic, agricultural, and industrial sources. Industries such as food processing, rubber, textile, leather, and fertilizer manufacturing release wastewater containing high levels of ammonia, leading to serious environmental and health risks including eutrophication, harmful algal blooms, and oxygen depletion. Ammonia concentrations exceeding 1.9 mg/L are toxic to aquatic organisms, necessitating its reduction to permissible limits for aquaculture (0.5 mg/L) and environmental discharge (5 mg/L). Various physicochemical and biological methods are employed for ammonia removal from wastewater; however, physicochemical approaches are often limited by high operational costs and strict environmental conditions. Biological treatment offers an efficient and eco-friendly alternative due to lower sludge generation and energy demand. The present study focuses on developing an efficient bacterial consortium for ammonia removal from ammonia-rich wastewater. Ammonia-tolerant bacteria were isolated from four different aquaculture sites through serial dilution plating and streaking for obtaining pure isolates, followed by screening for ammonia mobilization and reduction efficiency. Out of a total of 61 bacterial isolates, 23 isolates exhibited measurable ammonia reduction potential and 11 isolates were further tested based on their extent of ammonia removal efficiency in different combinations. Among various combinations, the consortium SRCOD5:SRCOD6 achieved 99.07% ammonia and 75.07% COD (Chemical Oxygen Demand) reduction, while SRCOD3:SRCOD6 showed 99.21% ammonia and 71.05% COD reduction within 36 hours at an initial ammonia concentration of 132 mg/L under suspended conditions. Based on COD removal efficiency, SRCOD5:SRCOD6 was selected, achieving 99.57% ammonia and 80% COD reduction within 10 hours in a biofilm-based system. The results highlight that microbial consortia are more efficient and stable than individual isolates for ammonia bioremediation. Molecular characterization identified SRCOD3 as *Kytococcus* sp., SRCOD5 as *Pseudomonas* sp., and SRCOD6 as *Bacillus* sp. This study also reports, for the first time, the role of *Kytococcus sp.* in ammonia removal and proposes a biofilm-based microbial formulation as an effective and sustainable approach for wastewater treatment.

Keywords: Ammonia, Chemical Oxygen Demand, Biofilm based system, Eutrophication

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POSTER

Influence of Ba, Mn Co-Doped BiFeOƒ Nanoparticles on the Photocatalytic Degradation of Organic Dye in Visible Light

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ABSTRACT:

BiFeOƒ (BFO) is one of the most promising single-phase multiferroic material due to its room temperature magnetoelectric coupling and visible-light absorption. However, its practical utilization is limited by weak magnetization, high leakage current, and rapid electron–hole recombination, which restricts photocatalytic efficiency. To overcome these shortcomings, Bi ‹ " Ba" Fe€ .‰ ‡ Mn€ .€ ƒ Oƒ (x = 0.01, 0.03, 0.05) nanoparticles were prepared by sol–gel method using ethylene glycol, followed by drying, preheating at 400 °C, and annealing at 550 °C [1]. The structural, morphological, magnetic, optical, and photocatalytic performances of the samples were examined to understand the influence of co-doping. X-ray diffraction analysis confirmed the formation of a rhombohedral perovskite phase without any secondary impurity peaks in the co-doped samples. A noticeable peak shift and reduced crystallite size with increasing doping concentrations indicated lattice distortion due to ionic mismatch between Ba^{2}z /Bi^{3}z and Mn^{3}z /Fe^{3}z . FESEM images revealed agglomerated nanosized particles with more refined and homogeneous morphology in BBFMO samples. Magnetic hysteresis (M–H) showed enhanced room-temperature ferromagnetism for co-doped nanoparticles. BBFMO3 exhibited the highest saturation magnetization, attributed to the suppression of spiral spin structure and improved super-exchange interactions. UV–Vis spectroscopy revealed a slight band-gap widening in co-doped samples, reduced mid-gap recombination centers. Photoluminescence (PL) spectra showed reduced emission intensity for BBFMO nanoparticles, indicating improved charge separation efficiency.

The photocatalytic behavior was studied by the degradation of malachite green (MG) dye under visible light. Pure BFO exhibited limited degradation efficiency, whereas BBFMO samples demonstrated significantly enhanced performance. Photocatalytic degradation experiments revealed that the BBFMO3 sample achieved nearly complete degradation of MG within 30 minutes about two times faster than BFO. The BBFMO3 sample achieved the most efficient degradation and the highest kinetic rate constant. The improved activity is attributed to synergistic effects including optimized band structure, extended charge carrier lifetime, and increased production of reactive oxygen species.

Keywords: BiFeOƒ (BFO), Co-doping (Ba and Mn),Photocatalytic degradation, Magnetoelectric coupling, Charge separation efficiency, Visible light absorption

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“ Visible-Light-Driven Co–Al LDH/g-Cƒ N… Nanoarchitecture for Dual Pollutant Degradation and Sustainable H, O, Production with Photoluminescence Detection Capability.”

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ABSTRACT

The development of efficient and sustainable photocatalysts for environmental remediation is of significant interest in addressing the pressing concerns of pharmaceutical and dye contaminants in aquatic systems. In this work, a Co–Al layered double hydroxide (Co–Al LDH) decorated on nitrogen-enriched graphitic carbon nitride (g-Cƒ N…) nanocomposite (LN) with varying weight ratios (1:2, 1:1, 2:1) was successfully synthesised via a facile solvothermal strategy followed by ultrasonic exfoliation. The optimised $LN_{2:1}$ catalyst with enhanced photocatalytic behaviour was evaluated for photocatalytic organic pollutant degradation and oxygen reduction reaction (ORR). The $LN_{2:1}$ nanocomposite achieved the highest degradation efficiency

of 93.4% against ciprofloxacin (CIP) and 92.1% against cresol red (CR) within 120 minutes under solar irradiation, demonstrating its superior catalytic activity compared to pristine g-Cƒ N… and Co–Al LDH. Furthermore, the composite demonstrated enhanced hydrogen peroxide (H, O,) generation of 1903.28 ìML^{-1} (5.5 times that of g-C_3N_5 and 16.43 times that of Co-Al LDH), which was substantially higher than that of pristine components, indicating its ability to drive reactive oxygen species (ROS)-mediated photocatalytic pathways. The morphological and BET surface area analysis demonstrated a 2D nano-platelet-like composite with a higher surface area of 30.647 m²/g, providing abundant active sites for light harvestation and catalytic activation. Experimental analysis, including electrochemical analysis and radical scavenging tests, indicates the formation of a direct Z-scheme heterojunction, which markedly enhances charge carrier separation and utilisation, facilitating the generation of ROS such as superoxide (·O, {) and hydroxyl (·OH) radicals that drive REDOX processes. This study provides a sustainable photocatalytic strategy with the potential to tackle real-world environmental challenges by enabling efficient degradation of emerging contaminants and advancing water purification technologies.

Keywords: Photocatalysis, Cresol Red, Ciprofloxacin, H_2O_2 Production

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Remediation of Cr-contaminated plant-aqueous biosystem by *Cenchrus purpureus* (Schumach.) Morrone: an optimisation and modelling study via Response Surface Methodology

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ABSTRACT

The study investigates the chromium (Cr) remediation potential of *Cenchrus purpureus* (Schumach.) Morrone in a Cr-spiked hydroponic system, employing Response Surface Methodology (RSM) for process optimisation and modelling. A Box–Behnken design evaluated the interactive effects of Cr concentration (0–50 mg L^{-1}), Plant density (1–3 plants $unit^{-1}$), and exposure duration (3–45 days) on Cr removal efficiency and accumulation. Quadratic models exhibited strong predictive accuracy ($R^2 > 0.99$), with the optimum conditions (50 mg L^{-1} Cr, 3 plants $unit^{-1}$, 28 days) achieving 60.79% removal efficiency, 1639.6 mg kg^{-1} shoot, and 1703.6 mg kg^{-1} root accumulation. The bioaccumulation and bioconcentration factors confirmed *C. purpureus* as an efficient Cr phytostabiliser (TF < 1). Enhanced antioxidant enzyme activities (CAT, SOD, APX) reflected adaptive stress tolerance, whereas total chlorophyll, protein, and carbohydrate contents declined with increasing Cr exposure. Pearson correlation revealed positive associations among Cr removal, enzyme activity, and uptake indices. The validated RSM model demonstrated high reliability (RSE < 8%), supporting its application for predictive optimisation of phytoremediation systems. Overall, *C. purpureus* presents a robust, eco-sustainable candidate for Cr phytostabilisation in contaminated aqueous environments, providing an effective framework for modelling-based optimisation of heavy metal remediation.

Keywords: Phytostabilization, antioxidant enzymes, response surface methodology (RSM), chromium, biochemical

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Enhanced Photodegradation of Antibiotics and Antimicrobial Activity by $g\text{-}C_3N_4/g\text{-}C_3N_5$ Nanosheet Heterojunction Photocatalyst.

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ABSTRACT

An organic C-N polymeric nanocomposite, $g\text{-}C_3N_4/g\text{-}C_3N_5$ sheet (ECN45), was designed through thermal polymerisation, followed by KBr-assisted exfoliation, to investigate its potential as a photocatalyst for the photodegradation of organic antibiotic pollutants and antimicrobial activities. Graphitic carbon nitride ($g\text{-}C_3N_4$) is a 2D material recognised as a highly promising photocatalyst; however, it possesses an elevated frequency of photogenerated electron-hole pair recombination and a constricted absorption range for visible light up to 450 nm. Therefore, the formation of a heterojunction of 1D $g\text{-}C_3N_5$ upon $g\text{-}C_3N_4$ can minimise the charge recombination of $g\text{-}C_3N_4$. Furthermore, due to a lack of sufficient surface activation, the bulk composite (BCN45) was exposed to KBr exfoliation, resulting in a $g\text{-}C_3N_4/g\text{-}C_3N_5$ sheet (ECN45). The 1D/2D hybrid catalyst exhibits a reduction in band gap of up to 1.81 eV due to the presence of azo linkages and Đ-conjugated bonds, compared to its pristine elements. The nanocomposite shows a red shift towards the visible light spectrum compared to its pristine forms. The morphological, spectroscopic, and physicochemical investigations of the nanocomposite were confirmed by TEM, SEM-EDX, XRD, UVDRS, FTIR, XPS, PL, and electrochemical analysis techniques. The photocatalytic application shown by the composite for degrading the antibiotic CIP (Ciprofloxacin) for about 93.1 % at an acidic environment of pH 3, at its lowest concentration of 10 mgL^{-1} in 120 minutes. Further, the catalyst was examined to show antimicrobial action against gram-negative bacteria *Escherichia coli* (*E. coli)* and gram-positive bacteria *Staphylococcus*

aureus (*S. aureus*), with the help of the inhibition zone test, MIC (Minimum Inhibition Concentration), and photocatalytic cellular leakage of the microbial body. Also, the plausible Z-scheme mechanisms exhibited by the formed 2D/1D heterostructure for CIP degradation and antimicrobial activity were explained. The enhanced photoactivity is attributed to the synergistic effects of 1D/2D hybrid nanostructure, extended conjugation leading to enriched light harvestation, and Z-scheme heterojunction for better photo-generated charge separation. This approach makes grounds to establish an effective metal-free composite showing efficient photocatalytic activity.

Keywords : Nanocomposite, photocatalysis, Oxidative stress, Ciprofloxacin, antimicrobial

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"Unveiling the Interplay: Chitosan Nanoparticle Feeding Effects on Clarias magur fingerlings, Insights into Immunological Gene C3 and Stress Gene HSP70 Responses"

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ABSTRACT

The application of bio-sourced nanomaterials in bio-nanotechnology is a developing field that benefits fish healthcare. Crustacean-sourced chitosan nanoparticles (ChNPs) are well-known immunomodulatory and antioxidative agents, having minimal to no negative effects on fish or humans who consume them. Heat shock protein 70 (Hsp70), a family of highly conserved proteins with varied molecular weights, is renowned for its role in maintaining vital physiological activities, often referred to as stress proteins and extrinsic chaperones. Similarly, complement component 3 (C3) has long been acknowledged as a keystone of the innate immune system, and further study on it may shed light on the roles played by fish complement systems. These days, aquaculture production is paying close attention to nanotechnology. Data about the effects of chitosan nanoparticles (ChNPs) on *Clarias magur* are not currently accessible. To examine the expression profiles of heat shock protein (Hsp70) and complement component 3 (C3) gene using beta-actin (ß-Actin) as a reference gene, the current study examines the effectiveness of chitosan nanoparticle supplementation on *C. magur* fingerlings using quantitative real-time PCR (qRT-PCR). The loading concentration of chitosan nanoparticles to the feed mixture was 0.5 g/kg, 1.0 g/kg and 2.0 g/kg, where the post-feeding analysis of the groups supplemented with chitosan nano feed showed a trend of linear downregulation of stress (Hsp70) and linear upregulation of immune gene (C3).

Keywords: Chitosan Nanoparticles, *Clarias magur*, Immunology, Gene expression, Stress Response

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Effect of Heavy Metals on The Biophysiological Parameters of Tasar Silkworm (*Antheraea Mylitta* D.)

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ABSTRACT

Increasing human and industrial activities lead to extensive heavy metal pollution, with abandoned mining sites being notable sources of metal contamination even after centuries. Toxic metals can alter soil texture, cause nutrient depletion, enter the food chain, exhibit toxic effects, disrupt ecological balance and reduce biological diversity. Cadmium (Cd), Lead (Pb), and Chromium (Cr) are environmental pollutants that adversely affect the food chain. The present study aimed to evaluate the effect of heavy metal pollutants, Cadmium (Cd), Lead (Pb) and Chromium (Cr), on the physiological and cocoon quality of the silkworm *A. mylitta*. Larvae (5th instar) of *A. mylitta,* fed on *Terminalia arjuna* leaves supplemented with trace elements Cd, Pb, and Cr for 7 days. Experimental animals, comprising the control (group I: supplemented with distilled water) and experimental groups (groups II, III, IV, and V), were supplemented with cadmium, lead, and chromium at concentrations of 0.1 ppm, 1 ppm, 10 ppm, and 162.5 ppm, respectively. Our results showed that, metal-exposed larvae showed reduced body weight and length, poor cocoon quality (cocoon weight, shell weight and shell ratio) and noticeable colour changes compared to the control. Biochemical assays indicated decreased protein and carbohydrate contents along with H_2O_2 levels. The results suggest that selected heavy metals profoundly affect their growth and development. Thus, tasar silk cultivation may affect the silk industry, leading to the production of low-quality tasar silk.

Keywords: *Antheraea mylitta*, Cadmium, Lead, Chromium, *Terminalia arjuna*, toxic effect

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Oxidative Stress Responses in Plants Exposed to Radiofrequency Radiation: A Sustainable Science and Technology Perspective

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ABSTRACT:

In the era of rapid digital transformation, the increasing prevalence of radiofrequency (RF) radiation from wireless communication systems raises important questions about its ecological implications. This study investigates the physiological and biochemical impacts of RF radiation on plants, focusing on oxidative stress as a key response mechanism. Exposure to RF fields can disrupt the balance of reactive oxygen species (ROS), leading to enhanced lipid peroxidation, protein oxidation, and modulation of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD). These oxidative alterations may impair photosynthetic performance, membrane integrity, and growth dynamics, thereby affecting overall plant productivity and ecological resilience. Within the context of the Sustainable Development Goals (SDGs), specifically SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 15 (Life on Land), this study indicates the need for science-based technological innovations that minimize environmental risks while supporting digital progress. Advancing our understanding of plant oxidative responses to RF radiation can inform sustainable agricultural strategies and guide the responsible deployment of communication technologies in harmony with environmental sustainability objectives.

Keywords: Radiofrequency radiation, oxidative stress, reactive oxygen species (ROS), antioxidant defense, plant physiology, sustainable development goals (SDGs), environmental biotechnology, technological innovation.

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Sustainable Pest Management through Natural Fertilizers from Plants

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ABSTRACT

The increasing demand for sustainable agricultural practices has led to a shift towards eco-friendly alternatives for pest management. This study explores the potential of natural fertilizers derived from plants as a viable solution for sustainable pest management. Plant-based fertilizers, rich in bioactive compounds, can enhance soil health, promote beneficial microbial growth, and induce systemic resistance in plants, thereby reducing the reliance on synthetic pesticides. A comprehensive review of existing literature reveals that various plant species, such as neem (*Azadirachta indica*), garlic (*Allium sativum*), and marigold (*Tagetes* spp.), possess insecticidal and fungicidal properties, making them ideal candidates for natural fertilizer production. These plant-based fertilizers can be formulated through various methods, including composting, vermicomposting, and extraction of bioactive compounds. The use of natural fertilizers from plants offers several benefits, including reduced environmental pollution, improved soil health, and increased crop yields. Moreover, these fertilizers can also contribute to the development of pest-resistant crop varieties, reducing the economic burden on farmers. However, the efficacy of these fertilizers depends on factors such as plant species, formulation methods, and application rates.This study highlights the potential of natural fertilizers from plants as a sustainable solution for pest management. Further research is needed to standardize the production and application protocols for these fertilizers, ensuring their widespread adoption in agricultural practices. By promoting the use of plant-based fertilizers, we can reduce our reliance on synthetic pesticides, mitigate environmental hazards, and ensure a more sustainable future for agriculture.

Keywords: Sustainable agriculture, natural fertilizers, plant-based pesticides, eco-friendly pest management.

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Sustainable Photocatalytic Removal of Cosmetic Preservatives Parabens over a Dual S-Scheme $TiO_2/ZnO/g\text{-}C_3N_4$ Catalyst under Natural Sunlight Irradiation

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ABSTRACT

The widespread use of synthetic preservatives such as parabens is extensively employed in cosmetic and personal care products, but their persistence in aquatic environments poses ecological and health risks. In the present work, a ternary dual S-scheme photocatalyst, $TiO_2/ZnO/g\text{-}C_3N_4$, was rationally synthesized and comprehensively characterized using XRD, FTIR, FESEM, HRTEM, XPS, TGA, UV–Vis DRS, PL, and N, sorption analyses. The results confirmed the successful construction of a well-coupled heterojunction with optimized band alignment, facilitating efficient charge transfer and visible-light utilization. Under natural sunlight irradiation, the TiO, /ZnO/g-Cƒ N„ composite exhibited enhanced photocatalytic activity, achieving rapid degradation of MP and EP compared to pristine and binary counterparts. Kinetic analysis revealed pseudo-first-order degradation behaviour, while radical quenching experiments identified •OH and •O, { as the predominant reactive oxygen species responsible for the photocatalytic oxidation of parabens. The superior performance was attributed to the synergistic effects of dual S-scheme charge transfer, which promoted spatial separation of photogenerated charge carriers and preserved strong redox potential. Furthermore, LC–MS analysis enabled the identification of intermediate species, and a plausible degradation pathway was proposed, involving hydroxylation, dealkylation, and subsequent aromatic ring cleavage. This study not only demonstrates the efficacy of a dual S-scheme $TiO_2/ZnO/g\text{-}C_3N_4$ heterojunction in the solar-driven removal of cosmetic parabens but also provides mechanistic insights into its potential for sustainable water purification applications.

Keywords: Photocatalysis, S-scheme heterojunction, Wastewater, Cosmetics, Parabens

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Uranium Removal from Drinking Water using Iron and Aluminium Modified Tea Waste Composites: A Sustainable Approach

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ABSTRACT

Uranium contamination in groundwater is an increasing global concern due to its persistence and severe health implications, necessitating the development of efficient, sustainable, and cost-effective remediation strategies. In the present study, tea waste (TW) —an abundant, low-cost, and eco-friendly biomass—was utilized as a base material to synthesized and evaluate novel biomass-composites, namely iron doped TW (TW@Fe), aluminium doped TW (TW@Al), and bimetallic combination of iron and aluminium doped TW (TW@Fe+Al). Batch adsorption experiments were systematically conducted varying optimized conditions such as, uranium concentration, adsorbent dose, contact time, pH and temperature. Experiment revealed that TW@Fe, TW@Al and TW@Fe+Al shows 99.89%, 95.16% and 99.98% adsorption in 30 minutes respectively. Adsorption isotherm modelling indicated that uranium adsorption onto TW@Fe and TW@Fe+Al followed the Langmuir model, suggesting monolayer adsorption, while TW@Al conformed to the Freundlich model, reflecting heterogeneous surface adsorption. Kinetic studies demonstrated that all bio-composites adhered to a pseudo-second-order model, confirming chemisorption as the rate-controlling mechanism. Thermodynamic analysis revealed that the adsorption process was exothermic and spontaneous in nature. Furthermore, material characterization through SEM, EDX and FTIR confirmed the successful surface modification and functional group involvement. Importantly, the synthesized materials exhibited magnetic properties, enabling their facile separation from aqueous systems after treatment, thereby enhancing reusability and practical applicability. All the composites can be regenerated up to 3 cycles. TW@Fe, TW@Al and TW@Fe+Al show an excellent removal capacity in real field samples which exceeds permissible value of uranium concentrations (30 & 60 ppb according to WHO & AERB respectively) without altering its overall drinking quality. The study highlights that tea waste-based composites hold significant potential as sustainable adsorbents for uranium remediation in contaminated groundwater, offering an eco-friendly, economical, and efficient approach to address this pressing environmental issue.

Keywords: Tea waste, Biomass-composite, Adsorption, Thermodynamics.

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Synthesis and Characterization of Mn-Doped ZnO Nanoparticles for Possible Application of Nitroaromatic Compound Sensing

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ABSTRACT

Zinc oxide (ZnO) is a non-toxic, eco-friendly, wide bandgap semiconductor (3.37 eV) with a large exciton binding energy (60 meV), making it a promising material for optoelectronic, photocatalytic, and sensing applications. This study investigates the synthesis and characterization of ZnO and Mn-doped ZnO nanoparticles produced via co-precipitation with doping concentrations of 1, 3 and 5 mol% [1,2]. The structural, optical, and morphological properties of the prepared samples were systematically investigated. X-ray diffraction (XRD) analysis confirmed the hexagonal wurtzite structure of ZnO without any secondary impurity phases. Crystallite size was found to be in the range of 42-30 nm for ZnO and Mn-doped ZnO nanoparticles using the Debye-Scherrer equation. Field emission scanning electron microscopy (FESEM) images confirmed that nanoparticles were uniform and had homogeneous distribution. All the samples exhibit a sharp absorption edge around 380 nm, corresponding to the fundamental absorption of ZnO. A slight reduction in the optical bandgap is observed upon Mn doping from 3.18 eV for ZnO and 3.09 for 5% Mn doped ZnO nanoparticles . The excitonic photoluminescence (PL) peak was observed at 382-396 nm for ZnO and Mn-doped ZnO. The absorption spectra of the synthesized nanoparticles indicate that the Mn doped ZnO nanoparticles might be utilized for the detection of nitroaromatic compounds detection.

Keywords: Zinc oxide (ZnO), Mn doping, Co-precipitation synthesis, Hexagonal wurtzite structure, Optical bandgap reduction, Photoluminescence (PL)

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Comparative study of semi-quantitative histopathological indices in freshwater bivalve *Lamellidens marginalis* exposed to fibre form of Polystyrene microplastics

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ABSTRACT

The rise in plastic pollution has increased in recent years due to release of untreated plastic waste into water bodies through various sources. Here they experience a fragmentation process that ultimately results in the creation of microplastics (MPs). These MPs are becoming a considerable danger to aquatic species. While the impacts of MPs on marine species have been thoroughly researched, there is a lack of understanding regarding their effects on freshwater species. Freshwater bivalves hold significant social and economic importance and are regarded as excellent bioindicators. These organisms reside at the bottom and are more vulnerable to microplastics due to their feeding mechanism. Comparative examination of histopathological alterations was carried out alongside semi-quantitative histopathological metrics in the foot, mantle, gill, and hepatopancreas of freshwater bivalves *Lamellidens marginalis* subjected to polystyrene microplastics over varying exposure durations. In this study, freshwater bivalves *Lamellidens marginalis* were subjected to a concentration of 1mg L-1 of polystyrene microplastics in fibre form for durations of 7 days (Experiment I), 10 days (Experiment II), and 15 days (Experiment III) and a parallel control set was also maintained. Exposure to microplastics resulted in mild changes (mild necrosis) in the foot and mantle, while significant tissue lesions were observed in the hepatopancreas and gill in experimental groups I, II, and III compared to the control. Cellular degenerations, including lamellar distortion and necrosis, were noted in gill tissue. In the Hepatopancreas, several tubular alterations were noted. The semi-quantitative histopathological indices (HI) for foot tissue recorded the highest value in Experiment I (0.33), with Experiment II showing a value of (0.28±0.09) and Experiment III at (0.22±0.09). Experiments I and III for the mantle displayed comparable values (0.22±0.09), which were higher than those of Experiment II (0.17). The histopathological changes in gill were noted in this order: Experiment I (0.53±0.05) > II (0.43±0.03) > III (0.18±0.01), indicating a range from moderate to low levels. In contrast, for the hepatopancreas, HI showed a gradual increase as the exposure period increased with [Experiment I (0.14±0.05) < II (0.45±0.05) < III (0.53±0.09)], varying from low to moderate levels. Of the four tissues, the gill exhibited the highest HI value, followed by the hepatopancreas, foot, and mantle. The current study concludes that microplastics can cause lesions in various tissues of these bivalves, thereby adversely impacting their health and histopathological changes can be used as important biomarker tool to assess the impact on bottom dwelling bivalves.

Keywords: Microplastics, Polystyrene, *Lamellidens marginalis,* Toxicity, Histopathology.

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Second harmonic generation behavior of flux grown Potassium Titanyl Phosphate (KTP) crystal in broad wavelength range and a comparative analysis with Lithium Triborate (LBO) crystal

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ABSTRACT:

A thorough investigation has been done on the Second Harmonic Generation behavior of a commonly used biaxial flux grown Nonlinear Optical (NLO) Crystal; Potassium Titanyl Phosphate (KTP_F) in broad wavelength range. In particular, investigation has been done to find out the phase matching angle variation and effective second order nonlinear coefficient (d_{eff}) variation with respect to the working wavelengths of this NLO crystal in three different planes XY, YZ and ZX. In addition to this, a comparative analysis has been done with another widely used biaxial NLO crystal Lithium Triborate (LBO) on the basis of phase matching angle variation and effective second order nonlinearity in their best performing planes.

Keywords: Potassium Titanyl Phosphate (KTP_F), Second Harmonic Generation (SHG), Nonlinear Optical (NLO) Crystal, Phase matching angle, Effective second order nonlinear coefficient (d_{eff})

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Biogenic Silver Nanoparticles from *Woodfordia fruticosa*: Multifunctional Therapeutic Agent exhibiting Antimicrobial, Antioxidant and Anticancer Potential.

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ABSTRACT

Background:

The present study reports the green synthesis of silver nanoparticles using *Woodfordia fruticosa* leaf extract (*Wf-AgNPs*) and evaluates their biomedical significance.

Methods:

Methanolic leaf extract was prepared through microwave-assisted extraction and utilized for nanoparticle synthesis. *Wf-AgNPs* were characterized by UV–Vis spectroscopy, XRD, DLS, zeta potential analysis, FTIR, SEM, and HR-TEM to confirm morphology, size, and stability. Antioxidant capacity and total phenolic/flavonoid content were quantified. Anticancer effects were assessed using HeLa and H1299 cell lines through apoptosis induction, mitochondrial membrane potential disruption, cell cycle arrest analysis, DNA fragmentation, and intracellular ROS assays. Antimicrobial activity was examined against multidrug-resistant clinical bacteria. *In vivo* toxicity were evaluated in mice.

Results:

Wf-AgNPs displayed strong antioxidant properties, potent cytotoxicity against cancer cells, significant antibacterial activity, and were without observable toxicity.

Conclusion:

Woodfordia fruticosa-derived silver nanoparticles demonstrate multifunctional therapeutic potential and may serve as a promising natural nanomedicine for cancer treatment, infection control.

Keywords: Green synthesis, *Woodfordia fruticosa*, silver nanoparticles, anticancer, antimicrobial, antioxidant.

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Catalytic Dye Degradation by Novel Silver/Zinc Oxide Nano-Composites Using Concentrated Solar Light

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ABSTRACT

The waste water from the paper and textile industries polluted with synthetic dyes such as malachite green (MG), methylene blue (MB) and methyl orange (MO) seriously threatens the environment and human health. Over the years, photocatalysis based on metal oxide nanomaterials and ultraviolet-visible (UV-vis) light has gained significant attention for degrading synthetic dyes in a wet environment. The photocatalytic activities of ZnO nanoparticles (ZnO NPs) are within the ultraviolet region as it has a direct band gap of roughly 3.2-3.4 eV, which corresponds to a wavelength absorption edge of ~370-390 nm and this hinders its efficiency in photocatalytic applications in visible light region. Doping with metals (Ag, Cu, Fe, etc) can introduce new energy levels or plasmonic effects, improving visible light absorption and improvements in dye degradation using visible lights.

Undoped and silver doped ZnO nanoparticles (Ag-doped ZnO NPs) were successfully prepared by co-precipitation technique at Ag doping concentrations of 0, 0.2, and 0.5 % to enhance the photocatalytic ability of ZnO NPs in visible light region. The XRD results confirmed hexagonal wurtzite structure of undopped ZnO with crystallites size of ~50 nm. Ag-doped ZnO NPs resulted in nanocomposites of cubic Ag with crystallites size of ~45 nm embedded in ~36 nm ZnO nanomaterials. The SEM-back scattered micrograph revealed the uniform distribution of Ag on the surface of ZnO NPs and a decrease in the crystallite sizes. The displacement in the absorption edge of ZnO with addition of silver to a higher wavelength led to narrowing the optical bandgap, as calculated using the DRS spectra. Photocatalytic performance and photodegradation experiments were conducted using methylene blue (MB) dye contaminated in water (5ppm). The dye concentration decreases as irradiation time increases in the presence of the ZnO and Ag-dopped ZnO. The highest dye degradation of about 30 % with a catalyst loading of 1:10 ratio was observed.

Keywords: Silver dopped Zinc oxide nanoparticles, Co precipitation, Photocatalysis, Bandgap

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Direct Z-Scheme $BiVO_4$@g-C_3N_5 Core-Shell Heterostructure for Efficient Visible-Light-Driven Ciprofloxacin Degradation, Chromium Reduction, and Oxygen Reduction Reactions

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ABSTRACT

The efficient removal of persistent organic pollutants and toxic heavy metals from water and sustainable chemical synthesis remain a critical environmental challenge. In this study, an oxygen vacancy-$BiVO_4$@g-C_3N_5 (BC1:3) core-shell hybrid photocatalyst was developed, leveraging visible-light mediated photocatalysis as a green and scalable solution. The unique core-shell architecture facilitates enhanced charge separation and transfer at the heterojunction interface, significantly improving photocatalytic efficiency. BC1:3, synthesized via a simple hydrothermal-calcination process, showed remarkable ciprofloxacin degradation activity, reaching a rate constant of 0.0155 min^{-1} i.e. 90.2 % that is 1.38 times greater than g-C_3N_5 (CN) and 1.7 times greater than $BiVO_4$ (BVO), this performance further elevated to 95.12% in connection to an external oxygen purging. It also showed excellent Cr (VI) photoreduction performance (0.016 min^{-1}), approximately 2.66 and 1.7 folds higher than BVO and CN respectively. Furthermore, BC1:3 achieved remarkable H_2O_2 generation (1824.44 μM L{ 1), outperforming BVO and CN by factors of 19 and 8.5 times, respectively. Reactive species analysis confirmed the involvement of $\bullet O_2^-$, $\bullet OH$, and photogenerated h^+ as major contributors to its photocatalytic activity. The visible-light-driven Z-scheme heterojunction between BVO and CN extended light absorption and promoted efficient charge carrier dynamics. The catalyst demonstrated excellent stability and reusability, underscoring its potential as a robust photocatalyst for advanced water treatment and green chemical production.

Keywords: Photocatalysis, Visible Light, Core-shell, Heterojunction, Z-scheme, Charge separation, Ciprofloxacin.

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Bio-sourced Synthesis of *P. Guajava* Silver Nanoparticles as an Eco-Friendly Treatment Method for Dental Caries Associated with Oral Biofilm.

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ABSTRACT

Oral health is often disregarded within general healthcare, leading to inadequate hygiene practices and an increase in dental diseases. Dental caries, which commonly present as toothaches, not only cause pain but also diminish productivity and heighten absenteeism. Traditional treatments are becoming less favored, while natural alternatives are increasingly recognized for their safety and effectiveness. This study investigates the potential of synthesized silver nanoparticles (*P-AgNPs*) created from the extract of *Psidium guajava* stems as an antibacterial and antibiofilm agent against pathogens associated with dental caries. *P-AgNPs* were produced through an eco-friendly approach and analyzed using various spectroscopic techniques. Oral swabs collected from patients with caries were used to isolate bacterial strains (including *Streptococcus, Staphylococcus*, and *Enterococcus spp*.), and these strains were assessed for antibiotic resistance and biofilm production using Tissue Culture Plate, Tube, and Congo Red Agar methods, alongside an in vivo toxicity evaluation. Strong antibacterial activity was shown *by P-AgNPs'* antimicrobial and antibiofilm activities. They were most effective against *Streptococcus* and *Enterococcus spp.* (MIC/MBC: 12.5 µL; ZOI: 20–26 mm) and moderately effective against *Staphylococcus spp.* (ZOI: 21 mm; MIC/MBC: 25 µL). Assays for biofilm suppression verified important antibiofilm characteristics, while toxicity analyses showed no negative consequences *in vivo*. These findings suggest P-*AgNPs* to be a promising natural treatment for tooth caries, exhibiting potent antibacterial qualities without causing harm and encouraging further research into their therapeutic use as effective and long-lasting medicinal agents.

Keywords: Silver nano particle, *Psidium guajava*, Dental carries, Antimicrobial, *Staphylococcus spp*., Anti-biofilm.

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Water Mediated Imidazole Based Precursor-Derived $(NiCo)_3O_4$ Spinel Electrocatalysts for Efficient Alkaline Oxygen Evolution

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ABSTRACT

Advancing sustainable energy technologies requires the design of efficient, noble-metal-free electrocatalysts to overcome the kinetic limitations of water oxidation in alkaline media. In this context, carboxylate-based metal–organic materials (CMOMs) and their derivatives have gained attention for their excellent stability, catalytic activity, and intrinsic porosity. This study reports a water-assisted room temperature synthesis of a low-crystallinity 2-methylimidazole (2-MIM)-based bimetallic coordination polymer precursor. Subsequent calcination transforms this precursor into porous $(NiCo)_3O_4$ spinel oxides (NCO) with enhanced crystallinity, homogeneous cation dispersion, and a mesoporous framework. These structural features synergistically enhance charge-transfer kinetics and improve the electrocatalytic performance for the oxygen evolution reaction under alkaline conditions. Impressively, NCO-500 achieves a low overpotential of 250/ mV at 10/ mA/ cm^{-2} and maintains stable operation for 50/ hours. The straightforward two-step synthetic protocol and exceptional electrochemical results underscore NCO's viability as a sustainable electrode material for water splitting and scalable energy conversion applications.

Keywords: Binary transition metal oxides, Water assisted synthesis, Calcination, Electrocatalysis, Oxygen evolution reaction.

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Utilization of chicken slaughter house waste for purification of nitrate contaminated water : A sustainable waste management practices

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ABSTRACT

Excessive nitrate levels in water can pose a threat to the environment and human health, yet nitrate is an essential nutrient for plant growth. This study involved extracting of keratin from chicken feathers through alkaline hydrolysis. Extracted keratin was characterised by various analytical instruments such as SEM, EDX, pH_{zpc} and FTIR. The batch study results revealed that 87% nitrate removal was occurred under acidic condition with 34.5 mg/g Langmuir adsorption capacity (q_m). Kinetic studies indicated pseudo-second-order behaviour, while thermodynamic analysis confirmed the exothermic nature of the process. The presence of other anions negatively impacted nitrate removal in the following order: SO_4^{2-} > HCO_3^- > Cl^- > PO_4^{2-}. After the seventh regeneration cycle, the adsorbent was no longer able to absorb nitrate. Therefore, this study highlighted an easy waste management technique and exhausted adsorbent (keratin) was used as nitrogen rich fertilizer for both plant growth and development. Therefore, future research should focus to explore other waste management through which we can develop a win-win strategy.

Keywords : nitrate removal, chicken feather waste, keratin, nitrogen rich fertilizer

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Integrating non-conventional sol-gel synthesized TiO_2 with Carbonaceous material for high performance supercapacitor electrode application

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ABSTRACT

In recent years supercapacitors have gained considerable interest due to their ability to fulfil the requirements for power density in many energy storage applications. Because of their small size and the material they are made of, the electrodes themselves had a defined area that controlled the supercapacitor. In this study Titanium dioxide (TiO_2) was synthesized via a low-cost non-conventional sol-gel method to prepared high performance symmetric supercapacitor (SCs). TiO_2 was composited with Activated charcoal (AC) and graphite powder (G) in different ratios: TiO_2/G (1:1), AC/G (1:1), and lastly a mixture of TiO_2-AC/G (3:2:1) as composite electrode to prepare three different supercapacitors. These supercapacitors worked on a voltage window of 0-1 V. The electrochemical properties like cyclic voltammetry (CV) and galvanostatic charging-discharge (GCD) of these supercapacitors were studied by using three electrode system. Among all, the SC composed of TiO_2-AC/G with 2M KOH electrolyte showed highest value of areal specific capacitance of 22.5 mF/cm^2 at a scan rate of 5mV/s with a high energy density of 95.7 ìWh/cm^2 and a powder density of 18 mW/cm^2.

Keywords : Titanium dioxide, Graphite powder, Activated charcoal, Supercapacitor

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Sustainable Biosynthesis of Gold Nanoparticles from *Acacia auriculiformis* and Their Efficacy Against Multidrug-Resistant UTI Pathogens

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ABSTRACT

Urinary tract infections (UTIs) remain a major global health burden, exacerbated by the growing prevalence of multidrug-resistant (MDR) bacterial strains due to extensive antibiotic misuse. This study investigates an eco-friendly approach for the synthesis of gold nanoparticles *(AuNPs)* using *Acacia auriculiformis* bark extract *(Aa-AuNPs)* and evaluates their antimicrobial efficacy against MDR UTI pathogens. The green synthesis route was optimized and characterized by spectroscopic and microscopic analyses, revealing spherical nanoparticles with an average size of 98 nm stabilized by phenolic compounds. The *Aa-AuNPs* exhibited potent broad-spectrum antibacterial and antifungal activities, demonstrating significant inhibition against *E. coli*, *Pseudomonas spp.*, and *Streptococcus spp.* (MIC: 1.25 mg/mL; ZOI: 22–24 mm), and *Candida glabrata* (MIC: 0.156 mg/mL; ZOI: 13 mm). Acute toxicity studies in rat models confirmed their biosafety. These findings highlight the potential of *Aa-AuNPs* as a green nanotherapeutic for combating MDR infections.

Keywords: Gold nano particle, Green synthesis , *Acacia auriculiformis*, antibacterial, antifungal.

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Green infotainment communication for attainment of SDG goals through technological innovations

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ABSTRACT

The research paper shall explore into the idea of sustainable green communication through infotainment to nudge the listener's choice and influence for the SDG goals through technological innovations to promote green ideas. This research paper shall approach into the objectives of the 17 goals and 169 associated targets of sustainable development goals (SDG), for the global goals, which is ambitious enough to integrate, interrelate to the societal, economic, and environmental dimensions. It is more specific to bolster the development process. Basically, it would infuse awareness for economic growth, building an equitable society with the global initiative adopted since 2015 by the United Nations. This mandated approach through betterment of the infotainment communication can optimize for its implementation by 2030. Science, technology and innovations is crucial, and it is more crucial when it relates to the infotainment communicating tools like advertisements and short films because it has certain penchant for the students to address the complex challenges and, ensure fostering sustainable practice across various sectors. To improve the economic growth of human being and protect environment, harnessing the power of science and technology and innovations is important for sustainability and prosperous future. Sustainability and future growth in the areas of poverty reduction, access to clean water, sanitation, affordable energy and sustainable infrastructure are key component across the globe, and in India in specific. These challenges always confront, in the face of global warming, climate change, depletion of biodiversity and pollution, and the environmental challenges and their consequences of disasters impending from time to time. Groundbreaking understanding for providing solutions to SDG through the means of short films. Educating, creating awareness in the masses is the means to nudge their influence and make them abide by the kind of information that is being provided. So, advancement of technology for addressing global challenge is very important across all sectors, which includes energy,

healthcare, electronics and sustainability. So, it can also delve into manipulating the structures and properties of matter, ensuring proper research, development, innovative solutions. Employing smart technology, smart materials, nanomaterials, eco-friendly components and machines for a real-world application to resulting in a better sustainable development world order through innovations, resilience and responsibility. So, the paper would essentially include the tools and techniques required for the understanding of the subject and evolve with the output which is tangibly scientific and accurate.

Keywords: Infotainment, sustainability, technology innovations, environment protection, communication.

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Title: "*Shorea robusta* leaf filler as sustainable filler reinforcement in vetiver fiber biocomposites"

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ABSTRACT

Objective:

This study focuses on the development of fully biodegradable polymer composites reinforced with vetiver root fiber (VRF) and enriched with *Shorea robusta* (Sal) leaf filler, using soy-based resin as a sustainable matrix. The aim was to achieve an optimal balance between mechanical performance, hydrophobicity, and biodegradability to create eco-friendly alternatives to petroleum-derived plastics and conventional composites.

Methods:

Vetiver fibers were subjected to alkali treatment to enhance interfacial adhesion and were incorporated into polyvinyl alcohol (PVA)-modified soy resin. Sal leaf powder was introduced at different concentrations (0-50 wt.%) to prepare composite series VSP0-VSP5 through compression molding. The prepared composites were evaluated for tensile, flexural, impact, and hardness properties, along with thermal stability, water absorption, contact angle, and biodegradability. FTIR and FE-SEM analyses were employed to

study the chemical and morphological characteristics before and after degradation.

Results:

Mechanical properties improved with filler incorporation up to 30 wt.% (VSP3), after which performance slightly declined. The optimized composite (VSP3) showed a tensile strength of 53.85 MPa (8.5% higher than filler-free VSP0) and a tensile modulus of 1.46 GPa. Flexural strength and modulus reached 55.87 MPa and 4.37 GPa, respectively. Impact resistance increased to 29.27 kJ/m², while hardness rose from 9.2 VHN (VSP0) to 11 VHN (VSP3). The addition of Sal leaf filler also enhanced hydrophobicity, reducing 24 h water absorption from 40.4% to 38.2% and increasing the contact angle to 80.5°, indicating decreased hydrophilicity. Thermal analysis revealed improved stability, with the main cellulose degradation temperature shifting from 282°C (VSP0) to 295°C (VSP3). Biodegradation studies confirmed eco-friendly decomposition, with 63.5% weight loss after 60 days of soil burial for VSP3, compared to 74.2% for VSP0 and 60.2% for VSP5. FTIR spectra showed attenuation of OH, CH, and ester peaks, while FE-SEM images of degraded samples exhibited surface grooves and microbial attack. The optimized composite was further utilized to fabricate biodegradable sapling pots.

Conclusion:

The VSP3 composite (30 wt.% Sal leaf filler) demonstrated the most favorable balance of strength, hydrophobicity, and biodegradability. This study highlights the successful upcycling of waste vetiver roots and Sal leaves into high-performance green composites. Such materials show strong potential for use in disposable tableware, nursery pots, and eco-panels, providing a sustainable and scalable solution to replace single-use plastics and synthetic composites.

Keywords: Vetiver root fiber; Sal leaf filler; Soy resin; Biodegradable composites

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Fluorescent Carbon Quantum Dots from Agro-Waste: A Green Route to Tetracycline Detection and Water Quality Monitoring

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ABSTRACT

In this work, carbon quantum dots were synthesized from potato peel waste using a facile and sustainable hydrothermal route, thus providing a green valorization pathway for agro-waste. CQDs based on the prepared CQDs had a solid blue fluorescence of approximately 437 nm emissions, indicating its quantum-confined nature. TEM exhibited mono-disperse and spherical particles having a mean diameter around 3.5 nm. Furthermore, XPS established the existence of oxygenated functional groups that bring about increased aqueous dispersibility. The carbon structure was a mixed sp^2/sp^3 with Raman spectroscopy. Correlation studies on time correlated single-photon counting (TCSPC) demonstrated an average lifetime of 6.1 ns which confirmed effective radiative recombination.

The CQDs demonstrated great fluorescence quenching by Tetracycline (TC) as a result of photoinduced electron transfer and the inner filter effect. A straightforward fluorescence response was achieved in the concentration range of 0.562 to 6.18 uM (R^2 = 0.996), providing a detection limit of 25.8 nM. The binding constant (K_a = 1.41 x 105 M -1) was calculated to indicate high affinity between CQDs and TC molecules. The probe was also highly selective to TC in comparison to the other antibiotics and demonstrated stability of fluorescence more than 60 days, which also verified its photochemical

stability. Real-sample analyses in pond water, milk, and juice yielded recovery values ranging from 94.8 % to 104 %, affirming analytical reliability and practical applicability.

The designed CQD based sensing platform is in general an economical, environmentally friendly and sensitive approach for detecting antibiotic residues. Future work will focus on extending this fluorescence sensing approach toward multiplexed antibiotic detection and portable device integration for field-deployable water quality surveillance.

Keywords : Carbon Quantum Dots; Photoinduced Electron Transfer; Fluorescent Biosensor; Tetracycline Sensing; Agro-waste Valorization; Environmental Monitoring

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Biomass-Derived Porous Carbon from Marigold Flowers via Hydrothermal Activation for Supercapacitive Performance

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ABSTRACT

The sustainable conversion of biomass into functional carbon materials represents a promising approach for developing environmentally benign energy storage devices. In this study, marigold flowers, a readily available everyday temple waste, were utilized as a carbon precursor for the synthesis of high-performance electrode materials for supercapacitor applications. The transformation of marigold biomass into carbon was achieved through a controlled carbonization process followed by chemical activation using both acidic and basic treatments under hydrothermal conditions. This combined activation route effectively tuned the surface chemistry and pore structure of the resulting carbon, generating a hierarchical porous network for rapid ion diffusion and charge storage. The as-synthesized carbon material was incorporated onto a graphite substrate using polyvinylidene fluoride (PVDF) as a binder to form the working electrode. The structural properties and morphology of the carbon were examined using X-ray diffraction (XRD), Ramn, and Field emission scanning electron microscopy (FE-SEM), confirming the successful formation of an amorphous carbon framework with well-developed porosity. Its electrochemical performance was investigated using cyclic voltammetry (CV) and galvanostatic charge–discharge (GCD) measurements in a three-electrode configuration. The electrode exhibited a quasi-rectangular CV profile and symmetric charge–discharge curves, indicative of typical electric double-layer capacitive (EDLC) behaviour. Remarkably, the marigold-derived carbon electrode delivered a specific capacitance of 216 F g^{-1} at a scan rate of 5 mV s^{-1} , demonstrating efficient ion transport and charge storage capability. The findings highlight the potential of marigold-flower-derived carbon as a low-cost, renewable, and eco-friendly electrode material for supercapacitors. This approach provides a sustainable pathway for converting floral waste into high-value carbon materials, aligning with circular economy principles while addressing global energy storage challenges.

Keywords: Biomass-derived carbon, Marigold flower waste, Supercapacitor electrode, Chemical activation, Electric double-layer capacitance (EDLC), Sustainable energy storage

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Enhanced supercapacitive attributes employing sustainable pre-treatment strategies in biomass-derived activated carbons

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ABSTRACT

The increasing global demand for clean and sustainable energy highlights the urgent need to develop environmentally responsible energy storage materials. Transforming agricultural biomass waste into functional carbon materials not only reduces landfill and pollution but also contributes to a circular bioeconomy. This study explores a sustainable route for producing activated carbon from nitrogen-rich biomass and demonstrates its promise for supercapacitor energy storage applications, aligning with the United Nations Sustainable Development Goals (SDGs), particularly SDG 7: Affordable and Clean Energy and SDG 12: Responsible Consumption and Production.

To enhance the functional properties of the biomass, three eco-conscious pretreatment strategies were evaluated: distilled water washing, phosphoric acid activation (H_3PO_4)and sodium hydroxide treatment (NaOH). The biomass was converted to biochar via hydrothermal carbonization—a low-energy, water-based process with minimal environmental footprint. Structural and elemental analyses using XRD, SEM, and EDX revealed that acid-pretreated biomass produced biochar with superior pore development, enhanced hierarchical structure, and a 2% increase in nitrogen incorporation compared to untreated samples. These characteristics improved surface reactivity and ion transport.

Electrochemical evaluations using cyclic voltammetry and galvanostatic charge–discharge confirmed enhanced charge storage performance for the acid-pretreated biochar electrodes. The improved capacitance is attributed to the combination of optimized porosity and nitrogen-doped functional sites, which support both electric double-layer capacitance and pseudo capacitance.

Overall, this study demonstrates a green, cost-effective strategy to convert biomass waste into value-added energy materials. It underscores the role of material innovation in advancing sustainable energy solutions while addressing global environmental challenges.

Keywords: Biomass valorization, sustainable materials, biochar, pretreatment, activated carbon, clean energy storage, supercapacitors, SDG7, SDG12, circular economy.

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Exploring structural and optical properties of a novel compound $Na_{0.5}La_{0.5}TiO_3$ for possible applications

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ABSTRACT

In the present study, we are reporting the detailed study of structural, Raman and optical properties of a novel Perovskite compound $Na_{0.5}La_{0.5}TiO_3$ at room temperature. Room temperature X-Ray Diffraction (XRD) data reveals formation of the compound in rhombohedral crystal system with R-3c point symmetry. Positions of peaks in Raman spectra support the proposed crystal structure and point group symmetry. The optical characteristics of the synthesized compound is analyzed via UV-visible spectroscopy to check for the compound's possible applications in photo-catalytic and optoelectronic devices.

Keywords: Perovskite structure, Rhombohedral crystal system, Raman spectroscopy, UV-visible spectroscopy.

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Energy Storage Enhancement Using Sol-gel Grown Zinc Oxide (ZnO) Thin Films for Hybrid Supercapacitors

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ABSTRACT

The rapidly developing modern electronics and smart technologies has accelerated research on hybrid supercapacitors, as it bridges the gap between conventional battery and supercapacitor by offering superior electrochemical performance [1,2]. In this work, we have grown Zinc oxide (ZnO) thin film on a cupper (Cu) substrate by dip coating method via sustainable sol-gel synthesis. An all-solid-state hybrid supercapacitor (SHSc) is fabricated by using the ZnO thin film and Activated Carbon (AC) on top of conductive silver (AC-CAg) as the electrodes with a PVA-KOH gel polymer as solid state electrolyte. The electrochemical characterizations such as Cyclic Voltammetry (CV), Galvanostatic Charge Discharge (GCD) and Electrochemical Impedance Spectroscopy (EIS) of fabricated SHSc were carried out at room temperature using a CHI660F electrochemical workstation. The SHSc exhibited a high specific capacitance of 1136.42 F/g at a current density of 10 mA/g, along with a remarkable energy density of 77.34 Wh/kg at a power density of 175 W/kg. Further, it demonstrated a high-power density of 875 W/kg by maintaining a high energy density of 18.41 Wh/kg at 50 mA/g current density. The charge storage capacity and energy density of the prepared SHSc is comparable or higher than some published work on hybrid supercapacitors [3-5]. This study demonstrates potential of sustainable solgel synthesized ZnO thin film as efficient electrode materials for next generation hybrid supercapacitor systems.

Keywords: All Solid-State, Energy density, Hybrid Supercapacitor, Specific capacitance, Zinc Oxide

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Preliminary investigations on the efficacy of Black Soldier Fly (BSF) larvae in facilitating biodegradation of plastics

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ABSTRACT

Plastics such as polystyrene (PS), polyethylene (PE), polyvinyl chloride (PVC), polypropylene (PP), and polyurethane (PU) pose serious health risks to humans and other organisms. Biodegradation, unlike chemical processes emerge as an eco-friendly method for reducing plastic waste. Lately, insects such as mealworms (*Tenebrio molitor*), waxworms (*Galleria mellonella*), superworms (*Zophobas atratus*), and black soldier fly (BSF; *Hermetia illucens*) have been employed for degradation of plastics and solid wastes. In this research, we farmed BSF on a laboratory scale to understand the response of the larval biomass in facilitating biodegradation of PS and PVC. Pure culture and metagenomics profiling from the insect gut and carcass revealed diverse microorganisms. Further, the frass of the insect larvae were assessed as a soil supplement for rice cultivation. Protein and carbohydrate content of the PS, PVC, and PS+PVC fed larvae showed higher accumulation of protein and carbohydrate per gram of larval biomass. 16rRNA sequencing of the pure cultures identified the bacterial strains such as *Stutzerimonas stutzeni, Providencia stuartii, Staphylococcus hominis, Bacillus cereus,* and *Arthobacter creatinolyticus* with more than 96% similarity to the database. Further, low dose (5%) supplementation of frass in soil accounted for stunted growth in rice cultivars but at elevated doses (10-15%) inhibited germination.

Keywords: Plastic biodegradation, Black soldier fly (BSF), Polystyrene (PS) and polyvinyl chloride (PVC), Insect gut microbiota, 16S rRNA sequencing, Frass as soil supplement

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Design and Synthesis of 4-Phosphorylated-2*H*-Phenylchromenes *via* Phospha-Michael Addition Reaction

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ABSTRACT

Herein, we report an efficient one-pot approach for the synthesis of 4-phosphorylated-2*H*-chromenes through a base-catalyzed phospha-Michael addition-elimination of *H*-phosphonates with 2-phenyl-3-nitro-2*H*-chromenes. The transformation proceeds under mild conditions using catalytic amounts of DABCO in THF, delivering the desired products within short reaction times of 5 to 20 minutes. This method demonstrates broad substrate scope with 20 examples and affords excellent yields ranging from 70–92%. The resulting compounds were characterized by ^{1}H, ^{13}C, and ^{31}P NMR spectroscopy as well as HRMS analysis. Mechanistic investigations support a pathway involving nucleophilic addition of H-phosphonates at the C4-position of the chromene, followed by nitrous acid elimination. Owing to its operational simplicity, high efficiency, and metal-free nature, this protocol provides a valuable synthetic platform for accessing novel phosphorus-containing heterocycles, which may hold potential for future biological studies

Keywords: *Phospha-Michael Addition, 2H-Chromene, One-pot Synthesis, DABCO, Phosphonates*

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TECHNOLOGICAL SCIENCES
Abstracts (Oral)

Mechanical property of hygrothermally aged hybrid Glass/Carbon fibre based FRP composite dispersed with Industrial waste fillers

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ABSTRACT

Fly ash and red mud, as metallurgical waste materials, can be utilized as filler materials for mechanical strengthening of Fibrous polymer composites. In the present study, fly ash and red mud, after suitable processing, were dispersed in various proportions to fabricate hybrid FRP composites. The extent of filler contents was optimized separately for glass fibre/epoxy and carbon fibre/epoxy composite in reference to maximum inter laminar shear (ILSS) and glass transition temperature (T_g). Further, such hybrid FRP composites are assessed to evaluate the environmental stability with respect to moisture conditionings concomitant to various extent of humidity and temperatures. For this purpose, the hybrid FRP composites, filled with optimized industrial fillers, were exposed to hygrothermal conditionings with variations of humidity (75% R.H., 85% R.H. and 95% R.H.) for 90 days. Carbon fibre/epoxy composite filled with 6 wt % of red mud exhibited minimum moisture gain with all humidity level of hygrothermal ageing. 3-point bend test reveals the decrease in ILSS with increase in hygrothermal ageing times for all humidity levels, as considered in the investigation. Low temperature DSC test reveals the maximum glass transition temperature in case of red mud filled carbon fibre/epoxy hybrid composite. Despite of aggravate moist ageing with prolonged durations, hybrid FRP composites exhibited ILSS and Tg values more than that of untreated conventional glass fibre/epoxy and carbon fibre/poxy composites. SEM micrographs of fractured hybrid FRP specimens reveal some indicative failure modes showing the cause of moisture induced mechanical degradations.

Keywords: Fly ash, red mud, Hybrid FRP, ILSS, T_g

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Identifying Hydroclimatic Drivers of River Discharge Variability Using AI/ML Techniques

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ABSTRACT

River basins are highly sensitive to climate variability and extreme weather events. This study attempts to identify the key climatic drivers and extreme events which influence river discharge in the lower Mahanadi basin in Odisha, India. This study explores the river discharge variations under extreme climate conditions, addressing the major challenge of identifying specific climate indices which strongly influence discharge.

This study uses machine learning algorithms like Extreme Gradient Boosting (XGBoost) and explainable artificial intelligence (xAI) to model river discharge data which was collected from Central water Commission (CWC), for the period January 2000 to November 2021. The daily discharge data was aggregated into monthly discharge to represent seasonal variability. The "xclim" python library was applied on rainfall and temperature data collected from Indian Meteorological Department (IMD) for the same period to calculate 35 climate extreme indices. The study found that, out of the 35 chosen for the study, 8 indices were the most influential predictors of river discharge. These were median precipitation, total accumulated precipitation, Maximum 5-day total precipitation, Simple daily intensity index, days with maximum temperature above 90th percentile, days with minimum temperature above 90th percentile, 1 month lagged total precipitation, 2 month lagged total precipitation. After optimization, the model improved substantially, and the correlation factor improved from 71.8% to 85.6% and the Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE) correspondingly declined. It was proven beyond doubt that climate indices had a greater impact on river discharge than just the average daily rainfall and temperature. These findings have direct implications on climate resilient river basin management and demonstrated the use of explainable AI framework for prediction of accurate

discharge with the interpretable insights that overcomes limitation of traditional machine learning framework.

Keywords: River discharge, Machine Learning, Explainable AI.

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Land Surface Temperature Dynamics: Geospatial Insights for Climate Action and Sustainable Land Management

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ABSTRACT

Land Surface Temperature (LST) is a critical indicator of surface energy balance, urban heat stress, surface atmosphere interactions, ecosystem stability, and climate variability. At the same time, the spatial distribution of LST is influenced by land use and land cover. Despite several published work on LST, very few look into the spatially stratified heterogeneity and local clustering patterns of LST, especially in the eastern Indian region. Only a few studies have integrated hotspot analysis, Geodetector modelling, and spatial regression to quantify the spatial dependence and driving mechanisms of LST. Spatial dynamics of LST has not been utilised by policy makers to govern land cover and land use changes, especially for the state of Odisha, India. This study integrates MODIS/Terra LST, and other environmental variables to understand the geospatial dynamics of LST in the state of Odisha for the year 2021. Spatial autocorrelation confirmed significant clustering of LST across the state. Local Indicators of Spatial Association (LISA) identified the hotspots and cold spots for LST in the state. The Geodetector model evaluated the explanatory power of environmental and anthropogenic drivers behind LST variability. Regression analyses using Ordinary Least Squares (OLS), Spatial Lag Model (SLM), and Spatial Error Model (SEM) examined the spatial dependency of the influencing factors on LST. The analysis revealed that LST hotspots were clustered in urban and industrial belts, whereas cold spots were associated with highlands and forested regions. The Geodetector model showed that vegetation cover, water availability,

built-up intensity, and elevation were the most influential factors responsible for fluctuations in LST. SEM was found to perform better than SLM and OLS in determining the spatial dependency of the factors. This study provides a methodology of understanding of LST dynamics in eastern India by integrating hotspot analysis, factor detection, and spatial regression modelling. The use of this method, policy makers can gain valuable insights which can be used for environmental planning, sustainable land use, and take measures for urban climate adaptation.

Keywords: Land Surface Temperature, Geodetector Model, Hotspot, Local Indicators of Spatial Association.

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Sustainable Development Goals: Science and Technology Innovations

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ABSTRACT

The 17 sustainable development goals (SDGs), adopted by all United Nations member states in 2015 which combines science, technology and innovations to address sustainable challenges including hunger, poverty, health, employment, environment and energy. The implementation of SDGs along with the UN Technology Facilitation Mechanism (TFM) enable international cooperation and enhance knowledge sharing, thus ensuring all are included. Although the 2030 agenda for sustainable development is a global plan for a better future, still it is confronting internal and external obstacles. The commitment of leaving no one behind is greatly affected by the internal challenges arise from the limitations from the capacity and resource of countries. In addition to this, extreme weather conditions, disasters, challenges in food production and data gap collectively create a threat to sustainable development. "Approximately 41% of the 230+ indicators of the 17 SDGs still lack sufficient data as of May 2022 (UN Report, 2022)." The main objective of this study is to examine whether the science

and technology innovations facilitate or hinder the effective implementation of SDGs, especially in low- and middle-economic countries as these countries are generally in transition phase and experience both development and retardation in economy. Conduction of stakeholder survey is crucial to achieve the study objectives of SDGs, because they contribute primarily to the identification of goals and targets. The parent topic "Science and Technology Innovations" is not only the SDG 9 i.e. industry, innovation and infrastructure but is also crucial for the successful implementation of all other SDGs. Thus, maintaining a balance between environmental, social and economic growth through the SDGs is the key aspect of this study. So, the adoption of SDGs by UN ultimately creates a pathway to achieve the progress towards the sustainable production in various sectors such as agriculture, renewable energy and healthcare. However, the SDGs: science and technology innovations requires the successful execution to tackle the obstacles, solve them and create a better future for all.

Keywords: SDGs, Science and Technology, Innovations, International cooperation, Global development agenda, Stakeholder.

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Educational Deprivation in Tribal India: Evidence from School Closures and Enrollment Decline in Jungle Mahal, West Bengal

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ABSTRACT

Over the past decade, the closure of numerous schools in India due to declining enrollment and low academic performance has raised concerns about its impact on student achievement. This research examines 1,074 state-supported schools, particularly those with fewer than 30 students, in the tribally governed Jungle Mahal area of West Bengal. The study examines 36 factors related to infrastructure, teacher qualifications, and enrollment, using field surveys and secondary data from UDISE+, AIES, DHDR, Census 2011, and other sources. To evaluate discrepancies, statistical methods such as mean, standard deviation, and kurtosis were employed. The results show notable drops in enrollment among Scheduled Tribes (41%), SCs (0.9%), and OBCs (20%). There are significant differences in facilities, such as urinals (1.643 ± 1.211) and boundary walls (4.464 ± 1.792), while basic amenities like drinking water are generally available (1.00 ± 0.03). Particularly for CWSN, there is little digital infrastructure. According to teacher statistics, there is a gender disparity, with more male instructors (1.19) compared to female teachers (0.40), and many of them are underqualified or work part-time. These gender equality, infrastructural, and personnel shortcomings impede fair educational access and consistent academic achievement across blocks.

Keywords: *Declining Enrollment, Socioeconomic Factors, Educational Disparities, Infrastructure Gaps, Teacher Shortages,*

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BioSenseGrid-Q: A Bio-Intelligent, Carbon-Negative Sensor Network Integrating Nanotechnology, AI, and Green Computing for Sustainable Environmental Regeneration

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ABSTRACT

The rapid decline of soil, air, and water ecosystems due to industrial pollutants, agrochemical residues, and CO_2 emissions demands new technologies. We need solutions that merge smart sensing, sustainable practices, and ecological restoration. BioSenseGrid-Q presents a bio-intelligent sensor network that functions as a "living grid." It monitors, learns from, and regenerates the environment using green nanotechnology, artificial intelligence (AI), and Internet of Things (IoT) principles. Each node in the BioSenseGrid-Q network has biodegradable, self-healing sensing modules. These are composed of mycelium, chitosan, and graphene composites layered with biowaste-derived carbon quantum dots (CQDs) and ZnO nanowires. These hybrid nanomaterials enable detection of heavy metals, fertilizers, and organic toxins using optical and electrochemical signals. The nodes feature non-toxic antifouling coatings made from zwitterionic and PEG-based polymers. They mitigate biofilm buildup and material breakdown during field use without harming the environment. A key aspect of this platform is its carbon-negative operation. Algal biocoatings on the sensor surfaces actively fix CO_2 . Enzymatic layers help neutralize chemical pollutants right where they occur, improving local air and soil quality. The system receives its energy from solar-triboelectric hybrid microcells and microbial fuel cells embedded in the soil. This design allows it to work continuously in remote or off-grid locations. Integrated TinyML and spiking neural network algorithms enable on-node data processing and classification. This substantially reduces the need for cloud computing and the energy costs that come with it. Each node communicates through low-power LoRaWAN and BLE mesh networks. This setup creates a self-organizing, resilient grid that only shares high-value environmental insights. We maintain cybersecurity and operational integrity through cryptographically signed

firmware updates and hardware-level encryption. BioSenseGrid-Q aligns with Sustainable Development Goals (SDGs) 9, 11, 12, 13, and 15. It marks an innovative step toward eco-intelligent infrastructure that can monitor soil health, sequester carbon, and detoxify pollutants in real time. By integrating biocompatible nanomaterials, edge AI, and renewable energy harvesting, the platform monitors environmental dynamics and enables ecological remediation. It establishes an autonomous, adaptive eco-sensor network, a novel paradigm in sustainable environmental intelligence that connects biology, nanotechnology, and AI to reinforce ecosystem resilience and environmental homeostasis.

Keywords: BiosenseGrid-Q, TinyML, Biointelligent Sensor, Biocoatings, Solar-triboelectricity

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A preliminary study on Slip partitioning in and around Sundernagar, Himachal Pradesh

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ABSTRACT

The present study in and around Sundernagar, Himachal Pradesh, emphasises the importance of detecting active faults, which are vital for understanding earthquake genesis and guiding seismic mitigation. A new active strike-slip fault has been identified through the analysis of high-resolution CORONA satellite data (1.8m). A 20 km-long active strike-slip fault with dextral movement has been traced. Employing remote sensing techniques, this preliminary study integrates CORONA satellite imagery, Cartosat-1 Carto DEM, Google Earth visualisation, SRTM, Bhookosh GSI, and ALOS PALSAR DEM. Advanced GIS and morphometric analysis have facilitated precise delineation of geomorphic indicators of tectonic motion, including linear valleys, offsets, mountain front sinuosity, Beas River sinuosity, valley floor ratios, and triangular facets. A northwest-striking active fault with offsets measuring 274–833 meters was traced near Mandi, corroborated by substantial slip rates (~5.19 mm/yr) that suggest significant strain accumulation. The slip rate was calculated using the D/L ratio (Matsuda, 1975). Based on the fault length, the magnitude was estimated at 6.5 Mw using the empirical relationship by Wells and Coppersmith 1994. The newly identified active strike-slip fault exhibits slip partitioning in a thrust regime, resulting from oblique convergence between the Indian and Eurasian plates. This identification will certainly aid in seismic hazard assessment (SHA) of the thickly populated region.

Keywords: Active fault, Steam Offsets, River Sinuosity, Slip Rate, Rupture Length.

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Study on Nesting Architecture and Material Composition of Birds in Angul District, Odisha

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ABSTRACT

Birds are well known for constructing a wide variety of nests, and nest building is an instinctive behavior among them. The structure, design, and materials used in nest construction are species-specific. These intentionally built structures are made from diverse materials, including natural and, increasingly, synthetic components. Bird nests also serve as microhabitats that support ectoparasites, fungi, and other nest commensals. A single nest functions as a habitat, an environmental sample, an indicator of the breeding status of birds, and a record of species-specific interactions. It represents a remarkable example of animal architecture. The present study was conducted in an urban area of Angul district, Odisha, and includes nine species of local birds Common Myna (*Acridotheres tristis*), House Sparrow (*Passer domesticus*), Red-vented Bulbul (*Pycnonotus cafer*), Baya Weaver (*Ploceus philippinus*) and House Crow (*Corvus splendens*), Indian Robin *(Copsychus fulicatus),* Purple Sunbird *(Cinnyris asiaticus*), Oriental Magpie-Robin (*Copsychus saularis*), Munias (*Lonchura punctulata)* focusing on their nest structures and nesting materials. The study also reveals that birds prefer nesting at varied heights depending on their ecological and behavioral suitability. The main objective of the study was to analyze the nest structure, design, and composition of some common terrestrial birds inhabiting the urban areas of Angul district. The data provide insights into how the availability and incorporation rate of anthropogenic materials are correlated with nest construction.

Keywords: Birds, nesting and anthropogenic materials, nest construction.

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Seismic Hazard Assessment in and Around Kangra Valley, India

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ABSTRACT

The extensive Alpine-Himalayan convergent tectonic belt, encompassing the Himalayan arc, remains a hotspot for ongoing seismic activity. In light of its active tectonic regime and increasing developmental interventions in mountainous regions, it is imperative to continually update seismic hazard assessments with the latest data on earthquake occurrences and attenuation characteristics. The current study employs the Probabilistic Seismic Hazard Assessment (PSHA) approach to estimate the Peak Ground Acceleration (PGA) for the Kangra Valley and its surrounding regions. The 1905 Kangra Earthquake (Mw 7.8), which caused the most damage at the study site, as well as the recently identified Kangra Valley Fault (KVF) (Malik et al., 2015), have both been considered in this study. Improved procedures for PSHA have been adopted for this study, and PGA values have been estimated for 10% and 2% likelihood of exceedance in 50 years. The PGA values range from 0.06 to 0.14g and 0.16 to 0.3g, respectively, when taking into account the b-value. When necessary, the strong ground motion calculated at the firm rock level has been used to estimate ground motion at the surface by factoring in the site amplification factor. These findings are expected to support safer engineering practices and guide microzonation efforts in the reg ion.

Keywords: 1905 Kangra Earthquake; PSHA; PGA; Kangra Valley Fault (KVF); exceedance factor.

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Solar Plast Energy – From Plastic Waste into Solar Panels: A Sustainable Innovation For Greener Future.

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ABSTRACT

The global energy and environmental landscape faces two urgent challenges — plastic pollution and sustainable energy generation. India alone generates over 3.4 million tonnes of plastic waste annually, of which less than 30% is recycled, contributing significantly to environmental degradation. Simultaneously, the growing demand for clean, decentralized energy highlights the pressing need for cost-effective renewable solutions. SolarPlast Energy is an innovative, A sustainable initiative that addresses both challenges through waste-to-energy technology integration. The project focuses on recycling plastic waste to develop solar-grade polymer composites used in manufacturing solar panel frames, protective casings, and Solar tiles for building exteriors. These Solar Tiles not only serve as renewable energy generators but also as aesthetic, weather-resistant architectural materials, promoting green building practices and energy efficiency.

This innovation exemplifies a circular economy approach, where waste materials are re-engineered into value-added sustainable products. Laboratory simulations demonstrate that the use of high-density polyethylene (HDPE) and PET blends can reduce panel weight by 35%, enhance durability, and cut production costs by nearly 40% compared to conventional aluminum structures. Additionally, the modular solar tiles provide dual functionality—serving both as construction material and micro-energy sources for residential and commercial units.

The project aligns with multiple UN Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 5 (Gender Equality).

A preliminary financial model suggests an initial investment of ₹ 16.5 lakh with a projected ROI of 35–40% within two years. Beyond financial viability, SolarPlast Energy contributes to carbon reduction, waste management, and women-led technological entrepreneurship. In conclusion, SolarPlast Energy represents an innovative fusion of science, sustainability, and social impact, offering a scalable model for green urban infrastructure and a sustainable future under the theme "Sustainable Green Frontiers: SDGs through Science and Technology Innovations."

Keywords: Solar Tiles, Plastic Recycling, Green Energy, Sustainable Development, Circular Economy, Women Entrepreneurship

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Phytochemical-Based Discovery of a Potent Antimalarial Candidate Targeting PfPI4K: A Hybrid Structure-Based and Deep Learning approach

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ABSTRACT

Malaria is a parasitic infection that poses a threat to life and continues to be a serious challenge to global health. The recent COVID-19 pandemic has further escalated the situation. The emergence of artemisinin partial resistance and insecticide resistance emphasizes the critical need for novel antimalarial drug targets and agents with alternative mechanisms of action. This study focuses on Plasmodium falciparum phosphatidylinositol 4-kinase (PfPI4K), a phosphoinositide lipid kinase essential for membrane trafficking and biogenesis across multiple stages of the Plasmodium life cycle. We investigated a dataset of 58 natural anthraquinones with reported antimalarial activity as potential PfPI4K inhibitors. Employing Modeller 10.5 for homology modeling, we constructed the PfPI4K structure, validated by quality testing parameters. Subsequent in silico screening identified potential drug candidates. The top-scoring inhibitors were investigated by ADMET analysis. The compound AD37 (6'-O-methyl-knipholone) was identified as a prominent candidate. It complied with Lipinski's rule of five, displayed favorable ADMET parameters, and reported the highest binding affinity of -5.983 kcal/mol to PfPI4K as determined by GLIDE analysis. The stability and molecular interactions of the PfPI4K-AD37 complex were further confirmed by a 100 ns molecular dynamics simulation employing GROMACS. This investigation identifies AD37 as a promising drug candidate for treating malaria and provides valuable information regarding the molecular interactions essential for the future design and development of antimalarial drugs.

Keywords: *P. falciparum*, PI4K, Deep Learning, Virtual screening, Molecular docking

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Innovating For 'Life On Land': A Techno-legal Approach To Wildlife Conservation In India

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ABSTRACT

In India, the evolution of wildlife conservation has transitioned from traditional policing approaches to technologically driven ecological governance. Earlier conservation practices largely depended on data-based ecological management. However, as the nation progresses through rapid advancements in science and technology across various sectors, conservation efforts are encountering increasingly complex challenges. In contemporary India, shrinking land resources of which only about 5% remain under protection along with rapidly changing climatic conditions have intensified pressures on wildlife habitats. Moreover, rising disposable incomes have contributed to a growing demand for exotic animal products, further threatening biodiversity. These factors collectively highlight the urgency for innovative and adaptive conservation strategies in a highly advanced technological era. Combating illegal activities such as poaching, illicit logging, and encroachment necessitates robust monitoring mechanisms and the generation of credible evidence to support investigation and prosecution. Mitigating human–wildlife conflict, particularly incidents involving large and potentially dangerous species, likewise demands the strategic deployment of advanced technological interventions. Crucially, the successful implementation of these measures must be reinforced by a comprehensive and enforceable legal framework that mandates compliance and ensures accountability.

Sustainable Development Goal (SDG) 15- 'Life on Land', it mandates the protection, restoration and sustainable use of terrestrial ecosystems and wildlife. Being world's most mega bio diverse country, India holds extensive legal responsibility and ecological opportunity in fulfilling this goal. It has much progressive legal framework to address the challenges of wildlife conservation. Rather it is more challenging for Indian Law to manage equilibrium between human development in positive side and human interference in negative side. Key legislations such as, the Wildlife (Protection)

Act 1972, the Forest Conservation Act 1980 and Environment (Protection) Act 1986, creates regulatory framework for habitat preservation, protected areas, eco-sensitive zone etc. These acts need to undergo techno-legal upgrades for better environmental compliance in order to be in line with SDG 15. Digital forensics, remote sensing, geographic information systems (GIS), unmanned aerial vehicle (UAV) surveillance, and artificial intelligence (AI) may all be integrated to greatly improve monitoring, detection, prosecution, and governance capabilities. This article critically examines India’s progress towards SDG 15 by exploring how science, technology and the legal system interact to protect wildlife. The study ultimately argues for a holistic and adaptive governance model that harmonises ecological science, emerging technologies and strong safeguards, while empowering local communities as key stakeholders.

Keywords: Wildlife, Law, Habitat Conservation, Technology

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ENVIRONMENTAL SCIENCES
Abstracts (Oral)

Economic Assessment and Livelihood Contributions of Agroforestry Systems in Cuttack District, Odisha

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ABSTRACT

The investigation was undertaken on economic analysis of agroforestry models in Cuttack to quantitatively evaluate the contribution of major agroforestry systems to household income, livelihood resilience, and ecological sustainability. Specifically, the study aimed to characterize the prevailing agroforestry typologies, analyse their economic performance through cost–benefit metrics, and assess associated socio-economic and environmental impacts. Socio-demographic profiling of respondents revealed a predominance of middle-aged agricultural households, comprising primarily males (80%), with a high proportion of married individuals (80%). Educational attainment varied, wherein 40% possessed secondary-level education and 24% were graduates. Social stratification indicated representation primarily from OBC (44%) and General (36%) categories. Despite the adoption of agroforestry by 80% of respondents, the majority reported annual incomes below Rs. 4,00,000, indicating persistent livelihood vulnerabilities and suboptimal economic diversification. Five major agroforestry systems were documented: agri-silviculture, homestead gardens, block plantations, multipurpose tree plantations, and aqua-forestry. These systems integrate woody perennials with crops and/or aquatic components, enhancing biophysical productivity through complementary resource utilization and microclimate moderation. Economic evaluation demonstrated significant inter-system variability. Aqua-forestry exhibited the highest profitability, registering a benefit–cost ratio (BCR) of 2.87, a gross return of Rs. 88,500, and a net return of Rs. 65,650. Agri-silviculture recorded a BCR of 2.44, while homestead gardens yielded a BCR of 1.95. Despite differential establishment costs, all systems generated positive net returns, indicating financial feasibility and scope for upscaling. AFS demonstrated substantial socio-economic benefits by augmenting income streams through diversified outputs (timber, fuelwood, fruits, aquatic produce, fodder) and mitigating risk exposure arising from climatic and market fluctuations. Enhanced employment generation particularly for women in plant nursery management, seasonal harvesting, and primary processing improved social inclusion and household labour utilization. From an ecological standpoint, the systems conferred positive externalities, including improvements in soil organic matter, erosion control, hydrological regulation, and biodiversity enrichment owing to structural vegetation heterogeneity.

The findings affirm that agroforestry significantly contributes to enhancing livelihood security and ecosystem stability in Puruna Tigiria Gram Panchayat. To optimize system productivity and equity outcomes, the study recommends long-term monitoring of biophysical sustainability, capacity-building interventions for marginalized groups, particularly women and strengthening of market linkages for agroforestry value chains. Further, policy incentives promoting input support, value-addition, and climate-resilient models are essential to mainstream agroforestry as a nature-based solution for sustainable rural development in Odisha and similar agro-ecological regions.

Keywords : Agroforestry systems, Economic evaluation, Benefit–cost ratio, Aqua-forestry, Agri-silviculture, Homestead garden.

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Scope of Millet cultivation in the changing climatic scenario of Odisha

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ABSTRACT

Millets naturally constitutes a major crop of the tribal farmers of odisha for its ability to grow and yield in harsh conditions. Tribals of hilly districts of Odisha cultivate millets as a part of subsistence farming system and is intricately linked with their socio- religious and cultural life. Tribals in the southern districts of Odisha like Koraput, Malkangiri, Raygada, Nuapada, Kalahandi and Kandhamal are the major cultivators of millets. The different millets grown in Odisha in the order of their production are Finger millet, Sorghum, Pearl Millet, Little millet, foxtail millet, Kodo, Barnyard and Proso millet of which finger miller is the dominant one. The southern and western plateau regions of Odisha are highly susceptible to drought due to scanty and erratic rainfall patterns. A significant portion of the area remains rainfed, and existing irrigation systems are often poor or lack proper infrastructure. Over the last 25 years, Odisha has experienced climate change through manifestation of increase in the frequency and intensity of extreme weather events (such as cyclones, floods, droughts, heat wave), general rise in temperature and erratic rainfall patterns**.** There is a decreasing trend in rainfall (–16.5 mm/season) and an increasing trend in temperature (0.05°C/season) in Odisha which will have significant influence on the agricultural production of Odisha. Millets being climate-resilient crops can withstand extreme heat and drought, have low water and fertilizer needs, and are less susceptible to pests and diseases, their ability to grow in poor soils and diverse agro-ecological situations makes them an ideal choice for crop diversification in the face of climate change and its demand as a nutritious crop among the masses.

Keywords : Climate change, Millet, Odisha

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Diversity and temporal dynamics of major insect pollinators association with important trees in east coast of India

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ABSTRACT

Insect pollinators and trees play crucial roles in sustaining ecosystem productivity and stability. A field investigation conducted in 2024 examined the association between major insect pollinators and 15 important tree species under east coastal Odisha conditions in eastern India. The studied species included *Mangifera indica*, *Gliricidia sepium*, *Moringa oleifera*, *Litchi chinensis*, *Cinnamomum zeylanicum*, *Pongamia pinnata*, *Peltophorum ferrugineum*, *Lagerstroemia speciosa*, *Caesalpinia coriaria*, *Tectona grandis*, *Santalum album*, *Ziziphus mauritiana*, *Alstonia scholaris*, *Sapindus mukorossi* and *Anacardium occidentale*. The study assessed pollinator diversity and temporal activity patterns associated with these flowering trees. Results revealed a rich assemblage of insect pollinators belonging to several functional groups, including bees, flies, butterflies, moths, wasps, and beetles. *Ziziphus mauritiana* supported the highest pollinator species richness (12 species), followed by *Pongamia pinnata* and *Santalum album* (Flowering 2) with 11 species each, while *Gliricidia sepium* recorded the lowest (5 species). Pollinator individuals varied across flowering phases and tree species. Mid-flowering recorded the highest activity (20.14 individuals/5 min/m^2), followed by early (12.89) and late phases (8.42). Among species, *Ziziphus mauritiana* showed maximum numbers (20.83/5 min/m^2), while *Caesalpinia coriaria* had the lowest (7.67/5 min/m^2). Pollinator activity varied significantly throughout the day, with peak visitation observed between 09:00–11:00 hours, averaging 8.51 number of species per 5 min/m^2. Diversity indices reflected considerable variation among tree species. Simpson's Index ranged from 0.07 to 0.16, while

Simpson's Diversity Index (0.84–0.93) and Reciprocal Index (6.19–14.61) indicated moderate to high diversity. *Santalum album* (Flowering 2), *Ziziphus mauritiana*, and *Pongamia pinnata* supported the most diverse pollinator communities. Evenness values (0.26–0.67) demonstrated variable distribution patterns, with *Ziziphus mauritiana* showing the most balanced pollinator community. Among pollinator species, *Apis cerana indica* exhibited the widest association, visiting 12 tree species, followed by *Apis dorsata* and *Eristalinus* sp. (11 species each). Several taxa, including *Megachile disjuncta*, *Coelioxys* sp., *Polistes watti*, *Papilio polytes*, and *Eristalis tenax*, were linked to single host trees.

Keywords : Insect pollinators, tree species, diversity index, *Apis* spp, Ber, Karanj.

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Important Value Indices of Trees Planted in Urban Green Spaces of Bhubaneswar

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ABSTRACT

Urbanisation exerts a profound influence on biodiversity, consequently transforming urban environments into intricate human-anthropic systems. Notwithstanding this transformation, urban green spaces, particularly urban forests, function as essential refuges for biodiversity and are integral to conservation and management efforts. The present study, conducted in Jaydev Vatika, aimed to evaluate the significance of tree species, by determining the Total Importance Value (TIV) with respect to their provisioning ecosystem services. TIV index was arrived at, encompassing criteria such as medicinal, aesthetic, edible, and various economic values to evaluate the significance of trees. The findings indicated the existence 67 plant species, which included both native and exotic taxa. The analysis revealed a pronounced predominance of native species (83%) in comparison to non-native species (17%), in the urban green space. The TIV index successfully quantified the contributions of these species to the enhancement of the urban environment. By prioritizing high-value trees, urban forestry management can optimize benefits for residents. This approach also guarantees enhanced resource utilization, directing resources towards trees that yield the most substantial benefits. Ultimately, pinpointing trees of high value through TIV assessment allows urban forestry management to deliver focused care and maintenance efforts, leading to enhanced tree maintenance. However, these values need not necessarily be indicative of the actual value of the species; as the utility of all species may not well known locally, it may not be well documented or the local population may not use it at all. The suggested way to overcome this is to popularise the planted species among the visitors. This index is just an example among several other indices which are used for comparative studies. Based on this preliminary study it could be also understood the need for refined and specific indices for urban diversity studies

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Organic Farming: A Boon for Sustainability of Plant Biodiversity and Restoration of Microbial Flora

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ABSTRACT

Organic farming (OF) is a farming system that uses eco-friendly methods of weed, pest and disease control and management. OF offers an alternative to more widespread, high input farming practices that use synthetic fertilizers, fungicides and pesticides. It is based on the idea that the soil is a living system so these synthetic products are largely excluded from organic farms. Organic agriculture relies on crop rotation, animal manures, crop residues, green manures and the biological control of pests and diseases to maintain soil health and productivity. Organic crops are often of higher value than conventional ones and the volume of organic crops shows a continually increasing production trend. The sale of crops labeled as organic or biological is highly regulated in most advanced markets. The environmental impact of organic farming is low and can be seen as a way of cleaning up and improving degraded agricultural land.

To increase the profitability of marginal farmers, possibility of growing horticultural and agricultural crops are being evaluated at Kadambasole village of block Betnoti, Mayurbhanj, Odisha. The horticultural crops like sweet corn, watermelon, Zucchini (summer squash), pumpkin, and brinjal were cultivated with and without addition of organic manures like FYM, neem cake, mahua cake, azolla etc. Biopesticides, neem based pesticides, yellow card and pheromone traps were implemented to control the pests and diseases. The different biochemical and agronomic parameters were studied to check the productivity and quality of yield. The result indicated that organic products were less perishable with long duration of field residence period as compared to inorganic products. Moreover, initial evidence indicates that organic agricultural systems deliver greater ecosystem services and social benefits. The microbial population as well as earthworm

populations were significantly increased. Although organic agriculture has an untapped role to play when it comes to the establishment of sustainable farming systems, no single approach will safely feed the planet. Rather, a blend of organic and other innovative farming systems is needed. Significant barriers exist to adopting these systems, however, and a diversity of policy instruments will be required to facilitate their development and implementation.

Keywords: Organic farming, sustainability, Plant biodiversity, Microbial flora.

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Soil and ecosystem recovery through block plantation on iron ore mine overburden in Keonjhar, Odisha

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ABSTRACT

Iron ore mining in the Keonjhar district of Odisha has resulted in severe land degradation, leading to poor soil health, loss of biodiversity, and ecological imbalance. Effective reclamation of mine overburden (OB) soils is essential for restoring soil fertility, ecosystem functionality, and carbon sequestration potential. This study evaluates the changes in soil physico-chemical properties under reclamation plantations and compares them with freshly deposited mine overburden and degraded forest land in Gandhamardan Iron Ore mine at Suakati, Keonjhar, Odisha. Soil samples were collected from three depths (0–15 cm, 15–30 cm, and 30–45 cm) across four sites: freshly deposited mine overburden (FDMO), 1-year-old plantation (PLS-1), 2-year-old plantation (PLS-2), and adjacent degraded forest land. The plantations were established in 2022 and 2023 following land levelling and natural weathering. Soil physico-chemical parameters and pioneer species diversity were monitored to assess reclamation progress. Results revealed significant improvements in soil properties with plantation age. Bulk density decreased from 1.58–1.64 mg m^{-3} in FDMO to 1.17–1.29 mg m^{-1}

in PLS-2, accompanied by an increase in porosity from 38.35% to 55.34%. Soil texture shifted toward higher sand content (82.6%) in PLS-2, compared to 23.6% clay in barren land. Soil pH ranged from slightly acidic to near-neutral (5.78–6.44), with PLS-2 showing the lowest electrical conductivity (0.044 dS m^{-1}). The organic carbon content increased notably in PLS-2 (1.42%) supporting higher nutrient concentrations for available nitrogen (77.84–303.78 kg ha^{-1}), available phosphorus (0.38–2.05 kg ha^{-1}), and available potassium (73.36–337.12 kg ha^{-1}). Bulk density showed a negative correlation with organic carbon and nutrient availability, indicating improvements in soil quality. Pioneer species diversity and density also reflected ecological recovery. One year old block plantation supported more species (16 numbers) than the second year plantation site (14 species). Similar trend was observed for Shannon-Wiener index, however the density have a reverse trend. Overall, the study shows that plantation-based reclamation improves soil health, nutrient status, and biodiversity in iron ore mine overburden soils, offering a sustainable approach for land restoration and carbon sequestration.

Keywords: Gandhamardan iron ore mine, Suakati Keonghar, mine restoration, pioneer species.

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A Innovative practical Approach to a solution to Plastics and other waste pollution to maintain clean Air and sanitation and Environmental Protection in Balangir town Balangir District in state of Odisha

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ABSTRACT

The earth is only planet life exit due to Air, water, soil, ecosystem environment that why it called living world, Indian called mother earth. Air contain Oxygen for respiration, water fordrinking body contain 60-70 % water, get food and selter Waste is a majore cause of pollution, if burnts lead to Air Pollution, affect respiration, ifdumping in open space and unsanitary landfills contributes to contamination of drinking waterand cause infection and transmit diseases. The dry waste flows up to sea, ocean and contaminetsthe water which endanger to life in water. The dry waste dumps to soil makes soil infertile, unsuitable for farming and plantation, blocks ground water . The pollution is also one of the cause of global worming and climatic changes That's why effective waste management suitable to Environment with out polluting and hampering the life on earth. The solution which controls pollution, save waste, save environment, save earth is an innovation by Dr. Manmohan Bagh professionnally Anesthesiologist and critical care with pain physician and passionately working as Environmental Activist since 2015. The Innovation highlights is Recycling and Utilization of Waste' decentralized model's success in fostering stakeholder reengagement, behavioral change and resource recovery. The principle behind the management is to stop waste related pollution, aiming to reduce dumping reduce Burning, reduce land filling reduce Pollution. The activities includes door to door collection, road collection, collection from dumping yards, transferred to segregation centre, segregations to different items channelized for Recycling and other used where it not creates Pollution.

Keywords: Dry waste management, material recovery facility, plastic waste, Recycling.

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Anthropogenic Intervention in the Riverine Ecosystem of the Southern Part of Nadia District in West Bengal, India

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ABSTRACT

The Southern part of Nadia District of West Bengal lies within the *moribund* sector of the Ganga Delta where all the rivers *viz.* Bhagirathi-Hooghly, Churni, Ichamati, Anjana, Jamuna *etc.* are stagnated. The rivers have erratic water flow causing floods over large tracts spilling over the banks during torrential rains, but remaining practically flowless (even dry in stretches) during dry season. The repetitive occurrence of the 9-metre contour in the study area indicates that the ground slope does not have a persistent direction. The rivers are at a loss to find a perceptible slope and consequently have extremely intricate meandering courses. At some places the course of a river has taken a complete turn around. Detached lengths of old courses (including ox-bow lakes and *bils*) are strewn over the entire area indicating the extent of degeneration of the drainage condition. Such condition has most intensively developed as pockets in the study area. Such pockets are liable to inundation in the heavy cyclonic weather during the monsoons. Built-in settlements with increasing density and without any regulation cause more loss of life and property.

The riverine environment of the area is in a highly deplorable condition. The river zone faces the problems of siltation, industrial pollution (especially from the sugar mills in Bangladesh), encroachment, unscientific fishing techniques, after-effects of retting of jute, construction of bridges, destruction of aquatic flora and fauna, weed infestation particularly with water hyacinth, *char* (river island) disputes. Illegal occupation alongside the rivers is also narrowing the river channels. Anthropogenic interventions with the rivers have intensified the severity of floods. 63.6% of fish species appeared to have been eliminated from the polluted Churni river since 1983. Built-in settlements with increasing density and without any regulation in the river zone cause more loss of life and property. River bed cultivation is being carried out in places where the beds have become dry. The number of *bils* has reduced from 17 to 11 within a span of about 50 years mainly due to reclamation of land. The areas of the existing ones have also changed significantly.

The present paper is an attempt to analyse the riverine conditions of the area and also to highlight the modifications caused by natural hydrological changes as well as by human interference which can provide a right direction for combating the problems of the area.

Keywords: moribund, contour, *bils*, *char*.

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Diversity, Impact and Management of Invasive Alien flora in Similipal Biosphere Reserve, Odisha, India

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ABSTRACT

Similipal Biosphere reserve (21° 28' N to 22° 08' N and 86° 05' E to 86° 45' E) covers an area of 5569 sq km and is situated in the heart of Mayurbhanj district of Odisha state in India. This reserve is one among the seven Biosphere Reserves of India that form a part of the world Network of Biosphere reserves. This area is a treasure house of 1076 species of plants belonging to 102 families. 96 species of orchids have also been identified here. It lies in the Eastern Highlands moist deciduous forests ecoregion, with tropical moist broadleaf forest and tropical moist deciduous forests with dry deciduous hill forest and high level Sal forests. The forest boasts of innumerable medicinal and aromatic plants, which provide a source of earnings for the tribal people. The taxa were considered at the taxonomic rank of species; infra specific taxa have been subsumed into their respective species. To identify the native ranges and invasion status of the species and compare the intensity of plant invasions in India with those of other countries of the world, we calculated the species density as D=N/log(A); where N is the total number of species at different stages of invasion (casual to invasive), and A is the area of the country (Rejmanek and Randall 1994). This study aims to investigate the diversity, ecological impact, and management strategies for invasive alien flora in Similipal Biosphere Reserve. The study will identify and document invasive plant species, assess their impact on native biodiversity, and evaluate effective management practices.

Keywords: Alien flora, Invasive species, Biodiversity, Ecological impact

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Biophysical Vulnerability Assessment of Wetlands

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ABSTRACT

Wetland management requires an understanding of the vulnerable ecological elements that are at risk to a particular event, their possible impact and the ability of current management practices to cope with the impacts or improvise management efforts needed to minimize the impacts. The understanding of the elements at risk due to a hazard, the probability of its occurrence and vulnerability assessment is an important element of wetland risk management. Ecosystem components and processes determine the ecosystem services provided by the wetlands and the social and livelihood systems dependent on those services implicitly subjects conditions on the ecological health of the wetland through a social decision making process. Assessing vulnerability of wetlands can therefore be decoupled into two interlinked components: viz biophysical vulnerability and social vulnerability. The biophysical vulnerability assessment focuses on ecological character description of the wetland and its changes over a period of time, whereas social vulnerability assessment focuses on the exposure of communities living in and around the wetland system to the impacts of hazards specifically climate related hazards.

This paper attempts to understand the biophysical vulnerability of wetland w.r.t the ecological character elements of Chilika Lake. The information from sensitivity and capacity assessment, along with information of trends in ecological character elements is used to draw a generic picture of wetland biophysical vulnerability. The prioritization process further uses a set of criterions to narrow the range of ecological character elements. Three sets of criteria were used: administrative/regulatory requirements, ecological and social. Based on the evaluation of ecological character, six ecological character elements, namely salinity, sea-lagoon connectivity, freshwater inflow, inundation regime, macro-invertebrate, and sea grass distribution have been identified as being in high-risk category. The authors conducted and contributed to this work as a part of IDRC funded project at Wetlands International South Asia, New Delhi.

Keywords: Biophysical vulnerability, Chilika Lake, ecosystem services

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Impact of Precipitation and Participation of Aerosol Regulating the Rainfall

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ABSTRACT

In coastal and semi-coastal belt aerosol precipitation is mostly influenced by natural and anthropogenic particles. These particulate matters mostly react with moisture, cloud, weather which in turn leads to a complex effect on rainfall. Coastal aerosol involves Sea Salt Aerosol (SSA) mineral dust aerosol, anthropogenic aerosol. Among these aerosols the suspended particulate matter leads to increase in cloud droplets and decrease the size of the droplet. Due to which the cloud becomes more reflective and decreases the effective formation of droplets that reduce the Rainfall. This effect is called TWOMEY effect and semi-direct effect. In the present paper, an attempt has been made to understand the semi-direct effect of aerosol particularly by absorbing the black carbon. When black carbon absorbs the solar radiation it heats the air and leads to evaporation of water droplets and forms a smoky haze. Thus, in the study attempt has been made to evaluate the mechanism of carbon black heat absorption and its implementation to reduce the rainfall. The result showed that carbon black being a fine particle has extensive effect on heat absorption and with a rise of temperature between 40^0C to 48^0 C, almost 28% of cloud gets evaporated. The studies have been carried out with the help of a smoke chamber placed at An NEERI Nagpur. The data has been collected and compiled.

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Identification of soil quality indicators in South-eastern Ghat agro-climatic zone of Koraput

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ABSTRACT

Assessment of soil quality is a holistic approach for supporting ecological stability and maintaining long term sustainability. The present study was undertaken to evaluate the physico-chemical and biological properties of surface soil (0-20 cm) collected from South-Eastern Ghat agro-climatic zone of Koraput district based on variation in topographical features (upland, midland and lowland) and vegetation types (forest, maize, millet, rice–fallow, rice–pulse, rice–vegetable, and rice–rice). The collected soil samples were analyzed for different soil properties to compute SQI with respect to soil organic carbon (SOC) stock. The soils of the region varied texturally from loamy sand to sandy loam, with uplands showing the highest sand content (up to 85.8 percent). The soils were acidic in reaction (pH 4.57–5.26) and exhibited low electrical conductivity, indicating minimal salinity. Lowland and midland soils possessed greater porosity and water-holding capacity than uplands. The SOC content ranged from 5.0 to 11.8 g C kg^{-1}, being highest in lowland rice and upland forest soils. The available nitrogen, phosphorus and potassium varied from 207 to 299 kg ha^{-1}, 15.9 to 39.5 kg ha^{-1}, and 195 to 346 kg ha^{-1} respectively. Enzymatic activities such as dehydrogenase and fluorescein diacetate were recorded to be highest in the upland forest ecosystem, indicating active microbial processes. Similarly, microbial biomass carbon and nitrogen were also greater in forest plantations, followed by rice–pulse (midland) and rice–rice (lowland) systems. The values of Soil Quality Index ranged from 3.70 to 4.40, with the highest in uplands (4.32) and lowest in rice-fallow systems (3.70). Among the land types, natural forests recorded the best SQI (4.40), confirming the importance of vegetation cover in maintaining soil quality. Out of 19 studied soil quality parameters, six were identified as key indicators: sand content, available nitrogen, available phosphorus, available sulfur, SOC, and DHA activity. Among these, sand content contributed the most (21%) and SOC the least (13.1%) to SQI

computation. Lowland rice cultivation and legume-based midland systems showed the greatest potential for improving soil quality in the hilly, tribal-dominated regions of Koraput.

Keywords: Soil Quality Index, Soil health, Sustainable land use, Key soil indicators, C sequestration

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Ecological and Socio-Economic Implications of Vanya (Tasar) Sericulture on Forest Conservation and Rural Livelihoods in Mayurbhanj and Sundargarh Districts of Odisha, India

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ABSTRACT

Tasar (vanya) sericulture, a non-mulberry silk production system based on *Antheraea mylitta* (Drury), represents a climate-resilient and forest-dependent enterprise that integrates ecological and socio-economic dimensions in eastern India. This study investigates the long-term environmental and livelihood impacts of tasar sericulture in Mayurbhanj and Sundargarh districts of Odisha, two major tasar-producing landscapes characterized by extensive deciduous forest cover and tribal populations. Secondary data were sourced from the Forest Survey of India (FSI, 1972–2023), Central Silk Board (CSB), Census of India, and NABARD livelihood reports, supplemented with household surveys conducted in tasar clusters between 2010 and 2023.

Analyses focused on forest cover change, rural-urban migration trends, women's income patterns, and ecological benefits of sericulture-based afforestation. Results reveal that forest cover in Mayurbhanj increased from 380.63 kha in 2000 to 390.12 kha in 2020, while Sundargarh experienced growth from 420.05 kha to 427.12 kha in the same period, indicating the role of sustainable sericulture plantations in maintaining canopy density. Tasar cocoon production rose by approximately 60% during 2005-2022, and women's income from cocoon marketing and yarn reeling increased by an average of 41%. Furthermore, the rural-urban migration rate declined by ~22% after the establishment of community sericulture clusters (2010–2020).

These findings demonstrate that tasar sericulture has significantly contributed to both forest conservation and rural economic upliftment, particularly among tribal women's self-help groups (SHGs). The practice supports ecosystem restoration, biodiversity maintenance, and socio-economic stability, making it a model for nature-based livelihood systems in semi-arid forest regions of India.

Keywords: Tasar silk; *Antheraea mylitta*; community forestry; forest regeneration; non-mulberry sericulture; sustainable livelihoods

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Removal of arsenic using immobilized amylase extracted from *Tinospora cordifolia*: Green Technology for clean water

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ABSTRACT

Arsenic has been identified as one of the most hazardous elements causing hyperpigmentation, skin lesions and cancer. The major source of arsenic is ground water and the Gangetic plains of West Bengal and Bangladesh is the worst affected area by arsenic pollution. Conventional technologies like membrane technology, complexation and chelating processes may be applied for removal of arsenic. However, the processes are expensive and may lead to further pollution of other chemicals. The present study uses amylase from *Tinospora cordifolia*, a plant widely available in Eastern India, for removal of arsenic. Amylase extracted from *Tinosopra* has been immobilized in calcium alginates. Being a sulfur-containing enzyme amylase from *Tinospora* has been reported to be inhibited by heavy metals. The metal-binding property was exploited to remove arsenic from water. Amylase was immobilized in calcium alginate. The immobilized enzyme was found to be inhibited by arsenic indicating the binding of arsenic(III). The optimum condition for inhibition, with respect to metal concentration, pH and incubation period, was determined by Response Surface Methodology. The major assumption was that the optimum inhibitory parameters will represent the best conditions for arsenic(III) binding and thus the best conditions for removal of arsenic(III). The optimum conditions for inhibition was found to be 4mM arsenic(III), 6.5 pH and incubation period 6 minutes. Quadratic model was suggested after ANOVA analysis for the process and an equation was obtained to predict the percentage removal. Design Expert Software was used for designing the experiments and statistical analysis. Arsenic removal was studied under this optimum condition by AAS which showed 94% removal. The percentage removal was close to the one obtained from the equation. This validates the model and suggests that the immobilized enzyme has the potential for removal of arsenic(III). The beads containing immobilized enzyme retained the metal removal ability at least for five cycles.

Keywords: arsenic, *Tinospora cordifolia*, Response Surface Methodology, optimization

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An assessment of Environmental challenges in the Attributes of Hot Water Spring, Atri, Odisha

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ABSTRACT

Hot springs are those places where the temperature of water lies significantly above the mean of annual temperature of that region. In this investigation, environmental challenges are in the form of physico-chemical properties such as total dissolved solid (TDS), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), alkalinity, hardness, chloride,sulphur, pH, temperature and bacteriological examination of hot spring water from Atri region in Odisha, India was studied.These findings were compared with WHO potability parameters. Highly variable dissolved oxygen (2.3–7.5 mgl^{-1}) and relatively higher values of nitrate ranging from 163 to 2573 μgl^{-1} noticed during the study period. The findings of this study revealed that the springs are predominantly hard water type as the water samples found were calcium-rich and exhibited higher total phosphorus and sulphur level owing to limestone lithology. The value for BOD was found to be 4.8 mg/lit According to WHO the value of BOD should not exceed 30 mg/lit. The experimental values for COD and alkalinity were found to be 2.7mg/lit and 196mg/lit which seems to be lesser than WHO standard.

Keywords: Hot spring, physicochemical analysis, sulphur, DO

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Variations in physicochemical parameters of wastewater from different sources in Odisha and their environmental impact

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ABSTRACT

Water pollution from domestic, industrial, and agricultural wastewater has become a growing concern in Odisha, posing significant risks to environmental and public health. This study evaluated the physicochemical characteristics of wastewater collected from nine locations across three districts of western Odisha. Industrial wastewater samples were obtained from the ACC Cement Factory (Bargarh), Shyam Metal Factory (Sambalpur), and Vedanta Factory (Jharsuguda). Domestic wastewater samples were collected from Rajendrapada (Balangir), Balasinga (Boudh), and Gujarati Colony (Sambalpur), while agricultural wastewater was sampled from rice fields in Debaipali (Sambalpur), groundnut fields in Rengalbahal (Deogarh), and sugarcane fields in Attabira (Bargarh). Physicochemical analyses included pH, color, turbidity, total dissolved solids (TDS), total suspended solids (TSS), alkalinity, hardness, and ionic composition (calcium, chloride, fluoride, nitrite, sodium, and potassium). Results indicated that industrial effluents, particularly from the ACC Cement Factory, exhibited elevated pH and fluoride levels but low ammonia content. Domestic wastewater, especially from Rajendrapada, showed highly acidic pH and high concentrations of ammonia and fluoride. Agricultural wastewater displayed moderate pH, fluoride, and ammonia levels, with rice field samples showing the greatest contamination. The observed variations across sites highlight the urgent need for region-specific wastewater management strategies and advanced treatment technologies to mitigate the escalating environmental and health impacts in Odisha's semi-urban and rural landscapes.

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Ecological Assessment of Spider Diversity in Aquatic and Residential Areas in Cuttack, Odisha

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ABSTRACT

The present study was undertaken to evaluate the diversity, distribution, and ecological significance of spiders in selected habitats. Spiders, belonging to the order Araneae, are important bioindicators and biological control agents that maintain ecological balance by regulating insect populations. Despite their ecological importance, very limited studies have been conducted on spider fauna in Odisha, particularly in Cuttack district. The investigation was carried out between January and March 2025 in two contrasting habitats: the aquatic site (Naraj, Mahanadi River View) and the residential site (Jobra, Ravenshaw University Campus). Sampling was conducted using multiple standard methods such as active visual search, vegetation beating, net sweeping, hand picking, and pitfall trapping. Collected specimens were preserved in 70% ethanol and examined under a stereo zoom microscope for taxonomic identification using standard keys.

A total of 34 genera belonging to 15 families were recorded during the study. The dominant families included Salticidae (jumping spiders), Lycosidae (wolf spiders), and Araneidae (orb weavers), which were widely distributed across both habitats. Habitat-specific differences in species composition and abundance were noted, reflecting the influence of vegetation structure, humidity, and prey availability on spider assemblages. Spiders were categorized into distinct ecological guilds such as orb weavers, ambushers, stalkers, ground runners, and space-web builders based on their foraging strategies and web architecture. The diversity index revealed that the aquatic habitat supported a higher number of orb weavers and sheet-web builders due to its dense vegetation and high moisture, whereas the residential habitat favored ground runners and ambushers adapted to open and disturbed conditions. The findings emphasize that environmental heterogeneity plays a key role in shaping spider communities. This study provides the first comprehensive baseline data on spider diversity from Cuttack district, Odisha. It highlights the ecological significance of spiders as potential indicators of habitat quality and environmental health. Further long-term studies are recommended to monitor seasonal variations and the impact of anthropogenic activities on spider populations, contributing to biodiversity conservation and sustainable ecosystem management in the region.

Keywords: Spider diversity, Odisha, Araneae, Orb weavers, Biodiversity conservation

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Potentially toxic elements accumulation in soil-vegetable system in an agri-intensive region of Punjab, India: Screening human health risks and source of contamination

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ABSTRACT

Potentially toxic elements (PTEs) accumulation in agricultural soils and vegetable crops poses a significant threat to global food safety and public health worldwide. This issue is relevant in the Malwa region of Punjab, India, due to intensive agricultural activities and use of contaminated groundwater for irrigation purpose. However, little is known about the metal accumulation in different vegetable crops and corresponding cultivated soils in this region. To address this gap, this study is aimed to conduct an inventory of heavy metal accumulation in 12 vegetable species (including both edible and non-edible parts) and their corresponding root-zone soils from various sites of the Bathinda and Mansa districts of Punjab. The results showed that the soils were mostly slightly alkaline and not saline in nature. The contents of PTEs were significantly higher ($p < 0.05$) in cultivated soils than in undisturbed soils, with notably higher levels in soils which previously used for rice cultivation. In cultivated soils, the average concentrations of As, Cd, Pb, Mn, Fe, Cr were 1.49 mg/kg, 0.31 mg/kg, 7.84 mg/kg, 219.78 mg/kg, 10188.65

mg/kg, 21.44 mg/kg, respectively. However, when compared to the regional studies and reference values of World and Indian background soils, PTE levels in cultivated soils remained within the limits, indicating no significant enrichment. Contamination indices revealed low to moderate level of contamination in the cultivated soils, except Pb, which showed moderate to very high level of pollution. Fertilizer analysis revealed that this contamination could be due to overuse of chemical fertilizers especially phosphate fertilizers, which enriched with U, Cd, Pb and other metals. Irrigation waters (both canal and groundwater) exhibited lower levels of metal contents, which were mostly below the FAO/WHO Irrigation water quality permissible limit, which indicates that the role of irrigation waters in PTEs accumulation tends to appear minimal, except U. Uranium enriched groundwater can be linked along with P fertilizers for higher U content in cultivated soils, although it doesn't have any strong impact on U contamination in cultivated lands. The PCA analysis and strong correlation ($p < 0.01$) between Fe-Mn and Zn-Cr-Ni-Pb-Cd-U suggest that secondary Fe/Mn oxyhydroxides play a major role in adsorbing these elements in soils. The metal accumulation shows wide variation among different vegetable crops with higher levels of Cd, Pb, Cu, Zn, and Cr into leafy parts, whereas U and Ni comparatively accumulated in root parts. Cd, Zn and Cu had higher mobility in leafy and root vegetables. Although, leafy vegetables had shown higher bioconcentration factor (BCF) for most of the metals, metal accumulation is a function of soil metal content and mobility of the metal in plant and soil. This way, Fe, Al, Mn, Zn, Cu had shown higher accumulations in edible part of the vegetable while Pb, Cd and U had lower accumulations in edible part of vegetables. Within the edible part, significant but weak/ moderate correlations were detected between Cd and Pb, and between Cu and Zn, signifying their common translocation pathways in plant. When compared with the maximum permissible limits set by the WHO/FAO (2011), a considerable number of vegetable samples (especially those of spinach, coriander, radish leaf, fenugreek, beetroot etc.) surpassed the threshold limit for Pb, Cd, Cr and Ni). However, health risk indices such as, average daily intake (ADI), and health risk index (HQ), and hazard index (HI) were calculated to study the health risks upon consumption of the metal contaminated vegetables in the region. Upon calculations, hazard indices were recorded higher for spinach, beetroot, fenugreek and mustard, while they were lower for potato, cauliflower and cabbage. However, HQ and HI values for adults and children were below 1, indicating no serious health concern to the population.

Keywords: Potentially toxic elements, Vegetables, Malwa belt, Punjab, Groundwater contamination.

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Forest Conservation or Eviction Game? Empirical Evidence from Southern Junglemahal

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ABSTRACT

Forest conservation policies in India have increasingly revealed a tension between ecological protection and the livelihood rights of forest-dependent communities. This study critically investigates how state-driven conservation initiatives often translate into mechanisms of exclusion and displacement. Drawing on field surveys, interviews, and policy analysis conducted across selected forest villages in Southern Jungle Mahal, West Bengal, the research explores the socio-political dimensions of conservation governance and its implications for indigenous communities. Findings indicate that state interventions under programs such as Joint Forest Management (JFM) and Forest Rights Act (2006) have limited community access to non-timber forest products (NTFPs) and traditional forest spaces. These measures, legitimized as environmental restoration, frequently manifest as "green evictions," where forest conservation becomes intertwined with territorial control and bureaucratic dominance. Monoculture plantations, especially of *Shorea robusta* (sal), have further eroded ecological diversity and disrupted the subsistence economy of different tribal groups. The study argues that forest conservation in Southern Jungle Mahal reflects a broader "eviction game" perpetuated by the state apparatus, where governance, legality, and development narratives converge to marginalize local populations. It calls for a shift toward inclusive forest governance that recognizes customary rights, community participation, and indigenous ecological knowledge as essential pillars of sustainable conservation.

Keywords: Forest governance; Eviction; Non-timber forest products; State apparatus; Forest Rights Act

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Ramie (*Boehmeria nivea*): Sustainable cultivation, product development and waste valorisation

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ABSTRACT

Ramie (*Boehmeria nivea*) is an important fiber plant in the natural textile market due to its excellent fiber quality. Ramie cultivation is limited to some regions in India, and the majority of the fiber and yarn used in India is imported from China. It is a rapidly growing plant that requires adequate fertilization. This study reports a sustainable Ramie cultivation with a combination of 50% chemical fertilizer (NPK) and 50% bacterial biofertilizer (Indian Patent 347939) with approximately 1.2-3-fold enhancement in fiber yield as compared to chemical fertilizer. Less leaching of nutrients with enhanced yield makes it suitable for adoption in real-time application. The decorticated waste (with self-adhering property) after fiber extraction was found to be suitable for briquette formation with 18.62 MJ/Kg calorific value, that was higher than bamboo (17.84 MJ/Kg) and firewood (18.25 MJ/Kg). The decorticated waste showed 97.9% biological efficiency during *Pleurotus ostreatus* cultivation with maintained nutritional quality, hence edibility. Processing of these fibers need degumming for being spinnable. The gum in-turn could be used in 25% concentration for bacterial growth enhancement with diluted Luria Bertini Broth for extracellular cellulase, pectinase and amylase producing bacteria. A biochemical process (Indian Patent 474317) and a water retting based approached gave spinnable fibers with different strength that could be directly used for weaving. Hence, the production of Ramie fiber could be enhanced in non-agricultural lands, entire waste could be valorised to different products, and the fiber could be processed based on downstream application for various product development, ensuring a zero-waste cultivation of Ramie. So, this paper reports environmental protection through process optimization from cultivation to end-product valorization through eco-friendly product development.

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POSTER

Variations in Physicochemical Parameters of Wastewater from Different Sources in Odisha and their Environmental Impact

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ABSTRACT

Water pollution from domestic, industrial, and agricultural wastewater has become a growing concern in Odisha, posing significant risks to environmental and public health. This study evaluated the physicochemical characteristics of wastewater collected from nine locations across three districts of western Odisha. Industrial wastewater samples were obtained from the ACC Cement Factory (Bargarh), Shyam Metal Factory (Sambalpur), and Vedanta Factory (Jharsuguda). Domestic wastewater samples were collected from Rajendrapada (Balangir), Balasinga (Boudh), and Gujarati Colony (Sambalpur), while agricultural wastewater was sampled from rice fields in Debaipali (Sambalpur), groundnut fields in Rengalbahal (Deogarh), and sugarcane fields in Attabira (Bargarh). Physicochemical analyses included pH, color, turbidity, total dissolved solids (TDS), total suspended solids (TSS), alkalinity, hardness, and ionic composition (calcium, chloride, fluoride, nitrite, sodium, and potassium). Results indicated that industrial effluents, particularly from the ACC Cement Factory, exhibited elevated pH and fluoride levels but low ammonia content. Domestic wastewater, especially from Rajendrapada, showed highly acidic pH and high concentrations of ammonia and fluoride. Agricultural wastewater displayed moderate pH, fluoride, and ammonia levels, with rice field samples showing the greatest contamination. The observed variations across sites highlight the urgent need for region-specific wastewater management strategies and advanced treatment technologies to mitigate the escalating environmental and health impacts in Odisha's semi-urban and rural landscapes.

Keywords: Wastewater contamination, Physicochemical analysis, Odisha (Western districts), Industrial, domestic, agricultural sources, Water quality parameters.

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Climate-Smart Agriculture: Integrating Innovation and Traditional Wisdom for Sustainable Food Systems

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ABSTRACT

Climate change has emerged as one of the greatest threats to global food security, with unpredictable rainfall, soil degradation, and rising temperatures affecting agricultural productivity. Climate-smart agriculture (CSA) offers a holistic framework to address these challenges by enhancing crop resilience, improving resource efficiency, and reducing greenhouse gas emissions. Integrating modern technologies—such as precision irrigation, biofertilizers, and renewable energy—with indigenous farming knowledge can revolutionize food systems to become both adaptive and sustainable. This approach emphasizes three core goals: increased productivity, enhanced resilience, and reduced environmental impact. Practices like crop diversification, conservation tillage, and agroforestry restore soil health and sequester carbon, while sustainable water management ensures long-term ecosystem balance. Moreover, empowering farmers through community-based adaptation and technology-driven decision-making strengthens rural livelihoods and promotes environmental stewardship. By bridging science and tradition, climate-smart agriculture aligns directly with the United Nations Sustainable Development Goals, particularly zero hunger, climate action, and responsible consumption. It redefines farming as not only a source of sustenance but also a key solution to the climate crisis. Through innovative yet nature-respecting practices, CSA paves the path toward a greener, food-secure, and climate-resilient future.

Keywords: Climate-smart agriculture, Sustainability, Crop resilience, Agroforestry, Food security, Climate action.

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Impact of different fertilization regimes on the phytochemical profile of Lemongrass (*Cymbopogon citratus*) essential oil: An *In Silico* Study

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ABSTRACT

Lemongrass (*Cymbopogon citratus*) is an aromatic plant valued for its essential oil with diverse medicinal and industrial applications. This study investigates the impact of different fertilization regimes on the phytochemical composition of lemongrass essential oil, along with *in silico* molecular docking to assess potential bioactivities. A 1:1 combination of two microbial consortia, NB1 and BN7, were applied as biofertilizer alongside conventional nitrogen (N), phosphorus (P), and potassium (K) fertilization. The experiment was conducted at Tripura University, India, under subtropical field conditions. After three months of cultivation, statistical analysis using an F-test followed by a t-test showed a significant increase in biomass yield under bacterial biofertilizer treatment as compared to chemical fertilization. Essential oils were extracted through hydro-distillation and indigenous steam distillation methods, followed by GC-MS analysis of the volatile oil components. The analysis revealed 40 compounds in the control (without fertilizer), 43 in the nitrate broth treatment, and 41 each in the chemical fertilizer, bacterial biofertilizer, and liquid bacterial biofertilizer treatments. Seventeen compounds were common across all treatments, while the presence of unique compounds in specific treatments emphasized the effect of fertilization on oil composition. Neral (38.47%) was most abundant in the liquid bacterial biofertilizer treatment, whereas geranyl acetate (17.75%) and isogeranial (1.48%) were dominant in the bacterial biofertilizer treatment. *In silico* molecular docking revealed that succinic acid, di(geranyl) ester (-5.3 kcal/mol) from the bacterial biofertilizer treated sample exhibited strong affinity toward Vascular Endothelial Growth Factor (VEGF), suggesting anti-angiogenic potential. Additionally, in the liquid bacterial biofertilizer treatment, germacrene B, showed strong binding to DNA gyrase ß (-6.52 kcal/mol) and α-sterol demethylase (-7.2 kcal/mol), indicating possible

antimicrobial and antifungal activities. These findings showed that different fertilization regimes influence not only the yield of lemongrass but also the composition and biological potential of its essential oil. The use of bacterial biofertilizers provides an ecofriendly and sustainable approach to enhance productivity and oil quality. Overall, this study highlights the importance of biofertilizers in promoting sustainable agriculture that supports environmental conservation and human well being, in alignment with the Sustainable Development Goals (SDGs).

Keywords: *Cymbopogon citratus*, Fertilization, Essential oil, GC-MS, *In silico*, Phytochemical, Biofertilizer, Sustainable agriculture, SDGs.

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Eco friendly Liquid Fertilizers from Dal Lake Macrophytes: A Dual Assessment of Quality and Bioefficacy

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ABSTRACT

This study investigates the nutrient composition and bio efficacy of fermented liquid fertilizers (FLFs) derived from aquatic macrophytes collected from Dal Lake, a eutrophic water body in Srinagar. The objective was to quantify nutrient content and evaluate the effects of these FLFs on seed germination and early seedling growth of *Brassica oleracea var.virdis* (Collard Greens) and *Raphanus sativus*(Scarlet Globe Radish), thereby assessing any phytotoxic or growth promoting responses.

Nine FLFs were prepared via lactobacilli driven fermentation of macrophyte biomass collected from nine representative sites around Dal/ Lake. Each sample was analyzed for physicochemical properties, macro and micronutrient profiles, heavy metal concentrations, and phytohormonal content. The resulting pH values ranged from 6.45 to 7.8, electrical conductivity (EC) from 9.124 to 20.626 dSm, nitrate (NO_3^{-1}) from 65 to 550 mg/L, potassium (K^+)from190 to 520 mg/L, and phosphate (PO_4^{3-})from 22 to 110 mg/L. Secondary macronutrients included calcium (Ca^{2+})103–406.6mg/L, magnesium (Mg^{2+})37.6–109.4 mg/L, and sulphate (SO_4^{2-}) 6.4–

47.6 mg/L. Key micronutrients such as iron (Fe)0.21–0.59mg/L, zinc (Zn) 0.37–2.8mg/L and chloride(Cl^{-1})297.8–675mg/L, remained within agronomically acceptable limits, whereas heavy metals such as chromium (Cr)(1.37–7.64mg/L) and cadmium(Cd)(0.04–0.18mg/L) were present in trace concentrations below phytotoxic thresholds. The indole acetic acid (IAA) levels ranged from 10.28 to 42.8 mg/L, confirming microbial synthesis of growth promoting hormones during fermentation.

Seed vigor index (SVI) analysis demonstrated enhanced germination and seedling development compared to control: *B.oleracea* showed SVI values between 97.04 and 196.15% at a 1:20 dilution, while *R.sativus* achieved even higher values (126.94 – 293.05 % at 1:10 dilution).

These results show that fermented liquid fertilizers derived from Dal Lake macrophytes serve as nutrient rich, eco friendly soil amendments. They promote seed germination and early plant growth while providing a sustainable management route for excess lake biomass that contributes to the Dal’s eutrophication.

Keywords: Biomass; Macrophyte; Dal Lake; Fermentation; Fermented Liquid Fertilizer.

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Impact of Extreme Climatic Condition on Soil Fertility Puri: A Case Study

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ABSTRACT

Extreme climatic condition influences the soil fertility extensively which can be analyzed with the help of various soil analysis and related estimation. Puri being a coastal zone is highly influenced with saline aerosol, humid condition and extreme climatic incident like cyclone, super cyclone, depression & low pressure. These in due course impact on the soil fertility by capping the proper soil mechanism. It is mostly being seen that anionic aerosol influences the soil parameters such as magnesium, potassium, manganese, titanium, calcium. In the present study a quarterly analysis has been carried out of the soil sample of the year 2023-2025. The data obtained revealed that coastal aerosol mostly influence Potassium, Titanium & Magnesium with least impact on Calcium and Manganese. The insulated property of Manganese attributed to its diversified oxidation number and that of calcium is due to its stability. The data are incorporated resulting the conclusion that (a) extreme climatic condition has drastic influence on weather pattern (b) soil fertility loss (c) variation crop pattern and overall atmospheric condition.

Keywords: Soil Fertility; Extreme Climatic Condition; Soil Parameters.

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Study of Physico-Chemical Parameters in a Selected Stretch of the River Mahanadi in Odisha

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ABSTRACT

The Mahanadi River, the largest river in Odisha, traverses approximately 851 km through the state before discharging into the Bay of Bengal. The present study assessed the physico-chemical characteristics of the river water from August 2022 to September 2024 across four seasons—monsoon, post-monsoon, winter, and pre-monsoon—to evaluate its suitability for domestic, agricultural, and ecological purposes. Water samples were collected from seven locations: Hirakud (R1), Satakosia (R2), Kantilo (R3), Banki (R4), Cuttack (R5), Kendrapara (R6), and Jagatsinghpur (R7).
A total of twelve key physico-chemical parameters were analysed, i.e water temperature, turbidity, pH, electrical conductivity, total dissolved solids, dissolved oxygen, biological oxygen demand, chemical oxygen demand, total hardness and total alkalinity.

The seasonal variations indicated higher turbidity and COD during the monsoon due to runoff and suspended sediments, while DO and pH were relatively higher during winter, reflecting enhanced aeration and lower biological activity. Spatially, upstream sites (R1–R3) showed better water quality compared to downstream stations (R6–R7), which exhibited higher TDS and BOD levels, indicating moderate organic pollution from urban and agricultural inputs.

Overall, the Water Quality Index (WQI) ranged from 65.4 to 78.2, signifying good to moderately polluted conditions. The results suggest that while the Mahanadi River water remains largely suitable for irrigation and general domestic use after treatment, localised anthropogenic pressures in downstream stretches require effective management and continuous monitoring to sustain river health.

Keywords: Physico-chemical parameters,

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Scenedesmus obliquus as a Multi-Product Platform for Sustainable Biorefinery in Odisha: An Integrated Low-Cost Approach

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ABSTRACT

Microalgae are revolutionising renewable energy and bioproducts, with *Scenedesmus obliquus* emerging as a powerful yet underutilised green alga capable of producing biofuels, proteins, carbohydrates, and bioactive compounds in one integrated system. This study presents an innovative, low-cost biorefinery model that exploits the abundant municipal wastewater and industrial CO, available in Odisha, reducing input costs and driving a circular bioeconomy. By cultivating *S. obliquus* under optimised mixotrophic and nutrient-stress conditions, we achieved high-value biomass rich in lipids (25–40%), proteins (~50%), and carbohydrates (20–30%)—ideal for multi-product recovery.

Our process converts lipids to biodiesel via energy-efficient in-situ transesterification, cutting solvent use and operational costs by around 40%. The lipid-extracted biomass undergoes fractionation to yield nutraceutical-grade protein hydrolysates and ethanol-extracted pigments, including lutein and â-carotene. Carbohydrates are utilised for bioethanol fermentation or bioplastic production, while residual biomass serves as biofertilizer, enabling a zero-waste cascade. Economic assessment highlights that co-product recovery boosts profitability by over 50% compared to single-product biodiesel routes, with cost savings amplified by Odisha's tropical climate, solar drying, bioflocculant harvesting, and CO, recycling in open raceway ponds.

Beyond bioenergy, *S. obliquus* demonstrates pronounced bioactive properties: protein hydrolysates exhibit potent antioxidant and antiviral activities, and ethanol extracts rich in phenolics show strong antioxidant potential. This integrated biorefinery not only advances sustainable biofuel production but also paves the way for pharmaceuticals and nutraceuticals, positioning *S. obliquus* as a versatile platform for regional bioindustry growth and environmental sustainability.

Keywords: *Scenedesmus obliquus*, microalgae biorefinery, biodiesel, wastewater utilisation, CO, recycling, nutraceuticals, circular bioeconomy, Odisha.

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Effect of gibberlic acid on germination and growth of cape gooseberry under Odisha condition

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ABSTRACT

The global agricultural focus is increasingly shifting toward underutilized crops like the cape gooseberry (*Physalis peruviana* L.) due to their potential to enhance dietary diversity, bolster nutritional security, and improve climate resilience in local farming systems, especially in regions like Odisha. Despite its high vitamin C, carotenoid, and antioxidant content, cape gooseberry cultivation is often limited by the poor and erratic germination of its seeds, primarily due to physiological dormancy. This study investigated the effectiveness of pre-sowing seed treatment with the phytohormone gibberellic acid (GA_3) to overcome this barrier. GA_3 is known to play a crucial role in seed physiology by breaking dormancy, initiating the synthesis of hydrolytic enzymes (like alpha-amylase), and thus mobilizing stored endosperm reserves necessary for embryo growth and radicle emergence. Various concentrations of GA_3 (e.g. 100 and 200 ppm) against an untreated control was studied under the climatic condition of Odisha. The results demonstrated a significant positive impact of GA_3 on germination metrics. The optimal GA_3 concentration (200 ppm) resulted in the highest germination percentage (up to 85% compared to 40% in control) and the lowest mean germination time (MGT). Furthermore, the GA_3 treatment significantly promoted early vegetative development by enhancing cell elongation and division, leading to increased shoot length, number of leaves, and a higher leaf width. These findings underscore the importance of promoting underutilized, nutritious crops and provide an efficient, low-cost strategy using GA_3 to optimize seed establishment and unlock the full potential of cape gooseberry cultivation for improving local food systems and farmer income in Odisha.

Keywords: Cape gooseberry, Climate, Gibberellic acid, Odisha.

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Appraisal of soil fertility status of different rice-based cropping systems in Bargarh district of Odisha

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ABSTRACT

Rice-based cropping systems are the foundation of national food security in India. However, their long-term sustainability is increasingly threatened by continuous monocropping, unbalanced fertilizer use, and poor soil and land management, leading to declining soil quality. The present study was conducted to assess the soil fertility status of different rice-based cropping systems in Bargarh district of Odisha. The experiment comprised 12 treatment combinations, involving four cropping systems—rice–rice (RR), rice–mungbean (RM), rice–fallow (RF), and fallow (F) evaluated at three soil depths (0–15 cm, 15–30 cm, and 30–45 cm). The collected soil samples were analysed for different physical and chemical properties.

Results showed that soil pH ranged from 5.00 to 7.04 with a mean of 5.60. The Organic carbon status was found to be high varying between 0.08 to 1.17 percent. The results indicated low status of available N and K (249.7 and 174 kg ha^{-1}, respectively) while available phosphorus status was found to be high (75.19 kg ha^{-1}). Considerable variation was observed among the cropping systems. The rice–mung bean system recorded the highest nutrient availability, followed by rice–fallow and rice–rice system. The fallow system showed moderate to low nutrient levels.

Organic carbon status was high in fallow plots (0.67 percent) closely followed by rice–rice (0.66 percent), rice–mungbean (0.59 percent) while least value was observed in rice–fallow (0.54 percent).

Data revealed that cropping systems significantly influenced soil fertility status. Diversification of rice-based system with mung bean improved nutrient availability whereas, organic carbon status tended to be lower in more intensively cropped systems. Continuous rice monocropping depleted both nutrient reserves and soil organic matter. Therefore, cropping system intensification with legumes can be considered as an important approach to enhance soil nutrient health and ensure long-term sustainability of rice-based systems.

Keywords: Soil fertility, Rice-based cropping system, Crop diversification, Sustainability.

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Analysis of *In vitro* Leaf Essential Oil of *Curcuma caesia*from Eastern India

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ABSTRACT

Curcuma caesia Roxb. is an important medicinal plant belonging to the family Zingiberaceae. The plant leaf oil are used in the treatment of skin infection, asthma, health tonic, digestion, wound healing and many more. The *in vitro* micropropagation method has been developed to establish *Curcuma caesia* plantlets using Murashige and Skoog basal media. Among all the combinations tried, BA (3mg/l) and IAA (1 mg/l) were chosen as the best media for shoot multiplication followed by rooting. The regenerated plants showed 90 % survivality in the field condition. Further essential oil from micropropagated leaf was extracted using hydro distillation method and its chemical constituents were identified using Gas Chromatography-High Resolution Mass Spectrometry method. A total of thirty compounds were identified in which Bornyl acetate was found to be the major compound (13.81 %) followed by Isoborneol (7.72 %), â-Pinene (7.37 %), Eucalyptol (6.94 %), Camphor (5.65 %), Terpene-4-ol (5.35 %), Camphene (5.07 %) and â-Carotene (3.98 %) respectively. Also the ethanol leaf extracts showed the presence of alkaloids, flavonoids, phenolics, terpenoids, carbohydrates, tannins and resins using phytochemical screening test. Hence this could contribute to the development of natural therapeutic agent and large-scale mass propagation of *Curcuma caesia* for commercialization.

Keywords: *Curcuma caesia,* micropropagation, GC-HRMS, Phytochemical screening.

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Spatio-temporal Analysis of Land Use and Land Cover Changes and Forest Dynamics in the Midnapore Forest Division, West Bengal, India

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ABSTRACT

This work offers a detailed spatio-temporal analysis of Land Use and Land Cover changes and dynamics of the forest cover within the territory of Midnapore Forest Division located in West Bengal, India. Data provided by multi-temporal Landsat satellite images and further supervised Maximum Likelihood Classification was used to quantify land cover change in the period of 2000-2020. Interesting patterns of landscape complexity with the predominance of agricultural land cover and more than quadrupled settlements were revealed. Dense forest cover, overall added by growth, demonstrated significant spatial variability in each of the forest ranges. Some of them revealed deforestation due to different economic land use pressures, while others demonstrated a net growth related to participatory conservation-oriented interventions. Scrub vegetation showed the dynamics of land degradation by increasing first and then sharply declining. These two periods of growth were interpreted as the initial phases of land use transformation. The classification assessment verified the reliability of the classification for 2000 and 2010 and demonstrated the lowest accuracy for 2020 due to its increased land use complexity. These results indicated the interactions between anthropogenic pressures, conservation policy, and ecological processes in shaping the forest ecosystem in this area. The study suggests that continuous remote sensing monitoring is needed to support adaptive forest management and sustainable land use in ecologically sensitive areas.

Keywords: Spatio temporal analysis, Land use and land cover change, Forest dynamics, Midnapore Forest Division.

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Forest Conservation or Eviction Game? Empirical Evidence from Southern Junglemahal

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ABSTRACT

Forest conservation policies in India have increasingly revealed a tension between ecological protection and the livelihood rights of forest-dependent communities. This study critically investigates how state-driven conservation initiatives often translate into mechanisms of exclusion and displacement. Drawing on field surveys, interviews, and policy analysis conducted across selected forest villages in Southern Jungle Mahal, West Bengal, the research explores the socio-political dimensions of conservation governance and its implications for indigenous communities. Findings indicate that state interventions under programs such as Joint Forest Management (JFM) and Forest Rights Act (2006) have limited community access to non-timber forest products (NTFPs) and traditional forest spaces. These measures, legitimized as environmental restoration, frequently manifest as "green evictions," where forest conservation becomes intertwined with territorial control and bureaucratic dominance. Monoculture plantations, especially of *Shorea robusta* (sal), have further eroded ecological diversity and disrupted the subsistence economy of different tribal groups. The study argues that forest conservation in Southern Jungle Mahal reflects a broader "eviction game" perpetuated by the state apparatus, where governance, legality, and development narratives converge to marginalize local populations. It calls for a shift toward inclusive forest governance that recognizes customary rights, community participation, and indigenous ecological knowledge as essential pillars of sustainable conservation.

Keywords: Forest governance; Eviction; Non-timber forest products; Forest Rights Act.

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Sustainability of Submergence in response to NSi and SA in Black rice after desubmergence

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ABSTRACT

Submergence stress is a critical environmental challenge for rice cultivation, particularly in flood-prone regions like Odisha, where excessive monsoon and non-monsoon rains can cause prolonged flooding beyond the crop's tolerance limits, resulting in severely reduced yields and crop failure. A pot experiment was conducted to assess the adaptation capability of two indigenous, nutritious black rice landraces—Chakhao and Kalabiroin—against the known stress-tolerant check, Swarna sub-1. Plants at the active tillering stage (42 DAS) were subjected to 12 days of complete submergence. The primary objective was to investigate the stress effects and their mitigation through foliar application (NSi @1mM and SA @100ppm) administered seven days after de-submergence. Physiological and biochemical performance was evaluated at 1 and 14 days of re-aeration. Stress control plants exhibited a decrease in Total Soluble Carbohydrates (TSC %) and protein content compared to normal controls across both aeration periods, though the tolerant check showed a lesser decline. Foliar application of NSi @1mM increased TSC %, while SA @100ppm increased protein content over the stress control. Physiologically, SA @100ppm induced more plant height under stress, with the minimum increment noted in Swarna sub-1. Tiller regeneration was not significantly different among the three varieties. SA @100ppm also induced maximum dry matter and proline content at 1 day of aeration compared to NSi @1mM. Swarna sub-1's tolerance was marked by decreased chlorophyll degradation and the accumulation of carotenoid. Total Chlorophyll Content varied by variety and mitigant: NSi @1mM resulted in higher Chlorophyll in Chakhao (3.509 & 4.073 mg g^{-1}) and Kalabiroin (2.701 & 3.454 mg g^{-1}) at 1- and 14-days re-aeration, respectively, while SA @100ppm showed the highest Chlorophyll content in Swarna sub-1 (4.561 & 5.308 mg g^{-1}). Furthermore, a significant accumulation of the non-enzymatic antioxidant proline (1.83 mg g^{-1}) was observed over the control condition. Notably, both black rice varieties produced more proline after 14 days of re-aeration than Swarna

sub-1. Overall, both NSi and SA were effective in alleviating submergence stress, but SA was more inductive than NSi, which was also reflected in the final yield. Plant$^{-1.}$ The black rice landraces, Chakhao and Kalabiroin, demonstrated recovery capabilities on par with Swarna sub-1 under the mitigating effect of NSi and SA. Farmers may therefore rely on these traditional landraces in flood-prone areas for better survival, supported by post-submergence foliar application.

Keywords: Black rice landrace, Complete submergence, Foliar application, NSi, re-aeration, TSC.

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Topographic species–habitat associations of tree species in a lowland dipterocarp forest of Western Ghats, India

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ABSTRACT

Lowland dipterocarp forests of the Western Ghats exhibit high biodiversity, structural complexity, and substantial carbon content. However, these forests face severe threats from human activities, such as deforestation and land degradation. These threats result in biodiversity loss and alter the forests' role in the global carbon cycle. We established a 9.9 ha permanent plot in the lowland dipterocarp forest at Uppangala, Pushpagiri Wildlife Sanctuary, India. All trees with a diameter at breast height (DBH) of 1 cm or more were inventoried, following the standards of the Centre for Tropical Forest Science protocols. Previous research has shown that both taxonomic and functional community composition are influenced by topographic variability, acting as a form of environmental filtering in Uppangala. Topography shapes local conditions, including soil moisture, nutrient levels, and sunlight intensity. These factors then determine species composition and trait patterns in the tropics. Based on topographic characteristics, we defined five habitat categories in Uppangala. In this work, we aimed to examine differences among habitat types to determine if tree species show species–habitat associations at various life stages. We tested the results with a torus-translation test and Nonmetric Multidimensional Scaling (NMDS) for 78 species and 145 species, respectively. We considered two life stages—young and mature—of tree species that were positively associated with topography. NMDS identified considerable variation in vegetation composition between topographic habitats (ANOSIM, $R = 0.1132$, $p = .001$). We also found that topographic features (elevation and convexity) were significantly correlated with species composition in the plot (Elevation: $F = 6.36$, $p = .001$; Convexity: $F = 1.9$, $p = .027$; Elevation × Convexity: $F = 1.69$, $p = .07$). Of the 78 species subjected to the torus-translation test, 19 had strong positive and 14 had strong negative associations with one or more of the five habitats. Positive associations occurred more often in low slope habitats; negative associations were more frequent in valley habitats. This suggests that edaphic and hydrological variation related to topography plays important roles in habitat partitioning in lowland dipterocarp forests of the Western Ghats, India. The two most dominant species, *Dipterocarpus indicus* and *Vateria indica*, showed strong positive associations with high gully and valley habitats, respectively, when considering all individuals. At the adult life stage, both showed a strong affinity for ridge habitat. Additionally, mature *Vateria indica* showed a strong negative association with high gully habitat. We conclude that environmental filtering is important in maintaining the diversity of this heterogeneous species-rich, lowland dipterocarp forest. However, variation within habitats was greater than between habitats, suggesting that environmental filtering alone does not determine species composition in these forests.

Keywords: Torus-translation test, Uppangala permanent plot, Environmental filtering, Nonmetric multidimensional scaling.

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SPATIO-TEMPORAL ANALISIS OF AIR QUALITY DURING DIWLI IN BHUBANESWAR: A THREE-YEAR COMPARATIVE STUDY (2023-2025)

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ABSTRACT

Air pollution has become one of the most critical environmental affecting the urban population of India. The celebration of Diwali in India is closely related with a extensive use of firecrackers, which result in short term but considerable reduction of ambient air quality. The burning of firecrackers not only affects the human respiratory system but also releases fine particulate matter, gaseous pollutants and heavy metals into the atmosphere which has a major role in decoration of the air quality. The study is based on the variation in air pollutants for three consecutive years (2023,2024 & 2025) of pre-Diwali, Diwali, post-Diwali in Bhubaneswar, which is the capital of Odisha, a rapidly urbanizing city with traffic emissions, construction activities and population density already contribute to air quality challenges. The analysis is carried out of two continuous ambient air quality monitoring station at Lingaraj Mandir (OSPCB) and Patia (OSPCB) which represent mixed residential environments. 24-hour average pollutant concentration data have been collected from the Central Pollution Control Board (CPCB) and applies the National Air Quality Index (AQI) method which is prescribed by the Central Pollution Control Board of India. Pollutants like $PM_{2.5}$, PM10, SO2, and NO2 are considered which are commonly influenced by both background emission and festive-induced particular bursts.

The methodology involves computing pollutant-specific AQI values using standard breakpoint concentration tables and identifying the dominant pollutant for each observation period. The spatio-temporal variation in pollution level is being analysed using Inverse Distance Weighting (IDW) interpolation in ArcGIS. Expected results include a noticeable spike in particulate matter concentrations on the day of Diwali, followed by a gradual decline over the subsequent days. The magnitude of this increase is expected to differ across monitoring sites. Additionally, the study anticipates year-to-year variations influenced by meteorological factors, enforcement of pollution control measures, and differences in firecracker usage patterns.

The research contributes to understand the festival related pollution dynamics in rapidly growing urban areas and also offers insights for public health advisories, policy making and community awareness strategies aimed at sustainable celebration practices.

Keywords: Ambient Air Quality, Particulate Matters, Inverse Distance Weighting (IDW).

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Fabrication and characterization of eco-friendly biocomposites from waste coconut spathe fabric for sustainable progress

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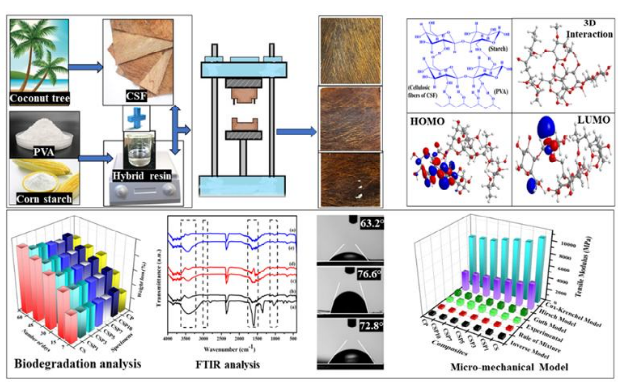
ABSTRACT

Composites reinforced with natural fibers derived from renewable and locally sourced materials provide significant sustainability advantages, embracing the principles of green chemistry, the efficiency of eco-friendly practices, and the harmony of industrial ecology. Coconut spathe, a byproduct located in the outer layers of coconut trees, has been employed as a reinforcing component in developing biocomposites based on corn starch and poly (vinyl alcohol). These biocomposites exhibited an optimum tensile strength of 46.8 MPa, a tensile modulus of 974 MPa, a flexural strength of 42.1 MPa, a storage modulus of 2322 MPa, and an impact strength of approximately 11.2 kJ/m², attributed to fundamental chemical interactions. The optimized composite demonstrated hydrolytic stability by absorbing only 33.6% of water after 24 hours. The biodegradability of these composites was assessed by composting, followed by monitoring weight loss and microscopic examination. These innovative biocomposites, fabricated from waste coconut spathe fibers and reinforced with cornstarch, are entirely biodegradable, positioning them as a promising and sustainable alternative to non-degradable thermoplastics, particularly in the automotive and packaging sectors.

Keywords: Fabrication, Coconut spathe, biocomposites, sustainable progress.



Phytoremediation for Environmental Cleanup and Ecological Restoration

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ABSTRACT

Phytoremediation is a groundbreaking approach that leverages the natural capabilities of plants to mitigate environmental pollution, offering a sustainable and eco-friendly solution to restore degraded ecosystems. The increasing industrial, agricultural, and urban activities have led to significant contamination by heavy metals, organic compounds, and other hazardous pollutants, posing serious threats to ecological and human health. This green remediation strategy harnesses the ability of plants to absorb, accumulate, degrade, or stabilize contaminants from soil, water, and air, providing a cost-effective and non-invasive alternative to traditional physicochemical methods. Phytoremediation employs various mechanisms, including phytoextraction, phyto-stabilization, rhizofiltration, phytovolatilization, and phytodegradation, depending on the nature of contaminants and plant species involved. The selection of hyperaccumulator species, optimization of plant-microbe interactions, and enhancement of biomass productivity are key factors that influence the efficiency of the process. Furthermore, integrating phytoremediation with ecological restoration practices contributes to the reestablishment of vegetation cover, improvement of soil fertility, and promotion of biodiversity. Recent advancements in biotechnology and genetic engineering have further improved plant tolerance and uptake potentials, enhancing overall remediation performance. By adopting phytoremediation as a component of integrated environmental management strategies, long-term remediation and eco-restoration goals can be achieved, fostering ecological sustainability and a cleaner environment for future generations. Overall, phytoremediation presents a promising eco-innovative approach to rehabilitate contaminated environments, underscoring its potential as a vital tool in the quest for environmental sustainability.

Keywords: Phytoremediation, Remediation, Plant-microbe interaction, Eco-restoration, Environmental sustainability.

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Sustainable Urbanization Beyond Metropolises: A Spatial Entropy-Based Analysis of Urban Expansion and Solid Waste Management on Bhawanipatna, Kalahandi, Odisha

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ABSTRACT

Class II urban centres play a pivotal role in achieving UN SDG 11 (sustainable cities and communities) by promoting balanced regional development, reducing migration pressure on large cities, enhancing administrative and environmental governance. The 2011 Census reported 109 new Class II towns across India between 2001 and 2011, while population projections for these towns show an increase from 40 million in 2021 to 70 million by 2047. Focusing on Bhawanipatna, a Class-II town in the Kalahandi district of Odisha, this study examines population and built-up land growth to highlight the urgency of effective town planning and solid waste management for achieving sustainable urban development goals. Population projections for the study area suggest an increase of nearly one lakh between 2011 and 2047, while built-up land expanded from 10 percent in 1991 to 34 percent in 2021, as calculated using geospatial techniques. The quantification of the pace of urban growth, represented by absolute Shannon's entropy within the town boundary, increased from 0.23 in 1991 to 0.29 in 2001, indicating rapid built-up expansion, high sprawl intensity, and unplanned outward growth. In the subsequent decades, the absolute Shannon's entropy values were 0.28 in 2011 and 0.27 in 2021, suggesting infill development and core densification within the town boundary, while the relative Shannon's entropy remained within 0.25, implying compact urban growth. Conversely, the absolute Shannon's entropy outside the town boundary (within one kilometre) rose from 0.11 in 1991 to 0.32 in 2021, reflecting the onset and intensification of peripheral urbanization, with ribbon development along transport corridors. The corresponding relative Shannon's entropy values—0.08 (1991), 0.14 (2001), 0.19 (2011), and 0.23 (2021)—further support this trend. A primary survey reveals that solid waste accumulation is commonly found on open patches of land in residential areas and near food and repair shops, correlating with the spatial entropy pattern. Thus, the spatial expansion of urban areas from the core to the periphery significantly influences solid waste distribution, underscoring the need for improved administrative and environmental governance.

Keywords: Class-II towns, Shannon's Entropy, Urban growth, Solid waste management, Kalahandi.

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Ore Petrography as a Tool for Understanding the Iron Ore Evolution: A Case Study from Bolani Iron Ore Deposits, Eastern India

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ABSTRACT

Iron as a metal has been playing a crucial role in shaping human civilization since the metal age to modern world. Iron is extracted from iron ore, which occurs naturally in different parts of the world. Odisha is famous for production of huge amount of high-grade iron ores from the Precambrian iron formation horizon. Bonai-Keonjhar Belt of North Odisha Iron Ore Craton (NOIOC) is one of the important iron forming terrains in Eastern India, which immensely contribute to commercial extraction and academic endeavour as well. The Bolani Iron ore deposit, located in the western limb of the Horseshoe Belt, represents one of the most significant iron ore deposits within the Bonai-Keonjhar Iron Ore Group (IOG) of Odisha. Ore Petrographic study helps in understanding the mineralogical composition, textural characteristics and genetic history of the ore bodies. Iron ores in Bolani area broadly occur as massive, laminated and powdery types and are primarily originated from the Banded Iron Formation (BIF) through supergene enrichment and secondary alteration. Microscopic investigations reveal that the iron ores are dominantly composed of hematite, magnetite, martite and goethite, with subordinate amount of silica minerals. Textural features such as bedding, banding, granular, specular, salt-and-pepper, replacement and colloform structures are common. Bedding and banding structures indicate the sedimentary origin of Banded Iron Formation (BIF). The development of skeletal, oolitic and salt-and-pepper textures reflects multi-phase mineral growth and recrystallization. These features collectively suggest progressive oxidation, hydration and recrystallization sequence associated with hydrothermal alterations and supergene enrichment. The observed paragenetic sequence indicates transformation of primary magnetite-hematite assemblages to secondary goethitic ores, marking the transition from primary BIF deposition to supergene enrichment of varieties of iron ores. Such petrographic evidence supports the evolution of iron ores of the BK belt as whole and Bolani area in particular through combined metasomatic alteration and residual/epigenetic concentration processes. The present study on ore petrography is indicative for the genesis, textural evolution and beneficiation potential of iron ores in the Bolani sector and serves as a model for studying iron ore evolution in other formations of Eastern India.

Keywords: Ore Petrography, Iron formation, Bolani, Odisha.

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Forest Cover Changes and Water Scarcity: Implementing Sustainable Water Management Practices in Odisha

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ABSTRACT

This report looks at the vital connection between Forest Cover and the problem of Water Scarcity in Odisha, focusing on successful Sustainable Water Management (SWM) solutions. Odisha has managed to increase its total green area to over 37.63%. However, the state has also diverted about 39,084.830 hectares of forest land for development projects since 2005. This requires careful study because, in forestry, dense cover is crucial: research proves that healthy forests help water soak deep into the ground, a process called Groundwater Recharge, which refills underground water stores. This is essential for Drought Resilience, helping the region cope with unstable rainfall and long dry spells. Odisha's SWM plan, which has received national recognition, uses a hands-on approach based on Watershed Management, treating natural water-flow areas as the main planning unit. The practical solutions involve building over 53,000 Rainwater Harvesting (RWH) structures and repairing 11,000 traditional water bodies. The state also helps farmers save water by converting over 90,900 hectares to efficient Micro-irrigation systems. These efforts show clear success: in dry areas like Nuapada, local conservation work has caused groundwater levels to rise by up to seven meters. Furthermore, integrating Agroforestry systems—planting trees with crops—has boosted harvests by up to 282% and stabilized income, which has successfully stopped seasonal migration for many vulnerable farmers. For long-term security, the state is aligning its policies (for food, land, and water) and investing in major projects, like the Rs 1,790 crore plan to link rivers, to ensure water is shared fairly across the region.

Keywords: Water Scarcity, Sustainable Water Management (SWM), Watershed Management, Rainwater Harvesting (RWH), Drought Resilience.

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Quantifying Endemic Flora as 'Cool Umbrellas': A Nature-Based Innovation for SDG-Driven Climate Resilience

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ABSTRACT

Escalating anthropogenic climate change is driving a costly positive feedback loop: rising temperatures increase reliance on energy-intensive air conditioning, which further exacerbates atmospheric warming. This study proposes and validates a Nature-based Solution positioning locally adapted trees as 'Cool Umbrellas' —a critical, technology-independent innovation for sustainable climate resilience.

A rigorous scientific methodology was employed in rural Koraput, India, to quantify the cooling efficacy of endemic flora, comparing 26 tree samples (from 14 families) against nearby sacred groves. The project meticulously assessed 30 biometric and structural parameters, including crown porosity, leaf area index, and shade area, to determine their quantitative impact on reducing ambient temperature and improving human thermal comfort.

The results confirm these shade-providing plants function as vital green infrastructure. They are highly effective at microclimate temperature reduction to levels cooler than nearby urban areas and contribute significantly to carbon sequestration, topsoil erosion prevention, and the maintenance of genetic reservoirs and pollinator habitats. These findings provide an evidence-based framework for selecting superior shade-producing species for targeted reforestation.

This approach directly advances SDG 13 (Climate Action) through scalable mitigation, SDG 11 (Sustainable Cities and Communities) by fostering healthier environments, and SDG 15 (Life on Land) by emphasizing endemic biodiversity preservation. The strategic implementation of these selected 'Cool Umbrellas' offers a critical, low-cost, high-impact innovation for restoring climate quality and promoting ecological well-being.

Keywords: Nature-based Solutions, Climate Resilience, Endemic Flora, Cool Umbrellas, Microclimate, Carbon Sequestration, Sustainable Development Goals (SDGs), Koraput.

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Assessment of floristic composition and biological spectrum of forest vegetation in Thakurmunda, Mayurbhanj

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ABSTRACT

The floristic composition and biological spectrum of forest vegetation are essential components in understanding the structure and functioning of forest ecosystems. The present study on floristic composition and biological spectrum of forest vegetation was carried out in Thakurmunda, Mayurbhanj, to provide baseline data on plant species present in the area and their ecological roles. A systematic field survey was done in different forest areas of Thakurmunda, located in the northern part of Odisha. The study observed that the region's forests are predominantly tropical dry deciduous and mixed forests. The floristic composition revealed a diverse range of species, with a high prevalence of angiosperms, including trees, shrubs, herbs, and climbers. A total of 170 species belonging to 141 genera and 57 families were documented from the study area. The most dominant families are in the order Fabaceae (20 genera & 26 species), Malvaceae (9 genera & 10 species), Rubiaceae (9 genera & 9 species). Euphorbiaceae (6 genera & 9 species), Poaceae (7 genera & 8 species), Acanthaceae (7 genera & 7 species), Anacardiaccae (6 genera & 6 species), Asteraceae (6 genera & 6 species), Moraceae (3 genera & 6 species) and Phyllanthaceae (2 genera & 6 species). Habit analysis revealed that, out of 170 species, trees possessed the highest number i.e., 68 followed by Shrub (50), Herb (38), Climber (11) and Liana (3). Further, the data collected were analyzed to understand the biological spectrum, Phanerophytes were the dominant life forms accounting for (67.05%; 114 species) of all species in the area, followed by Therophytes (14.70%; 25 species), Chamaephytes (13.52%; 23 species), Hemecryptophytes (2.94%; 5 species), Geophytes (1.17%; 2) and Hydrophytes (0.58%; 1 species). The study observed that this forest is influenced by some anthropogenic factors, which has affected the floristic diversity over time. Therefore, the need for conservation strategies should be prioritized. The study provided baseline data which will be useful for sustainable management practices in the region and to preserve the unique biodiversity of Thakurmunda.

Keywords: Floristic study, biological spectrum, anthropogenic factors, conservation strategies.

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An integrated assessment of pollution and potential ecological risks of microplastics in aquatic compartment and edible biota: Evidence from Chandipur, Bay of Bengal

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ABSTRACT

Microplastics (MPs, size <5mm) are considered water contaminants and pose a threat to our society. The integrated study of MPs contamination in water, sediment, and biota and ecological risks associated with them was not explored in the Chandipur coast, Bay of Bengal, despite being a centre of tourism, fishing, and other developmental activities. This study provides comprehensive data on MPs pollution, spatial distribution, along with their potential transfer in the environment, indicating bioaccumulation in coastal areas of Chandipur. Water, sediment, and organism samples were collected from 13 stations across the pre- and post-monsoon periods. The extracted MPs were visually analysed through compound, fluorescent, and scanning electron microscope (SEM) imaging, revealing dominance of black fibre form. The organisms collected were *Setipinna taty, Coilia dussumieri, Johnius belangerii, Arius arius,* and *Penaeus monodon* and alimentary canal (AC) and muscle tissues were dissected for the analysis of MPs contamination. The average abundance of MPs in water and sediments was found to be higher during the pre-monsoon (0.023±0.01g/L and 0.021±0.01g/ 10g of sediment) compared to the post-monsoon (0.006±0.002g/L and 0.012±0.01 g/10g of sediment). The MPs concentration in organisms varies from 0.007 - 0.047 g/g of tissue (in AC), 0.011-0.04 g/g of tissue (in muscle) of pre-monsoon and 0.011-0.029 g/g of tissue (in AC), 0.028-0.071 g/g of tissue (in muscle) of post-monsoon season. The molecular analysis using Fourier Transform Infra-red Spectroscopy (FTIR) resulted in dominance of polyvinyl chloride (PVC), polyethylene terephthalate (PET), cellophane, polymethyl methacrylate (PMMA), and latex in the post-monsoon, while PVC, PET, and polyamide (PA) were more abundant in the pre-monsoon season. While organisms retain

PET and Cellulose Acetate (CA) form of MPs, the highest was followed by PVC, polystyrene (PS), PA, and polypropylene (PP). The pollution load index (PLI) obtained was classified within hazard category I (low risk), for water (1-3.3) and sediment samples (0.93-5.07). The polymer hazard index (PHI) indicates the presence of a highly dangerous form of polymers that poses a significant risk. The MPs were identified to be bioconcentrated in *Setipinna taty* and *Coilia dussumieri* (with a BCF value of 1.1-2.05) in the pre-monsoon season, while all organisms (with BCF values ranging from 1.34 to 11.9) exhibited bioconcentration during the post-monsoon phase. Nonetheless, considering the variability in MP contamination across aquatic ecosystems and their interactions within food webs, trophic transfer seems to pose a significant health risk to both our environment and human society.

Keywords: Microplastics, Water, Tissue, Sediment, PLI, PHI, BCF, FTIR, PVC, PET.

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Drought in Odisha: Historical Trends and Future Projections

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ABSTRACT

Odisha, an agrarian state in eastern India, faces significant vulnerability to recurrent droughts, which pose a severe threat to agricultural productivity and regional water security. Evaluating the impact of future climate change on these drought patterns is critical for developing robust, district-level adaptation strategies. This study presents a comprehensive, district-wise assessment of drought characteristics for Odisha, quantifying historical trends and projecting future changes under different climate scenarios. Historical analysis was conducted using IMD (India Meteorological Department) gridded data from 1951 to 2024. Future projections were derived from bias-corrected, downscaled CMIP6 ensembles accessed via the Google Earth Engine platform for two shared socioeconomic pathways: SSP2-4.5 (middle-of-the-road) and SSP5-8.5 (fossil-fueled development) for the period 2025-2100. The Standardized Precipitation Index (SPI) was calculated at multiple timescales to assess meteorological drought (Figure 1-3). The historical analysis reveals significant spatio-temporal variability, identifying the western and northern districts—particularly Sundargarh (53.3% of months in drought), Koraput (52.4%), and Kalahandi (52.1%)—as historical drought hotspots. Conversely, coastal districts like Boudh (46.8%) and Jagatsinghapur (47.8%) were least affected (Figure 3). Future projections indicate a robust increase in drought frequency, duration, and severity across most of Odisha under both scenarios, with impacts being substantially more pronounced under SSP5-8.5. Under the SSP5-8.5 scenario, a sharp increase in the frequency of multi-year droughts is projected by the end of the century. These findings underscore the urgent need for district-specific adaptation plans focused on managing increased precipitation deficits and enhancing resilience to meteorological drought.

Keywords: Drought, Climate Change, CMIP6, SPI, IMD, Google Earth Engine, Odisha.

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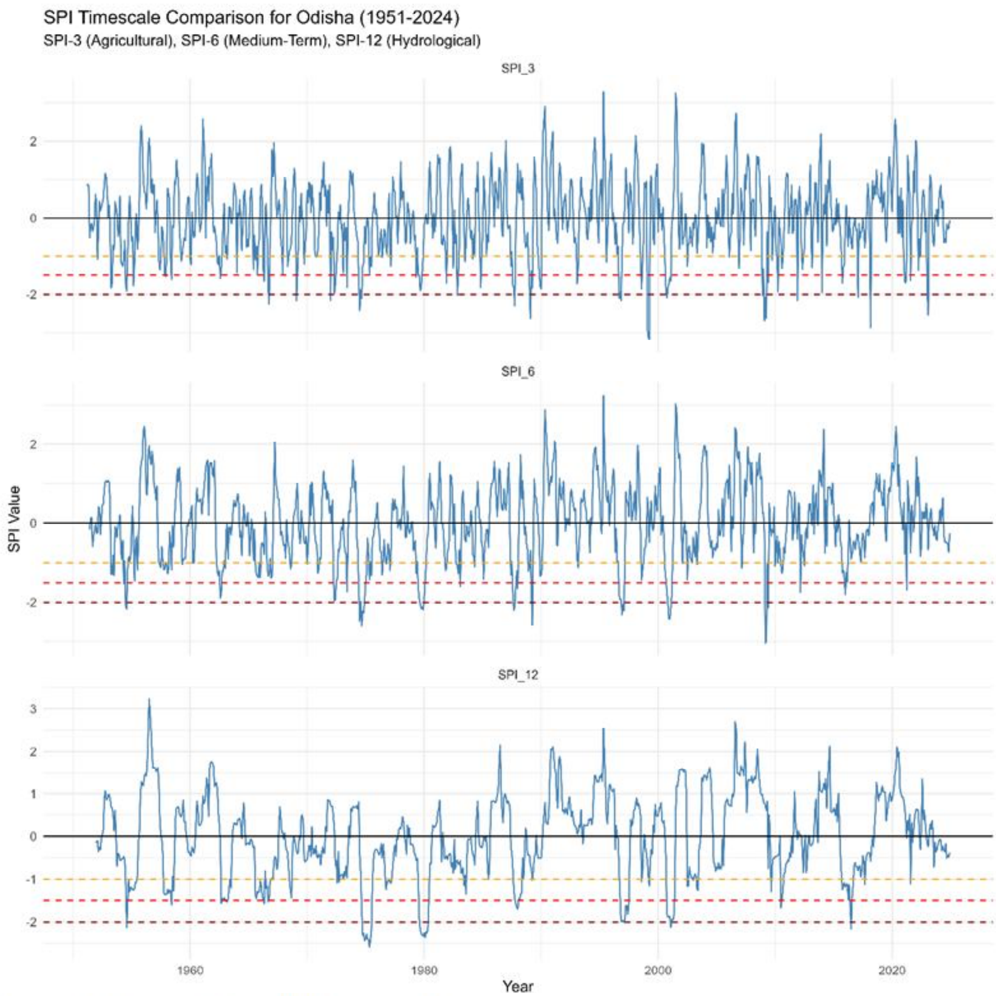

Figure 1: Historical Drought Types in Odisha

Health Risk Assessment of Heavy metal contamination in Rice cultivation of Eastern India

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ABSTRACT

The study describes the heavy metal content (Pb, Cd, As, Ni, Cu, and Zn) in irrigation water, soil, and rice plants in paddy fields of Sambalpur, Bargarh, and Subarnapur districts in Western Odisha, Eastern India. The heavy metals were analyzed by inductively coupled plasma optical emission spectroscopy. The soils in the experimental paddy fields had higher heavy metal contents than the soils in the nearby control field. Except for Cd, all heavy metal concentrations in soils were below the recommended limits of the national and international standards. All the heavy metal contents (except Pb and Cu) in the grain and straw were above the acceptable limit set by Indian standards. The relative heavy metal order for the soil-to-grain bioaccumulation factor was Zn > Ni > As > Pb > Cu > Cd. The bioaccumulation factor of all heavy metals (apart from Cd) was greater than 1, indicating that rice grain accumulates Zn, Ni, As, Pb, and Cu but absorbs only Cd. All heavy metals (except for Zn and Cu) had a health risk index value greater than 1, suggesting a potential threat to consumers through rice intake. Further, all of these metals (except Pb) have higher cancer risk values than the acceptable limit,indicating a possible cancer risk for consumers. Cd poses a significant risk, both non-carcinogenic and carcinogenic. Therefore, Cd exposure in the soil-rice system requires special consideration and effective regulation to ensure food safety in the study area.

Keywords: Bioaccumulation factor, Enrichment factor, Translocation factor, Health risk index, Cancer risk.

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Ecological restoration of Chromite mine overburden with hyper accumulating plant species: A Green Technology

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ABSTRACT

Ecological restoration of mine overburden (OB) dumps is a critical step toward sustainable mine management, especially in metal-contaminated areas such as Sukinda Valley, Odisha—one of the world's largest hub of chromite ore. The extensive mining and deposition of chromite overburden have led to severe degradation of soil quality and contamination with hexavalent chromium (Cr^{6+}), posing risks to local ecosystems and human health. This study focuses on the ecological restoration of chromite mine OB areas through the utilization of hyperaccumulating and tolerant plant species suitable for phytoremediation. A combination of grasses, shrubs, and hyperaccumulator plants—such as Crysopogon zizanioides (Vetiver), Cymbopogon fexuosus (Lemongrass) and Trema orientale (Trema) were evaluated for their capacity to stabilize and extract chromium under field conditions. Soil amendments, including organic compost and microbial inoculants, were employed to improve nutrient and metal bioavailability. Over a three-year monitoring period, significant reductions in bioavailable Cr^{6+} were observed in the rhizosphere, alongside measurable improvements in soil organic matter, microbial activity and vegetation cover. The selected plant species demonstrated strong establishment and resilience under metal-stressed conditions, indicating their suitability for large-scale reclamation programs. The findings highlight the potential of integrating phytoremediation with ecological restoration strategies to rehabilitate degraded mine landscapes. This approach not only aids in chromium detoxification but also enhances biodiversity recovery, ecosystem stability, and land productivity—contributing to long-term environmental sustainability in the Sukinda mining region.

Keywords: Ecorestoration, Chromium; Vetiver; Lemongrass; Bioavailability.

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Indoor air pollution and associated risk for library occupant and materials

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ABSTRACT

This present study considers airborne fungal spore with particulate matters responsible for respiratory health issues and material deterioration available in library. Throughout one full year, air sampling was conducted in the Bound Journal Room of Central Library of Jadavpur university using Temtop M2000 air sampler and Andersen sampler and Open plate methods, preparing pollutant Calender. The fungal spore concentration was 402±24.55 CFU/m^3, 1051.72±79.27 CFU/m^3 and 413.79±20.88 CFU/m^3 during the winter (December–January), monsoon (June–July), and summer (April–May) periods, respectively out of which the monsoon data exceeded the standard threshold limits of Occupational Safety and Health Administration (OSHA, 1000 CFU/m^3) and World Health Organisation (WHO, 500 CFU/m^3). *Aspergillus* sp. *Penicillium* sp. and *Rhizopus* sp. were the most found species there, out of which *Aspergillus* sp. The average Particulate Matters (PM 2.5 and PM 10) varied in summer, winter and monsoon season (66.2±24 μg/m^3 and 100.65±36 μg/m^3, 124.07±30 μg/m^3 and 194.95±49 μg/m^3, 20.97±7 μg/m^3 and 33.42±11 μg/m^3 respectively) which also crossed the permissible exposure limits set by U.S. EPA and OSHA (PM 2.5- 10 μg/m^3 and PM 10-150 μg/m^3). The relative humidity and temperature also favoured the fungal growth. During winter season the Respiratory Deposition Dose for male and female library workers revealed significant higher exposure in India due to prolonged indoor occupancy and poor ventilations. Material deterioration studies on the leather binding books and papers indicated substantial loss of strength (20%), discolouration, and surface integrity due to fungal colonization and enzymatic (collagenase and cellulase) hydrolysis. Scanning Electron Microscopy (SEM) confirmed hyphal penetration into the collagen and cellulose matrices, while FTIR spectroscopy revealed amide bond cleavage, lipid oxidation, and reactive oxygen species (ROS)-induced degradation in leather substrates. These findings strongly highlight the dual risk of biodeterioration and occupational health hazards in heritage libraries especially in the third world country located at tropical areas that are lacking proper infrastructures and maintenance, emphasizing the need for regular indoor air monitoring and preventive conservation strategies to safeguard both cultural materials and human health.

Keywords: Air quality monitoring, bioaerosols, conservation.

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Groundwater Pollution in the Coastal Aquifers of Balasore District, Odisha: Challenges for Achieving Sustainable Development Goal 6

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ABSTRACT

Groundwater is the primary source of drinking and irrigation water in the coastal aquifers of Balasore District, Odisha. However, rapid urbanization, agricultural intensification, aquaculture, and saline water intrusion have accelerated groundwater pollution, threatening both water quality and public health, and posing a major challenge to Sustainable Development Goal 6 (Clean Water and Sanitation). The present study investigates groundwater quality deterioration with special emphasis on saltwater intrusion and geogenic fluoride contamination, two critical threats to the region's aquifers. A total of 210 groundwater samples were collected from shallow and deep aquifers across Balasore District and analyzed using hydrogeochemical, statistical, and geospatial techniques. The results reveal elevated concentrations of chloride, sodium, and fluoride in several locations, exceeding the permissible limits prescribed by the World Health Organization (WHO). Saltwater intrusion was confirmed through ionic ratios, Gibbs diagrams, and hydrochemical facies evolution, while fluoride levels in certain pockets surpassed 1.5 mg/L, exposing local populations to risks of dental and skeletal fluorosis. Such contamination not only degrades water quality but also undermines the sustainability of local water resources. Spatial distribution maps prepared using GIS delineate high-risk zones, highlighting the severity of saltwater intrusion and fluoride contamination in coastal belts where groundwater is unsuitable for drinking and irrigation. The problem

is compounded by limited monitoring infrastructure, low community awareness, and weak enforcement of water quality regulations. Addressing these challenges requires coordinated interventions, including hydrogeochemical monitoring, real-time tracking of salinity, community-based water quality surveillance, adoption of low-cost defluoridation technologies, and sustainable groundwater extraction practices. Strengthened policy frameworks, integrated coastal aquifer management, and public awareness campaigns are equally vital. By linking hydrogeochemical evidence with the broader framework of SDGs, this study emphasizes that innovative scientific and technological solutions, combined with effective governance and community participation, are indispensable for safeguarding groundwater resources and ensuring equitable access to clean and safe water in coastal Odisha.

Keywords: Groundwater; Fluoride; Saltwater Intrusion; Balasore; SDG 6.

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Hidden Pathways of Pollution: Microplastic in Kuakhai River (Tributary of Mahanadi)

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ABSTRACT

Microplastic pollution has become a major environmental issue due to its widespread presence in aquatic ecosystems. This study aims to examine the occurrence and distribution of microplastics in the Kuakhai River, a key tributary of the Mahanadi River in Odisha, India. The river flows through Bhubaneswar, one of the fastest-growing cities in India. Water and sediment samples were collected from upstream to downstream at seven sites along the river. Microplastic particles were categorized by size, shape, and color. Size analysis revealed that microplastics ranged from over 5000 µm to as small as 50 µm, indicating a wide size range. The average concentration of microplastics was 582 ± 12 particles/m^3 in water and 1356 ± 13 particles/kg in sediments. Sediments consistently showed higher microplastic densities than water, suggesting that sediments may serve as long-term sinks for microplastic pollution. Fragments and fibers were the most common types of microplastics in all samples. Raman spectroscopy results indicated that polypropylene (PP) was the most abundant polymer, followed by polystyrene (PS), polyethylene (PE), and polyethylene terephthalate (PET). SEM images reveal roughness, cracks, and degradation on microplastic surfaces, reflecting ongoing environmental exposure. Scanning Electron Microscopy coupled with Energy Dispersive X-ray spectroscopy (SEM-EDX) shows the roughness, cracks, and degradation, including the presence of various elements (As, Cd, Al, Zn, Fe, Ca, Cl, Si, etc.) attached to the microplastic surface, suggesting anthropogenic activities as significant contributors. Thus, it is an urgent requirement for awareness, promoting sustainable practices and targeted management strategies to mitigate microplastic contamination in the environment, particularly in riverine ecosystems as per SDG-3, 6, 12, and 14. Overall, the findings emphasize the need for integrated monitoring of microplastics across surface water, sediments, and groundwater, along with policy measures to control plastic waste discharge. This research contributes baseline data for Odisha and underscores the urgency of addressing microplastic pollution in freshwater ecosystems.

Keywords: Microplastics, Riverine water, Sediment, Physical identification, Chemical properties, Metal bindings.

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Water quality degradation and its impact on the Ichthyofaunal diversity in the Eastern Ghats River Ecosystem: an assessment using WQI

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ABSTRACT

The Water Quality Index (WQI) serves as a comprehensive indicator for evaluating the overall condition of water bodies by integrating various physical, chemical, and biological parameters into a single, easy-to-understand value. Assessing WQI is vital for tracking the health of freshwater systems mainly the ichthyofaunal diversity, identifying pollution sources, and supporting sustainable management and conservation initiatives. The Eastern Ghats being a region especially known for its ecological richness but nowadays is increasingly burdened by human-induced pressures. It initiates from Odisha passing Andhra Pradesh and ending with Tamil Nadu, hosting several watersheds of major river systems, including the Mahanadi, Godavari, Krishna, Cauvery, Pennar, Vamsadhara, and Subarnarekha and there tributaries. These rivers are lifelines for both biodiversity and people, as they sustain a wide variety of aquatic organisms, especially fish, many of which are endemic or economically significant, and provide essential ecosystem services to the surrounding communities.

However, recent WQI evaluations have revealed a worrying decline in water quality across many of these rivers. The main causes include rapid urbanization, industrial effluents, mining activities, agricultural runoff, domestic sewage, and alterations to river flow from dams and water diversion projects. These stressors contribute to rising levels of nutrients, heavy metals, and microbial contaminants, particularly during and after the monsoon season. Consequently, water quality has deteriorated to levels that threaten both aquatic life and human use. This ongoing degradation poses a serious risk to the ecological stability of the region, leading to habitat loss and a decline in native fish populations. Therefore, this paper mainly deals with the WQI values of different rivers to demarcate the areas with low and high values, that is crucial to safeguard and restore the freshwater ecosystems and biodiversity of the Eastern Ghats.

Keywords: WQI (Water Quality Index), Eastern Ghats, Rivers, Freshwater ecosystems.

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Sustainable Agriculture: Harnessing Plant Biodiversity to Combat Climate Change and Global Hunger

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ABSTRACT

Humanity stands at a defining moment in its relationship with the Earth. Rapid population growth, degrading soils, and intensifying climate instability have pushed global food systems to their limits. Yet within this crisis lies an extraordinary opportunity — to redefine agriculture through sustainability and biodiversity. Sustainable agriculture is not merely an alternative; it is an evolution rooted in respect to nature's design. Plant biodiversity forms the living foundation of this transformation. Diverse crops such as millets, legumes, and indigenous species serve as natural architects of resilience—enriching soils, stabilizing yields, and restoring ecological balance. The incorporation of biofertilizers, green manures, intercropping systems, and pest-resistant varieties fosters long-term fertility while reducing chemical dependency. These approaches embody harmony between traditional agricultural wisdom and modern ecological innovation, proving that progress need not come at nature's expense. This model of farming directly advances key United Nations Sustainable Development Goals—Zero Hunger, Climate Action, and Life on Land— by linking environmental recovery with human well-being. When guided by biodiversity and ethics, agriculture transcends production; it becomes a force of regeneration. Sustainable agriculture is, therefore, more than a scientific pursuit— it is a moral and ecological renaissance. By empowering plants to do what they have always done best— heal, adapt, and sustain— humanity can cultivate not just food, but a future worth inheriting.

Keywords: Sustainable agriculture, Plant biodiversity, Climate resilience, Food security, Sustainable Development Goals, Ecological restoration.

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Amplifying Soil Carbon Persistence through Pyro-Char Stability: A Climate-Responsive Approach to SDGs

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ABSTRACT

In dry deciduous forests of Odisha, wildfires are common hazard that significantly influences the sustainability of forest ecosystems. Pyrogenic carbon (PyC), which is produced by incomplete combustion, is extremely resistant to heat and microbial destruction due to its aromatic and condensed structures. As a result, it endures for millennia in soils, impacting ecosystem resilience, nutrient cycling, and carbon sequestration. To study the persistence nature, PyC samples were collected from control and burned soils (0-5 cm depth) from the Sulia reserve forest in the Nayagarh district, Odisha in order to evaluate the dynamic behaviour. Thermogravimetric analysis (TGA) determined the TG-T_{50} index (50% thermogravimetric mass loss) for thermal stability; Carbon Nitrogen ratio (C:N) reflected carbon stability; Fourier transform Infrared Spectroscopy (FTIR) characterized aromatic and structural stability; X-ray diffraction (XRD) assessed clay mineral stability; organic carbon estimation provided oxidative stability; and Field emission scanning electron microscope-Energy dispersive X ray spectroscopy (FESEM-EDX) revealed surface topography as well as organo–mineral associations. TGA showed higher combustion-related mass loss in control soils than in PyC soils, as most of organic matter residue were consumed during combustion. The TG-T_{50} index indicated PyC thermal stability at 399 °C with 89.59% mass loss, compared to 360 °C with 96.09% in control soils. The C:N ratio was lower in PyC (0.34%) than in control soils (14.36%), confirming chemical alteration. FTIR spectra revealed phenolic residues and aromatic hydrocarbons in PyC, while XRD peaks showed destruction of kaolinite, feldspar, and hematite. Organic carbon content ranged from 7.16% in PyC to 6.38% in control soils. FESEM revealed porous structures, while EDX confirmed carbon-bound organo-mineral complexes. As PyC is inherently

resistant, studying its thermal stability and fate is critical to predict its longevity, mobility, as well as role in soil carbon stabilization along with long-term carbon cycling. High energy density and aromatic stability of PYC can also be useful for bioenergy source that might be used to connect carbon-neutral energy generation. Additionally, by investigating how pyro-char carbon from forest fires affects long-term soil carbon storage and helps reduce climate change, this study promotes SDG 13 (Climate Action). By comprehending the effects of forest fires on land ecosystems and encouraging sustainable land management, it is also aligned with SDG 15 (Life on Land). Furthermore, by investigating sustainable soil carbon practices, the study also advances SDG 12 (Responsible Consumption and Production). Conclusively, it strengthens resistance to climate-related hazards, promoting a sustainable environment for future heirs.

Keywords: Incomplete combustion; Black carbon; Carbon sequestration; Forest resilience; Recalcitrant carbon.

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Physicochemical analysis and Geo-Spatial Assessment of Drinking Water Quality in the Angul–Talcher Industrial Belt, Odisha

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ABSTRACT

Access to safe drinking water is vital for public health and a central target of Sustainable Development Goal 6 (SDG 6). Industrial regions, however, often face groundwater stress due to extensive mining, power generation, and metallurgical activities. The Angul–Talcher industrial belt of Odisha represents one such critical zone, where industrial expansion has heightened risks of contamination. This study aims to characterize the physicochemical properties of drinking water and assess its spatial distribution to understand environmental and public-health implications. A total of 101 water samples were collected from various drinking water sources wells, hand pumps, and piped supplies and analyzed for eleven major physicochemical parameters: pH, turbidity, total dissolved solids (TDS), chloride, total alkalinity, hardness, fluoride, iron, nitrate, sulphate, and arsenic. Using the weighted arithmetic mean method, the Drinking Water Quality Index (DWQI) was computed based on Bureau of Indian Standards (BIS 10500:2012) norms and categorized as excellent (8.9%), good (26.7%), poor (17.8%), very poor (10.9%), and unfit (35.6%). Overall, 64.4% of sampling sites were identified as poor to unfit. Total alkalinity (63.4%), hardness (60.4%), turbidity (52.5%), iron (30.7%), and fluoride (15.8%) exceeded acceptable limits. Geo-spatial mapping using the Inverse Distance Weighted (IDW) technique revealed contamination hotspots near industrial clusters. Source-wise analysis indicated that hand pumps were the most unsafe, showing consistent exceedances in alkalinity, hardness, fluoride, and turbidity, highlighting their vulnerability to both industrial and geogenic contamination. Correlation analysis further indicated strong inter-parameter relationships influenced by these combined factors. The findings highlight the need for sustained water monitoring, stricter effluent control, and promotion of safer water sources, especially in hand pump dependent

communities. Integrating physicochemical assessment with spatial modelling provides a scientific framework for targeted interventions and supports evidence-based policymaking toward achieving SDG 6 in industrially stressed landscapes of Odisha.

Keywords: Physicochemical parameters, Drinking Water Quality Index (DWQI), Geo-spatial mapping, Angul–Talcher industrial belt, Drinking water zonation.

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Assessing soil fertility status of different vegetation in South-eastern Ghat agro-climatic zone of Koraput

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ABSTRACT

Soil quality is essential for maintaining environmental sustainability and ecosystem functioning. However improper agricultural management practices, excessive tillage, non-judicious fertilizer application, and monocropping, have significantly degraded soil quality. The present study is focused on assessing the Soil Quality of various land types (upland, midland, and lowland) and cropping systems (forest, maize, millet, rice–fallow, rice–pulse, rice–vegetable, and rice–rice) in the South-Eastern Ghat agro-climatic zone of Koraput district, Odisha. Collected soil samples were analyzed for various physio-chemical properties to appraise soil fertility. The soil texture of the region varied from loamy sand to sandy loam, with uplands showing the highest sand content (up to 85.8%). The soils were acidic in reaction (pH 4.57–5.26). The nutrient status showed wide variability, with available nitrogen ranging from 207 to 299 kg ha^{-1}, phosphorus from 15.9 to 39.5 kg ha^{-1}, and potassium from 195 to 346 kg ha^{-1}. The SOC content ranged from 5.0 (lowland) to 11.8 g C kg^{-1} (upland). Enzymatic activities such as dehydrogenase (DHA) and fluorescein diacetate (FDA) were found to be highest in the upland forest ecosystem. Similarly, microbial biomass carbon and nitrogen were also greatest in forest plantations, followed by rice–pulse (midland) and rice–rice (lowland) systems. The findings highlight the significance of topography and crop management practices on soil quality.

Keywords: Soil health, topography, land types, Sustainable land use.

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Impact of Seasonal Recharge and Anthropogenic Activities on Groundwater Hydrochemistry With Reference to Fluoride Contamination in the Paradeep Regions, Odisha

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ABSTRACT

Groundwater quality in coastal regions is strongly influenced by seasonal recharge, seawater intrusion, and industrial activities, yet systematic seasonal assessments remain limited. This study investigates the hydro-chemical characteristics of groundwater in the Paradeep regions of Odisha, India, during pre- and post-monsoon seasons to evaluate temporal variations and contamination sources. A total of 70 groundwater samples were analysed for major cations (Ca^{2+} , Mg^{2+} , Na^{+} , K^{+} , Li^{+}, NH_4^{+}) and anions (F^{-},HCO_3^{-} , CO_3^{2-} Cl^{-} , SO_4^{2-} , NO_3^{-} , PO_4^{3-}) supported by pH, EC, TDS, DO, ORP, and other hydro-chemical parameters measurements. Hydro-chemical facies were delineated using Piper and Gibbs diagrams, and water suitability was assessed using Water Quality Index (WQI) and irrigation indices. Identifying the sources of the contamination by analysing the Pearson co-relation study of the different parameters. The novelty of this work lies in its integrated seasonal comparison of two ecologically and economically sensitive coastal aquifers, providing new insights into how monsoonal recharge and anthropogenic inputs jointly influence groundwater chemistry. Unlike previous studies limited to single-time sampling, this approach identifies dynamic shifts in ionic dominance, reveals zones of potential seawater intrusion and industrial contamination, and highlights parameters exceeding WHO/BIS limits. This study indicates, a notable finding is that during pre-monsoon fluoride concentrations across both regions remain below the WHO

limit (0.5–1.5 mg/L). There is not much variation in the fluoride concentration during post-monsoon, more than 90% samples are below the limit. While exceeding limits has been widely reported, sub-optimal fluoride levels are also a public health and environmental concern, as they increase the risk of dental caries and the persistence of fluoride within the aquifer system indicates potential ecological stress and raises concern for future mobilization under changing hydrogeological conditions. These findings establish a critical baseline for sustainable groundwater management in the region and demonstrate the need for continuous monitoring and geochemical modelling to protect vulnerable coastal aquifers. This research provides baseline data for Odisha and highlights the urgent need to address groundwater pollution in fragile coastal ecosystems.

Keywords: Fluoride contamination; Groundwater quality; Coastal aquifer; Seasonal variation; Hydro-chemical facies; Geochemical modelling.

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Predicting catchment scale sediment yield, export and retention capacity for managing reservoir sedimentation in an Indian Peninsular River

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ABSTRACT

Substantial alternation in the sediment transport patterns reported in fluvial systems of the Indian peninsula, attributed mainly to climate change and human activities. Therefore, quantifying the sediment yield from contributing catchment to the reservoirs is a major interest to support the development of management plans for maintaining reservoir sustainability. In this context, the InVEST (Integrated Valuation of Ecosystem Service and Tradeoffs) model was applied to assess the future impacts of land use and land cover (LULC) and climate change on network scale sediment dynamics in the Hirakud dam catchment. Predictions show that the average soil erosion rate will decrease by 13.41 (σ= 18.19) t ha-1 yr-1 under RCP 2.6 and 12.70 (σ = 16.33) t ha-1 yr-1 under RCP 8.5 scenario in 2033 due to attribution of rainfall variability and vegetation restorations. The sediment export of the catchment varies from 0 to 412 t ha-1yr-1 and 0 to 202 t ha-1yr-1 with an average of 1.139 (σ= 1.87) and 0.527 (σ = 0.930) t ha-1yr-1 for 2013 and 2023, which will drastically reduce 123 t ha-1yr-1 under RCP 8.5 scenario. Despite modeling uncertainty, results show that the suggested framework can contextualize potentially large regional hydro-climatic changes with implications for the sustainability of land and water resources.

Keywords: Land use and land cover, Hydrological modelling, Sediment dynamics, InVEST.

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26th Odisha Bigyan 'O' Paribesh Congress

&

1st International Conference on 'Sustainable Green Frontiers'

NATIONAL SEMINAR ON

'SDGs: Science and Technology Innovations'

November 28-30, 2025; Venue: KIIT Campus-5 Auditorium, Bhubaneswar

Organizers

Orissa Environmental Society, Bhubaneswar - 751015

KIIT Deemed to be University, Bhubaneswar – 751024

Programme

Day 1 (November 28, 2025 - Friday)

08:30 am-10:00 am	Registration
10:00 am-11:30 am	Inaugural Function Chief Guest: **Prof. Achyuta Samanta**, Founder, KIIT, KISS and KIMS, Bhubaneswar Guest of Honour: **Dr. Binay Kumar Das**, DG (ECS), DRDO, Bengaluru Keynote Speaker: **Dr. Arun Kumar Rath**, IAS (Retd.), Ex-Secretary, Govt. of India President: **Prof. Saranjit Singh**, VC, KIIT University, Bhubaneswar **Prof. Jaya Krushna Panigrahi**, Working President, OES - Adviser **Prof. Tapan Kumar Bastia**, KIIT University - Convener (In-house) **Prof. Sandeep N Kundu**, Life Member, OES – Convener **Er. Manoranjan Mishra**, Secretary, OES – Organizing Secretary [Felicitation to distinguished academics/scientists – Padma Shri Prof. Aditya Prasad Dash, Former VC, Central Univ, TN; Prof. Lambodar Prasad Singh, Former Prof. of Physics, Utkal Univ.; Prof. Binod Chandra Choudhury, Former Prof. in WTI, Dehradun; Dr. Binay Kumar Das, DG (ECS), DRDO, Bengaluru and Dr. Jayakrushna Panigrahi, Former Convener, ISCA: BC]
11:30 am-11:40 pm	*Tea Break*
11:40 pm-12:30 pm	Keynote Address on 'SDGs: Science and Technology Innovations' by **Dr. Arun Kumar Rath**, IAS (Retd.), Ex-Secretary, Govt. of India
12:30 pm-01:15 pm	Plenary Lecture – I: 'Zero hunger and food security – Role of Agriculture' by **Dr. Tusar Kanti Behera**, Director, Indian Inst. Horticultural Res., Bengaluru
01:15 pm-02:00 pm	*Lunch Break*
02:15 pm-05:30 pm	Parallel Technical Sessions – I (Life Sciences), II (Physical Sciences), III (Technological Sciences, IV (Environmental Sciences) Venue: Roof Top Convention, Campus 20
05:30 pm-7:00 pm	*Tea Break* followed by Cultural Program *Venue: Auditorium, Campus 5*

Day 2 (November 29, 2025 - Saturday)

10:00 am-11:30 am	**Panel Discussion** on SDGs: "Science and Technology Innovations-Challenges and Prospects" **Chair**: **Prof. Sunil Sarangi**, Former Director, NIT Rourkela **Panelists**: **Dr. Subhranshu Bhusan Ray**, Former Dy DG, Geological Survey India **Prof. Binod Ch Choudhury**, Former Prof, Wildlife Inst. Of India, Dehradun **Dr. Nisith Kumar Mohanty**, Chief Nephrologist, Apollo Hospitals, Bhubaneswar **Prof. G. C. Kundu**, Director, R&D, KIIT DU, Bhubaneswar
11:30 am-11:45 am	**Tea Break**
11:45 am-12:30 pm	**Plenary Lecture – II**: 'Life on land and under water – Conservation prospects' by **Prof. Dinabandhu Sahoo**, Dept. of Botany, University of Delhi
12:30 pm-01:10 pm	**Plenary Lecture – III**: 'Affordable and clean energy – Future sustainability' by **Mr. Trilochan Panda**, Former MD, GRIDCO, Bhubaneswar
01:10 pm-02:00 pm	**Lunch**
02:00 pm-02:40 pm	**Plenary Lecture – IV**: 'Healthy living and well-being – Role of Medical Science' by **Prof. Walter Luyten**, School of Pharmaceutical and Pharmacological Sciences, Katholieke Universiteit, Leuven, Belgium
02:40 pm-05:30 pm	**Poster Session**

Day 3 (November 30, 2025 - Sunday)

10:00 am-11:30 am	**Panel Discussion** on 'SDGs: Solving Global Challenges' **Chair: Prof. Pradeep K Chand,** Ex-VC, North Odisha University, Baripada Panelists: **Prof. Sarat Kumar Palita**, Ex-VC, Odisha Central Univ, Koraput **Prof. Dukhabandhu Sahoo**, Dept. of Econ., IIT Bhubaneswar **Dr. Amit Krishna De**, Ex-Advisor & Executive Secretary, ISCA, Kolkata
11.30 am-12.15 pm	**Plenary Lecture – V**: 'Industry, Innovation and Green Technology' by **Prof. Bibhuti Bhusan Biswal**, Vice-Chancellor, OUTR, Bhubaneswar
12:20 pm-01:30 pm	**Valedictory Function** **Chief Guest: Padma Shri Prof. Aditya Prasad Dash**, Ex-VC, Central Univ., TN **Guest of Honour: Prof. Bibhuti Bhusan Biswal**, VC, OUTR, Bhubaneswar **President: Dr. Jaya Krushna Panigrahi**, Working President, OES **Prof. Sandeep N. Kundu**, Prof. of Geology, Ravenshaw Univ. - Convener **Prof. Prasant Rath**, Dean, SAS, KIIT DU, Bhubaneswar **Dr. Alok Kumar Panda**, Co-Convener, OBPC-SGF **Dr. Surabhi Jain**, Co-Convener, OBPC-SGF **Dr. Subhangi D Sahoo**, KIIT DU, Bhubaneswar - Organizing Secretary

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Orissa Environmental Society

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LATE ABSTRACT

Assessment of Physico-Chemical Status and Heavy Metal Contamination in Soils adjacent to a Steel Plant in Dhenknal, Odisha

Mousumi Bagha* and Aliva Patnaik

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ABSTRACT

In the recent years, developing countries like India in their quest for economic growth has taken up industrialisation as a medium of strength and survival. This has led to rapid and excessive industrial growth in the country. The steel industry, while a critical driver of economic development, has become one of the largest contributors to environmental pollution. This is particularly evident in the form of soil contamination, where heavy metals (HMs) such as copper (Cu), iron (Fe), zinc (Zn), manganese (Mn), lead (Pb), cadmium (Cd), and chromium (Cr) are introduced into the environment as by-products of steel manufacturing processes. Therefore, seasonal assessment provides valuable insight into the dynamic behaviour of heavy metals in tropical soils. The present study investigates the physico-chemical status and heavy metal contamination in soils around TATA BSL steel industry in Dhenkanal, during the two major seasons of Odisha- dry (march- june) and wet (july-october). Soil samples were collected during both seasons and analyzed for **pH, electrical conductivity (EC), organic carbon (OC), total nitrogen (TN)**, and major heavy metals using **Atomic Absorption Spectrophotometry (AAS)** following standard protocols (APHA, 2017). The average value of pH, EC, OC, and TN of soil samples dry season was found to be 7.25, 0.34 dS/mtr, 1.06%, and 106.98 mg/kg respectively. The average value of pH, EC, OC, and TN in soil samples wet season was found to be 7.41, 0.439 dS/mtr, 1.09%, and 119.70 mg/kg respectively. The trend of HMs concentration during the dry and wet seasons in descending order was Fe>Mn>Cr>Zn>Ni>Cu>Pb>Cd and Fe>Mn>Cr>Zn>Ni>Pb>Cu>Cd respectively. Among all metals, **Cd exhibited the highest contamination factor (CF)**, indicating **very high contamination** and posing a serious ecological and health concern due to its toxicity and bioaccumulation potential. Other metals showed **low to high contamination levels**, depending

on the season and proximity to industrial emission sources. The **enrichment factor (EF)** analysis suggested **minimal to moderate enrichment**, confirming anthropogenic influence, especially from industrial discharges and atmospheric deposition.

The findings underscore the significant variability in soil quality and heavy metal accumulation between seasons, emphasizing the need for continuous monitoring and improved pollution mitigation strategies to minimize toxic HM load, particularly Cd, in the environment surroundings of Odisha.

Keywords: Metal, Heavy metal, Industry, Pollution, Soil, Steel.

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Youth Engagement with circular and Environmental practices: Insights towards sustainable development

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ABSTRACT

A circular economy reduces material use, redesigns materials and products to be less resource intensive and recaptures “waste” as a resource to manufacture new materials and products. This is a shift from the traditional, linear economic model, which is based on a take-make-consume- throw away pattern. The transition to a circular economy requires active engagement and readiness among youth who play a major role as future workers and contributors. Global sustainability frameworks namely the UN sustainable development goals, and European union policies emphasize expansion of renewable energy, eco design, waste reduction, management and resource efficiency as important circular economy strategies. There is no empirical research on how young men view and are ready to take part in this transformation, despite Odisha’s ambiguous green economy agenda comprising the projected creation of 10 lakh jobs and Rs 3.5 lakh crore of investments by 2030 in circular economy value chains. This study fulfills this gap by examining undergraduate and upper secondary students in BBSR. Which was ranked 9th in the swachh survekshan 2024-25.

The dataset was analyzed across key demographic categories such as gender, educational level, and city zones to investigate variations in readiness. Sociodemographic traits and awareness levels were analyzed using descriptive statistical techniques, such as frequency distributions, percentage, and mean scores. Cross tabulation analysis further examined patterns and disparities across subgroups. The results show that even if many young people show awareness towards circular economic practices, there are large gaps in their practical participation particularly when it comes to exposure levels and educational backgrounds. These results highlight the need for focused educational initiatives, public awareness, gatherings or camps, and youth focused involvements to motivate participation in Bhubaneswar's emerging circular economy.

Keywords: Circular Economy, Youth Engagement, Awareness and Behavior, Urban Sustainability, JEL Codes: Q56, J13, D91, R11.

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Gingivitis and the Protective Role of Micronutrients, Nutrition, and Phytotherapeutics

Pranita Rath[a], Manisha Dash[b], Shibani Mohapatra[c], Jyotirmayee Giri[b], Kabir Suman Dash[a*] and Alok Kumar Panda[b,d*]

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ABSTRACT

Gingivitis, which affects more than one billion people globally, continues to be an important public health issue because of its potential to progress to periodontitis. Tobacco smoking compromises gingival microcirculation, modifies the oral microbiome, acts as an immunosuppressant, and leads to an exaggerated inflammatory response—ultimately transitioning reversible gingivitis to a progressive periodontal disease via vascular- and microbial- and immune-mediated destruction of tissues. While certain conventional treatment modalities can often help relieve symptoms, they are generally less effective. Increasing evidence suggests nutritional approaches can potentially provide effective adjunctive methods for prevention and treatment; this is a review of several important micronutrients (specifically vitamins C, D, calcium, and zinc) known to offer approaches to modulate oral immunity, inflammation, and periodontal tissue repair, as well as omega-3 fatty acids, polyphenolic compounds, and probiotics. In addition, certain phytotherapeutics (e.g., neem (Azadirachta indica), tulsi (Ocimum sanctum), and other herbal preparations) have shown favorable inhibition of bacterial growth and anti-inflammatory effects. Dietary patterns (e.g., whole-food-based, Mediterranean diets and low sugar consumption) also evoke systemic anti-inflammatory reactions and improve overall oral and systemic health outcomes. However, while findings are promising, challenges remain regarding the standardization of formulary ingredients, dosage recommendations, and few trials with long-term outcomes. Future directions should include personalized dietary strategies, artificial intelligence (AI), and a nutraceutical formulation approach. Integrating evidence-based nutritional strategies along with typical periodontal management offers a safe, accessible, and holistic approach for the management of gingivitis and overall consistent oral health.

Keywords: Gingivitis, Nutritional interventions, Micronutrients, Phytotherapeutics, Omega-3 fatty acids.

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Fly Ash Pollution: A Major Threat to Water Bodies

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ABSTRACT

Fly ash plays a significant role, directly or indirectly, in the degradation of water quality in areas located near thermal power plants and coal-based industries. In a state like Odisha, approximately 14.2 million tons of fly ash

and bottom ash are generated annually from industrial zones such as Angul, Jajpur, and Jharsuguda. Generally, two methods are commonly used for the disposal of fly ash and bottom ash, settling ponds (wet disposal) and landfills. Usually, 3–4 ponds are provided with a primary basin, which receives overflow water from the main settling area. The use of liners in both wet basins and landfills has become more common due to growing concerns over surface and groundwater contamination. Fly ash and coal contain several toxic elements such as arsenic (As), lead (Pb), cadmium (Cd), and various hydrocarbons, many of which are carcinogenic. The leachate generated from coal combustion residues often contains high concentrations of toxic trace elements, including As, Ba, Cd, Cr, Pb, and Hg, as well as soluble salts such as Ca^{2}z and SO„ ^{2}{ . These components significantly increase the potential for groundwater contamination, especially in areas with unweathered ash deposits. The pH of the leachate may change rapidly upon contact with underlying soil layers or natural groundwater, further enhancing contamination risks. Observations from fly ash disposal sites reveal that both surface and groundwater quality are being severely affected. This contamination has also been linked to the reduction in rice yield in nearby agricultural fields and to the poor growth of local vegetation across different seasons. Recent analyses confirm that leaching of toxic metals from fly ash pond sites contaminates both the soil and groundwater systems. At present, efforts are being made to develop and implement engineering techniques aimed at minimising the contamination of ground and surface water through regular water quality monitoring near fly ash–ash-generating industrial units.

Keywords: Fly ash, groundwater contamination, toxic metals, thermal power plants, leachate, Odisha.

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Red Palm Weevil:
A Source of Nutrition, Minerals and Antioxidant Potential

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ABSTRACT

Red palm weevil (RPW), *Rhynchophorus ferrugineus* Olivier (Curculionidae: Coleoptera), is a common edible insect among the tribals. RPW is a major pest of tropical palm crops such as dates and oil palms trees etc. Generally, RPW goes through four development stages of egg, larva, pupa, and adult, of which the larva stage is the mostly consumed. RPW eaten by the people through frying, and in curry form. This species acts as medicine in different disease like common cold, fever, Jaundice, enteric problems, whooping cough and to increase the hungriness. The moisture content of the red palm weevil larvae was found to be 21.60±0.02 %. The nutritional composition of red palm Weevil Larvae (*R. ferrugineus*) includes Carbohydrate 6.00±0.01%, Protein 21.03 ± 0.14%, Crude fat 43.25 ± 0.12 %, Crude Fiber 5.95 ± 0.03%, and Ash 2.17±0.001%. The mineral composition of Red Palm Weevil Larvae includes Na (52.0±0.84), K (1025.0±4.96), P (685.0±2.42), Ca (54.1±0.75), Mg (131.8±022), Mn (3.5±0.30), Fe (30.8±0.53), and Zn (15.8±0.43) mg/100g dry weight basis. RPW larvae contained 17 amino acids, comprising eight kinds of EAA and nine kinds of nonessential amino acids. The Glu (6.86–9.88 g/100 g protein) was the amino acid with the highest content in the protein of RPW larvae. The content of Lys and Asp was also relatively high. Meanwhile, the contents of Cys and Met in the protein of RPW larvae were relatively lower. Twelve kinds of fatty acids were identified from RPW larvae with oleic acid (C18:1) 45.56%, palmitic acids (C16:0) 39.57%. The fatty acid profiling shows the presence of Caprylic acid (C8:0) 0.15 ± 0.02, Capric acid (C10:0) 0.13 ± 0.02, Lauric acid (C12:0) 1.09 ± 0.18, Myristic acid (C14:0) 1.69 ± 0.06, Palmitic acid (C16:0) Palmitoleic acid (C16:1) 5.53 ± 0.11, Stearic acid (C18:0) 2.10 ± 0.01, Oleic acid (C18:1) 46.79 ± 0.39, Linoleic acid (C18:2 n6) 0.54 ± 0.01, á-Linolenic acid (C18:3 n3) 0.17 ± 0.00 and Behenic acid (C22:0) 0.31 ± 0.00. DPPH scavenging radicals of the water and ethanol extract of the Early Larvae (EL) had the highest activity among the three (early, middle and old) different stages of larvae at the same concentration. EC50 value of the water extract (1.12 mg/mL) and ethanol extract (15.35 mg/mL) of EL was lower than that of the other two samples as well ($p < 0.05$). Whereas the EC50 of EL water extract for ABTS radical-scavenging activity was 2.52 mg/mL, which was less than its ethanol extracts (17.42 mg/mL). As a naturally occurring RPW larvae have a relative higher nutritional value and have potent antioxidant, could play a significant role in the prevention and treatment of diseases associated with oxidative stress.

Keywords: : Red Palm Weevil, Nutrition, Minerals and Antioxidant Potential.

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Sustainable Biomass-Based Carbon Electrodes for High-Rate Supercapacitor Applications

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ABSTRACT

The conversion of waste biomass into value-added functional materials has recently attracted considerable interest as a pathway toward sustainable and eco-friendly technologies. In this study, waste *Nerium oleander* (NO) flowers were utilised as a biomass precursor for the synthesis of activated carbon (AC), aiming to enhance the rate capability and electrochemical performance of supercapacitors and battery electrodes [1]. The NO biomass was carbonized and chemically activated under controlled thermal conditions to develop a highly porous structure with an enlarged specific surface area. The resulting activated carbon was subsequently used to fabricate electrodes by blending it with polyvinylidene fluoride (PVDF), N-methyl-2-pyrrolidone (NMP), and carbon black in an optimised proportion.

Electrochemical characterization was performed using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS). The AC-based electrodes exhibited excellent specific capacitance, superior rate capability, and low internal resistance, confirming efficient ion transport and charge storage behaviour [2]. The comparative analysis further demonstrated that the *Nerium oleander*-derived activated carbon delivers remarkable rate performance, underscoring its potential as a sustainable and high-performance electrode material for next-generation supercapacitor applications.

Keywords: *Nerium oleander,* Biomass, Activated Carbon, PVDF, NMP, Supercapacitor, Rate Capability.

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Smart materials: The next generation in science and engineering

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ABSTRACT

In recent years, fascinating developments in various areas of materials science have happened. Smart materials, also known as intelligent or stimuli-responsive materials, have attracted attention in science and engineering. Smart materials are divided into six different groups: shape memory materials, piezoelectric materials, magnetostrictive materials, electro-rheological and magneto-rheological fluids, and self-healing materials. Shape-memory and self-healing materials are the most popular and important kinds of smart materials. Shape-memory materials have the ability to react to certain stimuli, such as temperature, pH, light, magnetic fields, and electric fields, and transform from a temporary shape to their original shape after exposure to these stimuli. Shape-memory alloys and shape-memory polymers have attracted the most attention and are widely used among all kinds of shape-memory materials developed. The two most important properties of shape-memory alloys are shape memory and superelasticity. Shape-memory polymers are gaining popularity because of specific benefits such as their high shape recovery rate, light weight, low density, high strength-to-weight ratio, high shape deformability, and readily tailorable glass transition temperature. Self-healing materials have the ability to fully or partially repair their features and functionality after repeated damage. Self-healing materials are divided into two categories: intrinsic and extrinsic, as well as autonomous and non-autonomous. These materials have the potential to increase their lifetime while reducing maintenance costs. Smart materials have a wide range of applications, including aerospace, automotive, biomedicine, and construction. The goal of this paper is to provide an overview of smart materials.

Keywords: piezoelectric materials, magnetostrictive materials, electro-rheological and magneto-rheological fluids, and self-healing materials

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Trends and patterns of EV adoption in India: A time series analysis

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ABSTRACT

The Electric Vehicles (EVs) are one of the major green transformations of modern transport system which preach for sustainable development and net zero emission. In India this revolution is led by various governmental policies through intervention and subsidization. This study focuses on the long-term trends and patterns of EV adoption in India over the last ten years using autoregressive distributed lag (ARDL) modelling. The time series analysis from the year 2014 to 2024 examines growth path, structural break and future projections of India's sustainable green electric mobility. The study maps the acceleration and periodic momentum of EV transition by different governmental policies like National Electric Mobility Mission Plan (NEMMP) followed by FAME India scheme and other state level incentives. The analysis also goes through impacts of various economic, social and demographic factors those affect the EV mobility in the country. Factors like total income, population, infrastructure and subsidy show profound impact on shaping the long-term trend in the green transportation drive. Results suggest the steady upward movement in the trend with some structural breaks. The future projections are also optimistic when the current policy push up remains intact. The findings highlight the aggregate impact of economic, technological and supply side factors in realising India's transport sustainability. By offering a detailed empirical analysis of India' EV situation, this study provides enough evidence to policymakers and researchers about its technological growth trajectory.

Keywords: Electric Vehicles, India, EV Infrastructure, Time-series Analysis, Policy Determinants

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Reproductive Technologies in Kohaku Koi (*Cyprinus rubrofuscus*) Aquaculture: Breeding Technologies and Hatchery Performance

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ABSTRACT

The Kohaku Koi (*Cyprinus rubrofuscus*) is a freshwater ornamental fish known for its strong adaptability to diverse environmental conditions and its high commercial value, which is attributed to its striking colour patterns, attractive body form and graceful swimming behaviour. Because of their popularity among hobbyists worldwide, koi are widely traded in the global ornamental fish market. The present study focused on evaluating the seed production process of Kohaku koi using a natural spawning method in an artificial tank environment. Data were obtained through direct involvement and observational techniques. Natural spawning was carried out in a cemented tank, following a series of steps that included tank preparation, broodstock selection, spawning, hatchling rearing, water quality management, disease prevention and harvesting. A male-to-female broodstock ratio of 2:1 was used to ensure optimal fertilisation. Under these conditions, the experiment yielded approximately 80,195 eggs with a hatching success of 82.6%. After 12 days of rearing, the fry achieved a survival rate of 58% and were ready for transfer to the next culture phase. Overall, the breeding method for *C. rubrofuscus* in a cemented tank proved to be effective, technically reliable and suitable for practical application, aligning with Sustainable Development Goals (SDGs) 8, 9, 12 and 14.

Keywords: Broodstock management, Kohaku koi, Natural spawning, Ornamental fish culture, SDGs

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Crime Hotspot Prediction in Indian Districts Using Graph Attention Networks

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ABSTRACT

Crime hotspot prediction is a critical task for proactive policing and public-safety planning. Traditional machine-learning approaches often treat districts independently and fail to model relational crime patterns. In this work, we propose a Graph Attention Network (GAT)–based framework for predicting crime hotspots across Indian districts. Multi-year crime records were cleaned, standardized, and aggregated into district-level behavioral features describing long-term crime intensity, variability, and temporal trends. Hotspots were labeled using a percentile-based threshold to provide an objective classification target. To capture inter-district similarity without geographical maps, a k-Nearest Neighbors (k-NN) behavioral graph was constructed, connecting districts with similar crime signatures. The GAT model leverages attention mechanisms to assign different weights to neighboring districts, enabling richer pattern learning compared to classical models.

The proposed model achieved 98% accuracy, 96% precision, 92% recall, 94% F1-score, and an AUC of 0.996, outperforming Random Forest and XGBoost baselines with fewer false alarms and improved hotspot detection reliability. The results demonstrate strong applicability of graph-based learning for real-world crime analytics and public-safety forecasting.

Keywords: Crime Prediction, Graph Neural Networks, GAT, Hotspot Detection, k-Nearest Neighbors, Machine Learning, Crime Analytics.

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Assessing Antioxidant Deficiency as a Hidden Barrier to Achieving Sustainable Health Targets: A Community-Based Nutritional Profiling Approach in Odisha

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ABSTRACT

Antioxidant deficiency is increasingly recognized as a silent yet critical contributor to the global rise of non-communicable diseases (NCDs), including cardiovascular disorders, diabetes, metabolic dysfunction, cataracts, liver diseases, and neurodegenerative conditions. These health conditions significantly hinder the progress of key Sustainable Development Goals (SDGs), notably SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-Being) and SDG 12 (Responsible Consumption and Production). Despite its significance, antioxidant deficiency remains under diagnosed and insufficiently addressed within community-level health frameworks, particularly in semi-urban and developing regions of India. The present study investigates the prevalence of antioxidant-related risk indicators through Body Composition Analysis (BCA) among 100 local adults aged 17–74 years living in different districts of Odisha.

Using anthropometric measurements including BMI, Visceral fat percentage, Basal metabolic rate, Waist-to-hip ratio, and Waist-to-height ratio, the research identifies critical markers associated with oxidative stress and poor antioxidant status. Preliminary analysis reveals a high proportion of individuals with elevated BMI, central obesity, increased visceral fat, and metabolic irregularities conditions strongly linked to inflammation and oxidative damage. These findings suggest potential deficiencies in consumption of micronutrients such as vitamins A, C, and E, polyphenols, flavonoids, and other dietary antioxidants commonly found in fruits, vegetables, nuts, and whole grains.

The study further highlights social determinants such as limited nutritional awareness, reliance on processed foods, sedentary lifestyles, and low dietary diversity as major contributors to antioxidant insufficiency. From a sustainability perspective, these patterns indicate gaps in achieving SDG targets related to nutrition security, prevention of lifestyle diseases, and promotion of health-protective dietary practices. The research aligns scientific assessment with field-based community observation, illustrating the importance of integrating nutrition education, public health communication, and locally viable dietary interventions.

The study proposes scalable solutions including food-based approaches, community-level nutrition campaigns, and improved dietary guidelines focusing on affordable antioxidant-rich foods. Strengthening local food systems, empowering health workers, and leveraging digital tools for awareness can significantly mitigate risks associated with oxidative stress and NCDs. By bridging scientific data with sustainable health strategies, this study demonstrates that addressing antioxidant deficiency is fundamental to advancing public health resilience and achieving long-term sustainability in Odisha and beyond.

Keywords: antioxidant deficiency, NCD, oxidative stress, sustainable development goals, nutritional status, public health

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Eco-Friendly Synthesis of Fluorescent Carbon Dots for Bioimaging Applications

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ABSTRACT

Fluorescent carbon dots (CDs) have gained significant attention due to their tunable optical properties, low toxicity, biocompatibility and, making them promising candidates for bioimaging applications. In this study, we present an eco-friendly approach for synthesising fluorescent CDs using *S. saman* leaf extract as a natural carbon source. The green synthesis method eliminates the need for hazardous chemicals and complex processing, aligning with sustainable and environmentally friendly practices. The as-synthesised CDs exhibit excellent water solubility and remarkable stability. They show an excitation peak at 368 nm and an emission peak at 447 nm. Characterisation techniques such as UV-Vis spectroscopy, spectrofluorometer, and TEM confirm their structural and optical properties. Additionally, cytotoxicity studies indicate their biocompatibility, making them suitable for bioimaging applications. This green synthesis approach provides a cost-effective and sustainable method for producing fluorescent CDs and highlights the potential of plant-derived nanomaterials in biomedical applications.

Keywords: Fluorescent carbon dots, green synthesis, bioimaging

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Predictive Molecular Docking Analysis of *Aegle marmelos* Phytocompounds for Peptic Ulcer

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ABSTRACT

Peptic ulcer disease remains a prevalent gastrointestinal disorder caused by an imbalance between gastric acid secretion and mucosal defence mechanisms. The limitations and side effects associated with conventional antiulcer drugs have encouraged the exploration of natural alternatives. This study investigates the antiulcer potential of bioactive compounds from *Aegle marmelos*(Bael) using molecular docking based in silico approaches. Five major phytoconstituents such as marmelosin, quercetin, lupeol, skimmianine, and aegeline were chosen based on report by GCMS. To evaluate their therapeutic potential, key molecular targets implicated in ulcer genesis and mucosal damage were identified. These included Hz /Kz -ATPase (a central enzyme in acid secretion), COX-2 (a key inflammatory mediator), 5-lipoxygenase (5-LOX; a pro-inflammatory enzyme involved in leukotriene synthesis), and the histamine H, receptor (a G-protein coupled receptor regulating acid secretion). Molecular docking analyses were performed to predict binding affinity, interaction patterns, and potential inhibitory activity of the selected phytochemicals. Among the compounds studied, marmelosin exhibited a strong binding score of –9.2 kcal/mol with Hz /Kz -ATPase, suggesting a possible mechanism similar to proton pump inhibitors such as omeprazole. Quercetin displayed a high affinity of –9.6 kcal/mol toward COX-2, with docking poses indicating stable interactions within the cyclooxygenase active site comparable to standard anti-inflammatory drugs such as celecoxib. Lupeol demonstrated the highest docking score, –9.8 kcal/mol, with 5-LOX, indicating potent inhibition of leukotriene-mediated inflammatory pathways. Skimmianine and Aegeline also showed moderate to strong interactions with multiple targets, highlighting their potential roles in multi-target ulcer mitigation. The binding affinities of these phytochemicals were comparable to, or in some cases superior to, standard antiulcer medications, suggesting promising therapeutic potential. ADMET and drug-likeness evaluations indicated favourable pharmacokinetic profiles and compliance with Lipinski's Rule of Five for most compounds, suggesting good oral bioavailability and low toxicity. The multi-target interactions and synergistic effects observed highlight *A. marmelos* as a promising source of phytochemicals with potent antiulcer efficacy.

Keywords: *Aegle marmelos,* Peptic ulcer disease, Molecular docking, Antiulcer activity, ADMET

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Impact of Polyethylene Glycol-induced drought Stress on Seed Germination in Rice (*Oryza sativa* L.)

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ABSTRACT

Rice (*Oryza sativa* L.) a drought-sensitive crop shows significant varietal differences towards environmental stress. In-vitro PEG mediated assays provide a precise platform for assessing root architecture and growth dynamics, for drought-tolerance screening, which is challenging to quantify accurately in field conditions. To evaluate and identify drought-tolerant rice genotypes, an experiment was conducted in the laboratory of the Department of Botany, School of Applied Sciences, Centurion University of Technology and Management (CUTM), Bhubaneswar, Odisha from January-June 2025. The main objective of this investigation is to identify rice genotypes among ten, which exhibit early stage drought tolerance. Drought stress was artificially induced using PEG-6000, which provided a reliable platform for examining the performance of diverse rice genotypes. The genotypes were tested against three different stress levels, imposed by PEG-6000 at 0, 10 and 20% with three replications. The experiment was conducted in a complete randomized design (CRD). Germination percentage, shoot and root length, root and shoot fresh weight and dry weight, root and leaf number were recorded. All traits examined, differ significantly across all levels of PEG concentration. The results showed a progressive decline in all the measured traits including seedling height and dry weight, across the ten varieties with the increasing PEG concentration. The variation between control (0%) and 10% PEG concentration was minimal, however at higher concentration (20%) the changes became markedly pronounced.

Based on the findings, the genotypes namely Sahabhagi dhan, Mahulata and N22 showed the marked tolerance to higher concentration of PEG, consistently outperforming the other genotypes across all assessed parameters, whereas, IR20 showed markedly poor germination, indicating its susceptibility. This study identified three genotypes as promising for cultivation in water-limited condition and for use in future breeding programs

Keywords: Germination, Drought stress, Root traits, Shoot length, Tolerance.

Sustainable and Resource Efficient Agriculture using IOT

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Agriculture remains a very vital part of ensuring food security for the world, but it nonetheless has to grapple with constant challenges related to water shortages, climatic variability, inefficient resource use, and low levels of technological adoption among small-scale farmers. This paper, therefore, proposes an IoT-enabled, real-time agriculture monitoring and smart irrigation system to foster resource-efficient and climate-resilient agriculture in line with the focal theme of the OBPC-SGF Conference: Sustainability, Green Technology, and Future-Ready Innovations. The proposed system directly contributes to the United Nations Sustainable Development Goals, specifically SDG-2 (Zero Hunger), SDG-6 (Clean Water and Sanitation), SDG-12 (Responsible Consumption and Production), and SDG-13 (Climate Action).This system combines sensors for soil moisture, temperature, humidity, and rainfall with a micro-controller and a cloud platform to monitor field conditions continuously and allow automation of irrigation. Real-time data transmission enables informed decision-making, reduces manual intervention, and prevents over-irrigation and under-irrigation, hence saving water and optimizing crop health. The proposed system ensures operation that is secure, reliable, and scalable by making use of standardized wireless communication technologies along with IoT protocols. The support of cloud platforms allows analytics on long-term data, hence facilitating trend analysis and predictive decision-making that improve productivity and sustainability in agriculture. This work follows established literature that has demonstrated the trans-formative role of IoT, wireless sensor networks, and cloud-supported automation in precision agriculture.Experimental implementation has validated that the system offers precise sensor readings, effective pump actuation, and user-friendly access via web and mobile dashboards. From a design perspective, this system addresses many of the practical constraints to widespread agricultural technology adoption, such as high upfront costs, limited rural connectivity, and environmental durability. In particular, this system is more applicable to resource-constrained farming communities due to the low-power architecture, potential to integrate solar power, and compatibility with cost-effective communication protocols (e.g., Zigbee,

LoRa). Besides what is presently implemented, the proposed framework has great scalability for future enhancements. Integrating AI/ML-based prediction models with 5G-enabled edge intelligence, NPK and pH sensing, and drone-based crop imaging will further enhance precision to proactively manage crops and detect stress conditions at the earliest. These will contribute toward achieving sustainable agriculture by ensuring efficient resource use, minimizing environmental degradation, and building resilient digital farming ecologies to meet global sustainability goals. Overall, this work [redacted]

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Impact of InN-TMDC on the performance of Ag-Au bimetal-based plasmonic sensor

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ABSTRACT

Surface plasmon resonance (SPR) is a promising optical technique widely used across various scientific communities for sensing/ biosensing purposes. To enhance the performance of conventional SPR-based sensors, smart materials play a key role. In this study, Indium Nitride (InN) and transition metal dichalcogenide (TMDC) are incorporated on the surface of Ag-Au bimetal-based SPR sensor. Numerical simulations and conceptual analyses are conducted using MATLAB, while the electric field distributions at the interface of the sensing medium are analyzed with the help of COMSOL Multiphysics. The key performance parameters, including sensitivity, detection accuracy (DA), and figure of merit (FoM), are evaluated for various combinations of InN and TMDC materials. Among these combinations, the InN–WS, exhibited superior performance in terms of sensitivity and FoM, with values of 196.08 °/RIU and 33.46 RIU{ ^{1}, respectively, indicating effective plasmonic coupling and improved resonance. The evanescent electric field intensity shows a maximum value of 1.81 × 10{ t V/nm for the same combination at a resonance angle of 74.9°, suggesting enhanced field penetration and analyte interaction. These results confirm that integrating InN and WS, layers with Ag–Au bimetallic films can substantially improve SPR sensor performance through field enhancement and reduced losses. The proposed SPR structure offers significant potential for high-sensitivity detection in biochemical and environmental sensing applications.

Keywords: Surface plasmon resonance, Biosensor, Indium Nitride, Transition metal dichalcogenide, Performance

Employment of Head-Space Solid Phase Microextraction(HS-SPME) for innovative semiochemical analysis and quantification in Ladybird beetles for promoting sustainable agricultre

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ABSTRACT

Semiochemicals are useful natural compounds that insects use to communicate, and they can play an important role in insect life cycle. These semiochemicals are mostly hydrocarbons (HCs) and primarily serve as a waterproofing cuticular layer and function extensively in chemical communication by facilitating species, sex, and colony recognition. In lady bird beetles, these chemicals are closely linked to their mating and prey predatory behavior for pest control. Because of this, studying semiochemicals offers a new angle for developing sustainable pest-management strategies. In this study, headspace solid-phase microextraction (HS-SPME) an innovative method is employed for investigating the sex-specific semiochemical analysis and quantification in different Ladybird beetles . This method allows researchers to study the volatile chemicals released by the beetles without causing them stress or killing them. HS-SPME is a solvent-free technique that can detect volatile compounds quickly and requires only a small number of beetles for analysis. The SPME fibres used in this method are coated with materials such as Polydimethylsiloxane (PDMS) for trapping non-polar compounds and Carbowax Divinylbenzene (CWDVB) for capturing polar compounds for analysis. The ability of each coating to adsorb specific chemicals depends mainly on the shape, size and properties of the molecules. After extraction of semiochemicals, the proportions of different linear and branched chained hydrocarbons were analysed using GC-FID along with GC-MS platform**.** The variations obtained in semiochemicals analysis might have a role in the behavioral or ecological aspects of the studied ladybirds and can be commercially used for promoting sustainable agriculture.

Keywords: Semiochemicals, Ladybirds , Sustainable agriculture, Pest management, HS-SPME

Moonlight-Level Photo physiological Assessment of Crypto endolithic Cyanobacteria for Application in BPV Lunar devices.

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ABSTRACT

Biophotovoltaics (BPV) is a sustainable energy approach that harnesses photosynthetic organisms or isolated chloroplasts to transform sunlight into electrical energy. Among these organisms, cyanobacteria stand out as strong candidates due to their high photosynthetic efficiency, environmental resilience, and genetic tractability. This manuscript investigates the potentiality of cryptoendolithic cyanobacteria for low-light BPV applications, with a particular focus on their integration into a "Bio Lunar Panel" device. The cryptoendolithic cyanobacteria isolated from the Chou Satti Yogini Temple in Odisha demonstrated remarkable tolerance to intense solar radiation and desiccation stress, highlighting their suitability for such challenging environments. This inherent robustness suggests an underlying capacity for efficient light harvesting and protection mechanisms that could be translated to low-light efficiency, making them ideal candidates for extraterrestrial energy generation platforms where light conditions might be suboptimal or variable. The fundamental photosynthetic process in cyanobacteria involves the conversion of light energy into chemical energy (ATP and NADPH), followed by carbon dioxide fixation. Water is split at Photosystem II (PSII), releasing electrons, protons, and oxygen, with these electrons then traversing an electron transport chain to Photosystem I (PSI). These generated protons and electrons can be harvested in a bio electrochemical system to produce electrical current . We investigate strategies for optimizing these organisms for low-light conditions and propose a single-chamber biofuel cell design with a proton-exchange membrane and carbon electrodes

Keywords: Biophotovoltaics, Cyanobacteria, Low-light photosynthesis, Bio Lunar device, Cryptoendolithic, Extracellular electron transfer

Statistical and Machine Learning Models for Water Balance Prediction A Comprehensive Study of the Bankabal Watershed, Mayurbhanj District

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ABSTRACT

The paper is a hydrological analysis of the Bankabal watershed, located in Mayurbhanj District, using 10 years of monthly data (2010-2020) to explore water balance dynamics. Its main aim was to develop and evaluate predictive models for water balance and evapotranspiration using both statistical and machine learning approaches. The correlation analysis showed that the relationship between precipitation and water balance was almost perfect and positive ($r = 0.989$), and precipitation was the dominant force of the watershed hydrological process. Analysis of the data revealed that the maximum seasonal trends and large ranges of precipitation (CV = 112%), which should be considered as one of the most vulnerable to climatic changes, were observed. Linear Regression and Random Forest are two machine learning models that were applied. Since the relation is direct (water balance = precipitation - evapotranspiration), the Linear Regression model had a perfect R 2 = 1.0 in predicting water balance. In the case of the more complex, non-linear prediction of evapotranspiration, the Random Forest model (R^2 =0.775) had a vastly superior performance than the base Linear Regression model (R 2 =0.640). The most significant predictor in all models was always precipitation. These results offer solid, validated models of monthly water balance prediction and estimate evapotranspiration, and can have the significant implications to water resources management on the regional level, agricultural planning, and climate risk evaluation. The paper represents the strength of combining conventional statistical techniques with machine learning in order to understand the intricate systems in the environment and produce actionable data to manage resources sustainably.

Keywords: Water balance, Evapotranspiration, Machine learning, Precipitation, Watershed hydrology

An evaluation of strength of plant based remediation using *Azolla pinnata* and *Spirodela polyrhiza* in in Aquatic Systems

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ABSTRACT

This study investigates the phytoremediation potential of two aquatic plants, *Azolla pinnata* and *Spirodela polyrhiza*, in removing pollutants from contaminated water bodies. Phytoremediation, the use of plants to clean up pollutants, offers a sustainable and cost-effective method for water treatment. *Azolla pinnata* a floating fern, and *S. polyrhiza*, commonly known as duckweed, were selected due to their rapid growth rates, high biomass production, and known capabilities in nutrient uptake. Controlled experiments were conducted to evaluate the efficiency of these plants in removing heavy metals (cadmium, lead, and mercury) and nutrients (nitrate and phosphate) from aqueous solutions. Plants were cultured in contaminated water under laboratory conditions, and water samples were collected at regular intervals to measure pollutant concentrations using atomic absorption spectroscopy and colorimetric assays. Results indicated that both *Azolla pinnata* and *Spirodela polyrhiza* significantly reduced the concentrations of heavy metals and nutrients in the water. *Azolla pinnata* showed a higher removal efficiency for heavy metals, particularly cadmium and lead, with removal rates of up to 85% and 80% respectively over a 14-day period. *Spirodela polyrhiza* was more effective in nutrient removal, achieving 90% reduction in nitrate and 85% in phosphate concentrations within 10 days. Additionally, both species demonstrated high tolerance to the pollutants, maintaining healthy growth and biomass accumulation throughout the experimental period. The study highlights the complementary strengths of *Azolla pinnata* and *Spirodela polyrhiza* in phytoremediation applications. *Azolla pinnata* is better suited for environments with high heavy metal contamination, while *Spirodela polyrhiza* is more effective in nutrient-rich waters. These findings support the integration of both species in a combined phytoremediation strategy to maximize pollutant removal from diverse aquatic systems. Further research is recommended to explore field applications and the long-term sustainability of using these plants for large-scale water treatment.

Keywords: *Phytoremediation, Azolla pinnata, Spirodela polyrhiza, BOD, COD, pH*

Ecological factor affecting growth of *Azolla* species – A Review

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ABSTRACT

Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen because of its association with the nitrogen fixing heterocystous blue green algae *Anabaena azollae* in its dorsal leaves. *Azolla* occurs in fresh water ecosystems in tropical, sub-tropical and warm temperate regions throughout the world. *Azolla* plant can be used for a variety of applications such as protein - rich feed for livestock and aquaculture, biofertilizer as well as green manure in paddy field, phytoremediation, biocontrol for mosquitos, reduce methane emissions and for production of biogas. Under optimum conditions *Azolla* can double its biomass within 2 to 5 days. Due to these high economic potentialities, the present study was undertaken to add more information on the ecological factors that influence *Azolla* growth under natural conditions. *Azolla* requires all the macronutrients (except N) and micronutrients for its growth. Phosphorous is the most important and often limiting nutrient for its growth. Photosynthetic activity, growth and nitrogen fixation of *Azolla* and its symbiont are all affected by light intensity. *Azolla* prefers an environment with a certain degree of shading. When light intensity is high and amount of nutrients in water is low, *Azolla* turns red. The red coloration is due to the development of anthocyanin pigments. Optimal light intensity for *Azolla* growth is 15- 18 Klux, and its growth and photosynthesis are inhibited at higher intensities. Different *Azolla* species, strains or varieties have different temperature sensitivities. There have been numerous studies about the differences in temperature responses of *Azolla* species. A temperature of 20 to 30^0 C can be considered as optimal for growth of *Azolla*. Usually, *Azolla* prefers a medium near to neutrality or to some extent acidic condition for growth. Humidity, salinity, length of the growing season and day length are other ecological factors which regulate production of this aquatic plants. In addition to these biotic factors like various types of animals, insects, bacteria, fungi and viruses affect the growth of *Azolla*. However, out of these insects, snails and fungi have been reported to affect growth of *Azolla* seriously. So, understanding the ecological factors for Azolla production is very helpful for its practical applications in different fields.**Keywords**: *Azolla growth*, ecological factors, utilization

Rhizosphere microbiome profiling of high oil versus low oil yielding aromatic plants in the coastal belt of Ganjam districts of South Odisha.

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ABSTRACT

The coastal belt of Ganjam district in South Odisha presents a unique agro-ecological niche shaped by its edaphic heterogeneity, saline aerosol deposition, and humid tropical climate, which collectively influence the rhizosphere microbiome and essential oil biosynthesis in aromatic plants. This study investigates the microbial diversity and oil-yielding potential of high and low oil-bearing species—such as Cymbopogon flexuosus, Ocimum basilicum, and Vetiveria zizanioides through field sampling and GC-MS profiling of root-zone soils and plant tissues.

Hydrodistillation and GC-MS analysis revealed distinct chemotypic profiles between high and low oil-yielding species, with high-yielding plants exhibiting elevated concentrations of monoterpenes and sesquiterpenes such as citral, geraniol, and vetiverol. These chemical signatures correlated with microbial richness and functional diversity, particularly the presence of Pseudomonas, Bacillus, and Streptomyces spp., as well as beneficial fungal taxa including Trichoderma and arbuscular mycorrhizal fungi known for their roles in nutrient solubilization, stress tolerance, and secondary metabolite induction. low oil-yielding plants exhibited reduced microbial richness and a prevalence of stress-associated genera, suggesting suboptimal microbial support for oil biosynthesis.

The saline aerosols from the Bay of Bengal, combined with sandy loam soils and high organic matter, were found to modulate microbial community structure and plant-microbe interactions. High oil-yielding rhizospheres showed enhanced microbial colonization and metabolite exchange, suggesting a synergistic role of climate-driven edaphic factors and microbiome composition in oil biosynthesis.

This integrative approach highlights the potential of rhizosphere microbiome engineering and genotype selection for optimizing essential oil production in coastal agroecosystems. The findings offer a framework for sustainable aromatic crop cultivation in saline-prone regions of Odisha.

Keywords: Rhizosphere microbiome, GC-MS profiling, essential oils, saline aerosol, edaphic factors, Ganjam coast

Innovating Sustainable Journeys: Science and Technology Driving the Future of Tourism and SDGs

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ABSTRACT

Background of the Study- Tourism is a powerful engine for economic growth. So, it cannot be ignored for any country. But due to tourism, there are several problems such as environmental degradation, overconsumption of resources, and social inequities. Therefore, science and technology may provide appropriate direction to mitigate negative consequences of tourism and may align tourism development with the SDGs. Artificial intelligence (AI), the Internet of Things (IoT), and Geographic InformationSystems(GIS) are data driven tourism management by which resource efficiency, and enhanced visitor experience may improve in positive direction.

Problem Statement- While India's tourism and hospitality sectors increasingly adopts digital tools under the "Smart City" and "Digital India" India missions, the effectiveness of these technologies in driving measurable sustainability outcomes remain underexplored. There is limited comparative analysis of how cities like Kolkata and Bhubaneswar translate smart innovation into SDG-aligned tourism practices.

Objectives- To examine the role of science and technology in promoting sustainable tourism within Kolkata and Bhubaneswar. To assess the quantitative impact of technology adoption on key SDG indicators, including responsible consumption (SDG 12), and sustainable cities (SDG 11), and climate action (SDG 13). To proposes strategic model by which urban innovation and sustainable tourism governance connect each other.

Methodology- A mixed-methods design was adopted. The sample size was 200 including tourists, entrepreneurs, and municipal officials. Qualitative sample size was 30 which was the subset of selected sample size of quantitative data. Quantitative data were analysed through descriptive statistical tools (Mean, SD, and percentage) and inferential statistical tools such as corelation and multiple regression.The aim was to evaluate the

relationship between technological integration and sustainability performance indicators such as waste management, energy use, and local employment. The collected quality data were analysed through content and thematic analysis to understand GIS-based mapping of tourist flow patterns in heritage zones of Kolkata and eco-tourism circuits in Bhubaneswar.

Results and Discussion- As per results, an average 25% of reduction in waste generation per visitor and 20% improvement in local community engagement compared to baselines. IoT sensor and digital trial heritage are using Bhubaneswar and Kolkata respectively for waste segregation andtechnological enhances for sustainable tourism outcomes.Data infrastructure and community digital literacy are barriers for optimum results.

Conclusion- Science and technology are useful tool for sustainable tourism in India's urban ecosystems. The comparative analysis of Kolkata and Bhubaneswar reveals that localized innovation which are supported by governance and digital capacity, can significantly contribute and advance the SDGs. It also creates resilient, future-ready tourism models.

Keywords: Sustainable Tourism, Science and Technology, Smart Innovation, Sustainable Development Goals (SDGs), Digital Transformation

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Waste Management and Sustainable Development

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ABSTRACT

Waste is not waste until it is wasted. Waste is any substance which is discarded after primary use or it is worthless, defective and of no use. The spread of industrialization, population growth, urbanization etc has been accompanied by a large increase in waste production. On the daily basis, the country produces more than 1.50 lakh metric tons of solid waste and our state capital Bhubaneswar produces 600 tons of waste out of which plastic only takes the share of 30 tones.

Of the total collected waste, only 20 percent (27,000 MT per day) is recessed and the remaining 80 percent (1, 08,000 MT) is dumped in landfills sites. Out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted. As per the data the top waste generating cities of India are Delhi, Greater Mumbai, Chennai, Hyderabad.Bngaluru, Ahmedabad, Pune, Kanpur etc. Circular economy and sustainable Development (SD) are universal goals until 2030. Implementing Sustainable Development Goals (SDGs) is the responsibility of every individual, organization, and Nation. Sustainable waste management system is an efficient way to minimize the hazards or pollution caused by wastes. Sustainable waste management means using material efficiently to reduce the amount of waste generation as well as recycling the huge quantity of waste through indigenous technology that actively contributes to the economic, social and environmental goals of sustainable development. Sustainable Waste management (SWM) provides an action plan for effective, efficient and responsible changes in the entire system starting from waste collection, segregation, transportation, disposal processes. Waste problem is one of the burning issues. In order to meet the goal of sustainability we must make up a fruitful action as soon as possible. Clean environment leads to a better life and which will take us to our developmental goals, so this should be started from now on, may be from our kitchen first. It can only be achieved when we are aware by ourselves as well as give proper education to the people of our surroundings to make the best use of waste bins, try to produce waste to the least, and dump wastes in a scientific way. The involvement of people and private sector through NGOs could improve the

efficiency of SWM. Zero waste is a philosophy that encourages the redesign of resource life cycles to that all products are reused. The goal is for no trash to be sent to landfills, incinerators, or the ocean. The conservation of all resources by means of responsible production, consumption, reuse, recovery, rethink, refuse, rot, reduce, recycle, repurpose etc during our resource utilization (SDG 12: Responsible consumption and Production).

To enhance the efficiency of solid waste management in our country and state the participation of citizens should be promoted especially in source segregation and treatment processes. (SDG 17: Partnerships for the goals)

So Let us take a pledge to be the part of the solution not the part of the pollution.

Keywords: Waste management, SDGs, landfills, recycling, Zero waste, and source segregation

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Entrepreneurship opportunity in sericultural sector – A sustainable approach towards Viksit Bharat

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ABSTRACT

Sericulture is the art of rearing of silkworm for the production of silk. It is a labour intensive agro based cottage industry. India rank second globally in yielding of silk which serve as a livelihood strategy for both small and marginal farmers. This traditional practice of silk farming offers a pathway of socio-economic upliftment for the women and youth community. There are four types of silkworms eri silk, mulberry silk, muga silk and tussar silk. Mulberry silkworms are domestic in nature and monophagous in nature which feeds on fresh and tender mulberry leaves. This article emphasizes the direction in which the skill of sericulture provides the women and youth to engage in the society and earn money through a sustainable method of rearing of silkworm by the supplementation of extra nutrients in their regular diet. For experiment purpose P5 , a bivoltine silkworm race had been selected. The first meal of fifth instar larvae of P5 silkworm race was treated with vitamin C and vitamin E separately for seven days regularly. Then just after three hours of their first meal the silkworms were measured with the help of an electrical weight machine. Many parameters of body weight and gland weight were observed and recorded. It has been found that the silkworms treated with vitamin C yields much better in comparison to the silkworm larvae treated with vitamin E. This unique method of rearing of silkworm is very promising as it provides a gainful employment, fostering economic potentiality and improving the standard life of the backward women community and unemployed youths in rural, semi-urban and metropolitan places which really worth for the path of Viksit Bharat.

Keywords: Bivoltine, entrepreneurship, silkworm, vitamin

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Seagrasses linked Sustainable Development Goals(SDGs) along Odisha coast

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ABSTRACT

Seagrass ecosystems are globally recognized as critical blue carbon habitats and biodiversity reservoirs, directly supporting the objectives of Sustainable Development Goal 14 (Life Below Water). In addition to blue-carbon sequestration that directly links to SDG 13 (Climate Action), while their role in supporting small-scale fisheries contributes to SDG 1 (No Poverty) and SDG 2 (Zero Hunger) in coastal communities has been observed. However, researchers have already described that 16 of the 17 Sustainable Development Goals are directly or indirectly associated with sea grass meadows, highlighting their cross sectoral importance in global sustainability frameworks. Along the Odisha coast, recent observations reveal renewed saeagrass occurrences and spatial expansions, particularly in ecologically sensitive regions such as Chilika Lake and the Haripur Creek inlet near Gopalpur. Chilika, Asia's largest brackish water lagoon, hosts a diverse assemblage of seagrass species including *Halodule uninervis*, *Halophila ovalis*, *H. beccarii*, *Ruppia maritima*, and few patches of *Cymodocea rotundata*, representing one of the richest seagrass communities in eastern India. In contrast, the Haripur Creek system, although a dynamic sand–mud transitional zone, has recently exhibited re-emerging patches of *Halophila ovalis* and *Halodule uninervis*, suggesting improving environmental conditions in the post-COVID-19 period. These occurrences provide valuable ecological indicators of habitat functioning, sediment stability, and reduced anthropogenic stress. Several species of marine faunal community being recorded first time from this region. However the impacts of beach plastic litter and ghost fishing net cannot be ignored completely for their survival. So far the artificial restoration of sea grass is concerned Haripur creek could appear as the most suitable habitat for such kind of executions to tackle the climate change impacts in future. This study provides baseline ecological information essential for long-term monitoring and management of seagrass ecosystems along the Odisha coast.

Keywords: Sustainable Development Goals (SDGs), Chilika Lake, Haripur Creek inlet, Seagrass, sMarine faunal diversity, South Odisha coast, SDG 14 (Life Below Water)

Jellyfish bloom formation in a port-influenced marine corridor: First case study from Gahirmatha, Odisha, Bay of Bengal

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ABSTRACT

Frequent occurrences of jellyfish blooms have been documented along the specific locations of Odisha coast, notably from the Rushikulya, Puri, Konark, Astarang, and Gopalpur regions, attributed to rising sea surface temperatures, eutrophication, nutrient loading, overfishing, habitat smodification, marine litter, and pollution. The present study reports the first occurrence of a scyphozoan jellyfish bloom of *Lobonemoides gracilis* Light, 1914 from the coastal waters of the Gahirmatha sea turtle rookery, Bay of Bengal. The bloom, observed on 27–28 September 2022, spanned approximately 20 km^2 with an estimated 200–700 individuals per patch. Water quality parameters indicated warm temperatures (30.3–32.8 °C), variable salinity (0.9–20.9 PSU), and nutrient enrichment, which appeared conducive to bloom formation. The event coincided with a phytoplankton bloom dominated by *Pseudonitzschia seriata* and *Chaetoceros* spp., followed by high zooplankton abundance dominated by *Lucifer* sp. and *Paracalanus parvus*. This sequence suggests a trophic linkage among phytoplankton, zooplankton, and the subsequent proliferation of jellyfish. The bloom climaxed in the presence of olive ridley sea turtles along the Gahirmatha region, indicating a prey (jellyfish)–predator (olive ridley sea turtle) relationship. Interestingly, the bloom occurred between Dhamra Port and Paradip Port, further indicating the influence of anthropogenic stressors such as sewage discharge, dredging, overfishing, marine plastic pollution, and port activities that may have triggered conditions favorable for bloom formation . This study provides the first record of the simultaneous occurrence of jellyfish and plankton blooms near the Gahirmatha coastal waters, highlighting the need for long-term ecological monitoring, study on ecological drivers and trophic linkages, AI-based predictive modelling, and remote-sensing applications to understand, forecast, and manage jellyfish bloom phenomena along the

Odisha coast, along with strengthened conservation and management practices for protecting the Gahirmatha ecosystem.

Keywords: First Record, Jellyfish Bloom, Gahirmatha, Plankton bloom, Port based anthropogenic Influence, ecological drivers.

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Biodiversity Impacts of Bridge Construction on the Chilika Lagoon Ecosystem

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ABSTRACT

Discussion on bridge construction within the Chilika Lagoon has getting maximum attention in recent days. It is anticipated as a critical anthropogenic factor influencing the ecological functioning of one of Asia’s largest brackish water ecosystems. Chilika, a Ramsar-designated wetland of international importance, supports exceptional biodiversity, including seagrass meadows, benthic assemblages, estuarine and marine fish populations, migratory shorebirds, and the threatened Irrawaddy dolphin (*Orcaella brevirostris*). The development of bridge infrastructure across the lagoon and its associated channels can induce substantial alterations in hydrodynamics, water circulation, sediment transport, and salinity gradients, and tidal incursions that seems important to shape the lagoon’s productivity ecological stability and biodiversity. This study evaluates the potential and observed biodiversity impacts resulting from ongoing and proposed bridge construction within the Chilika Lagoon landscape. Changes in tidal exchange and flow regimes can cause localized sedimentation or erosion, affecting the spatial extent and health of seagrass beds, which serve as critical nursery habitats for fish and invertebrates. Modified water circulation may also influence dissolved oxygen dynamics, nutrient distribution, and plankton community structure, thereby altering the lagoon’s trophic pathways. Fragmentation of aquatic habitats due to elevated embankments, pilings, and construction debris can restrict fish migration routes, impair recruitment, and reduce population connectivity. Additionally, increased turbidity, underwater noise, and vibration during construction can disturb sensitive species such as dolphins and wintering migratory birds, leading to temporary or permanent displacement. The cumulative impact of such infrastructure development poses risks to Chilika’s ecological character, which has already undergone major transformations due to hydrological interventions in the past. This study highlights the need for integrated environmental assessment, hydrodynamic modelling, biodiversity monitoring, and mitigation strategies to ensure that developmental objectives are aligned with UN-SDG (Sustainable development goals) linked conservation priorities. This study will help Chilika Lagoon's long-term management frameworks that balance ecological connectivity with the preservation of its biodiversity.

Keywords: Chilika lagoon, SDGs, Bridge construction, ecology and biodiversity.

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Endogenous proline and Glycinebetaine level in four Rhizophoraceae mangroves on exposure to salinity and/or proline: a comparative study

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ABSTRACT

Mangrove species belonging to the family Rhizophoraceae occurring in mangrove belts of Odisha coast, India are facing increasing stress due to habitat loss and fragmentation. The destruction of mangrove forests for agricultural land, industrial activities, and pollution exacerbates the vulnerability of these ecosystems. Specifically, Rhizophoraceae family, which account for approximately 49.8% of the mangrove population in the region, are likely to be significantly impacted. To address such problems, application of various scientific methods and techniques are needed to augment vegetative propagation of mangroves species and their reintroduction into natural habitat. In this context, mass multiplication through shoot regeneration by decapitation from a single hypocotyl is a targeted tool. So, the present study was designed to proline and glycinebetaine level during *ex vitro* shoot multiplication in hypocotyls of fourmangrove species i.e *Bruguiera gymnorrhiza, Bruguiera parviflora, Kandelia candel and Rhizophora apiculata* in response to long term (10 day intervals up to 40 day) treatment with varied concentration of sodium chloride (100mM to 500mM) and fixed conc. (5mM) of proline. The result showed that with the increase of salt concentration and days of exposure, the content endogenous proline were increased in all studied species. In addition, the proline content was more pronounced in K. candel in compared with other three species. Statistical analysis revealed that proline content of the day after 10, 20, 30 and 40 were significantly different ($P< 0.05$) among all the species. However, the proline content was found statistically insignificant at control of all species with 100mM salt with/without proline in initial day (0 day) of treatment. Similarly, Glycinebetaine accumulation was more in response to high level of salt concentration with a processing days. *K. candel* registered the maximum accumulation of glycinebetaine than other species with high salinity. Whereas, Statistical study indicated that glycinebetaine content was statistically significant (P< 0.05) at all days of treatment even the day of initials. It may also be concluded that *K. candel* exhibited more tolerance to salinity than *B. parviflora*, *B. gymnorrhiza*, and *R. apiculata* possibly by more accumulation of osmolytes and it can easily survive well at 500mM NaCl condition under long term exposure (40 day), which is useful for mangrove restoration purpose.

Keywords- Mangrove, Multiple Shoot, Rhizophoraceae, Proline, Glycinebetaine

Quantification of Degraded Fishing Net Fragments on Coastal Beaches: A Rising Threat to Marine Life

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ABSTRACT

The accumulation of deteriorated fishing-net fragments along shorelines is an increasing source of coastal pollution and marine debris. These fragments originate from lost, abandoned, or damaged fishing gear and gradually break down due to waves, sunlight, and physical wear. Quantifying fishing-net debris on beaches is essential to assess the scale of the problem and identify areas where marine life and ecosystems are most at risk. Acknowledging the pressing need to tackle this rising concern, the Coastal Management Cell of the Odisha State Pollution Control Board has been conducting beach-litter assessments across selected tourist beaches—Gopalpur, Puri, Konark, and Chandipur—since 2023. Complementing this broader survey, the present study specifically examines the accumulation, quantification, and deposition of degraded fishing-net fragments along these tourist beaches. Seasonal surveys (summer, monsoon, and winter) were conducted along 1000 m × 20 m transects, with sampling areas subdivided into 1–3 sites based on topography and tourist activity. Each site included a 10 m × 10 m plot, with locations chosen both on the main beach and near fish-landing areas to assess the impact of fishing activities. After collection, debris samples were analyzed at the Coastal Management Cell laboratory following OSPAR (2010) guidelines. The survey identified various fishing-net materials, from macro- to meso-sized fragments, including tangled lines, strings, cords, ropes, and other discarded gear. Higher concentrations were found near fishing communities, while tourism-focused sites contained comparatively fewer items. The survey found that the annual average abundance of fishing-net debris across the four tourist beaches ranged from 0 to 14 items per 100 m², with mass between 0 and 229.25 gm/100 m² (10 m × 10 m), highest at Gopalpur and Puri and lowest at Chandipur. Although overall densities were lower than in other parts of India and litter levels have shown a decreasing trend over the years, these fragments continue to pose long-term risks to marine life through entanglement, ingestion, and microplastic formation. Even small pieces can persist for decades, entering the food web and disrupting ecosystems. These findings provide a foundation for mitigation, policy development, and public awareness efforts.

Keywords: Fishing-net debris, Quantification, Coastal pollution, Odisha beaches, Threat to marine life.

Marine Beach litter Pollution: Emphasizing Plastic Litter on Selected Tourist Beaches of Odisha

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ABSTRACT

Beach litter, persistent solid waste discarded in coastal areas, is mainly human-generated and transported by rivers, wind, or currents. It harms wildlife, degrades habitats, and impacts ocean health. Plastic litter has become a major global concern, with 5–13 million tons of debris, including 6.4 million tons of plastic, entering oceans annually, contributing to 5.25 trillion pieces worldwide. Beyond ecological damage, beach litter also imposes economic costs on tourism, fisheries, aquaculture, navigation, and coastal communities. Since 2023, the Coastal Management Cell of Odisha State Pollution Control Board has monitored plastic litter on selected tourist beaches. Seasonal surveys (summer, monsoon, winter) were conducted along 1000/ m × 20/ m transects at Gopalpur, Puri, Konark, and Chandipur, subdivided into 1–3 sites per beach. At each site, 10/ m × 10/ m plots were sampled, and collected debris was analysed in the laboratory following OSPAR (2010) marine litter guidelines. The survey recorded a wide range of meso- to macro-sized plastic debris across the beaches, including polythene and carry bags, food wrappers and containers, PET and beverage bottles, disposable cups, oil containers, Jerry cans, straws, bottle caps, medicine blisters, personal care and cosmetic items, shampoo packets, combs, toys, fertilizer/animal feed bags, plastic sheeting, pots, crates, jars, fishing buoys, and other unidentified plastic fragments. Analysis of two years of data showed that annual mean plastic litter on the four tourist beaches ranged from 10–84.5 items/100/ m^2 in 2023 and 14–58.5 items/100/ m^2 in 2024 (10/ m × 10/ m), with the highest values at Gopalpur (2023) and Puri (2024), indicating a declining trend. Seasonally, plastic deposition followed the order: winter/ >/ summer/ >/ monsoon. This seasonal pattern may be linked to higher tourist activity in winter. The survey found that the predominant beach litter on Odisha's tourist beaches consisted mainly of plastics, especially polythene bags, food wrappers, water and other soft beverages bottles. This may be improved by management practices and public awareness. Although litter density remained within permissible limits, these plastics pose long-term risks to marine life as they gradually break down into microplastics, which can enter the food web and disrupt ecosystems. The accumulation of such fragments along shorelines increases the risk of ingestion and other hazards to marine organisms. This preliminary study provides valuable insights for mitigation, impact assessment, policy development, management strategies, and public awareness.

Keywords: Beach litter, Plastic pollution, Trend analysis, Environmental impact, Tourist beaches, Odisha coastline.

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Wild Superfoods for Climate-Resilient & Nutritional Security

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ABSTRACT

Looking at the emerging population and climate change, it challenges food security. The promotion and exploration of wild superfoods, which are nutrient-rich and naturally resilient plant species, have gained attention for ensuring sustainable national security. Wild superfoods such as millets (*Pennisetum glaucum, Setaria italica* of the Poaceae family), Moringa (*Moringa oleifera),* Amaranth (*Amaranthus spp.*), Sweet Potato (*Ipomoea batatas*), Quinoa (*Chenopodium quinoa*), and Buck wheat (*Fagopyrum esculentum*) excel in marginal environments with minimal inputs, making them ideal crops for climate-resilient agriculture. This species is rich in micronutrients, antioxidants, vitamins, minerals and healthy fats which help to boost the immune system. For example, moringa leaves provide vitamin A and C, protein, and iron. Buckwheat is rich in fibre, protein, iron, riboflavin, and niacin. Millets and amaranth grain are drought-tolerant with significant quantities of calcium, magnesium and essential amino acids, making them suitable for conventional cereals. Quinoa is rich in fibre, protein, minerals, magnesium, phosphorus and vitamins. Beneficial for the immune system and promotes overall health. The formation of wild superfoods in local diets and agri-food systems contributes to diversified nutrition, ecological sustainability, and climate resilience. They require less water, adapt to poor soils, and capacity to restore degraded ecosystems, making them strategic resources for both rural livelihoods and environmental restoration. Promoting their cultivation and consumption can reduce dependence on climate-sensitive staple crops and foster food sovereignty. It represents a holistic solution linking biodiversity conservation, nutrition enhancement, and climate adaptation. Harnessing their potential through research, policy integration, and community engagement is crucial for building climate-resilient nutrition security in the 21st century.

KEYWORDS: Superfood, Climate resilient, Nutrition, Immune system.

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Biophysical Characterization of N-Terminal Mutants of *Mycobacterium leprae* HSP18 Reveals Their Roles in Structure, Stability, and Chaperone Function

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ABSTRACT

HSP18 of Mycobacterium leprae is an immunodominant antigen that belongs to small heat shock protein (sHSP) family and functions as a molecular chaperone. This chaperone activity is essential for survival and persistence of *M. leprae* in leprotic patients. Consistent with canonical sHSP architecture, HSP18 comprises of an N-terminal domain (residues 1-38), an alpha-crystallin domain (residues 39-121) and a C-terminal domain (residues 122-148). Experimental evidence supports the presence of bis-ANS binding sites, zinc-binding sites and T-cell epitopes within the N-terminal domain of HSP18 motivates us to hypothesize that this domain may be crucial for its structure, stability and chaperone function. To test this hypothesis, we constructed and purified several N-terminal deletion mutants of HSP18 alongside the wild-type/full-length variant. Chaperone activity, measured by aggregation suppression and thermal inactivation assays, decreased progressively with increasing lengths of N-terminal deletions and minimal activity was observed for the mutant devoid of entire N-terminal domain. Far-and near-UV circular dichroism analyses revealed significant secondary and tertiary structural perturbations in the deletion mutants. Synchronous fluorescence studies showed that perturbations in the tyrosine microenvironment were more pronounced than those in the tryptophan microenvironment upon sequential N-terminal deletions. Additionally, surface hydrophobicity and stability of the mutant proteins decreased with increase in the length of deletion. These findings highlight the critical role of N-terminal domain of HSP18 towards its chaperone activity, substrate specificity and structural stability. Altogether, this study provides a possible foundation for rational design and development of suitable HSP18 inhibitors in the context of effective treatment of leprosy.

KEYWORDS: Leprosy; Mycobacterium leprae HSP18; Molecular chaperone; Site directed truncation; Synchronous fluorescence.

Chronic Toxicity and Behavioural Effects of Neem-Based Biopesticides on Freshwater Fish *Channa punctata*

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ABSTRACT

Neem-derived biopesticides are frequently considered environmentally benign alternatives to synthetic chemical pesticides; nevertheless, their enduring impact on non-target aquatic organisms is insufficiently investigated.

The present study was conducted to assess the seasonal variation of pesticide residues at different stations along the Mahanadi River. The overall minimum and maximum values of key water quality parameters such as pH, dissolved oxygen (DO), alkalinity, hardness, and total dissolved solids (TDS) ranged between 6.2–7.6, 3–8.1 mg/L, 8–150 mg/L, 20.01–420.04 mg/L as CaCOƒ , and 12–324 mg/L, respectively. The concentration of nutrients such as nitrite, nitrate, phosphate, and ammonia varied between 0.001–0.254 µg-at-NHƒ -N/L, 0.115–4.9 µg-at-NO, -N/L, 0.142–0.495 µg-at-NOƒ -N/L, and 0.096–4.32 µg-at-PO„ -P/L, respectively. The BOD and COD values ranged from 0.11–6.4 mg/L and 0.4–19.0 mg/L, respectively. All physicochemical parameters were within prescribed limits for aquatic life.

In the experiment, juvenile *C. punctata* were subjected to chronic exposure of sub-lethal and ecologically pertinent concentrations of the neem formulation for a duration of 28 days within a controlled laboratory environment. The exposure conditions were intended to simulate realistic contamination scenarios arising from the frequent application of biopesticides in agricultural lands adjacent to the Mahanadi basin. A variety of behavioural traits, including swimming performance, balance maintenance, opercular movement, surfacing pattern, mucus secretion, and feeding responses, were systematically documented throughout the exposure period. We also looked at growth-related factors like weight gain and condition factor. We made sure to keep the water quality parameters stable so that we could be sure that the effects we saw were only due to the toxicant.

The results show that *C. punctata* behaviour changed in a way that wasn't lethal after being exposed to neem-based pesticides for a long time. The affected fish moved in an unsteady and erratic way, came to the surface often to gulp air, had less opercular activity, released a lot of mucus, and sometimes lost their balance. The feeding behaviour gradually diminished,

corresponding with decreased growth and inferior condition factors relative to the control group. Even though no deaths happened at the tested levels, the combined behavioural and physiological stress showed that overall health and adaptation effectiveness were going down.
The outcomes demonstrate that neem-based biopesticides, despite their natural origin, can adversely affect non-target freshwater organisms under sustained exposure. Altered behaviours related to respiration, feeding, and energy balance may ultimately impair survival, reproduction, and ecological performance of *C. punctata* populations in the Mahanadi River ecosystem.

KEYWORD: *C. Punctata*, Biopesticide, Toxicant, Behaviour, Mahanadi, BOD, COD.

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Integrative Computational Approach for *Homalium napaulense* (DC.) Benth. Bioactive compounds: PASS Prediction, Drug-Likeness, and Docking Studies for Wound healing

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ABSTRACT

Wounds are an increasing worldwide health concern that affects patient and healthcare facilities in many significant manners on both social and commercial levels. Wound healing progress through several sequential phases including inflammation, proliferation, extracellular matrix formation and remodeling. *Homalium napaulense,* a medicinal tree that belongs to Salicaceae, has been ethnobotanically used by tribal people of Odisha and Andhra Pradesh for treating wounds. The present investigation aimed to scientifically validate these ethnopharmacological practices using computational *in silico* approaches. This study provides, the first *in silico* prediction of the bioactive compounds present in the stem extract of *H. napaulense* along with their molecular docking interactions, to evaluate their potential inhibitory effects against the possible therapeutic targets like TNFá, MMP9 and VEGF. The identification of bioactive compounds present in our sample were identified by GC-MS analysis. The PASS prediction revealed high probabilities for pharmacological activities related to wound healing. We also evaluated the drug likeness, physiochemical properties and toxicity profile of bioactive compounds using Swiss ADME and Protox 3.0 software online tool. *In silico* studies it uncovered that eight compounds out of 25 compounds have acceptable drug-likeness properties. The identified compound with PubChem Id (6782) exhibited strong binding affinity against TNFá (2AZ5) and MMP9(1GKC) with binding energies of -7.33 and -7.70 kcal/mol respectively, whereas compound with PubChem Id (6423865) showed notable affinity for the VEGF (1FLT) with binding energy of -6.40 kcal/mol. The results indicated that *H. napaulense* may have the ability to repair wounds and might serve as a promising source for the discovery of potential drug candidates. Further in vivo investigations are required to validate our findings.

KEYWORDS: Wound healing, *Homalium napaulense*, GC-MS analysis, Molecular docking.

Exploration of the bactericidal property of the Indian Ghost Grasshopper (*Aularches miliaris*, Linn, 1758) Wing – A bioinspirational Surface

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ABSTRACT

Contamination of dental and orthopaedic implants, biomedical devices, loss of thermal control due to biofouling-mediated water clogging in industrial systems, corrosion of the ship's bottom, and microbial growth-mediated skin infections resulting from the wetting of clothes are common global problems associated with microbial biofilm formation. Therefore, there is a demand for antiwetting, antifouling and antibacterial surfaces in the material industry, biomedical industry, marine transportation sector and textile industry. Bacterial biofilm formation and contamination are common problems in the sectors above, causing adverse effects on human health, transportation, and quality of life. Common methods of treating bacterial biofilms are limited to chemical-based killing. However, bacteria are becoming increasingly resistant to chemical methods and have developed antimicrobial resistance over the decades. Hence, physical-based killing of bacteria is an emerging approach to diminish resistance. Nature has been a constant source of inspiration for solving various problems. Insects of the kingdom Animalia are adapted with self-cleaning, bactericidal, antiadhesive, antiwetting, and antifungal wings due to the presence of micro/nano-architectures on their wings. Therefore, the chemical and physical properties of the wings of insects can serve as inspiration for solving multiple problems. In the current study, we examined the wings of the Indian Ghost Grasshopper (*Aularches miliaris,* Linn, 1758) species to detect the surface micro-architectures and their effect on bacterial species. The wing's chemical composition, crystallinity, and hydrophobicity were measured using Fourier Transform Infrared Spectroscopy, X-ray diffraction, and a Drop Shape Analyser, respectively. A Scanning Electron Microscope was employed to study wing microarchitecture and elemental composition. Fourier Transform Infrared Spectroscopy and X-ray Diffraction study of the hydrophobic wing confirmed the presence of antibacterial compounds like chitin, melanin, and carotenoids. Confocal Laser Scanning Microscopy and Environmental Scanning Electron

Microscopy confirmed the death of the bacteria due to mechanical stress on the wing. Material scientists and engineers can utilise the surface architecture and chemical composition in multiple fields where antibacterial, self-cleaning, antifouling, and surface hydrophobicity are of prime interest.

KEYWORDS: Grasshopper, antibacterial, hydrophobic, chitin, melanin.

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Bacterial Biopriming: A Novel Approach for Conservation of Threatened Plant Species in Alignment with SDG 15

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ABSTRACT

The conservation of threatened plant species is recognised globally as a key priority under Sustainable Development Goal 15 (Life on Land), which emphasises the restoration of terrestrial ecosystems and the protection of biodiversity. In this context, bacterial biopriming emerges as a promising green biotechnology tool to enhance seed germination, vigour, and early growth of species facing natural regeneration constraints. The present study explores the biopriming potential of beneficial rhizobacteria isolated from cow dung and rhizosphere soils to promote the germination and seedling development of *Pterocarpus marsupium* Roxb., a highly valued and threatened medicinal tree species recommended under the Department of Biotechnology (DBT), Government of India's priority plant (IUCN Red book listed) for conservation. *P. marsupium* possesses remarkable pharmacological and economic importance due to its bioactive compounds with antidiabetic, antioxidant, and antimicrobial properties. However, its natural propagation is limited by seed dormancy and poor germination rates. Through bacterial biopriming, selected isolates exhibiting plant growth-promoting traits such as indole-3-acetic acid (IAA) production, phosphate solubilization, and ACC (1-aminocyclopropane-1-carboxylate deaminase) activity were applied to seeds. The results revealed a marked increase in germination percentage (up to 88% compared to 52% in controls), seedling vigour index (1.8-fold higher), and enzymatic antioxidant activity. Chlorophyll content and root–shoot length also showed significant improvement ($p < 0.05$), indicating enhanced physiological performance and stress resilience. These findings confirm that bacterial biopriming effectively mitigates dormancy barriers and accelerates early seedling establishment. This eco-friendly and low-cost biotechnology approach not only facilitates large-scale propagation but also contributes directly to ex-situ conservation, biodiversity restoration, and the achievement of SDG 15 targets. The study underscores the potential of

integrating microbial-assisted seed priming into sustainable forest management and conservation programs for threatened plant species globally.

KEYWORDS: Biopriming; Biodiversity restoration; Plant growth-promoting bacteria (PGPB); SDG 15; Threatened plant conservation.

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Ochratoxin A's in-ovo effects and N-acetyl cysteine's therapeutic effects in white pekin duck eggs

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ABSTRACT

An investigative study was designed to observe the effect of Ochratoxin A (OTA) and its amelioration by the administration of N-Acetyl Cysteine (NAC) in white Pekin Ducklings at ICAR- Regional Station, Directorate of Poultry Research, Bhubaneswar. Growth performances, body weight gains, hatchability, feed conversion ratio were studied besides haemato-biochemical alterations in those survived ducklings. There was improved hatchability in those eggs exposed with NAC (52%) as compared to OTA inoculated eggs (18%). Eggs exposed both to OTA on Zero day and NAC on 22nd day showed an intermediate hatchability of 32%. Similar trends also recorded with respect to body weight gain which showed a significantly lowest in OTA exposed eggs while relatively increased body weight observed in those eggs exposed with NAC. There was significantly lowered concentrations of Hb, PCV and TEC suggesting anaemia as well as leucocytopenia and thrombocytopenia in OTA exposed groups. Serum biochemistry in OTA exposed grops revealed an increased concentrations of liver specific marker enzymes like SGPT, SGOT as well significantly increased kidney specific markers as compared to NAC exposed groups. Pathomorphological changes in dead embryos inoculated with OTA showed stunted growth, hydrocephalous, microphthalmia, haemorrhgic as well as congested liver and kidney. Microscopic lesions predominantly concentrated in kidney as well as liver characterized by glomerular atrophy, degenerative changes in PCT, megalocytic hepatocytes with vacoular changes. Immune organs like thymus and Bursa of Fabriciuos showed atrophy and depletion of lymphoid follicles.

KEYWORDS: Ochratoxin A, N-acetyl cysteine, Pekin ducklings, hepato-renal toxicity, embryotoxicity.

Systems biology approach to identify core host genes and candidate drug interactions in Tuberculosis

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ABSTRACT

Tuberculosis (TB), caused by *Mycobacterium tuberculosis* (Mtb), continues to pose a major global health challenge due to the emergence of multidrug-resistant (MDR) strains, limitations of the existing BCG vaccine, and complex host–pathogen interactions. Understanding the genetic determinants associated with TB susceptibility is essential for the development of improved diagnostics and therapeutics. In this study, we systematically mined TB-associated genes using the NHGRI Genome-Wide Association Studies (GWAS) Catalog and performed functional annotation through Gene Ontology (GO) enrichment analysis using the annotation platform. Gene–gene interaction networks were constructed via STRING and GeneMANIA to identify key regulatory genes. Disease–drug association analyses were conducted using WebGestalt to explore potential therapeutic relationships. A total of 89 genes were initially retrieved from GWAS data, of which four HLA-DRB1, HLA-DQB1, NAT2, and BTNL2 emerged as major genes implicated in TB. Network analysis revealed a core cluster of 12 highly interacting genes, suggesting their pivotal roles in immune regulation during TB infection. WebGestalt identified two drug candidates, *immune globulin* and *lumiracoxib*, associated with nine key TB-related proteins. Protein structures were retrieved from UniProtKB and PDB, and active sites were predicted using CASTp. Molecular docking using AutoDock 4.2 showed that lumiracoxib demonstrated the most favorable binding energies with HLA-DQA1 (“6.03 kcal/mol), HLA-DQB1 (“5.84 kcal/mol) and HLA-DRB1 (“4.96 kcal/mol), whereas immune globulin showed significant interaction with HLA-DRB1 (“4.84 kcal/mol) and HLA-DMA (“4.41 kcal/mol). These findings suggest that host genetic variations significantly modulate TB susceptibility and drug responsiveness. The identified gene–drug interactions provide a foundation for personalized therapeutic strategies and support future development of synthetic or repurposed drugs targeting host immune pathways in TB.

KEYWORDS: Tuberculosis,Gene network, Molecular docking, *immune globulin, lumiracoxib.*

Pathological investigation and molecular confirmation of Lumpy Skin Disease

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ABSTRACT

Lumpy skin disease (LSD) is a trans boundary and re-emerging disease of cattle resulting sever morbidity as well as economic setback in dairy industry. Present investigation was aimed to have a detail investigation on a field outbreak suspected of LSD in four villages of Ganjam district. There was screening of 143 cattle for LSD infections based upon the presence of typical clinical signs in the skin and systemic illness varying from pyrexia, in-appetence and oculo-nasal discharges. Typical LSD cutaneous nodules in present study were predominant on head and neck with least occurrences of cutaneous nodules of variable size (1-5 cm) observed in the limbs. Younger cattle less than one year age suffered mostly (47%). There were increased incidences of LSD among females (93%). Blood parameters showed anaemia and thrombocytopenia followed by neutrophilia. Serum biochemistry recorded a significant increased liver (ALT, AST) and kidney specific biomarkers (BUN, Creatinine) in affected cattle. Lesions on skin varying from flat topped papules, fibrotic patches to ulcerated one owing to secondary bacterial infections. Microscopic lesions typically recorded the presence of intra-cytoplasmic inclusions as well as vasculitis, thrombosis with heavy infiltrations of inflammatory cells. Molecular confirmation was done through polymerase chain reaction of the LSD virus collected from skin biopsy in infected cattle with primers targeting 151 bp segment of LSD044 strain.

KEYWORDS: Lumpy skin disease, cattle outbreak, cutaneous nodules, molecular diagnosis (PCR), and haemato-biochemical alterations.

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Multiple regression approach to determine the effect of weather parameters on yield of potato in Odisha

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ABSTRACT

Potato is an important commercial and food crop in Odisha, contributing significantly to nutritional security and rural livelihoods. Potato cultivation in Odisha plays a central role in the state's vegetable production, with the cropping season predominantly spanning the Rabi months from November to February. The districts with highest yield of potato in Odisha are Nabarangpur, Rayagada, Puri, and Deogarh. Despite the increasing demand, production levels in the state remain inadequate to meet market needs. This gap could be influenced by variations in weather parameters such as temperature, rainfall, clear sky photosynthetically active radiation (PAR) and relative humidity during the crop's growing period. Understanding these climatic effects on yield is essential to improve productivity and ensure stability in potato cultivation across major districts of Odisha. Hence, the present study aims to analyze the influence of weather variables on potato yield using a multiple regression approach.

The study spans the period from 1996–97 to 2023–24, considering five major climatic variables—minimum temperature, maximum temperature, rainfall, and relative humidity. Monthly data from October to April, corresponding to the potato growing season, are used for analysis. Through multiple regression, all four weather parameters for each month of the growing period are regressed with yield to identify the most influential climatic variable. The month-wise results are further regressed with yield to determine the single climatic factor exerting the highest effect on productivity. Significant p-values are considered for months, helping to identify the critical growth stages affected by climatic variations.

April month rainfall has the highest significant positive effect on yield of potato. December month maximum temperature has significant negative effect on yield of potato. December month minimum temperature has a significant negative effect whereas, March month minimum temperature has significant positive effect on yield of potato. October month relative humidity has significant negative effect on yield of potato whereas April month relative humidity has significant positive effect on yield of potato. March and April month PAR have significant negative effects on yield of potato.

KEYWORDS*:* Potato, Climate, Yield, Multiple Regression, Odisha.

ISOLATION AND CHARACTERIZATION OF FUNGAL ENDOPHYTIC FRACTIONS ASSOCIATED WITH LEAVES OF MORINGA OLEIFERA LAM. FOR IN VIVO HEPATOPROTECTIVEACTIVITY IN CCl_4 INDUCED RATS

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ABSTRACT

The study of endophytes among the various microbial systems develops into a significant area of research for its significance in agriculture and medicine. Endophytes are tiny organisms that coexist symbiotically with robust plant tissues to live there. The goal of the study was to isolate, characterize, and screen the fungal extracts for in vitro antioxidants and in vivo hepatoprotective activity from the leaves of Moringa oleifera. One fungal endophyte, designated as MOL-1, was isolated and fermented to produce chloroform, ethyl acetate and n-butanol, (MOLC, MOLEA, MOLnB) extracts. In vitro free radical scavenging activity was carried by 2, 2-diphenyl-1-picrylhydrazyl (DPPH), hydroxyl radical and reducing power. MOLEA and MOLnB showed significant free radical scavenging activity. MOLEA and MOLnB (50 & 100 mg/kg) reversed the increased biochemical parameters such as serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), serum alkaline phosphate (SALP), total bilirubin, and direct bilirubin, as compared to CCl4 induced group (***$p<0.0001$).MOLEA and MOLnB (100 mg/kg p.o) also restored the lipid peroxidation (LPO), superoxide(SOD) and catalase (CAT) levels. Endophytic extracts showed liver protection and can be further utilized for pharmacological functions. MOL-1 was recognized as an isolate of Rhizopus stolonifer AR1 by PCR sequential analysis.

KEYWORDS: Moringa oleifera, Rhizopus stolonifer AR1, Endophytic fungi, Hepatoprotective, Antioxidant.

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Efficacy of *Carum copticum* extract as a green pesticide against the rice grain moth *Sitotroga cereallela.*

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ABSTRACT

Rice grains are susceptible to attack by numerous insect pests. *Sitotroga cereallela* is a significant major pest that infests rice grains. Synthetic chemical pesticides cause consumers serious health issues. The current investigation sought to extract phytochemicals from *Carum copticum* by Soxhlet extractor using methanol as organic solvent and evaluate its ability to combat the major pest *Sitotroga cereallela.* Mass spectroscopy and gas chromatography (GCMS) were used to identify the major bioactive chemicals in *Carum copticum*, and there were Thymol (C10H14O), Benzene 1-methyl ($C_{10}H_{14}$),7-Oxabicycloheptane ($C_{10}H_{18}O$), 1-Pentene4-methyl (C_6H_{12}) and Octane (C_8H_{18}). *Sitotroga cereallela,* was exposed to three distinct concentrations of the plant's crude and fractions of extract of organic solvents extract (hexane, ethyl acetate, and methanol). All concentrations caused substantial mortality of its eggs and grownups. The methanol fraction and crude extract showed significant adulticidal effects after 10 days of treatment, with 87.11 ± 2.21% and 70.10 ± 2.52%, respectively. A sex ratio imbalance, an extension or reduction of the developmental phases, decreased fecundity, and limited fertility were further manifestations of the biological action of *Carum copticum* extracts on the insects. In comparison to the control, the hexane fraction produced fecundity averages of 55.33 ± 2.01 eggs, and elevated levels of the fraction of ethyl acetate produced 41 ± 0.25 eggs, or a rate at which the spawning of rate at which the spawning of52.93% and 63.25%, respectively This study shows that the efficacy of *Carum copticum* is due to the active chemicals present in the extract that can be employed as a biocontrol agent against the major pest *Sitotroga cereallela* infection.

KEYWORDS: *Sitotroga cereallela*, Rice grains, Biocontrol, GCMS.

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Molecular docking analysis of eugenol against oral cancer molecular targets

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ABSTRACT

Oral cancer is one of the most common malignancies in developing countries, with high morbidity and mortality rates due to late diagnosis and limited therapeutic options. The exploration of natural compounds from plants offers a promising strategy for novel anticancer drug discovery. In this study, an *in-silico* analysis was carried out to evaluate the anticancer potential of eugenol, a phytocompound, against key molecular targets involved in oral cancer. The information about eugenol was retrieved from the PubChem database, and its molecular structure was optimized for computational screening. Target proteins associated with oral carcinogenesis, including EGFR, AKT1, HIF1A, P53, SRC, BCL2 and STAT3 were obtained from the Protein Data Bank (PDB) for molecular docking studies using online HDOCK docking server. The docking results revealed that eugenol exhibited strong binding affinities and stable interactions with crucial amino acid residues of EGFR and BCL2, comparable to other oral cancer targeting proteins. The binding energy performed by docking analysis are Eugenol with BCL2 (-91.40 kcal/mol), EGFR (-90.74 kcal/mol) showing best score relevant to others showing relevant good score like Eugenol with STAT3 (-78.81 kcal/mol), P53 (-78.43 kcal/mol), SRC (-76.62 kcal/mol), HIF1A (-75.66 kcal/mol) and AKT1 (-71.03 kcal/mol). The findings highlight the therapeutic potential eugenol as natural inhibitor of oral cancer progression. Further *in vitro* and *in vivo* studies are recommended to validate these computational results and to explore their mechanisms of action for potential clinical application.

KEYWORDS: *In-silico* analysis; *Eugenol*; Oral cancer; HDOCK; EGFR; BCL2.

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Computational Profiling of selected *Aegle marmelos* Phytochemicals for Wound Healing

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ABSTRACT

Impaired wound healing remains a significant global health concern due to rapid increase cases of *Diabetes mellitus* in recent years. Microbial infections, oxidative stress, and dysregulated inflammatory responses are major symptoms of the disease. In current time medicinal plants have gained considerable attention as alternative therapeutic agents because of their safety, affordability, and the presence of bioactive phytochemicals capable of enhancing tissue repair. *Aegle marmelos* (Bael), a well-known medicinal plant in traditional Ayurveda and folk medicine, has emerged as a promising candidate for natural wound-healing formulations owing to its rich phytochemical composition and diverse pharmacological properties. Phytochemical investigations reveal that *A. marmelos* contains a variety of bioactive constituents including flavonoids, tannins, phenolic acids, alkaloids, and essential oils which are very much helpful to wound healing. In the present study ten numbers of phytochemical constituents such as Halfornidol, Skimmianine, p-Mentha-1,3,8-triene, 2-Methoxy-4-vinylphenol, Bicyclogermacrene, Myrtenol, Myrtenyl acetate, from IMPPAT were chosen by help of literature review. These compounds contribute synergistically to its antioxidant, anti-inflammatory, antimicrobial, and collagen-modulating activities, all of which are essential for effective wound healing. An in sillico investigation was carried out for establishing the efficacy of phytoconstituents through docking and drug likeness properties of the small molecules were studied through Swiss ADME.4KDS was taken for the study of docking. Basically, The BOILED-Egg, iLOGP and Bioavailability Radar were estimated to find out the best small molecule which can be evolved as a lead molecule for treating the disease. The docking study revealed that Bicyclogermacrene showed the highest docking result of -5.01 Kcal/ Mol. which shows a close affinity with selected protein followed by Skimmanine-4.9Kcal/

Mol.However,2-methoxy-4-vinylphenol depicted a result of -1.8Kcal/Mol. which infers that the small molecule has very less attraction towards the protein and cannot be selected as a novel compound. Myretnol has XLogP3(Lipophilicity)value of 2.2. Future research is needed to establish its efficacy in human wound-care applications and to promote its integration into modern herbal therapeutics.

KEYWORDS: Wound Healing, *Aegle marmelos*,, Insilico, Docking,4KDS, Swiss ADME

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Flacourtia jangomas: A minerals rich wild fruit

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ABSTRACT

Fruits that are rich in nutrients and have mineral properties are essentially required for human health. The southeastern region of India is globally recognized as one of the major biodiversity hotspots, home to a rich variety of indigenous fruit crops. Many of these native fruits, despite their nutritional value, remain underutilized and receive less attention in terms of research, market development, and commercial cultivation compared to widely grown fruits. These fruits play an important role in ensuring the livelihood and nutritional security of local communities who depend on them for food and income. Flacourtia jangomas, also known as Indian coffee, plum or Paniol, is one such underutilized fruit species that grows naturally under semi-wild conditions in Assam, Odisha and other parts of Southeast India. However, very little information is available on its nutritional properties. Therefore, present study was designed to profiling minerals content of *Flacourtia jangomas.* Results of the study revealed that this fruit contain Sulphur (445.18 mg/kg), Potassium (2683.23 mg/kg), Magnesium (461.19 mg/kg), Manganese (93.75 mg/kg), Phosphorus (93.68 mg/kg), Calcium (1808.60 mg/kg), Iron (0.96 mg/kg), Nickel (7.59 mg/kg), Zinc (5.65 mg/kg), Copper (37.65 mg/kg). The findings provide a baseline mineral profile and help raise public awareness, promoting biodiversity conservation in the forest areas of Gajapati district, Odisha.

KEYWORDS: *Flacourtia jangomas,* Mineral properties.

In Silico investigation of phytocompounds of black ginger (*Kaempferia parviflora*) extract against breast cancer targets

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ABSTRACT

Breast cancer remains one of the most prevalent malignancies among women worldwide, necessitating the development of novel and effective therapeutic strategies with minimal side effects. Natural phytochemicals have emerged as promising candidates for anticancer drug discovery. In this study, an *in silico* investigation was conducted to evaluate the anticancer potential of bioactive compounds derived from *Kaempferia parviflora* (black ginger) against key molecular targets associated with breast cancer progression. Major phytoconstituents such as 5,7-dimethoxyflavone, 5,7,42 -trimethoxyflavone, 3,5,7,32 ,42 -pentamethoxyflavone , 5-Hydroxy-7,4' –dimethoxyflavanone, 1,3-Dihydroxy-2-ethoxymethyl-anthraquinone, Retusine, Denbinobin, Tectoruside, 5-Hydro-7,8,2' –trimethoxyflavanone, Acacetin-7-galactoside, Viscumneoside VI, 5-Hydro-7,8,2' –trimethoxyflavanone, and 3 ',5-Dihydroxy-7,4' -dimethoxy flavones were retrieved from the PubChem database, and their structures were optimized for molecular docking studies. Target proteins implicated in breast cancer, including estrogen receptor alpha (ERá), human epidermal growth factor receptor 2 (HER2), and epidermal growth factor receptor (EGFR), were selected from the Protein Data Bank (PDB). Docking analysis was performed using HDock online server to assess binding affinities and interaction profiles. The results demonstrated that certain flavonoids from black ginger exhibited strong binding interactions with critical amino acid residues of ERá and HER2, comparable to standard reference drugs such as tamoxifen. Overall, the *in silico* findings suggest that *Kaempferia parviflora* possesses significant potential as a source of natural lead compounds for the development of novel breast cancer therapeutics. Further *in vitro* and *in vivo* validation studies are warranted to confirm these computational predictions and elucidate their molecular mechanisms.

KEYWORDS: *Kaempferia parviflora*; Breast cancer; Molecular docking; HER2; PDB.

Neuroactive Ligand-Receptor Pathway Modulation by *Sterculia lychnophora* Phytochemicals in Parkinson's Disease

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ABSTRACT

Parkinson's disease (PD) ranks as the second most common neurodegenerative disorder. This research focused on examining the antiparkinsonian properties of phytochemicals found in the methanolic extract of dried *Sterculia lychnophora* fruit in rats induced with Haloperidol. The crude extract obtained was subjected to phytochemical screening through chemical tests. The analysis confirmed the presence of alkaloids, carbohydrates, saponin, and fatty acid ester, and these were separated using GC-MS, revealing 60 constituents. We developed a treatment approach aimed at inhibiting Monoamine Oxidase B (MAO-B) and Alpha synuclein using the same compound. To validate the above hypothesis RNA-seq data from publicly available datasets (BioProject: PRJNA608432; GEO: GSE145814) were examined to identify DEGs and pathways linked to neuroactive ligand-receptor interaction. In addition to RNA Seq analysis, molecular docking, MMGBSA, and ADME/T analyses were conducted to identify potential therapeutic mechanisms of ligands. Compound like Ascorbic acid 2,6-dihexadecanoate demonstrated a stronger binding affinity to the target proteins than Levodopa, a commonly used medication for Parkinson's disease, indicating its potential for curative use. The obtained methanolic crude extract was assessed by different studies including redox status, behavioural paradigms, biochemical markers, and histological observation in the brains of rats for its antiparkinsonian benefits against Haloperidol-induced PD model. The findings indicate that the methanolic extract may alleviate motor impairments, decrease oxidative stress, and preserve neuronal integrity in rats with Parkinson's disease. Studies indicate that methanolic extract shows potential to modulate various molecular mechanisms associated with PD.

KEYWORDS: RNA Seq analysis, Molecular docking, MMGBSA, ADMET, Neuroprotection.

Nutritional Composition and Bioactive Potential of Date Palm Heart (*Phoenix Dactylifera L.*)

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ABSTRACT

The palm heart, often referred to as the heart of palm, is the tender inner core of the date palm tree. It is derived from the young shoots that grow from the main trunk or branches, which are covered with large, protective leaves. Typically, palms that are four to five years old are selected for harvesting palm heart. The palm heart is white, cylindrical, and soft in texture, making it a delicacy in many cuisines. It is also known as palmetto and guomar. It is often featured in salads, soups, and fine dining recipes, where its mild flavor and crisp texture add a touch of elegance. In terms of its nutritional composition, studies on the Zaghloul variety (*P. dactylifera*) of date palm heart have revealed the following values after oven-drying at 50°C; 8.74 ±0.10% moisture, 23.08 ±0.21% protein, 3.73 ±0.11% ash, 0.56 ±0.08% fat, 5.50 ±0.15% fiber, and 58.39 ±0.61% carbohydrates. The ethanolic extract of palm heart has also been found to contain high levels of bioactive compounds, specifically phenols and flavonoids, which are known for their health-promoting effects. The total phenolic content has been reported at 79.65 ± 2.56 mg GAE/g, and total flavonoids at 37.75 ± 1.9 mg QE/g. Through GC-MS analysis, a range of important antioxidant compounds has been identified, including gallic acid (85.69 mg/g), chlorogenic acid (108.85 mg/g), catechin (70.63 mg/g), caffeic acid (132.38 mg/g), and rutin (136.22 mg/g). Other minor yet significant components include quercetin, ferulic acid, ellagic acid, naringenin, and kaempferol. Among these, gallic acid, rutin, chlorogenic acid, and caffeic acid stand out as the dominant phenolic compounds, providing strong antioxidant properties. This is supported by the low IC… € value of 73.97 ìg/mL, indicating potent free-radical scavenging ability. Antioxidants like these play a crucial role in protecting the body from oxidative stress, cancer, and cardiovascular diseases. Moreover, the flavonoids found in palm heart contribute notable anti-inflammatory benefits. Because of these properties, bioactive phenolic compounds from palm hearts are attracting growing interest in the food, pharmaceutical, and chemical industries. Research continues to highlight the anti-inflammatory, and antibacterial qualities of these compounds. Regular consumption or application of palm heart extracts could help lower the risk of cardiovascular diseases, diabetes, and certain cancers. In short, the palm heart is far more than an ingredient; it is a nutrient-rich, health-promoting natural resource with vast potential across multiple industries.

KEYWORDS: Palm heart, Nutritional Composition and Bioactive Potential.

Phytochemical Diversity and Bioactive Potential of *Citrus aurantifolia* Peel Essential Oils from Odisha

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ABSTRACT

Lime (*Citrus aurantifolia*) is widely cultivated and processed globally, yet more than half of the fruit, comprising peel, seeds, and dehydrated flesh, remains underutilized, contributing substantially to food-processing waste. Valorization of this biomass aligns with sustainable development goals by reducing environmental burden and enhancing economic value. In the present study, the phytochemical diversity of the lime peel essential oils (EOs) collected from twenty accessions representing ten agroclimatic zones of Odisha, India, was assessed. Essential oils obtained through hydro-distillation were analyzed using GC–MS, revealing significant qualitative and quantitative variability among accessions. Limonene (47.75-56.79%), â-ocimene (16.45-30.91%), ã-terpinene (5.06-9.47%), â-pinene (3.23-10.69%), and citronellal (5.29-13.35%) constituted the dominant volatile constituents across samples. Antimicrobial evaluation demonstrated pronounced activity particularly against *Klebsiella pneumoniae* and *Escherichia coli*, while antioxidant potential assessed via DPPH radical-scavenging assay showed considerable variation. Parenthetically, the Ca 20 accession exhibited the highest peel (0.9 ± 0.02%) and an exceptional antioxidant capacity (IC… € = 3.1 µg/mL), surpassing ascorbic acid (IC… € = 4.12 µg/mL). These findings underscore the significant impact of agroclimatic heterogeneity on EO composition and highlight the potential of *C. aurantifolia* peel oils as promising natural resources for pharmaceutical, nutraceutical, cosmetic, and industrial applications. This study provides a scientific basis for the sustainable utilization of citrus waste and supports future development of region-specific lime cultivars and optimized EO production strategies.

KEYWORDS: Lime, GC-MS, agroclimatic zone; antioxidant activity; antimicrobial activity.

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Histomorphology and transcriptomic insights into retinoid treated tail regeneration in the tadpoles of the Indian tree frog

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ABSTRACT

The phenomenon of tail regeneration represents a complex and intriguing biological process that has been extensively examined across various animal models. The extraordinary regeneration capabilities of anuran amphibians have attracted researchers' interest for many decades. Tadpoles of the Indian tree frog, *Polypedates maculatus* have been used as a model to study regeneration as many of its appendages can regenerate. Its tail regeneration process encompasses the restoration of muscle, spinal cord, vasculature, and skin, each of which adheres to specific spatial configurations. In contrast, the administration of retinoic acid, incites a transdifferentiation reaction among the cells in the tail, leading to the formation of pelvic girdle cells, which include components of the hindlimbs. The present study aims to investigate the histomorphology and transcriptome dynamics of retinoid treated tail regeneration at different time points. The outcomes of such treatment varied; they include the aberrant development of ectopic hindlimbs, the formation of substantial bulbous masses, and instances of incomplete and aberrant regeneration, particularly evident at the cut end of the treated tails. Histological analysis revealed that the control tail tissues closely resembled the original tail tissues. In contrast, retinoic acid-treated tail tissues exhibited a multilayered epidermal structure accompanied by a discontinuous basement membrane. Furthermore, the characteristic chevron patterning of muscle bundles was disrupted, with the notochord appearing in patchy formations. High-throughput transcriptome sequencing elucidated the transcriptional dynamics associated with distinct phases of tail regeneration in retinoid-treated tadpoles. The results from the differential gene expression analysis indicated the presence of specific transcriptional signatures associated with several biological processes. Noteworthy among these were markers for cytoskeletal reorganization, extracellular matrix remodeling involving MMP9 and collagen genes, stem cell activation, as well as inflammatory responses. Furthermore, the retinoid-treated tails exhibited an upregulation of tumorigenic genes which are integral to the homeotic transformation process. These findings signify the complexity of cellular responses elicited by external morphogen stimulation and their consequential impact on regeneration processes. This study aims to serve as a molecular framework for understanding vertebrate tail regeneration while also elucidating conserved pathways that may enhance future regenerative medicine applications.

KEYWORDS: *Polypedates maculatus*, tail, transdifferentiation, retinoid, Cytoskeletal reoganization

Graphene oxide - Carbon dot fluorescent hybrids for Optical Glucose Detection

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ABSTRACT

A fluorescent based nanosensor has been developed for glucose monitoring. The nanosensor is based on a nanocomposite comprising nitrogen doped carbon dots (N-CD) and graphene oxide (GO), where the interaction between N-CDs and GO results in a significant reduction in fluorescence intensity. Upon the introduction of glucose, the quenched fluorescence is effectively restored due to specific interactions between glucose molecules and the oxygen rich surface of GO. The sensor demonstrates a strong linear response over a broad concentration range, along with excellent stability, reproducibility, and selectivity against common interfering biomolecules. These findings highlight the potential of the N-CDs/GO nanocomposite as a rapid, cost-effective, and highly sensitive platform for glucose sensing in biological samples.

KEYWORDS: Glucose; Fluorescence sensing; Carbon dots; Graphene oxide; Nanocomposite

Green Synthesis and Structural Characterization of Copper Oxide Nanoparticles Mediated by *Lantana camara* Leaf Phytochemicals

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ABSTRACT

Effective agricultural pest management depends on agrochemicals that are target-specific, efficient, and environmentally sustainable. Phyto-derived biopesticides delivered through nanocarriers offer a promising alternative to conventional chemo-synthetic agrochemicals. The abundant phytochemical content of the medicinal shrub, *Lantana camara* (family Verbenaceae), suggests its potential utility in eco-friendly insect control strategies. The present study aimed to examine the phytochemical profile of *L. camara* leaf extracts and optimize the green synthesis of copper oxide (CuO) nanoparticles for potential use as nanoconjugates or nanocarriers in pest management.

Leaves of *L. camara* were subjected to maceration (MAC) and ultrasound-assisted extraction (UAE) using aqueous and ethanolic solvents to isolate secondary metabolites. Qualitative and quantitative phytochemical analyses confirmed the presence of key bioactive compounds, including alkaloids, phenols, flavonoids, tannins, terpenoids, and saponins. CuO nanoparticles were synthesized via the bio-reduction of $CuSO_4 \bullet 5H_2O$ using the plant extracts under ambient conditions. Observable colour changes, from light blue to dark green or brown, confirmed the reduction of Cu^{2+} ions and subsequent nanoparticle formation. The nanoparticles were characterized using UV–Vis spectroscopy and X-ray diffraction (XRD) to determine their structural and crystalline properties.

Comparative yield analysis revealed that maceration produced the highest extract mass (19.97%), whereas UAE provided the lowest (7.51%). However, despite its lower extract mass, UAE yielded significantly higher concentrations of bioactive phytochemicals and greater nanoparticle productivity, demonstrating the efficiency of ultrasonication as an eco-friendly extraction method. Quantitative phytochemical analysis showed that the total phenolic content (TPC) ranged from 52.00 mg/g (MAC–aqueous) to 97.44 mg/g (UAE–ethanolic), while total flavonoid content (TFC) varied between 79.00 mg/g (MAC–aqueous) and 183.33 mg/g (MAC–ethanolic). These results indicate that extraction efficiency is strongly influenced by solvent polarity and extraction method. The highest nanoparticle yield (128.71%) was observed in UAE–ethanolic extracts, followed by MAC–aqueous (61.17%) and MAC–ethanolic (24.45%). XRD analysis displayed sharp diffraction peaks consistent with the monoclinic CuO phase (JCPDS 80-1916), with an average crystallite size of approximately 33 nm. Ethanolic and ultrasonicated samples displayed relatively larger crystallite sizes (21–24 nm).

Overall, the study demonstrates that *Lantana camara* leaf extracts act as effective bioreductants and stabilizing agents for CuO nanoparticle synthesis. The findings highlight the potential application of *L. camara*–mediated CuO nanoparticles in biopesticide formulations and environmental remediation, supporting the development of novel, sustainable insect control strategies.

KEYWORDS: *Lantana camara*, Ultrasound-assisted extraction (UAE), Phytopesticide, CuO NPs, Green synthesis,.

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A STUDY ON UNSUPERVISED SMS SPAM DETECTION USING MAXWELL–BOLTZMANN DISSIMILARITY AND CLUSTERING TECHNIQUES

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ABSTRACT

Spam SMS (Short Message Service) messages continue to threaten the security and reliability of mobile communication systems by exposing users to fraudulent links, malicious content, and intrusive advertising. Their short length, informal structure, and high linguistic variability make them especially difficult to classify, particularly in scenarios where labeled data is limited or unavailable. Although numerous supervised machine learning approaches have shown high performance in SMS spam detection, research on unsupervised clustering techniques remains comparatively underexplored.

This work investigates the applicability of the Maxwell–Boltzmann mechanics–based dissimilarity measure, originally introduced by Kuppili et al., as a distance metric for grouping SMS messages into spam and ham categories in an unsupervised setting. The Maxwell–Boltzmann formulation models text data analogously to particle interactions in a thermodynamic system, thereby capturing inter-term relationships that traditional similarity metrics may overlook. Given the sparsity and inconsistency of SMS data, such a physics-inspired formulation may be better suited for distinguishing subtle textual patterns.

A comparative evaluation was performed using multiple clustering methods, including K-Means, K-Medoids, and Agglomerative clustering. Cosine-based models achieved modest performance, with cosine KNN reaching 51.1% accuracy and normalized cosine K-Means achieving 66%. In contrast, the Maxwell–Boltzmann dissimilarity yielded substantially higher performance, achieving **87% accuracy** consistently across K-Means, K-Medoids, and Agglomerative clustering. These results demonstrate that the mechanics-inspired dissimilarity measure provides a more expressive representation of short-text relationships, enabling more effective clustering of SMS messages without the need for labeled training data.

The findings highlight the potential of Maxwell–Boltzmann dissimilarity for unsupervised text mining applications and motivate further analysis with additional clustering algorithms, parameter tuning strategies, and alternative distance formulations.

KEYWORDS: SMS spam detection, Maxwell–Boltzmann dissimilarity, Unsupervised clustering, Text mining, K-Means clustering, Physics-inspired distance metric

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Interfacial Strengthening of PVC Composites through Deep Eutectic Solvent–Modified Cocopeat Lignocellulosic Fibers

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ABSTRACT

Pretreated lignocellulose has been recognized as an efficient reinforcement material due to its high strength-to-weight ratio, fibrous morphology, and abundance of surface functional groups that promotes strong interfacial adhesion with polymer matrices. In the present work, waste coconut fiber (coir) was pretreated with a choline chloride–citric acid-based deep eutectic solvent (DES), which produced lignocellulosic nanofibers and removed surface impurities, thereby enhances its compatibility with poly(vinyl chloride) (PVC). The treated lignocellulose was incorporated into PVC to produce PVC–lignocellulose composite films through the solvent casting method. The composite films with various fiber loadings (0 to 15% w/w) were fabricated and characterized by PXRD, FTIR, HR-TEM, contact angle, and mechanical analyses. Among all the prepared composites, the film containing 5 wt% lignocellulose exhibited the highest mechanical strength, which reflected improved stress transfer and stronger interfacial bonding between the polymer matrix and the modified fibers. The DES pretreatment also imparted better dispersion, enhanced hydrophobicity, and antimicrobial behavior to the composites. Overall, the study established a sustainable, eco-friendly, and cost-effective approach that utilized waste lignocellulosic biomass to strengthen and functionalize commercial polymer materials for advanced applications.

KEYWORDS: Pretreatment of lignocellulose, deep Eutectic solvent, PVC, mechanical strength, antimicrobial activity.

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Theoretical, Structural and Crystallographic analysis of $Ba_{1-x}Pr_xTiO_3$ Ceramics synthesized via modified Sol-gel route using Python based computational approach

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ABSTRACT

In this present studies, a theoretical structural and crystallographic analysis of $Ba_{1-x}Pr_xTiO_3$ for x = 0.04 wt% synthesized through the modified Sol-gel route was carried out using Python based computational technique. This approach provides a reproduceable and cost effective framework for predicting structural characteristics of complex Perovskite oxides material prior to experimental validation. The Sol-gel process was modelled to simulate precursor through hydrolysis, gelation and crystallization parameter influencing the formation of the required phase. Theoretical X-ray diffraction pattern were generated by using Python libraries such as numpy, panda and matplotlib in combination with crystallographic data from the ICDS database. Further, Rietveld refinement were conducted to estimate Lattice parameters , bond lengths, bond angles and atomic positions within the space group Im3m. The analysis reveal slight distortion in the TiO_6 octahedra attributed to the Ba/Pr cations coordinated environment . Theoretical modelling of crystal structure of the material was modelled using mplot3d library of the computational tool . This type of theoretical modelling demonstrate the capabilities of python as a powerful tool for crystallographic competition and structural visualization . The 3D model of the structure so generated(Crystal structure, its unit cell, electron density and electron cloud) is presented in this abstract. This sort of study gives a complete insight to the crystal structure of the material for better understanding and suitable applicability. The detailed structural parameter is beyond the scope of this abstract, however this will be used for further study and suitable applications of the materials.

KEYWORDS: Ba1-xPrxTiO3, Perovskite oxides, Sol-gel synthesis , Structural analysis, Rietveld refinement, Python computational modeling.

Design of a Dual-Linker Ce-MOF@Polypyrrole Composite for Efficient and Selective Detection of Hexavalent Chromium from aqueous medium

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ABSTRACT

Heavy metal contamination, particularly the extreme toxicity of hexavalent chromium (Crv z), has raised demands for advanced composite materials capable of both sensing and removal to ensure environmental and public health safety. In this work, polypyrrole (Ppy) was synthesized with cetyltrimethylammonium bromide (CTAB) as a soft template, sulfuric acid (H_2SO_4) as the dopant, and ammonium persulfate (APS) as the oxidizing agent. A cerium-based metal organic framework, Ce-MOF-808 was prepared and incorporated with PPy for Crv z removal in water, which showed negligible adsorption efficiency. With this limitation in view, a 4th-generation MOF hybrid strategy was then adopted through engineering of the linker environment using a dual-linker approach combining terephthalic acid (H, BDC) and trimesic acid (Hƒ BTC) in a 1:1 ratio. When such a linker-engineered Ce-MOF was integrated with PPy via an in-situ polymerization process, it demonstrated excellent Crv z sensing ability. Photoluminescence studies in acetonitrile and aqueous media using ten different analytes showed significant fluorescence quenching only in the presence of K, Cr, O‡ , confirming selective and sensitive recognition of Crv z ions. This work highlights the importance of linker modification as a signature of advanced 4th-generation MOF design toward a tailored polymer–MOF interaction and improved functional performance. Further efforts will be made toward UV–Vis titration for Crv z adsorption and desorption studies and testing on real environmental water samples to establish practical validity.

KEYWORDS: Heavy metal toxicity; Polypyrrole; 4th-generation MOF hybrid; Linker engineering; Chromium sensing; Fluorescence quenching

GC–MS Derived Phytochemicals from *Cynodon dactylon* Against ACC4 for Arthritis: An in silico Study

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ABSTRACT

Arthritis encompasses a diverse group of chronic inflammatory and degenerative joint disorders, with rheumatoid arthritis (RA) being one of the most debilitating forms. Among the key immunological markers involved in RA pathogenesis are anti-citrullinated protein antibodies (ACPAs), which target citrullinated collagen and play a crucial role in inflammatory signaling and joint degradation. The Anti-citrullinated Collagen Type II Antibody (ACC4) is particularly significant, as its binding to modified collagen triggers inflammatory cascades that accelerate cartilage deterioration. Plant-derived phytoconstituents, known for their anti-inflammatory, antioxidant, and immunomodulatory properties, have gained attention as potential anti-arthritic agents. In this study, seven phytochemical ligands were from *Cynodon dactylon* by the help of GCMS data. Molecular docking against the ACC4 antibody, followed by extensive in silico ADMET though pKCSM profiling were carried out to test for druggability of the ligands. Docking analysis revealed that PubChem CID 5486180 (–8.67 kcal/mol) and CID 528048 (–7.01 kcal/mol) exhibited the strongest binding affinities toward ACC4, suggesting stable interactions capable of inhibiting antibody binding or modulating downstream inflammatory events. Other compounds CID 637542, CID 443884, and CID 445858 showed moderate affinities ranging from –5.75 to –4.24 kcal/mol, indicating potential supportive roles in attenuating ACC4-mediated inflammatory responses. ADMET predictions further enhanced the therapeutic potential of several ligands. Most compounds showed high intestinal absorption (64–98%) and acceptable Caco-2 permeability, indicating good oral bioavailability. The absence of AMES toxicity, hepatotoxicity, and hERG inhibition in compounds such as CID 637542, CID 445858, and CID 528048 validated their safety and reduced cardio toxic potential. The majority of ligands demonstrated minimal inhibitory effects on major CYP450 iso enzymes, suggesting a lower likelihood of metabolic drug–drug interactions. In addition, ecological toxicity indicators such as T. pyriformis and minnow toxicity were low for most compounds, highlighting their environmental compatibility. Among all screened phytoconstituents, CID 528048 and CID 5486180 emerged as the most promising anti-arthritic candidates, showing strong affinity for ACC4 coupled with favorable pharmacokinetic and toxicity profiles.

KEYWORDS: *Cynodon dactylon*, ACC4, Rheumatoid Arthritis, Phytoconstituents Molecular Docking pKCSM ,ADMET Profiling

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Magnesium Ion Intercalation Mechanism in Orthorhombic 5ØüÞ-V_2O_5 for Rechargeable Magnesium-Ion Batteries: A First-Principles Calculations

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ABSTRACT

Investigating efficient two-dimensional (2D) layered materials for electrode and electro- chemical storage application is a major pursuit in the development of next-generation energy storage systems. Among various materials, vanadium oxides gained attention because of their layered geometrical structure and tunable electronic properties. This research examines how Mg intercalation affects the electronic structure and stability of V_2O_5 using first-principles calcula- tions. The stable layered structure of the orthorhombic *5ØüÞ*-V_2O_5 polymorph makes it particularly appealing among the other phases due to its accessible diffusion channels for multivalent ions. The Vienna Ab initio Simulation Package (VASP) implemented within the MedeA interface has been used for the structural optimization, electronic properties including band structure and density of states analysis, thermodynamic stability, and the diffusion kinetics study along with the theoretical capacity calculation. The results suggest that after Mg is intercalated into the V_2O_5 structure at different concentrations (*5ØeÜ* = 0.125, 0.25, 0.375, 0.5, 0.625, 0.75, 0.875, and 1.0) in $Mg_{5ØeÜ}V_2O_5$, the material remains structurally stable. A gradual decrease in the band gap and a shift of the Fermi level toward higher energy are observed, indicating an improvement in electronic conductivity. Additionally, the charge density difference and Bader charge analysis show an improved ion transport mechanism. Furthermore, the calculated diffusion barriers with the energetics indicate sluggish Mg-ion mobility within the layered structure, which is examined through the CI-NEB method by using two stable initial and final intercalation sites. These findings provide valuable insights into the potential of V_2O_5 as an efficient cathode material for next-generation rechargeable batteries.

KEYWORDS: Battery materials, *5ØüÞ*-V_2O_5, Mg^{2+} intercalation, First-Principles Calculation.

Zinc Intercalated V, O… as a Functional Material for Energy Storage Applications: A Computational Study

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ABSTRACT

Transition Metal Oxides (TMOs) have been materials of choice for designing batteries owing to the rich redox chemistry and structural flexibility they offer. Vanadium pentoxide (V, O…) is one such TMO that stands out because of its intrinsic layered architecture, redox chemistry, and cost-effectiveness. Its orthorhombic lattice allows the reversible insertion and extraction of metal ions which can be the ideal host for designing battery cathodes by intercalating metal ions. In this regard, zinc, with its multivalent nature and high volumetric capacity, has emerged as one of the most promising candidates for next-generation rechargeable battery systems. Ensuring improved electrochemical performance and long-term stability in these Zn-ion batteries requires a thorough understanding of the basic mechanisms behind Zn intercalation within the V, O… lattice. This work systematically investigates the electronic structure, thermodynamic stability, and ion transport characteristics of Zn-intercalated V, O… by using first-principles Density Functional Theory (DFT) calculations, utilizing the generalized gradient approximation with the PBE functional as implemented in Quantum ESPRESSO and VASP. To understand the consequences of intercalation on the properties of the host lattice, a series of structural models were built with gradually varying Zn concentrations. Analysis of the electronic structure through both projected density of states and band-structure computations indicates that the intercalated Zn atoms contribute significantly to the density of states near the Fermi level, effectively narrowing the band gap, pointing to an increase in electronic conductivity. Formation energy computations for the Zn-intercalated V, O… structures confirm that the intercalated lattices are thermodynamically favorable and stable, indicating that the framework is capable of sustaining long-term electrochemical cycling without significant structural degradation. The ion

migration pathways were determined by the Nudged Elastic Band method to calculate Zn diffusion barriers and mobility in the host lattice. These collective insights enable the theoretical understanding of Zn intercalation mechanisms in V, O… and provide guidelines for rational design of high-performance, safe, and efficient Zn-ion battery cathodes, which will contribute to the development toward next-generation energy storage technologies.

KEYWORDS: Zinc-ion battery, DFT, Intercalation, Energy Storage

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Enhanced Visible Light-Driven Photocatalytic Degradation of Methylene Blue and Ciprofloxacin by Magnetic $NiFe_2O_4$ @ZIF 67

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ABSTRACT

Designing of metal-organic framework (MOF)-based stable heterostructures remains a challenging task for material scientists. Here, a magnetic photocatalyst, designated as 30NFZ67, was synthesized using a simple and green method by combining ZIF 67 and $NiFe_2O_4$ at room temperature. The fabrication of hybrid MOF material has been characterized through IR,PXRD,TGA,FESEM and TEM; which reveals the successful formation of heterostructure. Under sunlight, the photocatalyst effectively degraded two major organic pollutant method by combining the ZIF 67 and NiFe, O„ . Under sunlight, the photocatalyst effectively degraded two major organic pollutants: Methylene Blue (MB) dye (~98%) and Ciprofloxacin (CIP) antibiotic (~88%) via a multistep charge transfer mechanism. The process is primarily driven by solar energy, highlighting its potential for sustainable environmental remediation. Trapping experiments identified hydroxyl radical (. OH) and superoxide radicals (·O, {) as the dominant reactive species in the degradation pathway. The degradation efficiency significantly increased with catalyst dosage, rising from 72% to 98% for methylene blue (MB) as the dosage increased from 2.5 mg to 10 mg. Similarly, for ciprofloxacin (CIP), the efficiency improved from 53% to 88% when the catalyst dose was increased from 5 mg to 10 mg within a reaction time of 60 minutes. The photocatalyst demonstrated excellent structural stability over four consecutive degradation cycles. Additionally, detailed analysis of the degradation mechanism, kinetics studies provides valuable insights into heterojunction design for developing high-performance magnetic photocatalysts for wastewater treatment.

KEYWORDS: Metal-organic framework (MOF), ZIF 67, NiFe2O4, Photocatalyst, Organic pollutant degradation, Heterostructure stability.

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Development of Therapeutic Polyurethane Nanocomposites Controlled Release of Drugs for Advanced Wound Care

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ABSTRACT

Now days chronic and acute wounds pose considerable clinical challenges, necessitating sophisticated therapeutic systems that can facilitate swift healing and inhibit infection. The development and characterisation of a drug-loaded polyurethane (PU) nanocomposite aimed at improving wound-healing applications. The nanocomposite combines biocompatible polyurethane with therapeutic agents and functional nanofillers to facilitate controlled drug release, enhance mechanical strength, and provide exceptional moisture-retention capabilities. Physicochemical analyses, which encompass assessments of morphology, thermal properties, and swelling behaviour, provide evidence stability of the material and its appropriateness for use in wound environments. Investigations into drug release demonstrate a consistent and reliable delivery pattern, whereas in vitro evaluations validate both antimicrobial efficacy and compatibility with cellular structures. Initial in-vitro wound models suggest a notable enhancement in tissue regeneration and wound monitoring when compared to untreated controls. An experiment utilising disc diffusion was conducted to assess antibacterial activity against Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus).The developed PU Nano composite demonstrates significant potential as a multifunctional material for wound healing, presenting a promising foundation for advanced wound dressings designed to enhance patient outcomes.

KEYWORDS: Polyurethane, Nano composite, Drug delivery, Antibacterial Activity, Wound healing

ECO-CONSCIOUS AMONG BALIJATRA VISITORS

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ABSTRACT

Balijatra, a historic festival commemorating Odisha's ancient maritime trade with Southeast Asia, is a unique socio-cultural phenomenon that draws approximately five million visitors. Beyond its profound Cultural roots, the fair is renowned as Asia's largest open trade event, generating significant seasonal employment and fostering a vibrant local Economic ecosystem.
This study examines the crucial transition of this immense gathering toward environmental sustainability. Specifically, we analyze the impact of recent Environmental policies—including the comprehensive ban on single-use plastics, the promotion of biodegradable alternatives, and enhanced waste management logistics—implemented by authorities to manage the event's vast footprint.

Our research utilizes empirical evidence to evaluate the interwoven outcomes: assessing the economic implications of the policy shift on vendors, measuring the effectiveness of waste reduction, and gauging the impact on public cultural consciousness regarding sustainability. The findings illustrate a successful model where regulatory action, driven by public 'eco-consciousness,' does not diminish, but rather enhances, the festival's economic and cultural vitality.

Balijatra thus stands as a vital case study, providing a replicable framework for integrating three seemingly disparate objectives—heritage preservation, economic dynamism, and ecological responsibility—into a single, cohesive, and sustainable public event policy.

KEYWORDS: Balijatra, Eco-conscious, Environmental sustainability, Biodegradable alternatives.

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Balancing the Scale: Addressing Hurdles and Harnessing Innovation for a Sustainable Future

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ABSTRACT

The process of achieving global sustainability, which is intrinsically connected with the aspirations of the United Nations Sustainable Development Goals (SDGs) is not a smooth one. It is a human narrative, full of great struggles and encouraging opportunities. The paper examines the fine line between walking this transition and believes that with the ability to face real-world challenges and the willingness to adopt innovation that is human-centered, we will be successful. We look at material obstacles, including the economic burden of constructing clean energy systems on local communities and the actual panic of employees with their jobs in the conventional industries. On the other hand, we bring out the tremendous possibilities of human ingenuity. As evidenced by the example of Patagonia, which actively promotes the idea of the circular economy, business models based on repairing and reusing can lead to the development of the health of the environment and the strength of the community. Moreover, intelligent digital technologies can make us control our common resources more efficiently than ever before. In conclusion, this paper finds that a fair and sustainable future, the one that will indeed mean what the SDGs promise, depends on our will. By developing well-thought policies, ensuring actual cross-sectoral cooperation, and planning that places people first, we can create a more stable and just world to all.

KEYWORDS: Global sustainability, United Nations Sustainable Development Goals (SDGs), Human-centered innovation, Circular economy, Cross-sectoral cooperation

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IMPACT OF MICROPLASTICS ON PLANT PHYSIOLOGY

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ABSTRACT

Microplastics (MPCs) are plastic particles smaller than 5mm, have emerged as an unwelcome environmental pollutant with significant implications. While their effects on aquatic ecosystems are widely studied, their impact on microplastics on terrestrial plants and their physiological process remains a growing concern. Recent studies reveal that microplastics can alter soil structure, nutrient availability and water retention there which influences plant growth and development. Microplastics are involved in negative impacts on plant processes, such as Growth inhibition (germination rate, plant biomass, root elongation), check water nutrient uptake, decrease in photosynthetic efficiency Fv/Fm ratio, net photosynthetic rate, oxidative stress leading to excessive production of Reactive oxygen species (ROS), nutrient and ionic homeostasis disruption, and hormonal dysregulation. This leads there by a negative effect on key metabolic processes. Microplastics reach plants through contaminated soil and water, enter the roots and are distributed throughout the plant system. To mitigate these effects, several approaches are being explored; reducing plastic usage and improving plastic waste management to limit soil contamination, adapting biodegradable plastic and natural munching materials; promoting microbial degradation of plastic through specific bacterial and fungal strains; and applying biochar or organic compost to immobilize MPs and enhance soil health awareness program and sustainable agricultural policies are also crucial to minimize the long term ecological risk of microplastics accumulation in agroecosystem.

KEYWORDS: Pollutant, Plant Biomass, Biodegradable plastic, Agroecosystem.

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Deep-Time Pathways of Climate Adaptation: Insights from the Early to Late Permian Sequences of Indian Gondwana

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ABSTRACT

We are at a point where we are seeking guidance from systems, scholars, and engineers about what seems to be the starting point of a global imbalance in natural harmonies. But what happened to the already existing hard evidence from deep time? Fortunately, geology has been collecting these traces for more than a century. Our focus will be on the organisms we call *plants*—to show how the Earth itself dealt with rapid changes in balance and recovered from them. During recovery, what was lost and what was gained is the core insight we need to internalize before debating endlessly about these complex planetary-scale systems.

Gondwana studies from the Early Permian Period in the Indian Peninsula expose this deep restructuring under rapid misalignments of critical systems. While the Talchir Formation (early Sakmarian) recorded the gradual deglaciation phase after a long ice age, surprisingly, some plants bled through the threshold beautifully. The *Rhacopteris* flora reappeared, but with some members missing from its inventory, and some new, evolved plants showed up for the first time. This is the story of the *Glossopteris* flora, a canonical account of Earth's first forests.

Our focus will shift from the glaciers of Talchir to the early forests of Karharbari, to the dense canopy of Barakar, and then to the deserts of Barren Measures, ending with another recovery represented by the Raniganj forests. This sequence reveals how the Earth itself works—not what we think or debate about how it might be working.

Human activities now condense these millions of years into mere centuries, testing the core mechanisms of system harmony. Palaeobotany has already accumulated a large amount of hard evidence showing how forests behave under various constraints, and how life bounces back with a new alignment each time. Understanding these rhythms can help us predict and align systems before major restructuring occurs—knowledge that the Earth already recognizes and uses as its native algorithm.

KEYWORDS: Early Permian; Talchir Formation; Karharbari Formation; Barakar Formation; Barren Measures Formation; Raniganj Formation; Palaeoclimate; Post-glacial Recovery; Climate Resilience; Sustainable Development Goals.

Quantifying the urban heat vulnerability (UHV): Role of urban expansion and green space, evidence from subtropical city, Eastern India

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ABSTRACT

Machine learning (ML) models are leading analytical techniques provides valuable insights into urban landscape dynamics over time; play a crucial role in city planning. The objective of this study is to assess the impact of land-use/land-cover (LU/LC) dynamics on urban land surface temperature (LST) of Bhubaneswar City in Eastern India during 30 years (1994–2024) using Landsat data (TM, ETM, and OLI/TIRS) and machine learning algorithms. The results show that built-up area in BMC increased by 34% from 1994 to 2024 by replacing agricultural land (32.20 Sq. km) followed by green space (16.36 Sq. km) and barren land (9.56 Sq. km). The succeeding growth of seasonal LST (increase of about 0.33p C and 0.27p C in mean LST during summer and winter season respectively) over BMC indicated that a warming trend of the urbanization surface during 1994-2024. The excessive urban expansion and landscape spatial heterogeneity in the study area significantly affects the urban land surface temperature (â = 0.775, 0.510, 0.392, 0.40S9 in 1994, 2004, 2014 and 2024 respectively). An increase in the urban green space and avoidance of non-impermeable surface is prospective strategies to minimize the adverse impact of ULST. Therefore, in the near future, the research findings can assist legislators and urban planners in developing solutions for mitigating the detrimental impacts of urban heat islands.

KEYWORDS: Landscape dynamics; Land surface temperature; Urban heat island; Machine learning.

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Eco-Friendly Synthesis of Fluorescent Carbon Dots for Bioimaging Applications

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ABSTRACT

Fluorescent carbon dots (CDs) have gained significant attention due to their tunable optical properties, low toxicity, biocompatibility and, making them promising candidates for bioimaging applications. In this study, we present an eco-friendly approach for synthesising fluorescent CDs using *S. saman* leaf extract as a natural carbon source. The green synthesis method eliminates the need for hazardous chemicals and complex processing, aligning with sustainable and environmentally friendly practices. The as-synthesised CDs exhibit excellent water solubility and remarkable stability. They show an excitation peak at 368 nm and an emission peak at 447 nm. Characterisation techniques such as UV-Vis spectroscopy, spectrofluorometer, and TEM confirm their structural and optical properties. Additionally, cytotoxicity studies indicate their biocompatibility, making them suitable for bioimaging applications. This green synthesis approach provides a cost-effective and sustainable method for producing fluorescent CDs and highlights the potential of plant-derived nanomaterials in biomedical applications.

KEYWORDS: Fluorescent carbon dots, green synthesis, bioimaging.

Sustainable Crop Suitability Assessment in Relation to Topography and Soil Properties in the Rainfed Agro-Ecosystem of the Eastern Ghats: A Case Study from Raighar Block of Nabarangpur district, Odisha, India

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ABSTRACT

Rainfed agro ecosystems in the Eastern Ghats of India are characterized by diverse topographic settings and spatial variability in soil properties, which significantly influence crop performance and land productivity. This study presents a case-based assessment from Raighar Block, Nabarangpur District, Odisha, focusing on sustainable crop suitability in relation to topography and soil physico-chemical parameters. Soil samples were collected across upland, midland, and lowland zones and analyzed for texture (sand, silt clay), pH, electrical conductivity (EC), organic carbon (OC), and available macronutrients (N, P, K). The results revealed marked spatial variation, with lowland areas exhibiting higher organic carbon and nutrient retention due to favorable moisture conditions, while upland zones showed reduced fertility and coarser textures.

Crop suitability was evaluated using crop-specific thresholds for rice, maize, and pulses, considering ideal ranges for soil pH, texture, slope tolerance, and nutrient requirements. Rice was found to be highly suitable in lowland soils with clay-rich textures and optimal pH, whereas maize and pulses showed moderate suitability in midland and upland zones with loamy and sandy loam textures, respectively. These findings underscore the importance of aligning crop choices with terrain-driven soil characteristics to enhance land use efficiency.

By integrating topographic analysis with soil fertility assessment, this study contributes to climate-resilient sustainable agriculture planning in heterogeneous rainfed landscapes. The Raighar Block case study offers a replicable framework for crop zoning, resource-efficient land management, and long-term productivity enhancement across similar agro-ecological zones in the Eastern Ghats region.

KEYWORDS: Sustainable Agriculture, Topography, Soil Physico-Chemical Properties, Crop Suitability.

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Wild Superfoods for Climate-Resilient & Nutritional Security

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ABSTRACT

Looking at the emerging population and climate change, it challenges food security. The promotion and exploration of wild superfoods, which are nutrient-rich and naturally resilient plant species, have gained attention for ensuring sustainable national security. Wild superfoods such as millets (Pennisetum glaucum, Setaria italica of the Poaceae family), Moringa (Moringa oleifera), Amaranth (Amaranthus spp.), Sweet Potato (Ipomoea batatas), Quinoa (Chenopodium quinoa), and Buck wheat (Fagopyrum esculentum) excel in marginal environments with minimal inputs, making them ideal crops for climate-resilient agriculture. This species is rich in micronutrients, antioxidants, vitamins, minerals and healthy fats which help to boost the immune system. For example, moringa leaves provide vitamin A and C, protein, and iron. Buckwheat is rich in fibre, protein, iron, riboflavin, and niacin. Millets and amaranth grain are drought-tolerant with significant quantities of calcium, magnesium and essential amino acids, making them suitable for conventional cereals. Quinoa is rich in fibre, protein, minerals, magnesium, phosphorus and vitamins. Beneficial for the immune system and promotes overall health. The formation of wild superfoods in local diets and agri-food systems contributes to diversified nutrition, ecological sustainability, and climate resilience. They require less water, adapt to poor soils, and capacity to restore degraded ecosystems, making them strategic resources for both rural livelihoods and environmental restoration. Promoting their cultivation and consumption can reduce dependence on climate-sensitive staple crops and foster food sovereignty. It represents a holistic solution linking biodiversity conservation, nutrition enhancement, and climate adaptation. Harnessing their potential through research, policy integration, and community engagement is crucial for building climate-resilient nutrition security in the 21st century.

KEYWORDS: Superfood, Climate resilient, Nutrition, Immune system.

Impact of industrial pollution on vermicast quality and soil health enhancement in Sundargarh, Odisha

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ABSTRACT

Sundargarh district of Odisha, home to large-scale steel, cement, mining, and thermal power industries, has witnessed persistent soil degradation due to long-term industrial effluent discharge and heavy metal accumulation. These pollutants significantly alter soil physico-chemical properties, diminish nutrient availability, and disturb soil microbial dynamics factors that collectively threaten agricultural productivity and ecological integrity in the region. Addressing such challenges is closely aligned with global sustainability frameworks, especially SDG-12 (Responsible Consumption and Production), SDG-13 (Climate Action), and SDG-15 (Life on Land), which emphasize sustainable land use, pollution reduction, and biodiversity protection.

Vermicomposting, a proven nature-based and circular resource recovery technique, offers considerable promise in mitigating soil degradation. By using earthworms to biologically transform organic waste into nutrient-rich vermicast, this process enhances soil structure, improves microbial richness, and supports long-term soil fertility. This study investigates the comparative effects of industrial pollutants on vermicast quality by evaluating outcomes from soil collected in polluted industrial zones and uncontaminated control regions of Sundargarh. The core objective is to examine whether vermicomposting can serve as a sustainable and ecology-driven solution for soil restoration in heavily industrialized landscapes.

Soil samples from industrial hotspots and cleaner ecological zones were subjected to standardized vermicomposting using Eisenia fetida. The resulting vermicast was evaluated for nutrient status, organic carbon content, microbial activity, and heavy metal accumulation (specifically Pb, Cd, Cr, and Zn). These metals are prominent in industrial discharge and are known to disrupt earthworm metabolism, suppress cocoon production, and modify enzymatic microbial activity.

Initial analysis suggests that vermicast derived from polluted soils may exhibit lower nutrient content, altered C:N ratios, reduced microbial biomass, and higher metal residues relative to vermicast from control soils. Such differences highlight the sensitivity of vermicomposting systems to industrial pollution stress and underscore the importance of biological indicators in monitoring soil health.

This study contributes to the development of sustainable environmental management strategies by demonstrating how vermicomposting can act both as a bio-indicator of pollution levels and a low-cost bioremediation tool capable of assisting in soil rejuvenation. The findings are expected to support farmers, environmental planners, and policymakers in adopting regenerative soil practices, promoting circular resource use, and reducing dependency on synthetic fertilizers—thereby advancing national and global sustainability ambitions under SDG-12, SDG-13, and SDG-15.

KEYWORDS: vermicomposting, vermicast quality, heavy metals, industrial pollution, soil restoration, bioremediation, sustainability, Sundargarh Odisha.

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Gardenia gummifera: An indigenous medicinal plant

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ABSTRACT

Gardenia gummifera, commonly known as Dikamali, is an important indigenous plant known for its traditional medicinal uses across various regions of India. *Gardenia gummifera* is a rare medicinal plant belonging to family Rubieacea. It has been used for centuries in folk and Ayurvedic medicine to treat a various health problem. The plant produces a yellowish gum or resin that is known for its healing properties. People have used different parts of this plant especially the gum, leaves, root and fruit to treat various health problems like toothaches, joint pain, stomach disorders, coughs, respiratory problems and skin infections. This plant is valued for its natural compounds that may have antibacterial, anti-inflammatory, and analgesic properties. Phytochemical studies have showed the presence of flavonoids, saponins, tannins, and other bioactive compounds that contribute to its medicinal value. In traditional medicine, the resin of *Gardenia gummifera* has been used to treat various ailments, including fever, rheumatism, and skin diseases. This plant has great potential to be used in herbal medicines. In rural and tribal areas, *Gardenia gummifera* is used in home remedies and traditional healing practices.

KEYWORDS: *Gardenia gummifera.*

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The potential of radiation-modified bacteria consortia for metal removal from wastewater

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ABSTRACT

Heavy metal contamination in water threatens the environment and public health due to the toxicity. The conventional treatment methods are costly and generate secondary waste. Present study investigates radiation-induced bacterial consortia as a sustainable and efficient alternative for metal decontamination. Metal-tolerant strains were exposed to controlled ã-irradiation to induce beneficial genetic and phenotypic changes, then screened for improved tolerance, biosorption, enzymatic activity, and biofilm formation. A batch experiments were performed using synthetic and real industrial wastewater to evaluate metal removal efficiency, kinetic behavior, and operational stability. The radiation-modified consortium demonstrated significantly improved removal rates for heavy metals such as Cd, Pb, Cr(VI), and Ni compared to wild-type controls, achieving up to 30 %–60% higher removal efficiency depending on metal type and concentration. Enhanced EPS production, increased surface functional groups, and upregulated metal-reducing enzymes were identified as key contributors to improved performance. Thus, the findings highlighted the radiation-induced microbial consortia as an eco-friendly, scalable, and cost-effective biotechnological tool for the treatment of metal-polluted wastewater. This approach offers a novel pathway for improving microbial resilience and remediation capacity, supporting the development of next-generation bioremediation strategies for industrial and municipal wastewater management.

KEYWORDS: Heavy metal; Removal; Microbe; Gamma radiation; Wastewater.

Eco-Bioprospecting of Ganga and Mahanadi River Microbes for Sustainable Enzyme Production

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ABSTRACT:

Rivers are dynamic ecosystems that house reservoirs of microbial diversity in them, consisting of bacteria, which in most cases are used due to their useful biochemical characteristics. This research paper was to present, isolate, characterise, and examine the enzyme producing bacteria around the Ganga and Mahanadi rivers. As we may understand, there are some possibilities of their sustainable use in industrial sectors. Samples of water were taken in the Ganga during the 2025 Kumbh Mela and the Mahanadi River in Cuttack, Odisha. The five bacterial strains were isolated by use of standard microbiological procedures, such as serial dilution, spread plating and morphological observation. Preliminary identification was assisted at gram staining and biochemical tests (IMViC, catalase, motility, mannitol, and TSI). Its isolates were Acinetobacter pittii (GW-A), Cedecea davisae (GW-B), Brevundimonas diminuta (GW-C), Pseudomonas aeruginosa (MW-A) and Pseudomonas stutzeri (MW-B). The screening analysis of enzymes showed that GW-B was found to possess both amylase and protease activity, whereas GW-C and MW-A had protease activity. The substrate flexibility of MW-A and dual enzyme activity of GW-B points at the high potential of enzyme production that is not harmful to the environment. These discoveries indicate riverine bacteria as a source of good biocatalysts, and this should be propagated to other applications of biotechnological processes in the future as a cost-effective and sustainable approach to the process.

KEYWORDS- Bacterial Isolation, Enzyme Production, Biotechnological processes, sustainable environment.

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Carbon Nanocomposites for Selective Sensing of Heavy Metal ions

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ABSTRACT

Due to fast growing industrialization, the levels of heavy metals such as As^{3+}, Cr^{6+}, Cd^{2+}, Hg^{+} and Pb^{2+} are increasing in rivers, lakes, and soils, a major threat to ecological environment and human health. It is thus important to develop technologies that efficiently, reliably, and effectively detect heavy metals in water samples. Commonly used techniques are electrochemical analyzers, spectrometry-based detection techniques and optical methods such as colorimeter, fluorescence, localized surface plasmon resonance and surface-enhanced Raman scattering. These techniques are costly, slow, and require extensive sample preparation and lack real-time, on-site measurements. Therefore, the development of real-time and highly efficient sensors capable of detecting and removing metal ions is of great importance.

Functionalized carbon nanomaterials derived from neem laves have been offering several advantages to develop highly sensitive, selective, easy-to-operate optical probes, ideal for detecting heavy metal ions such as $Cr^{6+}$and Pb^{2+}. The functionalized carbon nanoparticles preferentially absorb Cd^{2+} and Cr^{6+}, causing a sharp decline in fluorescence intensity. The developed carbon-based optical sensors can reliably detect Pb²z ions at concentrations as low as 50 ppm using visible light, making it highly promising for on-site detection.

KEYWORDS: Carbon nanoparticles, Nanocomposites, Heavy metal detections, Optical sensors.

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STATISTICAL STUDY OF CLIMATIC VARIABLES ON YIELD OF ONION IN ODISHA

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ABSTRACT

Onion holds great economic and nutritional importance in Odisha, serving as both a staple and a cash crop for many farmers. Despite its significance, the state consistently faces a gap between production and high consumer demand. This shortfall may be linked to the influence of climatic variables on crop yield. The ideal planting period for onion in Odisha begins in the last week of August with seed sowing, followed by transplanting around October 15 and harvesting in the first week of March. This schedule allows the crop to utilize favorable temperature and humidity conditions. However, as Odisha has primarily rice-based farming, farmers often start raining seedlings in nurseries during October and transplant onion after rice harvesting in December. This delayed transplanting exposes the crop to sub optimal climatic conditions during bulb formation, resulting in reduced yield. Hence, the present study aims to statistically examine the effect of important climatic variables on onion yield in key producing districts of Odisha.

The study covers a 28-year period from 1996–97 to 2023–24, utilizing time-series data on onion yield and four important climatic variables—minimum temperature, maximum temperature, rainfall, photosynthetically active radiation (PAR) and relative humidity. Monthly climatic data from August to April covers the growing period of onion in different parts of major onion producing districts of Odisha, were analyzed. Multiple regression analysis was employed to study the relationship between these climatic parameters and yield. Initially, the monthly data of individual climatic variables were regressed with yield to identify the influential month(s) of the climatic variable on yield. Statistical significance was assessed using p-values, and months with the significant positive or negative coefficients are identified as those exerting the positive or negative impact on onion yield respectively.

September and October month rainfall has significant positive effect and December month rainfall has negative effect on yield of onion. August and January month PAR has significant positive effect on yield whereas

October, February and march month PAR has significantly negative effect on yield of onion. November month maximum temperature has significant negative effect on yield of onion. January month minimum temperature has a significant negative effect whereas, April month minimum temperature has significant positive effect on yield of onion. Only august month Relative humidity has significant negative effect on yield of onion. Planting time should be adjusted to escape the vagaries of climate, which will help in increasing yield.

KEYWORDS: Onion, Climate, Yield, Regression Analysis, Odisha.

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Youth Engagement with circular and Environmental practices: Insights towards sustainable development

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ABSTRACT

A circular economy reduces material use, redesigns materials and products to be less resource intensive and recaptures "waste" as a resource to manufacture new materials and products. This is a shift from the traditional, linear economic model, which is based on a take-make-consume-throw away pattern. The transition to a circular economy requires active engagement and readiness among youth who play a major role as future workers and contributors. Global sustainability frameworks namely the UN sustainable development goals, and European union policies emphasize expansion of renewable energy, eco design, waste reduction, management and resource efficiency as important circular economy strategies. There is no empirical research on how young men view and are ready to take part in this transformation, despite Odisha's ambiguous green economy agenda comprising the projected creation of 10 lakh jobs and Rs 3.5 lakh crore of investments by 2030 in circular economy value chains. This study fulfills this gap by examining undergraduate and upper secondary students in BBSR. Which was ranked 9th in the swachh survekshan 2024-25. The dataset was analyzed across key demographic categories such as gender, educational level, and city zones to investigate variations in readiness. Sociodemographic traits and awareness levels were analyzed using descriptive statistical techniques, such as frequency distributions, percentage, and mean scores. Cross tabulation analysis further examined patterns and disparities across subgroups. The results show that even if many young people show awareness towards circular economy practices, there are large gaps in thier practical participation particularly when it comes to exposure levels and educational backgrounds. These results highlight the need for focused educational initiatives, public awareness, gatherings or camps, and youth focused involvements to motivate participation in Bhubaneswar's emerging circular economy.

Keywords: Circular Economy, Youth Engagement, Awareness and Behavior, Urban Sustainability.

JEL Codes: Q56, J13 , D91, R11

A sustainable waste management using phosphorus enriched composts to increases nodulation, growth and yield of *Vigna radiata* L.: A green alternative towards chemical fertilizer

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ABSTRACT

Organic materials from various sources have been commonly adopted as soil amendments to improve crop productivity. Phosphorus deficiency and fixation in alkaline calcareous soils drives a reduction in crop production. A six-month pot experiment was conducted to evaluate the impact of modified phosphorus enriched composts (MPEC) and chemical fertilizers both individually and in combination (with different %) on *Vigna radiata* L.; and estimated their productivity, biochemical characteristic, food quality as well as soil quality. The study conducted with different combinations of compost (MPEC) and single super phosphate (SSP) as T_0 (control; only garden soil), T_1 (100% SSP), T_2 (100% compost), T_3 (25 % MPEC + 75% SSP), T_4 (50% MPEC +50% SSP), and T_5 (75% MPEC +25% SSP). The experimental set T4 exhibited maximum nodulation, growth and productivity, after 7 days of application, compare to the T_0- T_3 and T_5, where results were exhibited non-significant when MPEC or SSP were applied >50%. At the optimum condition (T_4), number and dry wt. of nodules were increased 36.3% and 27.7%, respectively per plant, with the increase of 25.8% grain yield (t/ha). In straw and grains the P contents were increases 15.9% and 5.3%, respectively, compared to control. The carbohydrate and protein content were increased at the optimum condition (T_4), compared to control. The study also resulted that TOC, N, P, and K content in soil were increased 3.50%, 16.90%, 5.71% and 0.83% respectively, after harvesting, compared to control. Consequently, the substitution of chemical fertilizers, MPEC can be applicable to increase the production of edible crop (e.g., *Vigna radiata* L.) with soil properties. Thus, the present findings are applicable for the responsible consumption and production (SDG 12) as well as protection, restoration and promotion sustainable use of terrestrial ecosystems (SDG 15).

KEYWORDS: MPEC; *Vigna radiata* L.; Growth and yield, Nutritional value, soil quality.

IMPACT OF FLY ASH & INTEGRATED NUTRIENT MANAGEMENT ON MORPHOLOGICAL & BIOCHEMICAL TRAITS OF PEARL MILLET

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ABSTRACT

The rapid accumulation of industrial waste, such as fly ash from thermal power plants, presents a significant environmental challenge, while simultaneously offering a potential resource for sustainable agriculture. This study investigates the impact of utilizing fly ash as a soil amendment on the growth, yield, and nutritional quality of Pearl Millet (Pennisetum glaucum), a climate-resilient staple crop. A controlled experiment was conducted using four distinct treatments: Plot 1 (Control), Plot 2 (100% Fly Ash), Plot 3 (50% Fly Ash + 50% Organic Manure), and Plot 4 (50% Fly Ash + 50% NPK fertilizer). The initial soil analysis revealed low levels of essential nutrients, providing an ideal environment to test the efficacy of the amendments. Morphological parameters, including plant height, root length, and panicle dimensions, were monitored, and biochemical analysis was performed to quantify key components such as chlorophyll, total protein, and carbohydrate content in both leaves and grains. The results demonstrated a significant positive influence when fly ash was integrated with conventional nutrient sources. Specifically, the 50% Fly Ash + 50% Organic Manure combination (Plot 3) consistently yielded the best performance, showing the highest increases in plant height, root length, panicle size, and total grain protein (20.24 mg/g.f.w.) and carbohydrate content (0.68 mg/g.f.w.). Furthermore, Plot 3 registered the maximum increase in both leaf chlorophyll and protein content compared to the control. Treatment with 100% fly ash alone (Plot 2) showed limited effectiveness compared to the combined treatments, indicating that the true value of fly ash lies in its role as a supportive substrate when paired with organic or inorganic fertilizers. The strategic use of fly ash, particularly in conjunction with organic manure, offers a cost-effective and eco-friendly solution for managing industrial waste while simultaneously enhancing soil fertility and significantly improving the yield and nutritional profile of Pearl Millet. This research supports the potential for sustainable waste management practices within agricultural systems and warrants further long-term studies to assess cumulative effects on soil health and microbial activity.

KEYWORDS: Fly Ash, Pearl Millet, Sustainable Agriculture, Organic Manure, Nutritional Quality, Waste Management.

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Quantum Advantage in Environmental Modeling: A Focus on Sustainability of Forest Fire Prediction

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ABSTRACT

The prediction of forest fires needs to be accurate and timely for efficient disaster management and environmental conservation. This research introduces the Quantum Kernel-Aligned Regressor (QKAR), a novel hybrid quantum-classical model designed to enhance early forest fire prediction using MODIS data. QKAR leverages quantum kernel alignment to project geospatial, thermal, and radiative features to an optimized Hilbert space, thereby improving the capture of nonlinear correlations among key variables like brightness, brightness temperature (bright_t31), and fire radiative power. Experimental results highlight the significant enhancement of QKAR over state-of-the-art classical regressors, including Support Vector Regression and Random Forest, in predictive accuracy and robustness. Correlation heatmaps, spatial clustering, and temporal trend analyses validate the model's ability to capture seasonal fire patterns and localized hotspots. Improvement in forecasting precision, interpretability, and scalability is achieved with the proposed approach, making it suitable for integration into real-time forest fire early warning systems. These findings position QKAR as a promising framework for sustainable quantum-enhanced soft computing in environmental intelligence and remote sensing analytics. In future, we will explore quantum-assisted climate modeling to enhance the sustainability and effectiveness of forest fire prediction and management strategies.

KEYWORDS: Quantum machine learning, Kernel methods, Forest fire prediction, Hybrid Kernel Regression, Sustainability, Classical Models.

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Crime Hotspot Prediction in Indian Districts Using Graph Attention Networks

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ABSTRACT

Crime hotspot prediction is a critical task for proactive policing and public-safety planning. Traditional machine-learning approaches often treat districts independently and fail to model relational crime patterns. In this work, we propose a Graph Attention Network (GAT)–based framework for predicting crime hotspots across Indian districts. Multi-year crime records were cleaned, standardized, and aggregated into district-level behavioral features describing long-term crime intensity, variability, and temporal trends. Hotspots were labeled using a percentile-based threshold to provide an objective classification target.

To capture inter-district similarity without geographical maps, a k-Nearest Neighbors (k-NN) behavioral graph was constructed, connecting districts with similar crime signatures. The GAT model leverages attention mechanisms to assign different weights to neighboring districts, enabling richer pattern learning compared to classical models.

The proposed model achieved **98% accuracy, 96% precision, 92% recall, 94% F1-score, and an AUC of 0.996**, outperforming Random Forest and XGBoost baselines with fewer false alarms and improved hotspot d

etection reliability. The results demonstrate strong applicability of graph-based learning for real-world crime analytics and public-safety forecasting.

KEYWORDS: Crime Prediction, Graph Neural Networks, GAT, Hotspot Detection, k-Nearest Neighbors, Machine Learning, Crime Analytics

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Land Use Land Cover change and its influence on urban thermal environment: A Case Study of Cuttack City using Remote Sensing Data

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ABSTRACT

Rapid urbanization has significantly changed the natural land surfaces and modified land use land cover pattern. This process highly influences the Land Surface Temperature through modification of surface albedo, evapotranspiration and heat storage capacity. In-depth knowledge on the spatial relationship between LULC dynamics and LST is very important for sustainable management of cities in developing countries. The main aim of this study is to show the spatio-temporal change of LULC and its influence on LST pattern from 2004 to 2024 in Cuttack city and its periphery. This study also focuses on the measurement of the Urban Heat Island (UHI) level and Urban Thermal Field Variance Index (UTFVI) level for understanding urban thermal environment condition using Landsat images collected from the United States Geological Survey (USGS). The study used the supervised classification with maximum likelihood algorithm for LULC mapping and has also used several indices like NDVI, NDBI, MNDWI, UHI and UTFVI to analyse the impacts of LULC change on LST. The results show huge jump in built-up area by 40.70% in Cuttack city and the rise in mean LST from 30.89°C to 42.41°C in 2024. The thermal environment of the city has experienced extreme deterioration with temperature reaching to 55! in the last two decade from a maximum temperature of 38! recorded in 2004. The study observed that LST correlated positively with NDBI and correlated negatively with NDWI. The R^2 value indicates that built-up areas and waterbodies have a strong influence on LST. The study also reveals that the areas under ecological stress zones **have increased significantly** during the past two decades, making **the city uncomfortable for living**. There is urgent need of measurement and policies to reduce the risk of heat waves in the upcoming future and sustainable management of the city.

KEYWORDS: LULC modification; Land Surface Temperature; Urban Thermal Environment; Sustainable management; Cuttack City.

Variations in Physicochemical Parameters of Wastewater from Different Sources in Odisha and their Environmental Impact

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ABSTRACT

Water pollution from domestic, industrial, and agricultural wastewater has become a growing concern in Odisha, posing significant risks to environmental and public health. This study evaluated the physicochemical characteristics of wastewater collected from nine locations across three districts of western Odisha. Industrial wastewater samples were obtained from the ACC Cement Factory (Bargarh), Shyam Metal Factory (Sambalpur), and Vedanta Factory (Jharsuguda). Domestic wastewater samples were collected from Rajendrapada (Balangir), Balasinga (Boudh), and Gujarati Colony (Sambalpur), while agricultural wastewater was sampled from rice fields in Debaipali (Sambalpur), groundnut fields in Rengalbahal (Deogarh), and sugarcane fields in Attabira (Bargarh). Physicochemical analyses included pH, color, turbidity, total dissolved solids (TDS), total suspended solids (TSS), alkalinity, hardness, and ionic composition (calcium, chloride, fluoride, nitrite, sodium, and potassium). Results indicated that industrial effluents, particularly from the ACC Cement Factory, exhibited elevated pH and fluoride levels but low ammonia content. Domestic wastewater, especially from Rajendrapada, showed a highly acidic pH and high concentrations of ammonia and fluoride. Agricultural wastewater displayed moderate pH, fluoride, and ammonia levels, with rice field samples showing the greatest contamination. The observed variations across sites highlight the urgent need for region-specific wastewater management strategies and advanced treatment technologies to mitigate the escalating environmental and health impacts in Odisha's semi-urban and rural landscapes.

KEYWORDS: Wastewater contamination, Physicochemical analysis, Odisha (Western districts), Industrial, domestic, agricultural sources, Water quality parameters.

Mechanical and thermal property enhancement of TiO_2 dip coated FRP composite

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ABSTRACT

Conventional FRP composite suffers various problems such as improper curing in polymer matrix, generation of residual stress across interface and moisture induced mechanical degradation etc. Some probable solution can be adopted to overcome plasticization and swelling through surface modification as coating of metallic oxide / ceramic oxide on polymer matrix and composite. Some other modification can also be conducted by alternating lamination of glass /carbon fibers. It has been found that TiO_2, Al_2O_3, ZrO_2, SiC are some prominent potential oxides which could enhance mechanical property with limited thickness of deposition. Keeping this mind at first TiO_2 gel was prepared by sol gel method and coated substrates are obtained through dip coating method. 3-point bend test revealed ILSS value of composite increases with increase in no. of layer. The optimum layer was found at triple layer for each specimen. Flexural strength and glass transition temperature (T_g) value of TiO_2 dip coated triple layer of epoxy was attained maximum 32% and 40.36% than uncoated epoxy respectively. With this optimized result various FRP composites are also allowed for 3 layers of TiO_2 coating. Glass fibre/epoxy, carbon fiber/epoxy and glass-carbon fibre/epoxy with 12 layers were considered for this purpose. It is observed that inter laminar shear strength (ILSS) was increased up to 78.4% and 67.6% for TiO_2 coated carbon fibre/epoxy and glass-carbon fibre/epoxy composite, respectively in comparison to that for un-coated sample of Glass fiber epoxy composite. A comparative analysis revealed that coated sample exhibited maximum T_g value as compared to non-coated sample. Here it is claimed that in a cost effective approach, mechanical designing strength is enhanced up to 67.6% in glass-carbon fibre epoxy composite over conventional glass fibre/epoxy composite.

KEYWORDS: FRP composites, sol gel method, dip coating, ILSS, glass transition temperature (T_g)

Direct Z-Scheme $BiVO_4$@g-C_3N_5 Core-Shell Heterostructure for Efficient Visible-Light-Driven Ciprofloxacin Degradation, Chromium Reduction, and Oxygen Reduction Reactions

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ABSTRACT

The efficient removal of persistent organic pollutants and toxic heavy metals from water and sustainable chemical synthesis remain a critical environmental challenge. In this study, an oxygen vacancy-**$BiVO_4$@g-C_3N_5 (BC1:3) core-shell hybrid photocatalyst was developed, leveraging visible-light mediated photocatalysis as a green and scalable solution. The unique core-shell architecture facilitates enhanced charge separation and transfer at the heterojunction interface, significantly improving photocatalytic efficiency. BC1:3, synthesized via a simple hydrothermal-calcination process, showed remarkable ciprofloxacin degradation activity, reaching a rate constant of 0.0155 min^{-1} i.e. 90.2 % that is 1.38 times greater than g-C_3N_5 (CN) and 1.7 times greater than $BiVO_4$ (BVO), this performance further elevated to 95.12% in connection to an external oxygen purging. It also showed excellent Cr (VI) photoreduction performance** (0.016 min^{-1}), approximately 2.66 and 1.7 folds higher than BVO and CN respectively. Furthermore, BC1:3 achieved remarkable H_2O_2 generation (1824.44 μM L{ ^{1}), outperforming BVO and CN by factors of 19 and 8.5 times, respectively. Reactive species analysis confirmed the involvement of $•O_2^-$, •OH, and photogenerated h^+ as major contributors to its photocatalytic activity. The visible-light-driven Z-scheme heterojunction between BVO and CN extended light absorption and promoted efficient charge carrier dynamics. The catalyst demonstrated excellent stability and reusability, underscoring its potential as a robust photocatalyst for advanced water treatment and green chemical production.

KEYWORDS: Photocatalysis, Visible Light, Core-shell, Heterojunction, Z-scheme, Charge separation, Ciprofloxacin

Quantification of Degraded Fishing Net Fragments on Coastal Beaches: A Rising Threat to Marine Life

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ABSTRACT

The accumulation of deteriorated fishing-net fragments along shorelines is an increasing source of coastal pollution and marine debris. These fragments originate from lost, abandoned, or damaged fishing gear and gradually break down due to waves, sunlight, and physical wear. Quantifying fishing-net debris on beaches is essential to assess the scale of the problem and identify areas where marine life and ecosystems are most at risk. Acknowledging the pressing need to tackle this rising concern, the Coastal Management Cell of the Odisha State Pollution Control Board has been conducting beach-litter assessments across selected tourist beaches—Gopalpur, Puri, Konark, and Chandipur—since 2023. Complementing this broader survey, the present study specifically examines the accumulation, quantification, and deposition of degraded fishing-net fragments along these tourist beaches. Seasonal surveys (summer, monsoon, and winter) were conducted along 1000 m × 20 m transects, with sampling areas subdivided into 1–3 sites based on topography and tourist activity. Each site included a 10 m × 10 m plot, with locations chosen both on the main beach and near fish-landing areas to assess the impact of fishing activities. After collection, debris samples were analyzed at the Coastal Management Cell laboratory following OSPAR (2010) guidelines. The survey identified various fishing-net materials, from macro- to meso-sized fragments, including tangled lines, strings, cords, ropes, and other discarded gear. Higher concentrations were found near fishing communities, while tourism- focused sites contained comparatively fewer items. The survey found that the annual average abundance of fishing-net debris across the four tourist beaches ranged from 0 to 14 items per 100 m^2, with mass between 0 and 229.25 gm/100 m^2 (10 m × 10 m), highest at Gopalpur and Puri and lowest at Chandipur. Although overall densities were lower than in other parts of India and litter levels have shown a decreasing trend over the years, these fragments continue to pose long-term risks to marine life through entanglement, ingestion, and microplastic formation. Even small pieces can persist for decades, entering the food web and disrupting ecosystems. These findings provide a foundation for mitigation, policy development, and public awareness efforts.

Key words: Fishing-net debris, Quantification, Coastal pollution, Odisha beaches, Threat to marine life.

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Marine Beach litter Pollution: Emphasizing Plastic Litter on Selected Tourist Beaches of Odisha

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Abstract

Beach litter, persistent solid waste discarded in coastal areas, is mainly human-generated and transported by rivers, wind, or currents. It harms wildlife, degrades habitats, and impacts ocean health. Plastic litter has become a major global concern, with 5–13 million tons of debris, including 6.4 million tons of plastic, entering oceans annually, contributing to 5.25 trillion pieces worldwide. Beyond ecological damage, beach litter also imposes economic costs on tourism, fisheries, aquaculture, navigation, and coastal communities. Since 2023, the Coastal Management Cell of Odisha State Pollution Control Board has monitored plastic litter on selected tourist beaches. Seasonal surveys (summer, monsoon, winter) were conducted along 1000 m × 20 m transects at Gopalpur, Puri, Konark, and Chandipur, subdivided into 1–3 sites per beach. At each site, 10 m × 10 m plots were sampled, and collected debris was analysed in the laboratory following OSPAR (2010) marine litter guidelines. The survey recorded a wide range of meso- to macro-sized plastic debris across the beaches, including polythene and carry bags, food wrappers and containers, PET and beverage bottles, disposable cups, oil containers, Jerry cans, straws, bottle caps, medicine blisters, personal care and cosmetic items, shampoo packets, combs, toys, fertilizer/animal feed bags, plastic sheeting, pots, crates, jars, fishing buoys, and other unidentified plastic fragments. Analysis of two years of data showed that annual mean plastic litter on the four tourist beaches ranged from 10–84.5 items/100 m^2 in 2023 and 14–58.5 items/100 m^2 in 2024 (10 m × 10 m), with the highest values at Gopalpur (2023) and Puri (2024), indicating a declining trend. Seasonally, plastic deposition followed the order: winter > summer > monsoon. This seasonal pattern may be linked to higher tourist activity in winter. The survey found that the predominant beach litter on Odisha's tourist beaches consisted mainly of plastics, especially polythene bags, food wrappers, water and other soft beverages bottles. This may be improved by management practices and public awareness. Although litter density remained within permissible limits, these plastics pose long-term risks to marine life as they gradually break down into microplastics, which can enter the food web and disrupt ecosystems. The accumulation of such fragments along shorelines increases the risk of ingestion and other hazards to marine organisms. This preliminary study provides valuable insights for mitigation, impact assessment, policy development, management strategies, and public awareness.

Key words: Beach litter, Plastic pollution, Trend analysis, Environmental impact, Tourist beaches, Odisha coastline.

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Optimization and Scale-Up of a Biofilm-Based Sulfate-Reducing Bioreactor for Industrial Wastewater Treatment

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ABSTRACT

Sulfate-reducing bacteria (SRB) exhibit high efficacy in the bioremediation of sulfate-enriched industrial wastewater by catalyzing the reduction of sulfate (SO_4^{2-}) ions into less toxic end products such as hydrogen sulfide or elemental sulfur. A previously developed biofilm-based bioreactor system demonstrated a sulfate reduction concentration from 1600 mg/l to environmentally compliant discharge levels within 3.5 hours under ambient operational conditions, achieving a working capacity of 1.51 m^3/day using a 220-liter bioreactor. Among various reactor configurations, the single-unit bioreactor exhibited superior performance for continuous operation. Process optimization was conducted using Response Surface Methodology (RSM), which identified the optimal parameters at an initial sulfate concentration of 1250 mg/l and a flow rate of 1.8 L/h. Despite effective sulfate removal, the use of a modified DSMZ 641 growth medium elevated the Chemical Oxygen Demand (COD), thereby constraining its scalability for large-scale applications. Medium composition optimization was performed using a “one-variable-at-a-time” approach to evaluate the impact of individual parameters on sulfate reduction efficiency. The microbial consortium achieved sulfate removal efficiencies of 70% in suspended culture and 78% in immobilized biofilm systems at initial sulfate concentrations ranging between 2000 and 3000 mg/L within a 50 mL working volume. Upon scale-up to a 9-liter vertical biofilm reactor operating in batch mode, sulfate reductions of 76% (with optimized medium) and 74% (with modified DSMZ 641 medium) were obtained within 4 hours. RSM optimization further determined the ideal nutrient concentrations as follows: 6 mL/L lactic acid as the carbon source, 500 mg/L yeast extract and ammonium chloride as nitrogen sources, and 750 mg/L potassium phosphate as the phosphate source. Lower COD:SO_4^{2-} ratios facilitated rapid sulfate reduction kinetics, whereas higher ratios resulted in slower but efficient sulfate removal. To mitigate elevated COD levels, a two-step treatment process incorporating an activated charcoal adsorption column was implemented. Additionally, biofilm modification techniques were employed to enhance biodegradation performance and overall system efficiency.

Keywords: Sulfate-reducing bacteria, Industrial wastewater treatment, Biofilm bioreactor, Bioremediation, Response Surface Methodology, Chemical Oxygen Demand, Activated charcoal adsorption.

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Sustainable Energy from Food Industrial Waste: A Critical Review of Conversion Technologies and Environmental Impact

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ABSTRACT

The food processing industry generates substantial quantities of biodegradable waste, creating both environmental challenges and opportunities for renewable energy production. Food industrial waste; such as fruit and vegetable residues, dairy effluents, spent grains, molasses, and oil rich by-products which possesses high organic content, making it an efficient substrate for bio-energy conversion. This review examines the major technological pathways used to transform these wastes into valuable energy forms, with a focus on biochemical and thermo-chemical processes. Anaerobic digestion remains the most widely implemented approach, producing biogas through microbial degradation under controlled conditions. Key factors influencing digestion performance, including substrate characteristics, pre-treatment methods, carbon-to-nitrogen balance, and reactor configuration, are highlighted. Biochemical routes such as fermentation for bio-ethanol, bio-butanol, and bio-hydrogen production are also gaining importance due to advancements in enzyme technologies and microbial engineering. Thermo-chemical processes like pyrolysis, gasification, and hydrothermal carbonization which offer additional pathways for converting solid food residues into syngas, bio-oil, and biochar, each with distinct advantages in energy density and by-product utilization. Emerging technologies such as microbial fuel cells and integrated bio-refinery systems demonstrate potential to enhance energy recovery while generating value-added co-products. Despite technological progress, challenges persist relating to feedstock variability, process optimization, economic feasibility, and regulatory constraints. The review underscores the importance of adopting circular economy principles, promoting waste valorization, reducing environmental impacts, and improving energy security. Overall, food industrial waste represents a promising and underutilized resource for sustainable bio-energy production, warranting continued research, innovation, and policy support.

Key words: food processing industry, waste utilization, bio-energy, life-cycle analysis

Eco-Friendly Synthesis of Fluorescent Carbon Dots for Bioimaging Applications

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ABSTRACT

Fluorescent carbon dots (CDs) have gained significant attention due to their tunable optical properties, low toxicity, biocompatibility and, making them promising candidates for bioimaging applications. In this study, we present an eco-friendly approach for synthesising fluorescent CDs using *S. saman* leaf extract as a natural carbon source. The green synthesis method eliminates the need for hazardous chemicals and complex processing, aligning with sustainable and environmentally friendly practices. The as-synthesised CDs exhibit excellent water solubility and remarkable stability. They show an excitation peak at 368 nm and an emission peak at 447 nm. Characterisation techniques such as UV-Vis spectroscopy, spectrofluorometer, and TEM confirm their structural and optical properties. Additionally, cytotoxicity studies indicate their biocompatibility, making them suitable for bioimaging applications. This green synthesis approach provides a cost-effective and sustainable method for producing fluorescent CDs and highlights the potential of plant-derived nanomaterials in biomedical applications.

Keywords: Fluorescent carbon dots, green synthesis, bioimaging

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Effect of pre sowing treatments on germination and nursery performance in *Tectona grandis* linn.

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ABSTRACT

Teak (*Tectona grandis*L.f.), is a tropical hardwood species of the family *Lamiaceae*, holds immense commercial and ecological significance due to its durable, termite-resistant, and aesthetically appealing timber. Despite its value, seedling propagation in teak is often constrained by low and erratic germination caused by hard seed coats and inherent dormancy. This study was undertaken to evaluate the impact of different pre-sowing treatments on the germination behaviour and seedling performance of teak under nursery conditions.The experiment was conducted in the nursery of the College of Forestry, OUAT, Bhubaneswar, using a Completely Randomized Design (CRD) with 9 treatments and 3 replications in the year 2025. Pre-sowing treatments included mechanical scarification followed by various chemical, biological, and physical treatments—namely H2SO4, HCl, cow dung, cow urine, hot water, normal water, and gibberellic acid (GA3). Results revealed significant variation among treatments. The highest germination percentage (51.66%), peak value (0.271), and germination value (0.069) were observed in seeds treated with mechanical scarification followed by GA3. However, the highest seedling vigour index (SVI) was recorded in the HCL treatment (990), while the control recorded the highest seedling quality index (SQI) of (8.7). This research underscores the importance of targeted pre-sowing treatments in improving teak seed germination and seedling vigour. Among the treatments, GA3 and HCl treatments emerged as the most promising for enhancing nursery success, offering valuable insights for forestry professionals and plantation managers engaged in teak propagation.

Key words- Teak, Germination, pre-sowing treatments, nursery performance.

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Organic Farming : A Boon for Sustainability of Plant Biodiversity and Restoration of Microbial Flora

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ABSTRACT

Organic farming (OF) is a farming system that uses eco-friendly methods of weed, pest and disease control and management. OF offers an alternative to more widespread, high input farming practices that use synthetic fertilizers, fungicides and pesticides. It is based on the idea that the soil is a living system so these synthetic products are largely excluded from organic farms. Organic agriculture relies on crop rotation, animal manures, crop residues, green manures and the biological control of pests and diseases to maintain soil health and productivity. Organic crops are often of higher value than conventional ones and the volume of organic crops shows a continually increasing production trend. The sale of crops labeled as organic or biological is highly regulated in most advanced markets. The environmental impact of organic farming is low and can be seen as a way of cleaning up and improving degraded agricultural land.

To increase the profitability of marginal farmers, possibility of growing horticultural and agricultural crops are being evaluated at Kadambasole village of block Betnoti, Mayurbhanj, Odisha. The horticultural crops like sweet corn, watermelon, Zucchini (summer squash), pumpkin, and brinjal were cultivated with and without addition of organic manures like FYM, neem cake, mahua cake, azolla etc. Biopesticides, neem based pesticides, yellow card and pheromone traps were implemented to control the pests and diseases. The different biochemical and agronomic parameters were studied to check the productivity and quality of yield. The result indicated that organic products were less perishable with long duration of field residence period as compared to inorganic products. Moreover, initial evidence indicates that organic agricultural systems deliver greater ecosystem services and social benefits. The microbial population as well as earthworm populations were significantly increased. Although organic agriculture has an untapped role to play when it comes to the establishment of sustainable farming systems, no single approach will safely feed the planet. Rather, a blend of organic and other innovative farming systems is needed. Significant barriers exist to adopting these systems, however, and a diversity of policy instruments will be required to facilitate their development and implementation.

Key words : Organic farming, sustainability, Plant biodiversity, Microbial flora

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Category: Animal, Plant, Agriculture and Medical Sciences,etc.Anti-bacterial, Anti-viral and Anti- cancer efficacy of Nymphaea caerulea

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ABSTRACT

Background and Aim: Multiple antibiotic resistances make illnesses complex to cure and raise morbidity and mortality globally, making multidrug-resistant bacterial diseases serious challenges to global health. Along with these, the ageing of the population, increased exposure to alcohol, tobacco, obesity, and pollution, in lower-income nations, are all contributing factors to the rising burden of cancer, which is another major and expanding global health concern alongside infectious diseases. The rich phytochemical composition of *Nymphaea caerulea* (Blue lotus), includes flavonoids, glycosides, and phenolic acids, is responsible for its many biological actions, which include anti-inflammatory, antioxidant, antibacterial, and anti-cancer qualities. Therefore, in this article we have explored the antibacterial, antiviral and anticancer activities of ethanolic extract of *Nymphaea caerulea*.

Methods: The antibacterial and antiviral study was done with 14th day old fertilized chick embryo model. Several experimental sets were prepared and relative fold change in gene expression of several cytokines were studied which are responsible for pathogenicity, inflammation and tissue damage. The gross morbid anatomical changes of the embryo were studied. Anti-cancer activity of the extract was studied on acute myeloid leukemia cell line, THP-1 along with a control of normal human embryonic kidney (HEK 293) cell line. Cyto-toxicity study with MTT assay, cytopatheic study, cytokine gene expression changes together with apoptotic markers were also studied.

Results: Blue lotus extract was found to be remarkable immune-modulator agent as it suppressed pro inflammatory cytokine genes IL-8, IL-1â and IL-6 maintaining the immune homeostasis and triggered the IFN-ã gene expression that stimulated the host immunity in case of bacterial and viral infections. The extract also reduced the haemorrhages in the embryos when infected with *E. coli*. The flower extract is capable of inducing apoptosis in AML cell line and it can balance cytokine alterations in such disease.

Conclusions: Ethanol extract of *N. caerulea* showed promising antimicrobial and anticancer activities.

KEYWORDS: *Nymphaea caerulea*, anti-bacterial agent, anti-viral activity, anti-cancer activity

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Ramie (*Boehmeria nivea*): Sustainable cultivation, product development and waste valorisation

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ABSTRACT

Ramie (*Boehmeria nivea*) is an important fiber plant in the natural textile market due to its excellent fiber quality. Ramie cultivation is limited to some regions in India, and the majority of the fiber and yarn used in India is imported from China. It is a rapidly growing plant that requires adequate fertilization. This study reports a sustainable Ramie cultivation with a combination of 50% chemical fertilizer (NPK) and 50% bacterial biofertilizer (Indian Patent 347939) with approximately 1.2-3-fold enhancement in fiber yield as compared to chemical fertilizer. Less leaching of nutrients with enhanced yield makes it suitable for adoption in real-time application. The decorticated waste (with self-adhering property) after fiber extraction was found to be suitable for briquette formation with 18.62 MJ/Kg calorific value, that was higher than bamboo (17.84 MJ/Kg) and firewood (18.25 MJ/Kg). The decorticated waste showed 97.9% biological efficiency during *Pleurotus ostreatus* cultivation with maintained nutritional quality, hence edibility. Processing of these fibers need degumming for being spinnable. The gum in-turn could be used in 25% concentration for bacterial growth enhancement with diluted Luria Bertini Broth for extracellular cellulase, pectinase and amylase producing bacteria. A biochemical process (Indian Patent 474317) and a water retting based approached gave spinnable fibers with different strength that could be directly used for weaving. Hence, the production of Ramie fiber could be enhanced in non-agricultural lands, entire waste could be valorised to different products, and the fiber could be processed based on downstream application for various product development, ensuring a zero-waste cultivation of Ramie. So, this paper reports environmental protection through process optimization from cultivation to end-product valorization through eco-friendly product development.

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Impact of InN-TMDC on the performance of Ag-Au bimetal-based plasmonic sensor

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ABSTRACT

Surface plasmon resonance (SPR) is a promising optical technique widely used across various scientific communities for sensing/ biosensing purposes. To enhance the performance of conventional SPR-based sensors, smart materials play a key role. In this study, Indium Nitride (InN) and transition metal dichalcogenide (TMDC) are incorporated on the surface of Ag-Au bimetal-based SPR sensor. Numerical simulations and conceptual analyses are conducted using MATLAB, while the electric field distributions at the interface of the sensing medium are analyzed with the help of COMSOL Multiphysics. The key performance parameters, including sensitivity, detection accuracy (DA), and figure of merit (FoM), are evaluated for various combinations of InN and TMDC materials. Among these combinations, the InN–WS, exhibited superior performance in terms of sensitivity and FoM, with values of 196.08 °/RIU and 33.46 RIU{ ¹, respectively, indicating effective plasmonic coupling and improved resonance. The evanescent electric field intensity shows a maximum value of 1.81 × 10{ t V/nm for the same combination at a resonance angle of 74.9°, suggesting enhanced field penetration and analyte interaction. These results confirm that integrating InN and WS, layers with Ag–Au bimetallic films can substantially improve SPR sensor performance through field enhancement and reduced losses. The proposed SPR structure offers significant potential for high-sensitivity detection in biochemical and environmental sensing applications.

KEYWORDS: Surface plasmon resonance, Biosensor, Indium Nitride, Transition metal dichalcogenide, Performance

Employment of Head-Space Solid Phase Microextraction(HS-SPME) for innovative semiochemical analysis and quantification in Ladybird beetles for promoting sustainable agricultre

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Semiochemicals are useful natural compounds that insects use to communicate, and they can play an important role in insect life cycle. These semiochemicals are mostly hydrocarbons (HCs) and primarily serve as a waterproofing cuticular layer and function extensively in chemical communication by facilitating species, sex, and colony recognition. In lady bird beetles, these chemicals are closely linked to their mating and prey predatory behavior for pest control. Because of this, studying semiochemicals offers a new angle for developing sustainable pest-management strategies. In this study, headspace solid-phase microextraction (HS-SPME) an innovative method is employed for investigating the sex-specific semiochemical analysis and quantification in different Ladybird beetles . This method allows researchers to study the volatile chemicals released by the beetles without causing them stress or killing them. HS-SPME is a **solvent-free** technique that can detect volatile compounds quickly and requires only a small number of beetles for analysis. The SPME fibres used in this method are coated with materials such as **Polydimethylsiloxane (PDMS)** for trapping non-polar compounds and **Carbowax Divinylbenzene (CWDVB)** for capturing polar compounds for analysis. The ability of each coating to adsorb specific chemicals depends mainly on the shape, size and properties of the molecules. After extraction of semiochemicals, the proportions of different linear and branched chained hydrocarbons were analysed using **GC-FID** along with **GC-MS platform.** The variations obtained in semiochemicals analysis might have a role in the behavioral or ecological aspects of the studied ladybirds and can be commercially used for promoting sustainable agriculture.

Key words: Semiochemicals, Ladybirds , Sustainable agriculture, Pest management, HS-SPME

ECOLOGICAL AND SOCIO-ECONOMIC IMPLICATIONS OF VANYA (TASAR) SERICULTURE ON FOREST CONSERVATION AND RURAL LIVELIHOODS IN MAYURBHANJ AND SUNDARGARH DISTRICTS OF ODISHA, INDIA

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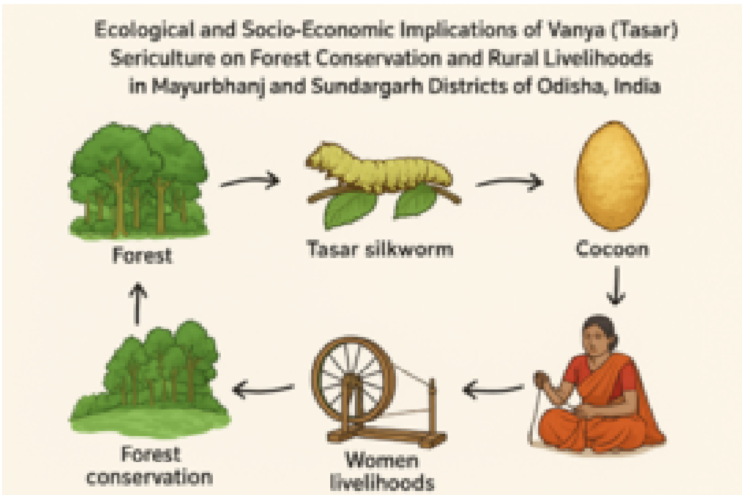
ABSTRACT

Tasar (vanya) sericulture, a non-mulberry silk production system based on *Antheraea mylitta* (Drury), represents a climate-resilient and forest-dependent enterprise that integrates ecological and socio-economic dimensions in eastern India. This study investigates the long-term environmental and livelihood impacts of tasar sericulture in Mayurbhanj and Sundargarh districts of Odisha, two major tasar-producing landscapes characterized by extensive deciduous forest cover and tribal populations. Secondary data were sourced from the Forest Survey of India (FSI, 1972–2023), Central Silk Board (CSB), Census of India, and NABARD livelihood reports, supplemented with household surveys conducted in tasar clusters between 2010 and 2023.

Analyses focused on forest cover change, rural-urban migration trends, women's income patterns, and ecological benefits of sericulture-based afforestation. Results reveal that forest cover in Mayurbhanj increased from 380.63 kha in 2000 to 390.12 kha in 2020, while Sundargarh experienced growth from 420.05 kha to 427.12 kha in the same period, indicating the role of sustainable sericulture plantations in maintaining canopy density. Tasar cocoon production rose by approximately 60% during 2005-2022, and women's income from cocoon marketing and yarn reeling increased by an average of 41%. Furthermore, the rural-urban migration rate declined by ~22% after the establishment of community sericulture clusters (2010–2020).

These findings demonstrate that tasar sericulture has significantly contributed to both forest conservation and rural economic upliftment,

particularly among tribal women's self-help groups (SHGs). The practice supports ecosystem restoration, biodiversity maintenance, and socio-economic stability, making it a model for nature-based livelihood systems in semi-arid forest regions of India.



KEYWORDS: *Tasar silk; Antheraea mylitta; community forestry; forest regeneration; non-mulberry sericulture; sustainable livelihoods; women empowerment; Odisha*

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Radio-tolerant novel bacterial consortium for the biodegradation of hexamine

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ABSTRACT

Biofilm-based bioremediation of emerging organic pollutants on a large industrial scale is an economically viable, ecofriendly and stable technology for prolonged uses. Biofilm provide, well establish cellular network, metabolic exchanges, and adaptability towards environmental fluctuation. Biofilm facilitate rapid absorption and degradation of the pollutants compare to suspended culture. Tailor-made, strong biofilm forming bacterial consortium was developed using six well characterized bacterial isolates from the hexamine and formaldehyde containing industrial effluent. The extent of hexamine removal was assessed (based on hexamine, formaldehyde and COD removal efficiency) in biofilm setup after low doses of ^{60}Co g irradiation, revealing the consortium to be radio tolerant recovering their efficiency within 96 hours of post irradiation. The immobilized system, showed 94.6%, 86% and 52.5% reduction in hexamine, formaldehyde and COD after 3.75Gy of ^{60}Co g irradiation and 92.2%, 84.2% and 52.57% reduction in hexamine, formaldehyde and COD after 5.25 Gy of ^{60}Co g irradiation, when starting with an initial 51.6 mg/L hexamine, 39.1 mg/L formaldehyde and COD 13359 mg/L. In suspended condition, the consortium could recover their efficiency within 192 hours post irradiation showing 90.6%, 71.6% and 32.43% reduction in hexamine, formaldehyde and COD after 3.75Gy ^{60}Co g irradiation while 91.6%, 72% and 31.9 % reduction in hexamine, formaldehyde and COD after 5.25 Gy ^{60}Co g irradiation, when starting with an initial concentration of 52.2 mg/L hexamine, 39.9 mg/L formaldehyde and COD 13037 mg/L. In immobilized condition the consortium could recover hexamine removal efficiency within 24 hours post irradiation following both 3.75Gy and 5.25 Gy of ^{60}Co g. In this study we report the hexamine removing ability of *Brucella pseudintermedia*. In this study we report the hexamine removing ability of *Brucella pseudintermedia* and *Ochrobactrum sp.*

Keywords: Hexamine, Ammonia, Formaldehyde, Bioremediation, Biofilm

Climate-Smart Agriculture: Integrating Innovation and Traditional Wisdom for Sustainable Food Systems

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ABSTRACT

Climate change has emerged as one of the greatest threats to global food security, with unpredictable rainfall, soil degradation, and rising temperatures affecting agricultural productivity. Climate-smart agriculture (CSA) offers a holistic framework to address these challenges by enhancing crop resilience, improving resource efficiency, and reducing greenhouse gas emissions. Integrating modern technologies—such as precision irrigation, biofertilizers, and renewable energy—with indigenous farming knowledge can revolutionize food systems to become both adaptive and sustainable. This approach emphasizes three core goals: increased productivity, enhanced resilience, and reduced environmental impact. Practices like crop diversification, conservation tillage, and agroforestry restore soil health and sequester carbon, while sustainable water management ensures long-term ecosystem balance. Moreover, empowering farmers through community-based adaptation and technology-driven decision-making strengthens rural livelihoods and promotes environmental stewardship. By bridging science and tradition, climate-smart agriculture aligns directly with the United Nations Sustainable Development Goals, particularly zero hunger, climate action, and responsible consumption. It redefines farming as not only a source of sustenance but also a key solution to the climate crisis. Through innovative yet nature-respecting practices, CSA paves the path toward a greener, food-secure, and climate-resilient future.

KEYWORDS: *Climate-smart agriculture, Sustainability, Crop resilience, Agroforestry, Food security, Climate action*

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Plant Growth–Promoting and Zinc-Solubilizing Rhizobacteria: Dual Role in Enhancing Zinc Availability and Crop Productivity

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ABSTRACT

The soils across all districts of Odisha exhibit zinc deficiency. To sustain and enhance crop production and productivity, the application of zinc-solubilizing bacteria (ZnSB) as bioinoculants is therefore essential for improving zinc availability and uptake by plants. The present study investigates the in vitro zinc (Zn) solubilization potential and plant growth–promoting (PGP) effects of native rhizobacterial isolates obtained from agricultural soils of Odisha, India, and evaluates their biofertilization potential in rice crop cultivation. A total of 55 rhizospheric soil samples with pH d" 5.0 were collected from five districts - Balasore, Cuttack and Khordha. One efficient zinc-solubilizing bacterial isolate from each district was selected and assessed for its ability to solubilize insoluble zinc compounds under laboratory conditions. Among the isolates, *Priestia aryabhattai*, *Alcaligenes faecalis* and *Bacillus subtilis* exhibited the highest Zn solubilization efficiency, releasing significantly higher concentrations of soluble Zn after eight days of incubation. The overall solubilization trend for all isolates followed the order ZnCOƒ > ZnO > Znƒ (PO„), . The three isolates could produce indole acetic acid in broth cultures and siderophores on CAS agar medium. All the three bacteria demonstrated superior zinc-solubilizing and growth-promoting capabilities, indicating their potential use as bioinoculants to enhance Zn bioavailability and crop productivity in Zn-deficient soils.

KEYWORDS: Zinc-solubilizing bacteria (ZnSB); *Priestia aryabhattai*; *Alcaligenes faecalis*; *Bacillus subtilis*; *Vigna radiata*; Zinc deficiency; Rice; Odisha soils

Eco friendly Liquid Fertilizers from Dal Lake Macrophytes: A Dual Assessment of Quality and Bio efficacy

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ABSTRACT

This study investigates the nutrient composition and bio efficacy of fermented liquid fertilizers (FLFs) derived from aquatic macrophytes collected from Dal/ Lake, a eutrophic water body in Srinagar. The objective was to quantify nutrient content and evaluate the effects of these FLFs on seed germination and early seedling growth of *Brassica/ oleracea/ var./ virdis*/ (Collard/ Greens) and *Raphanus/ sativus*/ (Scarlet/ Globe/ Radish), thereby assessing any phytotoxic or growth promoting responses.

Nine FLFs were prepared via lactobacilli driven fermentation of macrophyte biomass collected from nine representative sites around Dal/ Lake. Each sample was analyzed for physicochemical properties, macro and micronutrient profiles, heavy metal concentrations, and phytohormonal content. The resulting pH values ranged from/ 6.45/ to/ 7.8, electrical conductivity (EC)/ from/ 9.124/ to/ 20.626/ dS/m, nitrate (NOƒ {)/ from/ 65/ to/ 550/ mg/L, potassium (Kz)/ from/ 190/ to/ 520/ mg/L, and phosphate (PO„ ³{)/ from/ 22/ to/ 110/ mg/L. Secondary macronutrients included calcium (Ca²z)/ 103–406.6/ mg/L, magnesium (Mg²z)/ 37.6–109.4/ mg/L, and sulphate (SO„ ²{)/ 6.4–47.6/ mg/L. Key micronutrients such as iron (Fe)/ 0.21–0.59/ mg/L, zinc/ (Zn)/ 0.37–2.8/ mg/L, and chloride/ (Cl{)/ 297.8–675/ mg/L, remained within agronomically acceptable limits, whereas heavy metals such as chromium (Cr)/ (1.37–7.64/ mg/L) and cadmium/ (Cd)/ (0.04–0.18/ mg/L) were present in trace concentrations below phytotoxic thresholds. The indole acetic acid (IAA) levels ranged from/ 10.28/ to/ 42.87/ mg/L, confirming microbial synthesis of growth promoting hormones during fermentation.

Seed vigor index (SVI) analysis demonstrated enhanced germination and seedling development compared to control: *B./ oleracea* showed SVI/

values between/ 97.04/ and/ 196.15/ % at a/ 1:20/ dilution, while *R./ sativus* achieved even higher values (126.94/ –/ 293.05/ % at/ 1:10/ dilution).

These results show that fermented liquid fertilizers derived from Dal/ Lake macrophytes serve as nutrient rich, eco friendly soil amendments. They promote seed germination and early plant growth while providing a sustainable management route for excess lake biomass that contributes to the Dal's eutrophication.

Keywords:/ Biomass;/ Macrophyte;/ Dal/ Lake;/ Fermentation;/ Fermented/ Liquid/ Fertilizer

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" Visible-Light-Driven Co–Al LDH/g-Cƒ N… Nanoarchitecture for Dual Pollutant Degradation and Sustainable H, O, Production with Photoluminescence Detection Capability."

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ABSTRACT

The development of efficient and sustainable photocatalysts for environmental remediation is of significant interest in addressing the pressing concerns of pharmaceutical and dye contaminants in aquatic systems. In this work, a Co–Al layered double hydroxide (Co–Al LDH) decorated on nitrogen-enriched graphitic carbon nitride (g-Cƒ N…) nanocomposite (LN) with varying weight ratios (1:2, 1:1, 2:1) was successfully synthesised via a facile solvothermal strategy followed by ultrasonic exfoliation. The optimised $LN_{2:1}$ catalyst with enhanced photocatalytic behaviour was evaluated for photocatalytic organic pollutant degradation and oxygen reduction reaction (ORR). The $LN_{2:1}$ nanocomposite achieved the highest degradation efficiency of 93.4% against ciprofloxacin (CIP) and 92.1% against cresol red (CR) within 120 minutes under solar irradiation, demonstrating its superior catalytic activity compared to pristine g-Cƒ N… and Co–Al LDH. Furthermore, the composite demonstrated enhanced hydrogen peroxide (H, O,) generation of 1903.28 ìML^{-1} (5.5 times that of $g\text{-}C_3N_5$ and 16.43 times that of Co-Al LDH), which was substantially higher than that of pristine components, indicating its ability to drive reactive oxygen species (ROS)-mediated photocatalytic pathways. The morphological and BET surface area analysis demonstrated a 2D nano-platelet-like composite with a higher surface area of 30.647 m^2/g, providing abundant active sites for light harvestation and catalytic activation. Experimental analysis, including electrochemical analysis and radical scavenging tests, indicates the formation of a direct Z-scheme heterojunction, which markedly enhances charge carrier separation and utilisation, facilitating the generation of ROS such as superoxide (·O, {) and hydroxyl

(·OH) radicals that drive REDOX processes. This study provides a sustainable photocatalytic strategy with the potential to tackle real-world environmental challenges by enabling efficient degradation of emerging contaminants and advancing water purification technologies.

Keywords: Photocatalysis, Cresol Red, Ciprofloxacin, H_2O_2 Production

Repurposing of an FDA-Approved Drug Against Fluconazole-Resistant *Candida albicans*: An In Vitro and In Vivo Experimental Approach

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ABSTRACT

An inhibitory study of the repurposed FDA-authorized drug compound was done on *Candida albicans*, a primary potent fungal pathogen that causes both superficial and invasive infections, mostly in immunocompromised individuals. In vitro investigations employed minimum inhibitory concentration and minimum fungicidal concentration assays to determine the antifungal susceptibility of the *C. albicans* strain SC5314. Scanning electron microscopic observations revealed significant ultrastructural disruptions in treated fungal cells, including cell wall compromise and morphological irregularities. And when it administered in a murine model of candidiasis, the compound led to notable reductions in fungal burden and tissue pathology, as confirmed by histological analysis. Notably, antifungal resistance to fluconazole, a mainstay therapy for candidiasis, has emerged worldwide, with documented resistance rates for *C. albicans* varying by geographic region and clinical setting, ranging from less than 2% up to 23% and higher under certain conditions such as low pH or repeated exposure. In direct comparative assays, the repurposed FDA approved agent demonstrated greater inhibition of *C. albicans* growth than fluconazole at equivalent concentrations, suggesting superior antifungal potency against resistant clinical isolates. These findings indicate the strong potential of repurposed FDA-approved therapeutics as alternative agents in the treatment of resistant candidiasis, underpinning the need for further mechanistic elucidation and clinical validation.

KEYWORDS : *Candida albicans*, Drug Repurposing, MIC, MBC, SEM, Antifungal Resistance .

BioSenseGrid-Q: A Bio-Intelligent, Carbon-Negative Sensor Network Integrating Nanotechnology, AI, and Green Computing for Sustainable Environmental Regeneration

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ABSTRACT

The rapid decline of soil, air, and water ecosystems due to industrial pollutants, agrochemical residues, and CO, emissions demands new technologies. We need solutions that merge smart sensing, sustainable practices, and ecological restoration. BioSenseGrid-Q presents a bio-intelligent sensor network that functions as a "living grid." It monitors, learns from, and regenerates the environment using green nanotechnology, artificial intelligence (AI), and Internet of Things (IoT) principles. Each node in the BioSenseGrid-Q network has biodegradable, self-healing sensing modules. These are composed of mycelium, chitosan, and graphene composites layered with biowaste-derived carbon quantum dots (CQDs) and ZnO nanowires. These hybrid nanomaterials enable detection of heavy metals, fertilizers, and organic toxins using optical and electrochemical signals. The nodes feature non-toxic antifouling coatings made from zwitterionic and PEG-based polymers. They mitigate biofilm buildup and material breakdown during field use without harming the environment. A key aspect of this platform is its carbon-negative operation. Algal biocoatings on the sensor surfaces actively fix CO, . Enzymatic layers help neutralize chemical pollutants right where they occur, improving local air and soil quality. The system receives its energy from solar-triboelectric hybrid microcells and microbial fuel cells embedded in the soil. This design allows it to work continuously in remote or off-grid locations. Integrated TinyML and spiking neural network algorithms enable on-node data processing and classification. This substantially reduces the need for cloud computing and the energy costs that come with it. Each node communicates through low-power LoRaWAN and BLE mesh networks. This setup creates a self-organizing, resilient grid that only shares high-value environmental insights. We maintain cybersecurity and operational integrity through cryptographically signed firmware updates and hardware-level encryption. BioSenseGrid-Q aligns with Sustainable Development Goals (SDGs) 9, 11, 12, 13, and 15. It marks an innovative step toward eco-intelligent infrastructure that can monitor soil health, sequester carbon, and detoxify pollutants in real time. By integrating biocompatible nanomaterials, edge AI, and renewable energy harvesting, the platform monitors environmental dynamics and enables ecological remediation. It establishes an autonomous, adaptive eco-sensor network, a novel paradigm in sustainable environmental intelligence that connects biology, nanotechnology, and AI to reinforce ecosystem resilience and environmental homeostasis.

Keywords: BiosenseGrid-Q, TinyML, Biointelligent Sensor, Biocoatings, Solar-triboelectricity

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Remediation of Cr-contaminated plant-aqueous biosystem by *Cenchrus purpureus* (Schumach.) Morrone: an optimisation and modelling study via Response Surface Methodology

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ABSTRACT

The study investigates the chromium (Cr) remediation potential of *Cenchrus purpureus* (Schumach.) Morrone in a Cr-spiked hydroponic system, employing Response Surface Methodology (RSM) for process optimisation and modelling. A Box–Behnken design evaluated the interactive effects of Cr concentration (0–50 mg L{^{1}), plant density (1–3 plants unit{^{1}), and exposure duration (3–45 days) on Cr removal efficiency and accumulation. Quadratic models exhibited strong predictive accuracy ($R^2 > 0.99$), with the optimum conditions (50 mg L{^{1} Cr, 3 plants unit{^{1}, 28 days) achieving 60.79% removal efficiency, 1639.6 mg kg{^{1} shoot, and 1703.6 mg kg{^{1} root accumulation. The bioaccumulation and bioconcentration factors confirmed *C. purpureus* as an efficient Cr phytostabiliser (TF < 1). Enhanced antioxidant enzyme activities (CAT, SOD, APX) reflected adaptive stress tolerance, whereas total chlorophyll, protein, and carbohydrate contents declined with increasing Cr exposure. Pearson correlation revealed positive associations among Cr removal, enzyme activity, and uptake indices. The validated RSM model demonstrated high reliability (RSE < 8%), supporting its application for predictive optimisation of phytoremediation systems. Overall, *C. purpureus* presents a robust, eco-sustainable candidate for Cr phytostabilisation in contaminated aqueous environments, providing an effective framework for modelling-based optimisation of heavy metal remediation.

Keywords: Phytostabilization, antioxidant enzymes, response surface methodology (RSM), chromium, biochemical

Multi-Omics Approaches in Sustainable Oral Health Research on Probiotics and Functional Foods Against *Streptococcus mutans* Biofilm Formation

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ABSTRACT

Sustainability in oral health care is evolving beyond eco-friendly clinical practices to embrace molecular-level precision driven by multi-omics technologies. The integration of genomics, transcriptomics, proteomics, and metabolomics enables a comprehensive understanding of the complex interactions between the oral microbiome, host tissues, and environmental factors. This approach provides insights into microbial ecology, gene regulation, and metabolic adaptations influencing oral diseases such as caries and periodontitis. Targeted suppression of key virulence genes in *S. mutans* represents a novel, sustainable, and non-antibiotic approach to manage oral biofilm-related diseases. Moreover, metagenomic analyses capture community-level shifts, highlighting synergistic effects of probiotic strains and bioactive food components in reshaping oral microbiota ecology. Multi-omics facilitates the identification of natural and eco-friendly bioactive agents such as functional food, probiotics, and biodegradable nanomaterials that can replace conventional synthetic antimicrobials promoting targeted modulation of the oral microbiome without disturbing ecological balance, aligning clinical innovation with environmental responsibility, green biotherapeutics, biomaterials with enhanced biocompatibility and reduced environmental footprint that serves as a bridge between high-throughput biological discovery and eco-conscious oral healthcare, defining the future frontier of sustainable dentistry.

KEYWORDS:Oral biofilm, *Streptococcus mutans*, functional foods, multi-omics, Oral Bio-film.

Wild Superfoods for Climate-Resilient & Nutritional Security

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ABSTRACT

Looking at the emerging population and climate change, it challenges food security. The promotion and exploration of wild superfoods, which are nutrient-rich and naturally resilient plant species, have gained attention for ensuring sustainable national security. Wild superfoods such as millets (*Pennisetum glaucum, Setaria italica* of the Poaceae family), Moringa (*Moringa oleifera),* Amaranth (*Amaranthus spp*.), Sweet Potato (*Ipomoea batatas*), Quinoa (*Chenopodium quinoa*), and Buck wheat (*Fagopyrum esculentum*) excel in marginal environments with minimal inputs, making them ideal crops for climate-resilient agriculture. This species is rich in micro nutrients, antioxidants, vitamins, minerals and healthy fats which help to boost the immune system. For example, moringa leaves provide vitamin A and C, protein, and iron. Buckwheat is rich in fibre, protein, iron, riboflavin, and niacin. Millets and amaranth grain are drought-tolerant with significant quantities of calcium, magnesium and essential amino acids, making them suitable for conventional cereals. Quinoa is rich in fibre, protein, minerals, magnesium, phosphorus and vitamins. Beneficial for the immune system and promotes overall health. The formation of wild superfoods in local diets and agri-food systems contributes to diversified nutrition, ecological sustainability, and climate resilience. They require less water, adapt to poor soils, and capacity to restore degraded ecosystems, making them strategic resources for both rural livelihoods and environmental restoration. Promoting their cultivation and consumption can reduce dependence on climate-sensitive staple crops and foster food sovereignty. It represents a holistic solution linking biodiversity conservation, nutrition enhancement, and climate adaptation. Harnessing their potential through research, policy integration, and community engagement is crucial for building climate-resilient nutrition security in the 21st century.

Keywords: *Superfood, Climate resilient, Nutrition, Immune system*

Title: Scenedesmus obliquus as a Multi-Product Platform for Sustainable Biorefinery in Odisha: An Integrated Low-Cost Approach

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Keywords: Scenedesmus obliquus, microalgae biorefinery, biodiesel, wastewater utilisation, CO, recycling, nutraceuticals, circular bioeconomy, Odisha

Microalgae are revolutionising renewable energy and bioproducts, with Scenedesmus obliquus emerging as a powerful yet underutilised green alga capable of producing biofuels, proteins, carbohydrates, and bioactive compounds in one integrated system. This study presents an innovative, low-cost biorefinery model that exploits the abundant municipal wastewater and industrial CO, available in Odisha, reducing input costs and driving a circular bioeconomy. By cultivating S. obliquus under optimised mixotrophic and nutrient-stress conditions, we achieved high-value biomass rich in lipids (25–40%), proteins (~50%), and carbohydrates (20–30%)—ideal for multi-product recovery.

Our process converts lipids to biodiesel via energy-efficient in-situ transesterification, cutting solvent use and operational costs by around 40%. The lipid-extracted biomass undergoes fractionation to yield nutraceutical-grade protein hydrolysates and ethanol-extracted pigments, including lutein and â-carotene. Carbohydrates are utilised for bioethanol fermentation or bioplastic production, while residual biomass serves as biofertilizer, enabling a zero-waste cascade. Economic assessment highlights that co-product recovery boosts profitability by over 50% compared to single-product biodiesel routes, with cost savings amplified by Odisha’s tropical climate, solar drying, bioflocculant harvesting, and CO, recycling in open raceway ponds.

Beyond bioenergy, S. obliquus demonstrates pronounced bioactive properties: protein hydrolysates exhibit potent antioxidant and antiviral activities, and ethanol extracts rich in phenolics show strong antioxidant potential. This integrated biorefinery not only advances sustainable biofuel production but also paves the way for pharmaceuticals and nutraceuticals, positioning S. obliquus as a versatile platform for regional bioindustry growth and environmental sustainability.

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Spatio-Temporal Analysis of Land Use and Land Cover Changes and Forest Dynamics in the Midnapore Forest Division, West Bengal, India.

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Abstract

This work offers a detailed spatio-temporal analysis of Land Use and Land Cover changes and dynamics of the forest cover within the territory of Midnapore Forest Division located in West Bengal, India. Data provided by multi-temporal Landsat satellite images and further supervised Maximum Likelihood Classification was used to quantify land cover change in the period of 2000-2020. Interesting patterns of landscape complexity with the predominance of agricultural land cover and more than quadrupled settlements were revealed. Dense forest cover, overall added by growth, demonstrated significant spatial variability in each of the forest ranges. Some of them revealed deforestation due to different economic land use pressures, while others demonstrated a net growth related to participatory conservation-oriented interventions. Scrub vegetation showed the dynamics of land degradation by increasing first and then sharply declining. These two periods of growth were interpreted as the initial phases of land use transformation. The classification assessment verified the reliability of the classification for 2000 and 2010 and demonstrated the lowest accuracy for 2020 due to its increased land use complexity. These results indicated the interactions between anthropogenic pressures, conservation policy, and ecological processes in shaping the forest ecosystem in this area. The study suggests that continuous remote sensing monitoring is needed to support adaptive forest management and sustainable land use in ecologically sensitive areas.

KEYWORDS: Spatio temporal analysis, Land use and land cover change, Forest dynamics, Midnapore Forest Division

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Extremophile–Plant Interactions in Extraterrestrial Agroecosystem Design: A Conceptual Review of Mechanisms and Applications

ABSTRACT

Extremophile–plant symbioses represent an emerging approach to developing resilient, low-input agroecosystems capable of sustaining productivity in degraded, resource-limited, and climate-stressed environments. Extremophiles including halotolerant bacteria, thermophilic fungi, desiccation-tolerant microalgae, and radiation-resistant archaea exhibit distinctive genomic and metabolic adaptations that enable survival under salinity, heat, drought, nutrient scarcity, and high UV radiation. When functioning as endophytes or rhizospheric partners, these microorganisms enhance plant resilience through osmoprotectant synthesis, biofilm-mediated water retention, phytohormone regulation, nutrient solubilization, and antioxidant defense activation.

Integrating advances in microbial ecology, synthetic biology, and planetary agriculture, extremophile–plant partnerships offer scalable biotechnological strategies for regenerative agriculture aligned with the Sustainable Development Goals, particularly Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), and Climate Action (SDG 13). Tailored extremophile consortia can improve crop performance across distinct abiotic stress regimes: halophilic bacteria reduce sodium toxicity and promote potassium balance in saline soils; metallophilic microbes mobilize micronutrients in mining-affected regions; and xerotolerant fungal

endophytes enhance stomatal control and lower evapotranspiration in arid zones. Collectively, these mechanisms diminish reliance on chemical fertilizers and irrigation, thereby reducing emissions, conserving water, and mitigating eutrophication.

The resilience of extremophiles under Martian-analog conditions marked by radiation, desiccation, and perchlorate-rich regolith also positions them as biological candidates for closed-loop agroecosystems in extraterrestrial habitats. Extremophile-assisted cultivation systems could facilitate nutrient recycling, biogenic soil formation, and greenhouse stability within space habitats.

To operationalize this concept, a modular "symbiome-based" agroecosystem is proposed, integrating (1) extremophile bioinoculants optimized for local stressors, (2) soil conditioners derived from microbial biopolymers, (3) decentralized bioreactors for inoculum production, and (4) AI-based monitoring of plant–microbe systems.

By decentralizing production and lowering ecological input footprints, extremophile–plant systems contribute to circular bioeconomy models, ecological restoration, and climate adaptation. Ultimately, these symbioses may offer a biologically robust and scalable pathway for transforming marginal lands into productive ecosystems, possibly supporting food security on Earth and sustainable life-support systems in future extraterrestrial settlements.

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Topographic species–habitat associations of tree species in a lowland dipterocarp forest of Western Ghats, India

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ABSTRACT

Lowland dipterocarp forests of the Western Ghats exhibit high biodiversity, structural complexity, and substantial carbon content. However, these forests face severe threats from human activities, such as deforestation and land degradation. These threats result in biodiversity loss and alter the forests' role in the global carbon cycle. We established a 9.9 ha permanent plot in the lowland dipterocarp forest at Uppangala, Pushpagiri Wildlife Sanctuary, India. All trees with **a** diameter at breast height (DBH) of 1 cm or more were inventoried, following the standards of the Centre for Tropical Forest Science protocols. Previous research has shown that both taxonomic and functional community composition are influenced by topographic variability, acting as a form of environmental filtering in Uppangala. Topography shapes local conditions, including soil moisture, nutrient levels, and sunlight intensity. These factors then determine species composition and trait patterns in the tropics. Based on topographic characteristics, we defined five habitat categories in Uppangala. In this work, we aimed to examine differences among habitat types to determine if tree species show species–habitat associations at various life stages. We tested the results with a torus-translation test and Nonmetric Multidimensional Scaling (NMDS) for 78 species and 145 species, respectively. We considered two life stages—young and mature—of tree species that were positively associated with topography. NMDS identified considerable variation in vegetation composition between topographic habitats (ANOSIM, $R = 0.1132$, $p = .001$). We also found that topographic features (elevation and convexity) were significantly correlated with species composition in the plot (Elevation: $F = 6.36$, $p = .001$; Convexity: $F = 1.9$, $p = .027$; Elevation × Convexity: $F = 1.69$, $p = .07$). Of the 78 species subjected to the torus-translation test, 19 had strong positive and 14 had strong negative associations with one or more of the five habitats. Positive associations occurred more often in low slope habitats; negative associations were more frequent in valley habitats. This suggests that edaphic and hydrological variation related to topography plays important roles in habitat partitioning in lowland dipterocarp forests of the Western Ghats, India. The two most dominant species, *Dipterocarpus indicus* and *Vateria indica*, showed strong positive associations with high gully and valley habitats, respectively, when considering all individuals. At the adult life stage, both showed a strong affinity for ridge habitat. Additionally, mature *Vateria indica* showed a strong negative association with high gully habitat. We conclude that environmental filtering is important in maintaining the diversity of this heterogeneous, species-rich, lowland dipterocarp forest. However, variation within habitats was greater than between habitats, suggesting that environmental filtering alone does not determine species composition in these forests.

Keywords: Torus-translation test, Uppangala permanent plot, Environmental filtering, Nonmetric multidimensional scaling.

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Deep-Time Pathways of Climate Adaptation: Insights from the Early to Late Permian Sequences of Indian Gondwana

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We are at a point where we are seeking guidance from systems, scholars, and engineers about what seems to be the starting point of a global imbalance in natural harmonies. But what happened to the already existing hard evidence from deep time? Fortunately, geology has been collecting these traces for more than a century. Our focus will be on the organisms we call *plants*—to show how the Earth itself dealt with rapid changes in balance and recovered from them. During recovery, what was lost and what was gained is the core insight we need to internalize before debating endlessly about these complex planetary-scale systems.

Gondwana studies from the Early Permian Period in the Indian Peninsula expose this deep restructuring under rapid misalignments of critical systems. While the Talchir Formation (early Sakmarian) recorded the gradual deglaciation phase after a long ice age, surprisingly, some plants bled through the threshold beautifully. The *Rhacopteris* flora reappeared, but with some members missing from its inventory, and some new, evolved plants showed up for the first time. This is the story of the *Glossopteris* flora, a canonical account of Earth's first forests.

Our focus will shift from the glaciers of Talchir to the early forests of Karharbari, to the dense canopy of Barakar, and then to the deserts of Barren Measures, ending with another recovery represented by the Raniganj forests. This sequence reveals how the Earth itself works—not what we think or debate about how it might be working.

Human activities now condense these millions of years into mere centuries, testing the core mechanisms of system harmony. Palaeobotany has already accumulated a large amount of hard evidence showing how forests behave under various constraints, and how life bounces back with a new alignment each time. Understanding these rhythms can help us predict and align systems before major restructuring occurs—knowledge that the Earth already recognizes and uses as its native algorithm.

Keywords: Early Permian; Talchir Formation; Karharbari Formation; Barakar Formation; Barren Measures Formation; Raniganj Formation; Palaeoclimate; Post-glacial Recovery; Climate Resilience; Sustainable Development Goals

SPATIO-TEMPORAL ANALISIS OF AIR QUALITY DURING DIWLI IN BHUBANESWAR : A THREE-YEAR COMPARATIVE STUDY (2023-2025)

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Air pollution has become one of the most critical environmental affecting the urban population of India. The celebration of Diwali in India is closely related with a extensive use of firecrackers, which result in short term but considerable reduction of ambient air quality. The burning of fire crackers not only affect the human respiratory system but also releases fine particulate matter, gaseous pollutants and heavy metals into the atmosphere which has a major role in decoration of the air quality. The study is based on the variation in air pollutants for three consecutive years (2023,2024 & 2025) of pre-Diwali, Diwali , post-Diwali in Bhubaneswar which is the capital of Odisha , a rapidly urbanizing city with traffic emissions, construction activities and population density already contribute to air quality challenges. The analysis is carried of two continuous ambient air quality monitoring station at Lingaraj Mandir(OSPCB) and Patia(OSPCB) which represent mixed residential environment. 24-hour average pollutant concentration data has been collected from the Central Pollution Control Board(CPCB) and applies the National Air Quality Index(AQI) method which is prescribed by the Central Pollution Control Board of India. Pollutants like $PM_{2.5}$, PM10, SO2, and NO2 are considered which are commonly influenced by both background emission and festive-induced particular bursts.

The methodology involves computing pollutant-specific AQI values using standard breakpoint concentration tables and identifying the dominant pollutant for each observation period. The spatio-temporal variation in pollution level is being analysed using Inverse Distance Weighting(IDW) interpolation in ArcGIS. Expected results include a noticeable spike in particulate matter concentrations on the day of Diwali, followed by a gradual decline over the subsequent days. The magnitude of this increase is expected to differ across monitoring sites. Additionally, the study anticipates year-to-year variations influenced by meteorological factors, enforcement of pollution control measures, and differences in firecracker usage patterns.

The research contributes to understand the festival related pollution dynamics in rapidly growing urban areas and also offers insights for public health advisories, policy making and community awareness strategies aimed at sustainable celebration practices.

Key words : Ambient Air Quality, Particulate Matters, Inverse Distance Weighting (IDW)

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Assessment of Age-Specific Incidence and Clinical Characteristics of Endometriosis in Women of Reproductive Age: A Cross-Sectional Case study.

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Women of reproductive age who suffer from endometriosis, a persistent gynaecological illness, experience severe menstrual pain, pelvic discomfort, and a reduced quality of life. Despite its prevalence, there are still significant obstacles, such as delayed diagnosis and low awareness. Early detection and prompt management depend on an understanding of age-specific patterns and clinical manifestations. This study reveals systematic data collection and analysis to ascertain the prevalence of endometriosis symptoms and related traits in the reproductive age population across various age groups. From October 2025, women of reproductive age participated in a cross-sectional online questionnaire study. Menstrual characteristics (age at menarche, cycle regularity, flow intensity, and severity of dysmenorrhea), clinical symptoms (pelvic pain, dyspareunia, gastrointestinal and urinary symptoms), lifestyle factors (physical activity, dietary patterns, smoking, and alcohol consumption), reproductive history, family history, and healthcare-seeking behaviour were all recorded by the structured questionnaire. For comparative analysis, respondents were divided into three age groups: 18–25 years, 26–35 years, and >35 years. A total of seventy-two valid responses were gathered. The age distribution showed that 76.4% of the respondents were between the ages of 18 and 25, 19.4% were between the ages of 26 and 35, and 4.2% were older than 35. 43.1% of respondents reported considerable pain, and 31.9% reported severe dysmenorrhea that interfered with everyday activities. In 26.4% of respondents, heavy menstrual flow was seen. Of the respondents, 8.3% reported having pelvic discomfort frequently, while 29.2% reported having it occasionally outside of their periods. 63% of women reported experiencing gastrointestinal problems during their periods, primarily bloating. Seventy-eight percent of those surveyed were sedentary to moderately active. In 18.1% of patients, there was a family history of endometriosis or similar gynaecological problems. Remarkably, 38.9% of respondents said that neither family members nor medical professionals took their initial problems seriously. 73.6% of responders had regular 27–35 days cycles, and the mean age of menarche was 12.7 years. The need for increased awareness and screening in this age group is highlighted by the prevalence of substantial dysmenorrhea and related symptoms in younger women (18–25 years old).

The survey effectively recorded symptom patterns and age-specific distribution, indicating a considerable burden of endometriosis-related symptoms, especially among young women aged 18 to 25. To enable earlier diagnosis and intervention, the data highlights the critical need for increased awareness among the public and healthcare professionals.

Keywords: Endometriosis, dysmenorrhea, reproductive age, age-specific incidence, menstrual disorders, cross-sectional survey, diagnostic delay.

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GC–MS Derived Phytochemicals from *Cynodon dactylon* Against ACC4 for Arthritis: An in silico Study

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ABSTRACT

Arthritis encompasses a diverse group of chronic inflammatory and degenerative joint disorders, with rheumatoid arthritis (RA) being one of the most debilitating forms. Among the key immunological markers involved in RA pathogenesis are anti-citrullinated protein antibodies (ACPAs), which target citrullinated collagen and play a crucial role in inflammatory signaling and joint degradation. The Anti-citrullinated Collagen Type II Antibody (ACC4) is particularly significant, as its binding to modified collagen triggers inflammatory cascades that accelerate cartilage deterioration. Plant-derived phytoconstituents, known for their anti-inflammatory, antioxidant, and immunomodulatory properties, have gained attention as potential anti-arthritic agents. In this study, seven phytochemical ligands were from *Cynodon dactylon* by the help of GCMS data. Molecular docking against the ACC4 antibody, followed by extensive in silico ADMET though pKCSM profiling were carried out to test for druggability of the ligands. Docking analysis revealed that PubChem CID 5486180 (–8.67 kcal/mol) and CID 528048 (–7.01 kcal/mol) exhibited the strongest binding affinities toward ACC4, suggesting stable interactions capable of inhibiting antibody binding or modulating downstream inflammatory events. Other compounds CID 637542, CID 443884, and CID 445858 showed moderate affinities ranging from –5.75 to –4.24 kcal/mol, indicating potential supportive roles in attenuating ACC4-mediated inflammatory responses. ADMET predictions further enhanced the therapeutic potential of several ligands. Most compounds showed high intestinal absorption (64–98%) and acceptable Caco-2 permeability, indicating good oral bioavailability. The absence of AMES toxicity, hepatotoxicity, and hERG inhibition in compounds such as CID

637542, CID 445858, and CID 528048 validated their safety and reduced cardio toxic potential. The majority of ligands demonstrated minimal inhibitory effects on major CYP450 iso enzymes, suggesting a lower likelihood of metabolic drug–drug interactions. In addition, ecological toxicity indicators such as T. pyriformis and minnow toxicity were low for most compounds, highlighting their environmental compatibility. Among all screened phytoconstituents, CID 528048 and CID 5486180 emerged as the most promising anti-arthritic candidates, showing strong affinity for ACC4 coupled with favorable pharmacokinetic and toxicity profiles.

Keywords: *Cynodon dactylon*, ACC4, Rheumatoid Arthritis, Phytoconstituents Molecular Docking pKCSM ,ADMET Profiling

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Eco-Friendly Synthesis of Fluorescent Carbon Dots for Bioimaging Applications

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ABSTRACT:

Fluorescent carbon dots (CDs) have gained significant attention due to their tunable optical properties, low toxicity, biocompatibility and, making them promising candidates for bioimaging applications. In this study, we present an eco-friendly approach for synthesising fluorescent CDs using *S. saman* leaf extract as a natural carbon source. The green synthesis method eliminates the need for hazardous chemicals and complex processing, aligning with sustainable and environmentally friendly practices. The as-synthesised CDs exhibit excellent water solubility and remarkable stability. They show an excitation peak at 368 nm and an emission peak at 447 nm. Characterisation techniques such as UV-Vis spectroscopy, spectrofluorometer, and TEM confirm their structural and optical properties. Additionally, cytotoxicity studies indicate their biocompatibility, making them suitable for bioimaging applications. This green synthesis approach provides a cost-effective and sustainable method for producing fluorescent CDs and highlights the potential of plant-derived nanomaterials in biomedical applications.

Keywords: Fluorescent carbon dots, green synthesis, bioimaging

26th ODISHA BIGYAN 'O' PARIBESH CONGRESS & 1st International Conference on 'Sustainable Green Frontiers'

Focal Theme: SDGs: Science and Technology Innovations

Poster presentation Comparative study of semi-quantitative histopathological indices in freshwater bivalve *Lamellidens marginalis* exposed to fibre form of Polystyrene microplastics

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ABSTRACT

The rise in plastic pollution has increased in recent years due to release of untreated plastic waste into water bodies through various sources. Here they experience a fragmentation process that ultimately results in the creation of microplastics (MPs). These MPs are becoming a considerable danger to aquatic species. While the impacts of MPs on marine species have been thoroughly researched, there is a lack of understanding regarding their effects on freshwater species. Freshwater bivalves hold significant social and economic importance and are regarded as excellent bioindicators. These organisms reside at the bottom and are more vulnerable to microplastics due to their feeding mechanism. Comparative examination of histopathological alterations was carried out alongside semi-quantitative histopathological metrics in the foot, mantle, gill, and hepatopancreas of freshwater bivalves *Lamellidens marginalis* subjected to polystyrene microplastics over varying exposure durations. In this study, freshwater bivalves *Lamellidens marginalis* were subjected to a concentration of 1mg L-1 of polystyrene microplastics in fibre form for durations of 7 days (Experiment I), 10 days (Experiment II), and 15 days (Experiment III) and a parallel control set was also maintained. Exposure to microplastics resulted in mild changes (mild necrosis) in the foot and mantle, while significant tissue lesions were observed in the hepatopancreas and gill in experimental groups I, II, and III compared to the control. Cellular degenerations, including lamellar distortion and necrosis, were noted in gill tissue. In the Hepatopancreas, several tubular alterations were noted. The semi-quantitative histopathological indices (HI) for foot tissue recorded the highest value in Experiment I (0.33), with Experiment II showing a value of (0.28±0.09) and Experiment III at (0.22±0.09). Experiments I and III for the mantle displayed comparable values (0.22±0.09), which were higher than those of Experiment II (0.17). The histopathological changes in gill were noted in this order: Experiment I (0.53±0.05) > II (0.43±0.03) > III (0.18±0.01), indicating a range from moderate to low levels. In contrast, for the hepatopancreas, HI showed a gradual increase as the exposure period increased with [Experiment I (0.14±0.05) < II (0.45±0.05) < III (0.53±0.09)], varying from low to moderate levels. Of the four tissues, the gill exhibited the highest HI value, followed by the hepatopancreas, foot, and mantle. The current study concludes that microplastics can cause lesions in various tissues of these bivalves, thereby adversely impacting their health and histopathological changes can be used as important biomarker tool to assess the impact on bottom dwelling bivalves.

Keywords: Microplastics, Polystyrene, *Lamellidens marginalis,* Toxicity, Histopathology.

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Design of a Dual-Linker Ce-MOF@Polypyrrole Composite for Efficient and Selective Detection of Hexavalent Chromium from aqueous medium

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ABSTRACT

Heavy metal contamination, particularly the extreme toxicity of hexavalent chromium (Crv z), has raised demands for advanced composite materials capable of both sensing and removal to ensure environmental and public health safety. In this work, polypyrrole (Ppy) was synthesized with cetyltrimethylammonium bromide (CTAB) as a soft template, sulfuric acid (H_2SO_4) as the dopant, and ammonium persulfate (APS) as the oxidizing agent. A cerium-based metal organic framework, Ce-MOF-808 was prepared and incorporated with PPy for Crv z removal in water, which showed negligible adsorption efficiency. With this limitation in view, a 4th-generation MOF hybrid strategy was then adopted through engineering of the linker environment using a dual-linker approach combining terephthalic acid (H, BDC) and trimesic acid (Hƒ BTC) in a 1:1 ratio. When such a linker-engineered Ce-MOF was integrated with PPy via an in-situ polymerization process, it demonstrated excellent Crv z sensing ability. Photoluminescence studies in acetonitrile and aqueous media using ten different analytes showed significant fluorescence quenching only in the presence of K, Cr, O‡ , confirming selective and sensitive recognition of Crv z ions. This work highlights the importance of linker modification as a signature of advanced 4th-generation MOF design toward a tailored polymer–MOF interaction and improved functional performance. Further efforts will be made toward UV–Vis titration for Crv z adsorption and desorption studies and testing on real environmental water samples to establish practical validity.

Keywords: Heavy metal toxicity; Polypyrrole; 4th-generation MOF hybrid; Linker engineering; Chromium sensing; Fluorescence quenching

'Cool Umbrellas' for Climate Resilience

Quantifying Endemic Flora as 'Cool Umbrellas': A Nature-Based Innovation for SDG-Driven Climate Resilience

Escalating anthropogenic climate change is driving a costly positive feedback loop: rising temperatures increase reliance on energy-intensive air conditioning, which further exacerbates atmospheric warming. This study proposes and validates a Nature-based Solution positioning **locally adapted trees as 'Cool Umbrellas'** —a critical, technology-independent innovation for sustainable climate resilience.

A rigorous scientific methodology was employed in rural Koraput, India, to quantify the cooling efficacy of endemic flora, comparing 26 tree samples (from 14 families) against nearby sacred groves. The project meticulously assessed 30 biometric and structural parameters, including **crown porosity, leaf area index, and shade area**, to determine their quantitative impact on reducing ambient temperature and improving human thermal comfort.

The results confirm these shade-providing plants function as vital green infrastructure. They are highly effective at **microclimate temperature reduction to levels cooler than nearby urban areas** and contribute significantly to carbon sequestration, topsoil erosion prevention, and the maintenance of genetic reservoirs and pollinator habitats. These findings provide an **evidence-based framework** for selecting superior shade-producing species for targeted reforestation.

This approach directly advances **SDG 13 (Climate Action)** through scalable mitigation, **SDG 11 (Sustainable Cities and Communities)** by fostering healthier environments, and **SDG 15 (Life on Land)** by emphasizing endemic biodiversity preservation. The strategic implementation of these selected 'Cool Umbrellas' offers a critical, low-cost, high-impact innovation for restoring climate quality and promoting ecological well-being.

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KEYWORDS: Nature-based Solutions, Climate Resilience, Endemic Flora, Cool Umbrellas, Microclimate, Carbon Sequestration, Sustainable Development Goals (SDGs), Koraput.

A multi-functional novel Z-Scheme ZnIn, S„ /g-Cƒ N… heterojunction catalyst for enhanced visible light active photocatalysis and antimicrobial action

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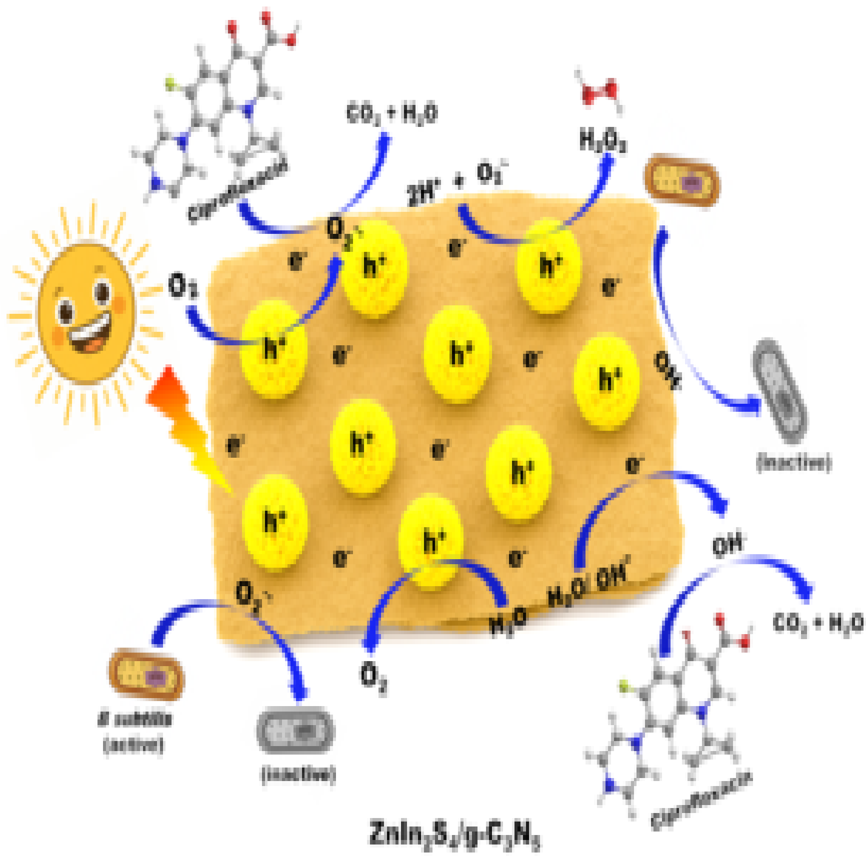
ABSTRACT

Photocatalysis represents a sustainable approach for cleaner energy production, wastewater treatment, and antimicrobial disinfection. Creating effective photocatalysts that respond to visible light is crucial for tackling worldwide challenges related to energy and the environment. Here, for the first time, we have reported a facile solvothermal strategy for the in-situ growth of $ZnIn_2S_4$ nanoflowers on g-C_3N_5 nanoflakes, where the latter were synthesized via thermal polymerization followed by ultrasonic exfoliation. The resulting $ZnIn_2S_4$/g-C_3N_5 (ZCN-10) composite demonstrated outstanding photocatalytic activity, achieving 88.4% degradation of ciprofloxacin within 90 minutes under solar irradiation and producing 3368 ìM L{ ¹ of H_2O_2 under visible light. This enhanced performance when compared to pristine $ZnIn_2S_4$ and g-C_3N_5 is attributed to the formation of a direct Z-scheme heterojunction, which promotes efficient charge separation, broadens light absorption, and optimizes the band structure and morphology. The ZCN-10 catalyst maintained high photocatalytic efficiency over four consecutive cycles and also exhibited notable antimicrobial activity, producing a 17 mm inhibition zone against *B. subtilis* and 30 mm inhibition zone against *E. coli*. Comprehensive analytical characterization confirmed the successful synthesis and structural integrity of the nanocomposite. Mechanistic studies, including radical scavenging and band structure analysis, revealed that the direct Z-scheme configuration significantly enhances charge carrier separation and utilization, facilitating the generation of reactive species such as superoxide (•O, {) and hydroxyl (•OH) radicals, which drive advanced oxidation processes (AOPs). This work highlights a promising route for developing earth-abundant, eco-friendly photocatalysts for environmental remediation and sustainable energy applications.

Keywords: Photocatalyst, Visible Light, Ciprofloxacin, Oxygen Reduction, Heterojunction



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Flacourtia jangomas: A minerals rich wild fruit

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ABSTRACT

Fruits that are rich in nutrients and have mineral properties are essentially required for human health. The south Eastern region of India is globally recognized as one of the major biodiversity hotspots, home to a rich variety of indigenous fruit crops. Many of these native fruits, despite their nutritional value, remain underutilized and receive less attention in terms of research, market development, and commercial cultivation compared to widely grown fruits. These fruits play an important role in ensuring the livelihood and nutritional security of local communities who depend on them for food and income. Flacourtia jangomas, also known as Indian coffee plum or Paniol, is one such underutilized fruit species that grows naturally under semi-wild conditions in Assam, Odisha and other parts of South East India. However, very little information is available on its nutritional properties. Therefore, present study was designed to profiling minerals content of *Flacourtia jangomas.* Results of the study revealed that this fruit contain Sulphur (445.18 mg/kg), Potassium (2683.23 mg/kg), Magnesium (461.19 mg/kg), Manganese (93.75 mg/kg), Phosphorus (93.68 mg/kg), Calcium (1808.60 mg/kg), Iron (0.96 mg/kg), Nickel (7.59 mg/kg), Zinc (5.65 mg/kg), Copper (37.65 mg/kg). The findings provide a baseline mineral profile and help raise public awareness, promoting biodiversity conservation in the forest areas of Gajapati district, Odisha.

Keywords- *Flacourtia jangomas,* Mineral properties

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Bio-sourced Synthesis of *P. Guajava* Silver Nanoparticles as an Eco-Friendly Treatment Method for Dental Caries Associated with Oral Biofilm.

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ABSTRACT

Oral health is often disregarded within general healthcare, leading to inadequate hygiene practices and an increase in dental diseases. Dental caries, which commonly present as toothaches, not only cause pain but also diminish productivity and heighten absenteeism. Traditional treatments are becoming less favored, while natural alternatives are increasingly recognized for their safety and effectiveness. This study investigates the potential of synthesized silver nanoparticles (*P-AgNPs*) created from the extract of *Psidium guajava* stems as an antibacterial and antibiofilm agent against pathogens associated with dental caries. *P-AgNPs* were produced through an eco-friendly approach and analyzed using various spectroscopic techniques. Oral swabs collected from patients with caries were used to isolate bacterial strains (including *Streptococcus, Staphylococcus*, and *Enterococcus spp*.), and these strains were assessed for antibiotic resistance and biofilm production using Tissue Culture Plate, Tube, and Congo Red Agar methods, alongside an in vivo toxicity evaluation. Strong antibacterial activity was shown *by P-AgNPs'* antimicrobial and antibiofilm activities. They were most effective against *Streptococcus* and *Enterococcus spp.* (MIC/MBC: 12.5 µL; ZOI: 20–26 mm) and moderately effective against *Staphylococcus spp.* (ZOI: 21 mm; MIC/MBC: 25 µL). Assays for biofilm suppression verified important antibiofilm characteristics, while toxicity analyses showed no negative consequences *in vivo*. These findings suggest P-*AgNPs* to be a promising natural treatment for tooth caries, exhibiting potent antibacterial qualities without causing harm and encouraging further research into their therapeutic use as effective and long-lasting medicinal agents.

KEYWORDS: Silver nano particle, *Psidium guajava*, Dental carries, Antimicrobial, *Staphylococcus spp*., Anti-biofilm

Eco-Bioprospecting of Ganga and Mahanadi River Microbes for Sustainable Enzyme Production.

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ABSTRACT

Rivers are dynamic ecosystems that house reservoirs of microbial diversity in them, consisting of bacteria, which in most cases are used due to their useful biochemical characteristics. This research paper was to present, isolate, characterise, and examine the enzyme producing bacteria around the Ganga and Mahanadi rivers. As we may understand, there are some possibilities of their sustainable use in industrial sectors. Samples of water were taken in the Ganga during the 2025 Kumbh Mela and the Mahanadi River in Cuttack, Odisha. The five bacterial strains were isolated by use of standard microbiological procedures, such as serial dilution, spread plating and morphological observation. Preliminary identification was assisted at gram staining and biochemical tests (IMViC, catalase, motility, mannitol, and TSI). Its isolates were *Acinetobacter pittii* (GW-A), *Cedecea davisae* (GW-B), *Brevundimonas diminuta* (GW-C), *Pseudomonas aeruginosa* (MW-A) and *Pseudomonas stutzeri* (MW-B). The screening analysis of enzymes showed that GW-B was found to possess both amylase and protease activity, whereas GW-C and MW-A had protease activity. The substrate flexibility of MW-A and dual enzyme activity of GW-B points at the high potential of enzyme production that is not harmful to the environment. These discoveries indicate riverine bacteria as a source of good biocatalysts, and this should be propagated to other applications of biotechnological processes in the future as a cost-effective and sustainable approach to the process.

Keywords-Bacterial Isolation, Enzyme Production , Biotechnological processes, sustainable environment.

Phenological Behaviour and Productivity of Mustard [Brassica juncea (L.) Czern and Coss.] under Varying Sowing Dates and Crop Geometry

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An experiment was carried out at the Agricultural Research Station, Binjhagiri, Chhatabar, Faculty of Agricultural Sciences (IAS), Siksha O Anusandhan (Deemed to be University), Bhubaneswar, Odisha, during the Rabi season of 2023-24. The study, titled "**Phenological Behaviour and Productivity of Mustard [Brassica juncea (L.) Czern and Coss.] under Varying Sowing Dates and Crop Geometry**" aimed to determine the optimal sowing time for mustard by establishing the relationship between crop phenology, weather patterns, and its impact on yield and yield-attributing characteristics.. The findings sought to provide valuable insights into the best agronomic practices and sowing schedules, thereby enhancing mustard production in the region under prevailing climatic conditions. The experiment was conducted in split plot design with 3 replications along with four different date of sowing in main plot i.e. D_1(10th November), D_2 (24th November), D_3(8th December) & D_4(22nd December) and three different crop geometry in sub plot i.e. S_1 (30 cm x 15 cm), S_2 (45 cm x 15 cm) & S_3 (30cm x 30cm).

The results of the experiment revealed that all the yield-attributing characters of mustard were significantly highest under the first sowing date (D_1), i.e., the 45th Standard Meteorological Week (SMW), followed by the second sowing date (D_2), i.e., the 47th SMW. However, beyond these sowing dates, there was a noticeable decline in growth parameters, yield attributes, and seed yield due to unfavourable climatic conditions that affected the growth and development of mustard, particularly at the later stages. The highest seed yield (1082.9 kg ha{ ¹) was recorded under early sowing on 10th

November (45th SMW), followed by the second sowing on 24th November, which yielded 822.1 kg ha{ ^{1}.

Among the different crop geometry, the yield-attributing characters were significantly highest in the 30 cm × 30 cm spacing (S_3), followed by 30 cm × 15 cm spacing (S_1). Despite this, the highest seed yield (857.50 kg ha{ ^{1}) was observed under the spacing of 30 cm × 15 cm due to a higher plant population (22 plants/m^2) per unit area compared to the wider spacing (11 plants/m^2). The highest seed yield (1151 kg ha{ ^{1}) was achieved in the combination of D1S1, which was statistically similar to D1S3, with a seed yield of 1145.33 kg ha{ ^{1}.When comparing the two spacing , S_3 (30 cm × 30 cm) proved to be more remunerative due to its lower input requirements (particularly seed), making it a more cost-effective option, despite the slightly lower seed yield than S_1.

The agro-meteorological indices indicated that the first sowing date (D1), i.e., the 45th Standard Meteorological Week (SMW), accumulated higher Growing Degree Days (GDD), Helio-thermal Unit (HTU), Photo-thermal Unit (PTU), and Heat Use Efficiency (HUE), with values of 1831.92°C days, 13225.15°C hours, 20171.47°C hours, and 0.60 kg ha{ ^{1} °C{ ^{1} days, respectively. A correlation study between the agro-meteorological indices and the yield across different sowing dates revealed a highly positive correlation between yield and HUE (r = 0.9928), GDD (r = 0.976), HTU (r = 0.977), and PTU (r = 0.957).

Based on the findings of the study, it can be concluded that sowing mustard during the first fortnight of November, combined with a wider spacing, results in higher productivity under the prevailing agro-climatic conditions of Odisha. This combination optimizes growth and yield, making it the most suitable agronomic practice for enhancing mustard production in the region.

Key words- Mustard, GDD, HTU, PTU, HUE

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Integrating non-conventional sol-gel synthesized TiO_2 with Carbonaceous material for high performance supercapacitor electrode application

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Abstract

In recent years supercapacitors have gained considerable interest due to their ability to fulfil the requirements for power density in many energy storage applications. Because of their small size and the material they are made of, the electrodes themselves had a defined area that controlled the supercapacitor. In this study Titanium dioxide (TiO_2) was synthesized via a low-cost non-conventional sol-gel method to prepared high performance symmetric supercapacitor (SCs). TiO_2 was composited with Activated charcoal (AC) and graphite powder (G) in different ratios: TiO_2/G (1:1), AC/G (1:1), and lastly a mixture of TiO_2-AC/G (3:2:1) as composite electrode to prepare three different supercapacitors. These supercapacitors worked on a voltage window of 0-1 V. The electrochemical properties like cyclic voltammetry (CV) and galvanostatic charging-discharge (GCD) of these supercapacitors were studied by using three electrode system. Among all, the SC composed of TiO_2-AC/G with 2M KOH electrolyte showed highest value of areal specific capacitance of 22.5 mF/cm^2 at a scan rate of 5mV/s with a high energy density of 95.7 ìWh/cm^2 and a powder density of 18 mW/cm^2.

Keywords: Titanium dioxide, Graphite powder, Activated charcoal, Supercapacitor

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SolarPlast Energy – From Plastic Waste into Solar Panels: A Sustainable Innovation For Greener Future.

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ABSTRACT

The global energy and environmental landscape faces two urgent challenges — plastic pollution and sustainable energy generation. India alone generates over 3.4 million tonnes of plastic waste annually, of which less than 30% is recycled, contributing significantly to environmental degradation. Simultaneously, the growing demand for clean, decentralized energy highlights the pressing need for cost-effective renewable solutions. SolarPlast Energy is an innovative, A sustainable initiative that addresses both challenges through waste-to-energy technology integration. The project focuses on recycling plastic waste to develop solar-grade polymer composites used in manufacturing solar panel frames, protective casings, and **Solar tiles** for building exteriors. These Solar Tiles not only serve as renewable energy generators but also as aesthetic, weather-resistant architectural materials, promoting green building practices and energy efficiency.

This innovation exemplifies a circular economy approach, where waste materials are re-engineered into value-added sustainable products. Laboratory simulations demonstrate that the use of high-density polyethylene (HDPE) and PET blends can reduce panel weight by 35%, enhance durability, and cut production costs by nearly 40% compared to conventional aluminum structures. Additionally, the modular solar tiles provide dual functionality — serving both as construction material and micro-energy sources for residential and commercial units.

The project aligns with multiple UN Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 5 (Gender Equality).

A preliminary financial model suggests an initial investment of [1] 16.5 lakh with a projected ROI of 35–40% within two years. Beyond financial viability, SolarPlast Energy contributes to carbon reduction, waste management, and women-led technological entrepreneurship. In conclusion, SolarPlast Energy represents an innovative fusion of science, sustainability, and social impact, offering a scalable model for green urban infrastructure and a sustainable future under the theme "Sustainable Green Frontiers: SDGs through Science and Technology Innovations."

Keywords: Solar Tiles, Plastic Recycling, Green Energy, Sustainable Development, Circular Economy, Women Entrepreneurship

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Phytochemical-Based Discovery of a Potent Antimalarial Candidate Targeting PfPI4K: A Hybrid Structure-Based and Deep Learning approach

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ABSTRACT

Malaria is a parasitic infection that poses a threat to life and continues to be a serious challenge to global health. The recent COVID-19 pandemic has further escalated the situation. The emergence of artemisinin partial resistance and insecticide resistance emphasizes the critical need for novel antimalarial drug targets and agents with alternative mechanisms of action. This study focuses on Plasmodium falciparum phosphatidylinositol 4-kinase (PfPI4K), a phosphoinositide lipid kinase essential for membrane trafficking and biogenesis across multiple stages of the Plasmodium life cycle. We investigated a dataset of 58 natural anthraquinones with reported antimalarial activity as potential PfPI4K inhibitors. Employing Modeller 10.5 for homology modeling, we constructed the PfPI4K structure, validated by quality testing parameters. Subsequent in silico screening identified potential drug candidates. The top-scoring inhibitors were investigated by ADMET analysis. The compound AD37 (6'-O-methyl-knipholone) was identified as a prominent candidate. It complied with Lipinski's rule of five, displayed favorable ADMET parameters, and reported the highest binding affinity of -5.983 kcal/mol to PfPI4K as determined by GLIDE analysis. The stability and molecular interactions of the PfPI4K-AD37 complex were further confirmed by a 100 ns molecular dynamics simulation employing GROMACS. This investigation identifies AD37 as a promising drug candidate for treating malaria and provides valuable information regarding the molecular interactions essential for the future design and development of antimalarial drugs.

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Keywords: *P. falciparum*, PI4K, Deep Learning, Virtual screening, Molecular docking

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Zinc Intercalated V, O… as a Functional Material for Energy Storage Applications: A Computational Study

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ABSTRACT

Transition Metal Oxides (TMOs) have been materials of choice for designing batteries owing to the rich redox chemistry and structural flexibility they offer. Vanadium pentoxide (V, O…) is one such TMO that stands out because of its intrinsic layered architecture, redox chemistry, and cost-effectiveness. Its orthorhombic lattice allows the reversible insertion and extraction of metal ions which can be the ideal host for designing battery cathodes by intercalating metal ions. In this regard, zinc, with its multivalent nature and high volumetric capacity, has emerged as one of the most promising candidates for next-generation rechargeable battery systems. Ensuring improved electrochemical performance and long-term stability in these Zn-ion batteries requires a thorough understanding of the basic mechanisms behind Zn intercalation within the V, O… lattice. This work systematically investigates the electronic structure, thermodynamic stability, and ion transport characteristics of Zn-intercalated V, O… by using first-principles Density Functional Theory (DFT) calculations, utilizing the generalized gradient approximation with the PBE functional as implemented in Quantum ESPRESSO and VASP. To understand the consequences of intercalation on the properties of the host lattice, a series of structural models were built with gradually varying Zn concentrations. Analysis of the electronic structure through both projected density of states and band-structure computations indicates that the intercalated Zn atoms contribute significantly to the density of states near the Fermi level, effectively narrowing the band gap, pointing to an increase in electronic conductivity. Formation energy computations for the Zn-intercalated V, O… structures confirm that the intercalated lattices are thermodynamically favorable and stable, indicating that the framework is capable of sustaining long-term electrochemical cycling without significant structural degradation. The ion migration pathways were determined by the Nudged Elastic Band method to calculate Zn diffusion barriers and mobility in the host lattice. These collective insights enable the theoretical understanding of Zn intercalation mechanisms in V, O… and provide guidelines for rational design of high-performance, safe, and efficient Zn-ion battery cathodes, which will contribute to the development toward next-generation energy storage technologies.

Keywords: Zinc-ion battery, DFT, Intercalation, Energy Storage

INNOVATING FOR 'LIFE ON LAND': A TECHNO-LEGAL APPROACH TO WILDLIFE CONSERVATION IN INDIA

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ABSTRACT

In India, the evolution of wildlife conservation has transitioned from traditional policing approaches to technologically driven ecological governance. Earlier conservation practices largely depended on data-based ecological management. However, as the nation progresses through rapid advancements in science and technology across various sectors, conservation efforts are encountering increasingly complex challenges. In contemporary India, shrinking land resources of which only about 5% remain under protection along with rapidly changing climatic conditions have intensified pressures on wildlife habitats. Moreover, rising disposable incomes have contributed to a growing demand for exotic animal products, further threatening biodiversity. These factors collectively highlight the urgency for innovative and adaptive conservation strategies in a highly advanced technological era. Combating illegal activities such as poaching, illicit logging, and encroachment necessitates robust monitoring mechanisms and the generation of credible evidence to support investigation and prosecution. Mitigating human–wildlife conflict, particularly incidents involving large and potentially dangerous species, likewise demands the strategic deployment of advanced technological interventions. Crucially, the successful implementation of these measures must be reinforced by a comprehensive and enforceable legal framework that mandates compliance and ensures accountability.

Sustainable Development Goal (SDG) 15- 'Life on Land', it mandates the protection, restoration and sustainable use of terrestrial ecosystems and wildlife. Being world's most mega bio diverse country, India holds extensive legal responsibility and ecological opportunity in fulfilling this goal. It has much progressive legal framework to address the challenges of wildlife conservation. Rather it is more challenging for Indian Law to manage equilibrium between human development in positive side and human interference in negative side. Key legislations such as, the Wildlife (Protection) Act 1972, the Forest Conservation Act 1980 and Environment (Protection)

Act 1986, creates regulatory framework for habitat preservation, protected areas, eco-sensitive zone etc. These acts need to undergo techno-legal upgrades for better environmental compliance in order to be in line with SDG 15. Digital forensics, remote sensing, geographic information systems (GIS), unmanned aerial vehicle (UAV) surveillance, and artificial intelligence (AI) may all be integrated to greatly improve monitoring, detection, prosecution, and governance capabilities. This article critically examines India's progress towards SDG 1+5 by exploring how science, technology and the legal system interact to protect wildlife. The study ultimately argues for a holistic and adaptive governance model that harmonises ecological science, emerging technologies and strong safeguards, while empowering local communities as key stakeholders.

Keywords: Wildlife, Law, Habitat Conservation, Technology

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Title: Physicochemical analysis and Geo-Spatial Assessment of Drinking Water Quality in the Angul–Talcher Industrial Belt, Odisha

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ABSTRACT:

Access to safe drinking water is vital for public health and a central target of Sustainable Development Goal 6 (SDG 6). Industrial regions, however, often face groundwater stress due to extensive mining, power generation, and metallurgical activities. The Angul–Talcher industrial belt of Odisha represents one such critical zone, where industrial expansion has heightened risks of contamination. This study aims to characterize the physicochemical properties of drinking water and assess its spatial distribution to understand environmental and public-health implications. A total of 101 water samples were collected from various drinking water sources wells, hand pumps, and piped supplies and analyzed for eleven major physicochemical parameters: pH, turbidity, total dissolved solids (TDS), chloride, total alkalinity, hardness, fluoride, iron, nitrate, sulphate, and arsenic. Using the weighted arithmetic mean method, the Drinking Water Quality Index (DWQI) was computed based on Bureau of Indian Standards (BIS 10500:2012) norms and categorized as excellent (8.9%), good (26.7%), poor (17.8%), very poor (10.9%), and unfit (35.6%). Overall, 64.4% of sampling sites were identified as poor to unfit. Total alkalinity (63.4%), hardness (60.4%), turbidity (52.5%), iron (30.7%), and fluoride (15.8%) exceeded acceptable limits. Geo-spatial mapping using the Inverse Distance Weighted (IDW) technique revealed contamination hotspots near industrial clusters. Source-wise analysis indicated that hand pumps were the most unsafe, showing consistent exceedances in alkalinity, hardness, fluoride, and turbidity, highlighting their vulnerability to both industrial and geogenic contamination. Correlation analysis further indicated strong inter-parameter relationships influenced by these combined factors. The findings highlight the need for sustained water monitoring, stricter effluent control, and promotion of safer water sources, especially in hand pump dependent communities. Integrating physicochemical assessment with spatial modelling provides a scientific framework for targeted interventions and supports evidence-based policymaking toward achieving SDG 6 in industrially stressed landscapes of Odisha.

Keywords: Physicochemical parameters, Drinking Water Quality Index (DWQI), Geo-spatial mapping, Angul–Talcher industrial belt, Drinking water zonation

IMPACT OF FLY ASH & INTEGRATED NUTRIENT MANAGEMENT ON MORPHOLOGICAL & BIOCHEMICAL TRAITS OF PEARL MILLET

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ABSTRACT

The rapid accumulation of industrial waste, such as fly ash from thermal power plants, presents a significant environmental challenge, while simultaneously offering a potential resource for sustainable agriculture. This study investigates the impact of utilizing fly ash as a soil amendment on the growth, yield, and nutritional quality of Pearl Millet (*Pennisetum glaucum*), a climate-resilient staple crop. A controlled experiment was conducted using four distinct treatments: Plot 1 (Control), Plot 2 (100% Fly Ash), Plot 3 (50% Fly Ash + 50% Organic Manure), and Plot 4 (50% Fly Ash + 50% NPK fertilizer). The initial soil analysis revealed low levels of essential nutrients, providing an ideal environment to test the efficacy of the amendments. Morphological parameters, including plant height, root length, and panicle dimensions, were monitored, and biochemical analysis was performed to quantify key components such as chlorophyll, total protein, and carbohydrate content in both leaves and grains. The results demonstrated a significant positive influence when fly ash was integrated with conventional nutrient sources. Specifically, the 50% Fly Ash + 50% Organic Manure combination (Plot 3) consistently yielded the best performance, showing the highest increases in plant height, root length, panicle size, and total grain protein (20.24 mg/g.f.w.) and carbohydrate content (0.68 mg/g.f.w.). Furthermore, Plot 3 registered the maximum increase in both leaf chlorophyll and protein content compared to the control. Treatment with 100% fly ash alone (Plot 2) showed limited effectiveness compared to the combined treatments, indicating that the true value of fly ash lies in its role as a supportive substrate when paired with organic or inorganic fertilizers. The strategic use of fly ash, particularly in conjunction with organic manure, offers a cost-effective and eco-friendly solution for managing industrial waste while simultaneously enhancing soil fertility and significantly improving the yield and nutritional profile of Pearl Millet. This research supports the potential for sustainable waste management practices within agricultural systems and warrants further long-term studies to assess cumulative effects on soil health and microbial activity.

Keywords: Fly Ash, Pearl Millet, Sustainable Agriculture, Organic Manure, Nutritional Quality, Waste Management.

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Enhanced Visible Light-Driven Photocatalytic Degradation of Methylene Blue and Ciprofloxacin by Magnetic $NiFe_2O_4$ @ZIF 67

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ABSTRACT

Designing of metal-organic framework (MOF)-based stable heterostructures remains a challenging task for material scientists. Here, a magnetic photocatalyst, designated as 30NFZ67, was synthesized using a simple and green method by combining ZIF 67 and $NiFe_2O_4$ at room temperature. The fabrication of hybrid MOF material has been characterized through IR,PXRD,TGA,FESEM and TEM; which reveals the successful formation of heterostructure. Under sunlight, the photocatalyst effectively degraded two major organic pollutant method by combining the ZIF 67 and NiFe, O„ . Under sunlight, the photocatalyst effectively degraded two major organic pollutants: Methylene Blue (MB) dye (~98%) and Ciprofloxacin (CIP) antibiotic (~88%) via a multistep charge transfer mechanism. The process is primarily driven by solar energy, highlighting its potential for sustainable environmental remediation. Trapping experiments identified hydroxyl radical (. OH) and superoxide radicals (·O, {) as the dominant reactive species in the degradation pathway. The degradation efficiency significantly increased with catalyst dosage, rising from 72% to 98% for methylene blue (MB) as the dosage increased from 2.5 mg to 10 mg. Similarly, for ciprofloxacin (CIP), the efficiency improved from 53% to 88% when the catalyst dose was increased from 5 mg to 10 mg within a reaction time of 60 minutes. The photocatalyst demonstrated excellent structural stability over four consecutive degradation cycles. Additionally, detailed analysis of the degradation mechanism, kinetics studies provides valuable insights into heterojunction design for developing high-performance magnetic photocatalysts for wastewater treatment.

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