ABSTRACT BOOK

NACONES - 2025

National Conference on Environment and Sustainability

(January 24, 2025)

पुत्रोऽहं पृथिव्याः

Organised by

INSTITUTE OF ENVIRONMENTAL STUDIES

KURUKSHETRA UNIVERSITY KURUKSHETRA

("A++ " Grade NAAC Accredited, India)

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NACONES – 2025

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(Established by the State Legislature Act XII of 1956)
(A++ Grade, NAAC Accredited)

कुरुक्षेत्र विश्वविद्यालय,
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MESSAGE

It gives me immense pleasure to extend my warmest greetings to all the participants, delegates and organizers of the **National Conference on Environment and Sustainability (NACONES – 2025)** organized by the Institute of Environmental Studies, Kurukshetra University, Kurukshetra on January 24, 2025. Environmental suitability is a critical challenge of our time, demanding collaborative efforts from academia, researchers, policymakers and society at large. This conference serves as an excellent platform to deliberate on innovative strategies, research advancements and actionable solutions to address pressing environmental issues and pave the way for a sustainable future.

Kurukshetra University, accredited with an "A++" grade by NAAC, has always been at the forefront of promoting excellence in education, research and societal development. The Institute of Environmental Studies, with its dedicated focus on fostering environmental awareness and sustainability, exemplifies this commitment.

I am confident that **NACONES – 2025** will inspire meaningful discussion, foster interdisciplinary collaborations and contribute significantly to our shared vision of a greener and more sustainable plant. I commend the organizing team for their tireless efforts in bringing together experts and stakeholders from diverse fields to engage in this noble cause.

I wish the conference grand success and hope it ignites new ideas and innovations and benefit the humanity and the environment alike.

Som Nath

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कुलपति

PROF. NARSI RAM BISHNOI
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No. VC/2025/2312 Dated: 20.01.2025

MESSAGE

It is a matter of great pride and privilege to know that the **National Conference on Environment and Sustainability (NACONES-2025)** is being organized by the esteemed Institute of Environmental Studies, Kurukshetra University, Kurukshetra. I extend my heartfelt congratulations to the organizers for bringing together scholars, researchers, and academicians to deliberate on one of the most demanding issues of our time—environmental sustainability.

As the world struggles with the challenges of climate change, biodiversity loss, and resource depletion, such platforms provide an excellent opportunity to share innovative ideas, research findings, and practical solutions. The role of academia in addressing these global challenges is indispensable, and this conference exemplifies the power of collaboration and knowledge exchange in advancing sustainable development.

I am deeply impressed by the comprehensive approach this conference has adopted to address emerging challenges and innovative solutions in environmental science and sustainability. This initiative resonates with our shared responsibility to foster a healthier and more resilient planet for future generations.

I commend Kurukshetra University, an institution of national and international repute, for its unwavering commitment to academic excellence and its proactive initiatives in promoting environmental awareness.

Wishing the event grand success!

20-01-25

Prof. Narsi Ram Bishnoi

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INSTITUTE OF ENVIRONMENTAL STUDIES
KURUKSHETRA UNIVERSITY KURUKSHETRA

(Established by the State Legislature Act-XII of 1956)
("A++" Grade Accredited by NAAC)

MESSAGE

It is with great pride and enthusiasm that I welcome all participants, speakers, and delegates to the National Conference on Environment and Sustainability (NACONES - 2025), organized by the Institute of Environmental Studies, Kurukshetra University, Kurukshetra, on January 24, 2025.In an era marked by unprecedented environmental challenges, the need for innovative solutions and sustainable practices has never been more critical. This conference provides a dynamic platform for researchers, academicians, policymakers, and industry partners to exchange ideas, share knowledge, and collaborate on addressing the pressing issues of environmental conservation and sustainability.

At the Institute of Environmental Studies, we are deeply committed to advancing environmental research, education, and awareness. We endeavour to foster a culture of sustainability and inspire actions that align with the global goals of environmental protection and resilience. NACONES - 2025 is a testament to our dedication to this mission.

I extend my heartfelt gratitude to our distinguished speakers, contributors, sponsors, and organizing team for their unwavering efforts in making this event a reality. I am confident that the deliberations and outcomes of this conference will significantly contribute to the collective pursuit of a sustainable future.

Sending my best wishes for a successful conference! I'm eager to see the meaningful insights and valuable outcomes it will bring.

With warm regards,

(Prof. Jitender Sharma)
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CHALLENGES AND STRATEGIES FOR ENVIRONMENTAL STEWARDSHIP AND SUSTAINABLE DEVELOPMENT- UN AGENDA 2030

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Keynote Address

As the world is undergoing rapid development, problems of environmental degradation and sustainability issues are fast escalating leading to serious challenges, such as, dwindling natural resources, energy crisis, air, water and soil pollution, increasing ecological footprints, carbon emissions and global climate change. Adopting a sustainable development approach ensuring environmental stewardship has therefore become very important in the present times. The United Nations' 2030 agenda is a universal policy agenda with 17 Sustainable Development Goals (SDGs), and 169 associated targets integrated to it. It aims to guide the Member States to adopt inclusive and people-centric approach for sustainable development that 'leaves no one behind' and simultaneously caters to the protection and conservation of Earth's environment. Policies to implement the agenda need to emphasize on inter-linkages within the social sector, as well as between the social, economic and environmental dimensions of sustainable development. The Agenda 2030 focuses on removing inequalities, hunger, poverty and illiteracy by improving the quality of life for all people through development and economic growth, it lays strong emphasis on environmental stewardship through Climate action, protection of life underwater as well as on land, clean water and energy and responsible production & consumption. Challenges to achieve all the targets of the 17 SDGs within the time frame are huge, especially due to wide disparities among various developed and developing nations that underscore the importance of regional, national and international networks for transfer of technical know-how and financial assistance. We must promote innovative technologies, infrastructure and business to achieve sustainable development with safe and sustainable environment that should suit the conditions and requirements of the nation. It is important to integrate specific sustainability elements in the national policy depending upon the needs of the country, which would help in sustainable development in a given time frame that is monitored as an SDG index and scored over a period based on the given indicators to achieve the targets.

AIR QUALITY MANAGEMENT: HARYANA'S ROADMAP TO CLEAN AIR

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Air pollution is a major cause of respiratory illnesses, particularly amongst the infirm, elderly and young, in the entire Indo Gangetic Plains (IGP), especially during winter months. During this period, particulate matter is the primary pollutant, for the majority of days.

Construction and road dust, vehicular & industrial emissions, and traditional cooking practices contribute significantly to air pollution during winters, apart from episodic events like paddy stubble burning, bursting of firecrackers, etc. Our national standards for acceptable limits of concentration of pollutants are more relaxed compared to WHO, EU, USA standards.

Haryana has taken several steps to control air pollution in the state, particularly in the NCR. Some of these include adoption of approved fuels by industries, expansion of PNG network and supply in major industrial areas, focus on continuous emission monitoring systems adoption and monitoring by highly polluting industries, conversion of brick-kilns to zig-zag technology, promoting bio-mass pellets as fuel, ensuring strict compliance of environmental norms by stone crushers and mining units, levy of environment compensation on non-compliant units, phasing out unfit and old vehicles, promoting EVs, launching of E-buses, IEC, smooth traffic management, remote monitoring of C&D sites through the dust portal, encouraging use of vacuum sweeping and sprinkler machines, pavement and greening of road berms and central verges, use of technology, awareness, subsidy support to farmers for in-situ and ex-situ management of paddy stubble, close monitoring of open waste dumping /burning, promoting clean cooking fuels, strengthening supply chain of LPG, ban on storage, sale and use of firecrackers (except green varieties) during peak winters, focus on strengthening infrastructure for air quality measurement, testing and management, capacity building, conducting source apportionment studies, etc

The Environment Department of Haryana prepared a Haryana Clean Air Project for Sustainable Development (HCAPSD), to be implemented with the World Bank support, over six years, to achieve clean air objectives, through an air shed approach. The $438 million project, including $300 million loan component from the World Bank, aims to promote E-buses, and E-3 wheelers (including supporting infrastructure), encouraging industries to shift to PNG-based boilers and low emission gen sets, setting up of common boilers in industrial

clusters, promoting tunnel-kiln technology for brick-kilns, strengthening C&D waste management, pavement of road berms, supporting mechanical road sweeping, greening, achieving sustainable elimination of stubble burning practices, secondary emission monitoring, piloting clean manure management technologies and practices in selected gaushalas, promoting clean cooking technologies and practices by house-holds, strengthening measurement and forecasting infrastructure, capacity building, citizen engagement, streamlining citizen grievance redressal systems, etc. The DPR of the project is currently under examination by the State Government, for approval.

SMOG HAZARD OF INDO-GANGETIC PLAIN: MAPPING, MODELLING AND DISPERSION TECHNIQUES

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Fog is a low-stratus cloud, which normally touches the ground. The great Indo-Gangetic Plain covering an enormous area, south of the Himalayas in Northern India is most affected by dense fog every year in the winter months (during December to February). Due to increasing air pollution, it has now become smog (smoke + fog) rather than normal fog. Increased air pollution adds the availability of aerosols which become prominent during winter months due to prevailing air flow conditions. Aerosols (small particles of about 0.2 μm size) serve as cloud condensation nuclei which become smog during winter months. The characteristic meteorological, environmental and prevailing topographic conditions and increasing pollution over the Indo-Gangetic Plain are the common factors favouring fog formation. In the present study, the fog of the Indo-Gangetic Plain has been mapped (between 2002 and 2017), and analyzed using NOAA-AVHRR and Terra /Aqua-MODIS satellite data sets. GIS-based analysis of different parametric surfaces derived through two different interpolations of meteorological and elevation data, the favourable conditions for fog formation were ascertained and forecasting was done for a few dates. Later fog formation forecasts were validated of using NOAA-AVHRR / Terra /Aqua-MODIS data sets in near real time. The dissipation and migration pattern of fog in the study area is also interpreted and analysed on the basis of the analysis of both meteorological and satellite data. A classification of the fog-affected area is also performed and the more fog-prone zones in the belt were identified. The present study also brings preliminary results on the ion-based fog dispersion technique (IBFDT). Initially, IBFDT has been tested in the lab and with limited field experiments and outcomes show highly encouraging results.

Keywords: Fog, Smog, Remote Sensing, GIS, Forecasting, Modelling, Dispersion

BASELINE STUDIES IN THE VICINITY OF PROPOSED NUCLEAR POWER STATION IN HARYANA

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Baseline studies are mandatorily carried out at all proposed nuclear facility sites. These baseline studies include estimation of radionuclides in different environmental matrices including water, soil, and air; transfer factor of radionuclides from soil to crops and fodder, ground and surface water quality and demographic studies. Based on the data health risks to the population living in the vicinity are predicted. This study has been conducted within a 30-km radius area of the proposed Gorakhpur Haryana Anu Vidyut Pariyojana (GHAVP), and the study area stretches into Fatehabad and Hisar districts of Haryana, India. The data generated in this work for the proposed nuclear power plant site have been used to predict radiological dose from different matrices to the population of the area.

Baseline levels of natural and artificial radioactivity in soil were assessed by detecting the activity of ^{40}K, ^{238}U, ^{232}Th, ^{137}Cs and ^{90}Sr in soil samples. The activity of ^{90}Sr was below the detectable limit in all the soil samples. The order of different radionuclides activity was $^{40}K > ^{238}U > ^{232}Th > ^{137}Cs$. The contribution of ^{137}Cs activity to annual effective dose equivalent ($\sim 10^{-1}$ μSv y^{-1}) and outdoor excess lifetime cancer risk ($\sim 10^{-5}$) from background radiation is negligibly small. The calculated dose rate from natural activity in soil samples was found equivalent to the Indian average of 64 nGy h^{-1}. The average outdoor excess lifetime cancer risk due to natural radioactivity in soil samples collected from different locations was slightly less than that of the world average (0.29×10^{-3}). Therefore, the data revealed that there is no hazard from soil to the population of study area even if the soil is used as construction material.

The data revealed that ^{40}K, ^{226}Ra and ^{232}Th activities were detectable in most of the grain and fodder samples. ^{40}K and ^{226}Ra activities were detectable in edible portion of all type of collected vegetables while ^{232}Th activity was found detectable only in leafy vegetables, green mustard. Activity of ^{90}Sr was below the detectable limit in all the agricultural produce samples. ^{137}Cs were detectable in 58% of the analysed agricultural produce samples. The maximum Transfer factor (TF) of ^{137}Cs was in mustard and pearl millet giving an idea about

the use of these crops as indicator samples for future studies. Total cumulative annual effective dose and excess lifetime cancer risk due to the presence of different radionuclides in locally grown agricultural produce were much lower than the permissible limit of 1.0 mSv y^{-1} for the general public. Hence there is no carcinogenic risk by ingestion of food items grown in the area. Radioactive dose analysis revealed ingestion of locally grown wheat, rice and vegetables is safe for the general public. Uranium concentration in drinking water has also been quantified at different locations in the study area.

Keywords: Natural radionuclides. HPGe, Environmental samples, transfer factor, risk analysis

THEME -1

Sustainable Technology for the Environment

Arbuscular Mycorrhizal Fungal Biodiversity Linked to Various Medicinal Plants in the Rewari District of Haryana, India

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ABSTRACT

This present research aimed to examine the biodiversity of Arbuscular Mycorrhizal (AM) fungi connected to several medicinal plants. The study aims to investigate the species composition and abundance of AMF spores in rhizosphere soil samples and the percentage root colonization of 33 plants belonging to 21 families in different locations of district Rewari, Haryana. The results revealed that the number of AM spores in the plant's rhizosphere was unrelated to the percentage of AM root colonization. The highest percentage of root colonization was reported in *Cannabis sativa* (90.91%) and *Eucalyptus maculates* (30%) have minimum colonization. The highest number of AM spore density was found in the rhizospheric soil sample of *Ocimum sanctum* (583.2±11.95) and the lowest number of AM spores in *Nerium oleander* (17.6±1.52.). Forty-five AM species belonging to six genera i.e. *Acaulospora, Entrophospora, Gigaspora, Scutellospora*, *Glomus (Funneliformis),* and *Sclerocystis* were isolated during an investigation. Maximum AM spore species were observed in *Tinospora cordifolia* followed by *Artemisia arborescens* and the least in *Calotropis procera*. The study confirmed that the diversity of AM fungi varies from plant to plant. The present study revealed that the genus of *Glomus, Gigaspora,* and *Acaulospora* were more predominant. *Scutellospora, Sclerocystis* and *Entrophospora* are the least among the recovered AMF spores. Root colonization in the plants was in the form of hyphae, arbuscules, and vesicles. The soil of the study site was sandy loam with an electrical conductivity of 0.264 dS/m, pH 8.21, total Nitrogen 0.182%, available phosphorus 18.66Kg/hectare, Potassium 270.48kg/hectare and organic carbon 1.26%.

Keywords: Arbuscular Mycorrhizal fungi, Organic carbon, potassium, total nitrogen

Biotechnological Methods for Biodiversity Conservation

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ABSTRACT

The degree of variation among living organisms is known as biodiversity. It is essential for maintaining the environment's ecological equilibrium. Biodiversity is also essential for human life and economic growth since it provides the foundation for food, shelter, clothing,

medicine, industrial raw materials, and maybe many other advantages to human well-being. In recent years ever increasing loss of biodiversity has posed a serious threat to the sustainability of ecosystem, environment and subsequently to the survival of mankind. Overpopulation of humans, overexploitation of plants and animals, introduction of exotic species, destruction of plant and animal habitat, and excessive use of natural resources are the main drivers of biodiversity loss. Pollution and climate change, both of which are caused by human activity, have a negative impact on biological variety. Plants, animals, and microbes are all impacted by global warming, both directly through temperature changes and by changes in their habitats. Furthermore, the loss of biological diversity can also be attributed to insufficient knowledge, ineffective information and economic systems, and policies of low environmental value. In order to promote environmental sustainability, biodiversity protection is therefore urgently needed. Biotechnology provides new tools for biodiversity conservation. In many special ways, biotechnological approaches like tissue-culture techniques, micro-propagation, marker-assisted breeding, artificial insemination, cloning, transgenic technology, cryopreservation of cells, tissues, gametes, oocytes, DNA samples, genetic databases, and genome editing are helpful for preserving and promoting biodiversity.

Keywords: Biotechnological approaches, biodiversity, environmental sustainability, genetics

Soil Nutrients Under Chemical and Organic Amendments: A Comparative Assessment

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ABSTRACT

The present study was carried out to evaluate the comparative effects of chemical fertilizer (CF) and organic amendments on soil nutrients (Nitrogen, phosphorus, and potassium) status. The experiment was conducted over a rice growing season using a pot experiment with four treatments comprising Chemical fertilizer (CF), vermicompost (A_1), biofertilizer (A_2), farmyard manure (A_3), and control (A_0, no amendments). Soil sampling was conducted at critical growth stages such as initial (DAS_0), 30-day (DAS_30), 60-day (DAS_60), and harvest stages (DAS_Har), and analyzed for available nitrogen by the Kjeldahl method, phosphorus by the Olson method, and potassium by the Flame photometry method. Results depicted the highest nitrogen content (110.81 kg/ha) at the DAS_0 stage under CF, while A_2 had the lowest nitrogen content at 4.18 kg/ha. By DAS_Har, nitrogen content dropped significantly across all treatments, with A_1 having the lowest content at 6.27 kg/ha. Initially,

CF showed a high phosphorus level of 2.03 ppm at DAS_0, whereas A_2 had only 0.45 ppm. By DAS_Har, phosphorus levels decreased across treatment with A_0 dropping to 0.10 ppm. At the DAS_0 stage, A_3 had the highest potassium level at 0.79 me/l, while A_2 showed the lowest at 0.18 me/l. By DAS_Har, potassium level was very likely to recover with CF to 0.33 me/l while that of A_2 dropped to 0.13 me/l. This study highlights the critical fluctuations in soil nutrient availability throughout the growth stages of rice, underscoring the necessity for tailored nutrient management strategies to enhance crop yield and sustainability.

Keywords: Chemical fertilizers; Organic amendments; Nutrient dynamics; Soil fertility; Sustainable agriculture

PGPR-Mediated Nanoparticles And Their Effect On Plant Growth

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ABSTRACT

The green synthesis of nanoparticles using plant growth-promoting rhizobacteria (PGPR) has emerged as a sustainable and eco-friendly approach in nanotechnology. PGPR, known for enhancing plant growth, acts as a biological factory for synthesizing nanoparticles by reducing metal ions through their metabolites. This method eliminates the need for toxic chemicals and high-energy processes typically associated with conventional nanoparticle synthesis. In this study, we explore the synthesis of metallic nanoparticles using selected PGPR strains and evaluate their impact on plant growth. The nanoparticles were characterized using spectroscopic and microscopic techniques, confirming their stability, size, and morphology. When applied to plants, the nanoparticles exhibited significant effects on growth parameters, including root and shoot length, biomass, and nutrient uptake efficiency. The results highlight the synergistic role of PGPR and nanoparticles in promoting plant health by improving stress tolerance, nutrient availability, and disease resistance. This work not only provides a sustainable route for nanoparticle synthesis but also demonstrates their potential as a novel bio-nanotechnological tool for enhancing agricultural productivity as well as integrating green nanotechnology into modern sustainable farming practices.

Keywords: Green Synthesis, Nanotechnology, PGPR, Stress tolerance, Sustainable

Nanomedicines: A growing field of drugs based on Nanobiotechnology

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ABSTRACT

One of the most significant new scientific disciplines of the twenty-first century is nanotechnology. It focusses on the design, development, analysis, and application of nanoscale systems. Biotechnology is another fascinating field of study nowadays that allows us to comprehend biological systems and apply our understanding to industrial manufacture. At the intersection of these two areas of study is nanobiotechnology. It makes use of biotechnology and nanotechnology to develop a wide range of applications and analyse and build nano biosystems to address a wide range of difficulties. The multidisciplinary field of nanobiotechnology has great potential in physical, chemical, and biological sciences, as well as in the development of improved medical engineering. The diagnosis, treatment, monitoring, and regulation of biological systems through the development of therapeutic agents and instruments utilising pharmacological and therapeutic targeting is known as nanomedicine. With applications ranging from drug delivery to immune-sensors, nanobiotechnology has enormous promise for transforming the biomedical sector. Recent advances in nanomedicine are exemplified in this issue, covering a broad range of medical problems — antibiotic resistance, effective vaccines, cancer, tuberculosis, tissue regeneration and dentistry. Nanomedicine is the application of nanotechnology to achieve innovation in healthcare.

Keywords: Nanotechnology, Biotechnology, Nanomedicines

Study of Vulnerable tree species in the forest of Northern Circle India

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ABSTRACT

This study utilizes a multi-criteria decision-making (MCDM) framework to integrate indigenous knowledge with scientific research, focusing on the identification of stressed tree species in the Yamunanagar forest division, Northern Circle, India. The Analytical Hierarchy

Process (AHP) was employed to facilitate the MCDM approach, enabling a systematic evaluation of the complex relationships between indigenous knowledge and scientific research. By leveraging this integrated framework, the study aimed to identify stressed tree species in the Yamunanagar forest division, providing valuable insights for sustainable forest management and conservation efforts. The study identified vulnerable tree species in the Yamunanagar forest division using a multi-criteria decision-making approach. The results ranked Kalesar forest range as the most stressed timber species, followed by Sadhaura. Jagadhari was identified as the most vulnerable fuelwood species, while Chhachhrauli was found to be the most vulnerable medicinal species. Kalesar was found to be the most stressed due to several factors including high demand for its timber, leading to over-exploitation, susceptibility to diseases and pests. These findings have significant implications for sustainable forest management and conservation efforts. The findings emphasize the need for sustainable forest management practices, conservation efforts, and community-led initiatives to protect and preserve these valuable tree species. By addressing the factors contributing to the decline of dense forest and the stressed species, we can work towards maintaining the ecological integrity and biodiversity of the Yamunanagar forest ecosystem. This study makes a significant contribution to the global discourse on sustainable forest management and conservation, offering a novel framework for identifying stressed tree species using a MCDM approach. By integrating indigenous knowledge with scientific research, this study can be c a pioneering model for international cooperation and knowledge sharing in the pursuit of preserving global biodiversity and promoting sustainable development.

Keywords: Indigenous knowledge, Multi-criteria decision-making (MCDM), Vulnerable tree species, Stress identification, Sustainable Forest management

Adsorption Investigation of Heavy Metals from Electroplating Wastewater Utilizing Novel Chitosan Polymer-Modified Green Magnetite Nanocomposite

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ABSTRACT

Ni(II) adsorption capacity of novel chitosan polymer-modified green magnetite nanocomposite (NCs) was investigated in this work employing batch mode experiments at 27^{o}C using an aqueous solution. Fe_3O_4/CLPC/CS NCs exhibited optimal Ni(II) adsorption at

30 mg/L initial metal ions concentration, 1.0 g/L NCs dose, and 90 minutes of contact time at pH 6.0. Further, a comprehensive isotherms and kinetics modelling study was conducted. It was found that Langmuir isotherm, PSO kinetic and Elovich kinetic best fitted among investigated models owing to their higher correlation coefficients. The Langmuir isotherm confirms the monolayer adsorption of Ni(II) onto the Fe_3O_4/CLPC/CS NCs with maximum monolayer adsorption of 98.04 mg/g, whereas PSO kinetic reveals the chemisorption reaction by electrostatic interaction and ion exchange mechanisms. Further, thermodynamics confirmed that the adsorption process was endothermic and spontaneous with increased randomness. Fe_3O_4/CLPC/CS NCs demonstrated remarkable recyclable efficiency of Ni (II) up to five ad-desorption cycles, with a regenerability of ≥96.19%. Feasibility study confirms that Fe_3O_4/CLPC/CS NCs removed nickel upto 56.15±3.10% along with the co-existing metals such as zinc (50.97±2.49%), lead (93.64±0.9%), cadmium (92.32±0.97%), iron (75.65±2.13%) chromium (92.07±3.02%) from electroplating wastewater. Overall, these findings revealed that Fe_3O_4/CLPC/CS NCs was an effective, low-cost adsorbent with excellent magnetic recovery characteristics.

Keywords: Fe_3O_4/CLPC/CS NCs; electroplating heavy metals adsorption; kinetics and isotherms; regenerability

Potential of Google Earth Imagery for the Classification of Urban Land Use

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ABSTRACT

Urbanization in developing countries is a key factor in economic growth, but it also brings challenges such as overcrowding, pollution, poor infrastructure, and resource scarcity, leading to social, environmental, and economic issues. Rapid urbanization causes uneven development, with central areas receiving more resources while suburban and rural areas lack adequate infrastructure, services, and growth. Accurate, up-to-date data on urbanization is essential for effective planning, resource management, and environmental monitoring. However, obtaining high-resolution satellite images to track urban changes is often expensive and limited by temporal and geographic constraints. This article explores the potential of Google Earth imagery which provides a solution by offering high-resolution information to monitor land use changes, urban expansion, and infrastructure development. It helps track the conversion of agricultural land to residential, commercial, or industrial areas and assesses the

effectiveness of existing infrastructure. Google Earth also supports environmental monitoring by tracking the loss of green spaces, changes in water bodies, and urban heat islands. Additionally, it is useful in disaster management, helping to identify vulnerable areas, assess flood zones, and conduct rapid post-disaster assessments. Overall, Google Earth offers accessible and detailed data, aiding urban planning and sustainable development.

Keywords: Google Earth Pro; Land Use; Urban Area, Environmental Monitoring.

Emergence of Antibiotic-Resistant Bacteria in Surface Water Ponds and the Efficacy of ZnO and Ag Nanoparticles in Antibacterial Applications

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ABSTARCT

The emergence and proliferation of antibiotic-resistant bacterial strains in surface water pose a significant threat to public health and the environment. This study focuses on the isolation and characterization of antibiotic-resistant bacteria from surface water samples collected from various sites within Kurukshetra city. The isolated strains underwent biochemical and antibiotic susceptibility testing, revealing resistance patterns against commonly used antibiotics, including Tetracycline (TE) at 30 μg, Kanamycin (K) at 30 μg, Streptomycin (S) at 10 μg, Chloramphenicol (C) at 30 μg, and Ampicillin (AMP) at 25 μg. The alarming levels of resistance highlight the urgent need for alternative antibacterial strategies. In this context, the potential of zinc oxide (ZnO) and silver (Ag) nanoparticles as antibacterial agents was investigated. The nanoparticles were coated using Azadirachta indica leaf and bark extracts and characterized using standard techniques, including X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy-dispersive X-ray spectroscopy (EDX), to confirm their structure and morphology. Antibacterial efficacy was assessed through disc diffusion and minimum inhibitory concentration (MIC) assays against the isolated resistant bacterial strains. The results demonstrated significant antibacterial activity of green-coated ZnO nanoparticles, with silver nanoparticles exhibiting superior efficacy. The mechanism of action, involving membrane disruption and oxidative stress induction, was also explored. This study highlights the critical role of green-coated ZnO and Ag nanoparticles in combating antibiotic-resistant bacteria in surface water. These findings provide a foundation for

developing nanoparticle- based antimicrobial strategies to mitigate the risks associated with waterborne antibiotic- resistant pathogens.

Keywords: Antimicrobial strategies, Kurukshetra, Nanoparticles, waterborne antibiotic-resistant pathogens

Deciphering Cadmium Tolerance and Biosorption Potential in Industrial Sludge Bacteria: *Achromobacter* sp. and *Bacillus* sp.

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ABSTRACT

Heavy metal (HM) contamination has sparked global concern due to its prevalence, low degradability, and propensity for bioaccumulation in host cells. Cadmium is extremely poisonous and a non-essential metal, and can be harmful to living things even at very low concentrations (0.001-0.1 mg/L). it is concerned with major ill effects and carcinogenicity as it lowers the concentration of Hb in adults and increases antioxidant levels, which can lead to oxidative stress, also damaging human kidneys and skeleton, primarily leading to osteoporosis in children. In heavily contaminated areas, bioremediation has proven to be an affordable and environmentally advantageous method of detoxification and ecological entity restoration for these metals. Bacteria has been widely used in several heavy-metal bioremediation techniques and is thought to be an intriguing remediation workhorse. Therefore, in this study, cadmium contaminated industrial soil samples were utilized for isolation of cadmium resistant bacteria for that matter and screened for maximum tolerance (MTC) for Cd^{2+}. Biochemical tests and microscopic examination were performed to prove their validity. Here, we reported four cadmium-resistant isolates named *Achromobacter xylosoxidans* strain BS3 (PP514688) and strain CS2 (PP486237) and *Bacillus* sp. (in firmicutes) strain CS5 (PP514687) and *Bacillus paranthracis* strain CS7 (PP514686) identified by 16S rRNA based gene sequencing and their phylogenetic analysis. These strains tolerated upto 200-1200 ppm $CdCl_2$. Furthermore, results of Atomic Absorption Spectroscopy (AAS) showed biosorption efficiency of *Achromobacter* strains between 70-73%, while, *Bacillus* sp. ranging between 74-77%. With the use of Fourier transform infrared spectroscopy (FTIR), putative functional groups underlying interactions between cells and metal ions were identified. The present study demonstrates that both the genus' have the potential for use in cadmium contaminated area in future for biodegradation applications.

Keywords: Cadmium Tolerance, Industrial Sludge Bacteria, biodegradation

Exploring the Potential of Nanofertilizers in Combating Salinity Stress in Plants

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ABSTRACT

Salinity stress is a major abiotic issue that affects plant growth, production, and agricultural sustainability on a worldwide scale. Plants under this stress have physiological abnormalities, decreased food absorption, and decreased photosynthetic efficiency. Innovative approaches, such as the use of nano-fertilizers, have generated a lot of attention in an attempt to mitigate these adverse effects. Nano-fertilizers offer practical means of enhancing nutrient availability, stress tolerance, and promoting plant growth in saline conditions due to their unique physicochemical properties. These nanomaterials can reduce the oxidative stress caused by salt by enhancing soil structure, boosting nutrient absorption efficiency, and fortifying the plant's antioxidant system. Additionally, nanofertilizers have demonstrated potential in improving water retention, controlling ion balance, and assisting plant development regulators—all of which are essential for preserving cellular processes in the face of salt stress. The methods by which nanofertilizers might lessen the effects of salt stress are examined in this paper, along with the kinds of nanomaterials that are employed in farming operations and the most current developments in this area. The findings imply that nanofertilizers may be a useful instrument for creating sustainable farming methods to address issues brought on by salt, guaranteeing food security in areas afflicted by salinity.

Keywords: antioxidant system, farming operations, nanofertilizers, Salinity stress.

Climate-Resilient Crop Enhancing Abiotic Stress Tolerance

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ABSTRACT

Climate change presents substantial obstacles to global agricultural productivity by means of erratic weather patterns, rising temperatures, and an increase in the frequency of droughts, heatwaves, and salinity intrusion. These abiotic stresses have a detrimental impact on the physiological processes of plants, resulting in decreased crop yields and a threat to food

security. Climate-induced stresses have already reduced the global production of staple commodities, including rice, wheat, and maize, by up to 7% in certain regions, as confirmed by numerous studies. It is essential to cultivate climate-resilient crops in order to mitigate the effects of abiotic stress and guarantee the sustainability of food systems. Enhanced tolerance to a variety of stressors, including drought, humidity, and soil salinity, is a characteristic of climate-resilient crops. Marker-assisted selection, genetic engineering, and genome editing are among the innovative breeding techniques that impart this resilience. For example, cultivating crops with improved root architecture and antioxidant systems can enhance water absorption efficiency and mitigate oxidative damage during drought duress. Furthermore, cultivars that are salt-tolerant, such as genetically modified rice varieties, have demonstrated an increase in productivity in saline environments. In addition to the utilization of modern molecular instruments, efforts to enhance abiotic stress tolerance also emphasize the application of traditional ecological knowledge. By fostering soil health and nutrient cycling, strategies such as intercropping, crop diversification, and soil amendments with biofertilizers enhance resilience. A comprehensive strategy that incorporates sustainable farming practices and sophisticated genetic technologies is required to mitigate the agricultural consequences of climate change. Particularly in regions that are susceptible to severe weather, investments in climate-resilient crop development can substantially enhance food security. In order to establish a more resilient global food system, future agricultural policies must prioritize the implementation of adaptive land management practices and resilient cultivars.

Keywords: Abiotic stress, Antioxidant, Climate Resilience, Food Safety, Sustainable Farming.

Integrating Satellite Imagery and Google Earth Engine for Predicting and Monitoring Land Use Land Cover Dynamics

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ABSTRACT

Integrating machine learning platforms such as Google Earth Engine (GEE) with high-resolution satellite imagery, including Sentinel-2 and Landsat, offers a powerful approach for analyzing and monitoring Land Use and Land Cover (LULC) dynamics. Sentinel-2 offers high-resolution imagery, while Landsat provides long-term temporal coverage, enhancing the

precision of LULC analysis and enabling detailed classification of land cover changes. This study utilizes the GEE platform to examine LULC changes over a 10-year gap, assessing past, present, and future trends on a university campus, and projects potential developments for the coming years. GEE's cloud-based infrastructure enables efficient processing of large datasets, facilitating real-time analysis and visualization of LULC transformations. This study applies a Random Forest classifier, a powerful machine-learning algorithm that leverages Sentinel-2 and Landsat data, to classify into various LULC types. The model was trained on labelled datasets spanning 10 years and tested for accuracy, yielding reliable classifications of vegetation, built-up areas, and other land cover types. The results reveal significant shifts in LULC, including changes in vegetation cover, urban expansion, and recreational land dynamics. This research highlights using Sentinel-2, Landsat, machine learning, and cloud computing to assess LULC changes, aiding sustainable campus planning. GEE enables large-scale, high-resolution analysis for forecasting land cover trends. Combining satellite imagery, machine learning, and cloud platforms offers a powerful real-time LULC monitoring and prediction tool.

Keywords: Google Earth Engine, Sentinel-2, Landsat, Machine learning, Land Use Land Cover, Monitoring

Bioactive Potential of *Datura innoxia*: Insecticidal and Antimicrobial Activities

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ABSTRACT

This study investigates the bio-pesticidal potential of *Datura innoxia* against *Spodoptera litura*, a major agricultural pest. The research explores the insecticidal properties of different parts of the *Datura* plant, including leaves, stems, roots, and seeds, using methanolic extracts. Morphological and biochemical analyses were conducted on 25 accessions of *Datura metel* L., and significant variation in flower length, scopolamine content, and other biochemical compounds are found. High-Performance Liquid Chromatography (HPLC) was used to quantify these variations. Among the tested plant parts, leaf extracts demonstrated the highest insect mortality rates at various concentrations, while root extracts were the least effective. Furthermore, silver nanoparticles were synthesized from *Datura* leaf extracts and characterized using UV-visible spectroscopy, SEM, EDX, FTIR, and XRD. These nanoparticles showed significant antimicrobial activity against *Escherichia coli*, *Shewanella*

putrefaciens, *Staphylococcus aureus*, and *Staphylococcus epidermidis*. This research highlights the potential of *D. innoxia* as a source of bio-pesticides and its application in sustainable agriculture and nanotechnology, contributing to the development of environmentally friendly pest management strategies.

Keywords: *Datura innoxia*, *Spodoptera litura*, Bio-pesticide, Insecticidal Activity, Silver Nanoparticles, Antimicrobial, Sustainable Agriculture, HPLC

Utilization of Deep Learning CNN Model for Infield Detection of Yellow Rust Disease of Wheat

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ABSTRACT

Wheat is one of the best staple foods with sufficient nutrients to serve the world and tackle food scarcity. In recent years, yellow rust disease became major threat for wheat especially in high humid regions. In India, northern states such as Punjab, Haryana, Rajasthan and Uttar Pradesh, the yellow rust cause great loss to wheat crops ranging from 20% to 80%. In Haryana North-eastern districts; Ambala, Yamunanagar, Kurukshetra, Karnal and Panipat are dominant by yellow rust with respect to all other foliar diseases. To avoid the loss of sources (time & cost), rust identification is the first priority of farmers. In this digital era, Convolutional Neural Networks (CNN), one of the applications of computer vision can identify the yellow rust within milliseconds. A dataset of 800 images, consisting two categories of yellow rust and healthy images, is used for training and testing of CNN model. The dataset is divided into three categories; training, validation and testing with the ration of 70:20:10 respectively. The propped CNN model is significantly identify the yellow rust on wheat leaf with accuracy of 98.92% and it can identify 3 images within 1 second. This study can help the farmers who do not recognize the yellow rust in wheat crop neither in initial nor in fully developed stage of rust.

Keyword: Wheat Yellow Rust, Convolutional Neural Network, Computer Vision, Disease Detection.

Comparative Analysis of Green and Chemically Synthesized Zinc Oxide Nanoparticles

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ABSTRACT

Zinc oxide nanoparticles (ZnO NPs) have garnered considerable attention for their unique properties and diverse applications in medicine, agriculture, and environmental science. The objective of this study is to synthesize ZnO NPs using *Musa paradisiaca* (Banana peel) aqueous extract and zinc salts (zinc acetate) as precursors. ZnONPs were synthesized by the co-precipitation method with some modifications. The nanoparticles were characterized using advanced analytical techniques, including scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), FTIR (Fourier transmission Infrared), and UV-visible spectroscopy. UV–Vis spectra showed typical absorption peaks of green and chemically synthesized ZnO NPs at around 347 nm and 356nm respectively, due to their large excitation binding energy at room temperature. The peaks that were observed correspond to Zn–O stretching and deformation vibration confirmed by FTIR analyses. SEM analyses showed nanorod and nanosphere shapes with the average size of green synthesized is 29.96 and chemically synthesized is 13.14 nm. EDX analyses confirmed high purity for the synthesized nanoparticles. Furthermore, the green method demonstrated a significant reduction in energy consumption and waste production, aligning with the principles of sustainable nanotechnology. However, chemically synthesized ZnO NPs showed greater uniformity in size and shape, which may benefit applications requiring precise control over nanoparticle morphology. The findings contribute to the growing body of research advocating for greener approaches, paving the way for broader adoption of eco-friendly synthesis methods in industrial and biomedical applications.

Keywords: Zinc oxide Nanoparticles, Green synthesis, Chemical synthesis

Quercetin Mediated Attenuation of Nicotine-Induced Reproductive Toxicity in Ovarian Antral Follicles of goat (Capra hircus)

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ABSTRACT

Cigarette smoke is a complex mixture of over 4000 compounds and over 60 well-established carcinogenic elements. Among them, Nicotine (NIC) [1-methyl-2-(3-pyridyl-pyrrolidine),

C10H14N2] is the principle component responsible for addictive properties. Nicotine has been shown to cause reprotoxic effects like alteration of steroidogenesis, delayed puberty and menarche, pregnancy loss, menstrual cycle disorders, altered ovarian steroid hormone and protein levels, oxidative damage, and female infertility. Thus, the current study has been designed to evaluate the nicotine-induced (0.1, 1, and 10 mM) reproductive toxicity in ovarian antral follicles of goats (Capra hircus) along with the ameliorative effect of antioxidant quercetin (Qcn) (10μM, 50μM, and 100μM) to mitigate Nicotine toxicity. The findings demonstrated that NIC causes histomorphological changes, such as vacuolization, pyknotic nuclei, fragmented nuclei, and empty spaces. As the dosage and duration of NIC exposure increased, the fluorescence test (EB/AO staining) revealed a higher incidence of apoptosis. As evidenced by elevated lipid peroxidation (MDA) and decreased total antioxidant capacity (FRAP), treatment with nicotine also raised oxidative stress levels. The level of antioxidant enzymes, e.g. Glutathion-s- transferase (GST) also dropped after nicotine treatment. Quercetin is a flavonoid shown to have anti-carcinogenic, anti-inflammatory, and anti-viral properties. Our findings demonstrated that quercetin co-administration reversed nicotine-induced reproductive damage by lowering oxidative stress levels and raising total antioxidant capacity. Based on this, we may infer that quercetin can be used to mitigate the negative effects of nicotine on the female reproductive system.

Keywords: Female reproductive system, quercetin, toxicity, ovarian antral follicles of goat

Groundwater quality evaluation of Kaithal district, Haryana

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ABSTRACT

For this study, 62 samples of groundwater were examined from 7 blocks of Kaithal District for 12 parameters: pH, hardness, TDS, alkalinity, chloride, ammonia, fluoride, iron, nitrate, nitrite, residual chlorine and phosphate by using the Water Testing Kit provided by Tamil Nadu Water Supply and Drainage Board (TWAD). By considering the BIS 10500:2012 drinking water standards, it is observed that more than 90% area comes under the potable water quality standards except the areas where nitrate, ammonia and fluoride were reported above the permissible limits as 99%, 76% and 45% due to nitrate, fluoride and ammonia respectively. This study emphasized the groundwater management in view of such quality parameters and spatial distribution mapping endow the precious data for agricultural and

drinking water use in Kaithal District and serves as a baseline for future temporal change analyses.

Keywords: Groundwater quality, Kaithal district, physico-chemical parameters

Microbial fuel cell amended constructed wetland for enhanced wastewater remediation and bio-electricity generation: A comprehensive study

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ABSTRACT

Constructed wetland-microbial fuel cell (CW-MFC) is a novel, sustainable, and environmentally friendly integration that addresses water and energy scarcity by simultaneously remediating wastewater and generating bio-electricity. This study examines the use of *Canna indica* as the plant species and graphite rods as electrodes, operated the system for 5 days to treat 36 L volume of sewage wastewater obtained from the university's sewage treatment plant. CW-MFC achieved removal efficiencies of 84%, 85%, 97%, and 72% for BOD, COD, nitrate, and phosphate, respectively, while generating an average voltage of 42 mV. In comparison, the standalone CW system demonstrated removal efficiencies of 55%, 62%, 87%, and 44% for BOD, COD, nitrate, and phosphate, respectively. In conclusion, the results indicate that the CW-MFC system outperforms the standalone CW system in terms of pollutant removal efficiency along with generating bioelectricity. Thus, this integration demonstrates significant potential to address the most pressing global challenges, with continued scientific advancements supporting its efficacy.

Keywords- Wastewater remediation, Hybrid technology, Constructed wetland-microbial fuel cell, Bio-electricity generation, Sustainable development.

Shelf- Life Study of Green Chilies coated with Zein based Film

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ABSTRACT

This study explores the use of zein-based edible coatings to extend the shelf life of green chilies, a highly perishable vegetable with significant post-harvest losses. Zein, a hydrophobic protein derived from corn, was chosen for its excellent film-forming ability, biodegradability, and potential to create a barrier against moisture and oxygen. The research

aimed to assess the coating's effectiveness in maintaining the quality and This study explores the use of zein-based edible coatings to extend the shelf life of green prolonging the freshness of green chilies during storage. Green chilies were coated with a zein-based film prepared using ethanol and glycerol as a plasticizer. The coated and uncoated samples were stored under ambient and refrigerated conditions, and their quality attributes were monitored over 7 days. Key parameters evaluated included weight loss, texture retention, color stability and sensory acceptability. The results demonstrated that zein-coated green chilies exhibited significantly lower weight loss, retained firmness, and showed enhanced color stability compared to uncoated samples. The coating effectively delayed spoilage and maintaining freshness. Sensory analysis revealed that the coating had no negative impact on taste, aroma, or overall acceptability, ensuring consumer preference. The study concludes that zein-based edible coatings offer a sustainable and effective solution for extending the shelf life of green chilies. This innovative approach reduces food waste, enhances marketability, and aligns with global efforts to promote eco-friendly alternatives to synthetic packaging. These findings highlight the potential of zein-based films in advancing sustainable food preservation techniques.

Keywords: Self life, green chilis, zein based film, food preservation

Arsenic: Its Exposure and Impact on Male Reproductive Health

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ABSTRACT

Infertility is rising as the most serious global problem affecting the large proportion of both animal and human populations. The ever-rising industrialization and urbanization led to the increases in environmental toxicant which are directly or indirectly linked to the reproductive health of humans. Among the various environmental pollutants, Arsenic which is a heavy metal enhances the consideration of world due to its harmful effects. Arsenic and its compounds are widely used in pesticides, rodenticides, herbicides, fossil fuels combustion, mining, glass, semi-conductor industries, and food stabilizers. Arsenic exposure and bioaccumulation causes damage to various body organs such as lungs, skin, kidney, liver and reproductive system. Due the natural presence of arsenic contamination in groundwater which is mostly used as drinking water makes it one of the potent reproductive toxicant.

Some studies documented that arsenic exposure to male shows erectile dysfunction, prostate cancer, and testicular disorders. A study on male albino rat showed the remarkable reduction in weight of testis, epididymis and seminal vesicles. Moreover, many animal and human studies also indicates that arsenic effects fertility by changing the levels of luteinizing hormones (LH), follicle-stimulating hormone (FSH), and testosterone and distorts the process of spermatogenesis. Evidences from previous literatures reveals that Arsenic produces its effects by enhancing the production of reactive oxygen species (ROS), leads to the oxidative stress which plays a pivotal role in increasing infertility among humans. Thus this review is going to summarize the effects and mechanism of arsenic-induced toxicity in reproductive system.

Keywords: Arsenic, male reproductive system, infertility, reactive oxygen species

Comparative Assessment of Soil Microbial Activity under Conventional, Organic, and Natural Farming Practices

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ABSTRACT

Agricultural management practices strongly influence the structure and function of soil microbial communities**.** Microbial activity is critical in maintaining soil health and ecosystem functions, particularly in agricultural systems. This study assesses microbial activity in soils subjected to different farming practices. We aim to understand the interaction between management practices and microbial dynamics. Soil samples were taken from three farming sites i.e., conventional farming, organic farming, and natural farming of wheat and rice crops planted in the field, and were evaluated for microbial biomass carbon (MBC), basal respiration rate (BRR), soil organic carbon (SOC) and nitrogen mineralization (NM). The results indicated that natural farming methods exhibited higher MBC in rice crops, while organic farming practices resulted in higher MBC in wheat crops. SOC levels were greater in rice crops under organic farming and in wheat crops under natural farming practices. BRR was higher in rice crops managed with organic farming methods, whereas wheat crops under natural farming showed the highest BRR. Nitrogen mineralization was significantly higher in organic farming for wheat and rice crops. Results of the study revealed that organic farming and natural farming practices are effective for microbial flora and improve soil microbial

properties, which serve as potential indicators of soil structure and fertility and affect crop productivity.

Keywords: Organic farming, Natural farming, Microbial Biomass Carbon, Microbial activity, Nitrogen Mineralization.

Electrocatalytic Performance in Direct Ethanol Fuel Cells: Contributions of Monometallic,
Bimetallic, and Trimetallic Catalysts

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ABSTRACT

There has been rapid growth in the development of clean energy sources along with fuel cell technologies over the recent past. Fuel cells are electrochemical devices that convert electrical energy into chemical energy. This paper presents the study of the electrocatalytic activity of monometallic, bimetallic, and trimetallic catalysts in direct ethanol fuel cell (DEFCs). Monometallic catalysts, for example, platinum (Pt) and palladium (Pd) along with other transition metals find application but have complications like poor tolerance to CO and incomplete oxidation of ethanol. On the other hand, bimetallic catalysts e.g. Pt-Ru, and Pt-Sn,have shown great advancements on account of these synergistic enhancements leading to improved performance, stability, and CO poisoning resistance. Another group of catalysts,trimetallic (e.g. Pt-Ru-Sn) prove to have both high efficiency and long-lasting capabilities which makes them stand out to be useful in most DEFC practical scenarios. This research proves the advantage of multi-metallic catalysts in developing the DEFC technology while solving both major factors of catalyst deterioration and their price.

Keywords: Direct ethanol fuel cell, Monometallic, Bimetallic, Trimetallic, EOR, Electrocatalysis, Synergistic effects

Direct Shoot Induction from Nodal Explants of *Barleria cristata* L.: A Valuable Ethnomedicinal Plant.

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ABSTRACT

Barleria cristata, also known as Philipine violet, is a valuable ethnomedicinal plant with numerous therapeutic applications such as anti-inflammatory, antimicrobial, anti-diabetic, anti-oxidant, hepato-protective, anti-plasmodial, anti-oxidant, and cytotoxic properties. The direct shoot induction from nodal explants of *Barleria cristata* was studied to develop a rapid and efficient micropropagation technique. Nodal segments were collected, sterilized, and cultured on Murashige and Skoog (MS) medium fortified with different concentrations of Indole-3-acetic acid (IAA) and Thidiazuron (TDZ). An increase in IAA concentration was positively correlated with bud break. However, TDZ exhibited an optimal range for effectiveness, beyond which its influence diminished or became inhibitory. This method provides a reliable and efficient approach for the large-scale propagation and conservation of *Barleria cristata*, ensuring its availability for medicinal and research purposes.

Keywords: Ethnomedicinal, Cytotoxic, Inhibitory, Medicinal and Research purposes

Isolation and screening of Neonicotinoid-Degrading Microorganisms from Polluted Soils

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ABSTRACT

Neonicotinoids, a commercial pesticide widely used in agriculture, are a major contributor to environmental pollution. Neonicotinoids are a class of synthetic insecticides that are commonly applied to plants in agriculture to keep sap-feeding insects like aphids and whiteflies away. They work by overstimulating insects' nerve systems, as their name suggests, inspiration from nicotine, a naturally occurring pesticide. However, these substances also function as environmental contaminants, posing significant risks to non-target fauna like butterflies and bees, because of their hazardous metabolites and prolonged buildup. Considerable attention has been paid to the prospective toxicity of the residues present in environment to humans. Studies have indicated that enhanced biodegradation of neonicotinoids can be achieved with microbial consortium under favourable environmental conditions. In the current study, bacterial strains from pesticide-polluted agricultural soil systems were isolated, identified, and their pesticide tolerance was assessed. The species of target bacteria were isolated that could use neonicotinoids as an extra carbon source to break them down into non-toxic chemicals. Identification and biochemical characterization of best performing isolates were done and can be subjected to further studies of bioremediation of

neonicotinoids. However, in order to comprehend the transformation pathways and progress bioremediation efforts, extensive study must be conducted on the discovery of microbial strains that degrade neonicotinoids as well as the identification of the genes and enzymes that cause their degradation.

Keywords: Neonicotinoids, bioremediation, pesticides biodegradation, toxic residues, pesticide degrading bacteria.

Sustainable Bioremediation of 4-Chlorophenol Using *Lysinibacillus* sp.: A Green Solution for Industrial Pollution

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ABSTRACT

The accumulation of 4-chlorophenol (4-CP), a hazardous contaminant frequently utilized in industrial processes, poses major environmental and health dangers. Bacterial biodegradation provides an economical and environmentally responsible way to remove such contaminants. The purpose of this study was to isolate and characterize bacterial strain capable of degrading 4-CP from contaminated soil utilizing an enrichment technique. Soil samples were taken from a polluted industrial area and enriched in a minimal salt medium (MSM) with 4-CP as the only carbon source. After several enrichment cycles, bacterial strain were successfully identified and purified. Here, out of interest, we reported *Lysinibacillus sp.* 4-CP degrading isolate. Morphological, biochemical, and molecular characterizations were used to identify the bacteria. Using 16S rRNA gene sequencing, the isolated bacterium was determined to be *Lysinibacillus sp.* and had notable biodegradation capabilities. Results showed that *Lysinibacillus sp.* could break down up to 90% of 4-CP in 72 hours. The degradation potential of this strains was assessed in liquid MSM cultures, with conc. 1000mg/L of 4-CP degradation quantified with 4- aminoantipyridine (APA) test . The strain's degradation efficiency remained constant over several cycles, demonstrating its resilience and versatility. This study demonstrates the efficacy of *Lysinibacillus sp.* as a viable option for bioremediation of environments contaminated with 4-CP. These results open up new avenues for investigation and expansion of microbial remediation methods for industrial contaminants. By putting such sustainable practices into practice, the ecological footprint of chlorophenol pollution can be greatly decreased, improving public health and environmental preservation.

Keywords: Bioremediation, chlorophenol pollution, microbial remediation

ANT-HILL Water Treatment System: Sustainable and Cost-Effective Solution for Wastewater Treatment

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ABSTRACT

"Air" symbolizes aeration, "Nexus" suggests a connection or intersection of elements which reflects the design's efficiency and effectiveness in treating water, and “High Inflow Liquid Load” represents Large operating volume of the wastewater In India, according to the Central Pollution Control Board estimates, total wastewater generation from Class I cities (no. of cities 414) and Class II cities (no. of cities 489) is around 26,164 and 2965 MLD, respectively. However, the existing sewage treatment capacity is only 6047 and 200 MLD, respectively, creating a sewage treatment capacity gap of 22,939 MLD. (CPCB | Central Pollution Control Board, n.d.). The precarious balance between growing demands and supplies has brought forward the importance of recycling and reuse of water and thereby reducing the freshwater demand supply. In this context, constructed wetlands represents a good alternative to wastewater management that protects, restores, or mimics the natural water cycle and doesn’t involve instalments of large STPs structure, has public acceptance, for being a natural process, low maintenance cost, avoids chemical treatment etc., over conventional wastewater treatment technologies. This eco-friendly approach encompasses two main types: free water surface (FWS) and subsurface flow wetlands, both proving effective in treating diverse wastewater types, including industrial effluents such as chromium-rich tannery wastewater. Research indicates their efficiency in contaminant removal through adsorption, phytoaccumulation, and microbial degradation. Case studies demonstrate their versatility in municipal, industrial, and agricultural contexts, offering promising alternatives amidst increasing water scarcity. Constructed wetlands boast several advantages, including lower capital and operational costs compared to traditional methods, facilitating wastewater reuse, and providing habitat for wetland organisms. The capital costs, primarily attributed to land, excavation, liners, gravel, plants, and distribution structures, can be managed through careful planning and selection of materials. Maintenance costs, including dredging to address sedimentation, are factors to consider but are generally outweighed by long-term savings. These frequent operational setbacks are addressed by means of amalgamating structural engineering that allows prevention of clogging and short

circuiting of the constructed wetland, added the cascade effect of the ANT-HILL system enhanced the contact time for adequate aeration thereby, reducing temperature of the influent wastewater resulting in increased Dissolved Oxygen (as high as 9ppm) compared to existing constructed wetland systems. ANT-HILL Constructed Wetland system represents a promising alternative for addressing wastewater treatment needs sustainably and cost-effectively. The versatility to integrate it for multiple applications, and efficient performance over a wide weather fluctuation establishes it as supplementary water treatment and a viable alternative imperative for sustainable water management.

Keywords: ANT-HILL, constructed wetland, aeration, dissolved oxygen

Genome wide identification and characterisation of RALF gene family in *Solanum lycopersicum* L.

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ABSTRACT

The Rapid Alkalinization Factor (RALF) gene family, a group of small peptides have gained importance in the recent years due to their important roles in plant growth, development and stress responses. However, the gene family is not characterized in *Solanum lycopersicum* L. In this study, we have performed a comprehensive genome-wide analysis of the RALF gene family in *Solanum lycopersicum* A total of 11 RALF genes were identified through HMM-based approach. The identified protein sequence of RALF gene family in tomato were subjected for physico-chemical parameters, chromosomal localisation, domain structure, motif analysis and homology modelling. The phylogenetic tree analysis also identified several distinct clades, highlighting functional divergence of this gene family in tomato. Gene expression profiling of identified RALF genes, based on publicly accessible RNA-seq data indicated stress-responsive expression patterns. Along with this promoter and cis-element analysis highlighted the response of RALF genes in different environmental stresses. These findings suggest the multifaceted role of RALF gene family in growth, development, stress tolerance and plant-microbial interaction in. This study will lay the foundation for further molecular characterization of RALF gene family in the context of growth, development and stress response.

Keywords: RALF gene family, tomato, genome-wide analysis, phylogeny, gene expression, stress response, plant development.

In Vitro Study of Phosphate Ion Release Kinetics from Synthesized Nano-Hyroxyapatite

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ABSTRACT

Bioinspired synthetic hydroxyapatite nanoparticles, resembling the mineral structure of bone and teeth, are gaining attention as sustainable materials for use in agriculture. These salts, characterized by their limited solubility, demonstrate self-regulating dissolution in under saturated aqueous environments—a phenomenon that remains inadequately understood at the molecular and nano-scale levels. Investigating the mechanisms of particle dissolution is essential for improving the delivery efficiency of macronutrients to plants. In this study, the release kinetics of phosphorus from synthesized nanohydroxyapatite was investigated using a holistic methodology under static water conditions over a 21-day period. Nanohydroxyapatite was synthesized via a sol-gel method and characterized through Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), dynamic light scattering (DLS), and Ca/P molar ratio. Phosphate release was quantified in triplicate, with measurements recorded every 24 hours alongside pH monitoring of the solution. The anion release mechanism was further explored using theoretical models, including zero-order, first-order, Higuchi, and Korsmeyer-Peppas kinetic models. The results indicated that the potential release mechanism was predominantly governed by diffusion and dissolution processes, with a potential contribution from ion exchange. Notably, the highest phosphorus release percentages were observed on the 2nd and 11th days of nanoparticle immersion in the liquid medium. These findings enhance our understanding of the dissolution behaviour of nanohydroxyapatite and provide insights into its potential as a controlled-release phosphorus nanofertilizer for sustainable agricultural practices.

Keywords: Sustainable agriculture, release kinetics, nano-fertiliser, nano-hydroxyapatite

Sustainable Co-Culture Systems for Effective Textile Effluent Degradation

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ABSTRACT

The textile industry, a significant contributor to both global and Indian economic growth, generates substantial environmental challenges due to the discharge of effluents containing recalcitrant pollutants such as synthetic dyes and aromatic amines. India, as one of the world's largest textile producers, faces acute pollution issues in regions like Haryana, Gujarat, Tamil Nadu, and Maharashtra, where untreated or partially treated effluents contaminate major rivers, including the Ganges, Yamuna, Sabarmati, Bhavani and the Ulhas Rivers. These pollutants, including Acid Black 1 dye and its toxic metabolite 4-nitroaniline (4-NA), persist in aquatic ecosystems, posing critical ecological and human health risks due to their carcinogenic properties. Conventional wastewater treatment technologies remain multi-staged, resource-intensive, and inefficient in the complete mineralization of complex dye structures and their metabolites, a challenge magnified in small and medium-scale textile enterprises across India. This study presents a novel, single-step microbial co-culture system capable of simultaneously degrading Acid Black 1 and 4-NA in real textile effluent. The microbial consortium achieved a degradation efficiency of 77.31±1.25% for 4-NA and 37.25±0.02% for Acid Black 1 under optimized conditions, with peak activity observed at 35°C. Colony Forming Units (CFU) analysis indicated active microbial growth during the degradation process, demonstrating the metabolic potential of the co-culture in pollutant removal. This research provides a mechanistic foundation for integrating microbial synergism in bioremediation, reducing the need for complex, multi-phase treatment protocols. Beyond its fundamental contribution to environmental microbiology, the findings have significant implications for India's textile sector**,** offering a scalable, cost-effective, and eco-friendly alternative suitable for both major industrial hubs and decentralized rural production units. The demonstrated efficiency of this system supports its alignment with global and national sustainability initiatives, particularly the United Nations Sustainable Development Goals (SDG 6: Clean Water and Sanitation, and SDG 12: Responsible Consumption and Production)**,** as well as India's National Water Mission and the National Mission for Sustainable Agriculture. Further investigations into microbial metabolic pathways and genetic optimization may enhance the biodegradation spectrum, positioning this technology as a transformative advancement in sustainable wastewater treatment strategies both in India and globally.

Keywords: Co-Culture Systems, Textile Effluent Degradation, SDG, CFU analysis

The Importance of AI for Water Resource Management and Conservation

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ABSTRACT

Artificial Intelligence (AI) has become an important area to tackle most environmental sustainability issues such as biodiversity, energy, transportation and water resource management and water resource conservation. Artificial intelligence applications and machine learning models have been increasingly used for predicting and optimizing water resource conservation. This article provides an overview of the value of environmental monitoring, the challenges of conventional methods, and potential AI-based solutions. AI technologies enhance environmental monitoring by enabling better understanding, prediction, and mitigation of environmental risks. However, realizing the full potential of AI faces hurdles such as a shortage of specialized AI experts in the environmental sector and challenges related to data access, control, and privacy with developing technological infrastructure. AI technology has the potential to revolutionize the future of water and wastewater systems and ensure the long-term viability of the water resource. AI algorithms can detect changes in water quality and identify potential contaminants or public health hazards such as pollution plumes and waterborne disease pathogens. Through this, AI can provide information regarding water quality monitoring, leak detection and prevention, infrastructure maintenance, weather prediction and management then focus on water conservation and resource management. AI extends beyond the traditional scope of pattern identification and data analytics. It presents a range of opportunities that have the potential to revolutionize the water resource management.

Key words: Artificial Intelligence (AI), Water Resource, Water Quality, Water Resource Management, Water Conservation

Enhancing the biodegradability and antimicrobial efficacy of natural rubber latex using graphene oxide/nickel oxide nanoparticles

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ABSTRACT

This study presents the development of antimicrobial natural rubber latex composites by incorporating graphene oxide (GO) and nickel oxide (NiO) nanoparticles at varying ratios. The nanocomposites were prepared using latex mixing, followed by a two-roll mill process and moulding with a heated hydraulic press. The chemical, physical, thermal, mechanical, and antimicrobial properties of the composites were thoroughly analyzed. The composite with an optimal GO-to-NiO ratio of 1:2 exhibited the highest tensile strength (24.9 MPa) and tear strength (47.4 N mm^{-1}) compared to other samples. Furthermore, the composites demonstrated notable antimicrobial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and Candida albicans. The biodegradability of natural rubber latex over seven months was 79%, while the optimal composite exhibited 46% biodegradability. Although the biodegradability of the composite decreased, it still retained a significant level of biodegradability. This study highlights the environmental sustainability of utilizing natural rubber latex as a biodegradable matrix, aligning with efforts to reduce synthetic polymer waste and promote eco-friendly materials. This work contributes valuable insights into the preparation of composite materials with intrinsic antimicrobial properties, enhanced mechanical performance, solvent resistance, and UV shielding, making them promising for a wide range of applications.

Keywords: Biodegradability, antimicrobial efficacy, natural rubber latex, nanoparticles

Efficient sonophotocatalytic degradation of methylparaben using graphene and manganese doped nickel sulphide (GO.Mn@NiS) nanocomposite

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ABSTRACT

Development of effective and sustainable degrading techniques is required due to growing environmental concerns about synthetic contaminants like methylparaben. The sonophotocatalytic activity of the graphene and manganese-doped nickel sulphide (GO.Mn@NiS) nanocomposite in the degradation of methylparaben under ultrasonic and UV- VIS light irradiation was assessed in this work. UV-Vis diffuse reflectance spectroscopy (DRS) and FTIR (Fourier Transform Infrared Spectroscopy) were used to characterise the GO.Mn@NiS nanocomposite. These techniques verified that manganese and graphene was successfully incorporated onto the surface of nickel sulphide nanocomposite. The results of the investigation of photocatalytic and sonocatalytic activities revealed that the GO.Mn@NiS

nanocomposite demonstrated a significantly improved degradation rate of methylparaben when compared to pure NiS and Mn@NiS due to the synergistic effects of graphene and manganese doping. The effect of ultrasonication and the irradiation UV-VIS light were found to have a significant impact on the degradation efficiency. Within 120 minutes, the GO.Mn@NiS nanocomposite achieved over 90% degradation. The increased surface area, improved charge separation, and efficient electron transfer characteristics of the nanocomposite improved the overall performance of the catalyst. This work offers a viable and effective method for removing organic contaminants from wastewater by employing cutting-edge sonophotocatalytic techniques.

Keywords: Sonophotocatalytic degradation , nanocomposite, graphene manganese doping

PCOS: Sustainable Management Through Eco-Friendly Approaches

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ABSTRACT

Polycystic ovary syndrome (PCOS) a prevalent hormonal disorder is a condition linked to a range of metabolic and reproductive issues including insulin resistance, obesity, and infertility affecting 5-10% of reproductive-aged women worldwide, with increasing rates of diagnosis in recent years. Emerging evidence suggests that environmental factors, such as exposure to endocrine-disrupting chemicals, pollution combined with sedentary lifestyles, poor diet and stress are contributing to a rising global prevalence of PCOS, especially in urbanized and industrialized areas. In the context of sustainability, the management and prevention of PCOS require a multifaceted approach that integrates environmental, social, and healthcare considerations. A sustainable approach to managing PCOS emphasizes the importance of adopting healthier lifestyle practices, including nutrition that supports metabolic balance, reducing exposure to harmful chemicals, and promoting physical activity. Sustainable diets that prioritize plant-based, organic foods, free from harmful pesticides and preservatives, can help improve metabolic health and mitigate PCOS symptoms. Additionally, reducing environmental pollution and minimizing exposure to endocrine-disrupting chemicals found in plastics and industrial products can help reduce the risk factors associated with PCOS.

Furthermore, a sustainable healthcare approach includes preventive care, awareness programs, and equitable access to healthcare resources. This holistic, sustainable strategy not

only addresses the immediate health concerns of those with PCOS but also aims to reduce the long-term prevalence of the condition. Addressing the lifestyle factors and environmental factors contributing to PCOS through sustainable approaches offers significant potential for improving health outcomes, reducing the global burden of the syndrome, and promoting a healthier future for reproductive women.

Keywords: PCOS, Sustainability, management, environment, diet, health

Porphyrin as Photocatalyst for Hydrogen Production

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ABSTRACT

Porphyrins are ubiquitous in nature having important biological functions spanning across plant and animal kingdom. These are well studied class of molecules which are once again the centre of attraction due to their biocompatibility and desirable photophysical properties. Porphyrins have been found to be potential candidates for applications in field of medicine, solar cells, sensing and catalysis. Here, a review of application of porphyrins as photocatalyst in generation of hydrogen will be presented. Meso-substituted porphyrins have shown promise as hydrogen-producing catalysts, mostly in photocatalytic processes. Their distinct electrical and photophysical properties, combined with the capacity to change their structure via different molecular substitutions, increase their effectiveness in facilitating the hydrogen evolution reaction (HER). Studies show that meso-substituted porphyrins, particularly when combined with transition metals like cobalt, nickel or platinum, have superior catalytic activity and durability under acidic, neutral, and aqueous conditions. This is because the introduction of electron-donating or electron-drawing groups at the meso-positions allows for precise modulation of the porphyrin's electronic structure, optimizing interactions with hydrogen evolution reaction intermediates. Porphyrins' potential uses in solar energy conversion and artificial photosynthesis are examined, showing their potential to overcome the world's energy problems. All things considered, porphyrins are a strong and adaptable family of materials for producing hydrogen sustainably; research is still being done to improve their characteristics and increase the range of real-world uses for them in renewable energy technology.

Keywords: Porphyrin Photocatalyst, Hydrogen Production, renewable energy technologies

Role of Multiple Ionization in detecting the Environmental Pollution

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ABSTRACT

The study of ion-atom interaction has accomplished much attention as it has many applications in the field of radiation physics, material sciences and environmental physics. This can be well understood by the detailed study of the ionization process. In particular, the ionization carried by the charged particle creates vacancies in the inner shells through the outer shells. This mechanism is known as Multiple Ionization (MI). It provides information about qualitatively as well as quantitatively over a broad range of elements. But the X-rays emitted through the multiple ionization are considerably shifted in both position and width. This alters the parameters viz. Fluorescence yield and Coster-Kronig probabilities involved in the process, suggested a method to correct these parameters. On basis of this methodology, calculations are performed to study the energy dependence of L shell X-ray intensity ratios of lead bombarded by protons. The significant results are obtained by including this effect (MI). This process forms the basis of a highly informative and non destructive technique known as PIXE (Particle Induced X-ray Emission).

Keywords: PIXE, MI, fluorescence yield, coster-kronig

Surface functionalized magnetite nanoparticles: Potential tool for waste water treatment

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ABSTRACT

Water contamination, driven by industrial effluents, agricultural runoff, and untreated sewage, is a critical global issue that threatens both human health and the environment. Conventional wastewater treatment methods often fail to efficiently remove persistent pollutants like heavy metals, organic dyes, and pathogens, necessitating the development of more effective solutions. Surface-functionalized nanoparticles (NPs), particularly magnetite nanoparticles, offer a promising alternative. Their high surface area and unique physicochemical properties make them ideal for removing various contaminants from water. By modifying the surface of these nanoparticles with specific functional groups (e.g., amino,

carboxyl, or thiol groups), their interaction with pollutants can be enhanced. This functionalization improves the nanoparticles' ability to adsorb heavy metals, such as lead or mercury, and degrade harmful organic dyes commonly found in industrial wastewater. The functionalization process also increases the nanoparticles selectivity. Furthermore, their recyclability is a key advantage, as they can be reused multiple times without significant loss of performance, making them a cost-effective and sustainable solution for wastewater treatment. This versatility improves the overall efficiency of wastewater treatment, offering a scalable and environmentally friendly approach to addressing water pollution and promoting clean water access. The present work describes the utility of surface functionalized magnetite nanoparticles in removal of contaminants from the aqueous solution.

Keywords: magnetite nanoparticles, surface functionalization, waste water treatment.

Removal of pollutants from aqueous solution using nanoadsorbent

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ABSTRACT

Nanoparticles are of immense importance due to their significant application in waste water treatment. Among these, surface-functionalized magnetite nanoparticles have garnered significant attention from researchers due to their high surface-to-volume ratio and magnetic properties. These magnetic properties enable magnetite nanoparticles to be easily separated from aqueous solutions using an external magnetic field. This present study focuses on the synthesis of surface-functionalized magnetite nanoparticles and their potential in wastewater treatment. Transmission Electron Microscopy (TEM), Vibrating Scanning Magnetometry (VSM), Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), and X-Ray Diffraction Technique (XRD) were used to characterize the surface functionalized magnetite nanoparticles. The effect of various parameters including contact time, amount of adsorbent, initial concentration of contaminants and pH of solution was also examined on the percentage removal of the contaminants from waste water by these nano-adsorbents.

Keywords: Magnetite Nanoparticles, Transmission electron microscopy, Surface Functionalization.

Advancing Electrochemical Performance in Fuel Cells: The Central Role of Noble Metal-Based Materials

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Noble metals are crucial in fuel cells, primarily serving as catalysts to drive essential electrochemical reactions. Their exceptional catalytic activity, durability, and corrosion resistance make them ideal for enhancing the efficiency and reliability of fuel cells despite their high cost. Because of high energy consumption in today's era, fossil fuels are unsuitable. That's why the use of different fuel cells is up to the mark nowadays, like direct ethanol fuel cells (DEFCs) and direct methanol fuel cells (DMFCs), etc. Platinum (Pt) is the most widely used noble metal, particularly in Proton Exchange membrane fuel cells (PEMFCs) and DMFCs. It catalyzes hydrogen oxidation at the anode and oxygen reduction at the cathode, ensuring high reaction rates and minimal energy losses. Palladium (Pd) is also utilized for its excellent hydrogen storage and catalytic properties, often as a complement or substitute for Pt. Other noble metals like Ruthenium (Ru) and Rhodium (Rh) are used in fuel cells to enhance tolerance of impurities such as carbon monoxide, especially in systems using reformated fuels. Using noble metal nanoparticles has further improved efficiency by increasing surface area while reducing material consumption. Research efforts aim to reduce dependence on noble metals through alloy catalysts, advanced nanostructures, and non-noble metal alternatives. Recycling and recovery strategies are also being developed to address cost and resource constraints. Despite these advancements, noble metals remain indispensable in fuel cell technology, enabling high efficiency, stability, and performance, contributing to the global transition toward sustainable energy solutions.

Keywords: Noble metals; Proton exchange membrane fuel cells; Sustainable energy; Oxygen reduction reaction.

Assessment of Heavy Metal Content In Medicinal Plants from Different Environment Sites

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ABSTRACT

Heavy metal distribution in medicinal plants is gaining importance not only as an alternative medicine, but also for possible concern due to effects of metal toxicity. The increasing

prevalence of environmental pollution, especially soil contamination with heavy metals has led to their uptake in the human food chains through plant parts. Accumulation and magnification of heavy metals in human tissues through consumption of herbal remedies can cause hazardous impacts on health. Plant samples of Abutilon indicum, Calotropis procera, Euphorbia hirta, Cytodon dactylon and Argemone mexicana were collected from four environmentally different site. The present study has been focused on emphasizing the heavy metal status of Mn, Fe, Co, Zn, (essential metals) and Cr, Ni, Cd, Pb and Hg (potentially toxic metals) in medicinal plants grown under four different environmental conditions e.g., near to Thermal power station, Heavy traffic area, cement industry, smoke stack all in India, using Atomic Absorption Spectrometry and compared. Accumulation of heavy metals varied from plant to plant. The level of heavy metal Fe(Iron) was found higher in all plant parts studied comparitvely with other heavy metal. Pb was the highest in Abutilon indicum from HTA site and the lowest in calotropis procera from cement industry site. It was also lower in smoke stack area than in heavy traffic area. This study reveals that level of heavy metal content differed in the same medicinal plant collected from different environmentally conditions. Thus, it makes us belief that every medicinal plant sample should be tested for contaminant load before processing it further for medication.

Keywords: Heavy metals, environmental sites, plants, atomic absorption spectrometry

Mitigating Environmental Risks and Toxicological Impact through Nanotechnology in Pharmaceutical Formulations

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ABSTRACT

The pharmaceutical industry faces increasing challenges related to environmental pollution from pharmaceutical waste. Contaminants from improperly disposed or non-degradable drugs contribute to the contamination of water bodies. Nanotechnology has the potential to address these environmental concerns by improving the sustainability of pharmaceutical formulations through enhanced biodegradability and controlled release. This study aims to explore how nanotechnology can mitigate environmental risks associated with pharmaceutical formulations by enhancing drug delivery systems, reducing pharmaceutical waste, and improving biodegradation profiles. A systematic review of existing literature was conducted to examine the role of nanotechnology in pharmaceutical formulations. This includes the

utilization of nanoparticles, nanostructured lipid carriers, and biodegradable nanomaterials in drug delivery. The study reviewed their effectiveness in reducing drug dosage, improving bioavailability, and decreasing the environmental persistence of pharmaceutical substances. Nanotechnology has shown significant promise in optimizing drug formulations, thereby reducing pharmaceutical waste. Nanoparticles like liposomes and nanostructured lipid carriers enhance drug delivery while reducing the dosage required, leading to less environmental contamination. Biodegradable nanomaterials demonstrate a lower risk of environmental accumulation compared to traditional excipients, enhancing both the safety of formulations and their environmental sustainability. Nanotechnology presents an innovative and sustainable approach to reducing the environmental risks posed by pharmaceutical formulations. By improving drug efficiency and biodegradability, nanomaterials help mitigate environmental contamination. However, further studies are required to assess their long-term ecological impact and to establish regulatory frameworks for their use in the pharmaceutical industry.

Keywords: Pharmaceutical industry, waste, nanotechnology

Leveraging Green Nanotechnology to Enhance Environmental Safety in Pharmaceutical Formulations

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ABSTRACT

The pharmaceutical industry significantly contributes to environmental pollution through the extensive use of synthetic chemicals in drug formulations and packaging. These chemicals, often non-biodegradable and toxic, present substantial risks to ecosystems and human health. Green nanotechnology offers a sustainable solution by utilizing naturally derived nanomaterials to reduce environmental toxicity while maintaining or enhancing therapeutic efficacy. The study systematically reviews literature on the green synthesis of nanoparticles, focusing on biocompatible, biodegradable materials, including plant-based gold and silver nanoparticles, synthesized using natural resources such as plant extracts, fungi, and algae. The study also examines natural polymers, including chitosan and cellulose, as eco-friendly alternatives to conventional toxic substances. Methodologically, the use of these nanoparticles in drug delivery systems and packaging is assessed, evaluating their biocompatibility, biodegradability, and non-toxic properties. Additionally, the potential of

these nanoparticles to replace harmful chemical agents traditionally used in pharmaceutical formulations is explored. It is demonstrated that green nanoparticles, particularly AuNPs and AgNPs, possess desirable characteristics, such as enhanced drug release properties, antimicrobial activity, and biodegradability, which are crucial for minimizing environmental toxicity. Furthermore, plant-based nanoparticles and natural polymers provide added benefits, such as reducing plastic waste and improving the stability of pharmaceutical products. These green nanomaterials show significant potential for replacing conventional materials in pharmaceutical formulations and packaging, thereby lowering the overall environmental footprint of pharmaceutical products. The integration of green nanotechnology, particularly gold, silver, and plant-based nanoparticles, offers a promising approach to enhancing environmental safety and sustainability in pharmaceutical formulations. Further research is needed to optimize these materials for large-scale industrial applications.

Keywords: Green Nanotechnology, Environmental Safety, Pharmaceutical industry

Optimization of culture conditions for enhanced cellulose production using *Komagataeibacter diospyri* RSA4

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ABSTRACT

Bacterial cellulose (BC) has gained global interest due to its exceptional characteristics and wide range of applications. Despite the high market demand, BC production remains limited due to its high productions cost, highlighting the need to explore economically and technically feasible bioprocesses and biowaste for enhanced production. Therefore, this study aimed to enhance cellulose production by optimizing culture conditions. Various physicochemical parameters such as inoculum size, inoculum age, pH, temperature, incubation period, and media-to-flask volume ratio were optimized using one-factor-at-a-time (OFAT) approach. The optimized conditions, including an inoculum age (48 h), inoculum size (6%), pH (4.0), temperature (30°C), incubation period (15 days), and media-to-flask volume ratio (1:2.5), led to 1.3-fold increase in cellulose production in Hestrin Schramm medium. These optimized conditions resulted into enhanced cellulose production by *Komagataeibacter diospyri* RSA4 compared to unoptimized culture conditions. Also, cellulose yield was about 1.78-fold higher in pomace waste extract based medium than standard Hestrin Schramm medium. Confirmation of cellulose morphology and purity was

achieved through analytical techniques- Field Emission Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), and Fourier Transform Infrared Spectroscopy (FT-IR) spectra analysis.

Keywords: Field Emission Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), Komagataeibacter diospyri RSA4

Microbially synthesised Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites for textile effluent

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ABSTRACT

Synthetic dyes, widely employed in the textile industry, are hazardous to humans and aquatic life when released into the environment. In this study, an attempt has been made to biosynthesis Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites adsorbents (Zn@Fe_3O_4(ME) manufactured using Bacillus Cereus bacterial extracts and Zn@Fe_3O_4(M) synthesised using Bacillus Cereus bacterial cell mass) to explore the treatment of industrial wastewater from a textile dyeing factory. The biomolecules of the bacterial extract function as a reducing and capping agent. Analysis techniques used to identify the characteristics of the fabricated nanocomposites included XRD, BET, SEM-EDX, UV-VIS, Zeta potential, and FTIR. Utilising Central Composite Design (CCD), the ideal conditions for colour adsorption using Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites were investigated. Models for colour removal from textile effluent with Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites exhibited adjusted R^2 values of 0.99 and 0.97; predicted R^2 values of 0.96 and 0.88, respectively, showing satisfactory model fit for the suggested quadratic model. Validation of the model shows calculated response is consistent with experimental results, and colour removal efficiency was found to be 80 and 76 % for Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites, respectively, at optimal contact time of 76 min at 14 mg adsorbent dosages for nanocomposites with desirability function 1. The experimental data showed a significant correlation with the pseudo-second-order kinetic model, which revealed a correlation coefficient (R^2) of 0.99 for both nanocomposites, suggesting chemisorption as the rate-limiting step. According to the results, Zn@Fe_3O_4(M) and Zn@Fe_3O_4(ME) nanocomposites are environmentally friendly, cost-efficient, and can perform well in adsorbing colour from textile effluent.

Keywords: Microbial synthesis, textile industry, nanocomposites

Assessing groundwater quality and suitability in Mahendergarh District: Strategic insights for sustainable water management and environmental protection

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ABSTRACT

Groundwater resources in semi – arid to arid regions are crucial for water management and food security and the maintenance of ecosystem services but face significant challenges of overexploitation and contamination, exacerbated by poor suitable water management practices. In Mahendergarh, the comprehension of the regional variability of groundwater quality and its appropriateness for household and agricultural applications is still constrained. This study examines groundwater quality near the Aravalli ranges and evaluates its suitability for drinking and irrigation employing comprehensive Geographic Information System (GIS) techniques and water quality assessments. Sixteen physiochemical parameters were analyzed to evaluate groundwater quality and determine the hydrogeochemical facies of groundwater samples. Geospatial analysis was employed to visualize and quantify spatial correlations between groundwater salinity, geology and recharge activities. Suitability for use was assessed using the drinking water quality index (DWQI) and Sodium adsorption ratio (SAR). SAR evaluates the soil sodicity 23%, 42%, 20%, 15% of groundwater samples are classified into excellent, low risk, moderate risk and high risk of soil sodicity respectively, values between 0.73 to 11.29 with an avg of 5.18, which indicate the low risk overall whereas DWQI showed the major indicators affecting groundwater quality include TDS, Na^{+}, Cl^{-}, Mg^{2+}, F^{-} and HCO_3^{-}, 3%, 38%, 23%, 35% groundwater samples of study area are classified into good, poor, very poor and unsuitable for drinking purpose respectively. In this first instance, it has been noticed that the quality is influenced primarily from the geogenic causes particularly the chemistry of rock types in the area. These findings highlight the critical importance of groundwater quality indicators for effective monitoring and underscore the need for integrated groundwater management strategies.

Keywords: Groundwater quality, Mahendergarh district, monitoring and management

Natural Resource Management: A Futuristic Perspective

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ABSTRACT

This study undertakes a comprehensive analysis of the future prospects of natural resource management (NRM). The increasing global demand for natural resources, coupled with the need for sustainable development, necessitates the adoption of innovative and integrated approaches to NRM. The research highlights the importance of adopting a systems-thinking approach to NRM, which considers the complex interrelationships between environmental, social, and economic factors. The study also emphasizes the need for effective governance, community engagement, and education and awareness-raising efforts to promote sustainable practices. The analysis is based on a comprehensive review of existing literature and empirical data, as well as expert consultations and stakeholder engagement. The study identifies key challenges and opportunities in NRM, including the need for improved data management and analytics, enhanced community engagement and participation, and increased investment in sustainable infrastructure. The research concludes that a futuristic approach to NRM is essential for ensuring the long-term sustainability of natural resources and promoting human well-being. The study provides recommendations for policymakers, practitioners, and researchers on how to adopt a more integrated and sustainable approach to NRM.

Keywords: Natural resource management, sustainability, environmental stewardship, governance, community engagement, education.

Synthesis, Characterization, and Biomedical Applications of Nanocomposites derived from Green Coconut Waste: A Sustainable Approach

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ABSTRACT

Nanotechnology has significantly transformed the biomedical sector by enabling innovative therapeutic solutions. This study focuses on the synthesis of lignin nanocomposites (LNCs) using ethanolic mesocarp extract from green coconut (GC) as a stabilizing and reducing agent. The synthesized nanocomposite was thoroughly characterized using techniques such as

X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, ultraviolet-visible (UV-Vis) spectroscopy, Scanning Electron Microscopy (SEM), and energy dispersive spectroscopy (EDS). UV-Vis analysis revealed a maximum absorption wavelength at 375 nm, while XRD confirmed a wurtzite hexagonal structure with an average grain size of 20–30 nm. FTIR spectra indicated the presence of functional groups and proteins stabilizing the nanoparticles, and SEM analysis highlighted their morphology. The green-synthesized LNCs exhibited notable antibacterial activity, demonstrating inhibition zones against bacterial strains such as *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Pseudomonas putida*, *Bacillus subtilis*, and *Staphylococcus aureus*. Antifungal activity was observed but was less pronounced. Additionally, the LNCs exhibited antioxidant activity, with a DPPH radical scavenging efficiency of 60.15 ± 0.31%. In vitro evaluations also revealed potent antidiabetic properties, showing significant inhibition of amylase and glucosidase enzymes. These findings highlight the potential of GC-derived lignin nanocomposites in biomedical applications, emphasizing their antimicrobial, antioxidant, and antidiabetic properties, and their promise for future therapeutic advancements.

Keywords: Antifungal, nanocomposite, XRD, FTIR

Eco-Nano Frontiers: Exploring the Environmental Implications of Algae-Based Nanomaterials

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ABSTRACT

Algae-based nanomaterials (ABNMs) offer promising alternatives not only to conventionally synthetic nanoparticles but also provide environmentally friendly solutions for numerous applications such as environmental remediation, agriculture and biocompatible products. Recently, nanomaterials have been recognized for their potential in environmental remediation and for increasing soil and crop productivity with much emphasis on the circular economy to avoid waste. ABNMs exhibit potential utility in agriculture for controlled and targeted delivery of nutrients and pesticides. Biochar-based ABNMs are more sustainable than synthetic nanomaterials and biodegradable, and they are widely applied for the purification of contaminated water by the degradation of dyes, heavy metals, and other pollutants. Also, the placement of PBNMs has been endorsed for use in food packaging and other consumer products that would not cause detrimental harm to the environment. The

potential for ABNMs to evolve has long-ranging advantages for sustainability efforts. Nonetheless, these need to be underpinned by sound outcomes not only in terms of the benefits they provide to the environment and society but also concerning potential risks. Our studies will concentrate on the eco-friendly production of ABNMs and reduce their environmental burden as well, along with their perspectives towards applications in greener sustainable agriculture or environmental management.

Keywords: Algae-based Nanomaterials, Environmental Sustainability, Biocompatible Nanomaterials, Sustainable Agriculture.

Methane Plasmalysis for Hydrogen Production

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ABSTRACT

Hydrogen is a clean fuel releasing energy and water as a byproduct. If Hydrogen can be produced by greener method, then whole process can be considered as carbon–negative process. One of the best methods of producing Hydrogen is 'Turquoise Hydrogen'. In this process methane is decomposed at high temperature into Hydrogen and solid carbon. It does not emit greenhouse gases as it creates solid carbon rather than CO_2 . It is more energy-efficient process. As the energy required for production of turquoise hydrogen is almost 7.5 times less than required for electrolysis of water. It is more economical method. Here, a review of different methane plasmalysis methods will be presented.

Keywords:Methane plasmalysis, Hydrogen Production, economical methods

Fabrication of a sensitive amperometric biosensor for neurotransmitter detection deploying laccase nanoparticles on a pencil graphite electrode

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ABSTRACT

Neurotransmitters including dopamine, adrenaline, and noradrenaline are members of the important class of biogenic amines known as catecholamines. They perform vital biological tasks in the human body and linked to a number of illnesses, including Parkinson's and Alzheimer's. An alternative for their detection, to overcome the drawbacks of conventional

techniques is the fabrication of electrochemical sensors. The development of amperometric biosensor based on cysteine functionalized laccase nanoparticles (Lac-NPs) immobilized onto the pencil graphite electrode is depicted. Successful synthesis of Lac-NPs was characterized using techniques like TEM, FTIR, UV-Visible spectroscopy, DLS and zeta potential. For the affirmation of immobilization and preparation of Lac-NPs/PGE biosensor, SEM, CV and EIS techniques were employed. The biosensor was optimized at various pH, temperature, scan rate, substrate concentration and response time for better detection. Lac-NPs/PGE biosensor showed high sensitivity (2320 µA/mM cm^2), lower detection limit (0.12µM), and a broad linear range (0.1-800 µM) with coefficient of determination of R^2=0.999. In real pharmaceutical sample analysis of the neurotransmitters, high recovery (94% to 99%) and accuracy has been attained. Superior analytical performance obtained with this simple fabrication process and cost-effective pencil graphite electrode shows presents biosensor is a promising tool for the accurate and real-time detection of catecholamines.

Keywords: Neurotransmitter, biosensor, pharmaceutical

The Consensus in the Query of Sound Science Responsibility for Sustainable Technology

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ABSTRACT

The cause and question in search of continuously changing prospects and goals of Sustainable Development here in this article a study of Climate and Climate induced changes over the Indian sub-continent is presented. Summer monsoon, Indian Summer Monsoon (ISM) is the main life line of South Asia. Since late 1980s, due to spike in Global surface temperatures, several (physical, observational, synoptic, numerical, simulation) studies exploring the possible changes in Indian Summer Monsoon. Still accurate prediction of ISM is a complicated task. The period 1871-2001 is an early phase of Global Warming era. During Post 1990s for "2019 ISM", it is examined significant changes in ISM features are studied. The period (2005- 2019) has undergone significantly noteworthy changes. 2019 ISM has revealed an extreme nature. Recent unusual 2019 ISM case is a glimpse of emerging climate change. The first lead in this study is rise in Antarctica's temperature and 2019 pre-monsoon rainfall activity a possible connection for fluctuation. The second one is rise in Static Stability supporting sinking motion associated with rise/decline in surface temperatures. Long term

trends in Meridional Tropospheric Temperature gradient (at 1% level) absence in June month. A Sound Science responsibility indicates investigation of the performance of global coupled models in simulating the climatic changes.

Keywords: Environment and Sustainability, Sustainable Technology and Environment

Energy Usage and Environmental Impact of Large Language Models (LLMs)

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ABSTRACT

Large Language Models (LLMs), such as GPT and similar AI systems, are revolutionizing industries by providing unparalleled capabilities in natural language understanding and generation. However, these advancements come with significant energy demands and environmental costs. The training of LLMs is an energy-intensive process, often requiring weeks or months of computation on thousands of GPUs or TPUs. Even inference tasks—when these models are used in real-world applications—add to the energy burden, making the lifecycle energy consumption of LLMs exceptionally high. These computational requirements are supported by large data centers, which consume vast amounts of electricity to maintain uninterrupted operations.

Cooling is a critical component of operating data centers housing LLMs, as the hardware generates substantial heat during training and inference. Advanced cooling systems, such as air conditioning or liquid cooling, are employed to maintain optimal operating temperatures for GPUs and TPUs. These systems are energy-intensive and often rely on additional electricity, increasing the carbon footprint of data centers. Moreover, water-based cooling systems exacerbate water scarcity issues in regions where data centers are located, while refrigerants used in traditional cooling systems may pose environmental risks if improperly managed. As the demand for AI services grows, the strain on local resources and ecosystems intensifies, underscoring the need for sustainable cooling solutions.

The environmental impact of LLMs extends beyond direct energy consumption. High electricity demands contribute significantly to carbon emissions, particularly in regions where fossil fuels dominate the energy grid. The production of GPUs, TPUs, and other essential hardware components for training and running LLMs involves mining rare earth metals, which disrupt ecosystems and deplete finite natural resources. Additionally, the rapid pace of

innovation in AI leads to frequent hardware upgrades, generating substantial electronic waste. Combined, these factors create a cascade of environmental challenges that warrant urgent attention.

While the environmental costs of LLMs are concerning, their potential to address environmental issues provides a compelling counterbalance. On the positive side, LLMs contribute to advancements in climate modeling, enabling more accurate predictions and better disaster preparedness. They also play a pivotal role in optimizing energy consumption in industries and smart grids, helping to reduce waste and promote efficiency. Furthermore, LLMs accelerate environmental research by processing large datasets for applications such as deforestation monitoring and species identification. However, these benefits are offset by their energy demands, cooling requirements, and indirect impacts, such as carbon emissions and resource depletion, highlighting the complexity of their role in sustainability.

To mitigate the environmental impact of LLMs, several strategies can be adopted. Transitioning data centers to renewable energy sources, such as solar and wind, can drastically reduce their carbon footprint. Optimizing algorithms and creating smaller, task-specific models can significantly decrease energy usage during both training and inference. In addition, implementing regulations to ensure transparency in reporting AI-related carbon emissions and promoting the development of energy-efficient technologies will encourage accountability. By prioritizing sustainable practices, the AI industry can harness the transformative potential of LLMs while minimizing their environmental cost.

In conclusion, while LLMs represent a significant step forward in technological innovation, their environmental implications cannot be ignored. Balancing their benefits with proactive measures to address their energy consumption and ecological impact is essential for fostering a sustainable future.

Enhancing quality of paper made from recycled paper using biopolymer

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ABSTRACT

This study explores the impact of using untreated and biopolymer-treated recycled water for repulping used paper, with a focus on pulp yield and the strength properties of the resulting

paper. A novel aspect of the research lies in employing biopolymer not only as a wastewater treatment agent but also as a wet-strength additive in papermaking. The recovered fiber yield remained at 82±2% until the 4th cycle but dropped below 77% from the 5th cycle onwards when using untreated recycled water. Notably, recycled water from the 5th cycle exhibited high levels of total solids, along with a cationic charge demand exceeding 10,000 mg/L and 2,000 µeq/L, respectively. Treating this recycled water with bioplolymer reduced total and dissolved solids by 30% and 40%, respectively, and cationic charge demand by 25%, compared to untreated recycled water. Using the treated recycled water of the 5th cycle for pulping the 6th cycle increased the recovered fiber yield to 79%. Furthermore, the paper produced in the 6th cycle with treated recycled water showed significant improvements in breaking length (10%), burst index (14%), tear index (5.4%), tensile energy absorption index (26%), and elongation (13%) compared to paper made using untreated recycled water

Keywords: Used paper; Biopolymer; Recycled water; Repulping; Paper properties

The Role of Molybdenum in Enhancing Nitrogen Use Efficiency for Sustainable Crop Production

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ABSTRACT

With the global population projected to reach 11 billion by 2100, achieving sustainable agriculture is crucial to meet the increasing food demand. Nitrogen fertilizers, though essential for crop productivity, exhibit low use efficiency (30-40%), resulting in environmental pollution and soil nutrient imbalances. Molybdenum (Mo), a critical micronutrient, plays a vital role in enhancing nitrogen use efficiency (NUE) by acting as a cofactor for key enzymes like nitrate reductase and nitrogenase, which facilitate nitrogen assimilation and fixation.

This review highlights the significance of Mo supplementation in agriculture, particularly in improving crop yields, nitrogen uptake, and nutritional quality. Research indicates that optimal Mo application boosts chlorophyll synthesis, stress tolerance, and phosphorus uptake while reducing nitrate leaching. Crops such as wheat, rice, and chickpea show substantial benefits from Mo application under varying soil conditions. However, Mo availability remains limited in acidic and sandy soils, necessitating targeted approaches.

The findings underscore Mo's potential to improve NUE, reduce dependency on chemical fertilizers, and promote environmental sustainability. Further exploration of Mo, including advancements in nanotechnology, offers promising prospects for developing efficient, eco-friendly agricultural practices to address global food security challenges.

Keywords: Nitrogen fertilizer, Nitrogen Use Efficiency, Nitrogen Reductase, Sustainable Crop

Harnessing Enzymes to Restore Polluted Soil and Enhance Fertility

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ABSTRACT

Phenolic pollutants, integral to numerous industrial processes, pose significant challenges to soil health and agricultural productivity. Despite the economic importance of phenolics, their detrimental impact on ecosystems necessitates effective remediation strategies. Current enzymatic approaches, particularly utilizing peroxidases, show promise in degrading phenolic contaminants; however, their application in restoring soil fertility and supporting plant growth remains inadequately explored. This study addresses this knowledge gap by investigating peroxidases extracted from Mesquite species, for their efficacy in treating phenolic-contaminated soils. We employed a novel experimental design that compares the performance of Mesquite-derived peroxidases with traditional horseradish peroxidase under varying soil conditions. Our findings reveal that Mesquite enzyme exhibits superior stability and efficiency in degrading key phenolic compounds across a broad pH range. Beyond contaminant removal, MPx treatment was found to restore critical soil enzymatic activities and improve overall soil fertility, thereby facilitating healthy plant growth in polluted environments. This research not only introduces a sustainable method for mitigating phenolic soil contamination but also highlights the potential of phytoenzymes in environmental management. Scalability of phytoenzyme application and its long-term impacts on soil ecosystems woule pave the way for developing biotechnological solutions for soil restoration.

THEME -2

Natural Resource Management and Climate Change

Ecklonia cava: Marine Algal Biodiversity; Conservation and Medicinal Use Against Cervical Cancer

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ABSTRACT

With the modernization in the lifestyle human beings forget to take care of the environment. As a result, all type of pollution level increases day by day. There is formulation of lot of organizations, which used to control soil pollution, air pollution etc but less preventive measures to control water pollution. Our water body is full of marine biodiversity; out of which some are useful while other is dangerous. *Ecklonia cava* commonly called brown algae when undergoes different lab processes result in control of many dreadful diseases. Cervical Cancer is one of them. Cervical cancer is defined as a cancer of the cervix or any layer of the wall of the cervix. The causative agent of cervical cancer is Human papillomavirus infection (HPV). HPV 16 and 18 strain is responsible for cervical cancer. The viral oncoproteins E6 and E7 inactivate the tumour suppressor proteins p53 and retinoblastoma (pRb). This disrupts DNA repair and apoptosis, leading to rapid cancer cell proliferation. Activation of tumor suppressor genes by the action of *E. cava* which check apoptosis. Efficiency of TLR9 receptor inhibitors by the action of piracetam, oleamide and vigabatrin molecules isolated from *E. cava* herbal formulation. Protein-ligand interaction plays a major role in structural drug design. In this study, the molecular interactions between the P3, retinoblastoma receptors (PDB ID: 2IOK), and the ligands isolated from *E. cava* ayurvedic formulation piracetam, oleamide and vigabatrin, an endogenous TLR9 receptor ligand using the Auto dockVina software tool. The ADMET properties of these substances were determined using popular web-based software tools that include pre-ADMET, admet SAR, Mol inspiration, and Swiss ADME. An in-silico method is used to determine the efficacy of TLR9 receptor inhibitors and the safety profile of isolated ligands. The binding energies (Kcal/mol) of ligands with human cervix epithelial receptors were calculated as follows: 1-phenyl-1, 1-dimethoxy-2, 2-difluoropropane (-71.84), 9-octadecenoic acid (-77.20) and 2-hydroxy-eicosanoic acid, methyl ester (-79.61). The results supported the drug-like properties of the molecules tested and they are likely to have a therapeutic effect. Further, in vivo and pre-clinical trials of the most active compound are also worthwhile for producing effective inhibitors. The present research has multidimensional uses. Uses of *E. Cava* as anti-cancerous

drugs, people get aware of its medicinal uses which lead to biodiversity conservation of marine ecosystem.

Keywords: anti-cancerous drugs, retinoblastoma receptors, apoptosis, Cervical Cancer, Protein-ligand

Arbuscular Mycorrhizal Fungi: A Key to Sustainable Agriculture and Soil Fertility

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ABSTRACT

Decades of poor farming methods are linked to the growing threat of climate change that devastates crop output and soil health, deteriorating the ecosystem. As a bioinoculant, arbuscular mycorrhizal fungi (AMF) play a beneficial role in sustainable agriculture by symbiotically associating with many crop plants. In this review, we primarily focus on the beneficial functionality of AMF in soil and plant productivity. However, inoculation with Arbuscular Mycorrhizae Fungi (AMFs) has been identified as an eco-friendly approach to improve soil fertility. AMF is the most widespread soil microorganisms that form a symbiotic relationship with more than 80 percent of plants, except for a few plant families, such as *Amaranthaceae, Brassicaceae, Cruciferae, Chenopodiaceae, Caryophyllaceae, Juncaceae, Cyperaceae,* and *Polygonaceae,* which do not exhibit any association. Several species of AMF have been studied in the world, however, the most species used as a model are *Funneliformis mosseae* (previously known as *Glomus mosseae*), *Gigaspora,* and *Rhizophagus irregularis* (previously known as *Glomus intraradices)*. AMF is not a pathogenic fungi but an obligate symbionts that need a host plant to complete their life cycle. They improve crop productivity by increasing water and nutrient uptake, such as nitrogen (N), phosphorus (P), and potassium (K). The increase in the host plant nutrient uptake is due to the characteristics of AMF mycelium. These mycelia or hyphae absorb nutrients by osmotrophy and explore more surface area compared to non-mycorrhizal roots. In the natural ecosystem, AMF and plant roots develop a beneficial relationship. Research indicates that the elevated AMF association indicated good health and strong agricultural yields that benefited other businesses and agriculture. By expanding their hyphal network into the soil, these fungi enhance nutrient uptake, especially phosphorus, nitrogen, and micronutrients, increasing the effective root surface area. AMF encourages sustainable farming methods by lowering the demand for artificial pesticides and fertilizers. AMF also helps in stabilizing the soil structure

by encouraging aggregation, which improves aeration, water retention, and soil health in general. By enhancing crop yield, soil health, and resilience, the integration of AMF into agricultural systems offers a novel strategy that promotes more environment-friendly and sustainable farming methods.

Key Words: AMF, sustainable, biofertilizers.

ग्लोबल वार्मिंग और जलवायु परिवर्तन

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सार

ग्लोबल वार्मिंग और जलवायु परिवर्तन एक बडा खतरा है जो हमारे ग्रह के पर्यावरण, हमारे जीवन और हमारे भविष्य को प्रभावित कर रहा है। यह समस्या न केवल हमारे ग्रह के पर्यावरण को प्रभावित कर रही है, बल्कि यह हमारे जीवन, हमारे भविष्य और हमारे ग्रह के अस्तित्व को भी खतरे में डाल रही है। ग्लोबल वार्मिंग और जलवायु परिवर्तन के कई कारण हैं, जिनमें से कुछ प्रमुख कारण हैं ग्रीनहाउस गैसों का उत्सर्जन, वनस्पति वृक्षों की कटाई और औद्योगिक गतिविधियाँ। इन कारणों के परिणामस्वरूप समुद्र के स्तर में वृद्धि, चरम मौसम की घटनाएं और जैव विविधता की हानी हो रही है। ग्लोबल वार्मिंग और जलवायु परिवर्तन के समाधान के लिए हमें कई कदम उठाने होंगे, जिनमें उर्जा की बचत, अक्षय उर्जा स्त्रोतों का उपयोग, वनस्पति वृक्षों की कटाई को रोकना और जलवायु परिवर्तन के प्रभावों को कम करने के लिए अनुकूलन रणनीतियों का विकास शामिल है। हमें इस समस्या का समाधान करने के लिए एक साथ मिलकर काम करना होगा, ताकि हम अपने ग्रह को बचा सकें और अपने भविष्य को सुरक्षित बना सकें। इस शोध पत्र में, हम ग्लोबल वार्मिंग और जलवायु परिवर्तन के कारणों, प्रभावों और समाधानों पर चर्चा करेंगे, ताकि हम इस समस्या का समाधान करने के लिए एक साथ मिलकर काम कर सकें। हमारा उद्देश्य इस समस्या के

बारे में जागरूकता बढाना और इसके समाधान करने के लिए एक साथ मिललकर काम करने के लिए प्रेरित करना है। हमें उम्मीद है कि यह शोध पत्र ग्लोबल वार्मिंग और जलवायु परिवर्तन के बारे में जागरूकता बढाने और इसके समाधान के लिए एक साथ मिलकर काम करने के लिए प्रेरित करने में मदद करेगा। हमें यह भी उम्मीद है कि यह शोध पत्र ग्लोबल वार्मिंग और जलवायु परिवर्तन के समाधान के लिए एक साथ मिलकर काम करने के लिए एक मंच प्रदान करेगा। हमें उम्मीद है कि यह शोध पत्र ग्लोबल वार्मिंग और जलवायु परिवर्तन के बारे में जागरूकता बढाने और इसके समाधान के लिए एक साथ मिलकर काम करने के लिए प्रेरित करने में मदद करेगा।

कीवर्ड – ग्लोबल वार्मिंग, जलवायु परिवर्तन, जागरूकता, रणनीतियां, अक्षय उर्जा स्त्रोत.

A Case Study of Siwalik Forest of Arunachal Pradesh: Issues and Challenges by Using Forest Inventory

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ABSTRACT

Forest inventory is a process of systematically collecting the data related to forest resources like biomass, species diversity, and forest health and vitality. This process helps us in assessing the current status of forest and provide a basis for planning its sustainable management. Arunachal Pradesh is one of the North Eastern State of India known for its diverse and vast forests which are considered ecologically significant, hence a periodical forest inventory is critical for its management. However, factors like dense vegetation, climatic conditions and rugged topography limits the efficiency for accurately and comprehensively conducting the forest inventory. Additionally, such a complex landscape with high level of tribal ownership introduces more complexities in gathering and reporting the data. The aim of this article is to highlight and explore various challenges and difficulties that are faced during traditional data collection in forest area under Siwalik range in Arunachal Pradesh, and finding possible solutions and ways to enhance its effectiveness for

future. For this, field inventory was performed in the Siwalik forests of central part of Arunachal Pradesh. The accessibility and signal blockage in GPS are found as major difficulties during ground survey apart from barrier of languages for interaction with the local community. The article also emphasizes need of emerging technologies for improving forest monitoring and management.

Keywords: Sustainable forest management, GPS, Topography, Tribal community

Preliminary Records of Moths (Lepidoptera: Heterocera) of Kurukshetra University, Haryana, India

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ABSTRACT

Kurukshetra university campus exhibits an enormous diversity of habitats including garden, grassland, bushes having a large number of trees, shrubs, and herbs. Moths are the least documented and highly diversed group of order Lepidoptera and sub-order Heterocera. Rare studies have been done in Haryana on diversity of moth and no documentation in the state of Haryana is available. Therefore, present study aimed to generate a baseline data of the diversity and distribution of moth fauna of Kurukshetra University, Haryana, India. For survey of moth fauna, random visits per month were conducted during September 2024 to November 2024, followed by Pollard walk method and Random sampling method. 18 diurnal surveys/visits were conducted during post monsoon season in different sites of campus. A total of 53 species of moth belonging to 10 families, 25 sub-family and 48 genera were reported across different areas of the campus. The most species rich families are Erebidae with 16 species under 16 genera and family Crambidae with 16 species under 14 genera followed by family Geometridae with (9 species: 7 genera) followed by family Sphingidae and Noctuidae both have (3 species: 3 genera) followed by family Pyralidae with (2 species: 1 genera) followed by family Bombycidae, Nolidae, Lenoidae and Limacodidae each have one species and one genera. Maximum Relative Diversity index (RDi) of families Crambidae and Erebidae with 30.18% followed by family Geometridae with 16.98% followed by families Sphingidae and Noctuidae with 5.66% followed by family Pyralidae with 3.77% followed by other families.

Keywords: Crambidae, Diurnal survey, Heterocera, Lepidoptera

Mitigation of Salt-Affected Soil Using a Combination of Organic and Inorganic Amendments.

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ABSTRACT

The present study was conducted to know the extent of improvement in physicochemical characteristics of salt-affected soil treated with organic (vermicompost) and inorganic (fly ash) amendments. Soil samples were collected from the surface 0-20 cm in the Bhandari village, Panipat, and the experiments were conducted in pot culture with the marigold plant. The soil was treated with three treatments: vermicompost, vermicompost + fly ash combined, and the control with no amendment. The results showed improvement in different soil chemical properties after applying the two soil amendments. The pH showed a reduction from 8.1 to 7.5 in the vermicompost-treated soil and from 8.38 to 7.9 in the combined treated soil. Electrical conductivity rose from 841 µS/cm to 2560 µS/cm for the vermicompost treated soil and from 1515 µS/cm to 4063 µS/cm for the combined treated soil. Organic carbon and nitrogen content also increased significantly from 2.55% to 5.06% for vermicompost and from 1.35% to 3.25% for the combined treatment while the potassium and phosphorus levels reduced in both the treatments. Sulfate and chloride also showed an increase from the initial to the harvesting stage. But sodium ions showed a reciprocating trend, as they increased in vermicompost-treated soil but decreased in combined treatment. As far as marigold plant growth is concerned, both the treatments enhanced the growth of the plant which proves the potential of using vermicompost and fly ash for the rehabilitation of degraded soils and increasing the production in agriculture.

Keywords: rehabilitation, vermicompost, fly ash, plant growth, salt-affected soil

A Review on Estimating Greenhouse Gas Emission from Wildfires Using Remote Sensing Technology

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ABSTRACT

Every year, wildfires, spread either by human activities or by naturally occurring phenomena, cause enormous amounts of damage. The decline in biodiversity and deterioration in air

quality and temperature are observed as a result of frequent wildfires. Wildfire flames are known to generate a number of greenhouse gasses (GHGs), with carbon dioxide being the most common. The emission and spread of GHGs causes the temperature to rise in both wildfire and non- wildfire zones. In the past, monitoring these pollutants was extremely challenging and mostly dependent on fire management authorities and visual assessments from watch towers. However, active fire management, emission monitoring, and post-effect estimation from wildfires are made considerably simpler by the development of remote sensing technologies. The sensors like Moderate Resolution Imaging Spectroradiometer (MODIS), Visible Infrared Imaging Radiometer Suite (VIIRS), and Advanced Very High-Resolution Radiometer (AVHRR) aboard remote sensing satellites have been used to collect important data on fire location, area burned, and fire emissions and to generate data streams essential for fire impact analysis. This study reviews the current approaches and the major challenges for estimating greenhouse gas emissions due to wildfires.

Keywords: Wildfires, Greenhouse Gas Emission, Remote Sensing Technology.

A Review of Mycorrhizal Fungi: The Foundation of Resilient Agriculture

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ABSTRACT

The increasing demand for food for the continuously growing world population calls for more sustainable management practices that promote yield whilst reducing the impact on the environment and biodiversity. Apart from this the increasing awareness of the negative impacts of chemical fertilizers on living organisms and the environment has led to the search for natural alternatives. One of the interactions of plant roots was found with arbuscular mycorrhiza fungi (AMF), a rhizosphere microbiome. Mycorrhiza is an important terrestrial mutualistic fungus, which is associated with the roots of the plant. Biofertilizers, prepared from promising microbial strains, especially mycorrhizal fungi offer a sustainable solution by enhancing nutrient uptake and improving soil health. Symbiotic associations between arbuscular mycorrhizal fungi and plant roots are widespread in the natural environment and can provide a range of benefits to the host plant. These include improved nutrition, enhanced resistance to soil-borne pests and disease, improved resistance to drought, tolerance of heavy metals and better soil structure. Fungi, due to their ability to thrive in diverse environmental

conditions and perform essential processes like nutrient cycling and organic matter decomposition, are significant contributors in this field. This review focuses on the role of fungi as biofertilizers, their interactions with other organisms, and their potential benefits in agriculture. Future research should focus on optimizing fungal inoculum production and application methods to fully harness their potential in sustainable agriculture.

Keywords: biofertilizers, arbuscular mycorrhiza fungi, nutrient cycling, rhizosphere microbiome

Millets: The Key to Resilient Farming in Changing Climate

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ABSTRACT

Millets, often referred as "nutri -cereals", have emerged as a promising solution to address the challenges posed by climate change .These ancient grains are inherently resilient, thriving in arid and semi-arid regions with minimal nutrient and water requirements. Beyond resilience, millets are nutrient–rich and provide vital proteins, fibers, and micronutrients which can combat with malnutrition and promote food security. With short growth cycles and diverse genetic varieties, they offer flexibility to farmers. Millets represent a viable pathway to resilient farming systems due to their ability to withstand high temperature, drought, and poor soil conditions which makes them an ideal choice for sustainable agriculture in a rapidly changing climate. The main types of millets include pearl millet, finger millet, foxtail millet, proso millet, barnyard millet, and little millet, each have own unique nutritional profile and culinary uses. Pearl millet is high in protein approx 11-12 grams, Finger millet has 7-8 g, in Foxtail millet (rich in dietary fibers) is 12-14 g. Though millets have drought tolerance and climate resilience, and hold significant potential in saline environment. Their growth and productivity can still be adversely affected by excessive soil salinity. The present study explores the potential of millets as a climate- smart crop which focuses on their adaptability, ecological benefits, and ensures global food security. By examining traditional cultivation practices, modern innovation, and policy interventions this study highlights the critical role of millets. Millets can build a resilient agricultural system for the future.

Keywords: Climate-resilience, Ecological restoration, Food security, Sustainable agriculture

Impacts of Pesticide on Health and Environment: A Case Study From Kurukshetra, Haryana

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ABSTRACT

Pesticides are used to kill and protect the origin of various pests such as insects, arthropods, rodents etc. Exposure to these dangerous pesticides due to incongruous use is causing life threatening diseases as well as polluting environment health. As per district-wise pesticide consumption data, Kurukshetra stood on fifth place among all districts of Haryana. The main objective of the study was to investigate the associated health and environment risks due to pesticide use to the farmers. The study was carried out in Umri and Ramsaranmajra villages of district kurukshetra, Haryana. Total 50 farmers were personally interviewed for sources of pesticides, types, application methods, use of safety measures, health impairments and disposal of containers. Various health symptoms were reported by farmers on use of pesticides such as eye irritation, respiratory problems, headache, nausea and vomiting, gastric problems etc. Also analysis of thirty five blood samples were used to identify the presence of organophosphate pesticide's contents. To obtain statistically significant result, blood samples were divided into two groups i.e. farmers and control group. Out of twenty five farmer's samples, seventeen were detected the organophosphate poisoning. Finally correlation coefficient was calculated through obtained data. The correlation coefficient values between type of protection taken & poison symptoms and type of protection taken and pesticide content in blood is 0.39 something which shows a moderate positive linear relationship (values between 0.3- 0.7) i.e. the people who were not taking proper protection are likely prone to poison symptoms with the presence of pesticide content in their blood. The most eye opening fact is, farmers commonly use Propiconazole, which is a possible human carcinogenic. Also, Profenofos and Quinalphos has cholinesterase inhabitation characteristics. To investigate the environmental impacts of the study site, five tube well water samples were analyzed. Three of them showed raised limit of Chlorpyrifos, Methyl parathion, Ethion and γ-HCH pesticides in water. Thus, it reflects the pesticide contamination of water. This could pose serious harm to human, crops, aquatic life and animals.

Keywords: Propiconazole, carcinogenic, pesticide contamination, parathion

Substitution of Agar- A Step Towards Biodiversity Conservation

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ABSTRACT

The ever-increasing exigence for orchid species, with therapeutic importance, calls for the development of applicable and sustainable *in vitro* cultivation techniques. Agar, which has long been extensively employed in plant tissue culture as a gelling agent, is obtained from marine algae, whose populations are being exploited to a larger extent to extract agar. Other substitutes of agar as solidifier must be discovered to save its populations in marine environment to keep marine ecosystem healthy. Materials such as coconut coir, pine bark, filter paper, cotton, rice husk, different types of gums (guar gum, Tragacanth, Gum Arabic) are investigated so far to support *in vitro* for regeneration and multiplication of the germplasm orchid species'.

In this study, explorations have been made to check the efficacy of some costless, biodegradable waste materials that could be used to replace agar, for *in vitro* propagation of *Cymbidium finlaysonianum*. The current study would be a step towards the conservation of both land and marine, biodiversity. The study would also support in making culture medium cost-effective by replacing agar and, thus, would support the long-term conservation of rare orchid species *in vitro*. The efficacy of using such substitutes, to agar, in plant tissue culture would be highlighted through this study.

Keywords: germplasm, therapeutic, guar gum, biodegradable waste

Carbon Sequestration Potential of Soil in Different Land Use Systems in Alluvial Plain Upper Terrace of Northern Haryana

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ABSTRACT

The Alluvial Plain Upper Terrace in Northern Haryana, India is a region of significant agricultural activity and environmental importance. The present study was carried out to gain insights of the carbon sequestration potential of the soil in wheat-rice crop in agriculture, wheat-poplar in agroforestry, mango in orchard and Eucalyptus in block plantation at Alluvial Plain Upper Terrace in Northern Haryana upto 30 cm of soil depth. For wheat-rice cropping system, the highest carbon sequestration potential was found to be 22.87 Mg/ha in

Yamunanagar followed by Ambala. In case of wheat-poplar agroforestry system, the highest carbon sequestration potential was observed 24.70 Mg/ha again in Yamunanagar. Mango cultivation in orchards yielded the highest carbon sequestration potential 37.30 Mg/ha in Yamunanagar while it was low in Ambala 31.94 Mg/ha, but highest of all estimated system. For Eucalyptus block plantation, the highest carbon sequestration potential was found to be 24.28 Mg/ha in Yamunanagar, followed by Ambala. The findings revealed that the soil in Alluvial Plains Upper Terrace in Northern Haryana hold substantial carbon sequestration potential, particularly in agroforestry and orchard systems.

Keywords: Carbon sequestration potential, Alluvial Plains Upper Terrace, Northern Haryana, climate change, land use

Ecological Impacts and Management challenges of *Lantana camara* L.

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ABSTRACT

Lantana camara is a shrub belonging to the family Verbenaceae. It is native to Central and South America. In India it is an invasive plant and it is largely cultivated as ornamental plant. It has adaptability to a wide range of environmental conditions; its allelopathic properties have contributed to its success as an invader. Invasive alien species are usually considered to be the second greatest threat to biodiversity after habitat destruction. It is one of the most notorious invasive alien species in Haryana as well as in India and spread over forests, agricultural fields affect native ecosystem i.e the toxic nature of *Lantana camara* leaves and fruit can harm livestock and decertain wildlife species pose significant challenges for biodiversity conservation and agricultural productivity. In Haryana's Shivalik forests, *Lantana camara* forms dense vegetation. Prevention of spreading of invasive species is quite cost effective. *Lantana* infestation can be controlled by public awareness campaigns and the use of *Lantana camara* for biofuel, handicrafts, baskets, toys etc and restoring native vegetation is a promising strategy for long-term management can help mitigate its impact while promoting sustainable livelihoods.

Keywords: *Lantana camara,* restoration, ecological impacts, management challenges

Replacing Growth Regulators By Organic Growth Supplements For Efficient Regeneration of *Cymbidium Finlaysonianum* Wall. Ex Lindl.: A Study *In Vitro*

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ABSTRACT

The aim of the study is to establish a simple and efficient, one step *in vitro* regeneration and multiplication protocol for *Cymbidium finlaysonianum* using organic growth supplements at varying concentrations, by replacing growth regulators in the Murashige and Skoog (1962) medium.

Growth regulators beyond certain concentrations are known to induce somaclonal variations in the *in vitro* grown cultures. The occurrence of somaclonal variations beats the purpose of clonal propagation. Presently, the protocorms of *Cymbidium finlaysonianum* were multiplied in Murashige and Skoog (1962) medium supplemented with varying concentrations of Yeast extract (YE) and peptone (P) (1,2,3,4 gL^{-1}) each. The protocorms multiplied in YE ($1gL^{-1}$) and Peptone (2 gL^{-1}). In comparative analysis, YE proved to be the best for the multiplication of (*neo*-formations) protocorms-like bodies (PLBs) of C. *finlaysonianum*.

Keywords: protocorms, PLB_s, growth regulators, somaclonal variations

Bats Conservation: Key to Biodiversity and Ecosystem Health

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ABSTRACT

Currently, there are more than 166,000 species listed on The IUCN Red List, with over 46,300 species threatened with extinction**,** including 44% of reef-building corals, 41% of amphibians, 38% of trees, 37% of sharks and rays, 34% of conifers, 26% of mammals, 26% of freshwater fishes and 12% of birds. Among mammals, bats are the second most diverse group, after rodents have species more than 1,455 (22%) out of around 6,400 species of mammals worldwide except harsh arid regions, Antarctic, Arctic and a few isolated oceanic islands. Bats play a crucial role in ecosystem functioning by acting as bioindicators, contributing to pollination, seed dispersal**,** act as predators, Soil fertility and nutrient cycling. They also serve as host for parasites, prey for vertebrates, and contribute economically through tourism, guano mining, education and research. The ecological services help in the

preservation of plant genetic diversity and the management of urban pests, insect diversity and agriculture. Over 114 plant species globally depend on bats for survival. Despite their ecological importance, bat populations worldwide are experiencing a decline. Threat factors include hunting (for bushmeat consumption, medicinal purposes, trade, recreation, the decorative and currency values of their teeth), Killings and Persecution Driven by Conflict and Negative Perceptions (such as crop-raiding and shared living space and misleadingly associating the disease with bats), urbanisation, low awareness of bats' ecological role, invasive species, anthropogenic stresses, wind energy, growing human population, pesticide exposure, environmental pollution, climatic factors, deforestation, electrocution, slow population growth rates of bats, scarcity of food and diseases including white-nose syndrome reflects the conservation challenges of our

era. Without prompt conservation measures, these impacts may result in rapid species declines. 1455 bat species assessed by the International Union for Conservation of Nature (IUCN), 236 are data deficient, 96 are near threatened, 110 are vulnerable, 86 are endangered, 26 are critically endangered and 9 are extinct. The bad news is that biodiversity is declining. It is essential that we conserve this diverse group of animals, not only for the benefits to our ecosystem but also to enhance our understanding of viral biodiversity and evolution, as well as mammalian immunology. These challenges highlight the critical need for conservation efforts to protect this ecologically important species and their natural habitats.

Keywords: evolution, near threatened, deforestation, pesticide exposure

Potassium Nitrate Modulate Biochemical Characteristics of Vigna *Radiata* (L.) R. Wilczek Grown Under Salt Stress

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ABSTRACT

Salinity is the major abiotic stresses that caused great reduction in crop production around the globe. Mung bean Vigna *radiata* (L.) R. Wilczek is an ecologically important food grain legume with high economic value. Mung bean is highly sensitive to salt stress, which continues to limit its production due to various environmental stress factors. Potassium (K), an essential macronutrient for plants, plays a crucial role in promoting growth and enhancing crop quality under salinity stress. Considering that, the present study investigates the effect of various doses of potassium nitrate (KNO3) application (K1- 0.24 g, K2- 0.40 g and K3- 0.48g) on biochemical parameters of two mung bean varieties; MH-1142 and MH-215,

grown under various level of sodium chloride (S1- 50 mM, S2- 75 mM, and S3- 100 mM) of NaCl. Salt stress has adverse influence on biochemical characteristics of mung bean. An increase in salt concentration led to a decline in photosynthetic pigments (Chl a, Chl b, and carotenoids). However, at the highest dose of KNO_3, these pigments showed a significant increase in both varieties. Proline accumulation was enhanced under increasing salinity but decreased as potassium application rose up to 100 mM. The application of KNO_3 significantly improved various biochemical parameters, including photosynthetic pigments, proline levels, and total soluble protein content. These findings indicate that an optimal supply of potassium not only enhances biochemical properties but also mitigates the adverse effects of NaCl-induced stress.

Keywords: Alleviation, Mung bean (MH 2-15 & MH-1142), potassium nitrate, salt tolerance.

Climate Change and Crop Production

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ABSTRACT

Due to fossil fuel consumption and over exploitation of natural resources, change in global climate has become a reality in contemporary times. Agricultural production is negatively affected by climate-related factors such as erratic precipitation, temperature, radiations, and green-house gas concentrations. Average global temperature is expected to rise from 2 to 6.4 ℃ and may cause heat waves, droughts and floods. The current temperature and precipitation patterns, along with future trends, pose significant challenges that may adversely affect agricultural production over time. Most of the studies have shown a declining trend in crop production due to changing environmental scenarios. To meet the demand of food crops, there might be an expansion in land use and excessive withdrawal of groundwater resources. This will certainly pose a threat to water and other natural resources and hence aggravate the situation further. Adaptation measures are prerequisite in order to reduce the impacts of climate change on crop production. Effective efforts are essentially required to conserve the natural resources including soil, water and biodiversity. There is a crucial necessity to efficiently implement the joint efforts and collaboration among governments, research institutions, farmers, and other stakeholders to combat the situation. Therefore, future research must explore the specific action mechanisms of climate change on agricultural output for desired results. This is absolutely required to develop concrete policies through

institutional efforts so as to address the underlying socio-economic and climatic challenges faced by agriculture-dependent communities across the nations.

Keywords: groundwater resources, land use, erratic precipitation, crop production

Human Health Issues in the Changing Climate Scenario

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ABSTRACT

Over the ages, human societies have degraded their local ecosystems and modified the climate. The Intergovernmental Panel on Climate Change found that global climate change will affect human health in many ways. Overall, the negative effects of this change are expected to outweigh the positive impacts. Climate change disrupts biodiversity, especially affecting rare medicinal plants and their bioactive compounds. Protecting the phylogenetic diversity of these plants is essential for maintaining human health. Important influences on health will include changes in the frequency and intensity of extremes of heat, cold, droughts, floods, tornadoes, and other forms of extreme weather conditions. Many prevalent human diseases are linked to climate fluctuations ranging from cardiovascular mortality and respiratory illnesses due to heatwaves, to altered transmission of infectious diseases and malnutrition from crop failures. The recent investigations show that this world will be subjected to the highest heat health risks, with rapidly increasing hazard levels and vulnerability over the century in lesser developed regions, such as Africa and South East Asia, at the highest risk. The World Health Organization estimates that the warming and precipitation trends due to anthropogenic climate change in the past 30 years already have claimed over 1,50,000 lives annually. Monitoring climate change and its health impacts is an important task that requires public health strategies and improved surveillance. There is an urgent need for extensive study to facilitate both health data and its linkage with indoor and outdoor climate and determinants of vulnerability. Further research shall predict the detailed impacts of climate change and bring out effective interventions.

Keywords: cardiovascular mortality, respiratory illnesses, heatwaves, bioactive compounds

Investigation of Differential Cross Section For Electron Interaction From Environmentally Relevant Molecules

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ABSTRACT

In recent years, many groups (Bettega *et al*, 2011; Zecca *et al*, 2012; Singh *et al*, 2016; Mozejko *et al*, 2017) have studied the cross sections for electron / positron collisions with a large number of environmentally relevant polyatomic molecules. These cross sections have important applications in environment, space and chemical physics. Many approaches ranging from as simple as (IAM) to *ab initio* methods have been proposed and developed.

Ab initio calculations are quite difficult to perform and, therefore, our objective here is to use a spherical optical potential approach in the fixed nuclei approximation. Here, the optical potential consists of three potentials namely, the static, the exchange and the polarization. A partial wave analysis approach is adopted to compute the phase shifts for the solution of Schrodinger equation. We have employed a variable-phase-approach to find its solution to compute elastic differential, integral, and momentum-transfer cross sections as well as total (elastic plus inelastic) cross sections for electron scattering in the low energy range. The detailed results will be presented and discussed in the conference related to the molecules.

Keywords: nuclei approximation, optical potential , variable-phase-approach, electron scattering

Comprehensive Evaluation of Pollution Levels through Integrated Water Quality Indices: A case study of Surajpur Wetland, Uttar Pradesh

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ABSTRACT

The water quality of the Surajpur wetland was assessed through the analysis of thirteen physicochemical parameters: pH, total dissolved solids (TDS), electrical conductivity (EC), temperature, total hardness, total alkalinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), phosphates, fluoride, nitrates, sulfates, and chlorides, using standardized methodologies. Over four months, these parameters were measured every month, and the outcomes were compared against WHO and BIS standards. The results indicated that TDS, EC, total alkalinity, phosphates, and fluoride concentrations exceeded acceptable thresholds. Water quality was then evaluated using the Comprehensive Pollution Index (CPI), the Canadian Council of Ministers of the Environment Water Quality Index (CCME-WQI), and

the standard Water Quality Index (WQI). The investigation revealed that water quality within the study area was characterized by a CCME-WQI score between 46 and 53, indicative of very low to marginal water quality. The CPI ranged from 0.9 to 1.15, similarly signifying very poor to marginal quality, while the WQI values fell between 82.80 and 96.18, reflecting acceptable water quality.The implementation of the WQI is essential to enhance the management of the wetland's health. The primary drivers of contamination in this area included the discharge of untreated sewage and agricultural runoff from adjacent lands. Additionally, the proliferation of water hyacinth has considerably impacted dissolved oxygen levels, leading to ecosystem degradation alongside temperature, TDS, and BOD alterations.It is recommended that targeted interventions such as de-weeding, cessation of untreated sewage discharge, and desilting be applied to safeguard the wetland's ecological integrity and aesthetic value. These proactive measures are critical to preventing further degradation of the wetland and ensuring the sustainability of its ecosystem.

Keyword: WQI, CCME-WQI, CPI.

Wetlands: Best Alternative For Economical and Ecological Security of the Society

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ABSTRACT

Wetlands are the shallow water aquatic ecosystems which account for 4.6% of total geographical area of India. There are 80 sites designated as Wetlands of International Importance in our country and over 2400 Ramsar sites around the world. They are ‘kidneys of landscape’ receive flows of water and waste water from upstream sources and ensure the functioning of water cycle. They recharge ground water aquifers, control flood, regulate climate and meets our food and water demand. Their extensive food chain and biological diversity makes them biological supermarkets. This review paper assessed the ecological and economical security of wetland ecosystems for the society and found that wetlands provide the habitat to a number of endemic and near threatened to highly threatened species and ensure their ecological security. It has been observed that Chilika lake (Odisha) maintain healthy population of endangered Irrawaddy Dolphin *(Orcaella brevirostris)*; Keibul Lamjao, a floating national park on the south of Loktak (Manipur) provide natural habitat to globally endangered Brow-antlered Deer *(Rucervus eldii)*; and River Son, Girwa and Chambal of Central India act as a habitat of critically endangered Gharial *(Gavialis*

gangeticus).Wetland plants such as Water Hyacinth, Duck weed and Azolla can store heavy metals such as iron and copper from wastewater and increase the availability of fresh water. Wetlands have been drained, filled and converted for alternate uses in almost all parts of the globe. Since 1900, the world has lost around 50% of its wetlands. Therefore, there is an urgent requirement for the management, conservation and restoration of wetland ecosystems as they are the best alternative for ecological and economical security of the society.

Keywords: Wetlands, Ramsar sites, shorelines, biological supermarkets, endangered species.

Carbon Emissions from Groundwater and Soil In Intensively Managed Agroecosystems

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ABSTRACT

Changing climate and shifts in weather patterns have significantly affected food production systems, which is evident in the form of crop damage, reduced yield, and market instability. Water and chemical-intensive agriculture practices have made the sector a major contributor of carbon emissions, affecting the global climate, nutrient cycling and food security. Modern agriculture tools and practices contribute nearly 13.5% of the total global anthropogenic GHG emissions. Apart from the use of agrochemicals, irrigation and soil respiration are the major contributors to carbon emissions in the agroecosystems in India. This study quantified the carbon emissions from groundwater pumping and soil carbon efflux. It was observed that electrified and diesel pumps contribute significantly to carbon footprint. The carbon emissions were observed to increase by 50% with 10% decrease in the pumping efficiency. Solar pumps can be a sustainable option to meet the target towards decarbonization. Furthermore, in semi-arid regions, higher soil moisture was observed to amplify the carbon emissions from soil. The carbon efflux from soil was also observed to be significantly affected by climatic conditions. The study concludes that judicious management interventions, improved methods of irrigation, maintenance of mulch layer and sustainable use of groundwater are crucial to ensure water availability and environmental quality in the region. Soil and water management practices in agriculture significantly contribute to achieving the Sustainable Development Goal (SDG) of climate

action, while simultaneously addressing interlinked goals such as eradicating hunger and poverty, and promoting good health and well-being.

Keywords: Climate change, Carbon emissions, Sustainable agriculture, ustainable Development Goals

Slope Instability: A Serious Threat To Himalayan Villages

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ABSTRACT

Landslide, a natural phenomenon which is very common in the Himalayan region. The complex geological and geomorphological factors are very crucial if ignored while developing hilly regions of Himalaya. Poor management and rapid developmental activities are also responsible for slope failures. The present study is focused on the part of Kinnaur district of Himachal Pradesh. Many of the villages in the Kinnaur district are situated on either debris of old landslides or the talus. Even Recong Peo, district headquarter is situated on the old landslide debris and facing problems of landslides. Four villages (Urni, Chooling, Sapni and Barua) are considered in the present study. Urni and Chooling villages are very adjacent to Raura Gad fault and HRT of Karcham-Wangtu Hydropower Project is aligned below the villages. Also slope is cultivated and irrigated. Urni landslide at the toe of the slope Along NH-5 at right bank of Sutlej river is more than 3 decades old and is presently advancing in terms of height and width. Barua and Sapni villages are Situated in the Baspa valley. Both the villages are situated very close to Kullu and Jutogh thrusts which are regional thrusts and rocks along these thrusts are highly deformed. Both the villages are facing the serious problems of slope instability. In Sapni toe erosion and poor drainage system are among the main causes of day light of slopes. Barua is the most affected village among the four villages. Barua is an old and traditional village preserving the heritage and old architecture of Kinnaur. In 2005 Government of Himachal Pradesh declared the village unsafe but the people refused to vacate the village. Now the whole village is sinking. As per the villagers, it has experienced a subsidence of around 5-7m. Tilted trees and cracks of width greater than 10 cm at mid slope and 1 feet width at crown at many locations in the area are recoded which signifies that the slope is completely unstable. The investigation yield that an immediate restoration of slopes is required and Brua village is required to be declared unsafe again and the people must be rehabilitated to the safe location. Also it is recommended that a detailed engineering geological investigation of all villages in the region must be done so that

adequate mitigation and slope restoration can be done and any loss in all terms may be avoided or minimized.

Keywords: Hydropower Project, Poor drainage, heritage, Landslide

Assessment of Seasonal Precipitation Trends and Water Resource Implications in Arid Ecosystem of Western Rajasthan

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ABSTRACT

This research examines shifting seasonal precipitation patterns in five major locations across western Rajasthan—Bikaner, Hanumangarh, Nagaur, Sikar, and Jaisalmer—using statistical methods such as Sen's slope estimation and Kendall's tau. The results reveal notable spatial and seasonal differences in rainfall trends, intricately tied to the region's water resources and the impacts of climate change. Monsoon rainfall shows an upward trend in Hanumangarh (Sen's slope: 20.217) and Jaisalmer (18.457), indicating potential improvements in water availability during this critical season. In contrast, Bikaner and Nagaur exhibit declining annual precipitation trends, with Sen's slopes of -2.2 and -0.22, respectively, signaling increased vulnerability to water scarcity. Rainfall patterns in the post-monsoon and winter seasons remain largely unchanged across all stations, offering minimal contribution to groundwater replenishment during these periods. The observed increase in monsoon rainfall in certain areas presents opportunities for improved water harvesting and aquifer recharge. However, regions experiencing reduced precipitation require immediate measures to address potential water shortages. These findings emphasize the urgency of implementing adaptive water resource management strategies, including rainwater harvesting, sustainable irrigation techniques, and community-driven watershed development. By focusing on localized, data-informed solutions, this study enhances understanding of the impacts of climate variability on water security in arid ecosystems, offering practical guidance for sustainable resource management in western Rajasthan.

Keywords: Shifting Seasonal Precipitation Patterns, Sen's Slope Estimation, Rainfall Trends, Water Scarcity, Adaptive Water Resource Management

Exploring Anuran (Frog) Diversity of Arunachal Pradesh

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ABSTRACT

Amphibians are one of the most diverse groups of vertebrates. Within amphibians, Anurans (frogs) make up the majority, followed by Gymnophiona (Caecilians) and Caudata (Salamanders). Anurans inhabit both aquatic and terrestrial habitats, thus serving as a crucial indicator of environmental health. In total, there are 8828 species of amphibians worldwide (2024), out of which about 415 species are in India occupying diverse habitats, from the Western Ghats' lush forests to the Himalayan foothills, coastal wetlands, and central Indian plains.

In the Himalayan area, Arunachal Pradesh is geographically the largest northeastern state of India and ranks second in forest cover in the country. It connects two biodiversity hotspots namely, the Himalaya biodiversity hotspot and the Indo-Burma biodiversity hotspot. This location supports a rich diversity of flora and fauna, including that of amphibians. Even though amphibian studies in Arunachal Pradesh have advanced over the last two decades, much of the region's amphibian diversity remains poorly researched, especially when compared with extensively studied areas of India, like the Western Ghats. Also, despite maintaining extensive forest cover; deforestation, agricultural expansion, and rapid infrastructure development has resulted in fragmented habitats and altered ecosystems, posing a significant threat to the amphibian biodiversity of the state.

In the current study, extensive herpetological surveys were conducted across the state between 2019 and 2024, during multiple seasons. Data required for morphological and molecular analyses were collected along with data on bioacoustics, breeding behavior, natural history as well as larval development. This study highlighted the rich anuran diversity of the state and the presence of multiple novel species that need proper identification, research, and conservation efforts. Collaborative efforts between scientists, policymakers, and local communities are crucial in the formulation of scientifically aware and sound policies.

Keywords: Amphibians, Biodiversity, Conservation, Arunachal Pradesh, Habitat Fragmentation

THEME -3

Waste Management and Circular Economy

Heavy Metals Contamination in the Groundwater of Rai Block, Sonipat, Haryana.

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ABSTRACT

Groundwater is one of Earth's most precious resources. Recognizing its importance, the present research assessed the groundwater quality around the industrial area of Rai block, Sonipat district, Haryana, over two consecutive years (2021 and 2022) across three seasons. Six heavy metals namely Cadmium (Cd), Chromium (Cr), Nickel (Ni), Copper (Cu), Iron (Fe), and Zinc (Zn) were estimated in the water samples in pre-monsoon, monsoon and post-monsoon season. During the study period, the concentrations were ranged as: Cr: Below Detection Limits (BDL)–4.0 mg/l, Cd: BDL–0.35 mg/l, Ni: BDL–0.23 mg/l, Cu: BDL–8.2 mg/l, Fe: BDL–23.0 mg/l and Zn: BDL–19.0 mg/l. The concentrations of Cadmium (Cd), Chromium (Cr), Nickel (Ni), and Copper (Cu) in the groundwater samples exceed the limits prescribed by the WHO drinking water standards (2011) such as Cd 0.003 mg/l, Cr 0.05 mg/l, Ni 0.07 mg/l, Cu 2mg/l, while Zinc (Zn) and Iron (Fe) are not included in these standards because there is no limits mentioned for the Zn and Fe in WHO (2011) standards of drinking water. The limits are mentioned in this study also calculated the Heavy Metal Pollution Index (HPI) to evaluate the contamination levels. The mean HPI values for 2021 were 118 (pre-monsoon), 139 (monsoon), and 139.56 (post-monsoon), while for 2022, they were 138 (pre-monsoon), 141.09 (monsoon), and 140.36 (post-monsoon), respectively. HPI values were consistently highest in the pre-monsoon season, followed by post-monsoon and monsoon. To mitigate groundwater pollution and safeguard public health, immediate action is necessary. Treatment methods such as ion exchange, adsorption, and filtration can effectively remove contaminants, making groundwater safe for consumption.

Keywords: Contamination; Groundwater; Heavy Metals; Industrial Impact; HPI; Rai Block.

Suitability of Himalayan water quality for domestic use: A systematic review and meta-analysis

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ABSTRACT

The Himalayan region, often referred to as the "Water Tower of Asia," is a critical freshwater source for millions of people. However, its water quality for domestic use faces

significant challenges due to anthropogenic activities and natural processes. However, the majority of existing research has focused on examining the heavy metal contamination levels of specific Himalayan water bodies or regions. There is a lack of a comprehensive synthesis that spans multiple regions and time periods. This study represents a novel contribution by systematically compiling and critically analysing data from 66 studies (2003-24) on Himalayan water. This study evaluated the water quality of the Himalayan region, namely, India, Nepal, Pakistan, and China, for domestic use. Methodologies include PRISMA-guided systematic reviews, pollution index calculations, and health risk assessments on the basis of ingestion and dermal exposure. Statistical analysis revealed that the concentrations of some HMs (As, Cd, and Pb) are higher than the WHO standard permissible values, particularly in India and Pakistan. There are improvements in pollution indices over time, such as the degree of contamination (DOC) decreasing from 138.02 (2003–13) to 49.86 (2014–24) and the pollution load index (PLI) declining from 2.68 to 0.29. However, the water quality of the Himalayan region still remains unsuitable for domestic use. Moreover, significant risks persist, with carcinogenic risk levels (CRs) exceeding acceptable limits, particularly affecting children, and hazard indices (HIs) for several heavy metals indicating serious noncarcinogenic health concerns. This study establishes trends over two decades, emphasizing notable improvements. However, persistent noncarcinogenic and carcinogenic health risks exist, particularly in children. This finding underscores the urgent need for monitoring, stricter regulations, and effective water management strategies to mitigate health risks and protect Himalayan water resources. Additionally, safe water access for domestic purposes should be ensured.

Keywords: Domestic use; Health risk assessment; Heavy metals; Himalayan water quality; Sustainable development goals

Suitability of the Himalayan water quality for irrigation purpose: A systematic review and meta-analysis

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ABSTRACT

The Himalayan region is a delicate area abundant in water resources and biodiversity, where the balance between hydrological parameters and the flora and fauna is crucial. The hydrochemical characterization and irrigation suitability evaluation of the Himalayan region

is of great importance and has critical implications for socioeconomic, ecological, and religious aspects. This study addresses a significant knowledge gap by conducting a systematic review and meta-analysis of 208 studies (2003-24). This study assesses hydrochemical parameters and also evaluates water suitability for irrigation purposes. The hydrochemical analysis indicated that water was slightly alkaline, with pH, TDS, EC, and central cation/anion values falling within acceptable limits for irrigation across different countries in two decades. The water across the region is generally suitable for irrigation across different countries based on key parameters like MH, PI, KR, and SAR. However, China's KR value (3.06bmeq/L) was exceedingly higher than allowable limits. Some metrics such as TH, PS, RSC, and CR were exceedingly higher than permissible limits in Nepal, China, and Pakistan, resulting in unsuitable for irrigation purposes. In India, CR values (34.06bmg/L) are higher than allowable limits, making it unfit for water transportation through pipes in this region. TH, RSC, PS, and CR values surpassed permissible values in two decades, thereby challenging agricultural sustainability in the Himalayan areas. Overall, water quality in the region requires improvement, and implementing effective mitigation strategies is essential for safeguarding the water quality of this region. This study provides critical information for researchers and policymakers, contributing to improved water management and ecosystem conservation in the Himalayan region, mainly due to growing anthropogenic and climate pressures.

Keywords: Himalayan water quality; Hydrochemical characterization; Irrigation suitability assessment; Major ions

Sustainable Cotton Waste Management in Khandesh Region of Maharastra

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ABSTRACT

Indians were known to cotton from the Harappan Civilization. Since then, cotton has been strength of the economic character of the whole sub-continent, generating significant employment opportunities for the masses. Although time passes year by year, the importance of cotton has not diminished. Since the establishment of the first cotton mill in India at Fort Gloster, cotton production has been a vital component of the Indian economy contributing a considerable share in the agricultural sector. India accounts for 24% of the global production,

with Maharastra playing the foremost role. Khandesh, situated in the northwest of Maharastra, is a major producer of cotton. However, the production and processing of cotton generates a large amount of waste which is hazardous to the environment as well as health. This study attempts to identify cotton residues such as cotton stalk, cotton gin trash, unpicked cotton, cottonseed hulls, and textile waste. This study investigates the current cotton waste management practices in the Khandesh area. The work also attempts to shed light on the challenges and opportunities in the sustainable management and disposal of cotton leftovers. The study identifies some current and prospects such as composting, recycling, animal feed, paper production, insulation material, crafting and textile art and bioenergy production. Mixed methods were employed including surveys and interviews. The study found some bottlenecks in the sustainable disposal of cotton waste, such as a lack of awareness among stakeholders, infrastructural constraints and Government intervention requirements. This paper also suggests a way forward in handling cotton waste. It was found that if managed effectively, cotton residues can double farmers' income by creating employment through the strong value chain, empowering women in the region, increasing soil conservation, reducing environmental pollution, reducing greenhouse gas emissions and so forth. The study will be helpful for farmers, ginners, textile manufacturers, policymakers and other stakeholders.

Keywords: Cotton production: Cotton residues: Waste Management: Sustainable management: Khandesh region:

Feasibility of Blending Brown Seaweed Pulp with Rice Straw Pulp for Sustainable Production of Packaging Grade Paper

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ABSTRACT

Everything now a days comes in a wrap or package. The packaging industry mainly relies on hardwood and recycled fiber. With depleting resources and increasing population, the demand to meet necessities sustainably has become a major challenge. Seaweeds and rice straws are abundantly available wastes that can be valorized as sustainable alternatives to wood. Thus, brown seaweed was valorized as a fibre source and its pulp was blended with

rice straw pulp to make packaging-grade paper. Pulping of brown seaweed was carried out in acid and alkali conditions at high temperatures and pressure. Subsequent treatment with laccase at low dose was given before blending the seaweed pulp with unbleached rice straw pulp. Among six differently produced seaweed pulps, only acid pulps could form sheets with rice straw pulp in a 1:1 ratio. Pulp produced from acid pulping at 1 and 1.5% concentration (v/v) of H_2SO_4, bath ratio 10:1, temperature 121 °C and pressure 12 psi for 2 hours showed similar paper properties. However, 2% acid concentration during pulping deteriorated the paper properties of seaweed pulp. Still, the strength properties of control unbleached rice straw pulp were superior due to inherent fibre properties and better sheet-forming ability. Further study is suggested to investigate the use of a strengthening agent or lowering the blending ratio of seaweed pulp to rice straw pulp to 0.5:1.5.

Keywords: Brown Seaweed Pulp; Rice Straw Pulp; Sustainable Packaging; Pulp Blending

Synthesis of Bioplastics for a Greener Future Using Agro-waste

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ABSTRACT

The growing environmental concerns surrounding petroleum-based plastics have led to the exploration of sustainable alternatives among which bioplastics derived from agro-waste stand out as a promising solution. Bioplastic is a biodegradable, eco-friendly invention made from renewable biological sources and a suitable alternative to traditional plastics. The extensive agricultural waste production shows its abundance and availability for bioplastic synthesis.

This research examines the production of cellulose-based bioplastic among all bioplastics from agro-waste and highlights its potential as an eco-friendly substitute. Cellulose is the most abundant organic polymer on earth and a key component of plant cell walls. It plays a crucial role in plant structure and strength, providing rigidity and support. In agro-waste, cellulose is present in varying quantities depending on the type of plant material such as crop residues, fruit and vegetable peels, stems, leaves, and other agricultural by-products. Due to its high cellulose content, agro-waste is often considered a valuable feedstock for producing bio-based materials like bioplastics. This research evaluates the synthesis methods and mechanical and biological properties of bioplastics. This research also discusses

environmental impacts such as carbon footprint, biodegradability, etc. of cellulose-based bioplastic.

Keywords: Agro-waste; Bioplastic; Cellulose; Eco-friendly; Sustainability.

Comparative Analysis of Composting and Anaerobic Digestion for Organic Waste

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ABSTRACT

Solid waste management has become a critical challenge globally, with organic waste comprising a significant portion of municipal solid waste. This study presents a comparative analysis of two widely adopted organic waste treatment methods: composting and anaerobic digestion. Composting is an aerobic process that transforms organic matter into nutrient-rich compost, suitable for soil amendment, while anaerobic digestion occurs under oxygen-free conditions, producing biogas as a renewable energy source and digestate for agricultural use. The comparison focuses on key parameters, including environmental impact, energy efficiency, waste reduction, economic feasibility, and by-product utilization. Results highlight the suitability of composting for decentralized waste management systems with an emphasis on soil health, while anaerobic digestion demonstrates advantages in energy recovery and waste stabilization at a larger scale. The findings underline the importance of waste characteristics and local conditions in determining the optimal choice of treatment technology, paving the way for sustainable waste management solutions.

Keywords: Composting; Anaerobic Digestion; Organic Waste; Solid Waste Management; Biogas Production; Soil Amendment

Assessment of Groundwater Contamination in Vicinity of Dumping Site: Physicochemical Impacts and Seasonal Variations.

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ABSTRACT

Dumping sites have been known to cause a significant environmental problem, especially the leachate's effect on groundwater quality. This study investigates the influence of dumping leachate on the physicochemical parameters of groundwater near an unmanaged dumping site. Groundwater samples were randomly collected from different locations surrounding the

dumping site of Pipli, Haryana during pre-monsoon and post-monsoon periods for the following parameters: pH, EC, TDS, total hardness, calcium, magnesium, nitrate, phosphate, fluoride, and chloride. Results show contamination levels are elevated, and many values exceed WHO and BIS permissible limits when measured closer to the dumping site. The pH of the groundwater was found to be slightly acidic to alkaline, influenced by the infiltration of acidic leachates. High EC and TDS levels indicate high ionic contamination, whereas total hardness, calcium, magnesium, and fluoride concentrations were found to be increased due to leachate infiltration from the dumping site. Seasonal variations indicate higher contamination levels during the post-monsoon period, with increased mobilization of leachate. Findings have highlighted the urgent need for effective dumping management practices, leachate treatment systems, and regular monitoring to mitigate risks of groundwater contamination in affected areas.

Keywords: Groundwater; Leachate; Dumping site; WHO; Water quality.

Sustainable Energy from Agricultural Waste: Effective Pretreatment and Co-Digestion Methods for Biogas Production

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ABSTRACT

The adoption of waste-to-energy technologies is increasingly recognized as a pivotal strategy for achieving sustainable energy development globally. Among the diverse biomass resources, agro-residues: crop straws, husks, stalks, leaves, and other agricultural by-products represent an abundant yet underutilized energy source with immense potential for renewable energy generation and greenhouse gas mitigation. These residues, rich in lignocellulosic content, pose challenges due to their complex structures of cellulose, hemicellulose, and lignin, which hinder biodegradability and bioconversion. This study provides a comprehensive review of pretreatment and co-digestion techniques designed to enhance the biodegradability and digestibility of agricultural lignocellulosic biomass. Pretreatment methods such as physical, chemical, and biological are evaluated for their effectiveness in breaking down lignocellulosic structures to improve microbial accessibility. The most effective strategies for pretreatment are mechanical, irradiation, thermal, chemical, biological, and integrated approaches have been identified. Additionally, co-digestion of lignocellulosic agricultural waste with nitrogen-rich substrates such as animal manure, cow dung, and food

waste is highlighted as a robust method for optimizing the carbon-to-nitrogen ratio, ensuring nutrient balance, and significantly increasing biogas yields. The biogas generated through these processes serves as a clean, renewable energy source, while the digestate byproduct can be repurposed into biofertilizer, promoting a circular economy. This model not only addresses the critical issue of agricultural waste management but also contributes to mitigating greenhouse gas emissions and reducing environmental pollution, offering a sustainable pathway for energy and resource recovery.

Keywords: Agroresidues; Anaerobic Digestion; Biofertilizer; Biogas; Co-Digestion; Pretreatment Techniques.

Utilising Fruit and Vegetable Waste as Poultry Feed for Chick Fowl

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ABSTRACT

In recent years, there has been growing concern regarding the issue of food waste and its impact on the environment. Fruit and vegetable waste, in particular, has been identified as a significant contributor to this problem. Seeking an innovative and sustainable solution, researchers have emerged with the idea of utilizing this waste as poultry feed for chick fowl. The purpose of this study is to explore the potential benefits and challenges associated with the utilization of fruit and vegetable waste as poultry feed for chick fowl. By examining existing literature and research in this field, we aim to provide a comprehensive overview of the viability of this innovative approach.

Fruit and vegetable waste offers a rich source of nutrients, including carbohydrates, protein, vitamins, and minerals, which are essential for the growth and development of chick fowl. Moreover, the inclusion of this waste in their diet can potentially reduce the cost of feed production, improving economic efficiency for poultry farmers. This approach also has the potential to address the issue of food waste, promoting a more sustainable and circular economy. However, challenges related to the feasibility, supply chain, and safety considerations need to be thoroughly investigated. Ensuring the safety of chick fowl and subsequently, the consumers of poultry products, is of utmost importance. Contaminants such as pesticides and microbial pathogens present in fruit and vegetable waste must be effectively managed. The utilisation of fruit and vegetable waste as poultry feed for chick fowl holds implementation. With careful consideration, this innovative approach has the potential to

address the issues of food waste, reduce costs, and contribute to enhancing nutritional value for the sustainable poultry industry. By exploring and implementing innovative practices, we can transform waste into valuable resources like as poultry feed for chick fowl.

Keywords: Fruit and Vegetable Waste; Poultry Feed Innovation; Sustainable Food Waste Management; Nutritional Value and Safety

Transforming Agricultural Waste with Mushroom-Derived Bioactives: A Leap Toward Sustainable Therapeutics

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ABSTRACT

The convergence of agricultural waste management and bioactive compound exploration provides innovative avenues for sustainability and health. This study delves into the potential of mushrooms cultivated on agricultural byproducts as a source of bioactive compounds with therapeutic relevance. By repurposing waste substrates, the research promotes a circular economy, reducing waste while driving advancements in fungal biotechnology. Mushroom species, including Hericium, Auricularia, Cordyceps, Pleurotus spp. and Ganoderma, were cultivated on crop residues such as wheat straw and rice husks. Bioactive compounds were extracted using methanol, ethanol and other aqueous solutions via sonication, followed by detailed characterization through phytochemical screening and spectroscopic techniques. The analysis identified substantial concentrations of polysaccharides, terpenoids, and phenolic compounds, recognized for their antioxidant, antibacterial, antiviral, anticancer, and anti-inflammatory properties. The findings underscore the dual benefits of transforming agricultural waste into productive growth substrates and unearthing bioactives that hold promise for sustainable drug development. This research highlights the critical role of fungal biotechnology in addressing global challenges, including waste reduction, healthcare innovation, and environmental sustainability. Future directions will focus on scaling these methodologies to optimize their industrial and clinical applications.

Keywords: Agricultural Waste Management; Mushroom-Derived Bioactives; Sustainable Therapeutics; Fungal Biotechnology; Circular Economy

Pretreatment of Potato Waste for Release of Fermentable Sugars: Optimization and Vodka Production

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ABSTRACT

Vodka is a clear distilled alcoholic beverage, traditionally produced by fermenting various raw materials such as cereal grains, potatoes, and molasses, making it both economically viable and widely accessible. In this study potato waste consisting of potato peel, mash, and industrial water underwent proximate and physicochemical analysis, revealing a high starch content (59%) and rich organic matter in the peel and mash mixture. Liquefaction optimization, achieved through Response Surface Methodology, involved an α-amylase dose of 0.72% (v/v) for 62.15 minutes at 59.8°C, followed by saccharification with a glucoamylase dose of 1.7% (v/v) for 28.5 hours at 52°C. Prior to fermentation, the wort contained 13.03 ± 0.08 mg/ml of total sugars and 10.69 ± 0.03 mg/ml of reducing sugars. Fermentation was carried out with Saccharomyces cerevisiae (MK680910) at a 6% pitching rate, producing an alcohol content of 7.7% after three days. Fractional distillation at 80°C resulted in an ethanol concentration of 38.7% with 77.4° proof. This study demonstrates an efficient process for converting potato waste into vodka through fermentation and distillation.

Keywords: Vodka; Fermentation; Distillation; Potato waste; Ethanol

Antimicrobial Properties of Fish Epidermal Mucus for Environmental Pollution Assessment

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ABSTRACT

Water pollution has emerged as a critical environmental concern, introducing various contaminants that threaten aquatic ecosystems. Among aquatic organisms, Fish, as key bioindicators, are especially susceptible to these pollutants, reflecting overall ecosystem health. In natural waters, to withstand harsh environmental conditions and high pathogenic load, Fish have evolved sophisticated defence mechanisms, with their epidermal mucus layer functioning as the first line of defence. This research investigates the antimicrobial properties of epidermal mucus from five freshwater fish species *Catla catla, Labeo rohita, Heteropneutes fossilis, Channa striatus,* and *Oreochromis niloticus* using agar well diffusion assays against *Aeromonas hydrophila* with HR-LCMS (High-Resolution Liquid Chromatography-Mass Spectrometry) analysis. It characterizes the bioactive compounds involved in their defence mechanisms. Results revealed significant antibacterial activity

against A. hydrophila with species-specific variations in mucus composition, with *Catla catla* exhibiting the most potent antimicrobial activity across species. Using HR-LCMS, we identified various antimicrobial compounds including D-Pantothenoyl-L-cysteine, 9,10-dihydroxy stearic acid, 7-O Methylluteone etc. which possess antimicrobial properties that protect fish against various pathogens in their aquatic environment. This research not only enhances our knowledge of fish immune systems but also provides potential indicators for monitoring aquatic ecosystem health in polluted environments, as changes in mucus composition could reflect responses to environmental degradation. These findings contribute to developing more effective environmental management strategies by providing a novel approach to monitor water quality through fish mucus analysis, while also offering insights into natural antimicrobial compounds that could indicate ecosystem stress responses.

Keywords: Antimicrobial Properties; Fish Epidermal Mucus; Aquatic Ecosystem Health; Pollution Bioindicators; Natural Antimicrobial Compounds

Production of Paver Blocks Using Plastic Waste: A Sustainable Approach towards Plastic Waste Management.

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ABSTRACT

Plastic waste management has become a critical global challenge. Plastics are extensively used in industries and daily life due to their unique properties like affordability, adaptability, and durability. Plastics are derived from petrochemicals and are primarily composed of hydrocarbons along with additives such as stabilizers and plasticizers. Their non-biodegradable nature causes them to linger in ecosystems for decades, significantly harming the environment. The primary reasons for the massive accumulation of plastic waste include insufficient technical knowledge for managing hazardous materials, inadequate recycling and recovery infrastructure, and a widespread lack of awareness about environmental laws and regulations. Another hazard to the environment is the cement industry which act as a major source of greenhouse gas (GHG) emissions, and cement production demands large quantities of materials and significant amounts of energy. Cement, widely used as a binding agent in the production of paver blocks may be replaced by plastic waste. This review explores the different types of plastics and their environmental impact, while also examining various studies on utilizing plastic waste in paver block production. Plastic waste has the potential to serve as a sustainable and cost-effective raw material for construction. The reuse of plastic

waste would offer improved strategies for managing plastic waste, facilitating cleanup efforts, and fostering a healthier environment.

Keywords: Plastic, Waste management, Reuse, Pollution, Paver blocks.

Isolation and Characterization of Bacillus sp. ND6D Produced Thermostable Keratinase: A Green Approach in Feather Waste Management

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ABSTRACT

Keratinous waste is a significant biological byproduct abundantly found in nature. Currently, this waste is primarily managed through dumping or subjected to physical or chemical treatments, resulting in environmental pollution, while its potential remains largely untapped. However, it can be effectively utilized in an environmentally friendly manner with the assistance of keratinolytic microorganisms. In this study, bacteria were isolated and screened from various sources for their ability to produce keratinase, using chicken feathers as a substrate. Initially, 265 bacterial isolates were obtained from 29 samples following enrichment. Among these, 142 bacterial isolates exhibited proteolytic activity, as evidenced by the zone of hydrolysis on skim milk agar. However, when tested for the degradation of chicken feathers, only 13 isolates could completely solubilize the feathers within 7 days. Furthermore, all 13 isolates exhibited a K:C activity ratio of more than 0.5. Morphological and biochemical characterization revealed that all these isolates were Gram-positive, sporulating bacteria belonging to the genus Bacillus. These selected isolates demonstrate significant potential for utilizing keratinous waste, particularly white chicken feathers, thereby making them promising candidates for industrial-scale keratinase production.

Keywords: Proteolytic; Keratin; Keratinase; Feather degradation; K:C activity; Bacillus

Synthesis and Characterization of Zinc Oxide Biochar Nanocomposites from Agrowaste.

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ABSTRACT

The synthesis of zinc oxide (ZnO) biochar nanocomposites has gained significant attention due to their potential applications in environmental remediation. This study focuses on the

fabrication of ZnO biochar nanocomposites through a sustainable and cost-effective process, utilizing agrowaste-derived biochar as a substrate. The biochar, produced through pyrolysis at an optimized temperature (550 °C), provides a high surface area and functionalized surface for ZnO nanoparticle anchoring. Zinc oxide nanoparticles were synthesized and incorporated onto the biochar surface using the co-precipitation method. The resulting nanocomposites were characterized using UV-visible spectrophotometry, Zeta potential, SEM, EDX, and FTIR to confirm their peak, size, morphology, structure, elemental composition, and functional groups. The absorbance peak of nanocomposites was observed at 355nm by using UV-Visible spectra and Zeta potential was found to be negative 25.9 mV. The SEM results revealed rod and spherical shape of nanocomposites with average size of 24.06 nm. EDX depicted elevated signal confirmed the chemical composition of nanocomposites and FTIR spectrum were found in the scale of 3000-4000 $cm^{-1.}$ The synergistic interaction between ZnO and biochar enhances adsorption efficiency, photocatalytic degradation, and antimicrobial properties, making them effective in the removal of various environmental contaminants from wastewater. This study highlights the potential of ZnO biochar nanocomposites as a sustainable and multifunctional material for wastewater treatment, emphasizing their environmental and economic benefits.

Keywords: Zinc oxide (ZnO); Biochar nanocomposites; characterization; Wastewater.

Synthesis and Characterization of Coconut Shell Biochar: Insights into Physicochemical Properties and Applications

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ABSTRACT

A sustainable way to reduce coconut shell waste while promoting soil health, soil quality, and plant productivity is using biochar, a carbon-rich substance produced by biomass pyrolysis. In this study, biochar was synthesized by slow pyrolysis at 550°C and characterized using FTIR, XRD, and FE-SEM. The FE-SEM micrographs of Coconut shell biochar (CSB) illustrate a predominantly porous structure, indicating enhanced surface area and adsorption potential. CSB is rich in phenols, isopropyl groups, and aromatic compounds and demonstrates chemical stability ideal for long-term carbon sequestration. CSB exhibited a crystalline structure. Physio-chemical properties revealed that the CSB had a neutral pH, EC of 417 μS/cm, higher bulk density and cation exchange capacity (CEC) better suited for water

holding capacity (WHC) and pollutant adsorption. CSB has lower moisture and ash content, making it less prone to degradation and better for long-term soil improvement. The results present a scalable framework for using coconut shell waste as a sustainable way to enhance plant productivity and soil health.

Keywords: Biochar; Coconut shell; Soil quality; Plant productivity; Sustainability

Bio-electrochemical system: Treating sewage wastewater with nutrient recovery using agricultural waste and hydrogen production

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ABSTRACT

The increasing demand for sustainable nutrient recovery and sewage wastewater treatment has spurred the development of novel methods for extracting nutrients from effluents. While existing technologies primarily rely on chemical processes and substantial energy consumption to achieve effective nutrient recovery, this study explores the use of agricultural waste for this purpose. The primary objective is to recover nutrients from the effluent of anaerobically treated sewage wastewater. The experimental procedure was conducted in two stages: first, the treatment of sewage wastewater using a bio-electrochemical system, and second, the use of this effluent for nutrient recovery with an adsorbent derived from agricultural waste, specifically rice straw. In this process, hemicellulose was extracted from rice straw using an alkaline method and employed as an adsorbent for nutrient recovery. Three different doses of the adsorbent were tested (0.1 g, 0.5 g, and 1 g), with the highest absorption capacity observed at the 0.1 g dose. To analyse the functional changes in the adsorbent before and after nutrient recovery, Fourier Transform Infrared (FTIR) spectroscopy was utilized, along with Field Emission Scanning Electron Microscopy (FESEM) to examine elemental and morphological alterations on the surface of the adsorbent. Additionally, elemental analysis was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The residual liquid hydrolysate from the extracted hemicellulose was subsequently employed in experiments for hydrogen production.

Keywords: Bio-electrochemical; Wastewater; Hemicellulose; Nutrient; Adsorbent.

A Review on the Impact of Ethnobotany on Sustainable Development

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ABSTRACT

Ethnobotany is the study of human interaction with plants. It has multiple applications in different fields of current global concern including climate change, biodiversity conservation, food security and human health. Ethnobotanical studies have potential and offer a unique opportunity to integrate indigenous knowledge with scientific research ultimately contributing to the conservation of biodiversity and cultural diversity. In this paper plant diversity represents the development in ethnobotanical research and focuses on unlocking its potential to tackle human issues and shape a more sustainable future. Agenda 2030's Sustainable Development Goals (SDGs) present a comprehensive framework of 17 goals, centred on ensuring the prosperity of humanity and the health of the planet while promoting holistic development and sustainability. Of the seventeen goals, at least seven goals are of interest to the ethnobotanist and are associated with traditional ethnobotanical knowledge.

Keywords: Traditional Knowledge; Ethnobotany; Sustainable Development Goals.

Augmentation in Growth and Physiology of Eggplant (Solanum melongena) by the Agricultural Soil Radioactivity Assessment in the Vicinity of Jharli Thermal Power Plants, Haryana

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In India, lignite to sub-bituminous type coal is mostly used in coal-fired thermal power plants for the generation of electricity. Due to its characteristics, the fly ash produced by its combustion poses a possible harm to the environment. The environmental paths of the radionuclides from coal-fired power plants are highlighted. In the present study, specific activities of ^{238}U, ^{232}Th, and ^{40}K have been determined by means of gamma-ray spectroscopy. In total 16 agricultural soil samples were collected through concentric sampling from the

surrounding of Jharli Thermal Power Projects in Haryana. The values varied from 25.99Bq/kg to 89.47 Bq/kg, 25.15 Bq/kg to 11.88 Bq/kg and 12.23 Bq/kg to 2.06 Bq/kg for ^{40}K, ^{238}U and ^{232}Th respectively. The purpose of this research is to determine whether the long-term deposit of fly ash on the agricultural soil's surface has caused any excess radioactivity in the soil by comparing the results to the global background average. The obtained results of this study would be useful for making a baseline data of radioactivity level in agricultural soils of the study area.

Keywords: Fly ash; Coal-fired power plants; Radionuclides; Agricultural soil; Radioactivity

Analysis of Treatment Efficiency of Liquid Waste Management facilities in Rural Areas of District Kurukshetra, Haryana

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ABSTRACT

Solid and liquid waste management and its end-to-end solution are key concerns in systematic and sustainable Rural Sanitation practices. Creation of infrastructure as well as its proper functioning and ultilisation is equally important. The present paper analyzes the status of available infrastructure and treatment efficiencies of liquid waste treatment facilities (Waste Stabilization Ponds, Seechewala Model) in rural areas of Kurukshetra district. The performance efficiency was evaluated through a periodic sampling of 10 wastewater treatment facilities in 2024.Various parameters including. pH, EC, alkalinity, TDS, BOD, COD total hardness, sodium and potassium, total coliform and faecal coliform were measured for both inlet and treated outlet wastewater..The pH ranges from 6.84 at inlet to 8.42 at the outlet and remaining within the discharge standard of HSPCB. The treatment efficiency of EC (16.6%-30%), TDS (4.7%-29.5%), alkalinity (14.2%-40%) and total hardness (0.72%-30.2%) were recorded. The removal efficiency of BOD and COD was found (24.7%-79.8%)and (5.7%-78.5%) respectively. Whereas, for total coliform and faecal coliform was upto 33.3%. The concentration of sodium was also found within discharge limits. The study revealed that the discharge limits of most of treatment facilities for various parameters i.e. EC, hardness, BOD, COD and faecal coliform exceed than HSPCB standard for irrigation as well as non-potable uses. The low removal efficiency was attributed to the dumping of the solid waste directly into treatment units, the decaying of water hyacinth plants and low operation and maintenance. The efficiency of these facilities can be improved through

periodic desludging, proper repair and maintenance and screening of solid waste entering into treatment units.

Keywords: Waste management; Liquid waste treatment; Rural sanitation; Treatment efficiency; Waste Stabilization Ponds

Microplastics in Landfill Leachate, Soil and Groundwater: A Comprehensive Review

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ABSTRACT

In this comprehensive analysis of available literature, the poster elucidates the contributions of plastics in solid waste landfills in the contamination of the surroundings with microplastics. Leachate from municipal solid waste landfills serves as a significant source of microplastics, with seepage of these leachates and runoff from landfill sites posing a potential risk of microplastic pollution in both soil and groundwater. The review dwells on the advanced methodologies to effectively isolate microplastics from a variety of samples procured from leachate, soil, and groundwater. The review offers comprehensive insights into the dimensions, morphology, and composition of microplastics, thereby enhancing the understanding of their physical characteristics and potential ecological ramifications. The characterisation of microplastics is important and techniques such as Fourier-transform infrared spectroscopy and Raman spectroscopy utilized. This review provides critical insights into the dynamics of microplastics as emerging environmental contaminants. Furthermore, it broadens the discourse to highlight the extensive implications of microplastics on the global ecosystem, stressing the urgent need for interventions to address and mitigate their impact.

Keywords: Landfill; Microplastic; Pollutant; FTIR; Raman spectroscopy

Assessing the Effect of Fertilizers on the Germination and Growth Parameters of Cucumber through a Germination Bioassay

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ABSTRACT

As the population grows continuously, fulfilling the global demand for food necessitates sustainable agricultural practices. The effective utilization of fertilizers is essential in this endeavour, as they play a crucial role in agricultural productivity. Seed germination is a

crucial stage in the life cycle of a plant. To better understand the direct effect of fertilizers on germination it is essential to use methods like germination bioassay that eliminate the influence of external factors present in soil-based studies. This study investigated the effects of aqueous solutions of seven distinct fertilizers like Urea, DAP, N.P.K poultry, pond slurry, and farmyard manure and organomineral at four varying conc. (110, 220, 330, and 440 mg/L) on germination and growth parameters. Additionally, regression analysis was used to better understand the relationship between N.P.K. content and growth parameters. The most suitable fertilizer was organomineral at 330 mg/L, but mineral fertilizer concentrations over 220 mg/L exhibited inhibitory effects. This study indicates that increasing fertilizer doses for enhanced productivity may result in considerable losses owing to toxicity. Furthermore, combined fertilizers should be used as they provide balanced nutrients to plants, enhancing growth and productivity.

Keywords: Germination bioassay; Organic fertilizers; Seed Germination; Shoot length

EFFICIENCY OF A BES-COUPLED PERSULFATE SYSTEM IN THE TREATMENT OF INDUSTRIAL EFFLUENTS

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ABSTRACT

Refractory and bio-refractory organic pollutants pose significant challenges in water treatment, as they cannot be effectively degraded by conventional methods (Chaturvedi & Katoch, 2020). To enhance the degradation of organic contaminants in microbial electrochemical systems (MES), there is potential for integrating advanced oxidation processes (AOPs). AOPs have been shown to effectively degrade toxic and recalcitrant compounds in industrial wastewater (Garcia-Segura et al., 2018);(Neyens & Baeyens, 2003);(Nidheesh et al., 2021). This study investigates the enhanced treatment of industrial effluents using a sulfate-reducing bacteria (SRB)-based bio-electrochemical system (BES) in combination with persulfate (PS). A single-chamber microbial electrochemical cell (MEC)-based BES, operating in batch mode with a two-stage configuration, was used. In Stage I, SRB-based treatment was applied, while Stage II involved the integration of BES with a PS-based AOP. Results from Stage I (BES-150 mV) indicated a total organic carbon (TOC) reduction of 51.52%, whereas Stage II achieved an 83.14% reduction after the first cycle,

reflecting a significant 30-43% improvement in TOC reduction due to persulfate application. COD removal was more pronounced during the first two cycles of Stage II, with subsequent cycles showing a decreasing trend in both stages. Reactors with 300 mV and 450 mV potentials exhibited notable COD reductions. Additionally, ammonia (NH4+) levels increased after Stage I treatment but were reduced in Stage II. The integration of BES with persulfate oxidation not only enhances treatment efficiency but also holds promise for reducing operational costs, making this combined system a reliable option for industrial wastewater treatment.

Keywords: Advanced oxidation process, Sulfate-reducing bacteria; Bioelectrochemical system

Agricultural Waste Management in Haryana: Challenges, Policy Gaps and Solutions

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ABSTRACT

A discussion on the state of the economy in Haryana hinges primarily on the agrarian sector. Once viewed as the poster child for higher agricultural productivity bolstered by the green revolution, the deleterious effects of the same on soil quality, crop health, groundwater contamination, over-dependence on wheat and paddy, deterioration of biodiversity etc. have been widely reported. Placed against the backdrop of the environmental emergency, and Haryana's strategic national position both geographically and agriculturally, the state of agriculture in Haryana and its impact on the environment assume extraordinary importance. One such facet of this impact is on agricultural waste management in the state. The burning of crop residue in situ and its impact on air pollution has been widely covered in popular media and policy circles. This unilateral and inordinate focus, however, belies the need for a holistic assessment of agricultural waste management in the state and policy directions that can be undertaken to optimise the same. This paper attempts to fill this discussion gap. In addition to highlighting the key challenges in this regard, such as lack of awareness or economic incentives, insufficient technological and infrastructural support and financial constraints, the main thrust of this paper is on mitigating strategies. It espouses a circular economic model that can be effectively utilised to turn waste into fuel by transforming it into biofertilisers, biogas, and compost via capacity building and community-level solutions. Special emphasis is also placed on incorporating solutions reached through a multi-stakeholder analysis to make agricultural waste management in the state truly resilient.

Keywords: Agriculture, Green revolution, Agricultural Waste Management, Circular Economic Model, Multi-Stakeholder Analysis

Analysing Waste Disposal and Management Techniques: A Comparative Study between Engineered and Non-Engineered Landfill

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ABSTRACT

Efficient waste disposal and management is of prime importance approaching the growing environmental concerns and health hazards. With increasing population and urbanization, there is a huge increase in the volume of solid waste generated making it difficult to ensure sustainable waste management. Among all the practices going around landfills are considered as one of the prime and safest methods of waste disposal. These landfills are categorized as engineered and non-engineered based on their designed structures. From the four well-known landfills of Delhi, India we have selected two landfills for studying waste disposal and management i.e. Ghazipur Landfill (oldest and non-engineered landfill) and Narela-Bawana Landfill (latest and engineered landfill). Engineered landfills promise structured designs with proper environmental safeguards while non-engineered landfills work without a structured design and controls. This study focuses on the comparison of waste collection and disposal techniques employed in both landfill types along with the strengths and weaknesses of each system focussing on their efficiency and sustainable practices. During the study period waste segregation and flow from sources (houses) to sink (landfills) was observed for both landfills. Along with it total number of vehicles and assets deployed for waste management was recorded. Ghazipur Landfill being the oldest landfill of Delhi covers 28.32 hectares of area while Narela-Bawana Landfill covers 40.46 hectares of land. In comparison to the Ghazipur landfill, it was found that waste collection in the Narela-Bawana landfill is more effective and tries to follow the concept of waste segregation in the best way possible.

Keywords: Disposal; Landfill; Segregation; Sustainable; Waste

Potential Use of Agricultural Wastes to Attain Sustainable Development Goals (SDGs)

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ABSTRACT

Agriculture is the largest contributor of any resource sector, to the economy and also a large generator of waste materials which is now become a major concern. For agricultural sustainability as well as human food and health security, methods for their timely utilisation and valorisation must be developed immediately due to their inadequate or inadequate management. Crop residue, agro-industries, livestock, and aquaculture are some of the sources of agricultural waste. The most prevalent biopolymer, cellulose, makes up the majority of crop residue and agro-industrial waste. Lignin and hemicellulose (lignocellulosic biomass) are following in order. Since most agricultural waste is now burned or buried in soil, it pollutes the air, and water, and contributes to global warming. As a result, agricultural waste and its handling are a global problem. Crop leftovers have historically been utilised for a variety of purposes, including papermaking, animal feed, composting, roof thatching, matchsticks, soil mulching, combustion, and the preparation of biochar. To address the scarcity of fossil fuels, the effects of climate change, and environmental sustainability, lignocellulosic biomass can also be used as a sustainable source of biofuel (biodiesel, bioethanol, biogas, and biohydrogen) and bioenergy. Therefore, the bioeconomy could be impacted by the valorisation of lignocellulosic residues by generating value-added products such as industrial enzymes, organic acids, biofertilizers, biobricks, biocoal, bioplastics, paper, and biofuels. The circular bioeconomy-based agricultural waste management techniques covered in this study include "reduction," "reuse," and "recycling" of agricultural wastes in order to promote sustainable agriculture and reduce pollution in the environment.

Keywords: Agricultural waste, Biopolymer, Mulching, Sustainability, Bioeconomy

Biodegradation of Poultry Feathers using Bacillus cereus Isolated from Poultry Waste Dump Sites.

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ABSTRACT

Globally the poultry feather is considered the foremost waste material, which has become one of the major pollutants and gets accumulated in nature due to their abundance, high mechanical stability, recalcitrant nature and poor management. Poultry feathers fall in the category of keratinous waste rich in carbon, nitrogen, and amino acids and are made up of a 90% protein called ‘keratins’, which are cysteine-rich fibrous structural proteins. The keratin-

rich wastes are mainly landfilled in developing countries or burned as waste in power plant generators. However, these methods have several shortcomings as they are considerably costly and burning the waste releases harmful gases into the atmosphere. The microbial degradation of poultry feathers is an alternative for the development of protein supplements, animal feeds, nitrogen fertilizers, biofilms as well as plastics. The present study is focused on the isolation and characterization of keratin-degrading bacterial isolates. For carrying out the study, soil samples were collected from the poultry waste dumping sites and bacterial strains were isolated. The potential bacterial strain was identified as B. cereus by 16SrRNA gene sequencing and was used for the biodegradation of the poultry feathers. Different amendments of soil with poultry feathers (2.5, 5, 7.5, 10% w/w) were prepared in plastic bins. Each bin was treated with 10% (v/w) bacterial inoculum. After 30 days, it was observed that there was no visible feather degradation in the control as compared to the bacterial treatment, indicating that degradation is augmented by the addition of microbial culture. The results indicated that

for the effective degradation of keratin rich poultry feather, presence of specific bacterial isolate is required for enhancing degradation process.

Keywords: Biodegradation; Poultry waste; Keratinous waste; Bacillus cereus.

Agricultural residue as an Eco-Friendly Adsorbent for Nitrate Removal from Wastewater

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ABSTRACT

Water pollution poses a significant global challenge, which is mainly caused by the excessive release of organic and inorganic pollutants such as heavy metals, phosphates, nitrates, and synthetic chemicals. If left untreated, these contaminants damage aquatic ecosystems, eutrophicate water, and deteriorate water quality. Particularly problematic among the contaminants are phosphates and nitrates, whose amounts exceed CPCB guidelines and cause water contamination. Wastewater treatment plants (WWTPs) are a significant source of phosphate (PO_4^-) and nitrate (NO_3^-) in natural streams, even though they reduce nutrient concentrations. Thus, effective removal methods are necessary to deal with this issue.

Adsorption has emerged as a promising method for nutrient removal due to its simplicity, cost-effectiveness, and high efficiency. A carbon-rich, porous substance produced by the thermochemical breakdown of biomass, biochar has shown great promise as a sustainable and

eco-friendly adsorbent. Due to its availability and the environmental problems connected with its disposal, such as air pollution from burning, agricultural waste, particularly rice straw, makes an excellent precursor for biochar. Rice straw's effectiveness as an adsorbent material is increased and pollution is decreased when it is converted into biochar.

This study investigates the potential of rice straw biochar (RSB) and its modified form for nitrate removal from synthetic wastewater. Batch experiments were conducted to evaluate the effects of parameters such as pH, adsorbent dosage, and contact time on nitrate adsorption efficiency. According to the results, RSB is an effective option for nitrate removal because of its large surface area, well-developed pore structure, and cost-effectiveness, which is in accordance with green technology and environmental sustainability objectives. The study highlights the dual benefits of mitigating nitrate pollution while providing a sustainable solution for rice straw management, contributing to improved water quality and reduced environmental impact.

Keywords- Biochar, Rice straw, Nitrate removal, Eutrophication, Environmental sustainability

Removal of methylene blue dye from aqueous solution using zinc oxide nanoparticles

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ABSTRACT

Methylene blue (MB) dye is frequently employed in the chemical and textile industries which causes serious environmental risks due to its toxicity and water-soluble nature. In this work, zinc oxide nanoparticles (ZnO NPs), an effective and sustainable adsorbent, are used to remove methylene blue dye from aqueous solutions. ZnO NPs, which are distinguished by their high surface area were synthesised using the chemical precipitation method. The ZnO NPs were characterised via UV-visible spectroscopy, Zeta potential and FTIR techniques. The effects of pH, contact time, adsorbent dosage, temperature and Initial dye concentration on the efficacy of MB dye removal were assessed by batch adsorption studies. ZnO NPs found to have adsorption properties with dye removal efficiencies of over 83.24% under optimized conditions. Studies using adsorption isotherms showed that the adsorption process adhered to the Langmuir isotherm model indicating monolayer adsorption on a uniform surface. To provide sustainable water treatment options, this study emphasizes the potential

of ZnO nanoparticles as a suitable material for the remediation of wastewater contaminated with dyes.

Keywords: Adsorption; isotherm; methylene blue dye; nanoparticles; synthesis

Sustainable Practices in Handmade Paper Manufacturing Using Agricultural Waste

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ABSTRACT

The growing demand for sustainable and eco-friendly alternatives to conventional materials has spurred interest in handmade paper production using agricultural residues. This study explores the feasibility of utilizing agricultural by-products such as rice straw, rice husk and sugarcane bagasse as raw materials for handmade paper manufacturing. These residues are abundant, renewable, and often discarded as waste, making them an attractive resource for value-added applications. The process involves fiber extraction, pulping, and sheet formation, utilising traditional and minimally mechanized techniques to maintain sustainability. Chemical and mechanical properties of the resulting paper, including lignin content, kappa number, ash content, moisture content, tensile strength, GSM, porosity, burst index and water absorption, are analyzed. Results demonstrate that agricultural residues can produce handmade paper with comparable, if not superior, properties to traditional handmade paper derived from wood pulp or cotton rags. Additionally, the process offers significant environmental benefits, including waste reduction, lower energy consumption, and reduced reliance on raw fiber sources. This study highlights the potential of agricultural residues as a sustainable raw material for handmade paper production, promoting circular economy principles while providing an eco-friendly alternative to conventional paper. Future work may focus on scaling up production, optimizing chemical treatments, and exploring additional applications such as packaging and decorative papers. This study upgrades the concept of "from waste to wealth''.

Keywords: Sustainable, Eco-friendly, Renewable, Economy, Conventional, Waste.

The Impacts of Microplastics on Terrestrial Ecosystem and Some Sustainable Solutions to Manage Them

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ABSTRACT

Microplastics (MPs) are generally defined as plastic pollutants with particle sizes less than 5 mm and include fiber, film, particle, irregular debris, and other morphologies. Their pervasive presence in both terrestrial and aquatic ecosystems has become a pressing global concern. While MPs impacts on aquatic ecosystems are well documented, their potential effects on the terrestrial ecosystem are still unexplored. In soils, MPs disrupt physiochemical and biological properties, damaging nutrient cycling and aggravating future climate risks. The association with plants makes the issue more complicated since MPs can adsorb to the plant surface, agglomerate in the rhizosphere below the roots, get taken up and translocated through the plant tissue, providing a direct way for MPs to enter into the food chain, ultimately posing risks to the ecological environment and human health. Such interactions can negatively impact plant growth, nutrient uptake, and physiological processes, ultimately affecting crop productivity and ecosystem stability. In addition to analysing the challenges, there is a need for solutions to mitigate MPs pollution. Plants have been shown to interact with MPs via adsorption, aggregation, uptake, and translocation, leading to their potentiality of phytoextraction, rhizo-filtration, and rhizo-stabilization. Thus, addressing the impacts of MPs on plants and using plant-based strategies for remediation are crucial steps in developing sustainable solutions to manage MPs contamination in terrestrial ecosystems.

Keywords: Microplastics; Terrestrial Ecosystem; Plant-Based Remediation; Sustainable Solutions

Exploring the Potential of Waste Cooking Oil as a Source for Sustainable Soap Manufacturing

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ABSTRACT

The inappropriate disposal of millions of liters of waste cooking oil annually poses considerable environmental and infrastructural issues, such as water poisoning and obstructed sewage systems. This study reviews critically the current research to investigate the revolutionary potential of waste cooking oil as a sustainable resource for soap manufacturing. The proposed framework introduces an innovative approach to waste management that aligns with the principles of the circular economy. The paper conducts a thorough literature review

to emphasize improvements in soap-manufacturing technologies utilizing waste cooking oil while evaluating their environmental, economic, and social impacts. Significant findings highlight the advantages of waste cooking oil in soap manufacturing, such as its capacity to reduce environmental pollution, offer economical substitutes for commercial soaps, and encourage sustainable behaviours for homes and small enterprises. Soaps produced from waste cooking oil exhibit similar cleansing and foaming characteristics to traditional soaps, enhancing their market feasibility. However, challenges such as the effective collection of waste cooking oil, the standardization of purification methods, and the need for public awareness initiatives to promote consumer adoption continue to hinder widespread deployment. Moreover, the analysis highlights significant research deficiencies, notably the absence of thorough lifecycle assessments, necessitating additional studies to substantiate sustainability assertions. This study provides practical recommendations for incorporating waste cooking oil-to-soap programs into comprehensive waste management strategies, explicitly targeting homes and small-scale industries. Overcoming technological, logistical, and policy challenges highlights the potential of soap manufacture from waste cooking oil as a fundamental element of the circular economy. This assessment aids global initiatives for environmental sustainability and acts as a framework for creative waste-to-resource strategies.

Keywords: Waste Cooking Oil, Soap manufacturing, Waste Management, Disposal

Fluoride in Groundwater of Haryana, India

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ABSTRACT

Approximately 80% of domestic needs in rural areas and 50% in urban areas of India are met by groundwater and it is under threat from natural geogenic pollutants i.e. fluoride, arsenic, iron etc. According to UNICEF (1999), 65% of India's villages are exposed to fluoride risk. The most seriously affected areas are Andhra Pradesh, Bihar, Madhya Pradesh, Punjab, Haryana, Rajasthan, Gujarat, Tamil Nadu and Utter Pradesh. Haryana is one the moderately affected by fluoride contaminated ground water. In view of the same, present paper is an attempt to review fluoride content in groundwater of Sonepat and Panipat district of Haryana. The study is part of the major research project sanctioned by UGC, New Delhi. The fluoride

concentration in groundwater was determined using a Fluoride ion specific electrode (Orion 96-09 BNWP) fitted with an Orion Star A329 ISE Meter, USA. Moreover, more than 500 school children were examined for varying grade of fluorosis. The result revealed that the fluoride content of studied ground water samples was ranged from 0.65- 3.20 mg/l. The fluoride bearing minerals in the rocks and their interaction with water is considered to be the main cause for fluoride in groundwater. The surveys were carried out to determine the relative prevalence of fluorosis among school children and study showed that about 65% of surveyed students suffered from varying degrees of dental fluorosis. In the study area most of the water samples had higher concentrations of fluoride. It is thus largely through the drinking water that fluoride finds its way to the human body. After revealing the results, the residents of the area are advised to use surface water and groundwater should be treated before consumption and other domestic use. Furthermore, it is also suggested that routine monitoring of groundwater for drinking purposes in the study area should be carried out regularly.

Keywords: Groundwater, Dental, Fluoride, Fluorosis, Ion Selective Electrode.

Augmentation in growth and physiology of eggplant (Solanum melongena) by the utilization of chicken feather compost prepared using Bacillus cereus.

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ABSTRACT

Chicken feather compost, rich in organic matter and essential nutrients, can significantly enhance crop growth and physiological performance. This study evaluates the impact of chicken feather compost on Solanum melongena (Pusa Brinjal Long) growth under varying compost levels (6% and 12%). The optimized composting conditions, identified using Response Surface Methodology (RSM), included 6.25% chicken feathers and 12% Bacillus cereus inoculum. Results showed significant improvements in plant height, leaf area, biomass, flower and fruit production, chlorophyll content, and physiological processes with compost treatments compared to the control. The 12% compost treatment resulted in 23.2% taller plants at 40 DAT and 15.9% taller plants at 75 DAT compared to the control. Leaf area increased by 7.91%, while total chlorophyll content rose by 45.3% in the 12% compost group relative to the control. Physiological measurements indicated a 43% higher photosynthetic rate and a 79.1% reduction in respiration rate in the 12% compost group compared to the

control, reflecting improved metabolic efficiency. Shoot fresh weight and dry weight were 7.65% and 47.3% higher in the 12% compost group, while root fresh weight increased by 40% and root dry weight by 85.6%. The total fruit yield in the 12% compost group was 627.4% higher than the control. These findings highlight the effectiveness of chicken feather compost as an organic amendment for enhancing plant growth, yield, and physiological performance. This research underscores the potential of repurposing poultry waste into nutrient-rich compost, promoting sustainable agricultural practices while addressing waste management challenges.

Keywords: Chicken feather, Compost, Solanum melongena, Bacillus cereus.

Sustainable Utilization of Agricultural Waste of Corn Silk in Food Production: Nutritional and Sensory Properties

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ABSTRACT

Background Corn silk, thread-like fibres, a major byproduct of corn processing, is often discarded as agriculture waste. Being rich in pharmacological properties such as anti-fatigue, anti-inflammatory, anti-diabetic and anti-oxidant properties, it can be utilized as a very sustainable, nutritious, and therapeutic ingredient in food production. **Objectives** This study aims to utilize Corn silk flour in food production by evaluating its physicochemical and sensorial properties. **Methodology C**ookies were formulated by incorporating corn silk flour in varying proportions (2%, 5%, and 8%) and assessed the nutritional profile and sensory attributes. **Results** As per sensory evaluation scores, corn silk flour-enriched cookies were very well accepted regarding taste and texture profile. Further nutrient analysis of developed enriched cookies revealed significant nutrient profiles. **Conclusion** Overall, the findings suggest that corn silk flour can be a valuable, sustainable ingredient for enhancing the nutritional content of food products promoting both food security and environmental sustainability.

Keywords: Corn silk flour; agriculture waste; utilization; cookies; nutritional

Production and Characterization of Bacterial nanocellulose by Gluconacetobacter kombuchae by Utilizing Rice Straw Hydrolysate as Nutrient Media

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ABSTRACT

The purpose of the study is to investigate the potential of rice straw as an alternative low-cost nutrient source, to produce bacterial nanocellulose (BNC) instead of using a costly commercial medium. Bacterial nanocellulose was produced using rice straw hydrolysate as a carbon source replacement in the standard Hestrin–Shramm (HS) medium. The BC films were evaluated for their productivity. The BC films were also investigated for their morphology using scanning electron microscopy (SEM), their crystallinity using X-ray diffraction (XRD) analysis, and their chemical composition using Fourier-transform infrared spectroscopy (FTIR). Rice straw hydrolysate proved to be an excellent carbon substitute as the production of BNC and its morphological and biochemical characteristics were also comparable to the bacterial cellulose produced using a standard HS medium.

Keywords: Bacterial nanocellulose; rice straw; low cost; characterisation; media

Synthesis and Characterisation of Green Copper Oxide Nanoparticles from E-waste and Plant Extract

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ABSTRACT

The electronics industry exhibits the highest global growth rate, yet waste generation is an emerging concern. The recycling of waste is essential as it preserves the Earth's natural resources. Various ways exists for recycling electronic trash, encompassing chemical, physical, biological, and mechanical processes. Nanotechnology refers to an emerging scientific field focused on the development of various nanomaterials as well as minimizing waste. This study utilizes a biological method to synthesis nanoparticles from electronic waste, as it represents an environmentally sustainable approach. The copper oxide nanoparticle was prepared from copper derived electronic waste and biologically reduced using Albizia lebbeck leaf extract. Nano-sized copper oxide particles (CuO) were synthesized from the bio-hydrometallurgical leachate of electronic trash (e-waste) utilizing

both chemical and environmentally friendly methods. Nano particles are characterized on basis of FTIR, XRD, SEM, and EDX. FT-IR spectroscopy examination revealed the presence of carbonyl groups, phenolics, and other reducing agents in the examined extract. SEM examination revealed variability in the size and form distribution of the nanoparticles. The particles' purity was confirmed by EDX analysis, which indicated the presence of elemental copper oxide. The crystalline characteristics of the nanoparticles were validated by XRD patterns and the measurement of crystallite size.

Keywords: E-waste; Nanoparticles; Biosynthesis; Copper Oxide; Characterization.

Isotherm, Kinetic, and Thermodynamic Analysis of Methylene Blue Dye Adsorption on Agricultural Waste-Derived Biochar.

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ABSTRACT

Dye contamination from industrial effluents poses significant environmental and health challenges due to the persistent and toxic nature of synthetic dyes. This work investigates the potential of biochar produced from water hyacinth and banana peel, as environmentally acceptable and cost-effective adsorbents for dye removal from aqueous solutions. Pyrolysis was used to create the biochar, which was then analyzed utilizing the batch adsorption technique with factors such as pH, initial dye concentration, biochar dose, contact time and temperature. Adsorption isotherms (Langmuir, Freundlich, and Temkin), kinetics models (pseudo-first-order, pseudo-second-order, and intraparticle diffusion), and thermodynamic analyses (using the Van't Hoff equation and Gibbs free energy) were used for completely understanding the adsorption mechanism. To validate the models advanced error analyses such as hybrid error analysis, MPSD, ARE, and chi-square are used.

The results showed that the Freundlich model provided the best fit for banana peel and water hyacinth biochar, indicating heterogeneous surface adsorption. The Pseudo-Second-Order kinetic model best represented the adsorption of methylene blue on water hyacinth and banana peel biochars, revealing chemisorption as the major process with excellent fits. Thermodynamic investigation verified endothermic and entropy-driven adsorption, with negative ΔG values indicating spontaneity These studies demonstrate the efficacy of unmodified biochars in methylene blue adsorption, providing long-term options for wastewater treatment.

Keywords: Biochar Adsorption; Methylene Blue Removal; Isotherm and Kinetic Models; Thermodynamic Analysis

Analysis of groundwater in Malakpur village of Kurukshetra, Haryana, India

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ABSTRACT

The groundwater quality assessment of the village Malakpur in Kurukshetra, Haryana was carried out by collecting 10 samples from different houses to estimate the groundwater quality through physico-chemical parameters in the post-monsoon season of 2022. Water quality parameters including temperature, pH, EC, total dissolved solids (TDS), turbidity, and dissolved oxygen were analyzed using standard methods. Results showed that the range of pH ranged from 7.1– 8.3, (8.05±0.3), temp 18.47-23.07^{0}C (22.18±1.10), TDS 526-790 mg/l, (673±88.2), EC 867-1301 µS cm-^{1} (1112 ± 144.44), Turbidity 0.02-0.26 NTU (0.14 ±0.06), Bicarbonate ion 52.7-140.2 mg/l (113.1 ±22.49) and dissolve oxygen 4 - 4.4 mg/l (4±0.14). All the parameters were below the WHO (2012) permissible limit for drinking water.

Keywords: Groundwater, Water quality, Permissible limit, WHO (2012).

Application of Copper Nanoparticles in the Photocatalytic Degradation of Water pollutants

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ABSTRACT

The aqueous extract of Punica granatum peel has been utilized as an effective reducing and stabilizing agent to synthesize copper nanoparticles (CuNPs) via a green approach. The physical properties of the nanoparticles were examined using UV–visible, Fourier transform infrared spectroscopy (FTIR), and Scanning electron microscopy (SEM) with energy dispersive X-ray analysis (EDX). UV–visible and FTIR analysis were used to find the presence of bioactive molecules which are responsible for the reduction and stabilization of CuNPs. The SEM and zeta analysis confirmed the average crystallite size was 10-50nm and exhibited a tubular structure. EDX analysis shows the presence of copper, oxygen, and chlorine elements. The functional groups present were alcohols, carboxylic acids, amines, and phenyl groups which are responsible for the reduction of copper into copper

nanoparticles. Furthermore, the photocatalytic capability of green synthesized CuNPs was employed to investigate the methylene blue degradation under solar irradiation. Photo-catalytic activity (PCA) of the synthesized NPs was evaluated by degrading the dye and a degradation of 98% was achieved (dye conc. 5, 10, and 15ppm) using 0.5 g, 0.10g and 0.15g CuNps after 180 min of irradiation time.

Keywords: Copper nanoparticles; *Punica granatum*; Methylene blue dye; Degradation.

Exploring Monoterpene β-Pinene as a Novel Approach for the Mitigation of Arsenic Toxicity in Plants

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ABSTRACT

Arsenic (As), classified as a metalloid element, is well known for its carcinogenicity and other toxic effects. Industrial activities, unregulated use of chemical fertilizers and the usage of contaminated water for irrigation have mainly contributed towards its introduction to the soil environment and groundwater, rendering it a significant threat to agricultural sustainability. Arsenic exposure in crop plants results in the alteration of their physiochemical and biological properties along with a consequent reduction in their yield. The conventional/advanced technologies used for its detoxification in the soil, are either too costly, time-consuming and/or generate hazardous wastes. Accordingly, researchers tend to explore novel, environment-friendly and cost-effective natural products for this purpose.

Pinenes (α- and β-), the most abundant monoterpenes in the atmosphere and soil, are involved in a multitude of ecological roles in the soil environment. Although these volatile/essential oil components are allelopathic in nature, they are also well known for protecting against oxidative damage induced by abiotic stress. Despite this, not many studies have been undertaken to investigate their potential in amelioration of heavy metal toxicity, particularly Arsenic. In the present study, the effect of exogenously supplied β-pinene was determined on the early growth of hydroponically grown Oryza sativa plants. β pinene alone (2.5-25 nl/cc) significantly reduced its early growth (measured in terms of root and shoot length and seedling dry weight) in a dose-dependent manner. Later, the comparative effect of β-pinene against Arsenic (As)-induced oxidative damage in roots of O. sativa was examined by providing it alone and in combination with Arsenic. Effect of As (50 μM), β-pinene (10 μM; β-10) and As + β-10 treatments on root length, shoot length, lipid peroxidation (as

malondialdehyde content), hydrogen peroxide accumulation, and activities of lipoxygenase was determined. Significant decline in As-induced oxidative stress by β-pinene supplementation was observed, at certain low concentrations.

Keywords: β-Pinene; Arsenic Toxicity Mitigation; Oxidative Stress Reduction; Rice (Oryza sativa) Growth

Formation of Vermicompost using Earthworms from agricultural and animal fecal wastes

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ABSTRACT

Earthworm species play an important role in the breakdown of organic matter and the release of the nutrients that it contains has been known for a long time. Some species of earthworms are specialized to live specifically in decaying organic matter and can degrade it into fine particulate materials, rich in available nutrients, with considerable commercial potential as plant growth media soil amendment. Biodiversity is responsible for the furnishing of many ecosystem services; human well-being is based on these services and in consequence on biodiversity. Earthworms are an important soil taxon as ecosystem engineers, used in different crucial ecosystem functions and services. Vermicomposting is composed of organic waste transformed through the different earthworm species' digestive systems into a homogeneous product of high nutritional value and with great possibilities for its application in agriculture. The different species of earthworms are used for the production a higher concentration of nutrients containing vermicompost through the biological activity of these worms, which might be compared to traditional composting and allow the reuse of residues of low fertilization potential. Starting from the same raw material, the increase in the concentration of P, K, and Ca-containing products obtained from the earthworm species can be used in crops with high nutritional requirements. Earthworms can remove toxic organic compounds that may present problems in traditional composting systems, being effective in the recovery of degraded agricultural soils with decreased nutrient reservoirs. Moreover, being a pathogen-free end product and the high percentage of nutrients in available forms makes compost extensively used in horticulture or extensive crops, both in cereals and legumes that increase the productivity of the crops and reduce the use of fertilizers that are very harmful in the food chain.

Keywords: Vermicomposting; Earthworm Species; Nutrient-Rich Organic Waste Recycling; Sustainable Soil Fertilization

Characterization of Flue Gas Desulphurized (FGD) Gypsum and Risk Assessment of Potential Toxic Elements.

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ABSTRACT

Coal is one of the major sources of energy for power generation in the world. The burning of coal releases many harmful gases (SOx, NOx), particulate matter, and heavy metals (HMs) into the environment which adversely affect human health. Thermal Power Plant generates FGD (Flue gas desulphurised gypsum) as by-product during coal combustion. This study evaluates the characterization, potentially toxic elements (PTEs) distribution, and environmental risk assessment of FGD gypsum for safe and sustainable use in agriculture. The XRD and SEM analysis confirmed the dominance of crystalline $CaSO_4 \cdot 2H_2O$ in FGD gypsum. The order of concentrations of PTEs in FGD gypsum was Fe >Al > Mn > Zn >Ni > Co. The residual fraction was the dominant pool, sharing 80–90% of the total PTEs. The heavy metals (HMs) were below the toxic range in the leachates. The Co, Ni, Al, Fe Mn, Zn had low (<10%) risk assessment code and the ecotoxicity was in the range of 0.0–7.46%. The contamination factor was also low (0.0–0.16) at the normal recommended doses of FGD gypsum application for sodicity reclamation. The enrichment factor was in the order of Al<Mn<Co<Zn<Ni. Mn [enrichment factor (Ef) 1.2–2.0] and Co (Ef 1.7–2.8) showed negligible enrichment of metals, whereas Ni (Ef 4.3–5.2) and Zn (Ef 4.5–5.6) reported moderate accumulation in soil. The application of FGD gypsum for sodicity reclamation will develop a geo-accumulation index below the critical values indicating its safe and sustainable use to achieve land degradation neutrality (LDN) and UN's Sustainable Development Goals.

Keywords: FGD Gypsum Characterization; Potentially Toxic Elements (PTEs); Environmental Risk Assessment; Sustainable Agriculture Application

Influence of Wood Apple Shell Fillers on the Mechanical Properties of Sugarcane Bagasse Fiber Epoxy Composites

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ABSTRACT

Sugarcane bagasse fibre is a residue of a sugarcane milling process. In this research, bagasse fibre and wood apple shell filler have been used as reinforcing components for

the resin to open up further possibilities in waste management. The chemical treatments using 0.5 N sodium hydroxide were carried out to modify the fibre properties. The effect of filler on the composite properties was investigated. At different filler loadings (5%,10% 15%), composites show different mechanical properties compared to those of neat composites. From mechanical properties, it was observed that the 10% filler-loading composite indicates higher mechanical properties compared to those of 5% and 15% filler-loading composites. Bagasse fibre-reinforced composites are becoming more popular in several applications because they contain features that are similar to those present in conventional materials due to its abundant supply, affordable price, and good chemical and mechanical characteristics.

Keywords: Sugarcane bagasse; Composite; Filler; Mechanical; Wood apple shell

From Waste to Wealth: Microalgae-driven Solutions for Sustainable Development

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ABSTRACT

According to the World Health Organization, approximately 3.4 million individuals perish annually, with countless others afflicted by numerous waterborne illnesses globally. The primary cause of this problem is the careless discharge of contaminated water from various industries and even from air sources that fail to meet stringent regulatory requirements. Effluents containing high concentrations of nutrients such as nitrates and phosphates, along with toxic metals, contribute to the depletion of scarce freshwater resources and promote eutrophication. This issue can be effectively addressed by incorporating microalgae into wastewater treatment processes. These photosynthetic organisms utilize carbon dioxide from the atmosphere and generate oxygen, which supports the growth of sludge bacteria. Algae can absorb urea, phosphates, and heavy metals like magnesium, zinc, lead, cadmium, and arsenic for their growth, while also aiding in the reduction of BOD and COD levels and eliminating coliform bacteria from sewage water. The resulting biomass can be transformed into valuable products, including biofuel, feed, biofertilizers, bioplastics, and exopolysaccharides. Consequently, microalgae serve as a life-giving elixir and can contribute to achieving sustainable development objectives.

Keywords: Microalgae; Waterborne Illnesses; Eutrophication; Nutrient Removal; Sustainable Development

Sustainable Routes for Recycling of Waste Plastic and its Composites

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ABSTRACT

In today's scenario, the production and consumption of plastics derived from nonbiodegradable petroleum resources are creating new challenges. The demand for plastics has increased immensely due to low cost and easy processing. However, accumulation of discarded plastic waste results in landfill and several ecological problems. Over the last two decades, recycling of these accumulated plastics has grown tremendously. It involves primary, secondary, tertiary, and quaternary recycling. Primary and secondary recycling refer to mechanical recycling while tertiary to chemical and quaternary to energy recovery processes. Mechanical recycling deteriorates several properties and the melt viscosity increases after many recycling steps. Thereby, the most prospective alternative for converting waste into useful products is the preparation of composites using different techniques. This chapter highlights the various recycling processes and recent advanced strategies to prepare composites for the efficient use of waste plastics. Furthermore, various physicomechanical properties of the recycled plastics composites reinforced with natural fillers are also discussed. Natural fibers such as bagasse, hemp, sisal, pineapple, corn husk, rice husk, banana, oil palm, jute, kenaf, bamboo, etc. have been employed to enhance several properties of recycled plastics. It has received considerable attention owing to smooth processing, renewability, low cost, easy availability, etc. Additionally, it also provides a sustainable pathway for the efficient use of waste agriculture biomass produced every year.

Keywords: Recycling, Plastics, Composites, Natural Fiber, Mechanical Properties

Waste Management in The Circular Economy

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ABSTRACT

Waste management and the circular economy are critical components in addressing global environmental and economic challenges. Traditional linear economic models, which rely on a "take-make-dispose" approach, contribute significantly to resource depletion and environmental degradation. Conversely, the circular economy emphasizes resource efficiency

by designing out waste, extending the lifecycle of materials, and fostering reuse, recycling, and regeneration. This abstract explores the intersection of waste management practices and circular economic principles, highlighting innovative strategies such as waste characterization and segregation, transforming waste into resources, and adopting decentralized waste systems. It addresses the impact of waste management on environmental pollution, emphasizing solutions for pollution control and sustainable practices. Special attention is given to agriculture and organic waste management, showcasing techniques for composting, bioenergy production, and soil enrichment. Case studies from various sectors demonstrate the effectiveness of these approaches in reducing waste generation, enhancing resource recovery, and minimizing environmental footprints. Key focus areas include technological advancements in recycling, policies promoting producer responsibility, and community-driven initiatives that integrate social, economic, and environmental benefits. The study underscores the importance of collaboration among governments, industries, and individuals in creating a sustainable waste management system. It also examines challenges such as infrastructure gaps, financial barriers, and behavioural resistance, offering actionable recommendations to overcome these hurdles. By aligning waste management with circular economy practices, this research advocates for a shift toward sustainability, enabling long-term ecological balance and economic resilience. The findings provide a roadmap for policymakers, practitioners, and researchers seeking to implement effective and equitable solutions to global waste crises.

Keywords: Waste characterization; resource recovery; decentralized systems; economic resilience

Effect of Biochar Amendment on Ammoniacal and Nitrate Nitrogen Contents of the Soil

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ABSTRACT

Predominant inorganic forms of nitrogen in soil exist as Ammoniacal-Nitrogen (NH_4^+-N) and Nitrate-Nitrogen (NO_3^--N). NO_3^--N is essential for plant growth and at the same time detrimental to human and environmental health when present in high concentrations.

Nitrate, leaching from soil or the fertilizers or any other source, can lead to groundwater contamination and eutrophication, while high levels in humans can cause methemoglobinemia. Similarly, excessive NH_4^+-N can lead to plant toxicity and aquatic

ecosystem disruption through runoff. The study explores the effects of addition of biochar to mitigate these issues by stabilizing nitrogen in the soil, thus preventing leaching and improving soil health. The present study investigates the impact of biochar, derived from agricultural residues, on the levels of NH_4^+-N and NO_3^--N in the soil over a 28-day incubation period.

Biochar produced from rice straw was amended with urea in different soil treatments. Results showed that soil pH fluctuated throughout the incubation due to the alkaline nature of biochar and microbial activity. NH_4^+-N concentrations increased during the initial 14 days and then started decreasing due to re-adsorption on the biochar surface. In contrast, NO_3^--N concentrations steadily rose over the 28-day period due to nitrification of available ammonium ions. These findings suggest that biochar can enhance nitrogen availability and nitrification initially, but over time, its adsorptive properties and microbial interactions help stabilize nitrogen levels. The present study highlights the potential of biochar as a sustainable agricultural practice to manage soil nitrogen dynamics, mitigate groundwater contamination, and reduce the environmental impact of agricultural residue burning.

Further long-term research is recommended to optimize biochar use for improved soil health and environmental protection.

Keywords: Biochar, Eutrophication, Nitrification

Ultrasound and Surfactant assisted Ionic liquid Pretreatment of Sugarcane bagasse for enhancing Saccharification using Xylano-pectino-cellulolytic Enzymes

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ABSTRACT

Ionic liquid (IL) pretreatment represents an effective strategy for effective fractionation of lignocellulosic bio-mass to fermentable sugars in a biorefinery. Optimization of combinatorial pretreatment of sugarcane bagasse (SCB) with ultrasound assisted IL (1-butyl-3-methylimidazolium chloride [Bmim]Cl) and surfactant (PEG-8000) resulted in enhanced sugar yield upon enzymatic saccharification. The saccharification enzymes (xylanase, pectinase and cellulase) used in the current study were produced from *Bacillus pumilus*. Enzyme saccharification was found to be best at enzyme dose in the ratio of 30:9:30 of xylanase: pectinase: cellulase, temperature 50°C, time period 60h and stirring speed 40 rpm resulting in production of maximum reducing sugar of value 258 mg/g. To get the mechanistic insights of combinatorial pretreatment physicochemical analysis of variously

pretreated biomass was executed using SEM, FT-IR and XRD. The combined action of IL, surfactant and ultrasound had very severe and distinct effects on the ultrastructure of biomass that subsequently resulted in enhanced accessibility of saccharification enzymes to biomass, and increased sugar yield.

Keywords: Ionic Liquid Pretreatment, Lignocellulosic Biomass, Enzymatic Saccharification, Sugarcane Bagasse, Biorefinery

THEME -4

Strategies for a Sustainable Environment

Evaluating Drinking Water Quality in Schools in Kurukshetra, Haryana, India

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ABSTRACT

In India, access to potable water is considered a fundamental right and is essential for achieving sustainable development objectives. This investigation assesses the quality of drinking water in both public and private schools within the Kurukshetra district of Haryana, India. The primary source of drinking water in this region is groundwater, which is utilized for daily consumption and meal preparation in schools. Ensuring students have access to safe drinking water is critical for their health and nutrition, given the substantial time they spend in educational settings. Water samples were collected from 25 schools during three distinct periods: pre-monsoon, monsoon, and post-monsoon seasons. These samples were analyzed for 14 groundwater quality parameters, including tests for bacterial presence. The concentration of major ions followed this sequence: $HCO_3^->Cl^->SO_4^{2-}$, $Ca^{2+}>Mg^{2+}$, $Na^+>K^+$. The Water Quality Index (WQI) values ranged from 23.12 to 69.99 in the pre-monsoon period, 22.72 to 94.30 during the monsoon, and 43.76 to 96.57 in the post-monsoon season. The majority of samples were classified as "good" to "excellent," indicating their suitability for drinking and household use. The results of bacteriological analysis revealed that the POM season had the highest count of total coliforms, followed by the MON and PRM season, and the PRM season had the lowest total coliform count. These findings suggest that the groundwater in the school is generally safe for consumption. Nevertheless, the implementation of a continuous monitoring program is recommended to mitigate potential future contamination of groundwater resources.

Keywords: Drinking water quality assessment, Children, SDG6, Monitoring, Health

Optimization of Pulping Conditions of Indigenous Brown Alga for Eco-friendly Sheet Making

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ABSTRACT

The global consumption of paper is rising at an alarming rate and in order to meet these demands finding raw materials other than wood sources has become a basic necessity. Present work illustrates the feasibility of using brown alga as a new raw material of alternative fiber source for papermaking. Utilization of alga into different value added products can lessen the environmental burden laid down due to massive algal growth and also increases its commercial value. Thus, present study deals with exploring indigenous wild brown marine alga for paper making. Since paper from alga can be produced without the need of extensive chemical treatments as compared to wood, mild treatments were given to obtain pulp. A simple autoclave was used instead of pulp digester for the pulping of brown alga. Extraction of algal pulp was also done by using varying dosage of alkali and acid during autoclaving. The acid and alkali extracted pulps were refined also to evaluate their sheet making ability. Optimization of extraction process revealed alkali treatment as a suitable step in terms of pulp yield and sheet forming ability. However, the alkali extracted pulp was refined in 4 steps sequential refining at 500 revolutions per minute in PFI mill. The results showed that brown algal pulp can be served as potent alternative raw material source for papermaking.

Keywords: Brown algae, Pulping, Refining, Papermaking

Investigating the Hydrogeochemical Seasonal Variability, Groundwater Quality, and Corrosion-Scaling Impacts: A Case Study of Southern Region of Delhi, India

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ABSTRACT

Groundwater is the most relied source of freshwater in the unplanned areas of southern region of NCT of Delhi. The present study envisions to evaluate the seasonal variability of the hydrogeochemical and qualitative nature of the groundwater, where its suitability was further checked through groundwater quality index (GWQI) and water stability indices for corrosion-scaling effects. About 12 physiochemical parameters were analysed with a total number of

102 samples in pre-monsoon (PRM) and post-monsoon (POM) seasons. Spatially, higher ranges of the quality parameters viz., EC, TDS, HCO_3^-, Cl^-, NO_3^-, F^-, Ca^{2+}, and Mg^{2+} were observed in both the seasons particularly in north, northeastern, and southeastern parts and has nearest dumping or industrial units such as printing, trade and textile effluent, food, and fruit processing industry etc. The hydrogeochemical characteristics of the groundwater showed that regulating processes is predominant by carbonate weathering process followed by silicate weathering under alluvial plains of the study area. Strong correlations and positive loadings (>0.8) among EC, TDS, HCO_3^-, Cl^-, Na^+, and moderate loadings of F^-, potassium (K^+), and Mg^{2+} were attributed to mixed pollution factors released from geogenic and anthropogenic inputs. GWQI based classification showed that more than 50% of the sampling sites showed poor to unsuitable groundwater quality at sites like Malviya Nagar, Okhla, Jasola, Shaheen Bagh, Badarpur and Greater Kailash for potability. The entire area is prone to ground water contamination, particularly northeastern, and southeastern region, falls under Yamuna flood and alluvial plains with shallower groundwater table. Water stability indices (LSI, RSI, PSI, LS, and AI) based corrosion- scaling effects have revealed that groundwater samples in PRM showed low to insignificant scaling and corrosive potential compared to POM season. Therefore, the findings of the study highlight the key areas that needs to formulate the strategies to sustain the quality of groundwater within the region.

Keywords: Groundwater, hydrogeochemical, Delhi, seasonal variability

A Study of Environmental Sustenance in Ancient Indian Culture

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ABSTRACT

India has an ancient tradition of protecting the environment. Most ancient texts teach us that it is the Dharma of everyone in any society to protect nature. This is why people have always worshipped the objects of nature. Environmental degradation due to deforestation, siltation, air, land, insanitation, water, and noise pollution all pose a grave threat not only to the quality of human life but also to its basic survival. In this context, there are many components in Indian culture related to environmental conservation, such as considering trees as sacred, revering the Peepal tree, worshipping the Banyan tree, treating water, air, fire, etc. as deities and maintaining their sanctity through rituals, and so on. Hinduism, which upholds the eternal culture, emphasizes the nurturing and preservation of water sources,

plants, animals, and all forms of life in its texts like the Ramayana, Puranas, Vedas, Upanishads, Mahabharata, etc. Acts like "having compassion for living beings," worshipping nature, and revering life sustaining plants have been integral parts of our culture. The Yajnavalkya Smriti prescribes punishment for cutting trees. The Indus-Saraswati civilization mentions urban planning, forts, cleanliness, and the worship of trees and plants. Even in the Vedic civilization, continuous environmental consciousness is evident. The queen of forests, "Aranyani," is revered by Vedic sages. The Yajurveda forbids cutting trees. The Earth is considered like a mother, nourishing all, and it is our duty to protect it as her child. Tulsidas even stated, “The earth, water, fire, sky, and wind are the five elements that make up this degraded body,” highlighting their importance for human health. In summary, nature is our life force, and preserving and nurturing it is our ultimate responsibility. However, in our pursuit of material development driven by science, we have neglected this reality, leading to the onset of natural disasters and a crisis for human life. This research paper reviews the excellent historical facts of environmental conservation, which have been integral to Indian culture and people's lives. Using historical methodology and secondary data, an exploratory research approach was adopted for this study.

Keywords: Environmental Sustenance, Indian Culture, Ramayan, Vedas, Mahabharat etc.

Groundwater Quality Assessment in the Vicinity of Karnal Landfill Site, Haryana, India

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ABSTRACT

Solid waste is one of the biggest challenge for most of developing countries including, India. Several policies, plans, strategies have been developed in the field of solid waste management (SWM). Open dumping, landfilling and incineration are the three main practices for solid waste disposal in our country. The groundwater quality in the vicinity of Karnal landfill site was assessed by collecting samples in relation to landfill site distance and water depth in pre-monsoon and post-monsoon seasons during May and November, 2021. Physiochemical parameters like temperature, pH, electrical conductivity, total dissolved solids, total hardness, chloride, calcium, magnesium, bicarbonates, sodium, sulphates, fluoride, phosphates, and nitrates were analysed using standard methods. Results showed that total hardness, fluoride, nitrate, magnesium ion, bicarbonates were above the permissible limits as prescribed by World Health Organisation (2011). It was observed that groundwater

from the boreholes located within or less than 600 m away from main landfill site were more contaminated than from the borehole water located at a distance of 1500 m. The findings of this study contribute to the achievement of the United Nations 2030 Agenda of Sustainable Development Goals (SDGs), specifically SDG-6 to ensure availability and sustainable management of water and sanitation for all.

Keywords: Municipal solid waste, Landfill, Water quality; Physiochemical parameters, WHO standards

Utilizing Bacterial Laccases for Azo Dye Degradation: Innovations in Environmental Sustainability and Industrial Applications

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ABSTRACT

Azo dyes released by the textile industries cause severe damage to the environment and living organisms. The degradation of azo dyes is widely studied using enzymatic methods. Laccase is a copper-containing enzyme that degrades the azo dyes into less toxic compounds. Laccases are found in a variety of organisms, including bacteria, fungi, insects, and plants, and they exhibit a high degree of substrate specificity. These enzymes can be produced by bacteria either inside or outside of their cells and are known for their stability across a broad range of pH levels and temperatures. This makes them suitable for numerous industrial applications, including the food, textile, and paper and pulp industries. Additionally, they hold significant potential for the production of biofuels, pharmaceuticals, biosensors, and the breakdown of various environmental pollutants and xenobiotic compounds. Given that bacterial laccases are more adaptable in terms of nutritional requirements and ecological conditions, they offer promising solutions to various challenges in industry and biotechnology.

Keywords: Azo dye, environment, laccases, pollutants, industrial application.

Biogenic Synthesis and Multifunctional Applications of Zinc Oxide Nanoparticles: Antibacterial, Antifungal, and Antioxidant Properties

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ABSTRACT

The growing demand for effective antibacterial agents, along with the potential of nanotechnology in treatments and diagnostics, has spurred research into the environmentally friendly synthesis of zinc oxide nanoparticles (ZnONPs). This study focused on the antibacterial, antifungal, and antioxidant properties of biologically synthesized ZnONPs. Isolated bacteria was employed for the biogenesis of these nanoparticles, which were characterized using multiple techniques, including UV-visible spectroscopy, X-ray diffraction (XRD), high-resolution transmission electron microscopy (HR-TEM), zeta potential analysis, scanning electron microscopy (SEM), energy-dispersive X-ray analysis (EDX), and Fourier-transform infrared spectroscopy (FTIR). The synthesized ZnONPs demonstrated consistent size, environmental compatibility, biocompatibility, ease of processing, and stability. Their potential biological applications include plant growth promotion, nano-pesticide encapsulation, antibacterial and antifungal activities, antioxidant properties, and cytotoxicity studies.

Keywords: Nanoparticles, FTIR, biogenesis, antioxidant properties

Role of PGPR in Sustainable Agricultural Development Under Drought Stress Condition

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ABSTRACT

Drought is one of the major constrictions on agricultural productivity and food security. Drought stress significantly reduced the expression of photosynthetic pigments and water relation parameters. Several adaptations and mitigation strategies are required to cope with drought stress. Plant growth promoting rhizobacteria (PGPR) play an important role in mitigation of drought stress in plants. PGPR used as an inexpensive and environmental friendly approach. These bacteria associated with rhizosphere of the plant root and found to be beneficial for plant. These rhizobacteria has a number of mechanisms through which they promote plant growth and induce resistance to various abiotic stresses. PGPRs induced tolerance to plants towards drought stress through a variety of mechanisms like improvement

of antioxidant system, production of ACC- deaminase and phytohormones, nitrogen fixation, phosphate solubilization, siderophore and exopolysaccharides production, enhanced root and shoot system, amplified photosynthesis rates and carotenoid production. It offers promising solutions to various challenges in agriculture and sustainable development.

Keywords: PGPR, nitrogen fixation, abiotic stress, rhizobacteria

Environmental Impact on SMAD 4 Gene Expression and Its Clinical Relevance in Patients with Breast Cancer

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ABSTRACT

Over the past decades, there is a dramatic rise in the incidence and mortality rates of breast cancer globally, despite the progressive advancement of therapeutic options. Numerous contaminants found in the environment have been shown to cause cancer in humans. Therefore, knowing which environmental elements are linked to cancer, where they are located, and how they affect the development of cancer is essential. It is well recognized that both genetics and epigenetics are important factors in gene-environment interactions in both health and disease. Environmental pollutants adversely affect the epigenetic modifications that are associated with up and down regulation of important biomarker in the TGF-β pathway, such as SMAD4 which may have a greater impact on the development of breast cancer. In the current investigation we examined SMAD4 expression in 20 samples of confirmed female breast cancer patients and surrounding normal tissue from same patients from different districts of Bihar with various histological grading by real time PCR and Western blot. Moreover, MS-PCR was used, respectively, to identify the genetic and epigenetic changes. SMAD4 expression dropped from Grade 1 to Grade 3 breast cancer both at mRNA and protein level as justified by real time PCR and western blot. This down regulation of SMAD4 expression is due to its promoter methylation as confirmed by bisulfite conversion of genomic DNA by (MS-PCR). Patient ER status was significantly correlated with decreased mRNA (63.38% instances) and protein (60.56% cases) expression. The majority of cases (53.52%) had a methylated SMAD4 promoter region, which may be a major contributing reason to the dysregulated production of SMAD4 in instances of breast cancer. Our results also showed a strong correlation between the patients' age, environmental location, lymph node status and SMAD4 mRNA down expression.

Keywords: SMAD 4 gene, breast cancer, environmental pollutants, DNA, mRNA

Arbuscular Mycorrhizal Fungi as a Sustainable Alternative for Chemical Fertilizers in Agriculture

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ABSTRACT

Rapid population growth tends to excessive dependency on chemical fertilizers to boost crop production leading to deterioration of the environment, biodiversity, human health and sustainability. To achieve the objective sustainably, scientific chronicles have explored the mutualistic interaction between plant roots and rhizosphere microbiome. One of the interactions of plant roots was found with arbuscular mycorrhiza fungi (AMF), a rhizosphere microbiome. Mycorrhiza is an important terrestrial mutualistic fungus, which is associated with the roots of the plant. This review concludes the prominent use of arbuscular mycorrhizal fungi (AMF) as a biofertilizer and to maintain the sustainability of soil and ecosystem. Nearly 340 species of AMF have been found. Several important applications of AMF such as plant fertilization (phosphorus, nitrogen and other micronutrients), improvement of soil organic matter content (SOC) and water holding capacity, alleviation of biotic stresses (protection from pests and pathogens), abiotic stresses (drought, salinity, heavy metal, low and high-temperature stresses), nutrient recycling, interactions with other PGPR (Plant growth promoting rhizomicrobes) has been recognized. Both AMF and PGPR boost each other growth and in turn, increase the plant growth and yield. AMF acts as a bio-regulator and induces plant growth by producing various phytohormones (polyphenols, carotenoids, ethylene, strigolactones and ABA). AMF as bio inoculants found to be an effective alternative facilitate major benefits in long-term soil fertility, plant nutrition and protection has a promising potency in substantial agriculture. Higher concentrations of major fertilizers especially phosphate, nitrogen, fungicides, pesticides, intensive tillage, and crop rotation with non-mycorrhizal crops hamper AMF diversity and activity. This review highlights the importance of AMF in sustainable agriculture, and ecosystem management and provides insights into their potential applications in environmental conservation and food security.

Keywords: AMF, Biofertilizer, Sustainable

Toward Sustainable Food Systems: Evaluating Duckweed as a Protein Source for Aquaculture

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ABSTRACT

The inevitable expansion of the global population, coupled with rising seafood consumption, has resulted in the intensification of aquaculture to meet the increasing demand for food resources. Yet it is critical to nourish the expanding population sustainably. Sustainable food systems are vital for sustainable development since they address interconnected issues such as environmental protection, food security, public health, and equitable economic growth. Fish can play an important role in sustainable food systems, but its sustainability relies on responsible farming practices. Fishmeal, a major source of nutritional protein has allowed fish farming to reach an elevated level of productivity. Therefore, creating affordable, environment-friendly nutritional supplies is one of the most important strategies for guaranteeing the system's sustainability. In this regard, attempts have been made to substitute fish meal in fish diets. Consequently, new, affordable proteins derived from plant or animal sources are now required to establish sustainable aquaculture. In this study, an attempt was made to substitute the fish meal with a plant-based protein source, duckweed (0%, 25%, 50%, 75%, and 100%) in the diet of a potential air-breathing fish, Channa striata. Based on growth parameters studies [specific growth rate (SGR), live weight gain (LWG), feed conversion ratio (FCR), protein retention efficiency (PRE)], it was inferred that C. striata fed with a diet incorporating 25% of duckweed has shown high values of SGR, LWG, PER, and low FCR. These findings suggest that fish fed with a diet made up of two different sources of protein (plant and animal-based) has shown better growth performance than the diet composed of a single protein source because, it provides a balanced range of essential nutrients that fish require for optimal growth, health, and reproduction. Using plant-based ingredients alongside animal-derived nutrients creates a balanced, sustainable feed that minimizes environmental impact.

Keywords: Aquaculture, environmental protection, food security, duckweed

Green-Synthesized Nanoparticles: A Biocompatible Strategy for Harmful Algal Bloom Control

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ABSTRACT

Climate change and nutrient pollution are the main causes of harmful algal blooms (HABs), which present serious ecological, financial, and public health issues. Conventional chemical and physical methods for HABs mitigation often have limited effectiveness and can pose risks to non-target organisms and the environment. Recent advancements in nanotechnology offer promising solutions for their mitigation. Green synthesized nanoparticles (NPs) act as an eco- friendly and sustainable approach in controlling HABs. Compared to traditional chemical procedures, green synthesis, which uses plant extracts and microbiological agents, guarantees biocompatibility, lower toxicity, and environmental sustainability. Studies reveal the interactions of green nanoparticles with algal cells and their mode of action, including their interference with biological functions like, decreasing photosynthetic activity, DNA damage, mitochondria membrane disruption etc. caused by physical and oxidative stress in the algal cell. The potential of biogenic nanoparticles, particularly those synthesized from copper, silver, and zinc, is significantly reducing algal biomass and controlling bloom proliferation under laboratory and field conditions. The environmental impact and safety of these nanoparticles are also assessed, highlighting their low toxicity to non-target organisms and biodegradability. This underscores the potential of green nanoparticles as a novel, sustainable tool for HABs management and calls for further investigation into scaling up applications while ensuring ecosystem health.

Keywords: Climate change, Green Nanoparticles, Harmful algal bloom, Oxidative stress

Harnessing Endophytes for Environmental Resilience And Agricultural Sustainability

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ABSTRACT

The global population is projected to reach 9.7 billion by 2050, intensifying the demand for agricultural practices that can sustainably increase crop yields. Traditional farming methods, heavily reliant on chemical pesticides and fertilizers, have raised significant environmental concerns, including soil degradation, water contamination, and the development of pest resistance. These challenges necessitate a paradigm shift towards more sustainable

agricultural practices that can enhance productivity while minimizing ecological impact. By harnessing the natural abilities of endophytes—beneficial microorganisms residing within plant tissues—improvement in plant growth, enhanced resilience to biotic and abiotic stresses, and reduced dependency on harmful agrochemicals can be achieved. Endophytes improve crop performance through various mechanisms, such as enhancing nutrient uptake, producing phytohormones that stimulate growth, and secreting bioactive compounds that promote plant health. They also play a crucial role in stress management by inducing systemic resistance against pathogens and mitigating the effects of abiotic stresses like drought and salinity. These microorganisms not only enhance crop resilience and productivity but also contribute to environmental conservation by reducing the need for chemical pesticides. By embracing endophyte application, farmers can cultivate healthier crops while promoting biodiversity and ecological balance. This approach not only addresses the immediate challenges of food security but also aligns with the broader goals of sustainable agriculture, paving the way for a more resilient and environmentally friendly farming future.

Keywords: Endophyte, environmental resilience, agricultural sustainability, microorganisms

Exploring the Role of Genetically Modified Algal Species in Sustainable Biofuel Production

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ABSTRACT

The rapid increase in human population, rising living standards, and rising demands of energy. Biofuels are a potential substitute for fossil fuels. Fossil fuels account for more than three-quarters of energy production, releasing enormous amounts of CO_2 that drive climate change effects and contribute to severe air pollution and health issues for human society. Microalgae have become a viable feedstock for biofuel production owing to their elevated lipid content, fast growth rates, and capacity to sequester carbon dioxide. Recent breakthroughs in genetic engineering have facilitated the creation of genetically modified algae strains exhibiting increased lipid yield, enhanced carbon fixation efficiency, and greater tolerance to environmental challenges. Advancements in understanding lipid and carbohydrate metabolism have paved the way for metabolic engineering to optimize biofuel production. This review focuses on discussing genetically modified strains for enhanced lipid content and fatty acid profiles of algal biomass for biodiesel production. Additionally, it highlights innovative approaches in engineering cyanobacteria for one-step biobutanol

synthesis, offering a streamlined and efficient pathway for renewable fuel generation while addressing global energy and sustainability challenges. It underscores the potential of genetic engineering to convert microalgae into effective platforms for sustainable and economically feasible biofuel production.

Keywords: Algal species, biofuels, lipid content, cyanobacteria

Assessment of the Factors Affecting Crop Yield for Sustainable Agriculture in an Agrarian District of Haryana

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ABSTRACT

As of now, nearly 40% of the world's population is aligned with agriculture. Agriculture accounts for 4% of the Global Gross Domestic Product (GDP) and in some least-developed countries, it comprises more than 25% of the total GDP (World Bank). India has been known for its vegetarian food products and reliability in agriculture which have been fulfilling the needs of the population since ancient times. Supported by well developed irrigation techniques and fertile alluvium deposits, Haryana is one of the leading agrarian states of India. Jind districts secures a significant place among the agrarian districts of Haryana that contribute nearly 10 percent of total food grain production of the state. But, during the last decade, the sustainability of the agriculture in the state has been doubted by the experts.Yield and Production of the crops depends on many factors which directly or indirectly. Assessment of these factors is necessary to improve the quality and quantity of the crops. In the light of the above discussion, a study has been performed to assess the factors affecting the yield of different major crops grown in the district. The study reveals that groundwater table is the most affecting factor along with the number of tubewells, rainfall, and fertilizers consumption. This study is performed by calculating various parameters and correlations using SPSS from 2006-2020.Various types of data has been collected for this study such as annual rainfall, seasonal rainfall, underground water table, consumption of fertilizers, yield of crops, production of crops, sown area of crops, number of tubewells, irrigated area of crops, HYV seeding area of major crops (Wheat, Mustard-Rapeseed, Bajra, Rice, Cotton and Sugarcane). The study reveals that the crop yield of these crops is highlycorrelated with the underground water table, number of tubewells and fertilizer consumption where R 2 value range from 0.30 to 0.50. The assessment of the factors affecting crop yield could be an

important asset to the future prediction of yield and assessing the production and growth rate of the crops.

Keywords: Crop yield, Irrigation, tubewells, Correlation, SPSS.

The Emergent Landscape of Green Rankings for Universities

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ABSTRACT

Over the past decade, green rankings have emerged to assess universities' sustainability efforts worldwide. This review examines prominent global rankings and highlights concerns about oversimplified methodologies, lack of transparency, and overreliance on quantitative metrics that fail to capture contextual nuances. Recent research reveals issues like strategic reporting, SDG-washing, and distorted perceptions of genuine progress. To align with 2030 Agenda, ranking methodologies must enhance transparency, incorporate feedback mechanisms, and adopt holistic approaches considering socio-economic, cultural, and geographical contexts. The emphasis should shift from symbolic commitments to measurable impacts and outcomes, discouraging selective reporting biasing long-term impact, especially with THE-Impact ranking. Collaboration should take precedence over competition, while establishing dedicated sustainability units within universities, with appropriate governance weightage in rankings, could ensure sustainability is driven from top levels. Robust guidelines utilizing AI for governance must prevent manipulation and SDG-washing in reporting. This review advocates for a comprehensive overhaul to propel universities towards authentic, impactful sustainability transformations.

Keywords: Green Rankings, Universities, QS-Sustainability, SDG-washing, THE-Impact ranking, UI Green Metric

Microalgae: Embracing the Potential in Nutraceutical Bio Factories as a Sustainable Solution in Nature-Based Products.

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ABSTRACT

Microalgae, the cynosure of today's research world embracing its potential in nutraceutical bio factories as a sustainable solution. The world's first life on the earth is still unexplored, benefitting the whole planet excluding humans. Presently, traditional food carries the load of feeding 8 billion population worldwide, and after facing a disastrous pandemic (Covid-19),

the recession phase has started in the international market that brought declining in food availability and ignited the problem of nutritional food globally. The environmental factors and climate changes are also creating hurdles in growth and cultivation of traditional food leads to hunger problem worldwide and holding up the SDG plans. The only dependence on the traditional food sources fails to fulfil the basic nutritional requirement of food worldwide. But algae have the potential to fill the void of nutrition in our daily diet. Microalgae is the best alternative source to tackle this situation worldwide. Algae grasp the basket of ample number of primary and secondary metabolites (such as proteins, carotenoids, PUFA (polyunsaturated fatty acid) that can fulfil both the nutritional requirement in our daily diet and to target the SDG 2 (End Hunger, achieve food security and improved nutrition) and SDG 3 (Ensure healthy lives and promote well-being for all at all ages). This review put lights on the nutritional bio-factories in microalgae as nature-based solution to promote a sustainable approach in green technologies. Microalgae have intense volcano of sustainable source of nutraceuticals inside which will erupt at its full potential by further research and development.

Keywords: Microalgae, Primary Metabolites, Secondary Metabolites, Nutraceuticals, SDG 2, SDG 3, Nutrition

GABA Regulation of Carbohydrates and Stress Response in Wheat Cultivars Under Stripe Rust Infection

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ABSTRACT

The role of carbohydrates and gamma-amino butyric acid (GABA) in wheat response to stripe rust caused by *Puccinia striiformis* f. sp. *tritici* (Pst) remains poorly understood. This study compares the wheat cultivars PBW725 (resistant) and HD2967 (susceptible) under different treatments (GABA, Pst, and GABA+Pst) at 1, 2, and 4 days after infection (dpi) during seedling growth at 30 days. The results revealed that starch hydrolysis and sugar levels were significantly higher over time in PBW725, indicating a robust carbohydrate metabolism response during infection. Conversely, HD2967 displayed improved sugar and protein levels only under the combined GABA+Pst treatment, suggesting a potential synergistic role of GABA in enhancing resistance in susceptible cultivars. Proline, an osmotic regulator, was elevated, while GABA levels decreased during the infection process in

HD2967, further highlighting the complex metabolic responses in susceptible wheat. Additionally, diamine oxidase (DAO) and glutamate decarboxylase (GAD), key enzymes in stress response, showed a progressive increase in PBW725, particularly during the infection stages, suggesting their role in regulating stress-induced changes. In HD2967, protease levels decreased at 4 dpi but were restored under GABA+Pst, whereas protein carbonyls, indicating oxidative damage, were only elevated under Pst infection, but decreased when GABA+Pst was applied. These findings suggest that GABA plays a critical role in modulating carbohydrate and protein responses under stripe rust stress. A sustained metabolic response over the course of infection is likely crucial for resistance, particularly in cultivars like PBW725.

Keywords: GABA, diamine oxidase, carbohydrate, Puccinia striiformis

Microbial Production of Bio-based Plastic Polyhydroxybutyrate (PHB) Through the Basic Stages of Fermentation for the Preservation of a Sustainable and Green Environment

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ABSTRACT

The cost of production of Polyhydroxybutyrate (PHB), its extraction and purification are the major hurdle in its commercialization. Halophiles offer simple and convenient extraction technique, reducing the overall cost. In the study, PHB production was carried out using a halophilic bacterium, which was identified as Bacillus spp. through 16S rRNA gene sequencing. The study determined the optimal conditions for cell cultivation in seed media. It has been discovered that the optimal conditions for achieving the best results were a preservation age of 14 to 21 days, a cell density ranging from 10^5 to 10^6 cells/mL, an inoculum size of 0.1% (w/v), 1% (w/v) glucose, and a growth temperature of 30°C. Glycerol and Corn Steep Liquor (CSL) were used as carbon and nitrogen sources, respectively, in a two-stage fermentation process to grow the cells. The PHB yield showed a remarkable improvement, with an increase from 2.01 to 4.36 g/L, due to the intermittent addition of glycerol and CSL. Thermogravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC), and X-ray Diffraction (XRD) were used to conduct an analysis of the physiochemical properties of PHB. The TGA results demonstrated the PHB's ability to withstand

temperatures of up to 220-230°C, showcasing its thermal stability. In addition, the XRD analysis showed a crystallinity index of approximately 33± 0.5%.

Keywords: Polyhydroxybutyrate, Halophiles, Biodegradable, Corn Steep Liquor, Fermentation, Crystallinity, Thermogravimetric Analysis, Differential Scanning Calorimetry and X- ray Diffraction

Impact of Global-Level Urbanization on Bird Community: A Review

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ABSTRACT

Urban development leads to the destruction and fragmentation of natural habitats, thereby diminishing the accessible space for bird species to breed, forage and roost. Destruction of habitat affects the survival of several avian populations and compromises ecological equilibrium, as these species are essential for pollination and seed dispersal. Urbanization facilitates the expansion of generalist species (e.g., rock pigeons, myna) that can thrive in human-altered habitats, but specialist species may face population decline or local extinction (Vultures, Owls). By cultivating an environment that supports generalist and specialist species, urban places can enhance their resilience and promote varied ecosystems. Urban environments offer alternative food sources (e.g., human food waste, bird feeders) but may diminish natural food availability, thereby impacting avian diets and foraging patterns. Domestic cats and other urban predators including free roaming dogs significantly impact bird populations, particularly ground nesting bird species. Artificial lighting and urban noises interfere with avian behaviour, communication and reproductive habits. Urban constructions may provide alternative breeding locations for certain species, but they also reduce the availability of natural nesting sites for birds due to lack of trees. Urban regions generally exhibit higher temperatures than adjacent rural areas, which may influence avian physiology and phenology. Urban development modifies natural water sources, impacting avian species reliant on water. Heightened exposure to pollutants and insecticides in urban environment adversely affects avian health and reproduction. Certain avian species modify their behaviour in response to urban surroundings, including alterations in vocalization patterns and foraging behaviour. To address these difficulties, the implementation of green infrastructure, including parks and green roofs, can establish habitats that sustain bird populations. Moreover, community involvement and education regarding the significance of biodiversity might promote a more harmonious coexistence between urban habitation and wildlife conservation.

This event highlights the necessity for localized conservation initiatives designed to protect distinct species and ecosystems. By advocating for indigenous flora and sustainable methodologies, urban areas can strengthen their ecological resilience and preserve diverse avian populations, thereby enhancing the overall vitality of urban ecosystems. To alleviate these effects, urban planners and policymakers ought to contemplate the adoption of avian-friendly urban design, the preservation of green spaces and the promotion of sustainable urban development practices. By establishing habitats that accommodate diverse wildlife requirements, urban areas can bolster ecological resilience while enabling inhabitants to appreciate the advantages of nature in their environment. Therefore, urban planners must emphasize solutions that incorporate green spaces and safeguard existing ecosystems to enhance biodiversity. This dual impact underscores the necessity for meticulous urban planning that takes into account the ecological ramifications of human actions. Integrating green spaces and protecting natural habitats in urban areas helps support bird populations and foster a more balanced urban ecology.

Keywords: Bird, Habitat, Food, Humans, Foraging, Nesting, Environment, Biodiversity

Ameliorative Effects of Quercetin on Cadmium Induced Reproductive Toxicity in Testicular Germ Cells of Goat (Capra hircus)

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ABSTRACT

Cadmium (Cd), an environmental toxic heavy metal, has been reported to cause testicular toxicity, which contributes to the recent decline in male fertility worldwide. Numerous pathological disorders have been demonstrated to benefit from the preventive effects of quercetin (Qcn), a significant dietary antioxidant. Nevertheless, it is unclear if Qcn offers defence against testicular toxicity induced by Cd. Therefore, the goal of the current investigation was to examine the mitigation of Cd-induced toxicity in the goat testis in-vitro in a dose (10, 50, and 100 μM) and time-dependent (4 and 8 h) manner by supplementing with Qcn. Various cytotoxicity, genotoxicity, and biochemical assays have been performed. The histopathological results have shown the vacuolization, delamination and pyknotic nuclei along with oedema. The ultrastructure results demonstrated loss of nuclear envelope, residual cytoplasm in spermatids, vacuolization and many mores. Fluorescence assay revealed increased cell apoptosis/death in time and dose dependent manner with increasing concentration of Cd. Also, Cd treatment led to increased oxidative stress, as demonstrated by

lower levels of antioxidant enzymes (CAT, SOD, and GST), decreased total antioxidant capacity (FRAP levels), and increased lipid peroxidation levels. In addition, it was found that quercetin co-supplementation effectively reduced the oxidative stress, apoptosis, and histological lesions induced by Cd. Qcn treatment improved the percent cell viability, restored the decreased activity of antioxidant enzymes, and boosted the levels of steroidogenic enzymes (3β-HSD, and 17β-HSD) and testosterone levels. Thus, according to our findings, quercetin can be used to lessen the negative effects of cadmium on the male reproductive system and intake of quercetin rich compounds in our regular diet can also assist to avoid male infertility.

Keywords: Quercetin, heavy metal, fluorescence assay, testosterone

Critical Analysis of Ecological and Social Impacts of Turning Desert into Green Projects

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ABSTRACT

Large-scale "desert greening" projects aim to combat desertification and land degradation by introducing vegetation and agriculture to arid and semi-arid regions. While seemingly beneficial, these projects can have complex and often unforeseen ecological and social consequences. This research critically analyzes the impacts of such endeavors, examining both the potential benefits and the associated risks, drawing upon examples like the Great Green Wall of the Sahara and the Sahel, the Kubuqi Desert Greening Project in China, Seawater Greenhouses in the UAE, afforestation efforts in the Thar Desert of India, and Negev Desert greening in Israel. Ecologically, the study investigates the effects on biodiversity, water resources, soil quality, and microclimates, considering the potential for unintended consequences such as invasive species introduction, disruption of natural ecosystems, and altered hydrological cycles as observed in some instances of large-scale afforestation. Socially, the research delves into the implications for local communities, including land tenure rights, economic opportunities, cultural heritage, and potential displacement, drawing upon lessons learned from projects like the Kubuqi initiative, which integrated community development with ecological restoration. Through a comprehensive review of these and other case studies alongside existing literature, this analysis aims to provide a nuanced understanding of the trade-offs involved in desert greening projects. It

highlights the importance of careful planning, community engagement, and long-term monitoring to ensure ecological sustainability and social equity in such ambitious endeavors.

Keywords: Ecological sustainability, social impacts, deserts, afforestation

Sustainable Approach to Conquer Type 2 Diabetes Mellitus

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ABSTRACT

Diabetes is a worldwide epidemic that has an impact on every country's health and economy. With 101 million diabetic patients, 136 million pre-diabetic patients, and 17% of all diabetic patients worldwide, India has become the world's diabetic capital. Diabetes has a significant financial impact and is predicted to keep increasing. It was projected that diabetes-related medical expenses would be $825 billion by 2030. Diabetes is a long-term condition. The main causes of the growing diabetes epidemic include sedentary lifestyles, poor diets, economic development, and modernization. Diabetes raises the possibility of further comorbidities such as diabetic retinopathy, diabetic neuropathy, diabetic nephropathy, diabetic cardiopathy, stroke. Effective diabetes care can delay or avoid these potentially fatal issues. A significant component in lowering the risk of diabetes is changing one's lifestyle. The key factor in the treatment of diabetes is leading a healthy lifestyle including exercise, yoga, herbal Nutraceuticals, dietary habits, and body weight maintenance are all crucial components of a balanced way of life. The current paper enumerates different coping techniques to conquer diabetes in a sustainable way.

Keywords: Type-2 Diabetes, Sustainable Management, Yoga, Herbal Nutraceuticals

Impacts of Fluorosis on Environment: Gaging Groundwater Contamination at Pavagada taluk, Tumkuru, Karnataka, India.

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ABSTRACT

The source of life and an essential part of all forms of the living beings water is polluted impacting the sustenance of human life and bio-diversity. Water scarcity at the surface level is increased due to which the dependency on ground water is equally crucial. India, among 23 the nations in the world is affected by fluoride contaminated groundwater, creating wellbeing

complications. The state and art report of UNICEF confirms the fluoride problems in 177 districts in India. This can be evidenced particularly in the region of Pavagada taluk where we have recently witnessed unusual rainfall from the semicentennial period enabling deliberations on the effect of the fluoride and other physicochemical parameters. Pavagada, having the Asia's biggest solar park has witnessed an imbalance in socio-economic well-being. The Grab Sampling reports of the pre and post monsoon seasons emphasizes on the content of high fluoride amongst other parameters like pH, TDS, calcium etc. Which supervenes that there is need of treated water. As around 90% of the Pavagada population is countryside, the consumption of untreated drinking water is huge which is attributing to the high mortality and morbidity of the infectious diseases like severe occurrence of dental fluorosis, musculoskeletal diseases, gastro-intestinal problems etc. This is mainly due to improper management and environmental degradation in this site. The matters are not in a significant thing in the study area and the approach has not stood up to the adequate standards. This research highlights the prominence for rain water harvesting and decorous utilization. On the contrary, ground water treatment is the only option for draught. Area like Pavagada taluk and any other options needs to be carved out to reduce ecosystem imbalance and circuitously increase the growth of industrialization and modernization. The water has to be handled in a advanced approach for achieving a decent eminence of water, the harvested water will also be fragment of this progression.

Keywords: Groundwater, fluorosis, physicochemical, industrialization.

Isolation and Screening of Silicase Producing Microorganisms from paddy field soil and their application

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ABSTRACT

In the Present study Isolation of silicase producing microorganisms was done from rice field soil. For isolation of silicase producing microorganisms enrichment technique was performed for 4 samples using 1% paddy field soil in tap water. Samples were enriched using paddy straw as substrate at 37^0C for 48 hours and dilutions were made upto 10. Each dilution was plated on nutrient agar media to obtain the pure cultures. Isolated colonies were obtained on differential medias. Silicase producing microorganisms were visualized by the clear zone formation on the differential media containing 1% silica component and further sub-cultured and isolated. All the silicase producing bacteria's were gram negative in nature. Silicase producing potential of these bacteria culture were further confirmed by silicase activity.

Keywords: Silicase, microorganisms, rice field, isolation

Exploring Plant-Based Alternatives for Mosquito Repellent Products

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ABSTRACT

The increasing resistance of mosquitoes to synthetic chemical repellents, along with their associated health risks, toxicity, and environmental impact, has spurred interest in natural, plant-based alternatives for mosquito control. This study explores the potential of plants with unique phytochemical compositions that offer effective mosquito-repelling properties. These plants contain active compounds that disrupt mosquito sensory receptors, making them viable sources for developing eco-friendly and efficient mosquito repellents. Compared to synthetic chemicals, plant-based repellents present a safer and more sustainable option. This paper highlights the plants which has potential for mosquito control, emphasizing their benefits for both health and the environment.

Keywords: Mosquito repelling plants; Eco-friendly repellent, Mosquito Control

Seasonal Air Quality Dynamics in Haryana: The Role of Stubble Burning (2020-2023)

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ABSTRACT

Air pollution, often termed the "silent killer," poses a significant threat to public health and the environment, with seasonal agricultural practices like stubble burning exacerbating the problem. This study investigates the impact of stubble burning on particulate matter (PM2.5 and PM10) concentrations in Haryana by analysing historical data from all 24 Continuous Ambient Air Quality Monitoring Stations (CAAQMS) across the state for the years 2020-2023. Hourly data was collected and systematically processed into daily, monthly, and seasonal averages to identify trends. The findings reveal pronounced seasonal patterns, with pollution levels peaking during the post-monsoon season (October-November), coinciding with stubble burning activities. During this period, PM2.5 and PM10 concentrations exceeded national air quality standards, indicating severe air quality degradation. The post-monsoon season was identified as the most critical period for air quality deterioration, followed by elevated pollution levels in the winter months (December-February) due to atmospheric inversion and additional local sources. Conversely, the summer (April-June) and monsoon

(July-September) seasons exhibited significant improvements in air quality due to enhanced atmospheric dispersion and rain-induced particulate scavenging. The results underscore the critical need for targeted interventions during the post-monsoon and winter seasons to mitigate the adverse health and environmental impacts of elevated pollution levels. This study highlights the persistence of seasonal trends in Haryana's air quality and emphasizes the importance of long-term, multi-faceted strategies for sustainable air quality management.

Keywords: Stubble burning, air quality, CAAQMS, air pollution

Assessment of Bacterial Endophytes Isolated from Halophytic Grasses for Salt Tolerance and Plant Growth Promoting Potential in Wheat Crop

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ABSTRACT

Haryana is primarily an agricultural state. Excess salinity in soil and water causes several morphological and physiological abnormalities in plants ultimately leading to plant growth suppression. The present study was aimed at isolating growth promoting halotolerant endophytic bacteria from three halophytic grasses, namely *Sporobolus marginatus* A. Rich. (KC1), *Urochondra setulosa* (Trin.) C.E. Hubb (KC2), and *Leptochloa fusca* (L) Kutnth (KC3). Out of total 56 bacterial isolates, 24 were screened from *S. marginatus*, 15 from *U. setulosa,* and 17 from *L. fusca*. The identified bacterial endophytes belong to diverse bacterial genera, i.e., *Pseudomonas, Bacillus, Enterobacter, Microbacterium, Rhizobium, Chryseobacterium, Brevibacillus, Klebsiella, Proteus, Escherichia, and Agrobacterium.* The isolates were further tested for their salt tolerance potential, as a result of which 24 isolates belonging to *Pseudomonas, Bacillus,* and *Enterobacter* genera demonstrated continual growth up to 10% salt concentrations (NaCl), suggesting their significant salt tolerating capability. The isolates were further checked for their Plant Growth Promoting potential (PGP) by testing them for various PGP traits. Out of total 56 isolates, 46 were ACCD & IAA producers; 22 were HCN producers; 14 were phosphate solubilizers; and 43 were nitrogen fixers. On the basis of quantitative and qualitative PGP trait analysis, two bacterial isolates i.e., *Pseudomonas sp. Strain SS46* and *Bacillus altitudinis 11-1-1* were selected and taken to the next tier of experiments. Two wheat varieties were preferred namely, KRL-210 (moderately salt tolerant) and HD-2009 (salt sensitive). The results define the significant role of these isolates in future as biofertilizers for salt sensitive crops and may aid in bioremediation of saline soil.

Keywords: bacterial endophytes, biofertilizers, Pseudomonas, Microbacterium, salt sensitive

Antioxidant Activity and Total Phenolic Content of *Symplocos Racemosa*

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ABSTRACT

Symplocos racemosa, commonly known as lodhra, is a small evergreen tree native to India, traditionally used in Ayurvedic medicine for its therapeutic properties, including anti-inflammatory, antimicrobial, and wound-healing effects. The study investigates its antioxidant activity and total phenolic content to explore its potential health benefits. Methanolic extracts of the plant were evaluated for antioxidant properties using DPPH radical scavenging assay. Total phenolic content was estimated using the Folin-Ciocalteu method, using Gallic acid as standard. The extract demonstrated significant antioxidant activity, correlating with its high phenolic content, suggesting its potential as a natural source of antioxidants. These findings support the traditional usage of *S. racemosa* and highlight its potential for pharmaceutical applications.

Keywords: *Symplocos racemosa*, Therapeutic Properties, Antioxidant, DPPH, Pharmaceutical.

The Green Divide: Exploring the conflicts Between the Judiciary and National Green Tribunal in India

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ABSTRACT

Indian judiciary has given landmark judgements since 80's and early 90's and used the constitutional provisions to protect and preserve the environment and natural resources of the country. Proactive efforts of Indian judiciary have played an important role in solving environmental issues while supporting the basic principle of social justice. The liberal and innovative interpretations of constitutional provisions led to the formulation of some notable judicial principles like the precautionary and polluter pays principle. Both judiciary and National Green Tribunal plays significant role in present scenario. However, in some cases the NGT and the Supreme Court orders contradict each other due to different interpretation of environmental laws and policies. As per NGT Act, 2010, the verdict of NGT can be challenged in Supreme Court which leads to conflict between the two. This paper review various judgement of judiciary and NGT to understand the nature of conflict between

judiciary and NGT and provide suggestions for improvement in environmental governance in India.

Keywords: Constitutional provisions, environmental jurisprudence, ecological sustainability, environmental justice, landmark decisions and National Green Tribunal.

Water Management for a Sustainable Environment

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ABSTRACT

Water management plays a pivotal role in ensuring environmental sustainability. As the global population rises and industrial activities intensify, the pressure on water resources has increased significantly. Water is essential for life, ecosystems, and human development. However, its availability and quality are under constant threat due to climate change, pollution, over-extraction, and inefficient usage. Effective water management practices are crucial for maintaining a balance between human needs and environmental conservation. This paper explores the principles, challenges, and strategies of sustainable water management, emphasizing its role in addressing global water crises, ensuring ecological balance, and promoting long-term environmental health.

Keywords: Environmental sustainability, environmental health, ecosystems, water management

Nanotechnology-Driven Strategies for Sustainable Remediation of Pharmaceutical Contaminants

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ABSTRACT

Pharmaceutical contaminants in water pose significant threats to both environmental and human health due to their persistence and bioaccumulation. These contaminants primarily enter aquatic ecosystems through improper disposal, pharmaceutical manufacturing, and excretion, leading to ecological disruptions and antibiotic resistance. Traditional remediation methods often fall short, but nanotechnology offers innovative solutions using advanced materials for sustainable cleanup. One effective method is photocatalytic degradation, where nanostructures activated by sunlight or UV light generate reactive oxygen species to break down harmful pharmaceutical compounds. This presentation highlights the unique properties of nanomaterials that enhance their effectiveness in adsorbing, degrading, and detoxifying

pharmaceutical pollutants. By integrating nanotechnology with renewable energy, we can develop eco-friendly and scalable solutions. Ultimately, this work emphasizes the potential of nanotechnology-driven strategies to revolutionize the sustainable management of pharmaceutical waste, paving the way for cleaner and safer environmental practices.

Keywords: Nanotechnology, remediation, pharmaceutical contaminants, photocatalytic degradation

Cultivating Sustainability: The Role of Millets in Food and Environmental Security

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ABSTRACT

In the face of escalating environmental challenges, the imperative for sustainable agriculture has become extremely critical. With the global population expected to reach 9.7 billion by 2050, the demand for food continues to rise, exacerbating the strain on natural resources. Sustainable agriculture, defined as the capacity to maintain healthy environmental, social, and economic systems over the long term, is essential to ensure food security, preserve ecosystems, and combat climate change. This paper explores the potential of millets, a group of highly nutritious and climate-resilient grains, in advancing environmental sustainability. Millets, including varieties such as finger millet, pearl millet, and sorghum, have been cultivated for thousands of years and are well adapted to diverse agroecological conditions. Their ability to thrive in arid and semi-arid regions, coupled with low water and input requirements, positions them as ideal crops for sustainable agriculture. Millets, leveraging their C4 photosynthetic pathway, effectively optimize water and nutrient use, thriving in harsh conditions like heat, drought, and poor soil fertility. Millet farming requires approximately 65% less water than rice and has a carbon footprint 30% lower than wheat. Additionally, millets contribute to soil health by promoting microbial diversity and reducing the need for chemical fertilizers. Millets also deliver significant socio-economic and health benefits. For smallholder farmers in developing regions, millet farming ensures income diversification and resilience to climate change. Nutritionally, millets are rich in dietary fiber, proteins, and essential minerals like iron, calcium, and magnesium. Their low glycemic index aids in managing diabetes, while their high fiber content supports digestive health and reduces the risk of cardiovascular diseases. Additionally, being gluten-free, millets are ideal

for those with gluten intolerance or celiac disease. Promoting millet-based dietary practices can enhance nutritional security, particularly in regions prone to food scarcity. Integrating millets into agricultural and dietary practices supports crop diversification, enhances sustainability for farmers, and improves the health of our planet.

Keywords: Millets, environmental sustainability, food security, nutritional security, C4 plants

Evaluation of Physicochemical and Mineral Content of Poultry Egg Quality with Special Emphasis on Health Risk Assessment In Haryana, India

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ABSTRACT

Rapid industrialization has escalated the risk of heavy metal contamination in soil, water, and food sources, posing a significant concern due to potential toxicity and severe impacts on human health. This study aims to analyze the physicochemical parameters, mineral, and heavy metal content in poultry egg samples, coupled with health risk assessment in Haryana. The mean values of egg for width, length, weight, shape, pH, and protein were 4.17 cm, 5.26 cm, 50.70 g, 22.22, 6.71, and 10.24 g, respectively, in summer, and 4.14 cm, 5.42 cm, 50.85 g, 22.93, 6.93, and 10.23 g, respectively, in winter. Regarding minerals and heavy metals, the mean values were recorded as follows in summer: sodium (123.51 mg/100 g), potassium (112.25 mg/100 g), calcium (71.47 mg/100 g), magnesium (18.96 mg/100 g), copper (2.29 mg/100 g), and iron (1.55 mg/100 g). In winter, the values were sodium (123.53 mg/100 g), potassium (110.24 mg/100 g), calcium (70.87 mg/100 g), magnesium (18.04 mg/100 g), copper (2.08 mg/100 g), and iron (1.61 mg/100 g). Arsenic, lead, and selenium were below the limit of quantification. The values recorded for estimated daily intake (EDI), Hazard Quotient (HQ) indicate no potential health risk, as HQ for Cu and Fe was less than one, for both adults and children. Thus, based on the results obtained from this study, there are currently no apparent health risks to human health. However, owing to rapid urbanization and industrialization, the likelihood of heavy metal pollution and toxicity in the near future is high. Therefore, more research must be conducted in this regard, and new strategies should be explored to combat heavy metal contamination.

Keywords: Estimated daily intake, Hazard Quotient, Heavy metal, SDG 3, SDG 12, Toxicity

Aphids: Agricultural Threat or Ecological Bioindicator?

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ABSTRACT

Aphids, small sap-feeding insects, are responsible for significant economic losses globally due to their intricate morphology, specialized feeding mechanisms, and rapid reproductive cycles, which have evolved over time. These attributes, coupled with molecular-level variations, enable aphids to inflict considerable damage on plants, particularly economically vital crops. This study explores innovative strategies for mitigating aphid-induced crop damage and improving agricultural resilience. We propose the integration of advanced biotechnological tools, such as gene editing, to enhance plant resistance to aphids at the molecular level, thereby promoting sustainable pest management. Furthermore, the application of artificial intelligence (AI), including machine learning algorithms and image processing technologies, offers enhanced monitoring capabilities, enabling more accurate detection and tracking of aphid populations. This approach also facilitates the identification of aphids as bioindicators, reflecting ecosystem health and environmental changes. With the increasing global demand for food, alternative agricultural practices such as controlled environment farming (e.g., hydroponics and aeroponics) are being explored to ensure food security. However, these systems, characterized by the absence of natural predators and dense crop arrangements, provide favorable conditions for aphid proliferation. Consequently, the management of aphid populations in such environments requires heightened attention to safeguard crop health and ensure sustainable agricultural practices.

Keywords: Aphids, sustainable agriculture, bioindicators, environmental changes

Agricultural Sustainability Using Organic Amendments and Comparison of their Antioxidant Activities

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ABSTRACT

The excessive use of synthetic fertilizers has led to soil degradation and compromised sustainability in agricultural systems. Organic amendments, such as vermicompost, present a viable alternative to enhance both crop yield and soil health. Vermicompost improves soil texture, water retention, and microbial diversity, which collectively support sustainable

agricultural practices. This study investigates the impact of vermicompost and synthetic fertilizers on crop antioxidant activities and soil properties, in comparison with a control treatment. The experiment was carried out at the IIHS parking area, Kurukshetra University, Kurukshetra, to assess the impact of vermicompost, synthetic fertilizers, and an unamended control on key agricultural parameters. Antioxidant activities were assessed using DPPH assay, and preliminary results indicate that vermicompost-treated plants exhibited significantly higher radical scavenging activity compared to both the control and synthetic fertilizer treatments. Additionally, soil parameters such as pH, organic matter content, and nutrient levels were analyzed to assess the broader effects of each treatment on soil health. These findings suggest that vermicompost not only contributes to enhanced antioxidant potential in crops but also fosters superior soil quality, supporting a more sustainable alternative to synthetic fertilizers.

Keywords: Organic amendments, agricultural sustainability, soil degradation, vermicompost

Exploring the Potential of Invasive Plant Species for Water Purification: A Sustainable Environmental Solution

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ABSTRACT

Invasive plant species are considered a major menace to ecosystems, as they can aggressively outcompete and displace native vegetation. They pose significant threats to ecological health, biodiversity, and human livelihoods. Despite their invasive nature, these species offer unexplored potential for sustainable environmental solutions, leveraging their remarkable growth rates and distinct biological characteristics. Industrialization and technological advancements play a considerable role in the civilization of mankind, but their repercussions are numerous including the deterioration of water quality. Utilizing invasive plant species for water remediation purposes, particularly for the removal of heavy metals, excess nutrients, and organic pollutants from wastewater and natural water systems, presents a multifaceted approach to their management. Key findings highlight that these species' hyperaccumulation capabilities, extensive root systems, and rapid biomass production enable them to absorb and immobilize pollutants efficiently. These plants can also be transformed into biochar, providing a sustainable solution for wastewater treatment applications. These plants offer a cost-effective and eco-friendly alternative to conventional water treatment methods. Additionally, it embodies the circular economy concept, transforming ecological challenges into sustainable resource opportunities and minimizing environmental harm. Through

sustainable practices and innovative research, invasive plant management via utilization offers a promising solution for ecosystem restoration and local economic growth, exemplifying the transformative potential of ecological challenges into opportunities for environmental stewardship, sustainable development, and circular economy advancement.

Keywords: Water purification, sustainable environment, invasive plant, ecological health

Assessment of Mechanical Properties of Rice Husk/Cement Bypass Dust/Epoxy Hybrid Composites

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ABSTRACT

Cement by pass dust(CBPD) is a fine, alkaline dust that's removed from cement kilns during production and rice husk is an agriculture waste which get generated from milling process of rice. Both of these waste materials are abundantly found over the globe. An effort was made in this study to generate natural fiber-reinforced polymer composites with CBPD and rice husk as reinforcements. The CBPD proportion in the epoxy matrix is constant at 5%, the amount of rice husk is variable (10, 20, and 30% weight percentages). Composites have been created using the hand-layup technique. All of the samples were evaluated on a universal testing machine for tensile strength, flexural strength, and compressive strength in accordance with the criteria. Additionally, impact and hardness tests were performed in accordance with ASTM standards. The composite containing 30% rice husk had the highest tensile strength, measuring 40.2 MPa. The flexural strength of a composite containing 35.3% rice husk was 42.67 MPa. With 18.2 J/m, the composite material containing 20% rice husk has the maximum impact strength. In the hardness test, the composite containing 20% rice husk fared best. The composite with 30% rice husk has the highest compressive strength. A composite comprising 30% rice husk and 5% CBPD, will be suitable for structural applications such as pot making, bricks, and so on.

Keywords: Rice husk, CBPD, hand layup, polymer, epoxy, composite

Groundwater Potential for Sustainable Irrigation in Karnal District, Haryana

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ABSTRACT

Groundwater plays a fundamental role in Indian agriculture, where the quality of irrigation water depends on several factors, such as water composition, soil type, climatic conditions,

drainage efficiency, and salt tolerance of crops. This study focused on evaluating the concentration of physicochemical parameters and heavy metals in the groundwater of agricultural farms in Assandh and Nissing blocks of the Karnal district to assess its suitability for irrigation. Samples were collected from bore wells and tube wells located on agricultural farms during the pre-monsoon (April to June 2022) and post-monsoon (October to November 2022) seasons. A comprehensive analysis of six heavy metals (Cd, Ni, Cr, Fe, Zn and Cu) and all major physicochemical parameters were conducted across two blocks. Additionally, key irrigation indices, such as the sodium absorption ratio (SAR), Kelly's ratio, residual sodium carbonate (RSC), permeability index, potential salinity, magnesium hazard (MH), sodium percentage (Na%), and chloralkaline indices (CAI), were calculated to determine water suitability for irrigation purposes. The values of total hardness (TH), MH and Na% were observed maximum in the samples from Assandh block and RSC was found higher in some samples from Nissing block in pre-monsoon season. The physicochemical analysis results indicated that TH, Ca, Mg, carbonate, bicarbonate, Cl and sulphate parameters were found beyond the permissible limits of Bureau of Indian Standards (BIS, 2012). Furthermore, Cu, Fe, Ni and Pb were found within the permissible limits of FAO (2023) while As was found above limits in 11.86% samples of the Nissing block. This study on water quality parameters revealed that the study area's groundwater is suitable for irrigation purposes.

Keywords: Groundwater, SAR, RSC, Irrigation, physicochemical parameters

Sugarcane Cultivation in Haryana: A Spatio-Temporal Analysis (1966-2022)

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ABSTRACT

Sugarcane is one of the most important cash crops in India and this crop has a significant role in the agrarian economy and the crucial in industry as a raw material. India has occupied second place in terms of sugarcane production in the world. In this paper, an attempt has been made to study the cropped area under sugarcane production and reveal the trends of sugarcane production in the state of Haryana from the formation of the state to the year 2022. The pattern of sugarcane cultivation in Haryana is very dynamic. There are several geographical factors that affect the distribution of sugarcane production in the state such factors as rainfall, temperature, soil, transportation facilities, irrigation, and the location of sugar mills from the farm. To examine the trend in the area and production of sugarcane in the state, the triennium averages have been computed for the period 1966-69, 1990-93, and

2019-22. The total production of sugarcane has substantially increased during the period of 1966-67 to 2021-22. It has increased from 550 thousand tonnes in 1966-67 to 835 thousand tonnes in 2021-22 which is a total increment of 65 percent whereas, the total cropped area under sugarcane decreased from 3.19 percent in 1966-67 to 1.53 percent in 2021-22.

Keywords: Sugarcane Cultivation, Spatio-Temporal, Cropped Area, CAGR, Cash crop

Food Security Through the Promotion of Underutilized Food Crop

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ABSTRACT

Food insecurity and malnutrition continue to be major global challenges. The 2024 edition of the State of Food Security and Nutrition in the World report reveals that between 713 and 757 million people experienced hunger in 2023, equating to one in every 11 people globally; additionally, more than 3.1 billion individuals were unable to afford a healthy nutritious diet. According to the International Food Security Assessment (2022-32), approximately 333.5 million people in India faced food insecurity in 2022-23 (Zereyesus et al., 2022). According to the 2024 Global Hunger Index (GHI) report, India is classified as having serious levels of hunger, ranking 105th out of 127 countries. Although India has made significant progress in agricultural production and is no longer food-deficient, it still struggles with nutritional disparities especially the hinder hunger. Hidden hunger, a form of malnutrition caused by deficiencies in essential micronutrients such as vitamins and minerals, poses a significant public health challenge in India. Despite the implementation of strong food security policies, challenges remain; henceforth the focus must shift from simply ensuring food availability to guarantee universal access to affordable and well-balanced nutritious diets. The present paper is concerned to find out cheapest sources of micronutrients. For this, underutilized food crop i.e. curry leaves, amla leaves, marjoram leaves, bengal gram leaves, and cauliflower stalks were analysed for micronutrient especially phytochemical content, antioxidant activity and antimicrobial activity. These micronutrients protect cells from damage caused by free radicals and oxidative stress and contribute to overall health by supporting immune function thereby play a significant role in promoting human health and preventing various diseases associated with hidden hunger. These crops are easily available thereby capable of filling the nutrition gap of most of the population.

Keywords: food security, hidden hunger, antioxidants, nutrients, underutilized food crop

Synthesis and Characterization of Cobalt-Ferrite Magnetic Nanoparticles Using Sol-Gel Auto-Combustion.

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ABSTRACT

Dye wastewater from the textile industry poses serious environmental challenges due to its toxic and non-biodegradable nature, threatening aquatic and human life. Developing an effective and sustainable way to clean up the environment is therefore crucial. In this study cobalt ferrite composite magnetic nanoparticles were used to assess their potential for wastewater treatment. The discussion here includes the synthesis route and characterization of the magnetic nanoparticles. The nanoparticles were synthesized using the sol-gel auto-combustion method using ferrites and cobalt salts as precursors in the presence of citric acid and ethylene glycol. This method is convenient, simple, fast, and effective, involving a low reaction temperature, and is better for preparing homogeneous and pure ferrites. Characterization techniques such as FESEM-EDX, FTIR, and XRD were used for the analysis of the synthesized nanoparticles. Structure analysis using XRD confirmed the crystalline nature with a crystallinity percentage of 75%. Surface and elemental analysis using FESEM-EDX revealed the irregular shape with some agglomeration and there were no impurities. FTIR shows the peak at 587 cm^{-1} and 472 cm^{-1} indicating the stretching frequency of the Fe-O bond at the tetrahedral site and M–O stretching vibration respectively. Due to the high specific surface area of magnetic nanoparticles, thus provide more active sites for adsorption. This can be a better absorbent for removing pollutants from wastewater.

Keywords: Magnetic nanoparticles, Adsorption, Wastewater, Pollutants, Characterization.

The Essence of Slow Living: A Qualitative Exploration of Goa's Rural Economic Landscape

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ABSTRACT

The accelerating pace of modern lifestyles, driven by consumerism and rapid economic growth, has exacerbated environmental degradation, resource depletion, and social inequalities. This unsustainable trajectory jeopardizes long-term ecological balance and

inclusive development. Effective community and environmental management is essential to counter these challenges and devise strategies for a sustainable environment that align economic progress with ecological and social well-being. Slow living emerges as a transformative framework for sustainable growth, advocating mindful, deliberate practices that prioritize quality over quantity. By integrating principles of the circular economy—such as resource efficiency, waste reduction, and equitable development—slow living presents a holistic approach to achieving environmental sustainability and social inclusion. Core practices like slow food, slow fashion, and community-driven education emphasize local resilience, cultural preservation, and ecological harmony. This study investigates the potential of slow living to promote sustainable growth through variables including slow pace, sustainable consumption, localized production, and community-oriented practices. These dimensions are analyzed for their impact on mitigating environmental harm, strengthening social cohesion, and fostering inclusive economic models that align with community and environmental management goals. The research focuses on Poinguinim village in South Goa, an agrarian community with a rich tradition of community-centric practices. As a case study, Poinguinim provides valuable insights into the integration of traditional lifestyles within broader sustainable strategies for the environment. The village's practices highlight the feasibility of harmonizing ecological conservation with socioeconomic development. By synthesizing theoretical perspectives and empirical findings, this research contributes to the discourse on inclusive and sustainable growth models. It underscores the importance of community and environmental management in addressing the socioeconomic dimensions of environmental challenges, aligning with global efforts to foster sustainable development.
Keywords: Slow Living, Sustainable Growth, Community and Environmental Management, Sustainable Strategies, Slow Pace, Slow Wear, Slow Food, Slow Education, Circular Economy

Comprehensive Molecular and Phytochemical Profiling of *Eclipta alba* for Genetic Authentication and Therapeutic Potential Exploration

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ABSTRACT

This study focuses on the molecular characterization of *Eclipta alba*, a medicinal plant renowned for its extensive pharmacological applications in traditional medicine. Molecular

profiling was conducted to identify genetic and phytochemical markers that contribute to the plant's therapeutic properties. Genomic DNA was isolated and amplified using polymerase chain reaction (PCR) techniques. DNA barcoding through specific markers, such as ITS (Internal Transcribed Spacer), ITS2, rbcL and matK, confirmed the genetic identity of *Eclipta alba*. Furthermore, secondary metabolite profiling was performed to complement molecular findings, utilizing advanced analytical techniques including Fourier Transform Infrared (FTIR) and UV-Visible spectroscopy. FTIR analysis revealed the presence of key functional groups, including hydroxyl (O-H), carboxyl (C=O), and aromatic ring structures, indicative of bioactive compounds such as flavonoids, alkaloids, and tannins. UV-Visible spectroscopy highlighted characteristic absorption peaks in the range of 300–450 nm, associated with polyphenolic compounds and antioxidants. The integration of molecular and phytochemical characterization underscores the unique biochemical and genetic makeup of *Eclipta alba*. These findings provide valuable insights into its potential for developing novel therapeutic agents and pave the way for its conservation and sustainable utilization in pharmacological research.

Keywords: *Eclipta alba*, DNA barcoding, Internal Transcribed Spacer (ITS), UV Vis-Spectrophotometer, Fourier Transfer Infrared Spectrophotometer (FTIR)

In Vitro Propagation of Endangered Slipper Orchid *Paphiopedilum Spicerianum*: A Floriculturally Important Species

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ABSTRACT

Slipper orchids flowers are one of the mesmerizing creations of nature. They are highly priced ornamental cut-flower species and collected from nature stealthily for trade purpose, making the *Paphiopedilum* as endangered species. In order to conserve germplasm of the species, it is propagated using asymbiotic seed germination methodology. The germination response of mature seeds from burst capsule was tested by varying physical and chemical stimulus in Burgeff medium. Early seedlings were obtained under light conditions within 36 wks of culture. Current efforts are a step forward in saving the genepool of this endangered orchid species.

Keywords: Slipper orchids, genepool, germplasm, *Paphiopedilum*

Conservation and Sustainable Use of Medicinal Plants

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ABSTRACT

India with its glorious past of traditional systems of medicine is one of the eight mega centers of origin and diversification of domesticated taxa. Several different plants have been used in India for thousands of years and are widely recognized as having high healing effects. Haryana is a home for wide variety of plants of great economic importance such as fruits, vegetables, flowers, spices, medicinal plants, trees etc which can be grown in one part of the state or another. However continuous destruction, degradation of forest areas and due to injudicious harvest of these plants by collectors, several plants are in the state of extinction. It is also very essential to conserve the knowledge about presence and distribution of economically important plants. The need of the hour to encourage farmers to grow more and more plants to fulfill the ever increasing demand of population and to increase the productivity of these plants through adoption and socialization of newer economic value added agricultural practices. Cultivation and domestication of these wild plants under *in situ* or *ex situ* condition is often suggested as a sustainable way to meet the growing market demand and also to create balance between the use and conservation of these economically important plants. To cope up with the alarming situation, biotechnical approaches (e.g. micropropagation, tissue culture and synthetic seed technology) are being used globally for the conservation and utilization of genetic resources.

Keywords: Plant tissue culture, micropropagation, conservation, genetic resources, phytomedicines

Green Business Practices: Balancing Environmental and Economic Development

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ABSTRACT

The escalating environmental challenges affecting individuals, corporations, and governments necessitate the widespread adoption of green business practices. These approaches aim to reconcile economic profitability with environmental sustainability by producing eco-friendly goods and services that meet consumer needs while minimizing ecological impact. This study delves into the concept of green business practices, focusing on their potential to mitigate environmental degradation and promote sustainable development.

By leveraging secondary data from peer-reviewed journals, conference proceedings, and credible media sources, the research highlights the growing integration of environmental considerations into business strategies. The findings reveal significant benefits of adopting green business models over conventional approaches. These include resource conservation, waste reduction, and a lower carbon footprint, all contributing to environmental efficiency. Furthermore, green practices foster innovation, enhance operational effectiveness, and strengthen brand reputation, ultimately driving long-term economic growth. Companies that embrace these practices experience improved regulatory compliance, increased customer loyalty, and enhanced competitiveness in the evolving market landscape. Key insights underscore the importance of collaborative efforts among businesses, consumers, and governments to foster an eco-friendly economic ecosystem. Promoting green business practices as a cornerstone of sustainable growth not only addresses environmental concerns but also ensures profitability and adaptability in a rapidly changing global market. Aligning corporate social responsibility with sustainable development goals, these practices offer a pragmatic solution to achieving an optimal balance between economic and environmental priorities. This transformative shift not only mitigates environmental risks but also lays the foundation for future generations to thrive in a balanced and sustainable economy. Green business practices thus emerge as a pivotal strategy for driving both ecological and economic resilience in an interconnected world.

Keywords: Green business practices, sustainability, corporate social responsibility, economic growth, environmental efficiency.

Economic Comparison of Open-Source vs. Proprietary AI Tools in Precision Agriculture.

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ABSTRACT

Precision agriculture harnesses data-driven technologies to optimize crop yield, reduce environmental impact, and improve farm efficiency. Open-source tools provide cost-effective, customizable solutions for data collection, analysis, and decision-making, offering an alternative to proprietary systems in precision agriculture. This study compares open-source AI tools such as Q Field for QGIS, OpenAg, FarmOS, OpenDroneMap, AgOpenGPS, and SoilGrids to proprietary tools, focusing on their economic implications for farmers. Open-source AI tools typically free from licensing fees , offer minimal ongoing costs, and allow full customization, making them particularly advantageous for small- to medium-sized

farms. However, they require technical expertise for setup, maintenance, and error correction , with support primarily from community-driven resources. In contrast, proprietary tools come with significant upfront costs, subscription fees, and vendor-dependent support. These tools are often more user-friendly, with professional assistance and regular updates, but are less flexible and offer limited customization. Proprietary systems may also retain ownership of data, potentially raising concerns over privacy and long-term costs. While proprietary tools are suitable for large-scale operations seeking seamless integration, open-source tools provide farmers with greater control over data and operational expenses. The economic benefits of open-source AI tools lie in their scalability and low long-term costs, as they do not require continuous subscription payments. They also enable farmers to tailor solutions to specific needs, fostering independence from proprietary systems. Despite challenges in technical support and usability, open-source tools offer significant opportunities for sustainable agriculture, particularly when considering the cost savings and adaptability they provide. This study concludes that open-source tools present a viable, economically sustainable alternative to proprietary systems, with substantial potential for enhancing precision agriculture practices.

Keywords: Precision Agriculture, Open-Source AI Tools, Proprietary AI Tools, Cost-E ffectiveness, Customization, Data Ownership, Farm Management, Sustainability, Economic Impact, Agricultural Technology

Isolation, Production, and Compatibility Testing of Silicase-Producing Microorganisms for Enhanced Paddy Straw Decomposition

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ABSTRACT

Paddy straw, with its high silica content, poses significant challenges for microbial decomposition, contributing to environmental issues like residue burning. This study focuses on isolating silicase-producing microorganisms, optimizing enzyme production, and assessing their compatibility for developing a microbial consortium.

Microorganisms were isolated from soil samples, screened for silicase activity through clear zone formation on silicate-containing media, and evaluated quantitatively via colorimetric assays. Compatibility tests revealed that all selected isolates were mutually compatible, highlighting their potential for use in a consortium.

These findings demonstrate the feasibility of utilizing compatible silicase-producing microorganisms to enhance paddy straw decomposition by effectively solubilizing silica and

breaking down complex lignocellulosic structures. This approach not only accelerates the decomposition process but also improves the accessibility of cellulose and hemicellulose for further microbial or enzymatic activity. By converting agricultural waste into nutrient-rich compost or other value-added products, this strategy offers a sustainable and eco-friendly alternative to the harmful practice of residue burning. Additionally, the use of a microbial consortium ensures adaptability to various field conditions, making it a scalable solution for effective agricultural waste management and soil fertility enhancement.

Keywords: Silicase, paddy straw, microbial consortium, compatibility testing, sustainable agriculture.

A Review on Impact of Ethnobotany on Sustainable Development

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ABSTRACT

Ethnobotany is the study of human interaction with plant. It has multiple applications in different field of current global concern including climate change, biodiversity conservation, food security and human health. Ethnobotanical studies have potential and offer a unique opportunity to integrate indigenous knowledge with scientific research ultimately contributing to the conservation of biodiversity and cultural diversity. In this paper plant diversity represents the development in ethnobotanical research and focus on unlocking its potential to tackle human issues and shape a more sustainable future. Agenda 2030's Sustainble Develoment Goals (SDGs) present comprehensive framework of 17 goals, centered on ensuring the prosperity of humanity and the health of the planet, while promoting holistic development and sustainability. Of the seventeen goals, at least seven goals are of interest to the ethnobotanist and are associated with traditional ethnobotanical knowledge.

Keywords: Traditional Knowledge, Ethnobotany, Sustainable Development Goals.

Untargeted Metabolomics of Root Exudates of Wheat Landrace and Domesticated Varieties Cultivated in Phosphorus Stress in the Indo-Gangetic Plains of India

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ABSTRACT

The present study was undertaken to determine how phosphorus starvation alters root exudate composition in wheat cultivars HD3086 and PBW725 and landrace LC306. This information is necessary for strategizing rhizospheric engineering for increased phosphorus use efficiency and improved crop productivity. Root exudates were collected at 20-25 days after sowing (DAS), 60 DAS, 90 DAS and at flowering stage from plants grown in P-amended and P-starved conditions. They were lyophilized and analysed by untargeted LC-MS/MS metabolomics using Waters 2795 Micromass Q-ToF. The MS/MS data was analysed using MassLynx. A total of 1,926 compounds were detected. The research revealed unique root exudate profiles among LC306 and the cultivars HD3086 and PBW 725. The phosphorus-starved samples contained 553 chemicals, while the phosphorus-amended samples contained 289. The heightened release of organic acids underscores the dynamic aspect of plant adaptability to low phosphorus environments. In HD3086, the levels of fatty acids, ketones and aldehydes elevated under phosphorus starvation, indicating involvement in energy metabolism and defensive mechanisms. A reduction in amides and sugars signified a metabolic transition away from nitrogen absorption and rapid energy sources. In contrast, PBW725 demonstrated a significant elevation in sugar concentrations in phosphorus-starved circumstances, particularly during the early growth phases, indicating an osmo-protective reaction to stress. Fatty acids and alcohols exhibited a declining tendency, possibly attributable to the reallocation of resources towards stress-related metabolites. LC306 exhibited a notable pattern, with fatty acids markedly elevated under phosphorus-amended throughout the flowering stage and a reduction under phosphorus-starved conditions. This drop indicates a transition from lipid storage or membrane production during stress. Conversely, ketones and flavones elevated during stress, presumably aiding adaptive stress responses. Carboxylates and amides exhibited considerable stability under varying settings, signifying their persistent function in fundamental cellular functions and adaptive mechanisms. Amides reached their maximum concentration in PBW725 under phosphorus-starved, indicating an elevated requirement for nitrogenous chemicals during stress. It aims to clarify how wheat plants adjust to phosphorus deficiency by altering their root exudation

patterns, hence affecting nutrient acquisition and interactions with soil microbes. Compounds of interest found as signaling molecules for root elongation include phytol and limonin, along with organic acids warranting further analysis: malic acid, aspartic acid, allantoic acid and mevalonic acid-5P.

Keywords: Phosphorus starvation, Root exudate composition, Wheat cultivars, LC-MS/MS metabolomics, Nutrient acquisition

Synthesis and characterization of iron, copper, and zinc nanopaticles for potential use as nano-fertilizer.

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ABSTRACT

Micronutrient deficiencies are a critical barrier to sustainable agriculture, impacting crop yield and quality worldwide. Iron, copper, and zinc deficiencies are particularly prevalent in plants grown in calcareous soils due to their alkalinity, low organic matter, and unfavorable texture. Traditional fertilizers often suffer from low bioavailability and environmental runoff, necessitating innovative approaches like nano-fertilizers. This study focuses on the chemical synthesis and characterization of nano iron (γ-Fe_2O_3), copper (CuO), and zinc (ZnO) nanoparticles. The nanoparticles of zinc were synthesized using sol-gel method, copper and iron using wet preciptation method. Various techniques were employed for characterization, such as UV-visible spectroscopy for optical properties, a Zeta analyzer for surface charge measurements, Scanning Electron Microscopy (SEM) for surface imaging, SEM-EDX (Energy Dispersive X-ray Spectroscopy) for elemental analysis, and Fourier Transform Infrared Spectroscopy (FTIR) for chemical bonding information.

The synthesised nanoparticles of zinc, copper and iron were in their oxide forms, with average sizes of 75 nm, 85 nm and 55 nm for CuO, ZnO and Fe_2O_3 respectively. The results of SEM showed that nanoparticles exhibit distinct shapes: cubic for CuO, spherical for ZnO, and nano-ball for Fe_2O_3. The FTIR characterization showed prominent FTIR bands at 775 cm^{-1} (Cu-O), 639 cm^{-1} (Zn-O), and 597 cm^{-1} (Fe-O), confirming successful synthesis at the nanoscale.

The elements studied as nanofertiliser are zinc, iron and copper because these elements are essential micronutrient to plants, and are often applied as soluble salts. Nevertheless, micronutrient availability to the plants applied may become low and deficiency occurs in some soils with alkaline pH, sandy texture, or those with low organic matter content. Presumably, nano fertiliser can improve the solubility and dispersion of insoluble nutrients in the soil, reduce fixation, and increase nutrient availability The application of these nanoparticles as nano-fertilizers offers enhanced nutrient uptake in plants due to their small size and high surface-area-to-volume ratio. These findings pave the way for sustainable agricultural practices, addressing critical micronutrient deficiencies while minimizing environmental risks.

Keywords: Micronutrient**,** sustainable agriculture, productivity, nano fertilizer, nanoparticles.

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