MANIPAL UNIVERSITY JAIPUR

1st International Conference on

WASTE Management-2025 (ICWM-2025)

Waste Assessment, Sustainability & Technological Empowerment for Solid and Liquid Waste Management

November 11-12, 2025 || Manipal University Jaipur

ABSTRACT BOOK

Organized by :

Department of Biosciences, School of Physical and Biological Sciences, Faculty of Science, Technology, and Architecture

About the Conference

The International Conference on Waste Management-2025 aims to bring together leading researchers, academicians, industry experts, policymakers, and practitioners to explore innovative and sustainable strategies for managing solid and liquid waste. The conference will focus on cutting-edge technologies, circular economy models, and integrated waste treatment systems to achieve a pollution-free and resource-efficient future.

Through knowledge sharing, case studies, and collaborative discussions, the event will highlight technological innovations, socio-environmental impacts, and policy frameworks that are vital to building a sustainable waste management ecosystem aligned with India's Swachh Bharat Mission, Net Zero targets, and the United Nations Sustainable Development Goals (SDGs).

International Conference on WASTE Management (ICWM-2025)
Waste Assessment, Sustainability & Technological Empowerment for Solid and Liquid Waste Management
Organized by
Department of Biosciences, School of Physical and Biological Sciences
Faculty of Science, Technology and Architecture
Manipal University Jaipur, Rajasthan, India
11-12 November 2025

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Prof. N. N. Sharma
President
Manipal University Jaipur

MESSAGE

It gives me immense pleasure to extend my warm greetings and best wishes to all participants of the International Conference on Waste Management-2025 (ICWM 2025), organized by the Department of Biosciences, Manipal University Jaipur, November 11-12, 2025. This international conference, centered on the theme "Innovations and Sustainable Practices in Waste Management," is a timely and commendable initiative that addresses one of the most pressing challenges of our era. Effective waste management is pivotal to environmental preservation, public health, and sustainable development, and I am delighted that this forum brings together leading academicians, researchers, policymakers, and industry professionals to deliberate on these vital issues.

The pursuit of sustainability requires collective effort, visionary thinking, and interdisciplinary collaboration. ICWM 2025 provides a valuable platform for knowledge exchange, fostering dialogue between scientific research and real-world application. I am confident that the discussions and outcomes of this conference will contribute meaningfully to shaping innovative solutions, responsible technologies, and sustainable policies that can guide future practices in waste management and environmental stewardship. I appreciate the efforts of the Department of Biosciences and the organizing committee for their dedication in conceptualizing and hosting this international event. The commitment to academic excellence and global engagement demonstrated through ICWM 2025 is indeed praiseworthy and reflects the ethos of Manipal University Jaipur in promoting research-driven initiatives for societal benefit.

I extend my heartfelt congratulations to all contributors, including the distinguished speakers, delegates, reviewers, and sponsors, whose participation and support have made this conference possible. I wish the organizers and participants great success and fruitful deliberations.

(Prof. N. N. Sharma)

Prof. Karunakar A. Kotegar
Pro President
Manipal University Jaipur

MESSAGE

It is with great pleasure that I extend my warmest wishes to all delegates, speakers, and participants of the International Conference on Waste Management – 2025 (ICWM 2025), organized by the Department of Biosciences, Manipal University Jaipur, during 11th – 12th November 2025. The theme of this year's conference, "Innovations and Sustainable Practices in Waste Management," highlights the urgent need for innovative approaches and collaborative strategies to address the global challenges of waste generation and environmental degradation. The efforts of the organizing committee to bring together experts from academia, industry, and government sectors on a common platform are truly commendable.

ICWM 2025 serves as an important avenue for fostering scientific exchange, encouraging interdisciplinary dialogue, and advancing the frontiers of knowledge in sustainable waste management practices. I am confident that the deliberations and discussions held during the conference will generate valuable insights, promote impactful collaborations, and inspire new directions for research and policy formulation in this critical area. The commitment of the Department of Biosciences in hosting such a prestigious international conference reflects the university's broader vision of promoting excellence in education, research, and innovation. By engaging global scholars and practitioners, ICWM 2025 reinforces the institution's role as a catalyst for meaningful change in the pursuit of environmental sustainability. It will aid in taking our nation a step closer to the fulfillment of the coveted United Nations Sustainability Development Goals 2030 (UN SDG - 2030).

I take this opportunity to congratulate the organizers, advisory committee members, session chairs, and all contributors for their dedicated efforts in ensuring the success of this conference. I extend my best wishes to all participants for stimulating discussions and productive engagements throughout ICWM 2025.

(Prof. Karunakar A. Kotegar)

Prof. Kuldip Singh Sangwan
Dean, Faculty of Science, Technology and Architecture (FoSTA)
Manipal University Jaipur

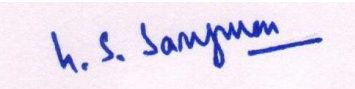
MESSAGE

Greetings to all the dignitaries, delegates and researchers of the International Conference on Waste Management – 2025 (ICWM-2025), organized by the Department of Biosciences, Manipal University Jaipur, during November 11-12, 2025.

The theme of the conference holds a great significance to the world, and India, in particular. Waste generation rates have been increasing globally. The projected increase in annual waste production is anticipated to reach 73%, resulting in a total of 3.88 billion tonnes by 2050 as compared to the reported levels of 2.24 billion tonnes in 2020 (The World Bank, 2022). This unprecedent waste generation places huge pressure on the researchers and governments to combat this problem.

I am sure the delegates to this conference will discuss and debate various methodologies and technologies to reuse/recycle/repurpose this, but we should also discuss social behaviour or responsibilities to reduce waste generation.

Looking forward to a successful and impactful conference.



(Prof. Kuldip Singh Sangwan)

Prof. Ashima Bagaria
Associate Dean, SoPBS
Manipal University Jaipur

MESSAGE

It is my great honor and privilege to extend a warm welcome to all the dignitaries, delegates, distinguished speakers, researchers, and participants to the International Conference on Waste Management – 2025 (ICWM 2025), organized by the Department of Biosciences, Manipal University Jaipur, during November 11-12, 2025. The central theme of ICWM 2025, "Innovations and Sustainable Practices in Waste Management," reflects the growing global emphasis on the efficient utilization of resources and the development of environmentally responsible technologies. The conference aims to provide a comprehensive platform for the dissemination of cutting-edge research, technological innovations, and policy perspectives in the fields of solid and hazardous waste management, wastewater treatment, recycling technologies, circular economy, and sustainability.

ICWM 2025 has attracted contributions from eminent academicians, scientists, industry professionals, and policy experts from India and abroad. The conference features keynote addresses, invited talks, and technical sessions that will facilitate the exchange of knowledge and foster collaborative research opportunities among participants. The Department of Biosciences, Manipal University Jaipur, continuously strives to promote research and innovation addressing environmental and societal challenges. The organization of ICWM 2025 is a significant step in this direction, reinforcing our commitment to advancing sustainable solutions through steadfast commitment and interdisciplinary collaborations.

On behalf of the organizing committee, I extend my sincere gratitude to our Patrons, Advisory Board Members, Session Chairs, Reviewers, Committee Members, Sponsors, and all those who have contributed towards the successful organization of this conference. I wish all the participants of ICWM 2025 a highly productive and intellectually enriching experience.

(Prof. Ashima Bagaria)

Prof. Sandeep K. Srivastava
Head, Department of Biosciences
Manipal University Jaipur

MESSAGE

I am delighted to welcome all participants to the International Conference on Waste Management 2025 (ICWM 2025), organized by the Department of Biosciences, Manipal University Jaipur, from November 11-12 November 2025. This conference is centered around the theme of Innovations and Sustainable Practices in Waste Management. It aims to provide a dynamic platform for academicians, researchers, industry professionals, and policymakers to share their insights and advancements in this vital domain. ICWM 2025 brings together global experts and scholars working on various aspects of waste management from solid and hazardous waste to wastewater treatment, recycling technologies, circular economy, and environmental sustainability. The conference will feature keynote lectures, invited talks, paper presentations, and interactive sessions designed to foster knowledge sharing, meaningful discussions and networking opportunities.

The Department of Biosciences takes pride in hosting this international event, which reflects our continuous commitment to promoting research and innovation for a cleaner and greener future. This year, the conference will be held in hybrid mode, allowing both in-person and virtual participation to ensure global accessibility and engagement. We are also proud to have the support of immensely talented researchers, academics, eminent organizations and industries working in the field of environmental management who have come together from different parts of the world. Their invaluable collaboration strengthens the impact and reaches ICWM 2025.

I wish all the external delegates have a fruitful experience in Pink City, Jaipur and hope that ICWM 2025 provides an enriching experience filled with knowledge exchange, networking, and new research opportunities that inspire sustainable solutions for our planet.

With best wishes for a successful and impactful conference.

(Prof. Sandeep K. Srivastava)

Abstract No: KN1

Science, Innovation and Circular Economy Pathways for Sustainable Waste and Resource Management

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Science, Innovation and Circular Economy Pathways for Sustainable Waste and Resource Management. India stands at a pivotal moment where rapid urbanization, rising resource demands, and increasing waste generation compel a fundamental shift from linear consumption to a circular and sustainable model. This keynote presentation highlights how science, technology, and innovation-anchored by the Department of Science and Technology (DST)-are driving transformative solutions in solid and liquid waste management through an integrated Energy–Water–Waste nexus approach. Showcasing advances in solar-to-fuel pathways, energy storage, methanol and biofuel technologies, advanced industrial wastewater treatment, and cross-cutting sustainability interventions, the talk illustrates how national missions such as Swachh Bharat 2.0, the Waste-to-Wealth Mission, and the Circular Economy framework align with DST-supported research and pilot demonstrations, including zero-waste community models and industrial wastewater valorization. The presentation further outlines the opportunities for academia, startups, and industry to collaborate in developing scalable technologies that convert waste into energy, materials, and value-added products—thus contributing directly to India's climate goals and the vision of a resource-positive, net-zero future. By integrating scientific innovation with real-world deployment, the keynote emphasizes that waste is not a burden but a renewable resource that, when harnessed effectively, can propel India towards a circular, climate-positive economy

Abstract No: KN2

From Linear to Circular: Pioneering the Next Generation of Waste Solutions

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This presentation examines how shifting from a traditional linear model to a circular economy (CE) in waste and resource management can accelerate progress toward the United Nations Sustainable Development Goals (UN-SDGs). The linear "take-make-dispose" approach has contributed to mounting environmental, social, and economic pressures. In contrast, a circular economy—rooted in principles of resource efficiency, environmental stewardship, and ustainable development—offers a regenerative pathway that aligns closely with the core pillars of the UN-SDGs, including public health, climate action, and inclusive economic growth. By embedding circular engineering strategies into policy frameworks-supported by tools like life cycle assessment (LCA) and technoeconomic assessment (TEA)-governments and industries can redesign systems to retain material value, minimize waste, and reduce environmental footprints. Yet, the transition is not without challenges: outdated policy structures, technological limitations, and lack of public awareness continue to impede circularity. Addressing these barriers will require a systemic approach, including the formalization of stakeholder roles, investment in green infrastructure, and targeted education and training-particularly for workers in the informal waste sector. The presentation will highlight how CE-based strategies can foster green job creation, particularly through resource recovery initiatives that contribute to both climate mitigation and sustainable livelihoods. Furthermore, circular product design and business models-enabled by digital innovation and advanced manufacturing—will be explored as tools to extend product lifecycles, enhance material reuse, and close resource loops. By transitioning to a circular economy, we can shift from managing waste to designing it out entirely-achieving long-term environmental and economic resilience.

Abstract No: KN3

Resource recovery from solid waste for energy and environmental sustainability vis-à-vis circular bioeconomy

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Solid waste management is one of the primary concerns in any civilization. Generally, agrarian waste and household waste share the largest chunk. In general, the cost involved in managing these wastes is not an affordable deal for small farmers or poor. Therefore, an inclusive approach is required which creates a revenue sharing with all stakeholders, offering not only environmental sustainability but also social and economic prospects. In the waste to wealth or waste to energy concept, the approach should be integrative, involving all stakeholders. Feasibility assessment, appropriate technology, supply chain, revenue sharing, socio-political approach, and policy design and their enforcement are considered as key factors which influence the success. Various kinds of solid waste affect the environment and humanity. While municipal solid waste (MSW) is a burning issue globally, horrifying situation world has today on waste of food, generating he quantities of food waste. Identification of gaps to develop the R&D-based appropriate tools, techniques, and technology to meet the goal effectively is still a big challenge. In a modern waste management system, it is imperative to recover resources from the waste and treat them following the principles of circular economy. The lecture will dwell upon opportunities and challenges on treatment and management of solid wastes with sustainability as key point vis-à-vis a circular bioeconomy perspective.

Abstract No: KN4

Waste to Energy: A Comprehensive Study on Biogas in India

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Fossil fuels and other conventional energy sources are scarce and harmful to the environment. Thus, the only option for achieving sustainable growth is to use renewable energy. Among the different alternative energy sources accessible, biomass-based energy is one of the most affordable while simultaneously tackling the pressing issues related to the management of waste. Estimating the potential is essential to making the most of the biomass. State-by-state biomass databases are useful for implementing regional bioenergy policies. A biomass resource database at the state level does not exist in India, though. The potential for producing biogas at the state level from a variety of sources, such as crop residues, animal and poultry wastes, municipal solid wastes, and wastewater (both industrial and sewage) was evaluated. India's potential for producing biogas from organic waste is estimated to be 74795 million m3 per year. In India, digesters capable of producing 3635 million m3 per year are now operational. This demonstrates the enormous disparity between potential and actual use. Although it is believed that biogas plants are environmentally benign, the frequent leaks and purposeful releases of biogas from badly maintained digesters raise doubts about any potential environmental advantages. It was determined how important biogas is as a fuel for energy, cooking, and bio-CNG. According to the research, biogas generation can cut India's household cooking emissions by 1/5th. It also shows that biogas-derived power and bio-CNG produce fewer greenhouse gases (GHGs) across their value chain than other fuels. However, there remain obstacles to the widespread use of large-scale biogas facilities, both technological and non-technically. Therefore, for the deployment of a large-scale biogas plant in India to be successful, multiple mitigating strategies must be developed. The rise of bioenergy generation will be accelerated by the successful installation of biogas facilities, which will also address urgent waste management challenges.

Abstract No: KN5

Old and New in Composting and Compost Research

Prof. Yael Laor

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Composting is widely recognized as a well-established technology for recycling organic waste. Essentially, it is a simple, low-cost, low-tech process that relies on natural biological activity. However, it also involves a range of scientific, engineering, and practical challenges of varying complexity. Over the years, extensive research has explored the fundamental principles and practices of thermophilic composting, while more recent studies have increasingly focused on emerging environmental concerns. This talk will highlight recent composting studies addressing three key environmental topics: (i) emissions of ammonia, volatile organic compounds (VOCs) and odors, (ii) composting of broiler carcasses during mass depopulation events, and (iii) the compostability of polymers. These studies were conducted using both an advanced laboratory composting simulator and a pilot-scale setup of composting sleeves with forced aeration.

Abstract No: KN6

Microwave-assisted Tetrahydrofuran-water pretreatments: Unlocking High Sugar Yields and Platform chemicals from Agricultural Residues

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One of the central challenges in lignocellulosic biomass valorization is its efficient conversion into fermentable sugars, bypassing its inherent recalcitrance. This calls for the development of efficient and economically viable pretreatment strategies. The present study explores the organosolv pretreatment approach, involving Tetrahydrofuran-water (THF-H2O) systems under microwave (MW) heating to improve the saccharification efficiencies in Rice straw. A high sugar yield of 63.4% (100 °C, 40 min) was observed in the MW-assisted pretreatment using THF-H2O in the Rice straw, which was much higher than the conventional pretreatment (21.3%). Process optimization using Central Composite Design-Response Surface Methodology (CCD-RSM) also demonstrated the critical influence of individual parameters, such as the temperature, residence time, substrate ratio, and enzyme load. The optimized conditions were fine-tuned to 100 °C, 40 min, 5% substrate ratio, 200 U enzyme load by the CCD-RSM method, yielding a high sugar yield of 76.6%, exhibiting statistical reliability with a p-value <0.05 and R2=0.97. Further, a comparative study using sequential dilute-organosolv (DASQ), autohydrolysis-organosolv (AHSQ), and single-step (SS) pretreatments across different agricultural residues. The results showcased the superiority of the MW-DASQ pretreatments, delivering high sugar yields of 80.9%, 69.0%, and 46.7%, respectively, in Rice straw, Sugarcane bagasse, and Wheat straw. The crystallographic (XRD) and spectroscopic (FTIR) analysis of the DASQ pretreated samples exhibited substantial reductions in the crystallinity of the pretreated samples, coalescing with their higher enzymatic digestibility. The profiling of the pretreatment hydrolysate revealed the presence of 11 platform chemicals in Rice straw and Sugarcane bagasse, 10 in Wheat straw. The dual applicability of the pretreatment systems for both sugar and platform chemical production underscores their importance in biorefineries. Further, the highly digestible pretreated biomass can also be used to create innovative products like Carbon Quantum Dots, Bio-adhesives, hydrogels, etc.

Abstract No: IS1

An Integrated Chemical and Biological Approach for Poly(ethylene terephthalate)

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Poly(ethylene terephthalate) (PET) is a globally well-known and used petroleum-based thermoplastic polyester that has intensely transformed and prompted a paradigm shift in the polymer industry. In this study, we established an innovative and integrated chemical/biological methodology for the complete poly(ethylene terephthalate) (PET) degradation and biopolyol production using cerium–iron oxide nanoparticles (CeFeNPs). Initially, three nanoparticles, i.e., CeNPs, FeNPs, and CeFeNPs, were synthesized and evaluated for PET glycolysis. CeFeNPs demonstrated the best catalytic performance for PET depolymerization to bis(2-hydroxyethyl) terephthalate (BHET) and were further recovered from the PET depolymerized slurry to be reutilized again. BHET was further biodegraded using the hydrocarbonoclastic bacterium Pseudomonas aeruginosa PR3 under the batch modes using a shake flask and a stirred tank bioreactor. To elucidate the fate of BHET biodegradation under aerobic conditions, identification of various BHET degraded metabolites was carried out using liquid chromatography–mass spectrometry analysis. The strain could produce an extracellular diol synthase enzyme, which transforms oleic acid into the biopolyol, 7,10-dihydroxy-8(E)-octadecenoic acid (DOD). CeFeNPs were further supplemented to enhance DOD production via whole cell and cell-free approaches.

Abstract No: IS2

Impacts of Adding Plastics and Their Degradation on the Integrated Biological Treatment of Food Waste through Anaerobic Digestion Followed by Composting

Dr. KC. Maturi

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The presence of plastics in food waste is an important consideration for integrated biological treatment systems combining anaerobic digestion (AD) and composting. This study investigated the influence of four plastics: polyethylene terephthalate (PET), oxydegradable, polylactic acid (PLA), and compostable plastics on process performance and plastic degradation. AD was conducted under thermophilic conditions (55 °C) for 30 days using inoculum with total solids (TS) of 2.51 ± 0.45% and food waste with TS of 36.34 ± 0.12%. The digestate was further stabilized by composting for 60 days with aeration, maintaining 35 °C for the initial 3 days, 55 °C for 7 days, and 35 °C for the remaining 50 days. A mixed substrate of food waste and sawdust was used with a C/N ratio of 27.62 ± 0.86. Results indicated biomethane potentials of 200 mL g^{-1} VS_added and 215 mL g^{-1} VS_added for PET and oxydegradable plastics, respectively, compared to 350 mL g^{-1} VS_added in the control. In contrast, compostable plastic and PLA reactors achieved biomethane potentials of 320 mL g^{-1} VS_added and 290 mL g^{-1} VS_added, demonstrating substantial performance close to the control. The degree of disintegration was notable, with compostable plastics achieving 22% and PLA 16% degradation after the integrated process. These findings confirm that compostable and PLA plastics undergo significant breakdown under combined AD-composting conditions, while maintaining favorable biogas yields, thereby supporting their suitability in sustainable food-waste management and high-quality compost production.

Abstract No: IS3

Industrial Scale Thermolysis for Waste Upcycling: Driving Circular Economy and Net-Zero Sustainability

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Waste upcycling is emerging as a critical strategy for advancing circular economies and achieving national net-zero targets. By converting municipal, industrial, and agricultural residues into syngas, oil, and char, upcycling mitigates environmental impacts while maximizing resource efficiency. Key approaches include biochemical methods (e.g., anaerobic digestion, fermentation), thermochemical routes (e.g., gasification, pyrolysis/thermolysis), and mechanical recycling. Among these, thermolysis or pyrolysis is a thermal decomposition process under oxygen-free conditions, offers distinct advantages: rapid processing (minutes to hours), high energy recovery (70–80%), and the ability to handle heterogeneous, non-biodegradable wastes, reducing landfill dependency by up to 90%. In contrast, biochemical methods are feedstock specific and slow (20–40 days), while gasification demands higher temperatures (>800 °C) and favors gaseous outputs, limiting solid product recovery. Scaling pyrolysis from pilot to commercial levels is crucial for realizing its full potential. Integrated systems with heat recovery and catalyst optimization (e.g., zeolite, Ni-based) ensure economic viability and reduced emissions. Within biorefinery frameworks, pyrolysis enables cascading utilization of all waste fractions, contributing to renewable energy portfolios (20–30%) and supporting decarbonization, zero-waste, and sustainable industrial development goals. Industrial-scale pyrolysis positions waste as a strategic resource, transforming environmental liability into economic and energy value, and reinforcing its role as a cornerstone of circular economy transitions.

Abstract No: IS4

Ecotechnologies and bioprocesses for the Sustainable Development Goals: Experiences from waste-gas treatment, and resource recovery systems

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Ecotechnologies and bioprocesses for waste gas treatment combine environmental engineering, microbiology, and sustainable design to control air pollution using biological means rather than purely physical or chemical ones. Waste gas treatment refers to the removal or conversion of harmful or odorous compounds from industrial emissions before they are released into the atmosphere. The traditional methods (e.g., thermal oxidation, absorption, adsorption, or chemical scrubbing) can be energy-intensive, costly and may generate secondary pollution. In this presentation, an example of waste gas treatment from a pulp and paper mill containing a mixture of volatile organic and inorganic pollutants (i.e. methanol, α-pinene and H2S) will be discussed. Experimental results from long term quasi-steady state and transient state operations will be presented. The maximum elimination capacities (ECmax) of the BTF were 302, 175, and 191 g m−3 h−1, with 100%, 67%, and >99% removal of methanol, α-pinene and H2S, respectively. The presence of methanol showed an antagonistic removal pattern for α-pinene, but the opposite did not occur.

Abstract No: IS5

Pretreatment of Sludge: A Sustainable and Renewable Energy Recovery Approach

Prof. Izharul Haq Farooqi

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Slaughterhouse wastewater (SWW) poses a major environmental challenge due to its high organic load comprising excreta, fat, undigested food, blood, and meat residues. Conventional physicochemical and biological treatment methods generate large sludge volumes, accounting for over 60% of total treatment costs. Anaerobic digestion (AD) offers a sustainable solution for sludge management; however, the hydrolysis step remains a critical bottleneck due to the complex colloidal structure of sludge particles rich in proteins, carbohydrates, and extracellular polymeric substances (EPS). This structure limits hydrolysis efficiency, affecting settleability, bioflocculation, and floc stability. Therefore, improving hydrolysis is essential to enhance AD efficiency and reduce sludge disposal impacts.Several pretreatment techniques—such as electrochemical, microwave-ozone, photo-Fenton, sodium hypochlorite, thermal-alkaline, and ultrasonic-Fenton—have shown promise in improving sludge disintegration and hydrolysis. Among these, the electro-Fenton (EF) process, an electrochemical advanced oxidation process (EAOP), is particularly effective due to its in-situ generation of hydroxyl radicals (OH), environmental compatibility, and low sludge formation. Despite limited research, EF shows strong potential for enhancing biogas yield and reducing environmental footprints in sludge treatment systems.This study investigates the application of EF pretreatment on waste activated sludge (WAS) from a cattle-based slaughterhouse effluent treatment plant to enhance AD performance. Key operational parameters—including H_2O_2 concentration, current density, and reaction time—were optimized using Design Expert software. The optimized EF conditions significantly increased soluble extracellular polymeric substances (sEPS) and soluble chemical oxygen demand (sCOD), while reducing suspended volatile solids (sVS). Consequently, the biomethane potential (BMP) was markedly higher in pretreated sludge compared to untreated samples, demonstrating that EF pretreatment effectively enhances anaerobic digestion efficiency and contributes to sustainable wastewater management.

Abstract No: IS6

Solid-state anaerobic digestion of agricultural residues and its concurrent treatment to enhance methanogenesis

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The global economic system relies heavily on fossil fuel sources for production of fuels and chemicals. However, these fossil fuels are finite resources, and their depletion is unavoidable. With the rising world population and improving living standards, global energy consumption and demand are expected to increase significantly over the next fifty years, potentially rising from the current 17.7 terawatts (TW) to 28 TW by 2050. To address this challenge, renewable energy sources such as biomass, wind, and solar power present a secure, sustainable, and environmentally friendly solution to meet energy demands. Agro-industrial residual resources and non-food plant biomass provide sustainable, renewable, and alternative feedstocks for energy and chemical production within the emerging bioeconomy. Consequently, the development of efficient biomass conversion technologies and sustainable biomass production systems will be crucial. Lignocellulosic biomass possesses inherent recalcitrance due to its chemical structure; thus, despite advancements in enzyme technology, its processing typically requires physicochemical pretreatment for optimal biochemical conversion. Thermal hydrolysis or steam explosion stands out as one of the most efficient and environmentally friendly pretreatment methods for lignocellulosic biomass, effectively applicable to both marine and terrestrial biomass. Ongoing research aims to uncover the mechanisms underlying lignocellulose breakdown through pretreatment, facilitating the extraction of more sugars and energy. Key areas of investigation include the fundamental characteristics of various biomass types (suchas lignocellulose, seaweed, and agricultural residues), their saccharification efficiency, biomethane potential, and composition of microbial consortia, all of which are essential for realizing the future potential of biomass in energy applications within bioeconomy.

Abstract No: IS7

Sewage Sludge to Biochar: Characterization and Agronomic Evaluation for Sustainable Waste Management

Dr. Rohit Jain

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This study investigates the physical and chemical properties of biochar derived from sewage sludge at different temperatures (300oC, 3T; 500oC, 5T & 700oC, 7T) and time durations (60 min, 1H, 120 min, 2H, 180 min, 3H), compared to an untreated raw sample. Key parameters such as yield, water holding capacity (WHC), pH, moisture, volatile matter (VM), fixed carbon (FC), and total ash content (TAC) were analysed. The raw sample exhibited moderate WHC, low pH, high VM, and significant TAC. Treated samples demonstrated high biochar yield for the 3T series, with increasing WHC and pH, low moisture content, reduced VM, and elevated TAC. The 5T and 7T series showed moderate to low yields, higher WHC, higher pH, and substantial TAC, indicating enhanced stability and reduced volatility. Heavy metal distribution analysis revealed stable concentrations of Al, Cu, Fe, Pb and Zn in oxidizable and residual fractions, with notable shifts in Co and Ni concentrations in 5T and 7T series. Fourier Transform Infrared Spectroscopy (FTIR) analysis identified decreasing carbonyl and hydroxyl groups and increasing phosphorus peaks with treatment intensity. Microscopic imaging highlighted significant carbonization and pore structure development, particularly at 500 °C. Based on these analyses, biochar produced at 500°C for 2 hours was identified as optimal for agricultural applications. The selected biochar (5, 10, 20, 30, and 50 %) was subsequently applied to soil to evaluate their impact on soil quality parameters and plant growth performance, using Indian Mustard (*Brassica juncea*) as the test crop. Biochar treatments significantly impacted plant growth metrics, with treatments T1 (5%) to T3 (20%) improving germination rates, shoot length, root length, dry biomass, chlorophyll content, phenol content, and peroxidase activity. Soil pH and WHC also improved across treatments, with the highest improvements in T5 (50%). Ecological risk assessment revealed reduced risks for heavy metals with treatment, though some treatments still posed moderate to high risks. These findings underscore biochars potential to improve soil quality and reduce environmental risks.

Abstract No: OS1

Pyrolyzed Food Waste-Derived Polymer Composite from Wood Apple Shells: A Circular Economy-Based Approach

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The increasing focus on sustainable waste management and circular economy has encouraged research into converting agricultural and food residues into functional materials for environmental remediation. In this study, a novel adsorbent composite was developed from wood apple shell, an abundant organic food waste, for the efficient removal of malachite green dye from contaminated water. The composite was prepared using pyrolysis-derived wood apple shell biochar, which was subsequently combined with microcrystalline cellulose to improve its structural stability and surface functionality. To quantify the removal/adsorption efficiency of the composite, batch studies were performed, where, 0.2 g of the composite was added to 25 ml of solution containing malachite green at varying concentrations up to 350 ppm, and the residual dye concentration was determined using UV-Visible spectrophotometry. The process was both rapid and effective, achieving over 99% dye removal within 20 minutes at neutral pH. Results highlight strong adsorption capacity, cost-effectiveness, and a strategic waste management process. This sustainable synthesis approach not only utilizes agricultural waste and reduces environmental burden but also provides a value-added solution to wastewater treatment challenges. This work transforms wood apple waste into a high-performance adsorbent, showcasing circular economy-based water purification while promoting environmental sustainability and resource valorization

Abstract No: OS2

Transforming Millet Residues into Value-Added Products

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Millet cultivation and processing generate substantial agricultural residues, which, if effectively utilized, can contribute to sustainable development and circular bioeconomy. India alone produces over 17 million metric tons of millets annually. The post-harvest millet processing results in generation of biomass waste, including husks, bran, stalks, and other by-products. These residues, often underutilized or discarded, hold immense potential for conversion into valuable products such as dietary fiber supplements, biochar, biodegradable packaging, livestock feed, and nutraceuticals. This research work explores the scope of millet residue valorization through innovative processing technologies. Techniques such as fermentation, extrusion, pyrolysis, and enzymatic treatment have enabled the transformation of millet husks and bran into functional food ingredients rich in antioxidants, polyphenols, and dietary fiber. Additionally, millet stalks and leaves are being repurposed into bio-based composites and organic fertilizers, thereby reducing environmental impact and enhancing soil health. The annual millet residue generation post-processing is estimated to be 2.5 to 3.4 million metric tons in India alone, based on current production and processing ratios. Harnessing this biomass through value chain development not only mitigates agricultural waste but also creates economic opportunities for rural communities, especially women-led self-help groups and small-scale enterprises. In conclusion, the strategic processing of millet residues into value-added products represents a promising avenue for sustainable agriculture, waste reduction, and rural entrepreneurship. Future research should focus on scalable technologies, policy support, and market integration to fully realize the potential of millet residue valorization.

Abstract No: OS3

Functionalized Graphene Nanocomposite-Anchored Biopolymer Film as Smart Sensor Platform for Fluorescent and Electrical Sensing of Chlorpyrifos

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Excessive application of chlorpyrifos (CPyF) has led to persistent residues that pollute the environment and threaten the health of both humans and wildlife. Current detection techniques, such as GC-MS, HPLC, and electrochemical methods, offer high sensitivity but are hindered by high costs, complex sample preparation, and limited portability. Moreover, the susceptibility of enzyme-based sensors to environmental conditions highlights the demand for robust, non-enzymatic sensors capable of providing fast and reliable CPyF detection. This study presents a sustainable, low-cost, and highly sensitive fluorescence and electrical-based sensing platform for CPyF detection, utilizing graphene-based nanocomposite from Adenanthera pavonina (AP) seeds via KOH-assisted gas exfoliation. AP seeds, abundant in carbon-rich lignocellulosic components and bioactive compounds, were processed to extract cotyledons, which served as the graphene precursor. The synthesized graphene oxide was further functionalized to obtain a fluorescent nanocomposite (Cot-GN-HAP), which served as a basis for creating a smart sensing platform. Photoluminescence (PL) studies revealed strong fluorescence emission, which was progressively quenched upon interaction with CPyF via a Foster resonance energy transfer (FRET)-based mechanism. Also, a Cot-GN-HAP-anchored biopolymer-coated cellulose-based flexible substrate is prepared, which is used as a multimodal sensor that can process electrical responses in the presence of CPyF. The effectiveness of this method was validated using three real samples: tap water, pond water, and vegetable extract, which yielded similar LOD values.

Abstract No: OS4

Optimizing methane yield through co-digestion of pig dung with food waste and water hyacinth at varying F/M ratios and its kinetic analysis

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Piggery waste is a major contributor to the environmental pollution in swine farming areas. To mitigate this challenge, recent research highlights its potential use for sustainable energy production through anaerobic digestion. This study investigates the co-digestion of pig dung with two different co-substrates, food waste and water hyacinth, at varying food-to-microorganism (F/M) ratios (0.5, 1.0, 1.5, and 2.0 based on volatile solids) to enhance biomass degradation. Results indicated that co-digestion significantly improved methane yield and process stability compared to mono-digestion (control). The highest methane yield for the co-digestion of pig dung was achieved at an F/M ratio of 1.0 with food waste and 1.5 with water hyacinth, showing increases of 30% and 20% over the control, respectively. Maximum cumulative methane production reached 5150 mL (food waste, F/M-1.0) and 4880 mL (water hyacinth, F/M-1.5) due to enhanced metabolic activity resulting from improved nutrient balance. In contrast, the lower methane yields occurred at F/M-2.0 for both co-substrates due to the process instability caused by excessive microbial proliferation. Kinetic analysis using the modified Gompertz model showed strong agreement between the experimental and predicted values with a coefficient of determination (R^2) of 0.998. FTIR (organic functional groups) and FESEM (morphological features) analysis showed the valid chemical and morphological apprehension of the substrates before and after digestion. Overall, the findings demonstrate a strong positive relationship between methane yield and key digestion parameters, indicating the possibility of coordination as an effective strategy for sustainable energy recovery from the piggery waste.

Abstract No: OS5

Household Waste Generation and Disposal Patterns in Dimapur: Community-Based Strategies Toward Circular and Sustainable Waste Management

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Household waste is a significant part of municipal solid waste, and its management remains a growing concern due to improper disposal practices and inadequate infrastructure. The increasing volume of waste, coupled with the lack of segregation at the source, has led to environmental and public health challenges. This study aims to assess the generation, composition, and disposal patterns of household waste in Dimapur, identifying key issues and proposing effective solutions. For this study, a detailed assessment was carried out through household surveys and field-based waste characterisation to analyse the quantity and type of waste generated across different areas of the city. The results indicate that biodegradable waste accounts for the majority of household waste, followed by plastic, paper, cardboard, and miscellaneous materials. The findings also highlight issues such as poor waste segregation, inefficient collection systems, and limited public awareness regarding sustainable waste disposal practices. To advance sustainable solid waste management, the study proposes community-driven interventions emphasizing source segregation, composting of organic waste, and integration of recycling networks for material recovery. Such approaches can support local circular economy transitions, reduce landfill dependency, and promote cleaner urban environments. The outcomes contribute to developing policy frameworks and eco-innovative solutions for achieving zero-waste and sustainable city goals in Dimapur and similar urban contexts.

Abstract No: OS6

Evolution of India's E- Waste Policy: An Overview with Global Comparison

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The growing volume of electronic wastes (e-wastes) across the world raises serious public health concerns and hampers the attempts to achieve environmental sustainability goals. E-waste management is especially challenging in rapidly developing countries like India with stringent economic budgets and dense population. In recent years, almost all countries have prioritised development of practical e-waste management policies and frameworks to encourage recycling, inculcate citizen responsibility and develop centralised collection, dismantling and disposal systems. This review provides a comparative overview of e-waste management policies in top five e-waste generating countries including China, United States, India, Germany, and Japan. It also highlights the evolution of India's policy landscape, which first represented basic compliance rules in 2016, and has now expanded its scope with numerous mandates and protocols described in E-Waste Management Rules, 2022 and subsequent amendments in 2023 and 2024. Notably, the review identifies opportunities for policy harmonization, technological innovation, and grassroots engagement in Indian policies to ensure a circular electronic lifecycle. Altogether, these insights aim to support future reforms that align with national efforts of achieving global sustainability goals.

Abstract No: OS7

Dual Organic Amendments Enhance Soil Fertility Through Improved Microbial and Enzymatic Processes

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Bajra (Pennisetum glaucum)isan essential staple crop widely cultivated in semi-arid and desert parts of Asia and Africa, and the growth may thrive by the application of biochar and a vermicompost solution (vermiwash) which has the potential to amplify the beneficial effects of the soil biomass and themicobial activity.In the present study, the effects of several treatments combining vermiwash, biochar, and a combination of the two on microbial populations, soil health, and Bajra growth was investigated. A 60-days study was performed with four treatments, including control, biochar treated plant, vermiwash treated palnt, and one treatment with a mixture of biochar soaked in vermiwash. The microbial load, enzymatic activity, and some chemical properties like organic carbon, phophorus content, and calcium carbonate content were analyzed. The application of biochar and vermiwash in combination showed outperformed results as compared with other treatments resulting in improved soil characteristics and enzymatic activity, suggesting higher microbial activity. The application also improved phosphorus, organic carbon levels and nitrogen availability for the plants. The research gave a conclusion, highlighting the complementary roles of vermiwash and biochar that contributes soil health and fostering beneficial microorganisms. Therefore, the results of study ultimately imply that the treatment in combination could serve as a long-term, sustainable addition to improve microbial health and soil fertility for agricultural purposes.

Poster No: P1

Occurrence of Microplastics in different stages of Sewage Treatment Plant in Noida

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Microplastics (MPs) are emerging pollutants widely found in diverse environmental compartments, with sewage treatment plants (STPs) recognized as main source for their release into aquatic and terrestrial systems. Since conventional STPs are not specifically designed for MP removal, both treated effluent and sewage sludge often retain considerable loads. This study investigated MP occurrence, abundance, and characteristics in a municipal STP in Noida, Uttar Pradesh, India. Samples were collected from influent, post-screening, post-aeration, effluent, and sludge, and processed using chemical digestion and density separation. MPs were identified and characterized through stereomicroscopy, Fourier-transform infrared spectroscopy (FTIR), and field emission scanning electron microscopy (FESEM). MPs were detected at all treatment stages, with influent showing the highest concentration (460 ± 4.35 MPs/L) and effluent displaying a reduced but still substantial load (310 ± 4.72 MPs/L). Sludge contained notable levels (256 ± 6.55 MPs/g), indicating its role as a significant sink. Color analysis revealed red (45%) and blue (39%) particles as dominant, followed by transparent (23%). Fragments (41%) and fibers (55%) were the prevailing morphologies. Polymer analysis confirmed the presence of polyethylene, polypropylene, polyvinyl chloride, polyethylene terephthalate, and polystyrene. Overall removal efficiency was limited to 32.6%, reflecting reliance on primary and secondary treatments, which are less effective at capturing smaller MPs (<50 µm). These particles frequently bypass conventional barriers, contributing to continuous discharges into receiving waters. Findings highlight the need for advanced tertiary treatment technologies, alongside strict regulatory frameworks and routine monitoring, to enhance MP removal and reduce associated ecological and human health risks.

Poster No: P2

Potential amendment of Deepor Beel soil through the application of biochar and nanoparticles

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Over the past few centuries, urbanization and agriculture have significantly reduced freshwater wetlands, with an estimated 21% loss in global freshwater wetland area (3.4 million km2). This degradation alters plant biomass, soil properties, and microbial diversity, thereby impacting the composition of soil organic carbon and enzyme activity. However, in India's northeastern region, these ecosystems remain largely underexplored. Taking these factors into consideration Deepor Beel was chosen as our study area because: (1) it is Assam's only Ramsar site and, is considered a representative of wetlands within the Burma monsoon forest biogeographic zone; (2) recognized for its rich biodiversity, Deepor Beel is listed in the Directory of Asian Wetlands, Important Bird Area (IBA) list of Birdlife International; (3) it faces severe threats from anthropogenic activities like illegal encroachment, intensive fishing, agriculture and industrialization. This ongoing degradation endangers its sediment's abiotic and biotic communities. Previous studies on Deepor Beel reported high concentrations of iron (Fe), zinc (Zn), manganese (Mn), Cr, nickel (Ni), and Co in sediments and water, elevated levels of Fe, Mn, Zn, and Pb in macrophytes and fish, and a high percentage of Pb in its exchangeable fraction (bioavailable form). In the present study, we investigated the potential application of biochar and nanoparticle (hydroxyapatite modified with magnesium and aspartic acid) in the biochemical restoration of degraded soils from the Deepor Beel wetland. The biochar used in this study was produced from Pistia stratiotes, an invasive macrophyte abundantly found in Deepor Beel, which is generally regarded as a weed

Poster No: P3

Assessment of Bioactive Compounds of Sphaeranthus Indicus Ethanolic Extract Against Xanthomonas Campestris Virulent Proteins Using in Silico Approach

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Xanthomonas campestris poses a major threat to global agricultural productivity, causing black rot disease in cruciferous vegetables and leading to substantial yield losses, particularly among small-scale farmers. Conventional management strategies largely depend on copper-based bactericides and synthetic antibiotics, which pose severe side effects not only to the environment but to human health as well. These environmental and public health concerns highlight the urgent need for sustainable alternatives. Medicinal plants offer an eco-friendly approach, providing naturally derived antimicrobial constituents with minimal ecological impact. Sphaeranthus indicus, a plant widely used in Ayurvedic medicine for treating infections and inflammatory diseases, remains an underexplored source of bioactive phytochemicals with potential antibacterial efficacy This study employs an integrated in silico approach to screen and evaluate the bioactive compounds of S. indicus ethanolic extract against virulence proteins of Xanthomonas campestris. In silico analysis revealed several bioactive compounds exhibiting strong binding affinities towards the selected target proteins, underscoring their potential as candidate antimicrobial agents. This could help demonstrate the potential of S. indicus-derived compounds as a possibility for natural sustainable and environment-friendly approach for integrated management pending experimental validation.

Poster No: P4

Assessing Water Quality Threats in Jaipur's Lakes: Integrated Analysis of Physicochemical Properties, Heavy Metal, and Microbial Contamination

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Jaipur, the capital of Rajasthan, is facing rising challenges in protecting its limited freshwater resources from rapid urbanisation and sewage discharge. The current study focuses on the analytical study of physicochemical parameters, heavy metal contamination, and microbiological assessment of Chandlai Lake and Man-sagar Lake to estimate the amount and consequences of pollution influx from nearby catchments. The sampling and testing procedures adhered fully to the Indian Standard (IS) and APHA guidelines. The observed physicochemical characteristics were compared to the permitted limits established by the Central Pollution Control Board (CPCB) and the National Pollution Control Authority (NPCA). While some measures remained below permissible limits, others, including BOD, COD, and conductivity, exceeded them, indicating both organic and inorganic contamination. The heavy metal concentration was also found to be elevated for certain metals, particularly chromium, indicating persistent anthropogenic input. Microbial enumeration revealed considerable bacterial load, suggesting active nutrient enrichment and oxygen depletion within the system. Overall, the study highlights the deteriorating water quality of Jaipur's urban lakes and underscores the urgent need for continuous monitoring, effluent management, and eco-restorative interventions to maintain long-term aquatic and environmental health.

Poster No: P5

Co-application of fly ash, compost, and gypsum on soil properties and growth of Calendula officinalis

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Fly ash (FA) is a problematic inorganic waste generated as a by-product from coal combustion process in thermal power plants. Similarly, there is a huge production of organic waste from different sources like religious places, fruit & vegetables sector, agriculture etc. FA is considered as a soil ameliorant; however, it causes heavy metal toxicity in high doses. To overcome this issue, in the present study FA was combined with compost and gypsum to prepare various soil treatments- Control (C) (100% soil), T1 (20% FA, 70% compost, 10% gypsum), T2 (40% FA, 50% compost, 10% gypsum), T3 (60% FA, 30% compost, 10% gypsum), T4 (80% FA, 10% compost, 10% gypsum) for cultivation of Calendula officinalis. Physico-chemical analysis was performed for all the treatments, as well as their impact on growth performance of Calendula officinalis was studied. It was observed that electrical conductivity, total dissolved solids, and water holding capacity showed an increasing trend however a decrease in pH and bulk density was observed from T1 to T4. Concentration of various elements such as sulphur, aluminium, magnesium, zinc, barium, iron, calcium, copper and nickel increased with increasing FA dosage, but they were within the permissible limits except for cadmium in T3 and T4. It was observed that the morphological parameters (root length, shoot length, dry weight, fresh weight, leaf area) of Calendula were enhanced in T1 treatment. Hence, T1 was the most suitable combination as it enhanced soil properties, maintained hazardous elements within the permissible limits and promoted healthy plant growth.

Poster No: P6

Waste-to-Energy: Co-digestion of Institutional Paper and Food Waste for Enhanced Biogas

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Educational institutions generate large amounts of paper waste, which often ends up in municipal solid waste, thereby increasing the overall waste burden. Effective utilization of this waste is essential, and biogas production offers a sustainable and eco-friendly solution. However, paper waste is highly carbonaceous, with a carbon-to-nitrogen (C: N) ratio from 100:1 to 170:1, which limits microbial growth during anaerobic digestion and reduces biogas yield under mono-digestion conditions. Therefore, co-digestion of paper waste with Nitrogen-rich substrate such as food waste - commonly produced in institutes canteens– can balance the C/N ratio within ideal range of 24:1, thereby improving process stability and methane production. The present study focuses on Co-digestion of paper waste and food waste to evaluate their combined potential for enhanced biogas production. Food waste, rich in organic matter and moisture, provides essential nutrients, while paper waste is composed largely of lignocellulosic fibers which provides structural stability. Experimental setups were prepared with varying substrate ratios (FW: PPW- 100:0, 75:25, 50:50, 25:75, 0:100) to determine the most effective combination for maximum gas production. Parameters such as pH, Total solids (TS), Volatile Solids (VS), Volatile Fatty Acids (VFAs) and cumulative gas volume were systematically analyzed. After one month of digestion, the combination of food waste: paper waste (25:75) showed the highest reduction in COD, VFAs and VS, indicating efficient conversion of waste into biogas. The study provides a sustainable solution to the paper waste problem in institutes, generating biomethane that can be used in the canteen kitchens, reducing the demand of conventional fuel (LPG).

Poster No: P7

Pennisetum Glaucum Husk Biochar as a Sustainable Adsorbent for the Removal of Nitrate, Fluoride, and Triclosan

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Water contamination and agricultural waste management is a matter of concern around the entire world. This study aims to determine the efficiency of bajra (Pennisetum glaucum) husk biochar for the removal organic (triclosan) and inorganic (nitrate and fluoride) contaminants from surface and ground water. The bajra husk waste converted into biochar and used to prepare a filter-bed consisting of cotton, sand, gravels, powdered and granular biochar. The contaminated water samples were run through filter bed under the influence of gravity. The prepared biochar found to be alkalinity (pH-12.01) and microporous (MB adsorption: 86.7mg/g for powdered biochar and 93.7mg/g for granular biochar). The functional properties of the biochar were evaluated using different instrumental (FTIR, XRD and SEM) analysis The continuous filtration experiments showed removal efficiency of 50% to 73% for the target inorganics and 75% for triclosan. According to the results, biochar made from bajra husks was shown the potential to be an inexpensive, renewable adsorbent in decentralised water treatment systems.

Poster No: P8

Assessment of Seasonal Variation in Some Selective Chemical Parameters in SubSurface Water Sources Around Jabalpur Using Remote Sensing, GIS Techniques, and Conventional Methods

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Groundwater is one of the most dependable resources for domestic and agricultural use in Jabalpur city, Madhya Pradesh. However, rapid urban expansion, unplanned waste disposal, and increasing population pressure have significantly influenced the quality of sub-surface water. The present study focuses on assessing the seasonal and spatial variation of key chemical parameters — namely pH, Total Hardness (TH), Calcium Hardness (CaH), and Chloride (Cl^-) — in selected groundwater sources in Jabalpur.A total of ten sampling locations were identified based on population density, land use, and proximity to pollution sources: Sunderpur, Hanumantal, Gwarighat,Bargi Hill, Ranital, Vijay Nagar, Adhartal, JEC Well, Bilpura, and Dumna. Samples were collected during three distinct seasons — Summer (May), Monsoon (August), and Winter (February) of year 2025. Laboratory analysis was conducted following American Public Health Association (APHA) 2020 standard methods. The measured values of total hardness ranged from 180–420 mg/L, calcium hardness from 120–300 mg/L, and chloride from 40–260 mg/L.GIS-based Inverse Distance Weighted (IDW) interpolation technique was applied in QGIS 3.34 to generate thematic maps showing spatial distribution of each parameter for all three seasons. The maps revealed that southern and central zones (Hanumantal, Ranital, Adhartal) exhibited relatively higher hardness and chloride values, indicating anthropogenic influences such as sewage percolation and solid waste leachate. In contrast, Dumna and Bilpura regions showed comparatively lower concentrations due to their semi-forested recharge zones and lesser urbanization.The study concludes that seasonal variation is strongly governed by evaporation rate, rainfall dilution, and land use intensity. The findings emphasize the need for regular monitoring and integrated water management to ensure sustainable utilization of subsurface water resources in Jabalpur region.

Poster No: P9

Review of indicators, opportunities and challenges associated with implementing circular economy principles in peri-urban areas of Mumbai

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Peri-urban areas typically represent under-developed regions surrounding densely populated urban cities. These transitional zones thus form intersecting points between rural landscapes and expanding cities which offer strategic opportunities for sustainable planning of city expansions. In Mumbai, peri-urban areas include Bhiwandi, Panvel, Karjat, Ulhasnagar, Ambernath, and Alibaug. The rising property prices and housing shortages in Mumbai city, has led to an increased migration of city population to these peri-urban areas, which are thus experiencing rapid transformations. Additionally, these regions also witness industrial clustering and tourism-driven development, which further increases pressure on resources and infrastructure. This review explores the relevance of Circular Economy (CE) principles in shaping policy and practice to guide sustainable development of the city and peri-urban framework. Precisely, this review contextualizes global CE frameworks to peri-urban Mumbai and identifies a set of measurable indicators such as secondary raw material use, waste diversion rates, wastewater reuse, renewable energy share and ecological footprint. Though the peri-urban setting presents significant opportunities for sectoral diversity, informal recycling networks, community enterprises and potential for decentralized systems, some challenges persist. These challenges may be broadly summarized into infrastructure deficits, fragmented governance, data scarcity, ecological vulnerabilities, and financial constraints. Overall, the review highlights that integrating CE indicators into planning, governance, and community engagement frameworks can help transform Mumbai's peri-urban areas into resilient, resource-efficient, and inclusive growth frontiers, contributing to long-term sustainability.

Poster No: P10

Seasonal and Spatial Influence of Agricultural Non-Point Source Pollution on the Physicochemical Dynamics of the Beki River, Assam

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Agriculture is the main cause of river water pollution worldwide, as rain and runoff carry fertilizers, pesticides, soil, and other waste into rivers. This study evaluated the influence of agriculture on the seasonal and spatial variations in the physicochemical characteristics of the Beki River. The pH of the river varied between 5.5 and 8.4, showing localized acidity at stations BK4, BK8, BK10, and BK12 due to agricultural runoff. Seasonal trends indicated slightly acidic conditions during pre-monsoon (6.9) and monsoon (6.86), and neutral to mildly alkaline levels during post-monsoon (7.16) and winter (7.12). Electrical Conductivity (mean 0.194 mS/cm) and Total Dissolved Solids (TDS) (mean 185.96 mg/L in pre-monsoon) rose during dry periods and declined in monsoon (EC 0.158 mS/cm; TDS 77.31 mg/L) due to dilution effects. Dissolved Oxygen (DO) dropped to 4.8 mg/L in the monsoon, below the WHO's 5 mg/L threshold, but peaked at 9.41 mg/L in winter. Turbidity values remained high year-round, reaching 76 NTU pre-monsoon, signaling substantial suspended particulate matter input from agricultural fields. Chemical Oxygen Demand (COD) peaked at 302 mg/L in winter, surpassing permissible levels, while Biochemical Oxygen Demand (BOD) remained low (<2 mg/L), suggesting predominance of inorganic over organic pollutants. Nitrate concentrations reached 57.86 mg/L in winter and 34 mg/L pre-monsoon, exceeding WHO limits and indicating fertilizer runoff influence. Overall, the findings underscore significant agricultural impacts on the Beki River's water chemistry, highlighting the urgent need for continuous monitoring and sustainable land-use management to mitigate non-point source pollution and safeguard aquatic health.

Poster No: P11

Formulating Iodine-integrated $SmTaO_4$ for Efficient Visible-Light-Driven Degradation of Fluorene: A Synergistic Rare-Earth–Halogen Approach

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An effective partition of photogenerated charge carriers is a prerequisite for solar photocatalysis with an exalted efficacy. To serve our pollutant photodegradation purpose, iodine-incorporated bimetallic oxyhalide semiconducting nanotriangles were synthesised following a simple one-step solvothermal approach. The synthesised catalyst containing Sm and Ta as metals was analysed using XRD, SEM, XPS, Raman, FTIR, TEM, etc. Our study's assortment of performance interpretations mutually unravels the potential of I@SmTaO4 in the solar-light-propelled degradation of persistent organic pollutants. With the aid of advanced characterisation techniques like EPR and PAS, the initiation of oxygen vacancies in the metal oxyhalide matrix was confirmed. This provided evidence that the generation of sufficient hydroxyl radicals and holes boosted its overall catalytic function and degradation of our model pollutant, fluorene. The pollutant has been selected from the list of 16 Polycyclic Aromatic Hydrocarbons (PAHs), classified as priority pollutants by the USEPA.

Poster No: P12

Turning Waste into Wealth: Black Soldier Fly Larvae as Agents of Organic Waste Recycling

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The escalating generation of organic waste presents serious environmental and economic challenges, including landfill overloading, greenhouse gas emissions, and inefficiencies in waste management systems. Conventional disposal methods, such as landfilling and incineration, exacerbate pollution and resource depletion, underscoring the urgent need for sustainable alternatives. The Black Soldier Fly (Hermetia illucens) larvae (BSFL) have emerged as an effective and eco-friendly biological tool for converting organic waste into valuable biomass. This study investigates the potential of BSFL to degrade vegetable waste, cow dung, and sawdust in various proportions, while assessing their effects on waste reduction, larval survival rate, nutrient recycling, decomposition period, and byproduct utilization. The results demonstrate that BSFL can reduce waste volume by up to 94%, with a survival rate reaching 93.9%, and complete decomposition occurring within 10–15 days. The larvae accelerate organic matter breakdown, producing high-protein biomass suitable for animal feed and nutrient-rich frass that serves as an organic fertilizer. The bioconversion efficiency is influenced by substrate composition, moisture level, temperature, humidity, and larval density. Moreover, this process aligns with circular economy principles by minimizing landfill dependence, lowering greenhouse gas emissions, and advancing sustainable waste management practices. Overall, the findings position BSFL as a highly promising and sustainable approach for organic waste recycling, offering significant environmental and economic advantages while addressing global waste management challenges.

Poster No: P13

Exploring Dye-Degrading Bacteria from Textile Sludge for Environmentally Friendly Wastewater Treatment

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The textile sector, particularly in India, is rapidly expanding and contributes significantly to economic growth, employment, and exports. However, it is also one of the most water-intensive industries, consuming approximately 300–400 Liters of water per kilogram of fabric, mainly during dyeing and finishing processes. A large proportion of this water is discharged as untreated effluent containing high levels of particulate matter, organic compounds, salts, surfactants, and dyes (10–200 mg/L). Azo and reactive dyes, such as Reactive Blue 120 and Methylene Blue, are of particular concern due to their carcinogenic nature, persistence, and resistance to conventional treatment methods. These dyes not only impart intense coloration but also hinder light penetration and photosynthesis, even at low concentrations. In the present study, bacterial isolates were obtained from textile sludge collected from contaminated sites in the Sanganer industrial area to explore their potential in dye biodegradation. Seven isolates were screened for their ability to decolorize Methylene Blue and Reactive Red 120. Two isolates demonstrated high decolorization efficiency, achieving up to 92% dye removal within 24 hours. FTIR analysis of treated samples confirmed structural transformations in the dye molecules, indicating biodegradation. However, phytotoxicity assays revealed that the treated dye solutions did not support plant growth, suggesting incomplete detoxification. The results indicate that while individual bacterial strains effectively decolorize textile dyes, the transformation products may retain toxicity. Future research will focus on developing mixed microbial consortia to achieve both efficient decolorization and complete detoxification for sustainable textile wastewater treatment.

Poster No: P14

Aerobic Transformation of Parthenium hysterophorus via RDC Technology: Synergistic Chemical and Microbial Evolution Driving Detoxification and Sustainable Weed Mitigation

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Composting is a sustainable technique for converting biomass into nutrient-rich organic products through coordinated microbial and chemical transformations. Parthenium hysterophorus (PH), despite its invasiveness and phytotoxicity, can serve as a valuable source of nitrogen, phosphorus, and potassium when detoxified via composting. This study employed a 20-day rotary drum composting (RDC) process using PH, cow dung, and sawdust to examine chemical evolution and microbial succession under controlled aerobic conditions. Microbial dynamics, assessed through culture-dependent and metagenomic methods, exhibited phase-specific patterns. Mesophilic bacteria remained relatively stable (8.5×10^7–2×10^7 CFU g^{-1}), actinomycetes peaked on day 4 (11×10^7 CFU g^{-1}), fungi were most abundant initially (10.5×10^7 CFU g^{-1}), and spore forming bacteria reached maximum abundance on day 4 (22×10^7 CFU g^{-1}), coinciding with the thermophilic stage and peak metabolic heat generation. These shifts indicate intense biodegradation activity contributing to allelochemical breakdown. FTIR and GC–MS analyses revealed substantial transformation of PH's toxic compounds, particularly sesquiterpene lactones and phenolics, into more stable complex organic compounds. Metagenomic profiling confirmed a clear microbial succession, with early colonisers giving way to thermophilic degraders such as Bacillus, Pseudomonas, and Acinetobacter. Overall, the results demonstrate that RDC technology promotes a synergistic co-evolution of microbial communities and chemical composition, enabling rapid detoxification of Parthenium hysterophorus and the production of nutrient-enriched compost suitable for sustainable soil restoration and invasive weed management.

Poster No: P15

Review of Digital Solutions for Scrap and Waste Material Management: Towards an Integrated Platform for Sustainable Recycling

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The rapid growth of industrial production, urbanization, and consumerism has created a critical challenge in managing waste and scrap materials efficiently. Conventional recycling and disposal methods are often inadequate in addressing environmental concerns and economic inefficiencies. In response, researchers and practitioners have increasingly turned toward digital solutions such as artificial intelligence (AI), Internet of Things (IoT), blockchain, and robotics to improve waste monitoring, classification, and traceability. Early works emphasized lifecycle engineering and sustainability frameworks, while more recent studies focus on advanced machine learning models, multimodal systems, and predictive platforms that enable smart city integration. This review synthesizes key developments in digital waste management from foundational studies to the latest advances in 2024 and 2025, highlighting the evolution of approaches across different contexts. The findings suggest that while industrial applications of AI, IoT, and blockchain have advanced considerably, consumer-oriented and platform-driven solutions remain underexplored. The paper identifies gaps in scalability, interoperability, and inclusivity, offering directions for future research and digital innovation in sustainable waste management.

Poster No: P16

Indigenous Protease Producing Microbes from Varied Sources for Valorization of Protein Rich Waste

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Proteases, by virtue of their pervasive distribution, find prominent role in regulating diversephysiological processes, encouraging both biosynthetic and degradative pathways. Although proteasecan be sourced by plants and animals as well, but microbial protease shows extensive potential incommercial sectors including food industry. For that it's necessary to find the native microbial proteasewhich shows significant potential. To overcome increasing demand of proteases for valorisation ofprotein rich waste, numerous research work have been corresponded, still there is gap. In the presentwork, varied microbial strains have been isolated from diverse samples. A total of 288 microbial strainswere isolated and were screened for production of proteases at different pH. It was observed that 141isolates were found to be positive for extracellular protease production, studied at neutral pH, 176positives for alkaline proteases production and 154 suitable at working at acidic pH. Further, selectedisolates were analysed for protease activity in which 6PVM shows highest activity as 6.196 ± 0.213U/ml with specific enzyme activity of 108.77 U/mg. Further studies on application of these enzymeson valorisation of protein rich waste is in progress.

Poster No. P17

Biodegradation of Textile Azo Dye AR27 by Bacterial Consortium Immobilised on Chi-aKSB beads in a Multi-Stage Bioreactor with Post-Treatment Toxicity Evaluation

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Water pollution from textile effluents represents a significant ecological challenge, with the industry contributing over 93 billion m³ of wastewater annually. Approximately, 10–15% of the 280,000 tons of synthetic dyes are produced each year, predominantly recalcitrant azo dyes that enter aquatic systems, posing severe toxicological risks. The present study investigates an integrated bioreactor system for the biodegradation of Acid Red 27 (AR27) using a consortium of bacterial isolates obtained from textile effluent. Three efficient dye-degrading strains Aeromonas caviae, Paenibacillus dendritiformis, and Acinetobacter radioresistens were identified through 16S rRNA sequencing and immobilized within Chi-aKSB beads, a chitosan–activated kapok shell biochar composite providing enhanced microbial stability and surface interaction. The immobilized consortium achieved 98.3% decolorization of AR27 within 24 h under optimized conditions (pH 7, 35 °C, 50 mg L^{-1}) in a four-stage gravity-fed bioreactor. Phytotoxicity assays employing Lens culinaris demonstrated marked detoxification, evidenced by increased root length from 1.7 in untreated dye solution to 3.2 in treated sample. FTIR spectral analysis confirmed cleavage of azo (–N=N–) linkages and disruption of aromatic structures, while SEM micrographs revealed successful bacterial immobilization and morphological modification of the biochar–chitosan matrix. This study establishes a synergistic adsorption–biodegradation framework offering a sustainable, high-efficiency strategy for azo dye remediation and forms the basis for future genomic elucidation of dye degradation pathways.

Poster No. P18

Alkaline Protease Producing Microbial Strains for valorization of Protein Waste

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Microbial proteases plays pivotal role as biocatalysts with diverse ability to hydrolyze peptide linkages invaried protein substrates, making them indispensable in broad utility in biotech industries. Among all,alkaline proteases have high commercial potential finding applications in detergent, tanning, leather etc.The present research focuses on isolation and screening of alkaline protease producing organisms, for whicharound 288 microbial strains were isolated from different sample sources screened on skimmed milk agar(pH 9.0) through observation of hydrolytic zone. Around 176 strains were protease positive at alkaline pHand showed a significantly greater hydrolytic zone. Strain 6 PMF was observed as highest protease producerand activity estimated as 2.293 ± 0.013 U/ml. Application of the selected enzyme in solo and in consortiaon valorization of protein waste is in progress.

Poster No. P19

Global Bibliometric Trends in Biochar Use for Wastewater Management within Circular Economy Paradigms

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Over the last decade, Biochar has witnessed rapid growth as a promising material in wastewater management and circular economy frameworks. This bibliometric study surveyed 1522 publications from Scopus (2016-2026), examining global trends, key contributors, hotspot topics, and evolving research trajectories. The study identifies China as the leading contributor to publication volumes, with notable contributions also from India and the USA. Removal of heavy metals, adsorption of organic pollutants, nutrient recovery, and implementation of biochar systems for industrial, municipal, and agricultural wastewater treatment were core research themes. The Co-occurrence of keywords, such as "adsorption mechanisms," "wastewater remediation," "feedstock optimization," and "circular economy," demonstrates increasing interest. Most studies focus on lab-scale adsorption techniques, a few develop full-scale or pilot wastewater treatment systems, or evaluate life-cycle/environmental impacts. The gaps identified encompass the lack of standardized methods for biochar production and characterization, insufficient techno-economic analyses, and the underrepresentation of comprehensive circular economy assessments that connect biochar reuse to potential secondary pollution and economic viability. The study highlights biochar's potential as a key to circular waste management; however, there is a need for more interdisciplinary work, field-scale validations, and policy contexts to transition from laboratory-scale to large-scale implementation.

Poster No. P20

Development of biogas from industrial wastes and its process parameter optimization

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This review critically examines the potential of industrial residue as a sustainable feedstock for biogas production through anaerobic digestion. Natural gas serves as a substitute energy source, with anaerobic digestion (AD) being one example of this process. Microbes convert organic substances into biogas in four stages, producing mainly CO_2 and CH_4. Typically, biogas consists of 30 to 50 percent carbon dioxide (CO_2) and 50 to 70 percent methane (CH_4) by volume, along with trace gases. The presence of CO_2, H_2S, and water vapour can impact energy conversion, device longevity, and performance. By using organic waste from the beverage, food processing, and distillery industries, biogas provides a sustainable way to meet the growing demand for energy and lessen the negative environmental effects of fossil fuels. The review highlights the importance of optimisation to maximise yield and ensure process stability. It also addresses perspectives from India and international viewpoints concerning policy frameworks, technological challenges, and implementation barriers. The study concludes that technological integration can accelerate the adoption of industrial biogas systems and significantly contribute to energy security and economic development, especially when supported by robust policies and stakeholder engagement.

Poster No. P21

Bioengineered Algal–Bacterial Consortium: A Circular Biotechnology Model for Sustainable Wastewater Treatment and Carbon-Neutral Energy Recovery

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The increasing pace of industrialization and urban expansion has intensified wastewater generation, creating an urgent need for sustainable and integrated treatment strategies. Conventional wastewater management technologies are often energy-intensive, chemically demanding, and limited in their ability to recover valuable resources. In recent years, algal–bacterial consortia have emerged as a promising bioengineering approach that combines the metabolic versatility of microorganisms with the principles of circular biotechnology. These systems capitalize on the mutualistic interactions between microalgae and bacteria, where organic matter degradation, nutrient recycling, oxygen evolution, and carbon dioxide fixation occur synergistically. Such integrated frameworks enable efficient nutrient removal, biomass recovery, and energy generation, offering an eco-friendly route toward carbon-neutral wastewater management. The resulting biomass can be valorized for biogas, fertilizers, and high-value bioproducts, thereby closing the loop between waste remediation and resource recovery. Furthermore, these nature-inspired systems align closely with the objectives of the circular economy by transforming wastewater into a renewable source of carbon, energy, and nutrients. Recent advances in synthetic biology, reactor design, and metabolic optimization have expanded the applicability of algal–bacterial systems for diverse environmental and industrial contexts. By linking pollution control with energy recovery and greenhouse gas mitigation, algal–bacterial consortia represent a scalable and sustainable pathway toward achieving global sustainability goals. This review highlights the potential of such bioengineered systems to redefine wastewater treatment as a self-sustaining, carbon-conscious, and resource-efficient process.

Poster No. P 22

Integrated Biorefinery Strategy for Agro-Waste Valorization: Co-Production of Biofuel and High-Value Nano Biomaterials

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The escalating generation of lignocellulosic agro-waste and associated nutrient-rich effluents presents a dual ecological and resource management challenge, particularly in developing economies. The transition from linear resource consumption to a circular economy, this study explores an integrated biorefinery model designed for maximized resource recovery and minimized residual pollution.The proposed strategy employs a sequential bioconversion pathway, Enzymatic pretreatment of cellulosic residues is followed by microbial fermentation to yield next-generation biofuels, such as bioethanol or bio-butanol. Crucially, the process integrates the anaerobic digestion of high-organic content residues and wastewater to generate bioenergy (biogas) and nutrient-rich digestate. Further advanced valorisation focuses on the recovery of high value compounds, such as lignin derivatives, which is subsequently engineered into sustainable nano biomaterials for agricultural or biomedical application. This integrated approach ensures the utilization of virtually all waste fractions that is solid and liquid and simultaneously addressing pollution control, enhancing resource independence, and fostering sustainable economic growth. The adoption of such technologically empowered waste-to-energy (W2E) systems is critical for achieving zero-waste targets and advancing global climate action.

Poster No. P23

An Analytical Review on Harnessing Biosurfactant Producing Bacteria and Their Consortia for Effective Bioremediation of Heavy Metal Contaminated Water

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Heavy metal pollution poses severe risks to environment as they are toxic, non-biodegradable and form deposits in soil and water. Bacterial biosurfactants are biodegradable and stable under diverse environmental stress providing an eco-friendly alternative to conventional methods. This review focuses on heavy metal pollution of wastewater, its industrial sources and the potential of biosurfactants produced by bacterial strains and their consortia in heavy metal remediation. To gather relevant literature, a systematic search was conducted in google scholar using keywords like “biosurfactants”, “heavy metals”, “bacterial consortia”, etc. A PRISMA outlined the selection process for relevant articles and bibliometric analysis categorized research trends and papers. Evidences suggests that bacterial consortia perform better at bioremediation than the single strains by interacting synergistically and showing greater tolerance to heavy metal stress as well as enhanced micelle formation. This review includes phylogenetic studies, lab scale and pilot-scale studies to evaluate biosurfactants' efficacy in heavy metal remediation and case studies on phytotoxicity of treated wastewater. Analytical techniques such as ICP-MS, AAS, FTIR and SEM-EDS showed the concentration of heavy metals and helped to visualize the morphological changes in bacterial cell after treatment with biosurfactant. Therefore, biosurfactant producing bacterial consortia show high activity in reducing heavy metal during wastewater treatment for heavy metals. It’s potential depends on factors like time and concentration of inoculum used. Further research on structural analysis, gene regulation, and commercial production of biosurfactant is needed to scale biosurfactant based bioremediation of industrial wastewater.

Poster No. P24

The Production of Bioplastics from Rice-Husk

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The persistent challenge of managing agricultural residue finds a promising solution in the Waste-to-Wealth concept. Rice husk, which is the hard outer covering of the rice grain removed during milling, is also one of such agricultural wastes whose disposal by conventional methods like open-air combustion, poses an environmental threat. This has led to the exploration of alternative methods of either disposal or its reuse. One such method is the production of Bioplastic from rice husk. It serves a s a promising strategy for resource-recovery by enabling the generation of high-value, bio-based product. It includes the extraction of cellulose, the main polymer or its derivative like Carboxymethyl Cellulose (CMC) from rice husk by various processes like alkali treatment (delignification), and bleaching. This is then converted into bioplastic film by a solution casting technique, incorporating a suitable plasticiser like sorbitol, and potentially an additive like chitosan to enhance film properties. Its biodegradability and mechanical strength aretested using analytical techniques like FTIR (Fourier Transform Infrared Spectroscopy) and UTM (Universal Testing Machine), and their composition can be varied depending on the one giving the best biodegradiblilty and tensile strength. Optimisation of film composition resulted in the best performing bioplastic film, exhibiting a maximum tensile strength of 1.1058 N/mm2 with 0.8g mass cellulose variation, and with 5.4147 N/mm2 with chitosan mass variation 1.2g. This Waste-to-Wealth strategy offers an effective pathway for sustainable resource recovery, reducing relive on petrochemical polymers and mitigating the environmental impact of agricultural waste streams.

Poster No. P25

Microalgae-based biodesalination for biofuel production: A Sustainable approach

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The growing global challenges of freshwater scarcity, rising energy consumption, and environmental degradation have prompted an urgent need for sustainable and integrated biological solutions. Among various renewable resources, microalgae have emerged as a promising and eco-compatible platform capable of addressing multiple environmental and energy-related issues simultaneously. This review explores the multifaceted potential of algae, emphasizing their cultivation in saline and wastewater systems and their subsequent utilization for biofuel production. Owing to their high adaptability, algae can thrive in saline, brackish, and nutrient-rich wastewaters while efficiently removing excess nitrogen, phosphorus, heavy metals, and organic pollutants. During cultivation, they also capture and fix atmospheric carbon dioxide, contributing to greenhouse gas mitigation. Moreover, their biochemical composition, rich in lipids, carbohydrates, and proteins, renders them an excellent feedstock for the generation of biodiesel, bioethanol, and biogas. Utilizing saline or wastewater as a growth medium not only reduces freshwater dependency but also integrates bioremediation with renewable energy generation, forming a closed-loop and sustainable system. The review further highlights recent advancements in strain selection, nutrient optimization, and bioprocess design aimed at enhancing biomass yield and energy recovery. From a holistic approach, the concept of “one algae, multiple roles” exemplifies the potential of microalgal biotechnology as a green and circular approach that bridges environmental protection, resource recovery, and clean energy development.

Poster No. P26

Sustainable Extraction of Curcumin from Turmeric Agro-Waste Using Green Solvent Technologies

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The increasing demand for curcumin, a bioactive compound derived from turmeric *(Curcuma longa)*, has prompted exploration of sustainable extraction methods that minimize environmental impact and maximize resource utilization. This study investigates the potential of turmeric agro-waste specifically rhizome peels and spent powder from spice processing units as a viable source for curcumin recovery. Employing green solvent technologies such as deep eutectic solvents (DES) and ultrasound- assisted extraction (UAE), the project aims to optimize yield, purity, and cost-effectiveness. Comparative analysis of conventional solvent methods versus eco-friendly alternatives highlights the advantages of reduced toxicity, lower energy consumption, and enhanced extraction efficiency. The recovered curcumin is evaluated for its antioxidant and antimicrobial properties, confirming its suitability for pharmaceutical and nutraceutical applications. This approach not only valorizes agricultural waste but also supports circular bioeconomy principles by transforming low-value residues into high-value products. The findings offer scalable solutions for rural industries and contribute to sustainable development in agro-processing sectors.

Poster No. P27

A Systematic Review on the Synergistic Use of Bacterial Consortia and Biosurfactants on Bioremediation of Soil Contaminated with Polycyclic Aromatic Hydrocarbons

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Industrial effluents such as polycyclic aromatic hydrocarbons (PAHs) possess greater risk to human health and ecosystem if not degraded completely. Bioremediation using biosurfactant-producing bacteria and their consortia offers a cost-effective and eco-friendly method for industrial soil. This review aims to critically examine the effects of biosurfactant-producing bacteria and their consortium on bioremediation of these pollutants. Relevant articles were found through keyword-based search on major databases, followed by bibliometric analysis and PRISMA chart preparation. The selection criterion included recent researches on biosurfactants and bacterial consortia. Latest trends, advances, and research gaps were analysed after synthesizing key findings. Studies consistently proved that consortia performs better than single strains in bioremediation of the pollutants. Biosurfactants produced from bacteria enables simultaneous degradation of multiple types of pollutants. *Pseudomonas* and *Bacillus* contribute the most in the consortium and are major producers of rhamnolipids and surfactin, respectively. Analytical techniques like GC-MS, AAS, and microbial counts are used to confirm higher degradation percentage using consortia. *In silico* phylogenetic analyses using 16S rRNA are used to categorize bacterial strains in the consortium. Further studies on standardized consortia formulations and large-scale applications of this method can be revolutionary in sustainable industrial waste management.

Poster No. P28

Global E-Waste Trends: Challenges and Opportunities for a Circular Economy

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The amount of electronic waste generated worldwide keeps picking up speed. It topped 62 million tonnes back in 2022. Experts project it will climb to 65.3 million tonnes by 2025. From there, the figure could hit 82 million tonnes by 2030. All this growth makes things tougher, yet the global recycling rate stays disappointingly low. Just 22.3 percent of e-waste saw formal collection and recycling in 2022. At the same time, around 347 million tonnes go unrecycled across the planet as of 2025. Europe stands out in handling e-waste recycling. The region averages a formal rate of 42.5 percent. In contrast, heavy hitters like China at 16 percent and the USA at 15 percent trail far behind. Areas in Africa manage even less, with rates dipping below 2 percent. Every year, key materials slip away unused. Think gold, silver, lithium, cobalt, and rare earth elements. Their value adds up to about 62 billion dollars. Poor recovery practices leave all that potential behind. New technologies offer real promise for shaking up e-waste handling. They could support a true circular economy in practice. Methods like bioleaching stand out now, along with robotics and AI for sorting. These approaches simplify pulling out vital metals. They also help limit harm to the environment. India provides a clear example through its latest incentives for recycling e-waste. Such policies encourage pulling lithium and other essential minerals from discarded electronics and batteries within the country. Global teamwork adds to the momentum. Apples partnership to reclaim rare earth magnets shows this well. It underscores moves toward more effective resource recovery. Supply chains get more localized in the process. Shifts in the e-waste field bring hurdles along with possibilities for circular management. Rising volumes pose risks to natural systems and human well-being. Still, cleaner automated tools powered by AI open reliable routes forward. Resource saving becomes feasible this way. Recovery of essential raw materials improves too. Sustainability gains ground across the board.

Poster No. P29

Empowering Waste Management: Sustainable Practices and Advanced Treatment Technologies

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Sustainable waste management is recognized as a fundamental component of sustainable development as particularly in rapidly growing countries such as India. Sustainable methods and advanced treatment technologies is examined in the study to determine how solid waste can be transformed from an ecological issue to a valuable resource. According to the Central Board of Pollution Board, approximately 165,000 tonnes / day in 2025 to 145,000 tonnes/day in 2019 waste generation in India increased steadily representing a 14% rise driven by industrial growth. Waste collection efficiency improved moderately reaching about 75% by 2025, yet only 30% of collected waste is scientifically treated with the rest disposed in open dumps. The per capita waste generation climbed from 0.36 kg/day (2019) to 0.46 kg/ day (2025), reflecting lifestyle and consumption changes. Significant issues are encountered by the country such as poor waste segregation, inadequate infrastructure, unregulated landfills and low public awareness. As a result groundwater becomes contaminated and greenhouses are emitted. Effective solutions are used such as anaerobic digestion, pyrolysis, composting, waste- to- energy conversion projects have been scaled nationwide with Indore, Pune, Delhi and Mysore serving as flagships examples. It is highlighted in the study that in India sustainable waste management necessitates the integration of technology, effective regulatory enforcement and community involvement and education to create well-rounded system. By increasing Eco- innovations and collective strategies being embraced, India's waste footprint can be remarkably reduced and advancing the nation toward environmentally sustainable urban development.

Poster No. P30

Evaluation of Heavy Metal Toxicity in Textile Industry Wastewater and Its Evolution

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Production of textile globally and locally involves usage of many heavy metals such as Zn, Cu, Pb and Cr. Effluents from textile industries if released into the environment without any treatment, can cause harm to water bodies, soil, flora and fauna, agricultural crops, drinking water, and health of individuals. In short, heavy metal toxicity causes serious environmental harm. Liquid waste management remains a major global problem. New ways for sustainable treatment and disposal of waste water are actively being looked into. To assess the level of heavy metal toxicity in textile industry effluents, various physio-chemical parameters were analysed using atomic absorption spectrophotometer and gas chromatography- mass spectrometry (GC-MS) analysis. Various methods involving bacteria and fungus for bioremediation of heavy metal contaminated waste water were discussed. It was found that co-cultures (common cultures of bacteria and algae) and bacterial consortia (group of different bacterial species) work better for removal of toxic heavy metals from waste water rather than pure cultures of bacteria or fungi. Genetically modified bacteria developed specifically for liquid waste management can also contribute majorly toxic heavy metals removal from waste water. Advancements in genetic engineering can further impact the research in development of new liquid waste bioremediation methods.

Poster No. P31

Bioremediation of crude-oil by Achromobacter sp. HZ01, review

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Achromobacter sp. HZ01, a gram-negative marine bacterium (0.8-1.2 x 2.5-3.0 µm) isolated from oil-contaminated seawater in Daya Bay, South China Sea in 2014, shows promise for bioremediation. Genome editing tools like CRISPR-Cas9 and TALEN enable precise DNA modifications to enhanceits pollutant degradation capabilities. These tools, successfully used in model organisms like Pseudomonas and E. coli, can be adapted for non-model organisms like Achromobacter to expressbioremediation genes, offering targeted solutions for environmental cleanup. Achromobacter sp.HZ01, a Gram-negative rod, was isolated from marine samples stored at 4°C to preserve microbialviability. Enrichment used a seawater-mimicking medium (1 g/L NH4NO3, 0.5 g/L K2HPO4, 0.2 g/LKH2PO4, 0.1 g/L MgSO4, 3% NaCl, pH 7.0). Enriched cultures were diluted, spread on mainstreammedia agar with 2% diesel oil, and incubated at 28°C for 5–7 days, yielding ~20 isolates. HZ01degraded 96.6% n-alkanes in 10 days, confirmed by gas chromatography. Pure cultures were grownon LB agar, and 16S rRNA sequencing identified HZ01 as Achromobacter spp. (99% similarity), demonstrating its high potential for marine oil spill bioremediation. It degrades 29.8% anthracene,50.6% phenanthrene, and 38.4% pyrene in 30 days. Its 5.53 Mb genome encodes pathways foraromatic compound degradation, energy production, and transport, but lacks some dioxygenases. RNA-seq shows upregulated oil-degrading enzymes after 16 hours of petroleum exposure, making HZ01 a cost-effective, sustainable solution for removing harmful PAHs from marine environments

Poster No. P32

Therapeutic activities of *Diospyros melanoxylon (Roxb.)*: a critical review

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Diospyros melanoxylon Roxb (Ebenaceae**)** commonly known as Tendu or Kendu, is widely distributed across the tropical and subtropical forests of India. Plant leaves may be bundled and is used to make a commercially viable product, Indian cigarette "beedi". It's application as a folk-medicine for wound healing effect is popular among tribal communities. The leaves are used for treatment of wounds or scabies. The fruit helps treat stomach disorders. The dried fruit powder is used as carminative and astringent agent. A systematic study to understand the role of *D. melanoxylon* in modern medicine has been explored considering keywords and bibliometric analysis. The layout of the review was prepared using the results of our searches using keywords, google scholar, Scopus and PRISMA chart was created. Recent investigations by preparation of various plant part extracts showed that the plant possessed pharmacological properties such as antioxidant, antidiabetic, anticancer, analgesic, anti-inflammatory, antimicrobial. Analytical studies of the extracts revealed that these attributes were conferred due to the presence of flavonoids, terpenoids, triterpenoids, tannins, saponins, polyphenols. In conclusion, *D. Melanoxylon* exhibits huge pharmacological potential and with future research it could be established as a valuable source for natural product-based drug delivery systems.

Poster No. P33

Production, Optimization, and Application of Bacillus Chitinases in Dye Bioremediation and Pathogen Inhibition

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The toxicity, durability, and non-biodegradability of synthetic textile dyes, including methyl red, alizarin red, brilliant green, and malachite green, make them significant industrial pollutants that pose a threat to human health and the environment. Microbial enzymes used in bioremediation process for detoxification and colour breakdown. My study identified and optimized Bacillus subtilis and Bacillus anthracis for the production of chitinase under various substrate and different temperature conditions. B. subtilis had the highest chitinase activity at 25°C with 0.5% chitin, demonstrating a noticeable protein band of about 45 kDa. Within three to fifteen days, the purified enzymes successfully decolorized different variety of dyes, eliminating alizarin red and malachite green by over 98%. Furthermore, bacterial strains *(*E. coli, K. pneumoniae, S. aureus, P. aeruginosa*)* and fungal pathogens (Aspergillus, Alternaria, Penicillium, Cladosporium, and Fusarium spp.) were both powerfully inhibited by the chitinases. Maximum inhibition zones of 15 mm against K. pneumoniae and 35 mm against Fusarium spp. were demonstrated by B. subtilis chitinase. Because of their twin roles in microbial suppression and dye biodegradation, Bacillus-derived chitinases are powerful, environmentally friendly biocatalysts for treating wastewater and reducing microbial risks in environmental systems.

Poster No. P34

Advanced Bioengineering Solutions for Circular Waste Management

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The rapid growth in business, agricultural, and municipal waste has emerged as a prime environmental and public health assignment, disturbing innovative, sustainable, and price-effective management techniques. traditional waste remedy strategies, together with landfilling, incineration, and chemical processing, often exhibit low efficiency, excessive operational costs, and the danger of secondary pollution. superior bioengineering techniques offer transformative answers via using microbial consortia, genetically engineered microorganisms, and enzyme-primarily based structures to convert complex natural and inorganic wastes into treasured sources. This overview highlights current biotechnological techniques for circular waste management, focusing on metabolic engineering, artificial biology, and bio electrochemical structures that improve biodegradation efficiency, procedure specificity, and scalability. Integration with bioreactors, biopolymer recovery, and power technology structures in addition demonstrates the capability for sustainable waste valorization and useful resource recovery. Case research of wastewater remedy, solid waste processing, and business effluent remediation underscore both environmental and monetary benefits. challenges which include regulatory compliance, biosafety issues, and procedure optimization also are mentioned, imparting a holistic angle for future studies. common, superior bioengineering answers are key to setting up circular bioeconomy frameworks, remodelling waste into treasured merchandise, lowering environmental impact, and improving useful resource efficiency.

Poster No: P35

Natural Dye Extracted from Waste *Chrysanthemum* Flowers for Use in Textile Dyeing and Assessment of Its Antibacterial Properties

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Dyeing is one of the oldest known arts, with evidence of its practice dating back to the Bronze Age in Europe. Early methods involved attaching plant materials to fabrics or rubbing crushed pigments directly onto cloth, which later evolved into more sophisticated techniques utilizing natural dyes derived from fruits, flowers, berries, and other plant materials. These dyes were commonly fixed onto textiles through boiling, enhancing their light and water fastness. In many developing regions, natural dyes serve not only as a sustainable and diverse source of colorants but also as a potential means of livelihood through the cultivation, harvesting, and commercialization of dye-producing plants. Many such dyes can be easily obtained from agricultural residues or tree waste, making them a practical and eco-friendly alternative in areas where synthetic dyes, mordants, and chemical additives are costly or imported. Among various dye-yielding plants, Chrysanthemum, a member of the family *Asteraceae*, is a promising source of natural pigments. This study aims to extract natural dyes from varieties of Chrysanthemum flowers, apply them to different textile materials and assess their antimicrobial activity against Gram-positive (*Staphylococcus aureus* MTCC 737) and Gram-negative (*Escherichia coli* MTCC 1687) bacteria.

Poster No: P36

Evaluation of the Water Quality Parameters of Wastewater Obtained from Selected Wastewater Discharge Sites of the Jaipur Region

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In the present study we have collected the wastewater samples from ten different site of the Jaipur region, Rajasthan, India. We assessed the water quality parameters of the different samples by using standard method. Metal concentration and other parameters of the waste water samples were analyzed to assess the degree of contamination and to understand their potential impact on the aquatic environment. Water quality parameters of the collected wastewater samples recorded viz, maximum pH in WW2: 12.01, maximum EC in WW9; 4.2 mS/cm, maximum TDS in WW2; 3200 mg/ L, maximum TSS in WW6; 20726 mg/L , maximum chloride in WW9; 997.99 mg/L, maximum nitrate - nitrogen levels in WW8; 7.86 mg/L, phosphate levels in WW5; 4.34 mg/L, sulphate in WW6; 0.31mg/L. In addition, maximum concentration of metals recorded in the waste water samples in order of Fe in WW6; 12.65 mg/L ,Mn in WW6; 0.98 mg/L , Pb in WW6; 0.06 mg/L , Cu in WW10; 17.58 mg/L. Highest concentrations of BOD and COD were recorded, viz, 346 mg/L in WW6 and 368 mg/L in WW9 respectively, during the analysis of the collected samples. This characterization provides essential baseline data to guide effective wastewater treatment design and management strategies for urban wastewater in Jaipur. Analysis of key wastewater quality parameters provides valuable insights into the physicochemical characteristics of the samples. Overall, the findings emphasize the importance of continuous wastewater monitoring for maintaining ecological balance, improving treatment efficiency, and safeguarding community health.

Poster No: P37

Emerging Nanotechnology and Advances in Biosensor Systems for Heavy Metal Detection in Water: A Review

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Heavy metal contamination in water poses a major concern to human health and ecosystems and thus requires advanced detection strategies for immediate action. This review explores the emerging role of nanoparticles and nanocomposite-based systems, highlighting their potential to detect and monitor heavy metals in water. The method offers significant advantages, including enhanced sensitivity, selectivity, and portability compared to conventional techniques. A scientific keyword search was conducted to retrieve literature focusing on recent studies published. This enabled the creation of comprehensive tables and diagrams for a detailed study of scholarly works. Various engineered nanoparticles (NPs) are utilised for detecting heavy metals, including metallic NPs such as gold and silver, which leverage surface plasmon resonance for sensitive optical sensing, carbon-based NPs such as graphene oxide and carbon nanotubes, for their electron transfer capabilities and magnetic NPs, like iron oxide, which facilitate efficient analyte separation. The integration of these NPs into biosensors enhances detection performance. Optical biosensors utilise quantum dots for precise fluorescence-based quantification of contaminants such as lead and mercury. Electrochemical biosensors provide real-time tracking through changes in impedance. In the future, smart sensors with AI and IoT could help detect heavy metals in water in real time. Advances in green synthesis of nanoparticles will further promote sustainability.

Poster No: P38

Polychlorinated Biphenyl Exposure from E-Waste and Induced Neurodegeneration: Implications on Parkinson's Epidemiology

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Polychlorinated biphenyls (PCBs) in the environment have garnered scientific interest due to the potential health risks they pose to humans. They are neurotoxic legacy contaminants that were widely used in industrial applications during the 20th century. This systematic review investigates the complex association between Polychlorinated Biphenyls and Parkinson's disease (PD), a disorder defined by loss of dopaminergic neurons. Although banned globally since 2004 under the Stockholm Convention, the majority of the original PCB stock persists, posing an ongoing health threat through bioaccumulation and environmental release, particularly from e-waste hotspots. To collect global data for this review, countries were stratified based on their economic development status (developed, underdeveloped, and emerging) using Gross Domestic Product and Human Development Index scores. Indian data was analyzed regionally (North, South, East, and West). This review establishes that PCB exposure is a potential risk factor for Parkinson's disease. A quantitative analysis of various studies conducting post-mortem on brain tissue of PD patients revealed elevations in PCB congeners: PCB-153 (2.08-fold) and PCB-180 (2.49-fold) compared to control subjects, demonstrating a positive association between brain PCB load and PD pathology. The risk appears to be more in females, highlighting significantly elevated concentrations of total PCB congeners: PCB-138, 153, and 180 compared to male counterparts. Global contamination is severe in e-waste depots located in industrial areas of emerging nations such as China, Turkey, and India, suggesting a shift in pollution levels from developed countries like the United States. These findings highlight the critical need for continued global regulation and neurotoxicological studies regarding such persistent organic pollutants.

Poster No: P39

Carbonation-Induced Durability Assessment of Concrete Containing Sludge Biochar as a Supplementary Cementitious Material

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The present paper investigates the long-term durability performance of concrete made using biochar, prepared from a faecal sludge treatment plant (FSTP). Replacement of Ordinary Portland Cement (OPC) with sludge-derived biochar at 5%, 10%, and 15% by weight, mixes with different water-to-binder ratios (0.40, 0.45, 0.50, 0.55, and 0.60) to see how well they would resist carbonation over time. The depths of accelerated carbonation at 3 months, 6 months, and 1 year were observed. Results show 5% biochar replacement made the mixes more resistant to carbonation than the control mixes (0% replacement) for most water–binder (w/b) ratios. At 5% biochar replacement, the carbonation depth decreased from 12 mm in the control mix (OPC400) to 9.55 mm in the biochar mix (BC401) after one year of accelerated carbonation. The best possible reason is because of pore-refining and improved microstructural densification resulting from secondary hydrations in biochar mixes. In cases of higher replacements (≥10%), the carbonation depth went up, which discloses the possibility of a porous and weaker matrix of material. Raising w/b ratio demonstrates, as the carbonation depths went almost tripling from 0.40 to 0.60. The study concludes that 5% replacement of sludge biochar to cement makes it more durable against CO_2 ingress, supporting its use as a sustainable cementitious additive made from waste materials. Ideas also connect the circular economy and help by lowering the environmental impact of cement-based materials.

Poster No: P40

Critical Review on Leveraging the Use Of Biosurfactant and the Microbial Consortia for Bioremediation of Textile Dyes

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This review examines the capability of various individual bacterial strains and microbial consortia for reducing synthetic dyes in industrial wastewater as an efficient treatment method. Biosurfactant-producing microbial consortia bioremediation is an economically feasible and environmentally sustainable method of industrial wastewater treatment. The literature was gathered through keyword searches in prominent databases to facilitate bibliometric analysis and the creation of PRISMA charts, focusing on recent research regarding microbial dye degradation, insights into enzymatic pathways, and bioinformatics methodologies. Use of single strains like *Acinetobacter sp., Pseudomonas putida,* and *Bacillus subtilis* shows vigorous enzymatic and redox activity; consortia add biosurfactant production that enhances dye solubility and accelerates degradation. Microbial consortia outperform single strains in dye decolorization, mineralization, and tolerance to mixed pollutants. Metabolic pathway studies, bioinformatics modelling, enzymatic activity assays, and phylogenetic analysis have been the primary techniques used to predict microbial interaction and confirm degradation of dyes in effluent water. To improve biosurfactant synthesis and enzymatic degradation pathways for effective industrial-scale wastewater treatment, future research should concentrate on expanding microbial consortia-based bioremediation technologies and investigating genetic engineering techniques.

Poster No: P41

Microbial-Polymer Hybrid Systems as Eco-Innovative Biosorbents for Heavy Metal Removal from Aqueous Solutions

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The increasing presence of toxic pollutants and heavy metals in aquatic environments necessitates the development of environmentally responsible treatment technologies that are efficient, scalable, and affordable. Conventional wastewater treatment methods often fall short in eliminating trace-level contaminants and typically require high energy and chemical demands. In this study, a sustainable microbial-polymer composite was developed to enhance pollutant removal through combined biological and physicochemical mechanisms. The incorporation of microbial biomass within a biopolymer framework enables the material to harness naturally occurring functional groups for effective metal binding, structural stability, and reusability. The composite exhibits favorable porosity, mechanical strength, and surface reactivity, facilitating adsorption through electrostatic attraction, chelation, and ion exchange. Structural analysis confirmed the material's integrity and the presence of active functional groups responsible for pollutant capture. The system maintained efficient performance under environmentally relevant conditions and showed stable activity over repeated use, highlighting its potential for long-term application. Overall, this work underscores the potential of microbial-polymer integration in developing cost-effective, circular, and sustainable materials for water purification. Such eco-innovative systems contribute toward global efforts in sustainable wastewater management and align with the United Nations Sustainable Development Goals (SDG 6 and SDG 12) focused on clean water, resource recovery, and responsible production.

Poster No: P42

Advanced Biotechnological Solutions for Waste Treatment

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The increasing generation of solid and liquid waste from industrialization, agriculture, and urbanization has become a major global concern. Conventional waste management practices like landfilling, incineration, and chemical treatment often lead to air, water, and soil pollution. In this context, advanced biotechnological solutions have emerged as promising and sustainable alternatives for effective waste treatment and resource recovery. These modern approaches utilize biological systems such as bacteria, fungi, algae, and enzymes to degrade, detoxify, or convert waste materials into less harmful or valuable products.

Key technologies including bioremediation, phytoremediation, biosorption, bio filtration, and microbial fuel cells have shown remarkable efficiency in treating organic and inorganic wastes. The integration of genetic engineering, synthetic biology, and Nanotechnology has further improved the degradation capacity and stability of microorganisms under diverse environmental conditions. These advancements not only help in pollutant removal but also promote waste-to energy conversion, leading to the generation of biofuels such as biogas, bioethanol, and biodiesel. Such innovations align with the global goals of circular economy and zero-waste strategies.

Despite their success, the large-scale use of these technologies still faces challenges like high cost, process optimization, and limited public awareness. Future research should focus on developing low-cost, energy-efficient, and hybrid systems combining biological and physicochemical methods. Overall, advanced biotechnological waste treatment represents a sustainable and eco-friendly pathway for environmental protection, resource recovery, and energy generation, ensuring a cleaner and greener planet.

Poster No: P43

Advancing Sustainability in Food Systems: Integrating Circular Economy Principles to Combat Food Waste

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Food waste is a major global issue with significant economic and environmental impacts, contributing to high levels of greenhouse gas emissions and threatening the sustainability of food systems. Despite efforts from researchers, governments, and NGOs, the traditional linear food supply chain model, which follows a 'take-make-dispose' approach, still results in billions of tons of food waste, much of which ends up in landfills, with no opportunity for resource recovery. To address this, there is a growing need to explore sustainable food value chains that reduce losses during food processing. Integrating circular economy principles offers a promising solution, emphasizing the six-R concepts: reducing, reusing, repurposing, repairing, refurbishing, and recovering. These principles create opportunities for improved food waste management and sustainability by fostering a closed-loop system where resources are continually reused. Food waste management strategies span the entire supply chain, from waste reduction at early stages to recovery and recycling in later stages. However, challenges include logistical complexities, stakeholders' resistance to change, and lack of consumer awareness. Public-private partnerships are essential to support businesses adopting circular economic practices, raise consumer awareness, and incentivize waste reduction. Thus, by integrating circular economic principles, food waste can be reduced, and environmental resources such as land and water can be preserved.

Poster No: P44

Waste to Resource: The Potential of Weed Composting in Modern Waste Management

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The escalating generation of organic waste and invasive weed species poses significant environmental, economic, and agricultural challenges worldwide. This study explores the innovative potential of weed composting as a sustainable waste-to-resource strategy within modern waste management frameworks. Drawing on recent research, we examine the biological treatment of invasive species such as *Ageratum conyzoides* and *Parthenium hysterophorus* using rotary drum composters, highlighting their capacity to immobilize heavy metals (30-69% reduction in bioavailable fractions) and enhance humification processes. Additionally, the integration of organic waste streams including vegetable market waste, municipal solid waste, and agricultural residues via large-scale composting methods (rotary drum and vermicomposting) has demonstrated significant improvements in nutrient content (up to 50.1% nitrogen, 26.1% potassium) and reductions in phytotoxicity and greenhouse gases. Microbial diversity studies reveal dominant bacterial groups such as *Bacteroidetes*, *Bacilli*, and *Proteobacteria*, crucial for efficient biodegradation. Moreover, advanced technologies, including microbial immobilization and biostimulants like seaweed extracts, have shown to enhance plant growth and detoxify contaminated soils. From an economic perspective, composting offers benefits including waste reduction, cost savings, and environmental sustainability, despite challenges like high initial costs and market competition. This chapter underscores that weed biomass, often considered a pollutant, can be transformed into valuable soil conditioners, fostering a circular economy and promoting sustainable agriculture. Overall, weed composting stands as a promising resource recovery approach that can mitigate pollution, improve soil health, and support ecological balance in contemporary waste management practices.

Poster No: P45

Biochar from Crop Residues as a Sustainable Soil Amendment and Carbon Sink

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Every year, the skies turn grey over northern India. Smoke rises from the fields, Farmers burn what's left behind. paddy straw, wheat husk, sugarcane bagasse. It's quick,and cheap and it clears the land for the next crop. But it also fills the air with carbon dioxide, methane, and tiny dust-like particles that sting your lungs. The air gets heavy. The soil loses life. All that burning affects nutrients, organic matter, the very things the land needs to breathe again. These crop residues are full of lignocellulosic richness, but most people don't really know that. Managing waste isn't easy. Machines cost money. Awareness is low. Still, there's hope. Known as biochar. It takes what's burnt away and give it a second life. Biochar helps the soil heal, locks away carbon, and gives the air a chance to clear again. Biochar is synthesized from crop residues by the process called pyrolysis, where organic waste is heated at 300-800°C under oxygen deficient conditions. This process prevents complete combustion and turns waste into a stable carbon rich substance. Biochar has porous and negatively charged structure, because of that it helps the soil hold water and enhance soil aeration, cation exchange capacity (CEC). Also, it supports microbial activity and nutrient supply. Highly stable carbon bonds. Biochar helps sustain in soil for long periods, functioning as a carbon sink that reduces pollution and carbon preservation. Initial studies have demonstrated that the integration of biochar markedly improves soil fertility, increases crop yield, and stimulates microbial activity, all while decreasing greenhouse gas emissions. Its porous structure makes the soil more breathable, holds more water, and holds more nutrients, which makes farmland more resilient and productive. Also, biochar's stable carbon structure keeps carbon from the air in the soil for hundreds of years, allow Farmers turn waste biomass into useful soil amendment. This approach is environmentally friendly and can be used on a large scale. It supports India's Net Zero and Swachh Bharat initiatives and is in line with the UN Sustainable Development Goals 2 (Zero Hunger), 12 (Responsible Consumption and Production), and 13 (Climate Action).

Poster No: P46

Infiwastex: An Integrated Framework for Autonomous Mobile Manipulation, In-Situ Sorting, and Dynamic Payload Management in Waste Segregation

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The proliferation of solid waste presents a critical challenge to environmental sustainability and public health. This paper introduces Infiwastex, an autonomous mobile manipulator system engineered to address systemic inefficiencies in modern waste management. The system architecture integrates a 6-Degrees-of-Freedom (6-DOF) robotic arm onto a robust mobile platform, enabling both autonomous navigation for collection and intelligent, in-situ sorting of waste into a multi-compartment onboard storage unit. The cognitive functions are driven by an NVIDIA Jetson Nano, an edge AI computer running a YOLOv8 deep learning model fine-tuned on the TACO dataset for real-time waste detection and classification. To address the critical issue of dynamic instability arising from a shifting payload during collection, a Zero Moment Point (ZMP) based control strategy is proposed to ensure tip-over prevention. Furthermore, this work conducts a security analysis of the perception system, investigating its vulnerability to adversarial attacks and proposing defense mechanisms such as adversarial training to enhance model robustness. Navigation is accomplished using a LiDAR-Inertial SLAM algorithm, with the entire system orchestrated via the Robot Operating System 2 (ROS 2). Experimental results validate the efficacy of the baseline system, demonstrating high accuracy in waste classification and reliable performance in navigation and manipulation. The Infiwastex project establishes a comprehensive and viable architecture for the next generation of intelligent, secure, and dynamically stable robotic solutions in environmental technology.

Poster No: P47

Bioresource-Derived Adsorbents from Fruit and Vegetable Wastes for Efficient Heavy Metal Sequestration

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The biosorption of heavy metals using fruit and vegetable wastes is increasingly being recognized as a sustainable and intelligent way to clean contaminated water. Everyday kitchen and agricultural residues—such as orange, banana, lemon, and vegetable peels—are surprisingly rich in natural polymers like cellulose, hemicellulose, lignin, and pectin. These compounds carry a variety of reactive groups that can attract and bind metal ions, turning what is often considered waste into a valuable resource. Compared to conventional chemical or physical treatment methods, which are often costly and generate additional waste, biosorption offers a more natural, low-cost, and environmentally responsible solution. At its core, the process works through multiple interactions-ion exchange, complex formation, surface adsorption, and micro precipitation—each influenced by factors such as pH, temperature, particle size, and adsorbent preparation. Recent studies have shown remarkable removal efficiencies for heavy metals like lead, cadmium, chromium, copper, and zinc using both raw and chemically modified fruit and vegetable wastes. Yet, while laboratory results are highly promising, scaling up this process for real-world use remains a challenge. Questions of biosorbent regeneration, long-term stability, and cost-effective optimization still need to be addressed. Current research is moving toward enhancing surface modification methods and gaining a deeper understanding of the molecular mechanisms involved. With continued innovation, biosorption from fruit and vegetable waste could redefine wastewater treatment-transforming discarded materials into powerful tools for environmental restoration.

Poster No: P48

Smart Waste Management Using IoT and AI

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Significant problems with waste management in smart cities have arisen as a result of increased urbanization, including ineffective collection methods, overflowing trash cans, and rising operating costs. The knowledge and flexibility required to control the ever-evolving dynamics of urban garbage generation are absent from conventional waste management techniques. In order to improve waste management in intelligent urban environments, this article presents a thorough strategy that makes use of artificial intelligence (AI) and the Internet of Things (IoTs). Real-time waste level monitoring and the creation of prediction models for collection schedules are made possible by combining AI-driven data analytics with IoT-connected sensors and devices. This, in turn, leads to more effective and sustainable waste management procedures. A network of smart garbage cans with Internet of Things sensors is used in the proposed approach to monitor variables including temperature, weight, and fill levels. Low-Power Wide-Area Networks (LPWANs) are used to send the collected data to a cloud-based platform for instant analysis. AI methods are used to optimize collection routes and schedules based on expected trash generation trends. These methods include machine learning models for predictive maintenance and pattern recognition. Additionally, computer vision technologies are used to improve recycling operations and automate waste sorting. Waste management is now much more efficient because to the adoption of the AI-driven IoTs system. According to case studies, recycling rates have increased, operational expenses have decreased by 30%, and waste collection frequency has decreased by up to 40%. Furthermore, the technique has successfully reduced overflowing trash cans, improving environmental responsibility and public health. These results highlight how AI and IoT technologies have the potential to revolutionize trash management in smart cities by promoting increased environmental sustainability, cost effectiveness, and adaptability. The suggested approach promotes more sustainable urban growth and lays the groundwork for upcoming advancements in smart city infrastructure.

Poster No: P49

Enhancement of Bacterial Strains for Heavy Metal Detoxification Using CRISPR Technology

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The rapid increase in the amount of heavy metal pollutants is a dangerous threat to human health and to the environment. So, it is desperately needed that we find lasting, efficient way of getting grid these poisons. Traditional bioremediation that takes advantage of bacteria already present in environmental settings is disadvantaged with low metal-tolerance and restricted metabolic function. Inthis study, whether CRISPR-Cas9 technology can be used to breed engineered strains of bacteria with increased ability to biodegrade toxic heavy metals. Targeted gene modifications were made to strengthen the expression of metal-chelating proteins, metallothioneins and gene pump systems which confer resistance to cadmium, lead and mercury cations. The modified strains were far superior to wild-type controls in terms of their ability for metals uptake, growth rates in toxic concentrations and resistance against oxidative stresses via a mutated gene exit strategy. Because the molecular analysis showed that the inserted genes had taken hold and persisted from one generation to the next, these results were confirmed at genetic level. These findings demonstrate the transformative potential of CRISPR technology in developing next-generation bioengineered microorganisms for eco-friendly and cost-effective remediation of heavy metal-polluted environments. Consequently, this method not only speeded up the detoxification process but also heralds a new, biology-influenced era for environmental sustainability.

Poster No: P50

IoT-Enabled Predictive Waste Management for University Campuses Using Machine Learning Classification Method

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Smart bins are equipped with sensors that monitor fill levels, weights, and other environmental factors, while a cloud-based system collects and analyzes the data in near real time. We developed a unique dataset containing more than 5,000 variables related to bin characteristics, collection events, and vehicle transportation for waste collection. This comprehensive dataset enabled us to create models that identify and predict emerging waste profiles. Data preprocessing was conducted to enhance model performance, including cleaning, normalization, and feature engineering. The models demonstrated strong predictive capability for determining when bins required servicing, achieving exceptional Area Under the Curve (AUC) scores of approximately 0.99 across all Logistic Regression (LR) models. Overall, this study presents a flexible, adaptable framework for smart waste management solutions in smart city environments, promoting sustainability, operational efficiency, reduced greenhouse gas emissions, and data-driven decision-making.

Poster No: P51

From Desert to Design: The Rise of Cactus-Crafted Eco-Leather

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Traditional leather production is increasing sustainability issues such as animal abuse, toxic chemical tanning and wastage of water. These environmental concerns are accelerating the search for ecofriendly alternatives. Leather derived from plant- based materials called vegan leather can be a potential solution to these issues, encouraging environmental-friendly fashion. According to various studies, Vegan leather can be produced from several natural and waste materials such as pineapple leaves, apple peels, banana stems, mushroom mycelium, and coconut husks. However, cactus leather is especially suitable for regions like Rajasthan because it explores the potential of a drought-resistant and eco-friendly plant. Vegan leather made from cactus highlights the ability to imitate real leather's properties. Primarily, this bio-based leather is derived from mature leaves of *Opuntia ficus-indica* which grows abundantly with minimal water requirements in arid regions. The roots and the plant itself remain unharmed after harvesting the cactus, allowing it to keep growing and sequestering carbon dioxide. This is achieved by harvesting mature cactus pads, sun-drying followed by processing the fibers with bio-based binders to yield durable, flexible and bio-degradable material that shows leather-like texture without toxic chemicals. Water pollution caused by synthetic dyes and chemicals used in the process of conventional leather made from animals can be reduced by using natural dyes. It is not only beneficial for the environment but also promotes local economic opportunities in dry regions. Hence, Vegan based cactus leather serves as promising innovation in bridging the gap between conscious consumerism and environmental safeguarding.

Poster No: P52

Mycelium-Based Biofilters for Sustainable Removal of Pharmaceutical Contaminants from Hospital Wastewater

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Pharmaceutical compounds such as antibiotics, analgesics, hormones, and cytotoxic drugs are increasingly detected in hospital wastewater and represent a significant class of emerging contaminants. These substances often bypass conventional wastewater treatment systems and enter the environment, where they promote the spread of antibiotic resistance genes, disrupt hormonal balance in aquatic organisms, and accumulate through food webs. Continuous exposure to low concentrations of these pollutants poses long-term risks to both ecosystem and human health. To address this challenge, we propose a mycelium-based biofiltration system employing white-rot fungi *Pleurotus ostreatus* and *Trametes versicolor* cultivated on lignocellulosic agricultural residues such as rice husk and sawdust. The fungal mycelium serves as both a biosorbent and a biocatalyst. Through the secretion of ligninolytic enzymes including laccase, manganese peroxidase, and lignin peroxidase, the fungi can oxidize and break down complex pharmaceutical molecules into less harmful intermediates. The porous mycelial matrix enhances surface interaction, adsorption efficiency, and hydraulic retention time, allowing improved contaminant removal.This approach integrates waste valorisation with pollution control by converting agricultural by-products into functional biofiltration media. Preliminary bench-scale trials demonstrate significant reduction of pharmaceutical residues and decreased antibiotic resistance gene signatures in treated effluents. This is scalable, affordable technology offers a promising, biology-driven alternative for hospital wastewater management, supporting India's Swachh Bharat Mission, Net Zero goals, and UN SDGs 6, 12, and 14. Our future work will focus on optimizing flow parameters, testing with real effluents, and evaluating long-term operational stability to support integration into existing treatment infrastructures.

Poster No: P53

Hybrid Microbial Fuel Cell–Constructed Wetland System for Simultaneous Wastewater Treatment and Electricity Generation

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The development of bioelectrochemical technologies has increased due to the growing demand for renewable energy generation and sustainable wastewater management. This study examines a hybrid Microbial Fuel Cell–Constructed Wetland (MFC–CW) system designed to treat wastewater and produce electricity at the same time. The system combines the electrochemical energy conversion of microbial fuel cells with the effective pollutant removal of artificial wetlands. To increase conductivity and cost-effectiveness, locally accessible materials were used, such as electrodes made of biochar made from agricultural waste. The substrate was domestic wastewater, and operational parameters like hydraulic retention time (HRT), wetland plant species (Canna indica and Phragmites australis), and electrode type were optimised. With a maximum power density of 1.2 W/m2, the hybrid system removed more than 85% of the chemical oxygen demand (COD) and 80% of the biological oxygen demand (BOD). Vegetation improved treatment performance and energy output by increasing microbial activity and oxygen diffusion. The hybrid configuration performed noticeably better than standalone systems, according to comparative analysis. In line with Sustainable Development Goals (SDGs) 6, 7, 12, and 13, these results demonstrate the potential of hybrid MFC–CW technology as an affordable, energy-positive, and sustainable solution for decentralised wastewater treatment.

Poster No: P54

Integrating Biotechnology and Policy Frameworks for Sustainable Waste Management in the Circular Bioeconomy Era

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Global waste accumulation poses escalating environmental and socioeconomic challenges that demand sustainable, biotechnology-driven solutions. This review critically examines recent innovations in microbial biotransformation, enzyme catalysis, omics technologies, and nanobiotechnology that are redefining modern waste management. Engineered microbes and catalytic enzymes efficiently convert organic residues into biofuels, bioplastics, and high-value biomolecules, enabling waste-to-wealth transformations. Integration of omics and artificial intelligence facilitates precision bioprocessing, enhancing efficiency and adaptability. Emerging nanobiotechnological approaches and biosensors enable real-time pollutant detection and accelerated biodegradation. Beyond scientific advancements, the review emphasizes the growing role of law, policy, and governance frameworks in promoting safe and ethical deployment of biotechnological waste management. International agreements such as the Basel Convention, coupled with national circular economy strategies, shape implementation and ensure biosafety compliance. This interdisciplinary convergence of biotechnology, digital intelligence, and environmental policy paves the way for a resilient circular bioeconomy. Despite progress, challenges remain in large-scale application, cost optimization, and regulatory harmonization. By integrating scientific innovation with policy mechanisms, this review provides a comprehensive roadmap toward sustainable waste valorization and global environmental restoration.

Poster No: P55

Role of Amendments, Plant Extracts and Mulch in Plant Disease Management

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Plant diseases significantly reduce crop yield and quality, posing major challenges to sustainable agriculture. Eco-friendly alternatives to chemical pesticides are essential for long-term productivity and environmental health through soil amendments, plant extracts, and mulching in managing plant diseases. Sustainable and eco-friendly approaches for disease management are increasingly gaining importance as alternatives to chemical pesticides. Disease management in organic farming is largely based on the maintenance of biological diversity and soil health by balanced crop rotations, including nitrogen-fixing and cover crops, intercrops, additions of manure and compost and reductions in soil tillage. Most soil-borne diseases are naturally suppressed, while foliar diseases can sometimes be problematic. Only when a severe disease outbreak is expected the pesticides can be suggested in used and approved for organic farming. Organic amendments such as compost, vermicompost, and biochar improve soil structure, enhance microbial activity, and suppress soil-borne pathogens. Similarly, plant extracts from neem, garlic, turmeric, and other botanicals show potent antifungal and antibacterial effects against various crop pathogens. The application of organic and plastic mulches helps reduce weed growth, maintain soil moisture, and lower disease incidence by modifying the soil microclimate. This eco-friendly management strategy minimizes reliance on synthetic chemicals and contributes to healthier agro ecosystems and long-term agricultural sustainability.

Poster No: P56

Role of Nanotechnology in Plant Disease Management

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Nanotechnology has emerged as a promising frontier in sustainable agriculture, offering innovative solutions for the effective management of plant diseases. Nanotechnology is one of the most fascinating and rapidly advancing sciences and posses potential to revolutionize many discipline of sciences, technology, medicine and agriculture. The application of nanomaterials, such as nano-fertilizers, nano-pesticides, and nano-formulated antimicrobials, allows for the controlled and targeted delivery of active ingredients directly to infection sites. This approach enhances treatment efficiency while minimizing chemical waste. Metallic nanoparticles, including silver (Ag), zinc oxide (ZnO), and copper oxide (CuO), exhibit broad-spectrum antimicrobial properties against fungal, bacterial, and viral pathogens, disrupting their growth and survival mechanisms. Furthermore, the use of nano-encapsulation and polymer-based delivery systems improves the stability, solubility, and bioavailability of agrochemicals, thereby reducing volatilization, leaching, and environmental contamination. Nanotechnology has also transformed disease diagnostics through the development of nano-sensors and smart detection systems, which enable rapid, sensitive, and early identification of pathogens in plants. These advanced tools allow for timely disease intervention and precise management, reducing reliance on conventional pesticides and promoting safer food production. Overall, the integration of nanotechnology in agriculture presents a comprehensive and sustainable approach to plant disease control, combining enhanced efficacy, environmental protection, and long-term productivity.

Poster No: P57

Eco-Friendly Management of Plant Diseases Using Waste Products

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The indiscriminate use of synthetic pesticides and fertilizers in modern agriculture has raised significant concerns about environmental pollution and human health, driving the demand for sustainable and eco-friendly alternatives for plant disease management. Sustainable agriculture requires innovative and environmentally safe strategies to manage plant diseases without relying heavily on chemical pesticides by utilization of agricultural, municipal, and industrial waste products and medicinal plant by-products as effective, sustainable tools for controlling plant pathogens and enhancing crop resilience for eco-friendly disease management in crops. Various organic wastes such as compost, biochar, crop residues, and biogas slurry were explored for their potential to suppress soil-borne and foliar pathogens through improvement of soil health, induction of systemic resistance, and enhancement of beneficial microbial activity. Additionally, extracts and compost teas prepared from agricultural wastes exhibited promising antifungal and antibacterial properties against major phytopathogens. The approach not only offers a cost-effective and sustainable alternative to synthetic agrochemicals but also contributes to circular economy principles by converting waste into valuable resources. The integration of waste-based bio-inputs in plant protection can significantly reduce environmental pollution, improve soil fertility, and promote sustainable crop production. Therefore potential of waste-to-wealth strategies in achieving eco-friendly and sustainable disease management systems for future agriculture.

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