

Preface

In this new volume entitled, “Harmonising Chemical and Biological Sciences for Sustainable Development” the authors offer fresh insights and innovative frameworks for reinterpreting sustainable development in the context of global development. The book delves into potential strategies for addressing the complex interplay between energy, environmental sustainability. It explores the intersection of chemistry and biology in addressing the pressing challenges of sustainability bringing together cutting-edge research that delves into the transformative potential of science in creating eco-friendly solutions. By examining various applications, from green solvents and organic synthesis to the role of antioxidants in human health, the contributors provide a comprehensive overview of how harmonising these fields can lead to innovative, sustainable technologies and practices.

The first article delves into the promising applications of nano-photocatalysis in solving global challenges such as energy scarcity and environmental pollution. By utilising nanomaterials like TiO_2 , ZnO , and various metal nanoparticles, the article explores their use in a wide range of consumer products, including self-cleaning surfaces, UV-protective textiles, and medical devices.

This article entitled “Heterogeneous Catalysts for CO_2 Chemical Transformations in Sustainable Pathways” presents a comprehensive overview of the use of heterogeneous catalysts in the chemical transformation of carbon dioxide (CO_2) into value-added products. The focus is on catalytic cycloaddition reactions that utilise CO_2 to synthesise cyclic carbonates and other chemicals, highlighting their applications in industrial processes.

Moumita Roy in her article explores the significant role of indium-based catalysts in green organic transformations, emphasising their sustainability and recyclability. The study outlines various techniques for enhancing the catalytic efficiency of indium salts by immobilizing them onto functionalised polymers and metal-organic frameworks (MOFs).

The article “Ornamental Fish diversity of Mridangabhanga River - A distributaries of River Ganga” delves into the rich biodiversity of ornamental fishes in the Mridangabhanga River, a distributary of the River Ganga. Through seasonal assessments, the study identifies 49 species of ornamental fish, shedding light on their distribution, ecological roles, and the environmental pressures they face. This study is vital for understanding how human activities and natural environmental factors interact, and it advocates for the preservation of these valuable resources.

In the article “Thermal Stability and Swelling Behaviour in Aqueous Medium of Acrylamide-Based Hydrogels”, the authors examine the thermal stability and swelling Behaviour of acrylamide-based hydrogels in various aqueous environments. The study highlights the relationship between crosslinking and swelling Behaviour, demonstrating that the hydrogels' swelling characteristics are influenced by temperature and network structure.

Sobhana Palit (Paul) in her study investigates the bioaccumulation of heavy metals in

the muscle tissues of two commercially important prawn species from the Hooghly estuarine system. By analysing concentrations of metals such as copper, lead, and cadmium, the research highlights the potential health risks associated with consuming contaminated seafood.

Suman Mandal in his article explores the synthesis of copper nanoparticles (CuNPs) using different non-ionic surfactants, particularly polysorbates, and their morphological changes under varying conditions. Through a combination of techniques like transmission electron microscopy (TEM), dynamic light scattering (DLS), and UV-visible spectroscopy, the study provides insights into how surfactant concentration and type affect the size and shape of CuNPs.

The article “The Future of Zinc Implant: Its Revolutionary Effects in Modern Advancements” discusses the emerging field of zinc-based biodegradable implants as alternatives to traditional non-biodegradable materials used in orthopaedic surgeries. Focusing on zinc alloys such as Zn-Mg and Zn-Mn, the article highlights their mechanical properties, biocompatibility, and potential for reducing post-surgical complications.

The article, authored by Dipasree Roychowdhury, presents a comprehensive review of the pharmacological properties of guava (*Psidium guajava* L.), focusing on its medicinal benefits. The fruit and various plant parts of guava have been used traditionally to treat a wide range of ailments, including diabetes, diarrhoea, and inflammation. Recent studies support these traditional uses, with evidence of the plant's anti-diabetic, antimicrobial, anti-inflammatory, and antioxidant activities.

The article “Physico-Chemical Parameters for Checking Drinking Water Quality: A Review” provides a critical review of the physico-chemical parameters used to assess the quality of drinking water, emphasising the importance of these parameters in ensuring public health. The study outlines the various characteristics of water, such as pH, electrical conductivity, total dissolved solids, hardness, and levels of contaminants like chloride and sulphate, which are key indicators of water quality.

Another article authored by Debarati Dey, investigates the impact of external magnetic fields on electron transfer reactions, with a particular focus on homogeneous mediums. The study delves into the role of spin correlation and the mechanisms underlying photoinduced electron transfer (PET) processes, providing insights into how magnetic fields affect the dynamics of these reactions.

The article “Functional Molecules for Organic Light-Emitting Diodes (OLEDs)” addresses the crucial role of functional organic molecules in the development of organic light-emitting diodes (OLEDs). With a focus on amorphous molecular materials, the study reviews key components such as hole- and electron-transporting materials, charge-blocking layers, and emissive substances.

The article “Assessment of Total Flavonoid Content and Antioxidant Activity of Mango Pulp Extracts” presents an in-depth assessment of the flavonoid content and antioxidant activity of mango pulp extracts. Utilising various extraction techniques, including microwave-assisted extraction, the study compares the efficacy of different solvents in extracting bioactive compounds from mango pulp. The findings highlight

the potential health benefits of mango pulp due to its high flavonoid content and antioxidant properties, which are essential in combating free radical-related diseases.

In another article, Chandan Kumar explores the growing applications of ionic liquids (ILs) as alternative solvents in organic synthesis. Characterised by low vapour pressure and excellent thermal stability, ILs are considered green solvents and have gained significant attention for their eco-friendly properties. The article provides a detailed examination of the use of ILs in catalysis, nanoparticle synthesis, and other chemical reactions.

Another article, *Advancing Sustainable Chemical Processes through the Use of Green Solvents and Reaction Media*, emphasises the critical role of environmentally benign solvents in modern chemical synthesis. It explores emerging green alternatives, their benefits, and practical applications in sustainable chemistry. This work contributes to the global shift toward eco-friendly practices, offering valuable insights for researchers and industries focused on reducing the environmental impact of chemical processes.

The article, authored by Shib Shankar Biswas and colleagues, explores cutting-edge advancements in nano-engineered materials for defence applications. It provides a comprehensive review of processing methods, integration challenges, and transformative applications in stealth, armour, and energy systems. Emphasizing interdisciplinary innovation, the work highlights nanotechnology's critical role in enhancing operational efficiency, resilience, and protective capabilities in modern defence systems.

Rupankar Paira presents a comprehensive overview of recent advances in cobalt-catalysed C–H activation reactions involving alkynes, allenes, and arenes in his article. Highlighting cobalt's potential as a cost-effective and sustainable alternative to noble metals, the work underscores key developments in synthesis and selectivity that contribute significantly to modern organic chemistry.

This volume stands as a testament to the transformative power of integrating chemical and biological sciences in pursuit of a more sustainable and equitable future. By aligning with the United Nations Sustainable Development Goals—particularly SDG 12: Responsible Consumption and Production and SDG 3: Good Health and Well-being—the contributions within this book highlight innovative strategies to reduce environmental impact, promote efficient resource use, and enhance public health through science-driven solutions. This work not only advances academic inquiry but also inspires meaningful action toward responsible innovation and improved quality of life for communities around the world. We hope this book will serve not only to enrich scholarly discourse but also to catalyse tangible progress in responsible innovation, ultimately enhancing the well-being of communities worldwide.

Hari Shankar Biswas
Sandeep Poddar
Dilip Kumar Maiti
Amiya Bhaumik