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EDITORIAL

Recent trends in environmental sustainability

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Introduction

Environmental contamination by diverse types of potentially toxic elements (PTEs, generally termed pollutants) is not a new occurrence; nevertheless, it is still one of the world's greatest issues faced by humanity (Rios-Fuster et al. 2023; Shaheen et al. 2023). Regardless of considerable global attention, environmental contamination and associated issues and risks have become more intense and pervasive in the recent past (Shah et al. 2022). Ecological contamination (soil, water, and air) by PTEs has become highly pertinent and evident both in developing and developed nations, although ecological awareness is high in developed nations (Iqbal et al. 2023).

A pollutant can be in any form, such as a biological organism, a chemical (radionuclide, toxic metal, gases), a geochemical element (sediment, dust), or a physical substance (radiation, heat). Numerous natural and anthropogenic activities are responsible for the constant release of these pollutants into the ecosystem, thereby continuously degrading environmental quality (Natasha et al. 2022b; Rios-Fuster et al. 2023). Man-induced activities such as ever-increasing population, urbanization, industrialization, mining, rapid development, and associated socio-economic factors accompanied by unsustainable use of non-renewable resources are declining environmental quality in respect of eco-sustainability, food safety, and animal health (Shahid 2021). The pollutant-induced decline in environmental quality is evidenced by the loss of biological diversity and vegetation as well as the presence of high levels of PTEs in the ambient air, food, and water (Han et al. 2018; Shahid et al. 2021). Consequently, there has been a tremendous increase in environmental misfortunes and threats to life support systems.

The continuous release of PTEs at a high rate into the environment has received considerable attention globally, owing to their high persistence, bioaccumulation tendency, and potential toxicity. When living organisms (humans, animals, and plants) get exposed to high levels of these pollutants, it results in the induction of numerous biochemical, morphological, structural, and physiological toxic effects (Natasha et al. 2022a; Rios-Fuster et al. 2023). For example, PTEs have been reported to alter plant development, growth, physiological, metabolic, biochemical, immunity, defense mechanisms, and pathways (Khalid et al. 2022b). Human exposure to supra-optimal concentrations of PTEs causes numerous disorders such as cancer, respiratory diseases, reproductive illnesses, and damage to the immune system (Zhang et al. 2023). Thus, the toxic effects of PTEs have appeared as crucial social and scientific challenges to sustaining healthy and pollutant-free food.

Nowadays, biomonitoring, risk assessment, remediation, and understanding the biogeochemistry of these PTEs in the ecosystem have gained immense importance (Khalid et al. 2023; Nagra et al. 2022). Biomonitoring is an ideal tool to observe and monitor emerging environmental issues. To date, numerous plant and animal biomarkers have been utilized to assess environmental quality and contamination (Natasha et al. 2022a; Singh et al. 2023). Similarly, risk assessment based on pollutant levels in edible plant or animal tissues has gained considerable attention worldwide. Pollutants can accumulate in the food chain via different pathways and mechanisms. Thereby, humans can be exposed to these pollutants through the consumption of contaminated food (Shahid et al. 2023b). It is considered highly useful to trace the possible exposure routes of PTEs to living organisms, including humans. During the last 2–3 decades, numerous studies have focused on environmental contamination by pollutants, their transfer to living organisms, and associated potential health risks (Shah et al. 2022; Zhang et al. 2023). It is reported that the levels of different types of pollutants may surpass the permissible limits in soil, water,

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plants, and animals, thereby inducing numerous potential risks (Rios-Fuster et al. 2023; Shahid et al. 2023a). Therefore, it is highly practical to monitor health risks associated with the existence of toxic levels of PTEs in different compartments of the ecosystem.

The above-mentioned environmental and health issues governed by different types of PTEs imply the significance of a sustainable environment, which is highly topical nowadays. In fact, increased awareness among people about the ecological and health consequences of PTEs has signified the demand for environmentally sustainable and balanced development. Accordingly, environmental sustainability and conservation developments are highly topical nowadays. The term sustainable represents a key driver of ecological balance. Sustainability applies to almost every facet of life on Earth, ranging from a local to a global scale. It demands that we meet our current requirements without jeopardizing ecological balance and quality. Industrial development should be made in line with environmental sustainability by identifying ways to minimize the production and release of PTEs and toxic gases into the environment (Bie et al. 2023). Moreover, conservation and recycling/reuse of natural resources must be high on the agenda of organizations operating at national and global scales.

Taking into consideration the above-mentioned standpoint, this special issue, "ESCON-2022", was established to present the latest trends and advancements about sustainable environment. In this issue, we have collected and presented a group of highly important and relevant articles based on the international symposium on "Recent Trends in Environmental Sustainability" held on February 21–23, 2022, at COMSATS University Islamabad, Vehari, Pakistan. The selected articles delineate multidisciplinary approaches and recent trends in environmentally sustainable development.

Articles selected in SI of ESCON-2022

A study by Aslam et al. (2022) assessed the nickel (Ni) build-up and tolerance potential of two quinoa genotypes (Vikinga and Puno) by treating them with different levels of Ni (0, 100, 200, 300, and 400 µM) for 21 days in a nutrient solution. Results delineated a dose-dependent decrease in growth parameters of both quinoa genotypes. Nickel application inhibited potassium (K) uptake by roots and transfer to leaves. Moreover, Ni exposure mediated oxidative burst by overproducing radicles, which caused lipid peroxidation. The comparative results of the bioconcentration factor, tolerance index, and translocation factor showed that genotype Vikinga was lesser tolerant to Ni than Puno. It is proposed that the higher Puno tolerance to Ni toxicity is due to its potential to mediate higher levels of reactive radicle-scavenging enzymatic antioxidants such as peroxidase, ascorbate catalase, peroxidase, and superoxide dismutase. Multivariate analysis revealed a strong negative correlation of Ni with physiological/growth parameters and a positive association with oxidative stress parameters. The authors recommended that the Puno genotype performed better than Vikinga to stabilize and remediate Ni-contaminated soil.

Hussain et al. (2022) studied the consequences of variations in land use/land cover (LULC) on land surface temperature (LST) of Southern Punjab, Pakistan, using data of remote sensing (RS). They collected 30-year data from Landsat images to identify LST and vegetation indices in the study area. Results revealed an increase from 29,620 (3.6%) to 88,038 ha (10.8%) for the last 30 years in the built-up area. The values of LST ranged from 11–47 °C, 11–45 °C, 11–44 °C, and 12–42 °C, respectively, for the years 2017, 2007, 1997, and 1987. The authors proposed that the data about LST and LULC can be of great use for legislators to establish environmentally sustainable policies to manage land resources.

Khan et al. (2023) studied the collective effects of benzene and formaldehyde (volatile organic compounds) on the tolerance mechanism of C3 plants such as *Dracaena mysore*, *Chlorophytum comosum*, and *Ficus longifolia*. Formaldehyde and benzene were applied in combined applications (0, 0; 2, 2; 2, 4; 4, 2; and 4, 4 ppm) in an airtight glass chamber. There was a substantial increase in total phenolic compounds of *D. mysore* (8.7 mg GAE/g); *C. comosum* (9.2 mg GAE/g); and *F. longifolia* (10.7 mg GAE/g) than their corresponding control values (6.1, 5.4, and 3.8 mg GAE/g). A similar trend of increased content was observed for total flavonoids, proline, and total carotenoid contents in all three plants. Similarly, *D. mysore* showed significantly increased the activities of antioxidant enzymes including catalase, and guaiacol peroxidase. The results revealed that the combined application of formaldehyde and benzene affects the physiological responses of indoor plants.

Jiang et al. (2022) evaluated the mechanisms of three different kinds of microplastics (MPs) [polypropylene (PP), polyvinyl chloride (PVC), and polyethylene (PE)] to clean butachlor (BUT) from wastewater under varied experimental conditions such as pH, aging, and ion concentration. Results showed that the BUT adsorption potential of PP, PE, and PVC were, respectively, 14.82 µg/g, 13.65 µg/g, and 18.88 µg/g. Data deleted low adsorption potential (microgram level) of MPs for BUT. The BUT adsorption potential of PP, PE, and PVC followed pseudo-second-order kinetics. The adsorption mechanism was considered as a single-layer adsorption process because the Langmuir isotherm model fits well. Moreover, a high ion level can improve the interaction between BUT and MPs, while a low ion level can minimize the carrier effect. The aging experiment also revealed significant effects on the adsorption of BUT by MPs.

Shahzad et al. (2022) conducted a 70-day experiment to determine the influence of probiotic-supplemented rapeseed meal–based feed on nutrient digestibility, growth parameters, and mineral uptake in *Catla catla*. Six levels of probiotics (0, 1, 2, 3, 4, and 5 g/kg) were used to prepare six test feeds. Results revealed that probiotics supplementation improved nutrient digestibility (fat, 75%, CP, 72%; and GE, 70%), mineral uptake (Na, 76%; Ca, 72%; P, 70%; and K, 70%), growth rate (1.55), feed conversion ratio (1.22), and weight gain percentage (303%) of *Catla catla*. Additionally, supplementation of probiotics reduced the release of nutrients and minerals through feces than control feed. Results concluded that 2 g/kg probiotic inclusion helps to prepare eco-friendly and cost-effective fish feed.

Hammad et al. (2023) assessed the effects of coronavirus disease (COVID)-19. COVID-19-mediated deaths were about 5.32 million worldwide by 2021. COVID-19-mediated numerous beneficial effects such as a decrease in pollution of water, air, and noise. The reason behind reduced environmental pollution during the COVID-19 pandemic was a lockdown. Nevertheless, the negative effects of COVID-19 are crucial such as enhanced generation of biomedical waste, death rate, municipal solid waste generation, and enhanced discharge of microcontaminants (biocides, pesticides, surfactants, pharmaceuticals, heavy metals, and flame retardants). Although COVID-19's negative effects were severe to all groups of society, the most vulnerable members of the population were particularly affected. Globally, COVID-19 enhanced food safety risk due to increased prices and decreased revenues. Moreover, several activities were severely affected such as fisheries, horticulture, agribusiness, and domesticated animals. It was proposed that the proper application of some useful approaches such as face masks, vaccination, social distancing, and sustainable industrialization can be highly supportive of global environmental sustainability.

Khalid et al. (2022a) assessed the sustainability issues associated with food waste owing to its negative effects on the ecosystem, economy, and food safety. This study examined the food waste behaviors of the people and the levels of financial losses through wasting food. The total volume/mass of food wasted during 24 h period was sampled from 51 houses in Kahror Pakka Tehsil, Pakistan. Moreover, a questionnaire survey was performed to determine the respondents' behaviors and knowledge of food waste. The survey revealed that respondents from low- and high-income households have fruit and vegetable losses 31% and 32%, and scrap and peel losses 48% and 53%. The survey revealed that the main reasons for food losses were the preference of respondents to use fresh food and lack of time for saving food. Moreover, high-income households have high financial losses due to wastage of food (> Rs. 3677 per capita per annum).

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