Abstract

Water and sanitation are a United Nation's Sustainable Development Goal (UNSDG) to be attained by 2030. From the UNSDG report of 2021, about 26% of global population lacks safe drinking water and about 3 million people are facing the threat of water scarcity globally! Natural and manmade aquatic pollution of water resources is the major cause of global water scarcity, and pose rigorous threat to human health, ecology, and global economy. Untreated waste water discharged from households, agriculture, industrial, municipal, and health care facilities is rich in plant nutrients (nitrogen, phosphate, potassium, sulphur, etc.,), microorganisms (bacteria, virus, fungi, prions, protozoa, etc.), organic pollutants (phenols, nitro aromatics, amines, carboxylates, dyes, detergents, pesticides, and drugs), micro plastics (phthalates, Bisphenol A, polychlorinated biphenyls, etc.), heavy metals (As, Cr, Bi, Cd, Hg, Pb, Sn, etc.), and other inorganic maters (metal salts, and oxides) accounts for the water deterioration. ***Under ideal weather, the prolonged accumulation of plant nutrients (especially nitrates, and phosphates) in water bodies triggers Harmful Algal Blooms (HAB) and consequent release of cyanotoxins (!); thus, spoil the aquatic system (marine and freshwater) making them inconsumable and inhabitable for other species.*** Water, food, and ecosystem swamped with plant nutrients and cyanotoxins have become a substantial threat to human health, food safety, drinking water, and other socio-economic parameters. For instance, cyanotoxins are profound in fish, mussels, crustaceans, and plants such as lettuce, tomato, cabbage, radish, carrot and rice grains. Much alarmingly, lake water treated under standardised drinking water treatment protocols of filtration, chlorination, ozone treatment, and ultraviolet disinfection have shown that about 58% of the tested samples retained about > 0.3 µg L^{-1} of Microcystin-LR after standard water treatments (!). In like manner, the blue green algae supplements constituting A. flos-aquae cyanobacteria are found to be rich (1 µg g^{-1} to 35 µg g^{-1}) in Microcystin-LR (!). Further, a recent study in the Baltic coast of Poland, reported that the airborne Synechococcus sp., microalgae produce significantly large amounts of Microcystin-LR (420 fg $cell^{-1}$) (!), which possess serious hepatotoxicity and carcinogenicity. A potential overdose of nitrates, phosphates and cyanotoxins can cause mild to serious side-effects ranging from nausea/vomiting, diarrhoea, lung disease, gastrointestinal diseases, stomach cancer, abdominal pain, liver inflammation, behavioural disorders, respiratory stress, oxidative stress, DNA damage, mitochondrial toxicity, delayed metamorphosis acute pneumonia, dizziness, temporary blindness, salivation, metabolic, immune, and endocrine disorders, respiratory paralysis, etc. The economic cost of HAB on medical and loss of productivity accounts for an annual cost of 350 million USD in the USA; meanwhile, as of 2005 the ASP and CFP alone costs about 11 million USD to the European Union annually. The HAB thrived closure of fisheries and loss of consumer demands costs an annual loss of 37, and 147 million USD for the USA, and the EU, respectively. Similarly, the EU loss about 637 million USD annually due to drop in tourism and recreation costs caused by HAB. Furthermore, the annual cost of monitoring water bodies costs about 18 and 4 million USD for the EU, and the USA, respectively. Analytical platforms that enable rapid periodic on-site screening of fresh and marine ecosystem for plant nutrients (nitrates, and phosphates) and cyanotoxins contaminations are seldom and complex at present, Taking note on the merits and limits of existing analytical platforms, the sH2Oft project will provide a comprehensive study on the electrochemical behaviours of target analytes and their potential interfering agents at soft interfaces which will potentially unlock the complexity in determining the target species in the pool of potential snooping agents. the sH2Oft aims at developing an alternative assay platform for the comprehensive monitoring of water quality and addressing the analytical niche in this mean. Sensing will be achieved with the help of specifically engineered soft interfaces (liquid-liquid interface and thin polymeric membranes) which when properly formulated are expected to provide desired detection selectivity and sensitivity. The sH2Oft propose an efficient and alternative sensing approach based on soft junction targeting the nitrates and phosphate enrichment to monitor HAB events and cyanotoxins contaminations of fresh and marine ecosystems. The goal of the sH2Oft project is to develop a robust, and functional electroanalytical platform for presumptive (limitation of the electrochemical sensors family) nitrates, phosphates, and cyanotoxins detection in water samples collected form aquatic systems. ***This project aspires to deliver an innovative, robust and an economical analytical platform to monitor the waterbodies (marine and fresh) for nutrient enrichment and cyanotoxin pollution; which may eventually reduce the cost of HAB monitoring and its sequential governmental expenses towards counteracting nutrient enrichments, HAB, and cyanotoxin pollutions.***