Sustainable Crop Production in Bangladesh: Navigating Climate Change and Embracing Agriculture 4.0

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Abstract

Bangladesh, an agrarian economy supporting over 170 million people, faces critical challenges in sustaining food security and agricultural productivity. The sector's vulnerability to climate change, compounded by rising sea levels, erratic weather, and soil salinity, significantly impacts crop production, especially in coastal regions. With over 85% of rural households relying on agriculture, adopting sustainable practices and advanced technologies is imperative for resilience and long-term growth. The country is implementing climate-smart agricultural strategies, including integrated pest management, organic farming, and developing climate-resilient crop varieties. These practices aim to enhance soil health, preserve biodiversity, and reduce dependence on synthetic inputs. Techniques such as crop rotation, agroforestry, and conservation tillage are gaining traction, contributing to sustainable intensification and environmental conservation. Innovative solutions like seaweed extracts, nano-fertilizers, and enhanced biofertilizers are being explored to improve nutrient use efficiency and minimize environmental impact. For example, nano-potash supplementation has shown the potential to boost crop yields while reducing fertilizer usage, which is crucial for sustainable agriculture. These practices are aligned with the broader adoption of Climate-Smart Agriculture (CSA) approaches. The Fourth Industrial Revolution (4IR) offers new opportunities through technologies like artificial intelligence (AI), Internet of Things (IoT), drones, and big data analytics. These tools enable precision farming, smart irrigation, and real-time crop monitoring, enhancing decision-making and resource use efficiency. Initiatives under the Smart Bangladesh Vision are promoting digital agriculture, though challenges remain due to limited infrastructure, financial constraints, and technical skill gaps. Government support, international collaboration, and targeted farmer education are essential to overcoming these barriers. By integrating climate-smart practices and leveraging Agriculture 4.0, Bangladesh aims to ensure sustainable crop production, enhance resilience, and secure long-term food security. Coordinated efforts will be key to achieving these goals and meeting the country's development targets.

About:

Professor Dr. Mirza Hasanuzzaman is a is a Professor of Agronomy at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. He completed his Bachelor of Science in Agriculture (Hons.) and M.S. in Agronomy from Sher-e-Bangla Agricultural University with a Gold Medal and earned a Sher-e-Bangla Agricultural University Award. He received his Ph.D. in 'Plant Stress Physiology and Antioxidant Metabolism' from the United Graduate School of Agricultural Sciences, Ehime University, Japan. Later, he completed his postdoctoral research at The University of the Ryukyus, Okinawa, Japan. Subsequently, he became an Adjunct Senior Researcher at the University of Tasmania with an Australian Government's Endeavour Research Fellowship. Prof. Hasanuzzaman has over 300 Scopus-indexed publications and more

than 250 on the Web of Science. He has edited over 25 books and written over 50 book chapters on important aspects of plant physiology, plant stress responses, and environmental problems in relation to plant species. His publications are cited about 27000 times as per Scopus with an h-index of 84. He has established a Crop Science Laboratory at Sher-e-Bangla Agricultural University, where he has facilities to investigate plant stress responses and plant-soil interaction. During the last 18 years, he has been investigating the mechanisms of how plants can survive in adverse environments like floods, drought, salinity, and metal toxicity. One key mechanism Prof. Hasanuzzaman focuses on is antioxidant defense in plants. Prof. Hasanuzzaman is an Editor and a reviewer for more than 80 peer-reviewed international journals and the recipient of the 'Publons Peer Review Award 2017, 2018, and 2019'. He is an active member of 40 professional societies and is the acting Treasurer of the Bangladesh JSPS Alumni Association. He received the World Academy of Science (TWAS) Young Scientist Award 2014; the University Grants Commission (UGC) Gold Medal 2018; the Bangladesh Academy of Sciences (BAS) Gold Medal Award-2022 (Senior Group); Global Network of Bangladeshi Biotechnologists (GNOBB) Award 2021; Pothikrit Biggyan Sommanona 2022; Society for Plant Research Young Scientist Award (Agriculture)-2023; Eminent Scientist Award-2022 from the Society for Science of Climate Change and Sustainable Environment. He is a member of over 40 professional societies and a fellow of the Bangladesh Academy of Sciences (BAS), the World Academy of Sciences (TWAS), the Linnean Society of London, the Royal Society of Biology, the International Society of Environmental Botanists, and a foreign fellow of The Society for Science of Climate Change and Sustainable Environment. Prof. Hasanuzzaman attended over 40 international conferences as a Keynote speaker, invited speaker, and oral presenter and chaired/cochaired several workshops/sessions.