Theme Seminar

Closing the nutrient loop: Phosphorus management in protein farming

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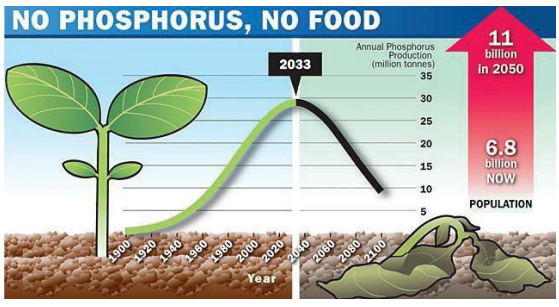
When nutrients are applied in excess of food and fodder crops' requirements, they can escape from fields to surrounding soils, air, and waterways, thereby leading to environmental degradation and economic loss. Moreover, the portion of the nutrients harvested in food and fodder crops, and subsequently consumed by human and farm animals is generally concentrated in the locations where humans and animals reside, with the majority of the nutrients excreted along with wastes. Thus, there is an uncoupling of the site of nutrient inputs to soil to meet crop demands and the site of recovery of nutrients exported from farms. Closing the nutrient loop includes strategies to recover nutrients from sources in which nutrients tend to concentrate that include wastewater treatment plants, livestock production facilities, compost operations, and food processing plants, and recycle these nutrients back to cropping systems. By recovering nutrients from these sources, we can increase the amount of nutrients recycled for food and fodder production, thereby creating a more 'closed' system and achieving food security.



Poultry meat and egg are the major sources of protein consumption by the human population in most countries. The poultry industry is one of the largest and fastest growing agro-based industries in the world. This can be attributed to an increasing demand for poultry-based protein products including meat and egg. However, a major problem facing the poultry industry is the large-scale accumulation of wastes including manure and litter, which may pose disposal and pollution problems unless environmentally and economically sustainable management technologies are evolved. Poultry litter and manure are rich in nutrients, especially nitrogen and phosphorus, and most of the litter produced by the poultry industry is currently applied to agricultural land as a source of nutrients and soil amendment. However, environmental pollution, resulting from nutrient and contaminant leaching, can occur when poultry litter is applied under soil and climatic conditions that do not favour an effective agronomic utilisation of the manure-borne nutrients by food and fodder crops.

This presentation examines the poultry feed, manure, soil and nutrient management practices to improve the phosphorus use efficiency in poultry farming. Phosphorus is a major nutrient in food production, but we have only a finite supply of P ('P Peak'). Large-scale application of poultry manure results in the accumulation and loss of P in soils. Efficient management of P in the poultry industry is essential to achieve economic and environmental sustainability. Manure management practices include efficient feed use, P recovery from manure, and soil and crop management.

It is important to note that poultry manure may also contain contaminants such as heavy metals (*e.g.*, arsenic) and antibiotics which can be toxic to soil microorganisms and plants. Therefore, it is imperative to devise integrated management practices to manage nutrients and contaminants in poultry farming, thereby improving the nutrient use efficiency and farm productivity.

Prof. Bolan *has been a visiting scientist at the University of Newcastle upon Tyne (United Kingdom), University of Georgia (USA), Federal Agricultural Research Centre (Germany), University of LaFrontera (Chile), and Jinju National University (Korea). He has served as the Professor of Soil Science at Massey University, New Zealand, and also as the Chair in Environmental Science at the University of South Australia (UniSA), the Dean of Graduate Studies of UniSA and as a Program Leader of the Co-operative Research Center for Contaminant Assessment and remediation of the Environment. He is currently serving as a Professor of Environmental Chemistry at the University of Newcastle, Australia while serving as a Program Leader of the Co-operative Research Center for High Performance Soils. He is one of the Chief Investigators of the Australian Centre for Cannabinoid Clinical and Research Excellence undertaking research on the distribution and bioavailability of contaminants in cannabis. Prof. Bolan's teaching and research interests include agronomic value of manures, fertilisers and soil amendments, soil acidification, nutrient and carbon cycling, pesticide and metal pollutants interactions in soils, greenhouse gas emission, soil remediation, mine site revegetation, and waste and wastewater management. He has supervised more than 60 postgraduate students, and was awarded the Massey University Research Medal for excellence in postgraduate students' supervision. He has published more than 400 book chapters and journal papers, and was awarded the M.L. Leamy Award in recognition of the most meritorious contribution to soil science. Prof. Bolan has achieved more than 32,000 citations with an H index of 84 (Google Scholar), and is one of the Web of Science's Globally Highly Cited Researchers for 2018, 2019 and 2020.*