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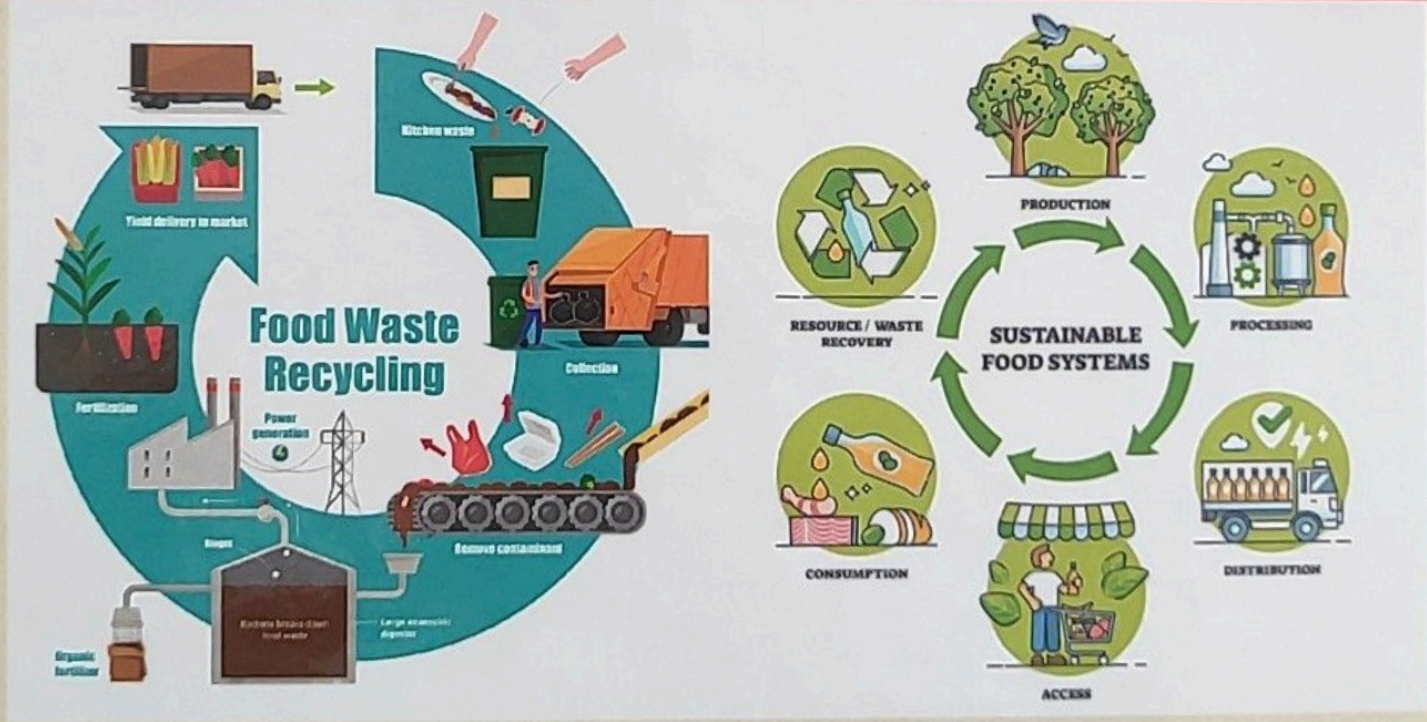
Sustainable Technologies for Food Waste Management

SUSTAINABLE INDUSTRIAL AND ENVIRONMENTAL BIOPROCESSES



Edited by
Ranjna Sirohi, Ayon Tarafdar,
Luciana Porto de Souza Vandenberghe,
Mohammad J. Taherzadeh, and Ashok Pandey

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4 Biological Processes for Food Waste Treatment

Prachi Gaur, Komal Kumari, Poonam Sharma, Vartika Gupta, and Vivek Kumar Gaur

4.1 INTRODUCTION

Globally, about 1.3 billion tons of food, equating to one-third of the world's total food production, is wasted across the entire food supply chain, causing various social, environmental, and economic issues (FAO, 2020). Waste emerges across the entirety of the food chain, starting from primary production (agricultural residues), moving through secondary production (industrial processing residues), and culminating in household and catering consumption (food surpluses). An expanding body of research endeavors to quantify the total loss of food across the supply chain, consistently underscoring its adverse effects on the food system. This loss incurs unnecessary burdens on land, water, and energy resources, consequently amplifying greenhouse gas (GHG) emissions. The economic ramifications of food wastage from households, retail, catering, and manufacturing sectors are profound, amounting to approximately US $680 billion in industrialized nations and US $310 billion in developing ones (Morone et al. (2019). Forecasts predict a significant escalation in these figures over the next three decades due to the projected global population surge. Projections indicate that the global populace will burgeon by nearly one billion individuals in the coming decade and reach 9.6 billion by 2050 (FAO, 2013). This will drive heightened demand for food and its by-products, thereby exacerbating pressure on food supply chains globally. The issue of global food security and supply is a pressing concern. Several countries are actively implementing mitigation and prevention measures to reduce food waste (FW). Along these approaches, there exists a dire need for different consumption models and novel technological approaches for valorizing the FW.

Traditionally, FW has been disposed of through dumping or incineration within municipal solid waste systems. However, these methods pose significant environmental and health risks (Sharma et al. 2021). Incineration, due to FW's high moisture content, can lead to the production of dioxins, while open dumping contributes to environmental degradation. FW contributes substantially to greenhouse gas emissions, estimated at 3.3 billion tonnes of CO2 per year (Sharma et al. 2020). Consequently, there is growing global interest in exploring alternatives to enhance environmental sustainability and address socio-economic concerns. Valorizing FW by converting it into value-added products has emerged as a promising solution, garnering attention from researchers worldwide. Therefore, this chapter aims to highlight the biological methods, including traditional composting and anaerobic digestion, as well as advanced ones such as enzymatic hydrolysis and microbial fuel cells (MFC) for the treatment of FW.

4.2 BIOLOGICAL TREATMENT OF FW

In the global arena, food waste generation has surged due to intensified industrial and human activities, contributing significantly to environmental degradation and resource scarcity. With annual disposal reaching 1.3 million tons, comprising 44% of the world's organic solid waste, and human activities accounting for 33%, totaling 1.6 billion metric tons per year, the inefficient use of resources

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