

Invited Session Proposal - MIM 2025, 11th Edition

Design, Optimization and Control Systems for Sustainable and Resilient Food Supply Chains

Keywords: *Sustainability, Optimization, Food Supply Chain, Decision support systems, Digital Twins, Resource Efficiency, Circular Economy*

The impact of climate change on natural ecosystems is substantial, leading to air, water, and soil pollution, as well as the unsustainable depletion of non-renewable resources. Projections indicate a significant rise in the global population and per-capita consumption of food and animal products, resulting in a predicted doubling of food demand by 2050. The expansion of the agri-food sector exacerbates environmental pressures, creating a feedback loop that poses a threat to sustainability. These challenges affect every aspect of the food supply chain, from agricultural systems design and agri-processes management to food processing planning, distribution operations optimization, packaging configuration design, by-products valorization and waste management. It is imperative to implement comprehensive and integrated sustainability strategies across the supply chain to address these issues. This approach should encompass solutions that involve stakeholders, scholars, and practitioners, focusing on food security, environmentally sustainable development, and the role of ecosystem services. To establish the food supply chain as a sustainable ecosystem, the integration of advanced decision-support tools is essential. These tools should not only promote resource efficiency and energy optimization but also harness technological innovations to ensure traceability, transparency, and environmental responsibility.

By integrating optimization, simulation, Machine Learning (ML)-driven decision-making, and sustainability targets, this session aims to provide a comprehensive view of how cutting-edge technologies and managerial solutions are transforming the agri-food supply chain into a more efficient, resilient, and environmentally responsible ecosystem.

Topics may include (but are not limited to) the proposal of solutions and technologies as well as design, analysis, and evaluation methodologies for:

- Optimization of agri-food systems for resource efficiency and sustainability
- Decision-support systems for sustainable agriculture and agri-food operations
- Digital twins and simulation for food supply chain optimization
- Machine learning and AI for agri-food system management and decision-making
- Energy efficiency and renewables integration in food supply chains
- Sustainable cold chain management and optimization
- Circular economy in food industry
- By-product valorization and waste management in food production.
- Life cycle assessment (LCA) for environmental impact in food supply chains
- IoT and digitalization in food operations control
- Supply chain resilience in response to climate change and emergency
- Sustainable packaging systems in the food industry
- Digital twins in food production and processing
- Consumer-centric innovations for sustainability and transparency
- Sustainability KPIs for agri-food systems assessment and benchmarking.

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