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**Editorial**

# The Imperative of Systems Thinking Approach in Driving Food Systems Transformation through Science and Innovation

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***Abstract***

As the world became progressively aware that increasing production did not solve global hunger and health problems, the issue of the environmental and social costs of focusing solely on food security and nutrition came to the fore. The term '***food systems transformation***' was introduced as a radical idea of rethinking the key outcomes of food systems. A complete rethink of the attributes of food systems, including its purpose, rules, and power structures. Food system transformation processes would ideally reshape the way a food system is organized for the desired outcomes: food security, healthy diets, economic wellbeing, social wellbeing and environmental sustainability.

Most of the social, economic, moral, and environmental challenges are interconnected and interact with each. Fully understanding the causes and solutions to these challenges is not possible when handled in isolation. Food systems are complex adaptive systems consisting of several actors, linkages, dynamics, etc. These complexity means food systems exhibit unpredictable behaviour, with nonlinear change, tipping points, and unintended responses to shocks and interventions. Systems thinking is a high-level approach to thinking, acting and practice necessary to effect transformational change in any domain.

For food systems transformation to be inclusive, science and technology-based innovations must be accompanied by institutional innovations (social, business and policy innovations), underpinned by science (basic sciences and applied sciences, natural sciences and social sciences). Also, innovations need to be aligned with sustainability concerns. All these certainly requires attention and joint engagement by researchers from all areas of the food system-related disciplines.

**Keywords:** *Food systems transformation, science and innovation, systems thinking, food security and nutrition*

## Introduction

The conceptual tools that enable us to overcome siloed thinking are collectively known as "***systems thinking***". The systems thinking approach requires that one explores the systems (food) rather than breaking it down linearly into smaller component, the whole would include actors, linkages, behaviours, dynamics, etc. System thinking approach is therefore relevant along all food systems domain, including, research conceptualization, research execution.

A food systems approach is therefore one that pays attention to how whatever is being focused on

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(the part) affects, and is affected by, the whole. Food's life cycle from production to consumption involves a journey of activities undertaken by people or organisations (actors), processes (harvesting, processing), inputs are used (energy or water), outputs are produced, some desirable (food) and others undesirable (pollution).

## Characteristics of Food Systems

***Feedback loop*:** Core to a systems thinking approach is a recognition that causation can often be circular in nature. For example, food system activities can lead to the release of greenhouse gas emissions; which in turn drives climate change; which then affects greenhouse gas emissions from the food system. These circular interactions between different parts of systems are known as feedback loops which can act to reinforce a change in the system (e.g. climate change), or alternatively may resist it, maintaining stability. Understanding feedback loops within systems helps in preventing and mitigating extreme and irreversible shocks.

***Trade-offs and synergies*:** changes to food systems will inevitably affect multiple issue with negative or positive outcomes. For example, agricultural intensification portends benefits for land use while it could worsen environmental pollution. In the case of synergy, decrease food loss and waste would reduce resource use, and increase the food available for consumption

***Drivers of change*:** trends (affecting bits of the system or external) which overtime affect the functioning, and the outcomes related to the whole system. Examples in the context of food systems include climate change; resource scarcity; population growth and demographic change; technological innovation; social attitudes towards consumption, etc. Identifying and understanding the effects of drivers of change is another important part of applying a food systems approach.

***Scale effects***: Food systems have subsystems. Interactions across these different scales, can lead to:

- Local changes having globalized effects and vice versa.
- Changes in one geographic location causing changes in distant locations.
- Changes taking place at one place or point in time, lead to impacts on a wider system across a range of timescales, and potentially delayed by decades or more.

## The Role of Science and Innovation for Food Systems Transformation

Science offers many important contributions, including, generating basic inputs for policy, institutional and technology-based innovations to catalyse, support, and accelerate food systems transformation. For instance, through quantitative analyses and food systems modelling, science analyses drivers, goals and activities along pathways towards achieving food systems transformation. However, policy, institutional and technology innovations must be pursued using an interdisciplinary framework for constructive interaction and outcomes.

Science generates new breakthroughs that can become innovations in food systems, e.g.: genomics, plant nutrition, animal production and health, biosciences, earth sciences, social sciences, remote sensing, artificial intelligence and robotics, digitization, big data, health and nutrition science, behavioural research, etc.

Science contributes valuable evidence; from primary research, discovery research to implementation research, including modelling techniques. Also, science informs and shapes decisions, policies and interventions-investments, policies and institutions. Science is also

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involved in monitoring and evaluation: the design, implementation and monitoring of actions needed to learn and draw lessons for impact at scale

**Systems Thinking Approach in Practice for Food Systems Transformation**

An appreciation (understanding and practical application) of how the different parts of the food systems, interrelate to each other, and to the bigger picture. Depending on the parts, activities, actors, etc of the food systems components involved, this inevitably involves choice and selection, in terms of:

- What needs to be explained / understood?
- What parts, interconnections, and interactions are considered important?
- How is the system conceptualized and represented?
- What disciplines, theories, and methods are necessary to bring to the task?

The food systems framework is increasingly used as an analytical tool to enhance the understanding of agriculture, food security and nutrition, shape policies and strategic interventions for more desirable systems outcomes and involves application of systems thinking that links the production, processing, distribution, preparation, and consumption of food, with elements of the environment, people, inputs, infrastructure, and institutions. It also describes the connections and feedback loops between the elements and processes and shows how the outputs of all activities impact food security and nutrition, and socio-economic and environmental outcomes.

**Conclusion**

Science and research are fundamental drivers of innovation while systems thinking approach is about credible evidence-based science shaping policies and strategic interventions for a more desirable food systems outcome. Abstract food systems thinking needs actionable levels of application. Integration of sectors into food systems creates a multi-level analytical framework, which aligns sector transformation with food systems outcomes. Science, research, and innovation are therefore essential for accelerating the transformation to healthier, more sustainable, equitable, and resilient food systems.

Periodic sector assessments and prompt actions to mitigate negative food systems outcomes are also recommended. Overall, critical to food systems transformation is using systems thinking approach to combine the three broad and interconnected development domains: Food security and nutrition, Inclusive and equitable economic development, and environmental sustainability.

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