



ENSURING FOOD SAFETY IN A CIRCULAR ECONOMY: FOUR KEY AREAS

FOOD SAFETY IN THE TRANSFORMATION TOWARDS A CIRCULAR AGRIFOOD SYSTEM

Agrifood systems must produce sufficient, safe and nutritious food to ensure food security for all, while remaining within the planetary boundaries. Agrifood systems transformation is recognized as a key accelerator to achieving the Sustainable Development Goals. One of the routes for this transformation is the introduction of circular processes and policies into agrifood systems.

KEY MESSAGES

- > **Agrifood systems** based on linear “take-make-use-dispose” models are resource-intensive, generate waste and pollution, and contribute to climate change.
- > **Circular economy solutions** such as recycling water, repurposing food waste and by-products, food packaging innovations and integrated farming systems bring sustainability benefits but entail certain food safety risks.
- > Addressing **potential food safety concerns** in the context of circular agrifood systems and adapting food safety policies and principles will contribute to agrifood systems transformation.

Circular production processes promise benefits towards sustainability across all dimensions – economic, environmental and social. However, these processes imply a departure from many assumptions upon which current food safety approaches are built. Agrifood systems transformation requires adapting food safety policies and principles to ensure that food remains safe. New research is needed to fill data gaps on the potential risks associated with circular systems.

This brief explores four areas of interest in the transformation to a circular agrifood system – water scarcity, food loss and waste, food packaging waste, and land use efficiency.

1. WATER RECYCLING AND REUSE: CIRCULAR WATER ECONOMY AND FOOD SAFETY CONSIDERATIONS

The Earth’s water resources must be sustainably managed to ensure the supply of safe drinking water and water resources amid a changing climate. The agricultural sector, which uses over 70 percent of global freshwater resources, both drives water scarcity and is negatively affected by it, with knock-on impacts on food security.

In a circular economy, resources are used more efficiently, such as through reusing and recycling water and vertical farming systems. Depending on the source of the reused or recycled water, certain potential food safety risks need to be considered and addressed.



> **MANAGING PATHOGENS IN RECYCLED WATER IN AGRICULTURE**

When using recycled water in agrifood systems – for irrigation, stock drinking water or food processing – it is important to assess the microbial quality of the water to prevent the contamination of crops and subsequent foodborne illness.

> **CHEMICAL CONTAMINANTS AND MICROPLASTICS IN WASTEWATER**

Household and agricultural wastewater can contain chemical contaminants and micro- and nanoplastics. Our understanding of the food safety implications of these substances is evolving and the potential for residues to end up in foods needs to be carefully evaluated.

> **ANTIMICROBIAL RESISTANCE AND RECYCLED AND REUSED WATER**

Antimicrobial resistance (AMR) threatens human and animal health and jeopardizes food security. For example, a broad prevalence of AMR genes for clinically used antibiotics in recycled water sources can present a potential risk if they are transferred to humans.



2. FOOD WASTE AND BY-PRODUCTS: REDUCING FOOD WASTE WHILE MAINTAINING FOOD SAFETY

Food loss and waste generates greenhouse gas emissions, driving climate change and in turn, negatively impacting on food security. Transitioning to a circular model involves preventing food loss and waste across the entire food supply chain, redistributing surplus food that is safe and suitable for consumption, and recycling, upcycling or repurposing food by-products (like peels, seeds and pulp).

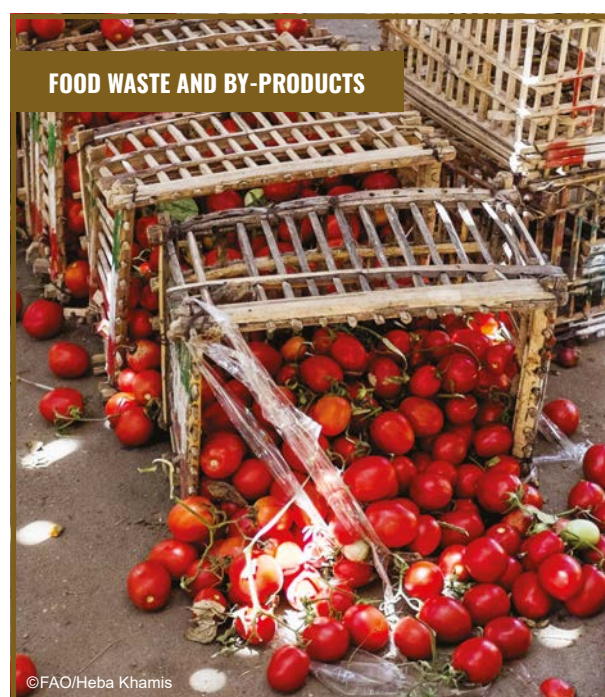
Since food waste and by-products may contain contaminants, it is essential to take care when redistributing or upcycling these materials for other uses, to ensure food safety.

> **RISK OF MICROBIOLOGICAL AND CHEMICAL CONTAMINANTS IN FOOD WASTE AND BY-PRODUCTS**

Food waste may contain pathogens and parasites or other contaminants like fungal toxins and heavy metals. Food waste compost systems must be correctly managed to eliminate pathogens and many countries have statutory or voluntary standards for compost sanitization.

> **PHYSICAL HAZARDS IN FOOD WASTE**

There is a potential for co-occurrence of other wastes, such as fibrous waste or plastic packaging, in food waste. While the food safety risks from microplastics are still not fully understood, the increase of plastic additives in the compost can potentially present a pathway for uptake of these substances into food crops.



3. FOOD PACKAGING WASTE: CIRCULAR INNOVATIONS AND FOOD SAFETY CONSIDERATIONS

Packaging plays an important role in keeping food fresh, ensuring it is safe to eat and extending its shelf-life to reduce loss and waste. However, non-biodegradable plastics from food packaging generates large amounts of waste, with significant negative impacts on both human and environmental health.

To reduce food packaging waste, circular packaging solutions include a transition from disposable to reusable packaging products, accelerating plastic recycling, and developing safe and sustainable packaging alternatives. When transforming agrifood systems toward more circular approaches, we must consider the food safety risks that may arise when moving away from virgin and single-use materials for food packaging.

> POTENTIAL HEALTH RISKS FROM RECYCLED PACKAGING

Recycling food packaging materials can be a cause of health concerns. For example, if not processed correctly, recycled aluminium cookware can contain high levels of leachable lead. Likewise, recycled paper and plastics commonly contain a broad range of substances that can potentially contaminate food if it comes into direct contact with packaging made of such materials.

> SAFE AND SUSTAINABLE PACKAGING ALTERNATIVES

Redesign of food packaging to improve environmental sustainability should be carefully implemented so as not to compromise food safety. For example, reusable bamboo cups, promoted as more environmentally sustainable, were found to have high levels of melamine and formaldehyde migration into food products, necessitating recalls in many countries.



4. INTEGRATED FARMING SYSTEMS: IMPROVING LAND USE EFFICIENCY WHILE ENSURING FOOD SAFETY

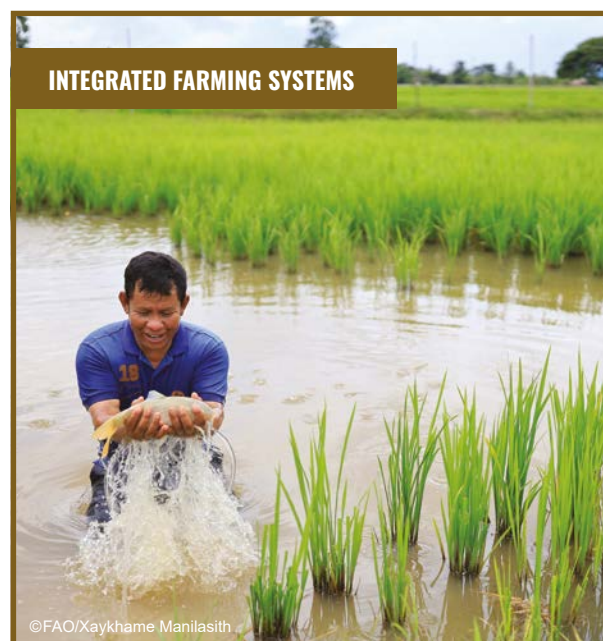
Integrated farming systems have the potential to achieve better land use efficiency and beneficially recycle wastes within the system. An integrated farming system looks at the whole farm as a system, diversifying production and adopting sustainable practices based on a circular economy model. Examples include integrated rice–duck farming, aquaponics (which combines hydroponics and fish-raising systems) and integrating bioenergy production into agriculture. To ensure integrated farming systems are safe as well as sustainable, some important food safety issues must be addressed.

> CONTROLLING DISEASE IN INTEGRATED FARMING

There is a potential risk of pathogen transfer into foods in integrated systems that rely on manure or droppings as a source of nutrients. However, in controlled-environment agriculture systems, such as aquaponics, controls can be introduced and maintained to prevent pathogens, pests and disease entering the system. When multiple animal species occupy the same land area, there is an increased risk of food safety hazards like parasites being transmitted to humans via food products.

> REDUCING CHEMICALS IN INTEGRATED FARMING

It is necessary to understand the life cycle of different inputs, such as agricultural chemicals and veterinary drugs, within the different system modules of an integrated model. Integrated farming practices can potentially reduce agrochemical use thanks to the introduction of natural pest and disease controls.



POLICY CONSIDERATIONS

Initiatives and innovations to build circular agrifood systems include treating and recycling alternative water sources, reusing and valorizing food waste and food by-products, developing alternative and innovative food packaging, and using integrated farming systems.

All these initiatives offer considerable promise in improving environmental sustainability and potential socio-economic gains. However, these benefits are juxtaposed with growing evidence that contaminants, whether microbiological, chemical or physical, can be introduced and potentially accumulate during these processes.

As the current understanding of these food safety risks is limited, this could lead to unsafe food and pose threats to commercialization.

It is important to proactively identify and address potential food safety concerns in the context of circular agrifood systems, in order to fully realize the opportunities for improving environmental sustainability.

Addressing food safety in a circular economy includes the following:

- > Identifying emerging issues to inform risk assessments on any emergent hazards.
- > Creating frameworks for assessing and managing decontamination in food contact or agricultural applications.
- > Developing appropriate guidelines and risk management measures.
- > Improving consumer education and risk communication to support sustainable and safe food practices in the home.

Embedding food safety within the transformed agrifood system requires raising food safety outcomes to an equal level of importance as sustainability and economic performance. Researchers, farmers, product and food manufacturers, regulators and consumers all play a role in supporting the transformation to safe, circular agrifood systems. National and international food safety policies that are adaptable, outcome-based and flexible are essential in the transformation to circular systems. Aligning these policies will bring food safety further into a circular economy for food.



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