Food and Agriculture Organization of the United Nations
World Health Organization
World Trade Organization
African Union

SCIENCE, **INNOVATION** AND DIGITAL TRANSFORMATION AT THE SERVICE OF FOOD SAFETY

KEY MESSAGES

Making use of new scientific discoveries, technical innovations and digital technologies can help attain more efficient and resilient food systems globally.

Supporting countries to gain access to scientific advances that enhance food production and safety can facilitate sustainable and more equitable development.

Responsible approaches and global policies need to promote appropriate transfer of technology and consideration of equity in establishing research priorities.

INTRODUCTION

Scientific advances, technical innovations and application of digital technology have the potential to contribute to a wide-scale structural transformation of food systems. In food safety and process control, as in other areas, technical advances outpace the understanding of how to use these tools to their greatest advantage and how they should be regulated. Given the need to produce more and safer food under pressure from demographic and dietary changes, and climate change, innovations such as novel analytical methods, gene-editing biotechnologies and new ways of producing food can help attain more efficient and resilient food systems. At the same time, major scientific advances, such as Whole Genome Sequencing (WGS), promise to better identify, characterize, determine and respond to potential risks, and prevent and reduce hazards in the food chain.

Innovations need not be complex to have impact: There are many opportunities to adapt and promote beneficial technologies, especially in low-income countries. Another important role for science is in generating best evidence to inform decision makers, private sector and consumers. Currently, much food safety prioritization and management is not science-based and hence may not represent the best use of scarce resources.

Obstacles and opportunities for equitable implementation of key scientific advances and for responsible digitalization of food systems need to be explored from the perspective of food safety impact, accessibility, and sustainability at a global level, paying attention to preparedness of regulatory frameworks and acceptance by consumers.

KEY ISSUES
STRATEGIC DIRECTION OF SCIENCE AND INNOVATION IN FOOD SYSTEMS

1.
WHOLE GENOME SEQUENCING (WGS)
Paving the way forward globally to better understand food systems

With the cost of rapid, high-throughput sequencing technology constantly decreasing, and accessibility increasing, WGS is quickly becoming routine in advanced food control systems. DNA sequence data on pathogens and other microorganisms in foods, the food production and processing environments can yield valuable insights into food hygiene and contamination. WGS can be used for epidemiological surveillance of foodborne pathogens, survival and persistence of microorganisms, monitoring of virulence factors and pathogen evolution, tracking antimicrobial resistance and to investigate foodborne outbreaks. While several countries have already adopted WGS into their food safety systems, there remain several challenges to implementing the method globally. Laboratory infrastructure, resources and capacities for performing WGS and bioinformatic analysis are often lacking, especially in less-developed countries. In addition to facilitating global access to the technique, there is a need to use validated, transparent and reproducible data analysis pipelines, and encourage open access global data sharing, while protecting data ownership. There should be a global commitment to make WGS available to all countries to strengthen the global and local food safety systems.

2.
NOVEL ANALYTICAL METHODS AND MODELS FOR ENHANCED SURVEILLANCE
Economic and reliability considerations

In increasingly regulated and globalized markets, and with regions of the world facing serious food safety problems (e.g. foods contaminated with mycotoxins in Africa), regulators, food industries and consumers are demanding rapid technologies for more complete genetic, chemical or microbiological analysis of contaminants in food at lower costs. In view of these drivers, a new generation of analytical methods (e.g. non-culture based diagnostics, nanomaterial-based assays, remote sensing or multiplexing, new spectroscopic applications, quantitative NMR) are being developed for quick and optimized analyses of an array of contaminants. However, countries most affected by foodborne diseases, where such tools might be most beneficial, often do not have access to such analytical innovations or a sufficiently strong voice in determining the priorities for their development. There are also questions about rapid analytics developed for direct use by the consumer: Is there adequate oversight on the accuracy of the devices? And how does such a trend impact on the relationship between consumers, regulators and the industry? In all cases, it is important to identify how these new tools will complement existing analytical methods to enhance surveillance, prevent disease and expedite emergency response systems.

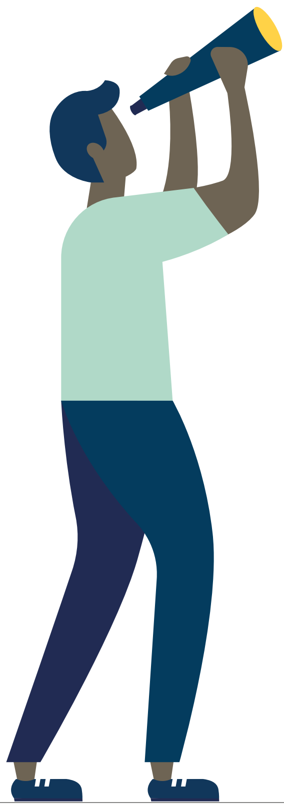
3.
NOVEL FOOD PRODUCTION SYSTEMS
Preparing for the future

With rapidly developing scientific advances, a number of new technologies with applications in food production systems are emerging. Examples of innovative food production systems include the following: the *in vitro* culture of animal skeletal muscle tissue for human consumption (aka, lab-grown or clean meat); meal replacement beverages for personalized nutrition; new food and feed ingredients produced from insects on a large scale; and 3D printed food. As these new food become more available, engagement and dialog between governments, the private sector and civil society is critical in the shaping of innovation and assuring adequate attention is paid to potential health and environmental hazards. Likewise, advances in molecular biology have led to a technological revolution for the breeding of plants, animals and microbes. New techniques, such as CRISPR/Cas9, RNAi technology and cisgenesis allow for precise and rapid manipulation of the genetic code, with the potential of accelerating the production of plants and animals with desired characteristics such as disease resistance, altered nutritional qualities, or production efficiencies. These “next generation” genetic engineering approaches are arriving while regulatory challenges associated with the “first generation” technologies are yet to be resolved. Critical, evidence-based assessments of the risks and benefits of using new gene-editing tools are needed, including consideration of the distribution of those risks and benefits.

Capacity development and training efforts must ensure that all countries can profit from these advances and meaningfully join the debate on the assessment of risks. In addition, comprehensive risk management and new approaches for risk communication that address the different risk perceptions among the public, regulators and the expert communities requires participation by all.

4.
TECHNOLOGY IN USE IN LOCAL VALUE CHAINS

In many low- and middle-income countries, food handling and processing activities in most locally important value chains utilize poor equipment and facilities and, as a result, the foods produced are often associated with high levels of food safety hazards. These foods are typically made by small-



1. FAO 2017. The future of food and agriculture – trends and challenges. http://www.fao.org/3/a-i6583e.pdf
2. FAO 2011. Global food losses and food waste. http://www.fao.org/docrep/014/mb060e/mb060e00.pdf

scale producers and the businesses are important in terms of the employment (especially for women) and income generation. There is much scope for simple, appropriate innovations that can improve the safety of food, reduce waste, reduce environmental footprint and create further spin-off benefits. For example, solar driers for fruit, food-grade containers for transport, improved techniques for fish smoking, use of waste in energy production, fermentation to preserve food and reduce pathogens, or even appropriate use of disinfectants for cleaning. Adoption of food handling innovations requires making available affordable, suitable technologies and providing capacity building and incentives, so value chain actors are motivated to use them.

5. DIGITAL TRANSFORMATION OF FOOD SYSTEMS

A growing linkage of electronic networks and the power of analysing and interpreting big data present both challenges and new opportunities for food safety. The ability to identify and handle emerging food safety risks and to decide on adequate risk management actions with the help of "self-learning" systems is potentially revolutionary. Digital policies and security measures need to keep pace with these changes. Furthermore, digitalization may facilitate international trade with faster, more cost-efficient and less bureaucratic electronic certifications of internationally traded food products coupled with increased food safety and reduced vulnerability to fraud. E-certification may reduce lengthy and cost-intensive clearances for official certification needed by food authorities, by streamlining processes and involving extensive food composition databases. Digital traceability of food by applying blockchain approaches may offer faster and more efficient food safety risk management options globally. These developments together with the increased volume of food traded by E-commerce, promises low-income countries and smaller businesses a better environment to participate in the global market place. However, a critical view is needed to clearly define responsibilities, regulations and controls for online traded food.

THE FUTURE OF FOOD SAFETY

Transforming knowledge into action for people, economies and the environment

ADDIS ABABA
12–13 February 2019

The First FAO/WHO/AU International Food Safety Conference

GENEVA
23–24 April 2019

The FAO/WHO/WTO International Forum on Food Safety and Trade

CONTACTS

FAO
Food Safety and Quality Unit
Rome, Italy
food-quality@fao.org

WHO
Food Safety and Zoonoses Department
Geneva, Switzerland
foodsafety@who.int

CA2790EN/1/12.18