

Transforming Food Systems Under a Changing Climate

Future technologies and food systems innovation for accelerating progress towards the SDGs: key messages

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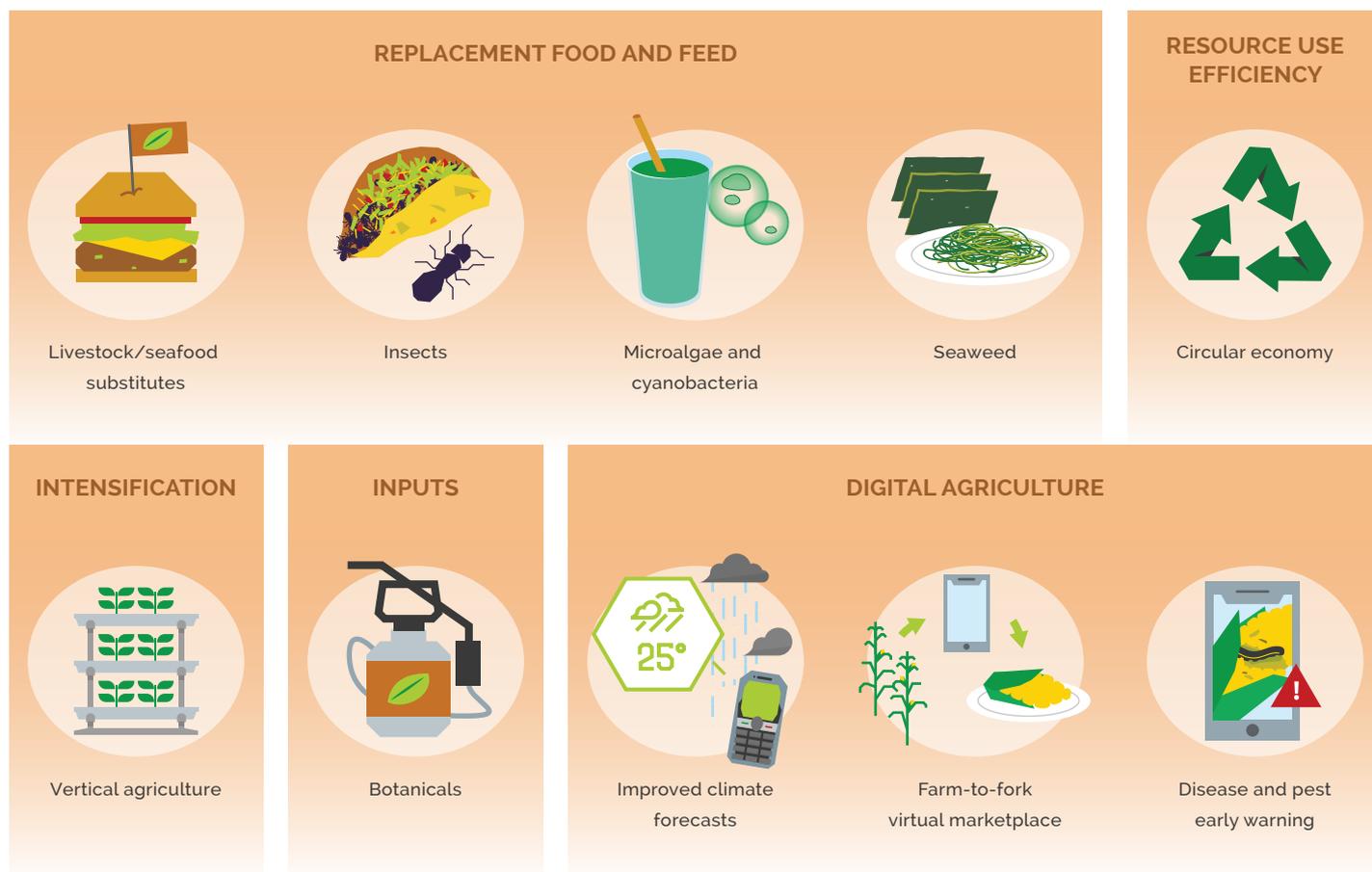
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The global food system is the single largest driver of global environmental change, contributing 24% of greenhouse gas emissions, consuming 70% of blue water, and being the primary cause behind the 60% loss of vertebrate biodiversity since the 1970s. In the next three decades we will need a 30-70% increase in food availability to meet the demand for food by an increasingly numerous, urbanised and affluent population. The food system will need to change profoundly if humanity is to be provided with healthy food that is grown sustainably in ways that are both resilient in the face of climate change and do not surpass planetary boundaries. Technological innovation will have a critical role to play in this process. What might be possible if we adopted new, game-changing technologies in the food system?

New and emerging technologies

1. A recent inventory shows that new and emerging technologies are well spread across the food system, from production processes right along the value chain to consumers. These technologies are from the domains of cellular agriculture, digital agriculture, food processing and safety, gene technology, health, inputs, intensification, replacement food and feed, and waste reduction.
2. Technologies differ widely in their readiness and potential for adoption by 2030. For example, several related to digital agriculture are relatively mature, such as improved climate forecasts, use of drone technology, and traceability technologies. Digital innovation continues apace, with declining costs and growing uptake in low-, middle- and high-income countries alike. Some other technologies were deemed highly unlikely to be available or widely adopted by 2030. An example is nitrogen fixation in cereals; several different approaches are currently being researched, and eventual success is considered plausible but not within this timeframe.
3. All 75 technologies in the inventory were scored for their potential impacts on the Sustainable Development Goals. Most technologies seem to have largely positive impacts on the SDGs most closely associated with the food system such as SDG 1 (no poverty), 2 (zero hunger), 3 (good health and wellbeing) and 13 (climate action). There are many unknowns about the potential impacts of different technologies in different contexts, however.
4. Across the food-related SDGs, different technologies vary in the extent and focus of their impact. There are no universal "silver bullets"; rather, the technologies make up an arsenal of ammunition of different sorts. This is inevitable, given the breadth of innovation that we found. But it is also desirable, so that countries can match available and commissioned innovation with their most pressing needs.
5. Several technologies seem to balance readiness, adoption potential and impacts. The "top ten" include four technologies relating to replacement food and feed for livestock and fish: plant-based substitutes, insects, microalgae and cyanobacteria, and seaweed. Many efforts are underway attempting either to address the demand for livestock products by providing alternative protein sources or to decouple livestock production from land via alternative feeds to reduce its environmental impact globally. Growth demand for fish is spurring activity to reduce competition for feed with the livestock sector.
6. Other technologies in the "top ten" include improved climate forecasts and pest/disease early warning; circular economy approaches for reutilising, recycling and repurposing resources, which can lead to improvements in food production while substantially reducing waste and creating new local business opportunities, as resources are revalued as part of the process; and vertical farming in confined spaces with no soil or natural light, another way in which food production can be decoupled from the land.

FIGURE: TOP 10 TECHNOLOGIES FOR FOOD SYSTEMS TRANSFORMATION



What's needed to foster food system innovation?

- For the "top ten" and other technologies that are near-ready and with high potential for impact, investment in their dissemination and implementation will be critical for achieving the food-related SDGs. We urgently need novel methods to insert these options into current food systems, as well as better understanding of what might affect their uptake to scales that transform. The private sector will have a crucial role to play in driving the uptake of these technologies.
- At the same time, regulatory frameworks and market structures need to be established to ensure that these advances are well aligned with the aims of public policy. This will be challenging: adoption of technologies that may be highly disruptive to existing food systems will drive a complex web of direct and indirect effects.
- Engagement with issues of social licence and acceptability in the adoption of new, disruptive

technology will require considerable investment in broad public dialogue to legitimise support. People have deeply engrained biological, psychological and cultural relationships with food – it's not just about price and safety.

- Throughout history, innovation has produced winners and losers. Although bottlenecks in the enabling environment need to be addressed, especially in lower-income countries where the potential impacts (both positive and negative) of technological innovation may be relatively larger, we also need to ensure that safety nets are in place for the losers of technological change in the short and long term. Success will create room across the SDGs for better health, wealth and environmental outcomes for all.

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About the Transforming Food Systems Under a Changing Climate Initiative

This briefing is part of Transforming Food Systems Under a Changing Climate, an initiative led by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) that aims to realize a transformation in food systems by mobilizing knowledge and catalyzing action. The initiative brings together leaders in science, business, farming, policy and grassroots organizations to identify pathways for transformation. To find additional publications in this series and for more information, please visit: <http://bit.ly/TransformingFood>.

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