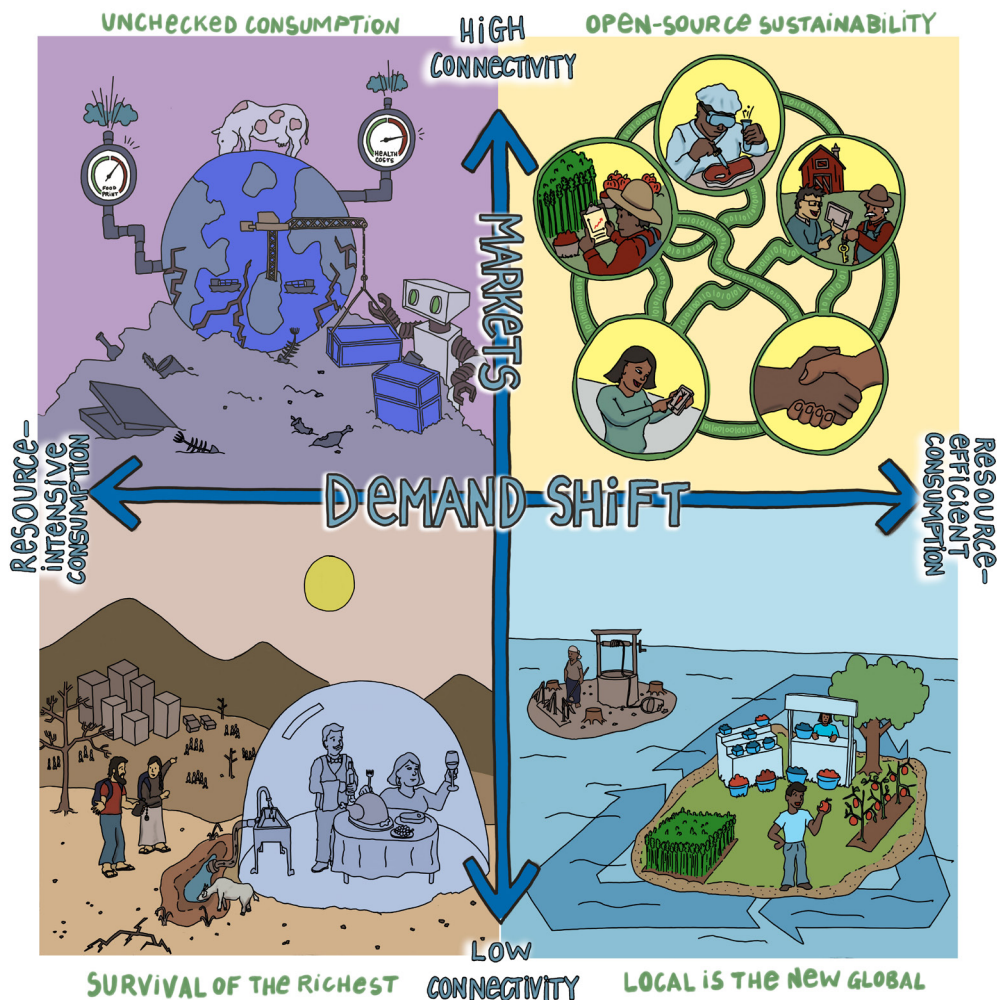


Shaping the Future of Global Food Systems: A Scenarios Analysis

A report by the World Economic Forum's System Initiative
on Shaping the Future of Food Security and Agriculture
Prepared in collaboration with Deloitte Consulting LLP

January 2017



"Achieving the Global Goals for Sustainable Development will require a new level of insight on how uncertain futures might unfold. These scenarios are a powerful tool for leadership action for 8.5 billion people to access sustainably-produced nutritious food in 2030."

David Nabarro

Special Adviser on the 2030 Agenda for Sustainable Development and Climate Change, United Nations

"Scenarios can help business leaders make more informed strategic decisions to cope with an uncertain world. This set of scenarios illuminates the tremendous risks and opportunities in global food systems and suggests actions towards a more desired future."

Jim Moffatt

Deloitte Global Consulting Business Leader

"Scenarios can provide an invaluable lens on the future. The world has changed since we developed the scenario planning approach in the early 1970's, but one thing has not: the value of planning for the unknown. I am delighted to see this methodology so aptly applied to address the critical challenges facing the future of food systems."

Peter Schwartz

Senior Vice-President for Strategic Planning at Salesforce and Author of "The Art of the Long View"

"The world today seems to be engulfed in a sea of pessimism, negativity, and cynicism. And yet, we have an opportunity to lift millions more people out of poverty, so that they can lead healthier and more meaningful lives. And we have a duty to work together toward a greener, more inclusive, and peaceful world by strengthening our global food systems. Whether we succeed will not depend on some external event, but rather on the choices our leaders make."

Klaus Schwab

Founder and Executive Chairman of the World Economic Forum

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REF030117

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Preface



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Food systems are central to human societies. Can we rely on them to feed 8.5 billion people in 2030 nutritiously and sustainably?

The world is increasingly volatile – 2016 alone was full of surprises. What unexpected events might take us down unforeseen paths in the future?

The international community has committed to achieving the Sustainable Development Goals, including ending hunger and establishing sustainable, nutritious food systems. Are leaders taking the necessary actions to reach those goals?

These questions inspired the World Economic Forum and its Partners to develop a set of scenarios for what the world's food systems might look like in 2030. Scenarios challenge us to think differently about the future, revealing forces of change and uncertainty that might take us in unexpected directions. Scenarios are not predictions – instead, they serve as illustrative stories. They provoke us to question our assumptions and go beyond the “default future” that many of us carry in our minds. Imagining how future scenarios could develop sheds light on our blind spots, enrich our understanding and helps us make better choices today.

The Forum is pleased to present this report as part of its System Initiative on Shaping the Future of Food Security and Agriculture, one of 14 major initiatives that aim to create systemic change on global challenges. Over the past decade, our System Initiative has developed a global network of over 600 organizations, aligned around a shared vision, which who have taken action in 21 countries, mobilizing \$10.5 billion in investment commitments and benefiting over 10.5 million farmers. We have taken a “System Leadership” approach to orchestrating change through alignment, collaboration and decentralized action, supporting leaders to work together in new ways. Working toward shared goals in a world convinced us that we should explore new ways of thinking about the future to be better prepared to navigate it.

This report was developed in partnership with Deloitte Consulting LLP, led by Shay Eliaz, Chris Ertel and Erika Merizzi. At the Forum, the project was led by Lorin Fries, with input from Lisa Dreier, Lisa Sweet, Tania Strauss and Saswati Bora. A group of world-class experts and Partner company executives (listed in the Annex) provided the lion's share of the expertise reflected here, for which we are extremely grateful. Members of our Transformation Leaders Network, a diverse group of action leaders from around the world, helped us think through the implications of the scenarios for different regions and stakeholders.

At a global level, our System Initiative receives generous support from the Governments of the Netherlands and Canada, the Rockefeller Foundation and the Wellcome Trust, all of whom provided input on the scenarios in this report.

We hope this report will bring new perspectives on the future to better inform the choices we make today.

Executive Summary

Shaping the Future of Global Food Systems: A Scenarios Analysis

Introduction: Preparing for the Future

Food systems are integral to the health of people and the sustainability of the planet. Developing inclusive, sustainable, efficient, nutritious and healthy food systems will be essential to achieve the Sustainable Development Goals (SDGs). Currently, nearly half of the world's population does not eat a properly nutritious diet.¹ The agriculture sector is a significant contributor of greenhouse gases, deforestation and water scarcity. In some regions, up to 40% of food is lost or wasted.² The volatility of weather events and food prices are growing.³

An observer focused entirely on the challenges in food systems might say “the future is bleak”; whereas one focused on innovations to meet the SDGs might say “the future is bright”. Neither perceives the whole picture; a more accurate observation might be that “the future is uncertain”.

Navigating uncertainty requires thoughtful consideration and contingency planning for unforeseen developments. Scenarios can be a powerful tool to explore potential futures, considering how combinations of key trends and uncertainties could lead to different outcomes. They can broaden our perspectives both on the possibilities for what the future may hold, and the implications of the choices we make today. This, in turn, can help inform strategic choices and action.

This report presents scenarios for the future of global food systems. It aims to provoke and challenge leaders to think in new ways about what the future may bring and to motivate action on the key issues that will shape that future.

Our Approach: How Scenarios Work

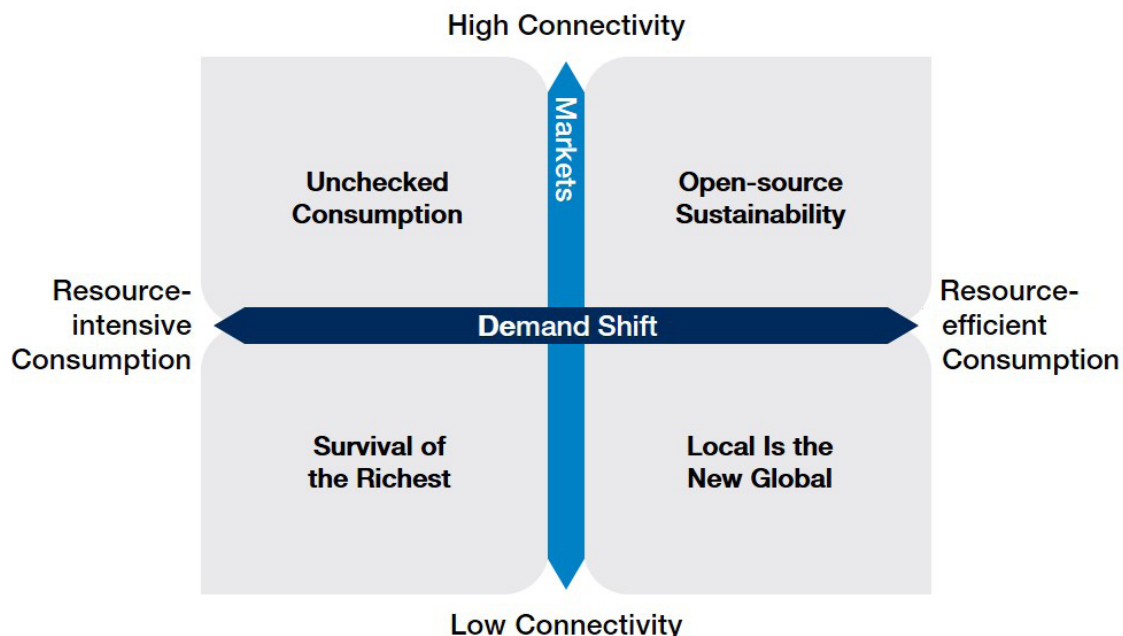
The Focal Question: The focal question of a scenarios analysis captures the core issue to be explored. In this case, our focal question is:

How will food systems nutritiously and sustainably feed 8.5 billion people in 2030?

Predictable Forces of Change: In tackling the focal question, a scenarios analysis first identifies trends whose future impacts are relatively certain. These include predictable developments such as demographic trends – for example, global population growth from now through 2030 can be taken as a given. For this analysis for instance, experts advised that climate change is a given – that global average temperatures will increase, bringing increased volatility and associated impacts on food systems. We incorporate that and other assumptions, such as the development of new technologies, into all future scenarios.

Critical Uncertainties: A scenarios analysis is built around the forces of change that will most profoundly and unpredictably impact the focal question. For this report, these include topics ranging from disruptive technologies to migration. After compiling a long list, experts chose the following two most critical uncertainties as the focus for this analysis:

The Scenarios: Four Potential Future Worlds



- **Demand Shift:** This uncertainty encompasses the nature of future demand for food and agricultural commodities, with particular focus on the environmental impact and health implications of consumers' choices. Although healthy diets and environmental sustainability are not necessarily correlated, they are considered in tandem given their critical importance. Demand shift uncertainty is thus focused on whether demand will be relatively more *resource-intensive* versus *resource-efficient*.
- **Market Connectivity:** This uncertainty pertains to the openness of trade, trust in and resilience of commodity markets, and inclusivity of technological innovations. The experts found that the relative connectivity of markets presents both significant opportunities and vulnerabilities related to the future of global food systems. Thus this uncertainty focuses on whether markets will be defined by *high connectivity* versus *low connectivity*.

The Scenarios: Four Potential Future Worlds

Pairing these two critical uncertainties, the matrix below reveals four scenarios for the future of global food systems. The opportunity of this analysis is to imagine walking into these worlds – Survival of the Richest, Unchecked Consumption, Open-source Sustainability or Local is the New Global – and explore their implications:

- 1. Survival of the Richest:** In a world of resource-intensive consumption and disconnected markets, there is a sluggish global economy and a stark division between the “haves” and “have-nots”.
- 2. Unchecked Consumption:** With strong market connectivity and resource-intensive consumption, this is a world of high GDP growth with high environmental cost.
- 3. Open-source Sustainability:** A future linking highly-connected markets and resource-efficient consumption has increased international cooperation and innovation, but may leave some behind.
- 4. Local Is the New Global:** In a world of fragmented local markets with resource-efficient consumption, resource-rich countries focus on local foods, whereas import-dependent regions become hunger hotspots.

The Implications: Today's Choices Will Shape Tomorrow's World

Any of these scenarios is possible: early signs of all four scenarios are present in our world today, and any of them could become a reality by 2030. Together, they demonstrate that **today's food systems require a fundamental transformation to meet human needs within planetary boundaries in 2030.**

The scenarios offer several additional insights:

- **Consumption will make or break global health and sustainability.** The scenarios emphasize the importance of incentivizing, enabling and encouraging consumers to eat more resource-efficient diets in their respective contexts.
- **Putting nutritious and sustainable food on every plate requires a fundamental redesign of food production systems.** Such a transition would put greater focus on the quality, rather than solely quantity, of agricultural production.
- **Climate change will affect all future scenarios and poses a significant threat.** Climate change and natural resource degradation may compromise the long-term

productive capacity of food systems, compromising social stability and economic well-being.

- **Food system dynamics are likely to exacerbate inequality within and between nations.** Growing inequality will affect all possible futures. Each scenario has winners and losers; the disparity between them is most evident in a disconnected world of more resource-intensive demand.
- **Fourth Industrial Revolution technologies and other innovations can revolutionize food systems but will introduce new challenges.** Technology innovations will dramatically reshape how we produce, manage and demand food in select markets, but their effects will be unevenly distributed.

The analysis recognizes opportunities for leaders to pursue food systems transformation:

- **A new era of business could capture market opportunities** for investing in health and nutrition, contribute to greater resiliency in global markets, increase the resource efficiency of business operations, and leverage technology to address social and environmental challenges in food systems.
- **New and bold “smart policies” are needed to redesign food systems**, with opportunities to adopt a “whole of government” approach to integrate the true costs of food systems; link food, agriculture and environmental policies to healthy diets; and create an enabling environment for inclusive technologies.
- **Social and ecological priorities should be at the centre of redesigned food systems**, including efforts to address structural inequality and meet basic needs, influence new dietary norms and aspirations, and elevate the needs of future generations.

Responsive and responsible leadership is needed from all sectors to secure inclusive, sustainable, efficient, nutritious and resilient food systems. Our choices – through action or inaction – will determine our path into an uncertain future.

Four Core Aspirations for the World's Food Systems



Overview of Global Food Systems

Future Aspirations: The World We Want

The world's food systems play a central role in the health and well-being both of human societies and ecosystems, and are a key driver of economic livelihoods. Food systems contribute to the majority of the 17 United Nations' Sustainable Development Goals (SDGs), adopted in 2015, and are fundamental to thriving businesses.

Through ongoing dialogues hosted by the World Economic Forum, leaders from all sectors and regions have aligned around four core aspirations for the world's food systems to be:

- **Inclusive**, ensuring economic and social inclusion for all food system actors, including smallholder farms, women and youth.
- **Sustainable**, minimizing negative environmental impacts, conserving scarce natural resources and strengthening resiliency against future shocks.
- **Efficient**, producing adequate quantities of food for global needs while minimizing loss and waste.
- **Nutritious and Healthy**, Providing and promoting consumption of diverse nutritious and safe foods for a healthy diet.

These aspirations are fundamentally interconnected. For example, creating inclusive food systems is directly tied to poverty, hunger, gender equality, job creation, innovation, infrastructure and inequality. Together, these four aspirations can strengthen system resiliency to the inevitable shocks and stressors of the future. At present, the complexity of food systems is driving siloed thinking and action. Creating a transformation in the world's food systems which realizes all four aspirations and drives progress across multiple SDGs will require a holistic approach.

Emerging Trends: Forces of Change and Disruption

The aspiration for inclusive, sustainable, efficient, healthy and nutritious food systems will not be easy to achieve. A number of major global trends will pose challenges and opportunities for food systems in the future. Several of these trends are outlined below.

Demographic Shifts are increasing and changing the demand for food. The world population is expected to reach 8.5 billion by 2030⁴ and the size of the global middle class is projected to increase from 1.8 billion in 2009 to 4.9

Four Core Aspirations for the World's Food Systems



billion by 2030.^{5,6} The growing size of mega cities and rate of urbanization are further compounding the strain on food systems; by 2050, over two thirds of the global population are projected to live in cities.⁷

Macroeconomic Trends, such as the increasing inequality of wealth and sluggish economic growth present additional challenges to food systems. Within the agricultural sector, 800 million people live below the global poverty line, representing nearly four fifths of the world's approximately 1 billion poor people.⁸ The world relies on small agriculture producers: some 500 million smallholder farms worldwide produce over 80% of the food consumed in the developing world.⁹ More broadly, the richest 1% of the global population currently have more wealth than the rest of the world combined.¹⁰ This economic inequality is increasing, translating into slower growth and compromising social cohesion.

The Triple Burden of Malnutrition – undernourishment, micronutrient deficiencies and over-nutrition – presents serious challenges and has the potential to worsen. Nearly 800 million people are hungry and, although significant progress has been made, this remains a challenge particularly in developing countries. Over 2 billion people suffer from micronutrient deficiencies, which can lead to diseases and development challenges, such as stunting. Meanwhile, over 2 billion adults are overweight or obese.¹¹ Poor nutrition and health habits can lead to non-communicable diseases (NCDs), which are now the leading cause of death in all regions except Africa.¹² The economic burden and costs of NCDs radiate through households in the form of lower wages and savings. These strain health and welfare systems, impacting business and the economic growth of countries.

Natural Resources are being depleted by unsustainable agricultural practices and other factors and are further threatened by climate change. The food sector accounts for 70% of water withdrawal¹³ and agriculture, forestry and other land use accounts for almost a quarter of global greenhouse gas emissions (of which half comes from land conversion).¹⁴ Water withdrawals have increased threefold over the past 50 years and demand is expected to rise by a further 40% by 2030.¹⁵ About a third of all arable land is degraded – a figure that continues to grow and that is related to farming intensity.¹⁶ Despite efforts to decelerate climate change, the plans of 170 nations to curb emissions would still lead to an estimated temperature rise between 2.7°C and 3.7°C by 2100 – far above the critical 2°C global target,¹⁷ with resulting increases in food prices by as much as 84% by 2050.¹⁸

Geopolitical Dynamics are intensifying food insecurity and other challenges. The world is currently experiencing the highest levels of displacement on record, with 65.3 million forcibly displaced people worldwide.¹⁹ At the same time, emerging political movements, evidenced by recent events and elections in the United States and Europe, are demonstrating nationalist and isolationist tendencies that may impact trade agreements and international collaboration.

Existing Innovations and Emerging Technologies present opportunities to tackle these challenges, but they will raise new questions and their impacts will not be evenly distributed. In complement to existing technologies, like mobile platforms, new Fourth Industrial Revolution

technologies will profoundly change the way we live, work and relate to one another.²⁰ Food systems will be dramatically influenced by this new era and the new tools it offers, including bio-innovation, gene editing, robotics, big data, artificial intelligence and machine learning. These innovations will continue to create unprecedented amounts of data. Indeed, 90% of the world's data has been created in the past two years²¹ and is expected to continue to grow exponentially. Such technologies depend on a world increasingly connected to the internet; while the number of internet users quadrupled from 2005 to 2015 to over 40% of the world's population²² over 4 billion still don't have access and the speed of connectivity is slowing down.²³ Gender inequality compounds this challenge: women in rural areas are much less likely to access the internet than men in the same communities.²⁴

The Global Response: Enabling Change in a Complex System

Meeting the formidable, multi-faceted challenges facing global food systems today requires a systems-level transformation rather than incremental improvement. Achieving that will require multistakeholder collaboration and dialogue, within and beyond the traditional food systems players, to build shared insights, agreed priorities and coordinated actions. This includes leaders of diverse industries, policy-makers, international agencies, research institutes and academia, farmers associations and NGOs, and others.

Many of the policy and business decisions affecting food systems today appear to be driven by short-term thinking and reactions to ongoing events. Indeed, especially in complex environments, decision-makers will naturally seek to optimize the outcome of a problem for their own concerns, rather than for the strength of the system. Task-focused decision-making can be appropriate when addressing food crises and other events requiring immediate attention and relief. However, transforming a complex system over multiple years will require an opposite mindset. This report focuses on strategic questions for 2030 to examine leaders' urgent choices to proactively drive transformation and to adapt to unforeseen developments.

The future scenarios presented in this analysis are intended to serve as a catalyst for new thinking, to inspire and provoke more cross-sectoral problem-solving and strategic decision-making. This, in turn, can help advance efforts to transform global food systems, and nutritiously and sustainably feed future populations.

Framing the Future

The Purpose of Scenarios

The Value of Scenarios

Scenarios inform present-day decision-making by exploring different possible futures. In contrast to forecasting, scenarios examine what is most *uncertain* and surprising, as a mechanism to generate insight and provoke action regarding future-focused risks and opportunities. Scenarios can stretch our thinking about divergent plausible futures. Importantly, the value of scenarios analysis is to examine *all* of the possible futures identified – rather than focusing on the more desirable ones – with the understanding that any scenario may occur. Thus, scenarios are a tool to uncover blind spots and broaden perspectives about alternative future environments in which today's decisions might play out. The implications drawn from the scenarios are designed to trigger discussion, rather than serving as prescriptive outcomes. For leaders whose organizations are highly impacted by evolving changes, scenarios can provide unique contextual intelligence to inform choices, reduce risk, improve strategic contingency planning, and pursue mutually-desired outcomes.

How to Build Scenarios

Focal Question

The focal question of a scenarios analysis captures the core issue to be explored through the scenarios. In consultation with global food systems experts, the World Economic Forum identified the focal question for this analysis to be:

How will food systems nutritiously and sustainably feed 8.5 billion people in 2030?

In defining this question, we made several choices, including:

- **Scope:** The geographic scope of this analysis is global to provide a big picture outlook for an international audience. This enables a systems-level, holistic view; it also limits specificity, noting that actions are carried out by stakeholders according to the more granular circumstances of their company or country. Action leaders in Africa, Asia and Latin America contributed regional and stakeholder perspectives included.

- **Future Aspirations:** Nutrition and sustainability are highlighted because they represent key challenges facing global food systems. According to the World Health Organization (WHO), nutrition refers to “an adequate, well balanced diet combined with regular physical activity”,²⁵ and the UN describes a sustainable food system as one “that delivers food and nutrition security for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised”.²⁶
- **Timeframe:** The timeframe of 2030 was deliberately chosen to align with the timeframe of the SDGs. The mid-term timeframe is intended to emphasize the urgency of leaders' actions in food systems.

Identifying Uncertainties

The critical uncertainties for a scenarios analysis are the most important yet unpredictable driving forces that will significantly impact the focal question. Complementing an analysis of relatively predictable givens, outlined in the previous section, an initial list of critical uncertainties was compiled through interviews with food systems experts representing academia, business and international organizations. This initial list covered topics ranging from disruptive technologies to migration, including:

Social Change: Will people choose to consume healthier, more balanced diets or diets high in animal-based protein and sugar, salt and fat? Will consumers demand food that is produced in an environmentally sustainable way? How will consumer opinion evolve regarding food produced through new technologies? How will urbanization and the growth of mega cities affect demand, especially among net-importing countries?

Economic Shifts: Will nations engage in cooperative trade through open markets or adopt more isolationist policies? How will confidence in commodity markets evolve? Will markets be more resilient or more volatile? Will the price of food accurately and consistently capture the externalities of health costs and environmental impact? What will be the impact of trade policies on global and local markets? Will there be an increased number of breadbaskets that supply most of the world's food? Will food systems become more centralized or more localized and where will decision-making power be held?

Technology Advances: What will be the rate of large-scale adoption and availability of new technology as it pertains to food? Will technological innovations be designed primarily for affluent or poorer populations? How will the benefits and risks of technological advances be distributed? Which disruptive technologies will emerge as game-changers in food and agriculture?

Environmental Trends: How will policy and business decisions affect climate mitigation and adaptation in food systems? How will climate change and other threats impact the long-term productive capacity of ecological systems, including soil health? How will an increased scarcity of water impact food production? What will be the rate of energy consumption, and from which sources?

Political Developments: How will the security landscape evolve? What will be the evolution of nationalistic tendencies in governments, with what implications on food systems? How will migration impact food production and what implications will it have for food security?

The Two Most Critical Uncertainties

From this long list of critical uncertainties, a diverse group of experts identified the two most important and critical uncertainties as the focus for the scenarios. These were identified to be:

- **Demand Shift:** Experts agreed that future changes in demand are a fundamental uncertainty, with the poles defined as resource-intensive consumption versus resource-efficient consumption. This axis encompasses uncertainties related to the nature of demand shift, including the externalities of environmental impact and health costs. Although healthy diets and environmental sustainability are not necessarily correlated, they are considered in tandem given their critical importance.



Key elements of Demand Shift as an uncertainty

- Will people choose to consume **healthier, more balanced diets** or more **excessive diets high in animal-based protein and sugar, salt and fat**?
- Will consumers demand food that is produced in an **environmentally sustainable way**?
- Will **food production be able to respond** to changing consumer demand (including less food waste and energy consumption)?

- **Market Connectivity:** For the second axis, experts highlighted uncertainties regarding the connectivity of markets. This axis captures questions pertaining to the relative openness of trade, trust in and resilience of commodity markets, and inclusivity of technological innovations.

Key element of Markets as an uncertainty

- Will nations engage in increased **cooperative trade** through global markets, or will more isolationist policies lead towards regional and local trade?
- How resilient will **commodity markets** be to shocks, and how will this affect **trust**?
- Will **innovation** (and intellectual property) be more closed and proprietary or will more **open source platforms and connectivity** emerge?
- Will value chain activities help **bridge the "last mile"** for smallholder farmers?

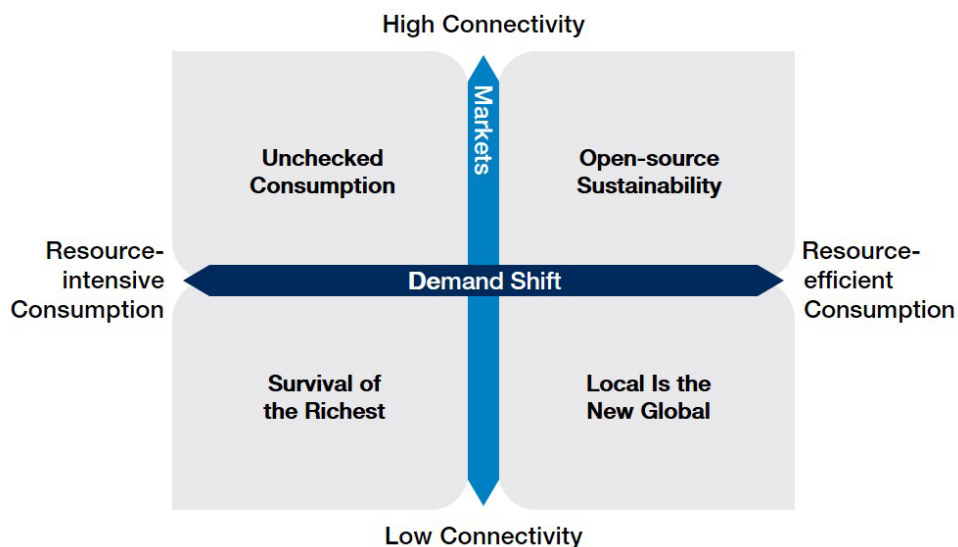


Outcome: Our Four Scenarios

Pairing these two uncertainties, the matrix below, reveals four scenarios for the future of global food systems:

1. **Survival of the Richest:** In a world of resource-intensive consumption and disconnected markets, there is a sluggish global economy and a stark division between the "haves" and "have-nots".
2. **Unchecked Consumption:** With strong market connectivity and resource-intensive consumption, this is a world of high GDP growth with high environmental cost.
3. **Open-source Sustainability:** A future linking highly connected markets and resource-efficient consumption has increased international cooperation and innovation but may leave some behind.
4. **Local Is the New Global:** In a world of fragmented local markets with resource-efficient consumption, resource-rich countries focus on local foods whereas import-dependent regions become hunger hotspots.

The Scenarios: Four Potential Future Worlds



Scenario 1 – Survival of the Richest

Scenario Description

In this scenario, a combination of resource-intensive consumption and disconnected markets creates stark differentiation between the haves and have-nots. A relatively few isolated, wealthy populations are able to produce and innovate to meet their needs; isolated, poor or import-dependent markets are facing intensifying hunger and poverty. Increasing distrust in globalization has led to nationalist sentiment and isolationist policies. There are fewer and weaker multilateral trade agreements, and trade barriers are slowing global economic growth. Population growth, rising inequality and food prices have led to increased conflict and migration, and intensifying resource needs have prompted a new wave of investments by foreign entities in land and water resources. Climate change continues unabated. Technology innovation is defined by a broad disparity of access and adoption. Reactionary decision-making and a crisis mindset are perpetuating a fragile system.

Most people are worse off in this world, but some fare better than others. Developed countries and upper classes are relatively better off than those in poorer contexts as, for the time being, they can still afford high food prices and comfortable lifestyles. Within these limited rich markets, technology and select other sectors are performing well financially (although growth is slow globally). Entrepreneurs still have access to funds from limited investors, and innovate with a focus on niche business opportunities rather than broader social services and underlying global challenges.

There are many losers in this scenario. For example, life for smallholder farmers has become riskier and more uncertain than ever before: dire economic conditions, limited access to natural resources (especially water) and more extreme weather conditions have forced tens of millions to seek other sources of income to feed themselves and their families. At the same time, export businesses are suffering from decreased trade, volatile markets and inconsistent access to raw materials. In the long term, future generations will also suffer from irreversible environmental damages and a weak global economy.

How Did We Get Here?

Key Choices that Led Us Here

- **Governments turned inwards to protect their populations.** As market disruptions from climatic and other shocks became more common, governments shifted reliance towards local production to lower their countries' exposure. The increase in such protectionist practices diverted resources and attention from global problem-solving and collaboration.
- **The public and private sectors prioritized immediate concerns over environmental sustainability.** Both sectors faced incentives to maximize near-term gains and comforts at the expense of the environment, and did not challenge them. A select few rich countries maintained environmental protections, but through fragmented approaches across disparate geographies. Environment and nutrition agendas were deprioritized in view of economic concerns, such as job creation.
- **Governments failed to make substantive progress to decelerate climate change.** There was a lack of meaningful global cooperation on climate mitigation and adaptation, and greenhouse gas emissions continued to increase far beyond safe levels for the planet.
- **Consumption choices led to malnutrition and waste.** Many consumers ate greater volumes of less nutritious foods, produced unsustainably. The extreme poor ate in lower volumes; the high prices and low availability of nutritious foods accelerated malnutrition.
- **Food producers struggled to maintain business in a weak economy.** Food producers continued to create and meet demand for processed foods and animal-based protein. Without new efficiencies, these practices expanded the environmental footprint and depleted natural resources at alarming rates.

Early Signs that Signal a Shift to this Reality

- **The income gap continues to widen and there is a concentration of capital** within and among countries whereby large, rich countries benefit and poor, import-dependent ones suffer. The patterns of 2016 – wherein the richest 20% of the world's population consume 86% of the world's resources²⁷ – is amplified. Africa is importing an increasing percentage of its food following years of failed harvests, and this pattern is reflected in other potentially high-productivity regions.
- **The percent of the population that is undernourished starts to rise again,** noting that food-price volatility will likely disproportionately impact the urban poor, who already spend 60%–80% of their income on food in 2016.²⁸



- **Strong intellectual property rights** are influencing technology development more than open-source platforms; the number of patents in life sciences research is on the rise.
- **International trade** is increasingly bilateral rather than guided by multilateral agreements.
- **Volatility in commodity markets increases**, without strong checks and balances. There is limited international coordination to mitigate increasingly frequent market shocks.
- **There is slow implementation of the Paris Climate Agreement**, leading to "business-as-usual" emissions trajectory and an acceleration of climate change.
- **Several countries exit the European Union** as part of a surge of nationalistic sentiments and anti-globalization.

Implications

In this scenario, most of the world's population eats unhealthy diets while a rich minority enjoys good nutrition: a small number of well-off consumers can still afford nutritious foods and animal-based protein. In contrast, the vast majority of consumers are either eating high-calorie, low-nutrient diets – and becoming increasingly overweight or obese – or are unable to access enough food and therefore becoming increasingly undernourished. Among the most vulnerable, increasing poverty and hunger rates reinforce instability, conflict and migration, and food aid is insufficient to meet the growing needs of refugees and internally displaced people. This intensifies the refugee crises and the resulting xenophobia.

This future is highly unsustainable for the world's productive resources. Climate change accelerates as a result of weak international cooperation and high consumption of resources, with detrimental effects to agriculture around the world. Critical ecosystem services are damaged or destroyed as actors focus on short-term survival, business interests or policy priorities. Conflict intensifies over access to natural resources, both within and between nations. Technology innovation occurs in relative isolation; therefore, even climate coping and adaptation technologies would be limited in scale and adoption.

In this scenario, a faltering global economy is intensifying hardship and breeding resentment. Broad distrust in markets is cyclical, leading to less-transparent practices. Food loss and waste increases in fragmented markets and inefficient value chains.

This world perpetuates inequality and weakens inclusivity in food systems. The poor get poorer, and those who traditionally hold less power, such as women, are most negatively affected by conflict and food insecurity. Short-term needs and the concentrated strength of a few businesses and governments hamper broad-scale civil society participation and access to opportunity among disempowered populations. Traditional agricultural production is an unattractive business for most farmers, perpetuating poverty in rural economies and reducing production volumes from these areas, as ageing farmers are not replaced by youth.

Scenario 2 – Unchecked Consumption

Scenario Description

In this scenario, there is a combination of resource-intensive consumption and highly connected markets which has enabled rapid growth with serious consequences. Driven by ever-increasing demand, trade is accelerating as markets boom. Technology has spurred efficiencies in food production and distribution, with yield improvements as the top priority. Obesity and health costs rise dramatically as billions of consumers transition to a high-volume, high-calorie, low nutrient-density diet. The “foodprint” expands as natural resources – including water, biodiversity and land – are severely depleted and components of key ecosystems such as fisheries and drylands begin to collapse, increasing costs of water purification and intensifying impacts in other regions as consumers seek alternate sources of food. Growing food demand is contributing to driving climate change well past 2°C of global warming.

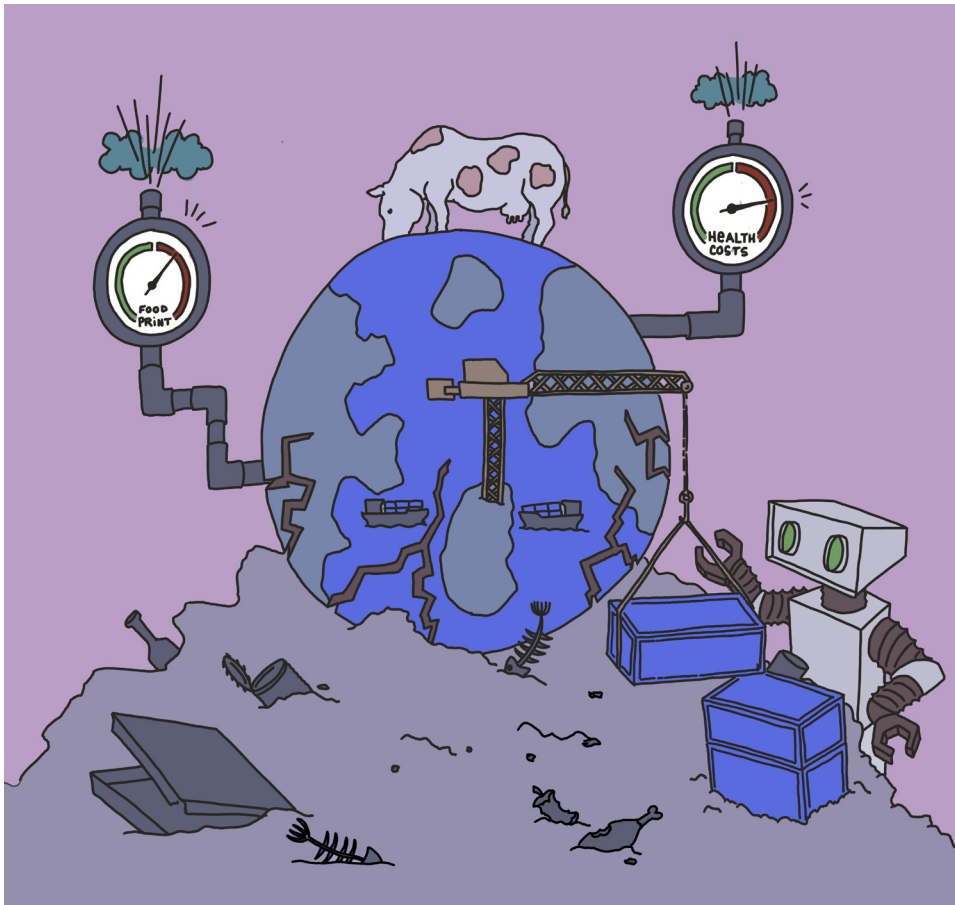
There are several short-term winners in this future. Many global food producers and retailers benefit from an increase in sales due to higher demands for foods – especially multinational companies which benefit from increased trade, globalization and strong global-brand recognition. Regionally, high-exporting countries benefit as trade levels increase to meet demand. Many consumers also benefit from low food prices: because the external costs of food are not incorporated into the price, resource-intensive foods remain relatively cheap. Importantly, however, these short-term benefits will be outweighed by longer-term costs and risks.

This future comes at a heavy cost for others. Regions with limited access to natural resources are facing even scarcer access, while those with abundant natural capital are under pressure from actors searching for more resources: for instance, tropical forest countries are facing alarming rates of deforestation. At the same time, small and medium enterprises are losing market share against efficient and powerful global players, and smallholder farmers disconnected from global markets are likely to be left behind.

How Did We Get Here?

Key Choices that Led Us Here

- **Consumer demand continued to shift towards over-consumption and unhealthy food choices.** The increase in trade and globalization prompted the spread of Western-style diets, which are high in sugar, salt, fat and animal-based protein. These increased diet-related diseases both in developed and developing countries.
- **Governments allowed market forces to override sustainable resource management.** In a “tragedy of the commons”, individual incentives outweighed collective concerns and action.
- **Governments and businesses invested in foreign land and resources.** Limited local production capability in select rich countries prompted aggressive moves to seek out resources abroad.
- **Technology players and food producers prioritized yield and logistical efficiencies.** Higher connectivity and access to data enabled more efficient distribution of goods; innovation was dedicated to producing and moving high volumes quickly.
- **Business, government and society deferred environmental protections in the hope of future “fixes”.** A broad-scale belief that society can grow now and fix environmental problems later, combined with the new ease of doing “business-as-usual”, masked the reality that many environmental problems are irreversible.



Early Signs that Signal a Shift to this Reality

- **Healthcare costs have skyrocketed** in developed countries. In the US, combined costs to treat diet-related, non-communicable diseases surpass the expected annual level of \$48 billion–\$66 billion.²⁹ Consumers following demand trends towards animal-based protein prompt a boom in livestock industry shares.
- **World Trade Organization (WTO) collaboration and free-trade agreements cover most large markets** and unprecedented levels of global trade are being achieved through key superpower trade nodes. Trade efficiencies are helping to keep food prices down despite the high external costs of resource-intensive foods.
- **Natural-resource degradation and increased emissions have reached new levels** perpetuated by the agri-food sector. As soil degradation and greenhouse gas emissions continue to rise, a biodiversity crisis is looming.
- **Few regulatory frameworks** have been effective at shifting consumption toward healthier foods.

Implications

In this world, the percentage of the population that is overweight or obese has exceeded the 2030 projection of one third of the global population.³⁰ Most of the global population has increased access to large volumes of mostly non-nutritious foods. Conflicting evidence about desirable diets and a proliferation of labels create confusion and perpetuate unhealthy choices and increased calorie consumption.

In this future, the depletion of natural resources has accelerated to make space for new agricultural production, and the effects of intensifying climate change are more acutely felt in an interconnected marketplace. Long and complex supply chains obscure transparency; consumers are less likely to demand, and know, the source of their food.

Infrastructure and technology have improved trade and efficiencies in this world. For instance, block-chain technology is strengthening value chains and decreasing investment risk in the agriculture sector. Such investments and innovations are largely directed towards the booming market, rather than to fix a fundamentally outdated agriculture sector. Decreased government oversight leaves space for innovation but weakens safeguards and the strength of international collaborative efforts towards complex challenges like the SDGs.

Scenario 3 – Open-source Sustainability

Scenario Description

In this scenario, a combination of resource-efficient consumption and highly connected markets enables a rise of greater transparency in business and in markets. Commodity markets have been stress-tested, and checks and balances instated, to reduce volatility and the risk of a crash. There is a proliferation of food sources, which reduces over-reliance on a few breadbaskets, improving the resilience of food systems. An increasingly interconnected trade system, however, still leaves the world susceptible to the effects of extreme weather events and other economic and political shocks. A stronger global economy enables more consumers to purchase food priced at its “real” cost, as influenced by new business models and policies that support sustainable choices and healthy diets. There is a movement towards personalized nutrition and healthcare, and more people use mobile apps to drive their shopping and eating habits. There is improved trust, interdependency and trade among governments. Governments uphold commitments to climate change agreements; however, inevitable volatile weather events continue. A rural transformation attracts youth to data-driven agriculture, but older farmers struggle to keep pace.

This future has a relatively high proportion of winners. For farmers, there is greater availability, affordability and adoption of technologies that increase productivity, decrease costs expand access to key information and services. For companies, although such scrutiny generated costs and difficult changes in the short term, many are benefiting from improved productivity and more reliable sourcing. Governments benefit from collaborative trade agreements and access to data that informs effective policy design.

Importantly, while this future may be bright for some, there are also stakeholders that are relative losers. For instance, some farmers may be shut out of the new, more connected economy, without viable alternative livelihoods. The surge in open-source information creates a disincentive for long-term research and development (R&D) among some companies; this is coupled with a shift in investment further towards the development rather than the research. More generally, consumers may be either winners or losers, based on their means, as food would become more expensive to capture its full cost.

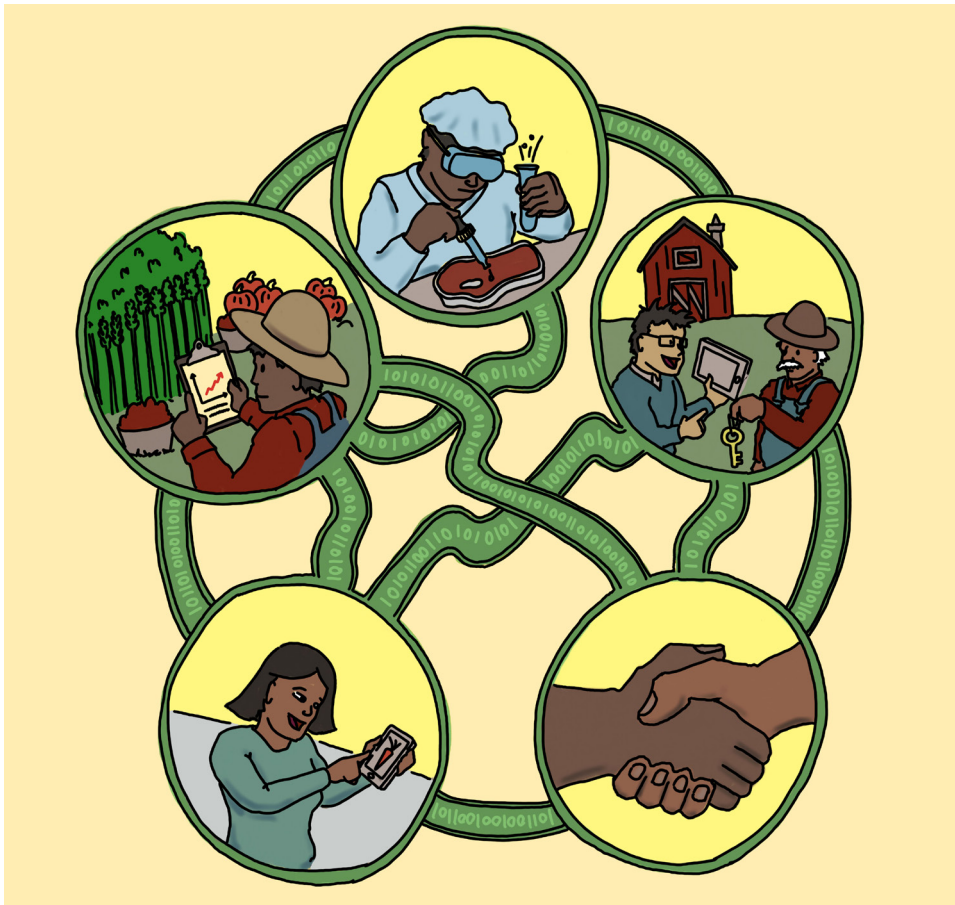
How Did We Get Here?

Key Choices that Led Us Here

- **Governments embraced international trade with provisions for responsible practices.** New agreements restricted reactionary policies that could disrupt global markets, leading to more open and collaborative trade. These created increased systemic risks related to increased interconnectivity, but strong institutions sought to minimize their impacts.
- **Policies enabled food value chains to become more transparent.** Responding to consumer demand and improved technology, there was a substantial increase in transparency in food sourcing and increased efforts to address inequalities along the chain. Companies integrated the SDGs into their business strategies, and regularly monitored and reported results.
- **Social media and new education and marketing campaigns influenced consumer demand,** drawing on the dietary guidelines already developed in over 100 countries to improve nutrition.³¹ These prompted greater awareness about the absolute cost of food and the possibilities available to consumers in disparate regions. Youth were at the vanguard of pushing changes in social norms around healthy diets.
- **Technology innovators engaged with consumers and influenced acceptance.** As part of their business model, technology companies position their products as a solution to health and environmental concerns, increasing social acceptance of food produced in radically new ways – such as in labs, through gene editing, or in “controlled environments” rather than fields.
- **Farmers used resources more efficiently.** There was broad-scale adoption of good agricultural practices (GAP), along with an increase in the availability and adoption of ICT and emerging technologies, which fundamentally changed production, such as through irrigation innovations.

Early Signs that Signal a Shift to this Reality

- **New and effective checks and balances measures** are in place and trusted, including both regulations in capital markets and new technological authentication mechanisms such as block-chain.
- **Food loss and waste decrease to 5% of global production,** largely attributed to market efficiencies, supported by new technologies. Consumer waste has also decreased due to policy incentives such as taxes.



- **There is a greater access to capital for farmers in developing countries.** The percentage of farmers using data systems to inform their production systems in real time has increased both in developed and developing markets. For smallholder farmers, greater access to capital allows them to invest in more efficient farming techniques.
- **Climate metrics and broader accounting regulations are in place** and stabilizing natural-resource usage. The goal of zero net deforestation has been achieved and reforestation is in full force, made possible by intensive production in the most feasible areas. Renewable energy has surpassed the use of non-renewable energy based on fossil fuels.
- **Private-sector agriculture R&D investment growth has decreased** and slowed innovation. Companies whose new products take 10–15 years to develop are experiencing new levels of competition from disruptors.
- **There is a reduction in urban migration** due to emerging opportunities in rural economies.
- **A broad shift in refugee policy** prompts a transition from aid to economic transformation in the urban and rural environments.

Implications

In this world, the percentage of the population that is malnourished has reached an all-time low. Synergistic policies, business practices and social efforts have increased accessibility to nutritious food and decreased the affordability and desirability of animal-based protein and foods high in sugar, salt and fat. It has become cool among younger generations in developed countries to eat a healthy diet, as a result of marketing campaigns and social media; in developing contexts, inclusive economic growth and a vibrant rural economy support access to healthy food, including in the critical first 1,000 days for cognitive and physical development.

In this future climate change is partially mitigated, and adaptive efforts supported, through international collaboration and a proliferation of shared best practices. These are guided by the Paris Agreement and measured through metrics. While climate shocks still occur, their impact is absorbed by more resilient food systems. The “mutual benefit” philosophy underlying this world is stewarded by strong civil society institutions and international organizations.

In this scenario, more people see technology as a tool in food systems. While the risks of new technologies persist, greater trust and strengthened cooperation mechanisms achieve a careful balance between regulation and innovation. There is greater availability, affordability and adoption of technologies that increase farmers’ productivity, such as satellites; strengthen value chain traceability, such as through sensors; and mitigate climate change, such as through carbon storage.

Scenario 4 – Local Is the New Global

Scenario Description

In this scenario, resource-efficient consumption and low connectivity of markets have led to fragmented food systems whereby nations rely heavily on self-sufficiency. There is a rise in local food movements as consumers increase their focus on sustainable local products. Consumers in developed countries rediscover and appreciate local diets and develop a new respect for food, taking additional measures to reduce food waste. Progressive policies have successfully reduced the price point for healthier diets relative to unhealthy diets. Together, these factors enable a shift towards more balanced diets and a reduction in obesity and related diseases. Markets become increasingly local, with large variances in standards and protocols. Shorter supply chains and increased plant-based diets reduce the strain on environmental resources. However, at the macro level, comparative advantages among food-producing regions are lost. Nations without good agricultural land struggle to meet demand and hunger hotspots proliferate. Country-specific innovation flourishes but diverse standards hamper scale.

In this future, the clear winners are the countries that can achieve self-reliance through available natural and human capital. Successful nations are able to rebalance crop production towards greater diversity, positioning smaller producers to successfully meet local demand. Additionally, a focus on local assets and building connections within communities unlocks strong entrepreneurship for food production – including through urban and vertical farming – and along the value chain.

In this world, import-dependent countries and emerging mega cities, such as Lagos, are struggling to feed a growing population and facing increasing malnutrition. This prompts scarcity, unrest and migration. Other losers in this scenario are industrial farmers who are unable or resistant to rebalancing their crop production as demand shifts toward a greater variety of crops. Local food movements could also negatively impact sales for global food producers and retailers, as clients defer to local producers and brands.

How Did We Get Here?

Key Choices that Led Us Here

- **Governments increased the use of environment and nutrition incentives.** Governments incentivized resource-efficient consumption to protect natural resources and control healthcare costs associated with poor diets.
- **There was a breakdown in international free trade agreements.** Governments increased the use of protectionist trade policies and public funding to protect their local producers.
- **Consumers shifted towards local diets and products.** Increasingly fragmented trade led to low access to imported goods as well as potential distrust of international brands.
- **Local entrepreneurship and innovations flourished, but were unable to scale across disconnected markets.** A focus on local assets unlocked strong entrepreneurial environments, but with fragmented application.
- **Businesses sourced locally and used fewer resources.** Government policies and consumer demand prompted businesses to change their sourcing models – including through shorter supply chains and applicable new technologies – thus decreasing resource consumption.
- **Farmers connected into small regional clusters and bilateral alliances.** Such clusters helped to overcome some resource shortage issues, and contribute to strengthen locally driven movements.

Early Signs that Signal a Shift to This Reality

- **There is a decrease in multilateral trade;** the World Bank and WTO continue to downshift their global trade growth forecasts.^{32 33} At the same time, there is a rise in bilateral agreements driven by necessity and resource needs.
- **There is a rise in a local, traditional diet movement globally.** Local movements triple in membership and have increased political influence. Simultaneously, there is a stark increase in urban farming and aquaculture to meet local and urban food demand.
- **Governments have set and carefully adjusted prices on carbon and water** to help protect natural resources and limit greenhouse gas emissions.
- **Development partners' food aid budgets diminish** as their populations prioritize domestic concerns.



Implications

The implications of this world for nutrition are mixed: consumers in regions with high productive capacity would enjoy healthy diets, but a disconnected market would limit such access for others. Local food systems would not capture economies of scale; this loss in comparative advantages would increase the cost of food to consumers, disproportionately affecting those in poorer regions.

The environmental impact of food production, in this world, is reduced: shorter food chains and more resource-efficient consumption ease environmental strains of the agri-food sector. In the longer-term, however, a lack of access to foreign markets may lead to unsustainable pressures on local land and ecosystems in certain regions. The effects of climatic shocks are more isolated in a disconnected market.

In this future, entrepreneurs in disparate markets are working in silos without consistent, global standards. As such, those most capable of innovation are unlikely to influence the lives of the world's poorest. Smallholder farmers are relatively better off where there is vibrant local demand for their produce. Local movements may contribute to greater empowerment, participation and economic opportunity.

Perspectives – A Day in the Life

The fictional characters depicted in this section illustrate a central conclusion of these scenarios: there will be winners and losers in any future. These brief snapshots show the diverse impacts that the four futures could have on different types of people. Such experiences will be a function of several contextual factors, including geography, social status, and role in food systems.



Billy, American, 58-year-old **industrial farmer** runs a large family-owned operation focused on grain and oilseed production.

Unchecked Consumption: The demand for Billy's crops has never been so high. In order to generate higher output to meet global demand, he relies on more intensive farming techniques despite increasing rates of soil erosion. He is concerned about the problems such as water shortages that his children will face when they take over the business.

Markets

Open-source Sustainability: Productivity on Billy's farm is soaring. He manages his farm on his iPad and this helps to increase efficiency and mitigate risk. He also takes out futures contracts and private crop insurance, and he was incentivized by recent legislation to start growing vegetables. He looks forward to handing over a thriving, modernized business to his children.

Demand Shift

Survival of the Richest: Given the increasingly fragmented and volatile market, Billy and his family are increasingly reliant on the US Farm Bill and its benefits to remain above the poverty line. There is more technology on the market to help protect his crops against extreme weather events, which have been increasing in severity and frequency, but he is taking out more loans to afford them.

Local Is the New Global: As producers focus on meeting local demand for diverse products, Billy's buyers are no longer interested in his crops. He is forced to shift towards polyculture. It is an expensive and difficult transition: Billy will need new farming equipment, and new relationships with buyers will take time to build.



Claudia, Brazilian, 50-year-old **government official**.

Unchecked Consumption: Claudia has seen trade increase as a means to meet demand for highly processed and animal-based foods. Brazil has maintained its position as one of the world's superpower trade nodes. But pressures are high to compromise on Brazil's strict forest code which is designed to protect vital natural resources.

Markets

Open-source Sustainability: Brazil is benefiting from a world that is highly connected. Given that more produce is being processed locally rather than being exported as raw material, Claudia has seen some decrease in trade, but farmers are now focused on becoming the world's leading exporters in a range of vegetables and are hard at work to shift their production systems accordingly.

Demand Shift

Survival of the Richest: Given the breakdown in international agreements and relations, Claudia is supporting trade policies to protect local producers. Trade agreements are in turmoil, especially with so many countries exiting the EU. Hunger increases in Brazil's poor communities, placing an increased strain on government support programmes.

Local Is the New Global: Due to the fragmented global market, Brazil is suffering from decline in the demand for beef and soy exports. Shipments are rotting on the docks. Claudia is working with colleagues to design new policies to diversify production for local needs as well as strengthen environmental measures.



Fatma, Tanzanian, 45-year-old **smallholder farmer** and widower with four children, who heads a small family-run coffee farm.

Unchecked Consumption: Foreign investors are buying the title to Fatma's land and she has to decide between becoming a contract farmer to this new entity, which focuses on exporting food, or searching for a different livelihood. Fights break out among her neighbours at the local water pump: until the local authorities drill a deeper borehole, there is scarce water to be found.

Markets

Open-source Sustainability: Fatma has expanded access to capital and has joined a co-op. Along with greater access to shared equipment, this means she can adopt more advanced farming techniques. Farmers from her region can now compete more effectively and more coffee is being processed locally rather than being sold as a raw material. Her son asked her yesterday if he can eventually take over the business.

Demand Shift

Survival of the Richest: Life for Fatma and her family is riskier and more uncertain than ever before. Access to both global markets and local resources has become more difficult. If she had the same access to productive resources as her male counterparts, she could increase her farm's output by 20%–30%,³⁴ but even the local microfinance institution won't lend to her. She falls asleep watching her children and wondering whether they could find work in the nearby city.

Local Is the New Global: As a result of the decrease in exports, Fatma no longer has access to consistent buyers for her coffee. But she has invested all her assets in coffee trees! She is unsure how to shift her production towards fruits and vegetables. She joins a regional farmers organization, which has become stronger and helps connect clusters of farmers to national markets.



Arif, Indonesian, 43-year-old man working as a regional **senior executive** for a global food retailer.

Unchecked Consumption: Arif's company is benefiting from increased global competition that has led to industry consolidation. Sales are up, especially for grain and meat. The market is booming, and a new port has just been constructed. However, Arif is preoccupied; a drought in the region means he is facing a significant supply shortfall this month.

Markets

Open-source Sustainability: New regulations are forcing Arif's company to adhere to more transparent business practices and broader accounting regulations. Consumers want more vegetables, and constantly ask about their source. Arif and his business decided to adopt new supply-chain management and labelling practices, and find that the initial investment generates greater sourcing stability and talent retention. While the company experienced some short-term decrease in profit margins, employee productivity has increased and the long-term forecasts look strong.

Demand Shift

Survival of the Richest: Arif's sales are up as regional demand increases. However, access to raw materials is more limited, climate change has become more extreme, and his suppliers are increasingly unpredictable. Every time Arif looks at the market, prices have changed; this makes long-term planning challenging and risky.

Local Is the New Global: The rise in local food movements has resulted in a sharp decline in sales as consumers are more interested in buying from local and regional retailers and are boycotting Arif's company. To make matters worse, disconnected markets are negatively impacting his retailer's entire supply chain and business model. Arif's company responds by redesigning its strategy to emphasize local markets and suppliers.

Implications of the Scenarios

Any of these scenarios is possible.

We are in a volatile, uncertain world. Any of these potential futures may occur, and early signals of all four worlds are present today. The geopolitical events of 2016 have been particularly unpredictable, raising new questions about the fragmentation of markets and the nature of international connectivity. Without careful attention, we risk compromising the ability of our systems to secure health and nutrition within the means of the planet. The need for informed, measured, long-term thinking and action has never been greater.



Consumption – as shaped by context – will make or break global health and sustainability.

The scenarios demonstrate that moving global consumption patterns towards more resource-efficient demand is critical, noting that consumers' choices shape entire food systems, from fork to farm. Yet shifting towards diets that are healthier, more nutritious, and more environmentally sustainable will depend on transforming current consumption patterns. This requires a significant change in how those choices are incentivized in different contexts. Accurate and clear marketing, consumer education, proactive policies and new business models will be needed to enable nutritious diets for the global population that are aspirational, accessible and affordable.



A redesign of food production systems is needed.

A fundamental shift is needed to enable food systems to promote sustainable, healthy eating. This includes how food is produced; a focus on quality rather than solely the quantity of agricultural production can redefine value in agricultural systems, mitigate risk in supply chains and enable diversified diets. As the world of "Unchecked Consumption" shows, even a future with higher yield has undesirable consequences if the production is unsustainable. There is need to invest in producers – whether farmers or innovators – and incentivize the production of healthy and sustainable food. The scenarios also illustrate the vulnerabilities of a highly connected system relying disproportionately on a few crops and limited productive regions across the world. An increase in on-farm diversity and in the number of "food basket" regions could increase the resilience of the system to inevitable shocks.



Climate change and natural-resource degradation will affect all future scenarios and require urgent action.

Climate change poses a significant threat to business and society. It may compromise the long-term productive capacity of ecosystems, the stability of societies and economic well-being. Climate change is also likely to exacerbate inequality and conflict. The "Survival of the Richest" world imagines increased competition for productive resources at the expense of the poor, while "Unchecked Consumption" demonstrates the danger of "business-as-usual" driven by short-term interests at the expense of the environment. There is also potential for low-likelihood, high-impact weather disasters – such as simultaneous crop failures in multiple breadbaskets – generating a system-wide shock that food systems are not sufficiently resilient to withstand. And while there is great potential in some technological solutions, many new innovations are not available to most of the world's population.



Without dedicated attention, future food systems may exacerbate inequality between nations and within them.

Every scenario has winners and losers. This disparity is most evident in a disconnected world of more resource-intensive demand, yet the growing inequality of today's world will affect all possible futures. Poverty and malnutrition form a vicious cycle that compromises access to food both in rural environments, where even farmers are likely to suffer from hunger, and among the urban poor, where price and access can make healthier and more sustainable food options prohibitive. This points to the need for attention to inclusivity in all futures, achieved both through structural changes in policy and business models, as well as safety nets for the truly vulnerable.



Fourth Industrial Revolution technologies and other innovations have the potential to revolutionize food systems but will introduce new challenges.

Technology innovations will dramatically reshape how we produce and manage food in select markets, but their effects will be unevenly distributed. Some of these technologies could be game-changing for food systems, contributing to radically new approaches along the agricultural value chain and beyond. For example, CRISPR technology could reinvent seeds, big data and ICT could allow for more efficient and climate-smart farming practices, robotics could increase efficiencies in harvest and processing, sensors could reduce waste dramatically in transportation, artificial intelligence could revolutionize retail models, and personalized nutrition could reshape consumers' preferences and behaviours. Many of these technologies will take a decade or two to change food systems at greater scale. For this reason, and noting that many such technologies will be out of reach to most of the world's population, the influence of technology in food systems elevates questions of access and control. The scenarios demonstrate that technology has the potential to exacerbate inequality if not directed with purpose at the needs of a global population. These futures also illuminate questions of governance. In an "Open-Source Sustainability" world, for instance, a broader-scale participation in innovation may disincentivize the type of proprietary research and development that incentivizes business risk and can address long-term challenges. Finally, the technologies themselves will raise a new set of social questions, including those on the control of data, the future of jobs, and the role of technology in food production.



Our choices – through action or inaction – will determine our path.

This exploration of our potential futures reveals that many of their most concerning elements are a product of inaction – highlighting the dangers of a "business-as-usual" approach. Adapting to any of the scenarios will involve difficult decisions, investments and trade-offs in the short run. However, the cost of inaction is higher – and mutual benefits greater – in the long run. It is, therefore, imperative for leaders to take a systems-level view, examining the implications of all stakeholders' choices for the future of food systems. These can inform structural changes and individual choices to secure a more positive future for food systems.

Building the World We Want

Today's food systems are not fit for purpose; a fundamental transformation is needed.

This analysis suggests that food systems are not positioned to deliver healthy and sustainably produced nourishment to the entire global population and will be even less prepared to do so in the future. A systemic transformation will be needed to meet the SDGs.

There is a window of opportunity for business to drive progress through innovation.

Future challenges present both significant threats and tremendous private sector opportunity to meet broad societal needs. "Business-as-usual" approaches will clearly be insufficient and, in fact, may accelerate many negative aspects of the future. Agile companies will recognize the need to think, prioritize and collaborate differently, including through the following priorities:

- **Capture the business opportunity of investing in health and nutrition.** Companies can respond to the changing nature of demand, positioning themselves competitively as responsible players in food systems at global, regional and national levels. This can include investing in new products and advertising that promote healthier diets, as well as technology, infrastructure, equipment and services that preserve the nutritional value of foods. Investors can evaluate industries against health and environmental externalities and incentivize more nutritious and sustainable market activity.
- **Contribute to greater resiliency in global markets.** Highly connected markets can bring many benefits, but the scenarios show they also increase the risk of systemic shocks. Companies can mitigate the effects of such shocks through market transparency, risk-management policies and contingency plans that protect both business and social interests. Businesses also have a role to enhance economic opportunity among their workers and collaborators, such as through living wages and more inclusive engagement of women and youth.
- **Increase the resource efficiency of business operations.** Proven strategies could be scaled to reduce waste and use of natural resources. Reducing food loss is a clear opportunity through stronger market linkages to producers and the use of often simple, already-available technologies. Other efficiencies can be gained with shorter supply chains: the "Local is the New Global" scenario shows that sourcing closer to market can decrease the complexity, risk and environmental footprint of supply chains and increase brand value. Importantly, if combined with smart policy and accurate market signals,

competitive business strategies could also include selling less while maintaining economic growth.

- **Leverage technology to address social and environmental challenges in food systems.** Companies in the technology, agriculture, food and beverage industries can create significant new value through innovations for food systems. Transformation opportunities are vast through ICT, bio-innovation, the internet of things, gene editing, 3D printing, robotics, big data, artificial intelligence, machine learning and other technologies. These are in complement to "low-tech" innovations, such as drip irrigation, that could also have a transformative impact if adopted at greater scale. To realize the potential of these innovations, however, is to direct their benefits toward the long-term goals of society. This implies both ensuring inclusivity and navigating new questions through transparent and inclusive mechanisms, addressing issues like the ownership of data.

New and bold "smart policies" are needed to redesign systems.

Proactive policies are critical to the transformation of food systems. Business strategies and consumer decisions are made in context; with care, policies can direct the power of these choices towards more nutritious and sustainable diets while increasing system resiliency. Policies can also strengthen integrated efforts in infrastructure, domestic economic policy, financial markets and other areas. Approaches to smart policy-making for mutual beneficial outcomes include:

- **Assess and integrate the true costs of food systems.** Integrating health costs and national capital depletion considerations into food-focused decision-making across national budgets, planning and policies would strengthen collaboration across traditional silos. Examples include the integration of nutrition into education systems and the prioritization of prevention in health policy, linked to dietary choices. Heightened consumer awareness regarding the environmental impact of meat consumption, for instance, may lead to a shift in choices. Such collaboration would also enable evidence-based trade-offs – noting, for instance, that higher-nutrient foods do not necessarily have a lower environmental footprint.
- **Adopt a "whole of government" approach to design food, agriculture and environmental policies to enable healthier diets.** Several policies could be redesigned to strengthen health and nutrition outcomes. For example, public subsidies could be redirected towards highly nutritious crops, lowering

the price point of nutritious foods. In complement, social marketing campaigns could promote dietary diversity and the prioritization of nutrient-rich foods. Practical environmental policies could better incentivize sustainable production practices in the market, testing and scaling strategies that reward climate-smart approaches and actors. Public funds could better leverage private investment to these ends.

- **Create an enabling environment for technologies designed for inclusion and oriented to fundamental challenges in food systems.** For existing innovations, such as ICT, policies can support accessibility at scale. For select Fourth Industrial Revolution technologies, participatory processes between regulators and innovators will be critical to shape a future that puts people first and technological tools in service to their needs. Continued public investment in R&D and in advisory services will be critical to enable uptake of appropriate technologies adapted to the specific needs of actors in different food systems' contexts.

Social and ecological priorities should be at the centre of redesigned food systems.

Robust civil society efforts will be needed to ensure that such priorities are elevated on business and policy agendas. Social institutions are also essential to strengthen food systems through efforts to:

- **Address structural inequality and meet basic needs.** As evidenced by the winners and losers in each scenario, there will always be populations left behind in the evolution of food systems. Indeed, even broad-scale progress may create significant hardship for some. Social programming can complement government safety nets to protect the most vulnerable.
- **Influence new dietary norms and aspirations.** Consumers' choices will be shaped by a trifecta of markets, policy and social influences. For the latter, social institutions and actors can promote a new type of eating that supports personal health and that of the planet. Traditional and social media, including cultural influencers, could reshape perceptions of what foods are enjoyable and desirable, and could create taboos on behaviours such as food waste.
- **Elevate the needs of future generations.** Social institutions' role is critical to advocate on climate change and ecological services protection, and to offer related technical assistance. Such actors can also ensure that the needs of poorer populations are among the priorities for future technological development.

Responsive and responsible leadership is needed from all sectors.

All pathways to a brighter future depend on collaboration among all stakeholders in food systems to:

- **Build trust and transparency.** In an increasingly volatile world, the resiliency of food systems depends on greater trust in governments, businesses and institutions, which must be earned through more responsible and transparent activities. For business, this means that short-term financial gains should not distract from long-term economic prosperity and social welfare. For government, it implies the need for policies that elevate inclusive social and environmental priorities for today and future generations. All sectors can embrace more

robust accountability in keeping with the SDGs and their targets.

- **Collaborate across traditional silos.** As this scenarios analysis indicates, to feed the global population nutritiously and sustainably by 2030 will require unprecedented innovation and coordination by all actors in food systems. Multistakeholder collaboration will be needed to achieve joint aspirations, as will the engagement of diverse stakeholders in policy (such as finance, health, environment and education ministers), business (such as executives in technology, energy, infrastructure, health and financial services) and key food systems stakeholders – with particular attention to farmers and consumers.
- **Exercise system leadership.** Creating system-wide transformation will require courageous leaders who take a holistic view of the challenges at hand, engage with diverse actors throughout the system to jointly tackle those challenges, and build new alliances to work towards shared goals. Leaders in business, policy and society must step up to cultivate a shared vision for our common aspirations, empower widespread innovation and action, and enable mutual accountability for progress.

Our future is in our hands.



Annex: Acknowledgements

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EMATER-Agência Goiana de Desenvolvimento Rural e Fundiário (EMATER-GO)

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Nanjing Agricultural University

NITI Aayog

Oxfam America Inc.

Protix

Rabobank

Royal DSM

The Nature Conservancy

The Rockefeller Foundation

The Wellcome Trust

Tufts University

Unilever

University of Leeds

World Bank

World Health Organization (WHO)

World Resources Institute (WRI)

Food Security and Agriculture Partners Group

Al Dahra Holding

Anheuser-Busch InBev NV

Bayer AG

Bunge Ltd

Cargill Inc.

The Coca-Cola Company

DuPont

Evonik Industries AG

HEINEKEN International

Hewlett Packard Enterprise

International Finance Corporation

Jerónimo Martins SGPS SA

Kuwaiti Danish Dairy Company

Louis Dreyfus Company

Monsanto Company

Nestlé SA

Novozymes A/S

PepsiCo Inc.

PJSC PhosAgro

Rabobank

REMA 1000

The Rockefeller Foundation

Royal DSM NV

SICPA Holding SA

Sinar Mas Agribusiness & Food

Solvay SA

Swiss Reinsurance Company Ltd

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UPL Ltd

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Endnotes

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