FoodWeb 2020: Forces Shaping the Future of Food








INSTITUTE FOR THE FUTURE

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THE GLOBAL FOOD OUTLOOK PROGRAM ...

Food is integral to our lives, but it is about more than just sustenance and nutrition. Our relationship to food is intertwined with politics, economics, environmental concerns, culture, and science. At IFTF, we see these strands forming a global food web. And from food chains to supply chains, from food markets to fuel markets, from agricultural ecologies to wilderness ecologies—this global food web is undergoing rapid change. Our Food Web 2020 program provides an analysis of the trends and drivers shaping the future of food and food markets on a global scale.

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Executive Summary

Food sustains and nourishes us, and it also increasingly connects us to a global food web that is intertwined with politics, economics, environmental concerns, culture, and science. This global food web is undergoing rapid change, presenting considerable challenges and significant opportunities. Every one of the six broad areas of activity in the food system—agriculture and stewardship, manufacturing and branding, distribution and logistics, retail and information, consumption and taste, and disposal and renewal—is being affected. As the impacts of disruptive forces are felt over the next decade, strategic responses will be required from your organization and other stakeholders in the food system. This report and its companion map, *FoodWeb 2020*, identify the forces reshaping the food web, share examples of innovative responses, forecast key shifts in direction, and present principles for long-term business decision-making that will confer competitive advantage while increasing the resilience of the food web by 2020.

We identify eight disruptions that are pushing stakeholders at every level—from individual consumers and small-scale farmers to food companies and national governments—to rethink their relationships to the food system. These range from new taste imperatives to growing food fears, from new attention to health impacts to an upsurge in food rights activism, from increasing cost volatilities to cascading environmental emergencies, and from a growing demand for sustainability metrics to an expanding effort to reduce the environmental footprint of food. We also look at innovative responses to these disruptions that have already emerged in locations around the globe.

We then forecast five key shifts in the food web that will present both threats and opportunities for producers and retailers at all scales. The first shift is toward greater transparency through labeling and through consumers developing a more personal relationship with their food sources. The second is toward preserving crop biodiversity by deemphasizing monocropping and standardized foods, and finding ways to offer locally differentiated products. The third is toward decentralizing food production and distribution as demands for safe, local, sustainable food increase. The fourth is toward improving food's environmental footprint by incorporating flexible farming and manufacturing strategies that address resource limits and take into account the whole life cycle of a product. And the fifth is toward collaboration in order to improve capacities and sustainability at both local and global scales.

Finally, we discuss the resilience principles that characterize products, processes, and organizations that have staying power. It is through incorporating flexibility, diversity, decentralization, collaboration, transparency, foresight, graceful failure, and redundancy that stakeholders in the food web can cultivate adaptation and competitive advantage—even as they embark on a journey to ensure that the world's food supply in 2020 will be more resilient than it is today.

Introduction

The Changing Food Web

As legendary American chef and food writer James Beard once observed, "Food is our common ground, a universal experience." Food sustains and nourishes us, and it also increasingly connects us to a global food web that is intertwined with politics, economics, environmental concerns, culture, and science. Now as environments, technologies, and populations shift and evolve, this global food web is undergoing rapid change, presenting considerable challenges and significant opportunities. This report and its companion map, *FoodWeb 2020*, portray the tensions and possibilities of the food landscape to provide you with new ways of thinking about innovative and creative responses.

Forces Shaping the Future of Food

In our research, we found that to forecast the future of food, it's not enough simply to look for change across the supply chain, at the set of actors that get a food product from farm to fork. Political and economic influences affect supply chains, and thus we have to look at the complex relationships between food systems and natural environments, cultural environments, and globalization.

The future of food will take shape in a world where biodiversity is declining, the climate is changing, infectious diseases are spreading more widely and rapidly, and global food sourcing is raising safety and sustainability concerns. Current worldwide migration trends will create new burdens as the rural-to-urban movement continues and population growth soars. The use of arable land for food production will compete with demand for fuel crops, while our oceans face degradation and decline in consumable marine life.

In this context, governments and their citizens are redefining food security, seeing it not as access to markets but as the ability to produce food—a shift that could help reinvigorate regional food production. Water- and energy-supply issues are also pushing in the direction of less-global supply chains for food while also contributing to volatile and uncertain agricultural prices. In addition, efforts to account for the environmental costs of agriculture and food production pose challenges to the just-in-time delivery of foods shipped around the globe.

Despite these constraints on food production, consumer demands for cheap, tasty, convenient, and increasingly functional food show little sign of abating. Indeed, the ability to obtain just about any food—regardless of local growing conditions—is practically a given for many U.S. consumers, and any effort to reimagine food systems will inevitably need to manage these expectations. At the same time, such an effort will need to confront the irony of the coexistence of malnutrition and obesity, as education, income, and health gaps grow worldwide.

In the face of these challenges, innovations are emerging globally from organizational leaders and grassroots enterprises. Dynamic technologies and policies are addressing energy volatility and unequal water scarcity. New and old coalitions seek to shorten and safeguard supply

chains, forming unexpected alliances to repurpose space and infrastructures. Institutional and citizen science already offers new insights and strategies for managing organisms, land, and ecosystems. And countless social justice and philanthropic efforts are burgeoning around the world to better the health and livelihoods of global citizens.

The Evolution of Food System Activities

One way to think about the food web of the future is to relate the changes taking place in six broad areas of activity in the food system: agriculture and stewardship, manufacturing and branding, distribution and logistics, retail and information, consumption and taste, and disposal and renewal. As the impacts of disruptive forces are felt, these activities are evolving to form new relationships and interconnections. (See Page 3).

Over the next decade, strategic responses will be required from stakeholders across all these activities in the food system. In this report, we prescribe principles for long-term business decision-making that identify vital attributes of resilient strategies. Applying these principles will guard against potential risks and confer competitive advantage over the next decade, as well as increase the resilience of the food web as a whole.

About This Report and How to Use It

In *The Future of Foodscapes*, IFTF focused on the disruptive relationship of food and health and on the new unprecedented powers of consumer-citizens in brokering this disruption in the food system. Here, in Chapter 1 we look more broadly at additional disruptions that will reshape the global food system, both through their direct impacts and through local, regional, and global responses to them. These disruptions are pushing stakeholders at every level, from individual consumers and small-scale farmers to large food companies and national governments, to rethink food systems.

Stakeholders around the world in all food system activities are responding to today's disruptive forces. The stories of their innovations, told in Chapter 2, are signals of what's to come. They illustrate how individuals, communities, cities, countries, and organizations are redefining the activities in the food web or creating entirely new activities.

These disruptions and the innovations arising in response form the basis of our forecasts regarding the future of food. These forecasts, outlined in Chapter 3, relate to the way we eat as well as to the nature and relationships of activities in the food system. The food web that will emerge out of this will encompass greater cultural and ecological complexity, impact current activities and stakeholders, and generate new ones. The forecasts situate us all in a food web future that is both fragile and potentially resilient.

Thus situated, we have the opportunity to design strategies that create competitive advantage for those who make the food system more resilient. Therefore Chapter 4 enumerates a set of principles that are key to designing resilient systems. These principles, and the exercises that follow in Chapter 5, are IFTF's recommendations on how you can foster resilience in the food web while keeping your organization's interests in mind. While perfect resilience may be impossible, improved resilience certainly is not.

Food System Activities

One way to think about the food web of the future is to relate the changes taking place to six broad areas of activity in the food system: agriculture and stewardship, manufacturing and branding, distribution and logistics, retail and information, consumption and taste, and disposal and renewal. As the impacts of disruptive forces are felt, these activities are evolving to form new relationships and interconnections.

AGRICULTURE AND STEWARDSHIP

The business and science of producing food will evolve in response to continued pressures from growing populations, shrinking arable land, species vulnerability, and environmental disruptions.

MANUFACTURING AND BRANDING

While processing giants balance the complexities of international sourcing and conflicting standards, local and artisan processors proliferate. A variety of entities tinker with brands to capture market share on the basis of value, trust, and taste.

DISTRIBUTION AND LOGISTICS

Developments in technology continue to improve efforts to track granular information about water, seed, fuel, and other factors involved in moving food from farm to fork, both near and far.

RETAIL AND INFORMATION

Venues for selling food range from guerilla food trucks to big box giants. Regardless of their size and scale, these vendors are increasingly becoming places to share information on nutritional content and other key data about the food they sell.

CONSUMPTION AND TASTE

New global connections are dramatically expanding the range of food choices and experiences we have. These experiences with new foods are shaping consumer preferences and demands, while scientific understandings of taste preferences offer opportunities for innovation.

DISPOSAL AND RENEWAL

Drives toward sustainability have placed an increased focus on developing integrated systems for managing waste products and on the optimal use and reuse of resources.

1 | Disruptions

Eight Forces Reshaping the Future of Food

Activities in the global food web—from our ability to grow sufficient quantities of food to the opportunity to sit down and enjoy a nice dinner—are being challenged by major disruptive forces inherent in the food system. We previously explored the myriad ways consumers are linking the consumption of food and health in IFTF's *Future of Foodscapes*.[1] Here, we broaden our scope to look at additional disruptive forces that will remake the ways we produce, distribute, brand, sell, consume, and dispose of food.

We have identified eight disruptions that are pushing stakeholders at every level—from individual consumers and small-scale farmers to international food companies and national governments—to rethink their relationships to the food system. These range from new taste imperatives to growing food fears, from new attention to health concerns to an upsurge in food rights activism, from increasing cost volatilities to cascading environmental emergencies, and from a growing demand for sustainability metrics to an expanding effort to reduce the carbon footprint of food. While these disruptions have been building over decades, many of their impacts are only now becoming apparent.

1. New taste imperatives

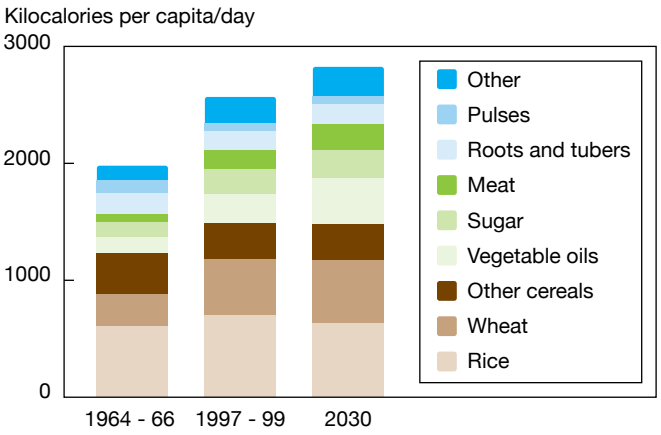
Amplifying food experiences, straining ecological capacities

Consumer tastes, both entrenched and rapidly proliferating, are straining the capacities of the food web. Foods that were once local, seasonal, and occasional can now be found in almost any part of the world at almost any time of year. But this global demand for novel and tasty foods—persistent in some regions and emerging in others—is straining ecological resources, contributing to rising obesity rates, and radically altering traditional foodways. Maintaining a richness and variety of tastes while keeping food system activities sustainable will become an increasingly acute challenge.

Luxurious expectations

Taste preferences that have evolved over thousands of years in contexts of geographical constraints and scarcity have been reconditioned to a food system with dramatically expanded options. The globalization of local tastes that began with Marco Polo has exploded on an unprecedented scale. Erstwhile local delicacies continue to spread as they are recontextualized to satisfy new appetites in locations far from the foods' roots. One example: urban dwellers in North America can now eat fresh mangos and papayas in the middle of winter.

Figure 1-1
Diversifying diets in developing countries include more meat.



Source: FAO 2003; based on a chart drawn by Hugo Ahlenius, Nordpil, http://maps.grida.no/go/graphic/dietary-change-in-developing-countries-1964-2030

This expanded availability of food has disconnected many consumers' choices from the practical limits of climate and location and instead created an expectation that food will be increasingly abundant, diverse, cheap, and pleasurable. The intense tastes possible through modern food science also excite our palates and alter traditional tastes. At the same time, we see countertrends rejecting this paradigm of global abundance and emphasizing instead the novelty and sustainability of local, seasonal foods, also evoking taste as an added motivator.

Strained capacities

While regional tastes have spread globally, production of many of the foods themselves is still constrained by local conditions including weather, season, and geography. Thus, global demands for certain food products are already stressing key components of the food system.

For example, as the health benefits of fish are touted and as a taste for sushi has globalized, the demand for fresh, high-quality fish has placed enormous strain on fisheries. Fish catches leveled off in the mid-1990s, but fish consumption has continued to increase globally. As a result, three-quarters of fisheries are being fished beyond maximum sustainable levels. While the fragility of fisheries has been recognized for decades, the immense demand drives illegal exploitation. Some estimates suggest that in Europe's largest market for fresh fish, nearly half the supply comes from illegal fishing.[2]

Similarly, ongoing demand for meat and dairy products in the United States and Europe, coupled with rapid shifts toward more meat and dairy consumption in emerging markets (see Figure 1-1), has contributed to environmental damage, increases in commodity crop prices, and hunger in some of the world's most impoverished places. It has also impeded responses to other disruptive forces. For instance, people in emerging markets just now gaining regular access to the flavors and social status offered by meat are turning a deaf ear to calls to adopt vegetarianism for environmental reasons. As the dietary proportion of meat increases, so too does the proportion of the world's cereal production used to produce animal feed, further straining agricultural resources. Already, nearly half the world's cereal grains are used for animal feed, with this proportion projected to increase in tandem with global meat consumption.

2. Growing food fears

Seeking food safety, encountering a crisis of faith

Food contamination is a constant specter in the modern food system, threatening human health and along with it brands, intermediaries, retailers, and entire food sectors. Other longer-term threats loom from the evolution of contaminant organisms. With fewer and fewer people producing their own food, and with the physical distance between food production and consumption increasing due to urbanization, distrust of the origins and safety of food is high and mounting across the globe. Consumer efforts to ensure protection from food-borne illness vary from region to region.

Systemic risks

Accidents do happen in complex systems, and in the modern food system, some of those accidents result in food contaminated with industrial chemicals and disease pathogens. Some practices amplify the significance of these accidents. Mixing a given input from many sources for processing, as is common with ground meat or precut and packaged vegetables, creates the vulnerability that one bad apple can spoil the barrel. The fragile reliance on a single supplier of a particular ingredient also leaves the larger system at risk—as was amply demonstrated by the contamination of wheat gluten with melamine that crippled the pet food industry in 2007.

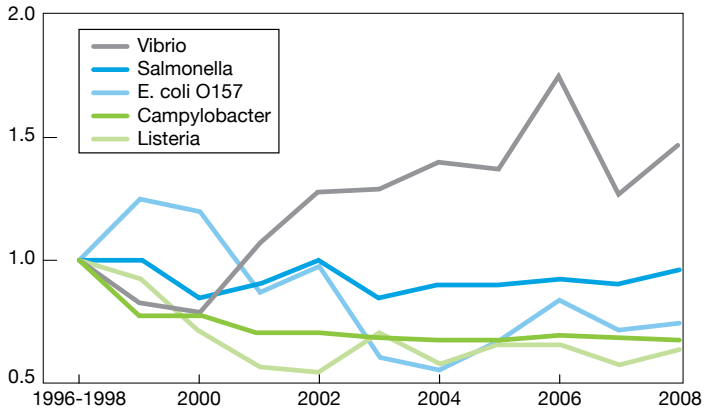
Longer-term systemic risks loom in the background. For example, the use and overuse of antibiotics have promoted the evolution of antibiotic-resistant bacteria, as well as new strains of bacteria that thrive on antibiotics.[3]

Splintering trust

High-profile cases of food-borne illness spotlight vulnerabilities in the food system, and in the process humble companies and cast doubts on product categories and even whole food-producing regions. In the United States, many shoppers still avoid peanut butter after a high-profile recall in 2009, and spinach has not fully recovered from the *E. coli* scare of 2007.[4] In China, all products from the whole province where a contamination scare originates are shunned, even if they are completely unrelated. Repeated scares shake consumer confidence. Although incidents of food-borne illness are nothing new, public anxiety over perceived risks seems to be rising (see Figure 1-2).

As a result of growing public scrutiny, national and international regulators have become increasingly concerned with food safety issues. Urban residents who rarely encounter food production or processing are demanding more information about their food to assuage their fears and may also choose to eat packaged foods in the belief that packaging indicates sanitary conditions. Different countries, regions, and food sectors are reevaluating who is responsible for keeping food safe. In the United States and Europe, the onus shifts between national and international regulators, agrifood companies, and consumers themselves. While responsibility in China remains vague, punishment can be severe. A 2007 law allows the government to punish companies and even celebrity endorsers of tainted food products.[5]

Figure 1-2
Incidence of most food-borne illnesses is declining, but public anxiety is not.



Source: "Foodborne Diseases Active Surveillance Network, United States," *New York Times*

3. New attention to health impacts

Confronting a nutritional gap, embracing enhancements

Food is intertwined with our health in ever more palpable and striking ways. Rates of food-related chronic health problems such as obesity, heart disease, and diabetes have skyrocketed in recent years. At the same time, growing awareness of the relationships between food and health is contributing to new practices involving consuming food as a form of health, wellness, and medicine. The contribution of food producers and retailers to individual and community health and well-being (or to health problems and disease) is becoming increasingly critical to food choices, policy, and brand identity. The health impacts of food products will be critical to food science and brand management strategies as the health costs and benefits of food choices become more apparent over the next decade.

Problems of plenty

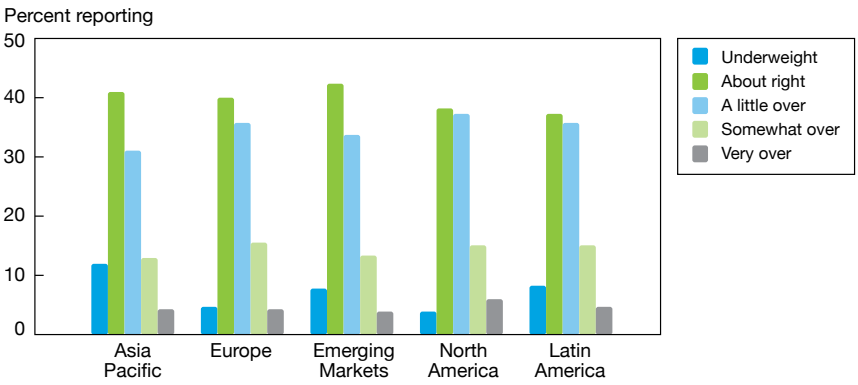
Recent data from the World Health Organization shows that more than 1 billion people worldwide are overweight, including 300 million people who are obese.[6] Although these problems are often most associated with the United States (where treating obesity now costs $150 billion a year) and southern Europe, obesity rates are increasing around the world. Even in developing countries in the Global South, obesity is rapidly emerging alongside those still suffering from malnutrition (see Figure 1-3).

At the same time, concern is mounting over the environmental and public health costs of industrial farming, such as the downstream health effects of antibiotic use in animals and the repercussions of waste streams from confined animal feeding operations (CAFOs). As these burdens have grown and as awareness of the long-term impacts of food production has increased, key players in the food system such as restaurants and food manufacturers have become a target of public resentment and hostility. Governments and citizen-driven efforts are seeking to improve the health content of food by taxing less healthy choices; they are also aiming to expand access to healthier foods in food deserts and to improve school lunches. Citizen pressure in California, for instance, led the state to pass a law setting nutritional standards for foods sold in schools, forcing many food manufacturers to reformulate their products.[7]

Augmentation diets

While some consumer demands are focused on long-term health, others focus on shorter-term experiential enjoyment and immediate physical or emotional enhancement through food. A recent study from PricewaterhouseCoopers projects that sales of functional foods—foods that offer some sort of health benefit such as improved digestion or increased energy—will increase as much as 20% per year in the United States, with demand also expected to surge in Asia. This study found that the most successful products offer benefits that are experienced immediately: boosts in concentration, energy, or relaxation.[8] Bridging the gap between those experiences and the longer-term benefits purportedly sought by aging baby boomers in the United States and Japan will offer key opportunities for food manufacturers over the next decade. Growing movements in North America and Europe to distance healthy food choices from manufactured and packaged foods altogether will simultaneously offer competing visions of healthy food.

Figure 1-3
Sixty percent of the world's people are dissatisfied with their weight.



Source: Jonathan Banks. Global resolution: Eat right, exercise more. *Nielsen Wire*, January 6, 2009. http://blog.nielsen.com/nielsenwire/consumer/global-resolution-eat-right-exercise-more/.

4. Upsurge in food rights activism

Striving for food security, finding volatility

Food security generally refers to the rights of individuals to get the food they need to live healthy, active lives, and embraces the rights of neighborhoods, regions, and nations to have enough food to be self-sustaining. Struggles to assure food security in the face of food price volatility and supply concerns are taking sometimes conflicting forms: while farmers are striving for greater control over their land, countries with little arable land are purchasing farmland from bigger, less developed countries. The conflicting interests of these stakeholders will propel market volatility and global food supply disruptions over the next decade.

Local empowerment

After decades of asserting increased trade and interconnectedness as the key to food security, development strategies for food security are tilting toward local control and self-sufficiency. This renewed focus on autonomy for food security highlights a key shift away from emphasis on access to markets and toward access to food itself.

Food rights movements such as the transnational La Via Campesina, active in 56 countries in Asia, Africa, Europe, and the Americas, are fusing family farming with the quest for food security.[9] Members of these movements are fighting to reorient farming toward producing food for domestic consumers, as a politically and economically empowering strategy in the Global South.

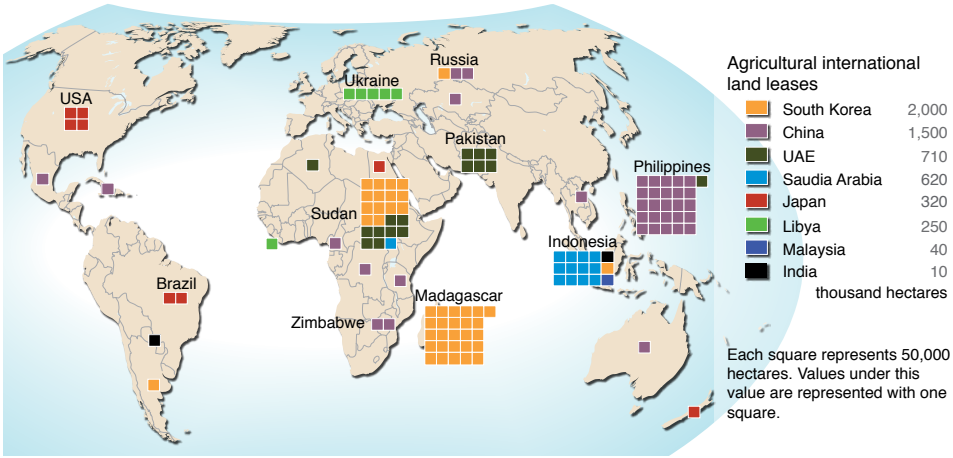
At a global level, as part of its most recent international food aid work, the G8 signaled its intention to focus away from solving acute hunger supply problems and toward funding international support programs aimed at developing self-sufficient local and national food systems.[10] This strategy, while seen as the best hope for reducing the staggering burden of poverty and hunger, will alter commodity supply chains.

Remote land control

Countries with money but constraints on agriculture—among them China, Saudi Arabia, and South Korea—have been buying and leasing land from larger, less wealthy countries in parts of Africa, Asia, and Latin America (see Figure 1-4), efforts that were quickly labeled "land grabs."[11] Similarly, international investment banks, hedge funds, and other investors have begun purchasing swaths of land for food production from the developing world, on the grounds that agricultural investment strategies appear to offer high returns with little risk. After all, the amount of arable land per capita has been cut in half since the 1960s, and projections suggest these steep losses will continue for several decades.[12]

As competition among small-scale farmers, large investors, and governments over control of food production increases, food is becoming, as the *Financial Times* notes, "the new

Figure 1-4
More countries are leasing land abroad for food production.



Source: GRAIN, 2008; Mongabay, 2008; map drawn by Hugo Ahlenius, Nordpil, http://maps.grida.no/go/graphic/an-increasing-number-of-countries-are-leasing-land-abroad-to-sustain-and-secure-their-food-production

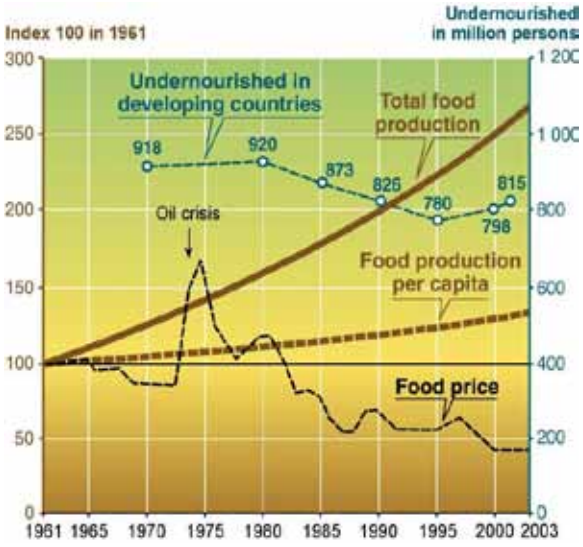
5. Increasing cost volatilities

Facing the hungry, seeking reliable supplies

oil."[13] The tension among these varying strategies to secure food supplies bespeaks a future of exacerbated volatility.

Increasing volatility in the cost of food commodities is disrupting both the global quest to end hunger and the sourcing of food ingredients. Multiple interlinked factors have driven rapid and wild fluctuations in global prices of commodities including wheat, corn, soybeans, and rice, which peaked in 2008 after 50 years of steadily falling. The price spikes sparked riots in some countries, and quiet strife among food manufacturers trying to keep costs down in others, before the pressure eased somewhat. But escalating demand for food, feed, and fuel along with diminishment of production capacities by climate change makes such sudden swings in food supplies and costs likely to recur. As food commodity markets become more volatile, farmers, governments, ingredient suppliers, manufacturers, and people both rich and poor will have to find ways to cope with undependable supplies.

Figure 1-5
Global food production, prices, and undernourishment.



Sources: FAOSTATS, SOFI, Millennium Ecosystem Assessment; cartography by Philippe Rekacewicz, Emmanuelle Bournay, UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/global-production-prices-and-undernourishment

Interconnected vulnerabilities

As complex forces reverse decades of declining costs for food commodities (see Figure 1-5), hunger has led to food riots and geopolitical instability. Thanks in no small part to price spikes, the number of people who are malnourished has surged beyond 1 billion for the first time in human history, a chilling milestone that will cause long-term, irreversible damage to undernourished children; the most acute effects will be felt in the Global South (see Figure 1-6). Protests in some 30 countries were sparked by the price spikes in 2007 and 2008 (see Figure 1-7), according to the UN World Food Programme.[14] Long-term pressures of population growth, rising incomes, and accompanying dietary transitions collided with acute global shifts: high oil prices, biofuel crop inflation, and unprecedented commodity speculation. Regional factors such as droughts, floods, protectionist trade policies, import hoarding, and sheer price gouging also accelerated the rapid, wild shifts in prices.

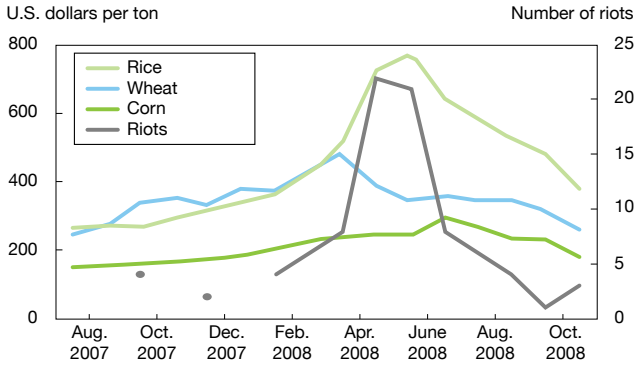
Consider rice, a staple food for half the world's population and the most dramatically impacted staple crop in 2008. The price more than tripled between 2007 and spring 2008, destabilized at first by long-term dietary shifts in Asia, long-term agricultural trends, and rising energy prices.[15] These factors were exacerbated by a drought in Australia, a hurricane in Burma, sharp restrictions on exports from the largest rice-exporting countries, and the chain reaction of dozens of other countries', companies', and families' contradictory interventions based on both market judgment and popular outcries.[16] The complex interactions among global market instability, extreme weather incidents, and political turmoil highlight the increasing vulnerability of the food system to rapid and destabilizing shocks.

Uncertain supplies

For countries, price volatility is a reminder of global dependencies that can be compounded by demands for food security—and policy reactions have been highly variable and often ineffective, as the International Food Policy Research Institute notes.[17] This volatility has been disruptive to food producers everywhere. Food manufacturers, in particular, have been challenged to develop consistent, scalable recipes in the face of jittering, undependable supplies.

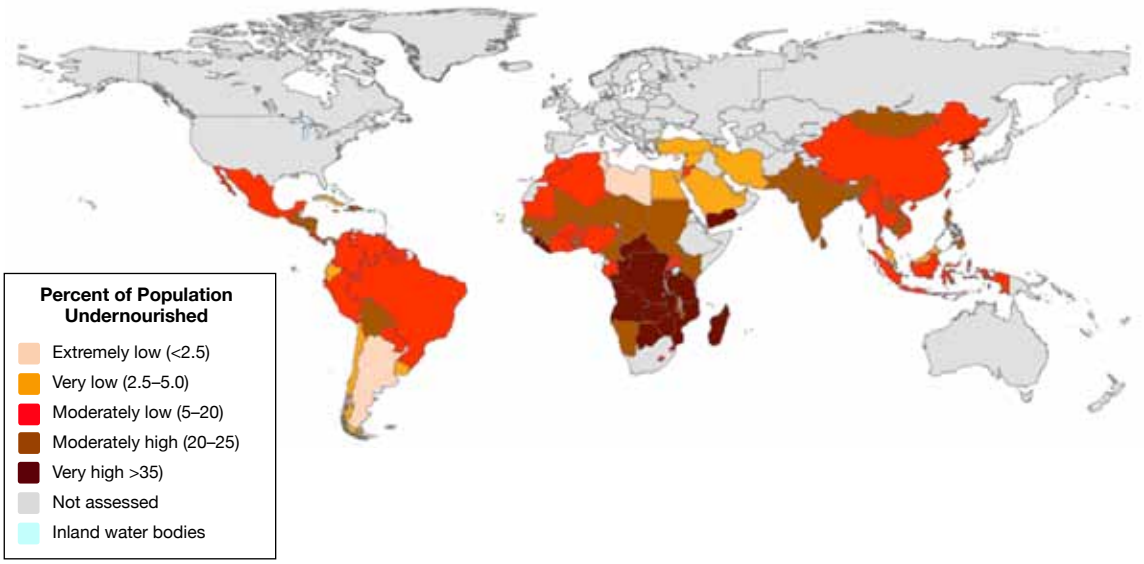
By mid-2008, in the face of rising costs of fuel and food ingredients, the practice of "short-sizing" (subtly decreasing the volume of product in a package while maintaining or even raising the price) swept across food industry sectors and product categories. Food retailers felt the pinch of declining margins and consumer sensitivity to value, significantly and likely enduringly reset by the global recession. Facing a decade of likely recurring upsets in food costs, these events and food industry reactions to them highlight the challenge of bringing readiness and flexibility to a system built on consistency, efficiency, and scale.

Figure 1-7
Price volatility and political turmoil.



Source: J. von Braun, based on data from FAO 2009 and news reports

Figure 1-6
Hunger and malnourishment remain major problems for countries around the world, particularly in the Global South.



Source: FAO 2008, http://www.fao.org/geonetwork/srv/en/metadata.show?id=14121&currTab=simple

6. Cascading environmental emergencies

Coping with climate impacts, securing safe water

The food web faces looming environmental emergencies. Some, like water depletion and soil degradation, threaten to disrupt agriculture, food transport, and other food system activities, while others, such as climate change and biodiversity loss, are exacerbated by these activities as they are currently practiced. The initial impact on crops from challenges such as declining biodiversity, the collapse of pollinator populations, and increasing water scarcity will be felt over the next decade. Other issues are "long-lag" threats where the worst impacts from other issues will likely not strike in the next decade, but our windows to act to avert disasters close on that horizon. While these threats are most pressingly tied to agriculture, their effects will resound throughout the food web in the coming decade and the next century.

Perilous world

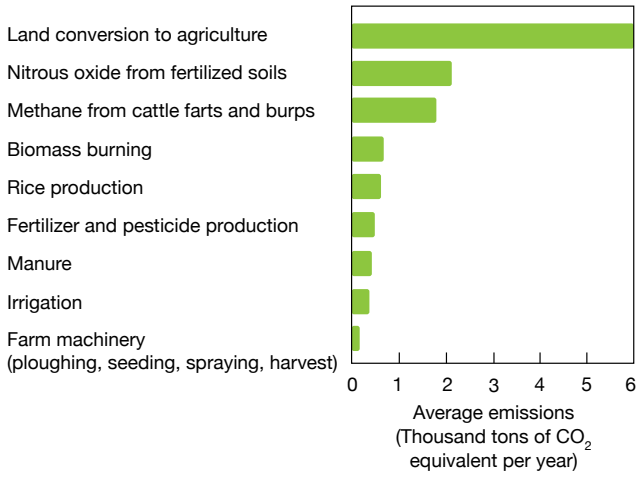
Projected changes in the climate threaten to reduce agricultural output in fragile dry regions in the tropics, in the semitropics, and even in Mediterranean climates, through altered rainfall patterns, higher evaporation rates, and changing pest problems. As severe weather events like floods and droughts strike more frequently, agriculture will not simply become less productive; food supplies will also become more uncertain. For instance, under a +4C climate change scenario, soybean yields are projected to decline in almost every region.

Industrial agriculture contributes to some of the worst effects of these scenarios. On average, converting land for agriculture results in a net emission of six thousand million tons of CO^2 equivalent per year (because croplands have a decreased ability to take up carbon), while ongoing agricultural activities produce an additional five thousand million tons (see Figure 1-8). This makes multicropping, reclaiming marginal lands, and resolving the tension of biofuel production with food cropland and rangeland critical challenge areas. Monocultures, intensive fertilizer use, and market-driven cropping patterns are contributing to numerous vulnerabilities in the food system and exacerbating the uneven distribution of nutrients and farm income around the globe.

Declining biodiversity leaves common food crops such as wheat, tomatoes, and bananas vulnerable to disease. The complex and ominous progression of bee colony collapse disorder since 2006 is an even trickier emergency, since its causes are still not well understood. The deaths of pollinating bees threaten one-third of the crops in the United States and Europe, including almonds and many stone fruits.

These stresses on food supplies will pose downstream challenges to food manufacturers to secure reliable and consistent supplies, and will become an increased source of geopolitical and social strain. As appetites for resource-intensive foods, including meat and dairy products, continue to spread, tensions will rise as food security in less wealthy areas suffers.

Figure 1-8
Agriculture contributes to CO^2 in the atmosphere, particularly as a result of land conversion.



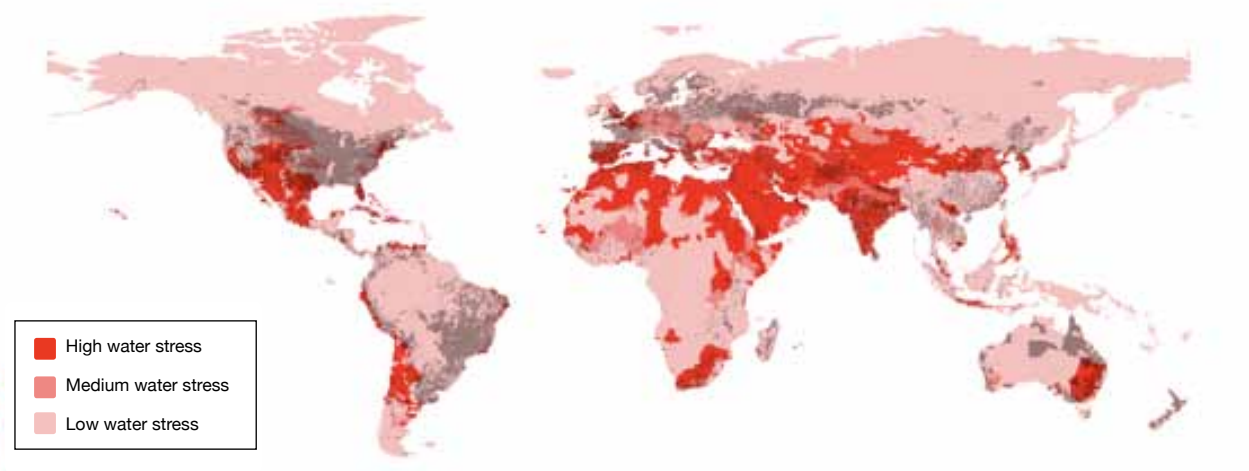
Source: Data from Greenpeace, Cool Farming: Climate impacts of agriculture and mitigation potential, January 2008 (data for 2005); chart by UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/emissions-from-agriculture1/

Water rights

Water concerns will challenge not just agriculture, but all food system activities and almost all other industries are dependent on water access to some degree. Decades of overuse have left many water systems fragile, placing agriculture at particular risk (see Figure 1-9). In many locations, the energy used and water delivered in irrigation systems are subsidized or simply not valued, which helps drive a cyclical pattern of mismanagement. The 20% of croplands that are irrigated use approximately 70% of the global water withdrawn for human consumption. Drought-resistant crops, better irrigation technologies, and careful cropping systems are essential to addressing global water problems.

Developing knowledge management and technological tools, as well as social, cultural, and political systems of governance, can help mitigate some of the greatest disruptions in water supplies. In addition, players throughout the food web will need to reinvent techniques and crops to cope with these impacts. Water management is no longer a local issue but has become a global one. The recognition of virtual water trade (*virtual water* refers to the water used to produce an agricultural or industrial product; *virtual water trade* refers to importing of water-intensive products by water-scarce nations and exporting of water-intensive products by water-rich nations) holds the possibility of better management but may also force even more intense competition over water rights among companies, industries, and countries.

Figure 1-9
Areas likely to experience water stress in 2050 span the globe.



Source: David Zaks, SAGE 2009 (Center for Sustainability and the Global Environment, University of Wisconsin)

7. Growing demand for sustainability metrics

Quantifying ecosystem costs, negotiating trade-offs

Over the past century, food systems have been able to produce, process, and transport food in ever-greater volumes at ever-cheaper prices but with little accounting for costs to the environment. Growing concern over environmental damage in general, coupled with new tools to measure ecological costs, will bring increased scrutiny to the environmental costs of food and rising demand for sustainability metrics. Over time, key players in the food system will have to adapt to a context where any activity in the food web—from growing a crop to processing it to selling it—is priced, promoted, and accounted for not only in terms of the direct costs of production but also in terms of the costs to the environment.

Food footprints

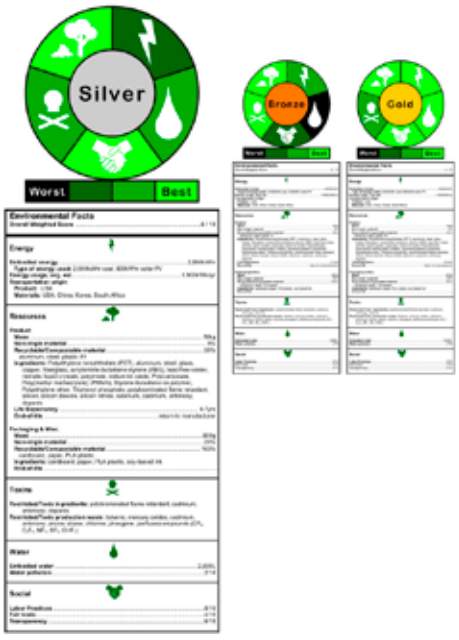
Food producers have long benefited from a system where "external" costs could go largely unmeasured, provided they did not directly disrupt food system activities. As accounting for environmental impacts becomes mandatory through formal taxation and informal civic pressures, companies will need to become accustomed to working within planetary capacities and supporting local efforts to maintain vital resources. In India, for example, citizen pressures over local water rights in rural towns eventually led Coca-Cola to rethink its entire water management strategy and look beyond cost accounting to broader impacts on local watersheds and local residents' well-being.[18] Coke has used these lessons to engage in a public discussion with consumers and citizens on water management.

As accounting for environmental costs takes off, food producers, processors, and retailers will be challenged to develop effective tools for limiting external costs of a centralized but interconnected food system. For large-scale stakeholders, conducting life-cycle analyses of the broad environmental costs of food production will become a new core competency and spur competition surrounding limiting the environmental impacts of food products. At the same time, more localized and small-scale efforts will aim to undercut the environmental impacts and financial costs of industrial food systems.

Life-cycle labels

Growing citizen concerns over pollution, biodiversity loss, food-borne disease, and other less quantifiable costs of production leads to bottom-up efforts to track activities of the food system and challenge suppliers, retailers, and manufacturers to communicate the environmental costs and benefits of their products through labeling. But even as their interest in sustainability metrics grows, consumers have enduring desires regarding price, taste, and choice. For many people, battles between cheap prices and long-term sustainability play out in the supermarket. Labels depicting the greenhouse gas, water, and general environmental impact of products' entire life cycles will eventually become as common as food nutrition labels. And as with food nutrition labels, consumer understanding will be variable. Consumers may also waver in the choices they make based on the labels, going through inexplicable reevaluations of environmental priorities just as they go through fad diets.

Figure 1-10
Sustainability metrics can be graphical icons or numeric life-cycle analyses; this hypothetical design merges the two.



Source: Jeremy Faludi http://faludidesign.com/design/Persuasive/_EcoLabel_index.html

8. Expanding push toward carbon neutrality

Building a post-oil food system, competing with food crops

Beyond contributing to commodity price spikes, volatile energy markets have highlighted the long-term fragility of modern agriculture, food processing and manufacturing, transport, and access. From chemical fertilizers to car trips to the grocery store, all parts of the industrial food system have been shaped and powered by low-cost, high-emission fossil fuels. New models of agriculture, retail, and consumption—from aggressive energy reduction measures to urban food production—are making energy costs a key factor in diets as well as agricultural production methods. Endeavors to supplant petroleum products such as plastics with agriculturally derived alternatives also disrupt the calculus of food, energy, and carbon.

Community food production

Although transportation often accounts for a relatively small percentage of the cost of getting food into a retail setting in the Global North, the coupling of energy and food price spikes in 2007–2008 helped cement the public perception that transportation inputs have major impacts on food costs.[19] At local levels, models such as urban and rooftop gardening and small-scale animal husbandry are gaining traction as a means to limit the environmental impacts of transporting food, even while expectations remain for diverse food options. Energy costs to retailers are spurring innovations to reduce both the energy and carbon costs of storage and refrigeration.

In the Global South, where transportation accounts for a greater portion of the cost of food—and where an energy price spike can cause far more financial hardship as well as hunger and social strife—efforts are under way to change the focus of smallholder farms from producing exports to producing subsistence food. This makes tremendous sense considering that half of the cost of international food aid in 2008 stemmed from transportation.

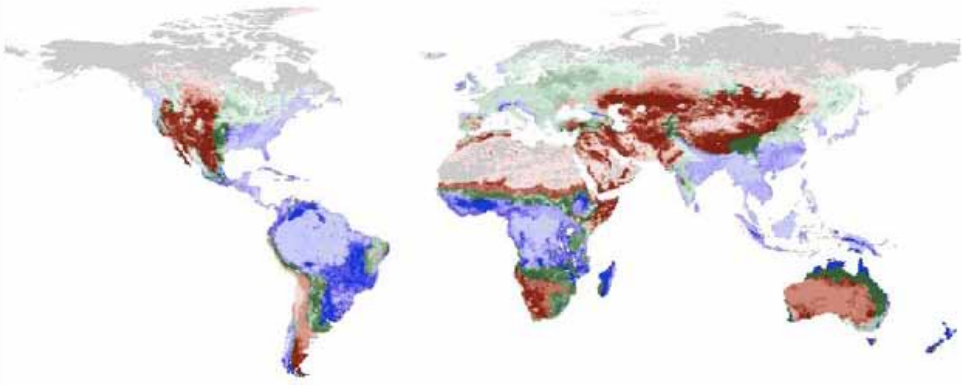
Competing land uses

As the market for biofuels has grown dramatically in recent years, crops from which replacements for petroleum-derived products—such as corn- and potato-based bioplastics—can be made have also become an increasingly important use of agricultural land. The demand for these replacements is projected to continue to grow rapidly.[20] Global biofuel production more than tripled between 2000 and 2007, and over the next decade biofuels are projected to account for a third or more of fuels in some regions. Finding ways to use land to grow food, fuel, and other petroleum product replacements—without sacrificing carbon uptake—will be an increasingly important challenge.[21]

Brazil has already undertaken a large-scale shift toward sugar-based ethanol programs. The United States, China, and other countries are seeking to ramp up industrial production of biofuel and other replacements for petroleum-based products. As efforts to produce biofuels on a mass scale have increased, global commodity crops have begun to be traded in unprecedented ways. For the first time in its history, the United Kingdom will be importing wheat as it increasingly uses land to meet demands for fuel crops,[22] while towns in Mexico have exported corn crops to the United States for ethanol and in turn eaten corn imported from America.[23] Multiple cropping strategies will be essential to reconciling biofuel crops with other agricultural activities (see Figure 1-10).

Figure 1-11

Productive pastures for potential biofuel production can be found on every continent.



Source: David Zaks, SAGE 2009 (Center for Sustainability and the Global Environment, University of Wisconsin)

2 | Innovations

Responses from Around the Globe

Individuals, communities, organizations, and nations around the world are responding to the disruptive forces outlined in Chapter 1. The stories of their innovations are signals of what's to come. These innovative behaviors are redefining, redirecting, or reinventing the activities that make up the food web as we know it. Through profiling selected innovations in this chapter, we hope to suggest the range of strategies being employed as people everywhere cope with changing food realities.

The 13 innovations described here operate at a range of scales and time horizons. For instance, challenges involving food security are prompting local leaders to remake urban food systems in the ruins of Detroit and national leaders to instigate military-controlled distribution of staple foods in the Philippines. These same challenges are also prompting international agreements as South Korea and other nations buy large tracts of land in Africa.

Some innovations address one or more disruptive forces; others might actually exacerbate or contribute to a disruption. New taste imperatives are causing people to want and expect exotic foods out of season at the same moment that scrutiny of the environmental impact of food production has never been greater. This is just one of the ironies—and challenges—of a food web that is increasingly intricate, interconnected, and volatile.

1. Craving sushi in India

Reconciling global demands with global constraints

India has had a long tradition of roadside eateries and vendors, called dhabas, hawking all kinds of Indian "fast food" cuisine such as chai (tea) and chole-bhature (chick peas and fried bread). These traditional foods are now being supplemented on the menu by an unlikely item: sushi.[24] Though sushi came to India as a higher-end delicacy, it has migrated into other venues entirely. Along with munching on greasy pakoras and chaat, Indians can enjoy a quick bite of a California roll while they wait for their bus. Sushi, in fact, has spread beyond roadside stands to home delivery, despite the challenge of keeping the fish fresh and safe in India's tropical climate.

Tastes have spread and are being remixed and reinvented in novel ways, despite remaining regional constraints on food production. This example of local, innovative ways to remake taste also illustrates how a response can further disrupt the food system. In this case, as described in Chapter 1, the increasing demand for sushi worldwide is partially responsible for pushing global fisheries toward collapse. The continued growth in fish consumption despite warnings of the potential collapse of many global fish stocks serves as a dark reminder that the in-the-moment desire for a taste can often override long-term concerns.[25]

2. Growing meat for the masses

Using biotechnology for the environment

In the 1930s, Winston Churchill forecast, "Fifty years hence we shall escape the absurdity of growing a whole chicken in order to eat the breast or wing by growing these parts separately under a suitable medium."[26] Seventy years later, diverse groups—from animal rights advocates such as PETA to environmentally minded scientific organizations such as New Harvest—are funding research to make lab-grown meat a reality. The goal is to bring lab-grown meat to market in the next ten years, overcoming current barriers of taste, texture, and scale.[27] This is one of several efforts to reduce the resource-intensiveness and downstream environmental impacts of animal husbandry while addressing a projected increase in demand for meat of more than 115 million tons from 1995 to 2020.[28]

Other projects, mostly based in North America, aim to genetically alter cattle, pig, salmon, and other species to limit their methane emissions, reduce the impact of their waste products, and speed their growth in order to gain more flexibility in the face of demand fluctuations.[29] Over the next decade, genetically modified pigs will likely begin appearing in China (where demand for meat is growing at a high rate in the face of dire environmental degradation); modified cattle with lower greenhouse gas footprints and water needs will likely emerge from Australia.

These novel efforts to use food science to radically remake the nature of meat may dramatically reduce the environmental impact of animal husbandry, but it remains to be seen how many people will be willing to eat lab-grown meat and the extent to which desires for more natural food might derail these sorts of efforts. And while these techniques offer the apparent opportunity to consume guilt-free, they also have the potential to introduce new variables into food production that could produce unintended effects. Moreover, these strategies might lower the measurable footprints of meat and dairy production but leave larger systemic and environmental relationships far from resilient.

3. Finding the farmers in North America and Europe

Personalizing complex relationships

Consumer demands for more information about their food products have led market players and governments in North America and Europe to experiment with a wide array of metrics to quantify and signify the nutritional content, environmental impact, and safety of food products. These demands and metrics have developed in industrialized countries where few people are directly connected to growing or producing their own food.[30] Find the Farmer, created by the manufacturer of Stone-Buhr flour, is shrinking that distance. Consumers enter a code from a flour package into a website to get a picture and profile of the farmers who grew their food.[31] Other manufacturers are putting up websites that lead to tours of growing and manufacturing facilities, aiming to show consumers their cleanliness, safety, and other purported values.

In business-to-business and regulatory contexts, transparencies remain metric-driven tools to manage complex logistics processes and verify information. The increasing number of complex metrics is beginning to alienate consumers, however. As a result, more qualitative forms of transparency are emerging that seek to communi-

cate values and trust. What is considered trustworthy differs by culture and ideals, while numerous cues communicate safety.

Diverging models of retail transparency highlight a shift toward a multiplicity of personified, value-laden, and niche-based retail attempts to connect with consumers surrounding their values and fears. Smaller farmers, millers and food makers, and companies such as Lays aim to personalize food relationships through online tools, attempting to call on ideals of personal trust.[32] Others, such as Whole Foods, are developing or employing certification labels to communicate the values behind their foods by proxy. In China, where the physical distance between farm and plate is growing rapidly, this distance is helping drive people toward buying packaged foods as markers of safety and distrusting entire regions when problems are found with any of their products.

4. Vending health in Italy

Making healthy food convenient

Italy may be thought of as the home of the Slow Food movement, but those homey, communal meals are increasingly giving way to on-the-go vending-machine food. As the trend toward vending-machine food has grown, the machines have become more popular and more capable of cooking a variety of foods. Over the past few years, European vending-machine revenues have grown to $33 billion annually. Entrepreneurs are planning to build new restaurants where all food is prepared by vending machines, such as the new Let's Pizza, which bakes a pizza from scratch in three minutes.[33] Other farmer-entrepreneurs are using vending machines as a tool to distribute organic produce so that people can eat healthy, farm-fresh food on the go.[34]

These new models of convenience food come as demands on time are increasingly leading residents in countries from the United Kingdom to Denmark to skip home-cooked breakfasts and other meals and instead eat snacks throughout the day. The trend toward replacing sit-down meals with on-the-go food is particularly acute among teenagers and young adults, signaling a future where European demands for convenience may come to resemble those of North Americans. For instance, only half of 15-to-24-year-old Danes eat breakfast every day, while consumption of pizza, hot dogs, and burgers increased by 33% among 4-to-18-year-old Danes and by 50% among 15-to-18-year-olds from 1995 to 2004.[35]

These developments correlate with an increase in obesity across Europe. During the last 20 years the percentage of obese 10-year-olds in Sweden nearly quadrupled, while the rate of overweight more than doubled; in Denmark the prevalence of childhood obesity has increased more than twentyfold since World War II; and presently Greece, Cyprus, and Italy have a higher proportion of overweight and obese children in the 8-to-18-year-old range than the United States. While the drive toward convenience food in Europe threatens to negatively impact health, creative efforts to package healthy food in traditionally unhealthy settings highlight opportunities there as well as in other parts of the world to meet the sometimes conflicting demands for food that is both healthy and convenient.

5. Programming moods

Enhancing bodies, minds, and experiences with food and beverages

Energy drinks have become a staple in colleges and offices in North America, East Asia, and Europe. With nearly $1 billion in annual sales, a number that continues to grow, energy-in-a-can has become a common way to get through a tough day.[36] These energy drinks are being joined on the shelves by a group of drinks with names like Vacation in a Bottle, Drank, and Slow Cow that are aimed at helping people relax after powering through the day. These relaxation drinks offer a calm, soothing feeling, or, as one drink maker puts it, a way to "slow your roll."[37]

The rising interest in functional foods highlights a broader trend. As food has become more closely intertwined with medicine and health, increasing numbers of people are attempting to manage and improve their short and long-term health through the foods they consume. In addition to presenting opportunities to retailers, this linking of food and health will continually push the boundaries of food science and challenge producers to maintain the nutritional quality of food. It also holds challenges for whole foods with similar yet unlabeled benefits.

6. Reinventing feral cities in Detroit

Growing food security in economic rubble

Declines in manufacturing and automobiles have hit Detroit hard. As people have migrated out, businesses have fled, leaving nearly 40 square miles of vacant lots.[38] Over time, a city that once was home to five major supermarket chains has seen all of them pull out, leaving hundreds of thousands

of remaining residents in a food desert, with few places to find fresh fruits and vegetables or other healthy foods. Residents have begun to look at the problems of empty space and lack of access to healthy food and seen a solution to both: repurpose the land and turn Detroit into a model for self-sufficient urban agriculture.

The interest in growing food in Detroit couples two major concerns: access to healthier food to maintain well-being and democratic efforts to produce and grow food. Since urban farming efforts began in earnest in Detroit, residents have been able to grow as much as 15% of their food within city limits during the growing season; the food gets distributed through farmers' markets as well as community charity and support programs. Though some residents have fought the return to agriculture, urban farming appears to be growing. One major urban agricultural nonprofit is aiming to triple the amount of land zoned for urban farming every year in Detroit, while planners are rezoning large chunks of the city for agricultural purposes.

Initial efforts surrounding food security have involved securing access to safe, reliable supplies, but the links between food and health are causing citizens to include access to healthy food as a key demand. As the right to healthy food is viewed as a more critical part of food security, particularly in parts of the Global North, retailers will find opportunities in struggling food deserts while food producers will be challenged to produce not simply more food but more high-quality food.

7. Curbing rice hoarding in the Philippines

Navigating dependence on volatile markets

In 2008, getting caught trying to hoard rice in the Philippines could land a person in prison with a lifetime sentence.[39] This drastic crackdown was the culmination of the government's response to the rapid run-up in global rice prices (Chapter 1, Disruption 5). As the cost of eating this most basic staple surged, government officials pulled out all the stops—beginning with buying large amounts of rice from global markets and eventually leading to troop deployment to distribute rice—to keep this crop on family dinner tables.[40]

But the government's swift efforts backfired completely. As the Philippines increased its rice reserves, major exporters pulled rice from the markets for a variety of domestic reasons, causing greater surges in prices and more hoarding among rice importers, causing the price of rice to skyrocket further. This panicked response caused rice to become wildly overvalued, and as recognition of this overvaluing spread, prices dropped almost as precipitously as they rose. In effect, the efforts of thousands of small purchasers and individual consumers—in the Philippines and across the globe—to secure affordable rice crops helped ensure that rice would become unaffordable during the summer of 2008.[41]

Although rice is eaten across the world, just five countries—Thailand, Vietnam, India, the United States, and Pakistan—contribute the vast majority of rice to global export markets.[42] As a result, countries that import significant quantities of rice, such as the Philippines, are extremely sensitive to the weather of the major exporting nations, currency and commodity values, and their own domestic politics. For smaller countries that rely on export markets, this spike signals both immediate and long-term responses. In the short run, given the lag times inherent to agriculture, these purchasers have few options but to buy up crops, potentially leading to more frequently recurring price spikes. And as food cost instability continues, many of these countries are beginning to look beyond purely market-based solutions to ensure access to food and experiment with more localized, self-reliant strategies of agricultural research and development to improve national food security.

8. Buying land elsewhere

Securing food for nations, not individuals

When food prices skyrocketed in 2007 and 2008 while global grain reserves shrank, countries with little spare land to produce food rushed to buy up farmland thousands of miles away in Argentina, Russia, and Africa. One of the most controversial of such actions came when the South Korean conglomerate Daewoo, acting in concert with the government of South Korea, began leasing about half of Madagascar's arable land. The stated goal was to produce huge quantities of corn to import back into South Korea for cornstarch processing and pork production, as well as palm oil for biofuels.[43]

Though Daewoo promised to invest billions of dollars in improving Madagascar's schools and infrastructure, the 99-year lease fell apart in a matter of months as a result of popular unrest. Madagascar's government was toppled in early 2009, and as one of his first acts after assuming control as transitional head of the government, Andry Rajoelina canceled Madagascar's agreement with Daewoo, saying the

country's constitution stipulates that the "land is neither for sale nor for rent."[44] He said that although the country is not against the idea of working with investors, the people will have to be consulted and the constitution changed before land can be sold or rented to other nations.

The rapid disintegration of the Madagascar-Daewoo agreement highlights new fragilities in agriculture that could potentially disrupt supplies, lead to price volatility, and contribute to hunger and other problems. As land-poor countries seek to ensure direct access to food by acquiring farmland in other countries, they are bound to sometimes come in conflict with the growing efforts of individuals in less-developed nations to assert local control over food and agriculture.

9. Algae-based, home biofuel brewing in the United States

Democratizing food and fuel production

At meet-ups all over the United States, groups of biofuel home-brewing enthusiasts talk shop and exchange pictures and diagrams of their home fuel-processing units, which can make biodiesel from common stocks such as used cooking oils and algae.[45] The latter raw material shows particular promise, as illustrated by a major national project that grew out of a local meeting. Founded in 2007 by a group of friends who were discussing corn ethanol at a coffee shop, Sapphire Energy recently developed algae-based jet fuel for a Continental Airlines test flight and used a different blend of algae-based fuel to power a Prius on a cross-country trip; the company plans to produce 1 million gallons of algae-based fuel in 2010.[46]

While the interest in locally brewed, algae-based biofuels is becoming more mainstream, potentially transformative culinary uses of algae, spearheaded by proponents such as Chicago-based chef Homaro Cantu, are less well known. Cantu's efforts are similar in spirit—he argues that algae can be produced in large quantities in almost any location in the world. As he sees it, home chefs will be able to print their own flavors onto algae functioning as a blank canvas.[47] He envisions people in the United States and the Global South growing their own algae on rooftops to turn into sustainable, local, processed food.

Algae is opening up a wide array of innovation opportunities to local and small-scale players because it can be grown in any climate, is not dependent on soil fertility, and is extremely cheap to produce. Although it remains to be seen if algae will realize the potential that some see in it, it could democratize fuel and food production and enable households and neighborhoods to become the locus of fuel refinement and food processing.

10. Paying for fallow farmland in the rain forest

Addressing land-use conundrums

The fecund Brazilian rain forest has been shrinking for decades as farmers cut down trees for crops and pastureland, but a new United Nations plan aims to reverse this trend. The draft plan earmarks $1 billion for stipends to be paid to farmers in Brazil, Indonesia, and other countries to induce them to leave their lands undeveloped with the hope of reversing deforestation and its contributions to climate change and loss of biodiversity.[48] In effect, the plan will place conserving land in market competition with developing that land for farming and other purposes. The move acknowledges the pressures of poverty that have hindered previous efforts; it gives local people an incentive to become stewards of the land rather than caving in to financial promise and the violence of poachers.

The willingness of conservation groups and international bodies to pay landowners in Brazil, Indonesia, and elsewhere to prevent development will reduce the availability of undeveloped land that can be used for food production. Demands for biofuels and bioplastics are also increasing the competition for arable land. As food producers are challenged to leverage smaller-scale production methods, ingredient suppliers and manufacturers will be forced to adapt to a decentralized food web.

11. Labeling green food in China

Promoting healthy sustainable food production

Food classification in China is in flux as government agencies, industry actors, and citizen activists compete to influence labeling through legislation, public relations, and online activism. "Green food," a category established in the 1990s to promote healthy sustainable food production, is being displaced by terms such as "pollution-free food" and "organic food," raising new regulatory implications. Additional ideas about labeling come from consumer advocates such as Beijing-based Wang Hai, who sued Coca-Cola in 2009 to demand the beverage giant advise consumers that its caffeinated products are unsafe for children.

Driving labeling trends is an awareness in government, private, and NGO sectors that healthy sustainable food production contributes to a prosperous food industry and a strong, energy-secure nation. In response to widespread urbanization and to the rising incomes and busy lifestyles of a growing middle class, hypermarkets and convenience stores have gained ground in a Chinese food retailing sector traditionally dominated by outdoor markets, street vendors, and family-owned grocery stores, and these large-scale retail platforms are positioned to drive food labeling trends as part of their retailing strategies. The large food retailer Carrefour, for example, offers food labeled as organic and reported that its organic food sales in some stores went up 50% between 2006 and 2007, an increase attributed to food scares.

For some elite policy types in China, developing clear national standards for green foods is critical to promoting a strong nation by encouraging entrepreneurship in rural areas and improving the climate. A recent series of posts on the blog The Green Leap Forward, for example, emphasized that China's organic food production has the potential to offset carbon emissions in some of China's other productive sectors while serving as a means to raise rural incomes.

While elites focus on strong industries and strong nations, value-based entrepreneurs and other bottom-up actors also shape labeling trends. One such seller is Ji Enosh, who uses tools including a website, a Skype phone, and an IM account to sell "health foods" and "green natural food products" with free delivery to Beijing customers. Enosh is smart to emphasize "green" and "natural." Given China's confusing and poorly-enforced regulatory standards, food labels often prompt responses that are more emotional than scientific, and evidence suggests that the labels *lüse* (green) and *ziran* (natural) are significantly more appealing to Chinese consumers than the somewhat menacing *youji* (contains organic matter).

12. Localizing standards in San Francisco

Controlling global food flows at a local level

While they still may not be growing most of their own food, an increasing number of local and municipal governments are exerting greater control over the food consumed within their borders. In 2009, San Francisco launched two major food initiatives: a mandatory composting law and a program to dramatically improve the health and sustainability of city food.[49] The healthy-food initiative will turn unused city land into community gardens, place health requirements on vending machine food, and require city meetings to serve food in compliance with rules from the local department of health.[50] San Francisco's rules for food share the spirit, if not the letter, of rules from cities such as Toronto, which have their own municipal laws governing food choices.

As urban areas, states, and regions exert greater control over the nutritional content, sustainability of production, and methods of disposal of food, the number of standards governing food choices will multiply. Food producers, distributors, and marketers will require new flexibility in producing and delivering food through global supply networks to meet local standards.

13. Burning fats in the United States

Diverting by-products to biofuels

As excitement over biofuels spread in the United States in 2007 and Congress passed a $1-per-gallon subsidy for producers of biofuels, corn farmers weren't the only ones investigating turning their crops into energy. Tyson Foods and Conoco Philips entered into an agreement to render chicken and other animal fats left over from slaughterhouses into commercial biofuels.[51] But their plan almost immediately ran into resistance from an unlikely source: soap and detergent makers. The $1-per-gallon

subsidy stood to make biofuels the most profitable use of rendered chicken fat, a key input in soaps as well as pet foods. This in turn would squeeze the supply and drive up prices for chicken fat. Lobbying took place, and an amendment to a credit market bill lowered the tax credit for biofuels that were co-processed in facilities with traditional fuels, placing the Conoco-Tyson project on hold.[52] Since then, Tyson has begun to pursue plans with a separate partner in a stand-alone facility in order to take advantage of the tax credit. And once again, chicken fat may start to look like a prized commodity.

With the price of oil drifting upward, agricultural products from commodity crops such as corn to processing by-products such as rendered chicken fat are being reevaluated for their potential use in biofuels. As demand for biofuels grows over the next decade, manufacturers of human food, pet food, and livestock feed will see prices for reliably cheap ingredients becoming ever more uncertain; for example, Brazil's commitment to sugar-based ethanol has already redrawn sugar taxes and tariffs. To coax sufficient quantities of food, feed, and fuel to meet demand will challenge producers to find ways to sustainably increase yields and utilize now-marginal land to the fullest.

3 | Forecasts

Five Key Shifts in Direction

Today's innovative responses to the disruptions currently affecting the food web shape our forecasts regarding the future of food. We forecast here five key shifts that will present both threats and opportunities for food producers and retailers at all scales. The shifts we foresee—stemming from the convergence of trends involving both large-scale, long-term environmental challenges and daily consumer preferences—will reshape global distribution networks and daily dinner choices alike.

The first shift is toward greater transparency through labeling and through providing consumers a more personal relationship with their food sources. The second is toward preserving crop biodiversity, by deemphasizing monocropping and standardized foods, and finding ways to offer locally differentiated products. The third is toward decentralizing food production and distribution as demands for safe, local, sustainable food increase. The fourth is toward improving food's environmental footprint by incorporating flexible farming and manufacturing strategies that address resource limits and take into account the whole life cycle of a product. And the fifth is toward collaboration in order to improve capacities and sustainability from a local to a global scale.

Taken together, these five shifts will affect not only the way we eat but also the nature and relationships of activities in the food system. What we now think of as the food supply chain will evolve into a more dynamic value chain, where social relationships as well as commodities are prized. The emerging food web will integrate greater cultural and ecological complexity into this already dynamic process. These forecasts paint a picture of this food web—organizations that can anticipate and adapt to these key shifts will gain new footholds in a changing landscape of food and food systems.

1. Competing transparencies

From blind trust to values-based choice

Consumer demand for better understanding of food choices is leading to new definitions of transparency that will challenge existing marketplace practices. Conventional food system players will focus on the environmental impact of food and on food safety, as what were once environmental externalities become increasingly central to financial and brand management. Detailed environmental information will join nutritional information on labels for packaged food. Retailers and independent entities will need to provide similar information for produce and other unprocessed foods. While international players scour supply chains for health threats and environmental risks, these efforts will collide in volatile ways with consumer demands for foods that are diverse, traditional, unique, and authentic.

Food manufacturers and big box retailers will seek to measure an increasingly broad swath of metrics. These new transparency requirements will strain the ability of small-scale stakeholders to comply with increasingly quantified and granular supply chain requirements. Though cheaper and more accurate tracing technology will enable significant improvements in food safety, retailers will be challenged to integrate small, local producers into larger-scale safety efforts. As a result, smaller producers will seek to connect with consumers by building trust and more personal relationships through online tools, visual cues in retailing contexts, and potentially through alternative retail channels.

The increase in transparency will empower citizens to assert greater control over global food activities while also challenging them to make choices. Different customer segments will have different and sometimes competing concerns—some will care more about safety or quality or authenticity while others will primarily value health or environmental impacts—but still have limited time to consider any specific food purchase. As a result, many consumers will focus on a single variable or qualitative story when making food decisions, leading to greater fragmentation of market choices and multiple, often conflicting demands on retailers.

Producers and retailers at all scales will need to learn how to present products differently in a world of conflicting metrics and visualized relationships. Food manufacturers will need to make actual investments in building regional food web capacity if they want to forge authentic connections between producers and consumers based on emotional, civic, and local values.

2. Diverse growth

From global standardization to local differentiation

The accelerating loss of crop biodiversity worldwide will prompt local and regional responses to preserve this biodiversity. These will be accompanied by a proliferation of new local efforts to grow, manufacture, and brand food. There is already a movement under way encouraging people to preserve biodiversity by eating it: building food webs that make it easier to include food from less common strains of crops and livestock in order to ensure that they do not die out. This movement will grow and, in turn, create demand for foods that are on the verge of extinction (with the exception of beleaguered fisheries) as well as renewed interest in traditional agricultural practices suited to local ecosystems.

Biodiversity will become a key strategy for coping with climate change. In the coming decade, climate change will pose serious expected and unexpected challenges to the global food web. Biodiversity will be a key agricultural strategy that food producers and manufacturers will employ to cope with the uncertainties of growing food on a warmer and drier planet. Vaults that store the genetic information of crops in all their varieties, heirloom seed exchanges, and other efforts to preserve diversity are emerging as ways to hedge against the most severe threats to global food security from climate change and other environmental emergencies. This push away from monocropping will disrupt the forces of consolidation that dominate many agri-food sectors.

As a result, food manufacturers will begin to explore heirloom and biodiverse packaged foods as core aspects of their brands, along with seeking to steadily increase the healthfulness and wholeness of their ingredients. New market opportunities for food processing and new challenges to managing ingredient supplies will emerge. This will accompany a movement away from mass standardization of tastes and toward a proliferation of foods that emphasize the uniqueness of individual and regional tastes and experiences—a movement already exemplified by the explosion of do-it-yourself and artisanal food processing and branding.

These artisan and do-it-yourself foods will reset expectations. More diverse processors will flourish in the shadows of major international conglomerates. As tools to manipulate the taste of food become more widespread, individuals—both scientists and laypeople—will develop unique flavors and tinker with food processing in isolated labs and home kitchens. Meanwhile, the push toward unique and interesting tastes will lead increasingly large numbers of people to produce dairy products, coffee, beer, and other food products in kitchens and communities, and will encourage people to explore more complex tastes in retail and restaurant contexts. A handful of these local efforts will turn into major national and international products, but the vast majority will stay local and involve community sharing and creative exploration. The aggregate effect of these varied community efforts will be to elevate notions of local, unique tastes as part of this broader push away from standardization.

3. Decentralized access

From fragile dependence to urban autonomy

Because more and more of us are living in cities and their sprawling extensions, the future of food is decidedly urban. In the next decade, cities and regional governments will become major focuses of influence over the food web as citizens and civic leaders try to meet local food security needs in the face of environmental challenges to food production. In rapidly urbanizing areas, this push will lead toward innovative models for integrating food production into metropolitan development. In existing cities, ill-defined demands for safe, local, and sustainable food will become key drivers in urban revitalization and development programs.

A strong movement for locally produced food, supported by new technologies of cooperation, will evolve in regionally distinct and uneven ways. Local governments will take a lead in developing new land-use strategies that will later be followed by larger governments. We will see more city-to-city cooperation on food production and distribution issues, and regional collaborations will emerge to meet demands for flexible production and diverse tastes. These re-engineered food webs will successfully integrate small-scale farms and accommodate inventive uses of land and other resources.

Even so, urban food producers will struggle to provide produce and protein in resource-effective and sustainable ways, and to cope with competition between civic interest in regional self-sufficiency and growing appetites for global foods. Meeting these competing needs will create a diversity of responses and provide a rich sandbox for distributed polyculture efforts, which will increasingly integrate animal husbandry, aquaculture, and wastewater restoration. Different efforts will be tailored to the cultural practices and environmental constraints of local neighborhoods.

Urban farming will spur improvements in agricultural technologies to make high-yielding agriculture viable in urban spaces. New experiments in urban farming at different scales, from vertical farms to rooftop gardens, will require varied technical solutions to provide for nutritional needs while stewarding resources. Visceral, emotional connections with food will be reestablished as consumers become more involved in growing food and accustomed to seeing agriculture as part of the built environment. This will also promote renewed interest in local artisanal food processing and branding.

4. Resilient life cycles

From efficiency to flexibility

The sharply opposing forces of dwindling resources and growing demands will prompt diverse stakeholders to make agricultural land use and waste disposal a new hotbed of innovation. Creative strategies will emerge to address shrinking water resources, petroleum scarcity, increasing food risks, and regulatory limits on pollution from food production just as demands for food, fuel, biofuels, bioplastics, and fiber increase. Current efforts are focused on making resource utilization more efficient; pressing disruptions, systemic threats, and rapidly shifting demands on agricultural outputs will spur innovations that make resource utilization more flexible as well.

Flexible farming strategies that leverage both collaborative and proprietary techniques will move to remake large-scale agriculture into a practice that improves, rather than degrades, the quality of local, regional, and international commons-resources while maintaining the ability to offer fresh food in retail contexts. Small- and large-scale farmers will move toward more flexible uses of land that emphasize interlocking crop life cycles and dense polycultures; they will also use biochar (a soil amendment that sequesters carbon from the atmosphere) to target both nutrient management and carbon uptake issues. Modeling tools will emerge to help producers foresee their own needs as well as those of local and regional markets in the face of local climate shifts.

Global and local lifecycle modeling will drive new production practices. Attention to the whole life cycle of foods from inputs to waste products will improve the environmental footprint of food manufacturing and retail; it will also create new opportunities for collaboration between stakeholders in the food web, as well as the ability to rapidly adapt to external developments. Through ever more detailed product lifecycle analysis, the concept of resilience will move into retail contexts, where new labeling will highlight foods that have been grown and produced in ways that do not damage environmental resources. Retailers and manufacturers will look for innovative ways to solve multiple problems at once by repurposing waste, making packaging materials compostable or recyclable, and lessening the environmental impact of other key inputs involved in processing and selling food.

As more retail becomes embedded in regional food systems, retail life cycling will increasingly reincorporate food waste as a vital resource. Strategies such as urban foraging, which involves harvesting crops from public plants and trees, or gleaning, the gathering of crop waste from fields to feed the hungry, are citizen-driven examples of creative efforts to reimagine food waste disposal. New local business models will turn food waste into energy in mobile and household contexts. Governments will also attend to municipal and agricultural wastes as powerful energy resources, while becoming more conscious of reserve capacity for food security.

5. Collaborative capacity

From development economics to open sustainability

As the focus of food security efforts shifts from food market access to control of food production, stakeholders—from government actors and major agricultural companies, to local citizen groups and food artisans—will adopt more collaborative strategies to improve local capacities to meet global needs. At local levels, efforts to ensure healthy food security are already inspiring neighborhood food sharing, direct-to-consumer community supported agriculture models, and other forms of food sharing. Collaborative efforts such as these are growing more common in North America and Europe and are being reimagined in new regions, such as the food deserts of rapidly urbanizing Chinese suburbs.

Regional food manufacturers will jointly develop food products with greater frequency and explore methods for pooling distribution channels and other resources. Government actors, especially in the Global South, will develop their own competencies and technologies at lower and nonrecurring costs as a long-term strategy for social and economic development, and build sustainable, transnational food security initiatives from local capacities. Because it will be imperative to understand the interactions of agriculture and ecosystems and to mitigate their negative interactions in a cost-effective way, a globally integrated system to measure, monitor, model, and verify the current state of agro-ecosystem services will emerge. This will encourage key stakeholders throughout the food web to collaborate on critical sustainability initiatives.

Collaborative and open-source strategies will disrupt intellectual property regimes in agriculture and food science. Developing crops and local food webs that are more tolerant of stress, particularly stress from climate change, will provide a major impetus toward cooperation. The adoption of collaborative, open-source knowledge management tools—for agricultural resource management as well as local market coordination of producers, processors, and consumers—will be a cornerstone of building local food web capacity. Emerging alliances between the open-source software and food rights movements will challenge IP regimes for genetic materials and other formulations. At the same time, tools to manipulate genetic material will become increasingly cheap and accessible. These efforts will coalesce into strategies that build local capacities through "open-source" seeds, patent-free pesticides and fertilizers, and open food processing techniques.

Processing, branding, and delivery will be increasingly collaborative. Already, regional craft brewing companies have developed a jointly produced and marketed beer, calling on the climatic assets of different hops strains to offer a unique fusion. This is an early signal of a broader movement where local producers who share an interest in the artistry of food production and have a common business case for collaborative work will share in developing products. The surge in farmers' markets in the United States and direct-to-consumer delivery services in western Europe sets the stage for an unprecedented level of collaboration in retail endeavors as well.

4 | Implications

Weathering the Storms

In this report we have painted a picture of a global food web undergoing change at all levels as disruptions and innovative responses to those disruptions transform the landscape of agriculture, food manufacturing and distribution, and consumer expectations and desires. We have outlined the key shifts we see happening over the next decade—shifts toward transparency, diversity, decentralization, collaboration, and resilience. These shifts will pose daunting challenges to stakeholders, particularly those most established in ways of doing things that rely on continuity, certainty, and predictability. In order to maintain or gain competitive advantage—to survive and thrive in the coming decades—organizations will need to cultivate resilience.

Resilience refers to a system's capacity to withstand unexpected shocks, to repair itself when necessary, and to thrive when possible. It's a term that you may be familiar with from materials or psychology, or perhaps from design, but of late it's begun to be used in the world of ecological science. The underlying assumption is that *failure happens* but systems can be designed to quickly bounce back from failure. Put simply, resilience is the opposite of collapse.

Resilience encompasses and expands upon the notion of sustainability: it is the core characteristic of a system that remains sustainable in a world of changing conditions. When applied to the worlds of food and agriculture, resilience refers to the capacity of these systems (networks, relationships, technologies, and industries) to continue to provide nutrition to the world during radical—or even unprecedented—environmental and economic disruptions.

There are a handful of key concepts underlying resilience, principles that apply to nearly all resilient systems. Particularly relevant to the future of food and agriculture are the principles of flexibility, diversity, decentralization, redundancy, collaboration, transparency, foresight, and graceful failure. These principles, developed by IFTF Research Fellow Jamais Cascio, are the basis of this chapter as well as his article "The Next Big Thing: Resilience" in the May-June 2009 edition of *Foreign Policy.*

Resilience Principles

FLEXIBILITY

Be ready to change your plans when they're not working the way you expected; don't count on things remaining stable.

Flexibility is the basic resilience idea: an organization must be able to co-evolve with rapidly changing conditions. It's all too common to be unable to alter processes and policies swiftly in response to environmental changes because the infrastructure and norms are too deeply embedded. This incapacity can be as simple as sluggish response to changing markets (for example, organics or high-fructose corn syrup) or as complex as inability to adopt new technologies without "breaking" the old.

DIVERSITY

Not relying on a single kind of solution means not suffering from a single point of failure.

Diversity comes down to the notion that polycultures are more resilient than monocultures. While this is literally true when it comes to crop diversity, it also applies to recognizing the potential of diverse production and distribution systems as well as the capacity of diverse stakeholders to contribute to an organization's resilience. Diverse systems are less vulnerable to disruption.

DECENTRALIZATION

Centralized systems look strong, but when they fail, they fail catastrophically.

Decentralization reduces the "single-point-of-failure" problem, where the breakdown of a central node has effects that cascade throughout a system. In practice, this means greater reliance on stakeholders on the ground, who will often have the best understanding of a problem and can resolve it more effectively if they're able to collaborate with other relevant stakeholders directly. While the cost of decentralization can be loss of control, across the spectrum of large organizations (from WalMart to the U.S. Army), the value of decentralization is causing the balance of central control and distributed responsibility to shift.

REDUNDANCY

Back up, back up, back up. Never leave yourself with just one path of escape or rescue.

Historically, redundant supplies of staple foods, such as grain reserves, have been a way to hedge against known risks from weather, blights, and political shocks. Over the last decade, grain reserves have been steadily dwindling and not being replenished, leaving dozens of countries and markets brittle in the face of sudden price shifts, as seen in 2008. It works well to combine this principle with flexibility by layering multiple strategies to hedge against the considerable uncertainties that will impact global food supplies in the next decade.

COLLABORATION

We're all in this together. Take advantage of collaborative technologies, especially those offering shared communication and information.

Collaboration links diversity to the next principle, transparency. More widespread information, distributed to the full range of partners and stakeholders—even competitors and detractors—can prove a powerful means of overcoming unexpected threats. For example, collaborative research supported by diverse stakeholders has accelerated research on new strains of wheat resistant to Ug99 black stem rust.

TRANSPARENCY

Don't hide your systems; transparency makes it easier to figure out where a problem may lie. Share your plans and preparations, and listen when people point out flaws.

Potentially one of the most challenging principles of resilience, transparency builds on the open-source adage that "more eyes make all bugs shallow"—that is, the more transparent a system and thus the easier it is to spot flaws, the easier it is to build stakeholder trust: transparency offers both the capacity to demonstrate good practices and the willingness to admit to—and fix—mistakes.

FORESIGHT

You can't predict the future, but you can hear its footsteps approaching. Think and prepare.

Foresight may not be an obvious element of resilience, but it's a crucial one. Building the capacity for "strategic anticipation" allows resilient organizations to make decisions with better long-term payoffs. Notably, successful foresight demands that you look beyond your issue area. Changing conditions rarely come solely from internal dynamics; very often, seemingly unrelated forces can conspire to have a dramatic impact. Spiking oil prices and changing energy regulations leading to tortilla riots in Mexico City is just one recent example.

GRACEFUL FAILURE

Failure happens, so make sure that a failure state won't make things worse than they are already.

Ultimately, even the strongest system can fail, so it's critical to be able to "fail gracefully"—to plan in advance what will happen if critical failures make it impossible for a system to continue. Simple examples of graceful failure systems are everywhere, from the air brakes on a semi to software that auto-saves files in progress. Sadly, examples of the lack of graceful failure are also readily available, from the Dust Bowl of the 1930s, to the 2003 Northeast electricity blackout, to the failure of levees in New Orleans in 2005.

Implementing resilience

Resilience is a complex topic and may be difficult to implement. It often requires embracing behaviors and principles that run counter to expectations or that are seen as contrary to what works—even when "what works" is prone to catastrophic failure when problems arise. Established leaders and institutions may even find aspects of resilience threatening.

For many organizations, the challenge of resilience will emerge in the recognition that efficiency, particularly production efficiency, can be problematic—or, rather, what we do to increase production efficiency can run counter to the demands of resilience. This is because resilience is based on the notion that systems we depend upon can fail, and it's important to be able to weather (even thrive during) failure. Efficiency, conversely, requires that the systems we depend upon work and work well. Efficiency-focused practices are more productive than resilience-focused practices when all systems are working; when systems fail, efficiency-focused practices tend toward collapse. The question for organizations, then, is how to achieve balance—how to maximize efficiency without degrading resilience.

System collapse can manifest in myriad ways, from diseases whipping through monoculture crops like wildfire to product contamination by low-cost manufacturers to the basic loss of consumer trust resulting from attempts to hide problems. These disasters are by no means constant or even commonplace—but when they do happen, resilient systems can handle them far better than systems optimized solely for efficiency.

It's useful to think of resilience not as a policy mandate but as a design principle: when systems are being built (or rebuilt), when policy changes are being made, when recovery from an unexpected problem is taking place, the new system must be more resilient than the last. Perfect resilience may be impossible; improved resilience most certainly is not. In this century, our ability to foster resilient food systems will be essential not only for the survival of our organizations but also for human survival. The principles of resilience thus provide the rules of thumb for anyone who is responsible for designing or managing activities within the global food web.

5 | How To Use This Report

Crafting Resilient Strategies

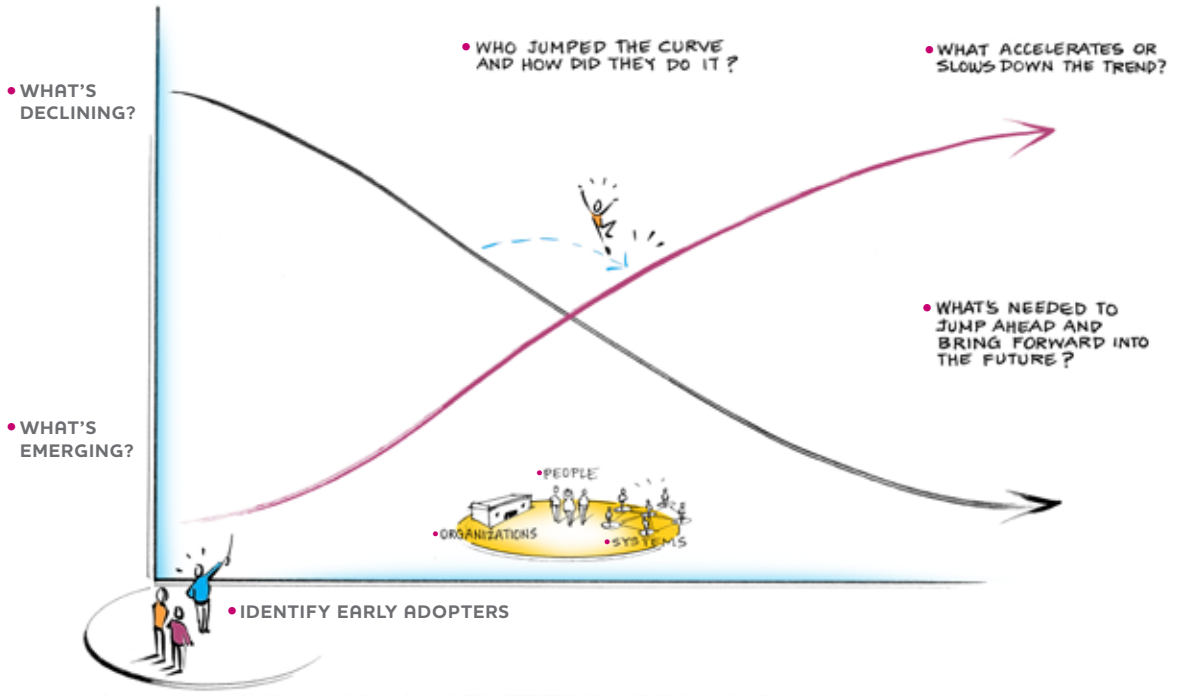
The series of strategic group processes included in this chapter have been designed to provide you with a set of tools to work with the disruptions, innovations, forecasts, and resilience principles presented in this report. Developed around IFTF's core foresight-insight-action framework, these tools will help you produce clear insights about how these future forces will present new threats and opportunities for your organization. The process tools will also allow you to use these insights to develop strategic actions that your organization can begin to take today to prepare for these future threats and opportunities. As you are engaging in these processes you should be asking yourselves two overarching questions: Are the directions that you're moving in making your organization more resilient? And are these responses improving the resilience of the food web as a whole?

All of the sections of this report can yield foresight for these processes; we give suggestions of which sections to use for each exercise. The first two chapters in this report, "Disruptions: Eight Forces Reshaping the Future of the Food Web" and "Innovations: Responses from Around the Globe" offer a systematic look at the major factors impacting the future of the food web. Extrapolating from these pressures, as well as the varied, global responses to these pressures, points to directional changes within the food web. Looking at the intersections of these forms of change formed the basis of the forecasts presented in the third chapter, which identifies major threats and opportunities emerging from the food web. The fourth section, "Implications: Weathering Storms" offers a set of principles for designing strategies, products, services, and systems to withstand future shocks and disruptions to the evolving food web.

Assessing the Pace of Change

The Two-curve Problem

This first process is designed to help you assess how a particular force will play out over time. For this first process, choose one of the eight disruptions identified in the first chapter. Use this disruption to begin to answer the questions, "What trend is emerging?" and "What trend is declining?" This will help you assess the pace of change between these two trends and potential tipping points that characterize this shift. You can use this to relate the forecasts described in this report to current trends in your market, or current practices and strategies of your organization. Understanding the tipping points and pace of change can help you decide whether, and when, to take the leap in your own strategies from the declining to the emerging trend.



Pace of Change: Process Guide

- Explain how the two-curve problem illustrates the intersection of emerging and declining trends and helps organizations time the pace of change before they jump to the second curve.
- Identify two trends relevant to the identified challenge and assign each to the curve that fits its directional change. (Example: For the disruption of better for you versus augmentations foods, two trends that could be mapped are old media versus new or social media.)
- Take note of the intersection of the curves and facilitate a group discussion to consider: Who are the early adopters? Are there cases of people, organizations, or systems that have already jumped to the second curve? How did they do this?
- Determine where your organization currently is on the two curves.
- Explore what would need to occur that would require your organization to jump to the second curve. (Example: When would you know you were at a tipping point?)
- Identify core competencies, technologies, and skills that are needed to move forward and jump ahead.

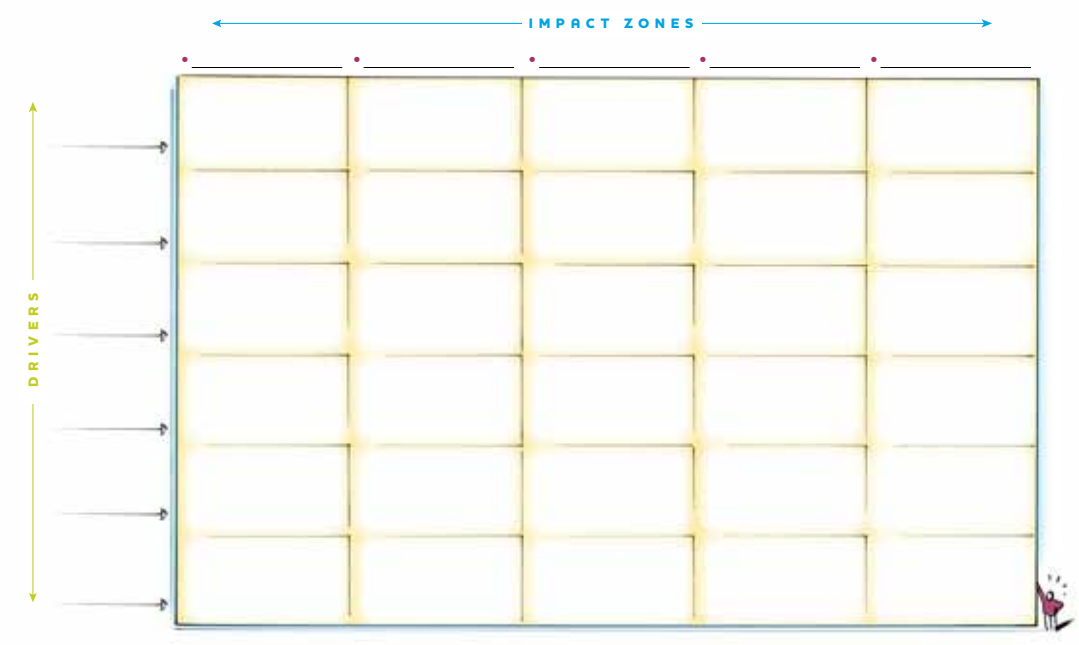
Systematically Identifying Impacts

The Cross-impact Matrix Analysis

This process offers a framework for developing a systematic look at how several driving forces will impact discrete components of an organization or system in order to identify innovation spaces. You can work with this process in two, complementary ways.

Exercise 1: Using the activities included in this report to define your impact zones and either the disruptions or forecasts on the vertical axis, conduct a cross-impact matrix analysis with the process below. This process will enable you to develop further insight into the evolving nature of the global food web.

Exercise 2: Using your organization's business functions to define your impact zones and either the disruptions or forecasts on the vertical axis, you can conduct the cross-impact matrix analysis with the process below. This process will produce insights into the threats and opportunities that could lead to innovative response strategies for your organization.



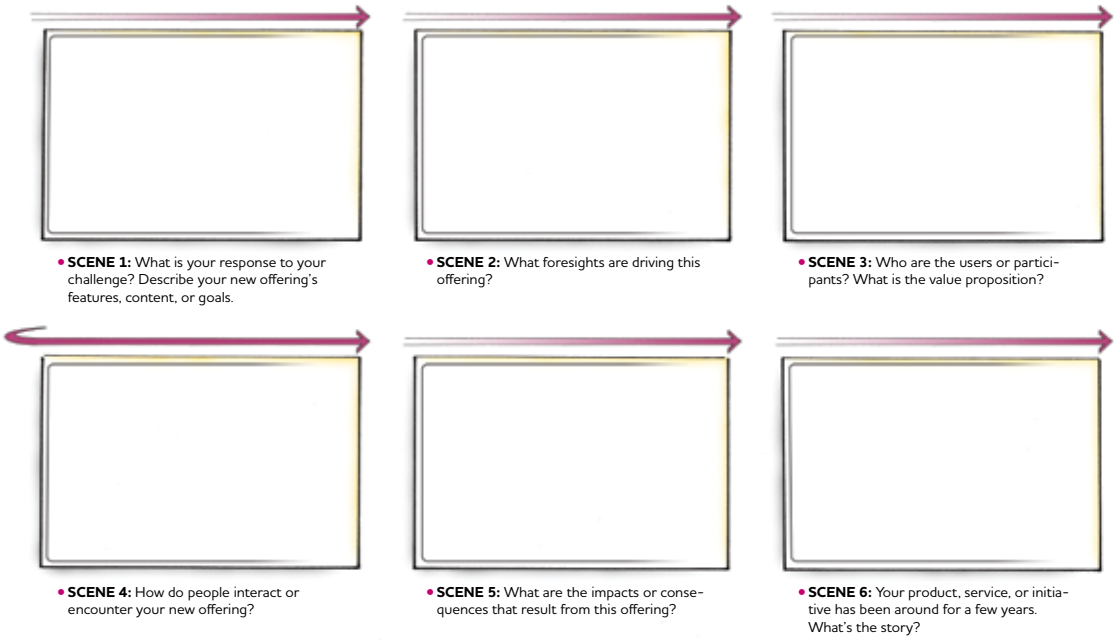
Cross-impact Matrix: Process Guide

- Facilitate a discussion to generate a list of Drivers that are relevant to the identified challenge and record them in the space provided on the left side of the template.
- Identify and record important Impact Zones to create your Cross-Impact Matrix. *(Tip: Think of your organizational practices as possible impact zones to explore future response strategies.)*
- Ask participants, working individually or in pairs, to identify insights that result from the *intersection* of Drivers and Impact Zones on your Matrix. Have them write each convergence on Post-it® sticky notes.
- Place each sticky at the appropriate intersection on the Cross-Impact Matrix; have participants elaborate on stories, threats, and opportunities.
- *(Optional: Assign working groups to different innovation spaces to research market size, organizational capabilities, potential partners, etc.)*

Innovating Responses

Prototyping the Future

Use the storyboard template below to describe a response strategy to one of the disruptions or forecasts identified in this report, and considering the insights you have developed in your cross-matrix impact analysis. Work with this storyboard template to help you outline the elements of your plan, product, offering, or other response. This process works best in small groups, in rapid iterations. It's a tool for exploring specific possibilities and thinking through the consequences.



- **SCENE 1:** What is your response to your challenge? Describe your new offering's features, content, or goals.
- **SCENE 2:** What foresights are driving this offering?
- **SCENE 3:** Who are the users or participants? What is the value proposition?
- **SCENE 4:** How do people interact or encounter your new offering?
- **SCENE 5:** What are the impacts or consequences that result from this offering?
- **SCENE 6:** Your product, service, or initiative has been around for a few years. What's the story?

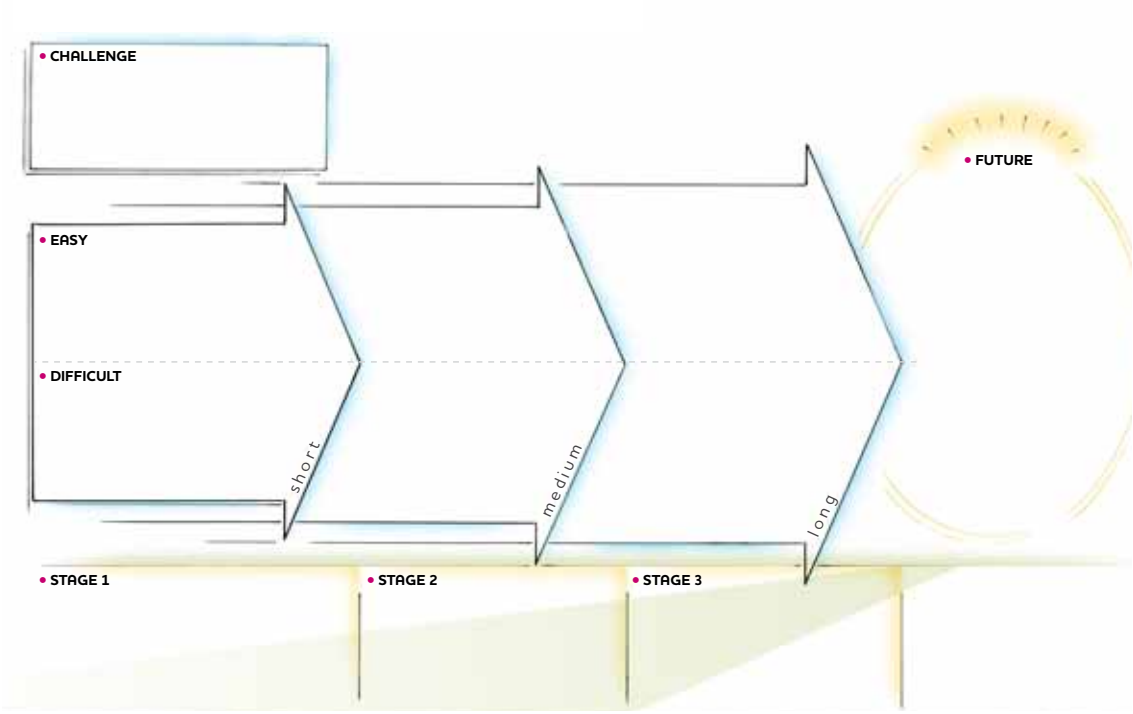
Prototype the Future: Process Guide

- Review the foresights and insights you've been working with and ask your group to consider how to respond to the identified challenge based on what they've learned.
- Have each participant generate up to three possible responses on Post-it® sticky notes. Collect the stickies along the edge of the template, then have the group work with the ideas to come up with a single product, service, or initiative.
- Describe this new product, service, or initiative in the first storyboard space (SCENE 1). (*Tip: Give it a name that captures the essence of its story or novelty.*)
- Facilitate group discussion using the graphic template to document and elaborate on your new offering. Work through all of the steps of the storyboard to develop your prototype and imagine it in the future.
- (*Optional: Have several groups working in parallel to generate multiple response prototypes to the identified challenge.*)

Planning Responses

Developing an Action Roadmap

Use the tool below to develop a roadmap of a variety of organization-wide responses to one of the disruptions or forecasts identified in this report as well as the insights you have developed in your cross-matrix impact analysis. This tool will help you map a range of actions across time in different stages and by degrees of difficulty. This is a conversation piece to capture strategies addressing multiple foresights and insights in the holistic context of an initiative, or even your entire organization.



Pace of Change: Process Guide

- Review the different sections of the template and fill in the identified challenge in top left box.
- As a group, decide on a response strategy for your organization and describe it in the "Future" section of the template, on the far right.
- Have participants work individually or in pairs to generate a list of actions that will lead to the stated response strategy.
- Map these actions in the appropriate spaces on the template, based on a realistic assessment of timing and degree of difficulty.
- Write a theme or assign a title to each of the three stages across the bottom of the template.
- Walk through from beginning to end *(e.g., left to right)* and build the narrative of your actions over time. Annotate the template with this emerging story at each stage.

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