TWIN GLOBAL 2018

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Nourishing the World: Exponential Challenges, Exponential Technologies

INTRODUCTION

In the coming decades, with a population booming to nearly 10 billion people, we will experience exponential growth in our global demand for food, while global food supply will continue to be under great stress. The World Economic Forum projects that global demand will be 60% higher than it is today, but climate change, urbanization, and soil degradation will have shrunk the availability of arable land. Further complicating matters are factors such as ever-growing challenges with crop disease, which impacts nearly one-fifth of global food production, as well as a rising demand for water and energy use, which place great stress on already-taxed natural resources.

These exponential challenges require exponential solutions. Technologies such as artificial intelligence, drones & autonomous machines, geospatial mapping, the internet of everything, advances in genomics and others, bring with them the promise of radically new approaches and solutions, as they have in so many other industries.

Global population levels will reach 10 billion or more by 2050. In the next 30 years, we have to solve the most important challenge in the history of the human population: **How do we nourish the world?** That means both providing the proper level of nutrients and sustenance, and leveraging the food system to *power up health* in our global population.

The next 30 years are not just the most important 30 years to date in the history of agriculture, but they always will be.

The decisions we make today are the only decisions that really matter.

These are the the topics we explored in this year's TWIN Global Session on Horizons in Food & Agriculture: Nourishing the World – Exponential Challenges, Exponential Technologies. Following are key highlights from speakers and our plenary discussion.

Speaker Summary ▶▶▶

ROBERT SAIK
FOUNDER, AGRI-TREND GROUP

Agriculture is in the process of a continued digital transformation. In the US, we are entering what Rob refers to as "Agriculture 5.0" – a time in which new technologies like biosynthesis, precision agriculture, and big data and AI, are all converging. Agriculture 5.0 will open up radical new possibilities. All parts of the value chain can be connected in a seamless flow of data, solving for challenges like transparency and trust across the supply chain. Sensory technology, AI-enabled tools and algorithms can simplify decision making and problem solving. There's a huge caveat to all of this, though: precision agriculture with poor agronomy is just precision agriculture poorly applied. We need a combination of high-tech and high-touch in agriculture. An inspirational example of AgriTech solutions that hold promise for the future is the Dot Power Platform—an autonomous tractor that is capable of performing 100+ jobs, from seeding to bailing hay, all supported by a GPS and aerial surveillance system that keeps it on track. In the end, technology, properly applied, will augment human expertise in agronomic techniques to enable radical new possibilities and grow what the world will need.

DIANA HORVATH
PRESIDENT AND CO-FOUNDER, 2BLADES FOUNDATION

The challenges we face are far more than merely boosting crop supply; they are also about *protecting* that supply. Crop disease is the biggest threat to crop production in the world; it impacts 16% of global food production and threatens key primary crops. Crop disease is affected by population growth and by climate change, with crop disease moving from the equator to the poles.

Scientific and technological advancements in molecular biology and genomics are helping us better understand plant DNA and pathogens and open up pathways for new solutions. DNA sequencing and gene editing are two such tools. In 2001 it cost $100 million to sequence one genome, and now the same process can be accomplished for under $500. Today we spend $14 billion annually on crop protection chemicals that only partially control diseases. CRSPR, the latest form of gene editing, is powerful, easy to use, and can be used to make small changes in DNA that would be considered normal within the plant gene so that "nature can be used to combat nature." This holds tremendous promise, because it means we can leverage entirely natural, non-chemically-based solutions to address problems that impact nearly one-fifth of global food production. CRISPR is an underlying technology, not a complete solution, but may become a vital part of the toolkit needed to help ensure the sustainability of our global food supply. Regulatory frameworks will need to be established and we will need to determine how best to engage and educate the public on the safety and efficacy of these new science-based solutions.

ANDREA DOOLAN
CEO, ATLANTIA FOODS CLINICAL TRIALS

Nourishing the world means more than just feeding the world. It also means fostering healthy populations, something that is vitally important given the pandemic we are facing with obesity, diabetes, and chronic diseases. Food as medicine is becoming a reality as we learn more about the connection between food and powering up health outcomes. As a result, food companies are increasingly incentivized to prove that the foods they sell have a functional health benefit.

The human microbiome is the next frontier, and holds great promise for the future. Humans are made of a collection of bacteria, fungi and viruses that make up the gut microbiome. The food we eat, the climate, medicines we take – these all affect the gut microbiome. There are some new and powerful technologies that we're starting to use to both understand the microbiome and correlate food intake with how it interacts with the microbiome. Advancements in RNA-sequencing technologies hold incredible promise for the future, including the ability to truly personalize food to the individual and their unique metabolic needs. While such technologies are still in their infancy, the science is moving quickly and opening up new possibilities. Once better understood, the microbiome's ability to regulate health should hold promise for such global challenges as diabetes, cardiovascular disease, inflammatory conditions; and also open up new potential with gut-brain connections in areas such as stress, mood and depression. Investment in these technologies is key to understanding how we can use food as medicine to improve health outcomes.

JACK BOBO
SENIOR VICE PRESIDENT, INTREXON

Nothing is more necessary than agriculture. And the next 30 years are the most important years in human history, in terms of nourishing the world. Population rates level off quickly after 2050, so if we can get through the next 30 years without ruining the planet, we could be good a very long time thereafter. The challenge of 2050 is a challenge for today. We really need to solve for the next 30 years.

Science and new technologies can arm us with bold new solutions, but we have to change the conversation first. Tension between science and public perception threatens those opportunities. Science tells us what we *can* do, but the public tells us what we *should* do. Consumers have never cared more or known less what's in their food. We are being marketed a vision of agriculture that's inconsistent with what it actually is, undermining consumer confidence in our entire food system. People love innovation but hate change, and consumer preferences have changed so that our food purchases are now seen as an extension of our values – sustainability, environment, the ethics of food production, etc. These feelings impact people's choices, and they ask for policy and regulatory changes based on what they hear about. We have to find better ways to engage around these issues, bringing together multiple stakeholders to build greater alignment around what should be done to serve our collective needs.

Insights ▶▶▶

We need all the tools in the toolbox, combining tech and touch.

Farming is fraught with risk, both biotic and abiotic. We need to find new ways to feed the planet for the next 30 years, which means we need to increase our ability to fight abiotic stresses like climate change. This depends on farmers having access to all the tools available, including genetic engineering and data analytics. Farming must be infinitely sustainable, and achieving this requires both the technologies and the farmer to effectively apply them.

Scientific advancements are creating greater food diversity, which is a good thing. Technologies like DNA sequencing and transgenics can combat crop disease, the biggest threat to global crop production, and increase the functional health benefits of foods to truly nourish a population, rather than just feeding them. But behavioral interventions are equally as important for the diseases that are plaguing the human population.

All stakeholders must be involved in creating the future of agriculture.

The challenges we are facing are system-wide challenges, and cannot be addressed within the silos of producers, food companies, distributors, regulators, or influencers. The future of agriculture involves everyone from the farmer to the consumer to the government. Each player in the ecosystem has to work collaboratively to get us through the next 30 years.

Food companies need to restore trust with consumers, and deliver solutions that are evidence-based. Farmers all the way to distributors need to employ new technologies that open up new possibilities and ensure authenticity, transparency and trust across supply chains. Regulators need to play a role as well in helping set the ground rules in productive new ways for new technologies such as CRISPR, alternative and plant-based meats and others. Regulations must be sensible and not burdensome, and need to work in established markets as well as in emerging markets in places like Africa and elsewhere.

Consumers also need to be engaged in the discussion. Most consumers don't even know what questions they should be asking, or aren't correctly educated on the choices or aren't aware of the broader issues. To illustrate, the example of blight infestation of tomato crops was brought up. Many consumers do not realize that tomatos are sprayed up to 44 times with chemicals before they reach the store shelf, whereas new advances in gene-editing can enable a gene from a sweet pepper to be spliced with the genes of a tomato to combat the blight through natural, biological processes. Essentially, this new approach involves "using nature to fight nature." And so, consumers are left with a choice: up to 44 sprays of toxic copper, or gene from a sweet pepper in your tomato. But, in a consumer environment that shuns the use of GMOs, conventional thinking may need to be challenged. Consumers aren't aware of the tradeoffs – toxic pesticides vs. GMOs. They just hear "GMO" and

automatically think "bad." Genetic modification technologies need not *all* be bad, and bad *all* the time. We need to explore new ways to frame a more productive dialogue.

There are new efforts that are attempting to achieve this. Food System Dialogues, founded by one of the World Food Prize winners, is a multi-stakeholder process that brings together all stakeholders to create a sustainable food system. We believe the TWIN can play a meaningful role in uniting multiple stakeholders for positive change, through a neutral forum. The TWIN has demonstrated an ability to do so in many prior efforts, through the platform of TWIN Catalyst. We believe the TWIN can also play a role uniting multiple stakeholders for positive change.

Governments have a key role to play in the adoption of new technologies.

As it stands now, governments are reactive to consumer demands when it comes to policy changes, and there are unintended consequences. For instance, as a result of the concerns consumers have about GMOs, the debate is largely controlled and influenced by large companies that have the resources to control the dialogue. That is not in the best interest of all stakeholders and often only furthers the divide and lack of trust in "big food." Stakeholders disagree only on the application of the science, not the science itself, but they don't know that because they're often only hearing a part of the story. Furthermore, the fact that most consumers are misinformed or lack context for their demands means we're introducing uninformed policy change, a danger to the future of agriculture and our goal to nourish the world.

Governments need to be more proactive in information sharing, and also need to introduce common-sense regulatory policies. In the US, the policy towards deregulating crops is onerous and irrational; it's not based on science and has not been revisited in decades. In Canada, however, food that is brought forward for registration is assessed based on creating a novel trait. If you have a crop that produces a novel trait, it doesn't matter how it was developed. Many experts believe this is the most level-headed and sensible approach.

We have to find common ground between science and the public perception, and align around the challenges we all need to solve for the common good.

Part of the problem with agriculture is that everyone on the planet is invested in it, but most don't understand all the moving parts, choices, and consequences. Our food system is better because of diversity. We need to de-escalate the tensions of the different sides and recognize that we're all part of the larger food tribe.

Economists have long talked about conspicuous consumption, but GMOs have manifested the idea of conspicuous production. We in the resource-rich western nations need to employ advanced technologies, but in smart ways that advance the common good and avoid harm. In a related sense, we want our food purchases to be an extension of our values. We have conditioned consumers to think of GMOs as "bad" because they're not naturally born from the soil, and yet we've been using genetically modified technologies for ages. The science of GMOs, and its applications, have evolved radically and the conversation around their use is much more nuanced. Broad, sweeping judgments are not helpful.

Additionally, our experts shared that there is an emerging disconnect between policy and consumer choice at the local level. Europe chooses not to produce GMOs, but they import their animal feed, which is genetically modified. These realities reflect a disconnect, and bridges to be built in the future.

We need to align around the end outcomes we all seek, and find the safest, and best, solutions to get to those outcomes. Too often we frame things in technical, scientific terms, which fosters unnecessary debate, and keeps us all from seeing the proverbial forest for the trees. Perhaps we can find common ground by talking about "an avocado that doesn't turn brown" rather than "an herbicide that does XYZ." Scientists are partly to blame because they're so accustomed to dealing with facts and figures, but often those terms don't appeal to consumers and only serve to pit the interests of big food and science against consumer interest groups.

Ultimately, if people don't trust you, science doesn't matter. If people do trust you, science doesn't matter. The take-away: don't tell consumers merely *what* you do – tell them *why*.

Food waste is a multi-stakeholder problem – and so is the solution.

Food waste has always been a problem, but there's more interest in this than there ever has been. But there isn't just one "food waste problem;" there are different food waste problems in different regions, because they tie back to choices and consequences, including some unintended ones. Those solutions can also pose additional problems. For example, the ugly food movement was created to reduce food waste, and has turned a product with no value that previously went to homeless shelters into a product with value that can be sold. As a result, food kitchens have less food than they've ever had. This is an unintended consequence of not using multi-stakeholder, or systems thinking.

There are a variety of ways to approach the issue of food waste, especially with the new technologies we're experimenting with, but we need to look at it across the value chain and across all stakeholder groups. Scientists are discovering medical uses for food products that before would have been thrown out, helping to reduce food waste. Farmers can contribute by composting food from restaurants and mixing with elemental sulfur to create a sustainable fertilizer for farming. Companies and regulators need to implement smarter packaging that can tell you precise expiration dates or verify extended shelf life claims. These are only examples.

A Way Forward ▶▶▶

The next 30 years are pivotal for our society. We face intractable challenges in feeding the world, nourishing health, and enabling authenticity, transparency and trust in our global food chain. In 1798, prompted by the work of Thomas Malthus, we had to figure out how to feed the world by the 20th century. Innovation got us out of that catastrophe, and now innovation is needed yet again to tackle the challenges of the next 30 years. Technology holds new possibilities—exponential solutions for exponential challenges—but bridges must be built. Science only tells us what we can do, while the public tells us what we should do.

The future of agriculture is one that is high-touch, high-tech, has a broader social license to operate, and focuses on the people above all else. Because of where they sit in the value chain, corporations are uniquely positioned to play a role as a catalyst for these necessary changes, not only feeding but also nourishing the world.

TWIN GLOBAL

About The World Innovation Network

The World Innovation Network (TWIN) is an invitation-only community of innovation and growth leaders from across sectors and geographies. In addition to other activities, TWIN convenes annually for a summit in Chicago from 25 countries and all sectors: business, government, non-profit, the arts, academia, defense. Our group includes leaders at the most senior levels of their organizations, as well as select individuals making differentiated impact around the world.
For more information, visit **www.twinglobal.org**

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