The Routes beneath the Roots, A System Map for Prospective Food Innovators Striving for Sustainable Disruption

By

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ABSTRACT

From sci-fi food-substituting floury drinks to lab-engineered, plant blood-based patties that grill and smell just like steak, food innovation is blossoming. The modern food movement is challenging the assumptions at the root of our current food system in the face of an appalling health and environmental bill; and all of the voices in the system are implicated in this resounding trial.

On the one hand, 40% of the food we grow goes to waste in a country in which two thirds of eaters are overweight or obese, prisoners outnumber farmers and all the cattle aligned head to tail could circle the earth up to 35 times. On the other hand, 2.3 billion dollars were injected in food tech in 2015 in the United States alone, to tackle these problems on the private front. But where do dollars meet flaws? What sparks innovation in food and agriculture today and what would a food innovation map look like for the United States?

The hereby report presents a selective, subjective and dynamic representation of food and agriculture innovation, after eight months of immersion in the American food system as a buyer, an eater, an investigator and a narrator; all of Netflix and TED's food repertoire; thousands of pages from food, agriculture, agronomy and system thinking literature; days of cumulated conversations with prominent food thinkers and fast-food queuers alike; and 10,000+ kilometers walked, driven and flown to food talks and conferences across Boston, Cambridge, New York and San Francisco.

This report explores the root causes behind the problematic symptoms of our broken food system, and the current and prospective pathways to spur innovation-driven systemic and behavioral change, in a collective effort to build a more sustainable food system.

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To my advisor Bill Aulet for his support and confidence in my abilities as I explored this new subject area.

To the scores of entrepreneurs, innovators, thinkers and eaters who took the time to share their thoughts and stories with me.

To my father Khattar for his invaluable guidance and support, to my mother Tania for her extraordinary patience and boundless love.

To Cai for ripening my passion for food.

To Valentina.

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Audience

The approach taken in the hereby report aims primarily to simplify and synthetize a representation of the American food system, and to present a transverse map for food innovation. It does not intend to represent a detailed, comprehensive panorama of the food industry, or to offer actionable solutions to the complex problems corroding the food system. It provides a tool, a theoretical framework, subjective food for thought for food disruption. It is a useful starting point for whoever intends to learn more about the food industry in the United States as a system, picture where their own action fits in the big picture, and potentially steer their actions in the right direction to maximize impact and sustainable action.

The targeted audience might include but is not restricted to:

- Current food entrepreneurs interested in getting a sharper representation of where they fit in the bigger system, to either adapt their approach to maximize impact, better market the full extent of their current impact or identify new collaboration possibilities to enhance targeted scope and reach;
- Prospective food entrepreneurs seeking to get a better understanding of the challenges in the industry, to identify new opportunities for building new ventures and / or orientate their positioning in a way that maximizes their value proposition;
- Financiers aiming to invest in food-related businesses to diversify their portfolio;
- Food-related incubators, accelerators, and other entities with an educational focus looking for clear, straightforward, transverse tools to use as teaching back-up material;
- Students interested in the food space, considering to make a career move in the food and agriculture industry and aiming to understand how to navigate their way through the industry and its challenges;
- Aspiring enlightened eaters, wishing to align their sustainability convictions and wellbeing aspirations with their eating practices and purchasing habits.

Introduction

1. A very short history of food innovation

1.1. A million-year-old history

It is easy to get the impression from the ubiquitous guerilla headlines in the media that we are currently undergoing the first major food revolution in History, disrupting an industry that has remained static since its early days. Yet food has constantly been disrupted since the very first civilizations. Fire domestication, grinding, refrigeration, pasteurization, canning – innovations we take for granted today, but which profoundly transformed the way we extract food from nature, process it and consume it. By boosting production yields, by cutting drastically the amount of effort required to extract food from the soil, the land and the sea and to process it for human consumption, and by extending its consumption life, we created space for larger, healthier, more robust societies with more resources and time to innovate, collaborate and create more advanced societies.

Area of progress	Efficient extraction	Safe, adaptable cooking	Enhanced conservation
Examples of innovations	*irrigation, selective breeding, soil chemistry and crop rotation, simple but life-changing objects ranging from knives to ploughs, fishing nets and threshing machines*	*fire domestication, grinding, fermentation, baking, frying, objects like pots, ovens and microwaveable ovens*	*refrigeration, freezing, pasteurization, sterilization, canning, objects like cork and barrels*

Table 1 - Mechanical, chemical and design innovations that transformed the food landscape accross History (Garber, 2012)

1.2. The perverse facet of convenience

Despite those disruptive innovations that deeply metamorphosed the food landscape historically, sustainability has only recently become a preoccupation within collective awareness.

The Brundtland report defines sustainable development as the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).

If we read this definition through a system dynamics lens, it correlates directly with the concept of carrying capacity. We refer here to the ecological definition of the term – the environment's maximum load, that is the number of people that it can support without long-term environmental degradation. This carrying capacity is determined by both the resources available in the environment and the resource requirement of the population (Sterman, 2000).

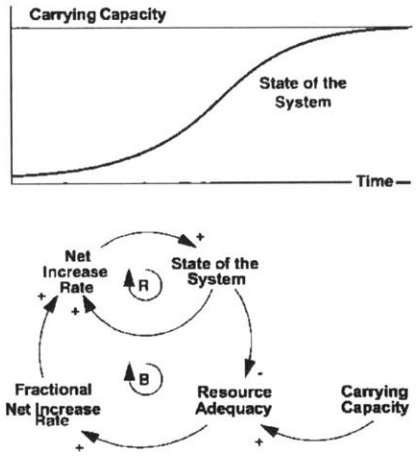


Figure 1 - Carrying capacity of a system (Sterman, 2000)

For a long time, reaching the environment's maximum load was not a source of concern, and particularly in the United-States – land was abundant, and the bottleneck to feeding the population was getting enough arms in the fields, which explains in part the 270 million acres of public land ownership given away at little or no cost to clean-record applicants through the Homestead acts in the 1860's (National Archives). That is nearly 10% of the total area of the United States.

The population underwent explosive growth over the last century – from 1 billion people in 1812 and 1,5 billion people a century later (or a 50% increase), we jumped to 7 billion people in 2012, that is a 550% increase in the same amount of time (Andersen, 2014). In essence, we are consuming resources faster than the time they need to replenish themselves – or the time we need to replenish them in the modern paradigm. This record population growth coupled with skyrocketing (meat) consumption habits and waste outputted at all the joints of the food chain cannot physically be sustained by our system's carrying capacity.

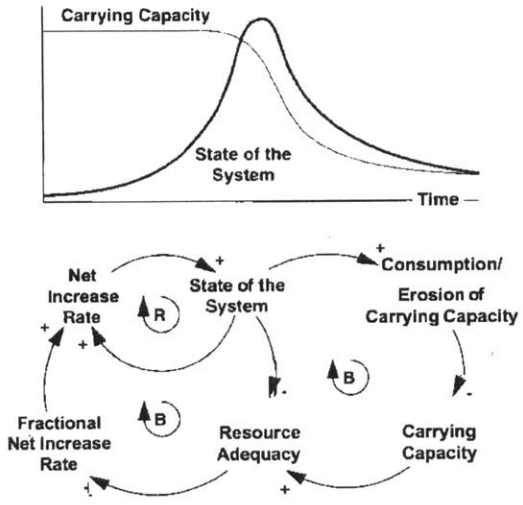


Figure 2 - Variability of the carrying capacity of a system (Sterman, 2000)

What we witness in this scenario is the permeability of our environment – the carrying capacity of our system – unlike what the modern technology paradigm tends to infer or at least grow in global consciousness – is not fixed. We can very significantly decrease this carrying capacity through our collective food system practices and individual action, eroding soils, depleting oceans, pushing further the boundary of desertification, deforestation and global warming.

Here are a few galvanizing facts, for the love of a good fright – and admittedly to startle reading minds a little (Andersen, 2014; Soechtig, 2014):

1. An acre (picture a football field) of rainforest is cleared every second to graze animals and grow their feed crops.
2. Everyday, close to 100 plant, animal and insect species become instinct.
3. 28 billion of animals were pulled out of the ocean last year. At this rate, oceans will be fishless by 2048.
4. One third of our planet is becoming desert.
5. Our life expectancy ranks 27th out of the 34 industrialized OECD countries.
6. Every minute, a person is killed in the U.S. by heart disease.
7. 40% of Americans are obese, this includes 1 in 5 Americans under 5, and 40% of the non-obese people have the same metabolic dysfunctions.

8. 95% of all Americans will be obese or overweight in two decades and 1 out of 3 Americans will have diabetes.
9. Healthcare weighs 5 times more than the defense budget.

And yet we keep swallowing food at compulsive rates and reproducing faster than dying.

One way to look at this is to consider the perverse face of our food system's global convenience model – the second balancing loop in the second system diagram above hinders the self-regulating effect of the initial two loops. The net disconnection between us and our food that results from our modern identity of shoppers, as opposed to hunters, obscures demand-offer friction. This intermediate food-producing layer prevents the direct adaptation of our diet choices and reproduction behavior to the current carrying capacity of our system. Besides, it is much rather the opposite: we are as consumers constantly urged to consume more food, through grocery store flash discounts, injections of gargantuan amounts of highly addictive components such as sugar – which has been claimed to be eight times more addictive than cocaine (Soechtig, 2014) – into the industrially processed food we consume daily, the Big Brothery presence of fast food chain restaurants around every street corner worldwide, the constant food advertising on the radio, Spotify and television including during the year's most-watched television events like the Super Bowl, where despite the mind-blowing price of $1 million the 6 seconds, a fourth of commercials this year were about food.

1.3. The modern food movement

Yet we also have the ability to increase the system's carrying capacity.

- Either by increasing resources available in the environment: we are close to be using our planet's arable lands at full capacity – more than half of U.S. land base is currently used for agricultural purposes (USDA), so this can mean one of two things: finding innovative ways to further increase yields per hectare sustainably or cutting dramatically on waste.
- Or by changing our conscious choices around what and how much we eat, which impacts both population requirements as well as the environment's available resources. This is notably true in the case of the American meat-centric diet and the absurdly inefficient yet prevailing paradigm of feeding our food – we use 6.5 times the amount all humans are eating daily, simply to feed our cows.

So yes, we are entering a new phase in the history of food. A new food innovation era, or the so-called modern food movement, which we could thus try defining: a reborn collective appetite for food and agriculture expressed through a dense series of radical innovations and amplified by strong media interest, in a context of rising public concern, growing offer-demand friction and extreme diet-related disease epidemics (see exhibits 4 and 5 for other definitions). The difference today is that in the face of a soaring population, looming health and ecological crashes, and immense technological potential, innovations are taking a much more radical turn. In that sense, the modern food movement is driven by a strong sense of urgency and a virtually free path to scaling up fast, which does contrast sharply with past trends.

But it is above all a movement in global awareness, partly sparked, amplified and relayed by the media. People start questioning the foundation of the long-praised fast food system in which convenience has been governing as a divine right monarch. They start questioning what their diet is, and reflecting over how it should evolve. Whistle blowing nutrition videos are flooding the social media, such as 3harmulfoods.com which was viewed over one million times. Controversial food-related terms are spiking in google search trends, as depicted below for respectively 'GMO' and 'gluten':

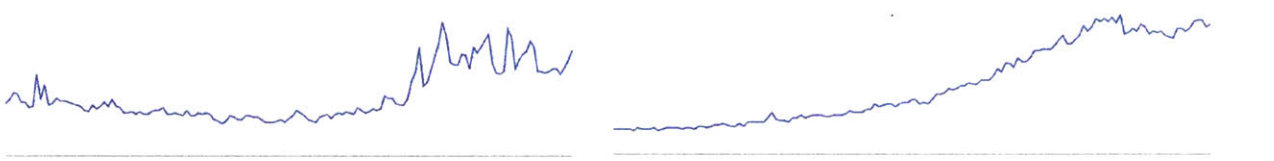


Figure 3 - Google Trends for "GMO" (left) and "gluten" (right) from 2005 to 2015

Policy is a key lever to establish sustainable change through our food system, and especially at both ends of the innovation spectrum: breaking existing legal locks to lay the ground for sustainability-oriented innovation, and / or locking in rising innovations by adapting a posteriori the legal framework. In our modern food system, the intermediate layer has the most power – food manufacturers, often referred to as Big Food. This is often rooted back to the emergence and wide spread of ultra convenient "drive in" fast-food chains, revolutionary concept first developed by the MacDonald's corporations in the 1950's, which brought Taylorist work optimization processes from factories to restaurant kitchens.

The stunning success of this model – paired with customers' and businesses' joint aspiration for universal, taste-identical experiences from one visit to another – rippled down the entire food chain,

causing on the way unintended consequences. This notably led to the concentration of meat manufacturers – in 1970, the top five beef packers controlled 25% of the market. 40 years later, the top four controlled over 80% of the market.

This concentration of actors did not come without a concentration of power, as those large meat manufacturers own for the most part both the animals and their feed, shifting greatly the control and bargaining power away from farmers. These practices are also often associated with concerning animal treatment and an alarming environmental cost. Furthermore, it is at this level that the most financial value is extracted, and part of this value often supports research, Non-Governmental Organizations and other mission-driven non-profits, as well as various food public campaigns, blurring the boundaries between actors and controllers, and often eroding public nutritional guidelines and other information releases.

Another way to impulse change is from the ground up. Many startups try to impulse change and drive sustainability through the system by somehow shortening the supply chain, and bringing power back at both of its ends – farmers and consumers. With every purchasing decision at the customer level comes a vote, either in favor for or against our current food system. Every vote impacts profitability, most of the time at the intermediate level – producers are paid upfront, and will keep supplying most food manufacturers relatively independently of the way our food is processed. Grocery stores adapt to shifts in demand by modifying their offering mix. Which ripples back to food manufacturers and processors, leading to a realistic redefinition of their practices as well as their specification terms with farmers – more accurately renamed "growers" in the specific context of industrial animal farming.

Yet generating change does not necessarily imply profound, sustainable change. As it has often been the case in the food industry, symptoms are tackled frontally rather than at the roots of the problem.

Let's take a closer look at these roots.

Breaking Down a Broken System

2. Panorama

"Many of the problems we now face arise as unanticipated side effects of our own past actions. All too often the policies we implement to solve important problems fail, make the problem worse, or create new problems." (Sterman, 2000)

2.1. Pre-symptomatic analysis: root causes

Our current food system has humongous consequences on our health, the environment and society. Table 2 below is an attempt to break down some of the major roots behind the observable symptoms described in introduction which testify that the current food system may be reaching its limits.

End of line symptoms	
Obesity	1
Cardio vascular diseases	2
Cancer	3
Food insecurity	4
Deforestation	5
Ocean depletion	6
Species extinctions	7
Soil erosion	8
Desertification	9
Global warming	10
Environment pollution	11
Labor exploitation	12
Food intoxications	13
Waste	14
Animal welfare	15

Level 1 root causes	**Related symptoms**
Unequal access, food deserts	1,2,3,4
Easy / cheap unhealthy alternatives	1,2,3,5,6,7,8,9,10,11,13
Fast food nation; culture of fast	1,2,3,10,1,13,14
Technology-enabled business opportunity	5,6,7,8,9,10,11,12,13,14,15
Tragedy of commons	5,6,7,8,9,10,11,14

Level 2 root causes	**Related symptoms**
Government subsidies	10,12,15
Culture of consumption & convenience	10,12,14,15
Low incomes	1,2,3,4
Lack of knowledge	1,2,3,5,6,7,8,9,10,11,12,15

Table 2 - Some roots behind the system's ills

It seems however that elements are interconnected within a similar column, symptoms and root causes alike.

Clearly, food insecurity often results in the purchase of cheap, unhealthy alternatives which correlation with obesity and cancer has been clearly established by research; and obesity in turn is likely to increase the risk of developing cardio vascular diseases. Low income individuals are less likely to have access to diet-related resources, nutritional information and extensive healthy shopping options. They are the first population at risk in terms of diet-related diseases, and yet they are the very reason why public subsidies for corn exist in the first place, allowing for unrealistically cheap animal feed, unrealistically cheap meat, and unrealistically cheap take-away hamburgers, which heavily contributed to making over one fourth of all adults in the U.S. obese in all states but five (Trust for America's Health, 2015). And this interconnection spans most of the variables included in the table above.

In an attempt to capture some of this interconnectivity, we map the following root cause analysis diagram, with end of line symptoms in the left column, first order root causes in the middle column and second order root causes in the third column.

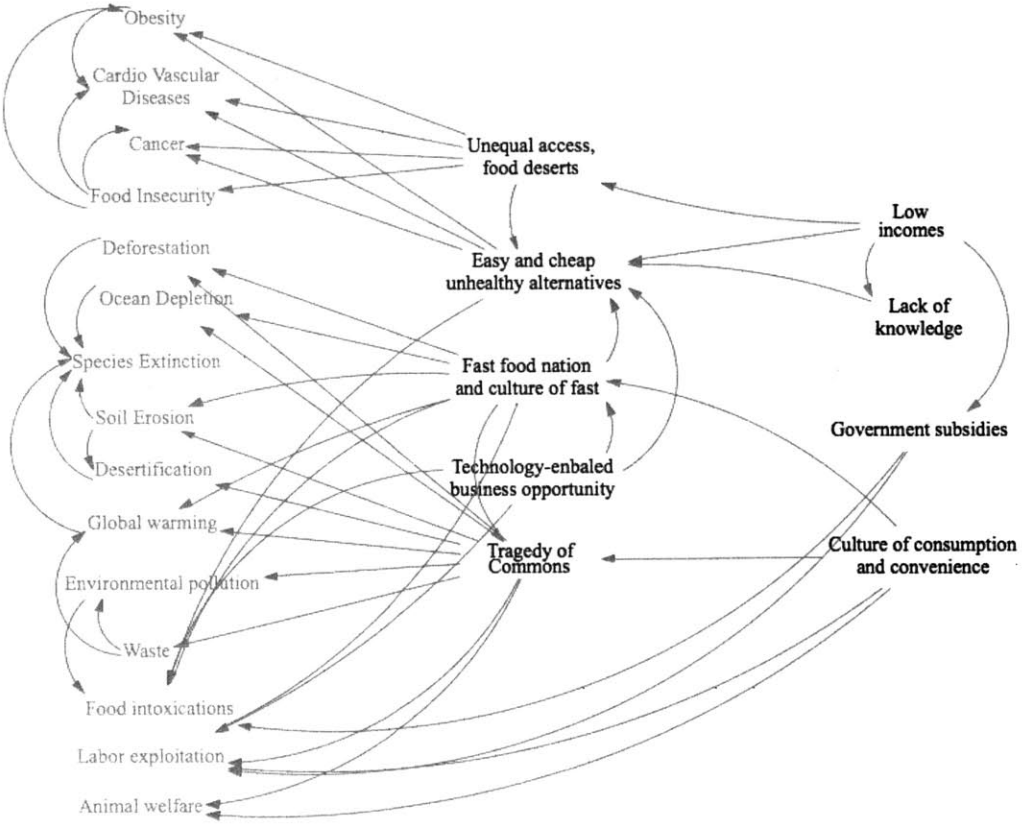


Figure 4 - A system map of the food system's ills, symptoms and key roots

For the sake of simplicity, we group the various symptoms in three buckets:

- Human health and overall wellbeing;
- Environmental health and system durability;
- Social values and ethics behind our current system and society.

Note that the third bucket, labeled as "Respect towards inputs" in the graph below, refers to the various inputs in the food production process, alluding to respect towards animals, towards farmers, towards manufacturing / processing workers, towards our food – and towards the soil, where the system durability bucket starts operating.

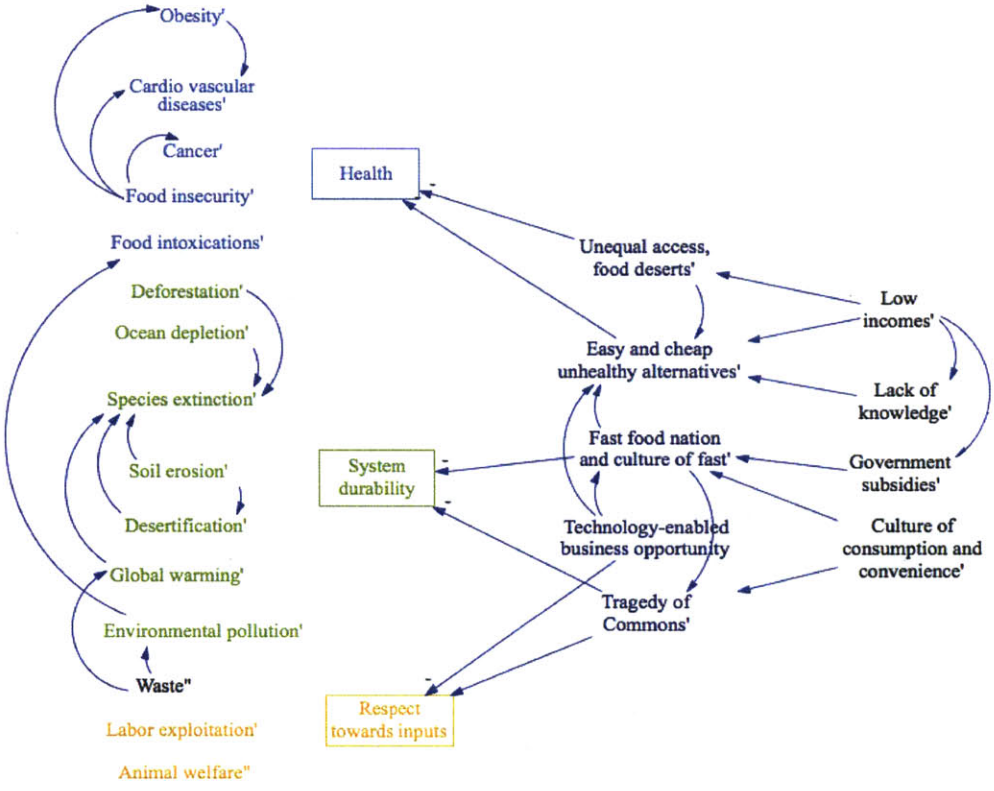


Figure 5 - Simplified system map of the food system's ills, symptoms and key roots

This explains in part our decision to include waste both in the symptoms relative to system durability and societal values. We stress our system significantly to output sufficient calories to nourish the world's 7.4 billion inhabitants, yet 30 to 40% of the food supply is wasted in the Unites States, equaling more than 20 pounds of food per person per month (Worldfoodday.org, 2015). At world's scale, the amount of food lost and wasted every year is equal to more than half of the world's annual cereals crops, or 2.3 billion tons in 2009 / 2010.

Not only is this further stressing the earth's stressed resources unnecessarily, but it is also reflective of our modern values as a collectivity and a society, deeply rooted in a culture of fast consumption and global commoditization. I believe that this culture impacts deeply the way people approach relationships and interact with one another, and possibly not for the best.

2.2. Post-symptomatic analysis: broader consequences

These three symptomatic buckets have a myriad of heavy direct and less direct consequences on society.

- **Health**: beyond the obvious damage caused by diet-induced epidemics on global health and the skyrocketing death rate that goes along with it, daily wellbeing is severely impacted, with numerous physical symptoms such as headaches, nausea, vertigos, tiredness and numbness, agitated sleep, as well as mental symptoms such as depression. This represents a global budget of $120 billion each year in the United States only, where healthcare weighs 5 times more than the defense budget. (Fulkerson, 2011). This represents both high public expenditures (and so both high taxes and a high opportunity cost), as well as burdensome financial stress for uninsured, sick families. This is also highly likely to drive innovation and productivity down nationally, which threatens the future self-reliance of the US as a country, its position as a leader, as well as the future quality of life of its citizens. It also jeopardizes national security in a context of rising cultural, economic and political tensions and global terrorism, when one in three young American adults is too fat to join the military (CBS news, July 15 2015).

- **System durability**: beyond serious ethical and ecological concerns, damage to our environment has heavy consequences on quality of life. Our current food system is destroying landscape, emptying oceans, impoverishing biodiversity at dizzying rates and creating a highly polluted environment which we touch and breath into on a daily basis. It is prone to degrading both our health and our comfort, both today and for future generations, and many things we take for granted today may not exist in a few decades – a world where fish has gone instinct and disappeared entirely from our plates, and in which taking a spontaneous dive in the sea has become a cancer-giving, life-threatening experience takes less and less imagination to picture. The loss in biodiversity is also a direct threat to our survival as a specie through adversity – we have been living in a rather docile

environmental, which lends itself well to our sedentary, globalized, intensive agricultural system. But, to borrow the words of food thinker Caithrin Rintoul (Rintoul, Creative Mornings, 2015), the decision of "going with stability and predictability", in other words monoculture, is a huge threat towards system vitality and adaptation capability in the event of drastic climate change or crops epidemic infections, putting the entire system, and beyond that our civilization at risk.

This is further amplified by the demographic consequences of food politics and food security imbalance between regional systems around the world – the degradation of our global environment has severe local repercussions, leading to ravaging earthquakes and temperature jumps which cause today – and is likely to cause in significantly greater proportions tomorrow – economically, politically, culturally transformative human migrations.

- **Societal values**: I am convinced that the absence of respect towards the various inputs that make the food in our plates (or take-away boxes) possible – farmers, workers, animals, soil – has very serious impacts on human interactions and relationships in our communities and our modern society. It is a complex ethical contention which shakes the values at the core of our human civilization, widening the gap between the moral ideal that shapes collective consciousness and the reality of collective perception and subconscious acceptance, driven by global commoditization. From a social and economic point of view, the modern treatment of farmers and labor throughout the supply chain is driving social inequalities, financial distress, as well as local and multinational tensions. Even Whole Foods, which has a worldwide reputation for and prides itself with its sustainable practices, scores surprisingly low in terms of labor welfare (Sustainalitics, MIT Sustainability Lunch Series, 2016).

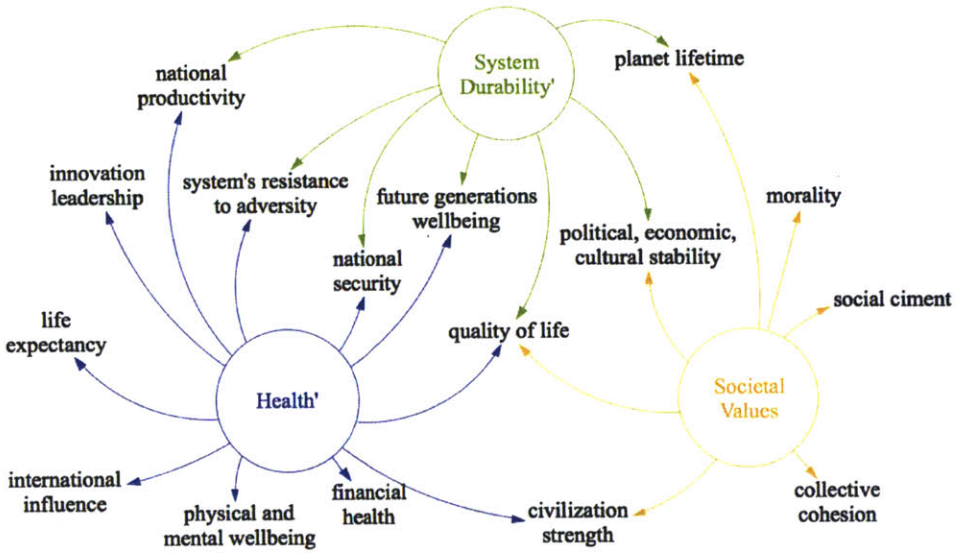


Figure 6 - Broader consequences analysis of the food system's symptoms

2.3. Redefining the modern paradigm in food

If we start from this symptomatic mapping to reverse-engineer the goals we should set ourselves to rethink our modern food system, we could set the following framework:

> An aware, transparent, mindful food system which sustainable growing and processing practices allow for sufficient – not excessive – output of nutritious food to feed our specie reasonably and evenly, without impacting the current or future ability of animals, plants and humans to thrive.

Furthermore, this mapping seems to go in the sense of a major redesign of our food system's paradigms, notably in terms of pace and diversity. The diagrams below (Rintoul, 2016 January 24) provide an interesting theoretical starting point to initiate this conversation.

The food system can be represented by this 2x2 matrix, which depicts the pace of the system on the horizontal axis (from slow to frictionless) relative to its degree of diversity on the vertical axis (from diverse to commoditized):

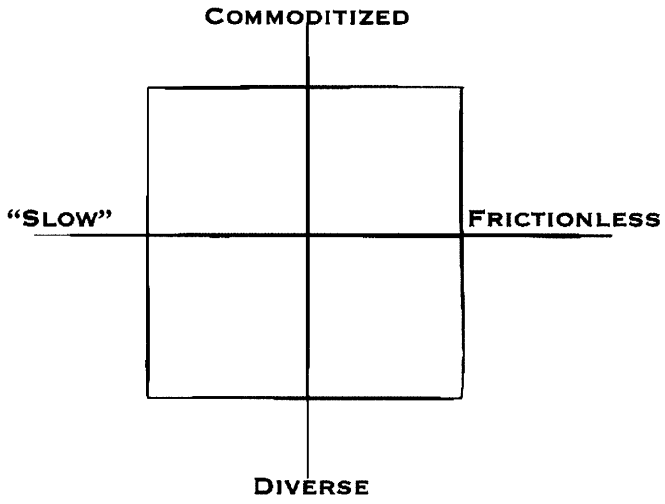


Figure 7 - Past and Future of Food Systems Innovation (Rintoul, 2015) (1)

If we look at the historical evolution of our food system, we have been moving from the bottom left to the top right quadrant – that is from a slow food system, with lower yields, more diverse crops that took longer to grow, harvest, and bring all the way to our plates, to a frictionless food system based on monoculture, productivity and hyper-convenience.

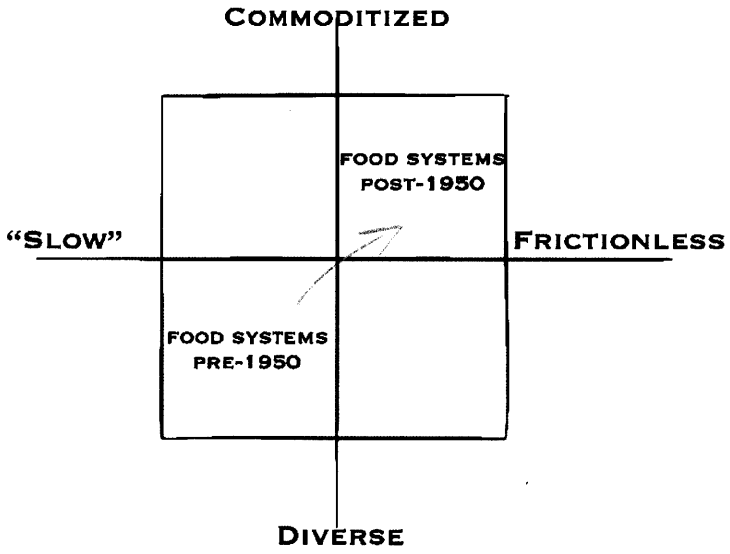


Figure 8 - Past and Future of Food Systems Innovation (Rintoul, 2015) (2)

Applying our previous analysis to this current framework, it seems that the leverage space consists in slowing down the system and / or introducing further diversification within the system:

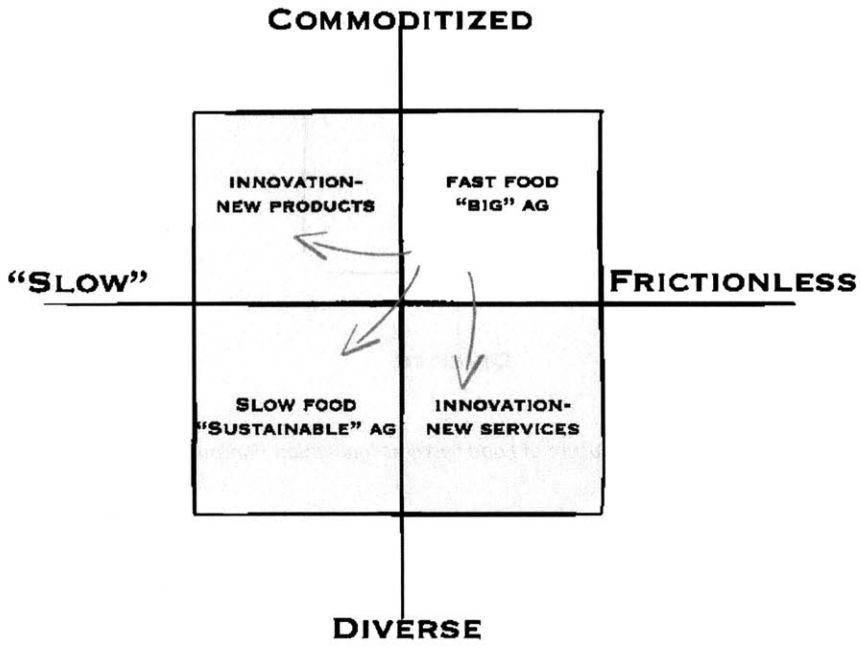


Figure 9 - Past and Future of Food Systems Innovation (Rintoul, 2015) (3)

3. *Voices of the system*

The food system in the United States is all the more difficult to read that it stages a myriad of players with correlated – overlapping and conflicting – interests. The five main players involved in the food ecosystem are outlined below:

- **The government**, elected by citizens to protect citizens, regulating corporate activity and subsidizing research;
- **Big Food manufacturing companies** and their lobbies, providing citizens with most of the food supply available in restaurant chains and grocery stores shelves;
- **Research bodies**, Non-Governmental Organizations and other non-profits realizing research and advocating for their driving causes;
- **Farmers** are the first layer in the system between us and the environment we extract our food from. Most farmers have limited bargaining power in our modern food system, but this frontal position in the system makes them key advocates, interlocutors and potential change agents.

- **Citizens**, who play a key role in the system as voters, consumers and readers.

There are two other players we could reasonably add to the diagram above. Players with less direct action power, but playing nonetheless a non negligible role in the equation:

- **The media** plays a central role in the system as the main connector between all the different voices of the system. It investigates the behavior of legislators, NGOs and the corporate world, and informs citizens of its – as well as the latest scientific – findings. However, the way it relays information and its choice of related stories are sometimes – often – controversial, and more aligned with readers' voyeuristic curiosity than collective interest and wellbeing.
- **Retailers**, who connect food manufacturing companies and farmers with citizens.

In Figure 10, the innovator can position onselef at each node, as well as on each axis connecting two different nodes – the rise of digital technology and the internet has created a lot of space in the system for transformative innovation opportunities as a connector.

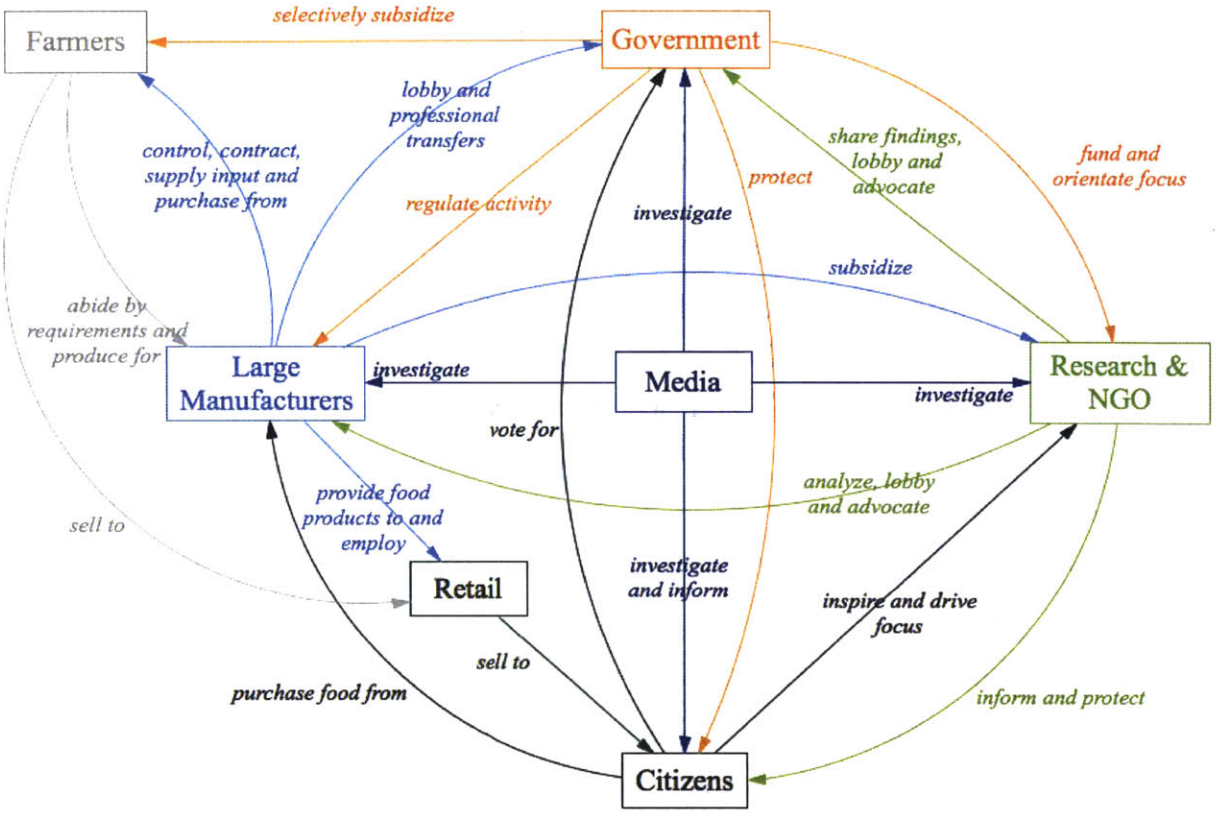


Figure 10 - Voices of the food system

Looking into the system's ills root causes without connecting them with associated change agents, advocates and detractors is worthless. In the diagram below, we link our initial symptom map to the different voices in the system which we have identified above and that have the power to directly impact, individually or collectively, a specific root factor.

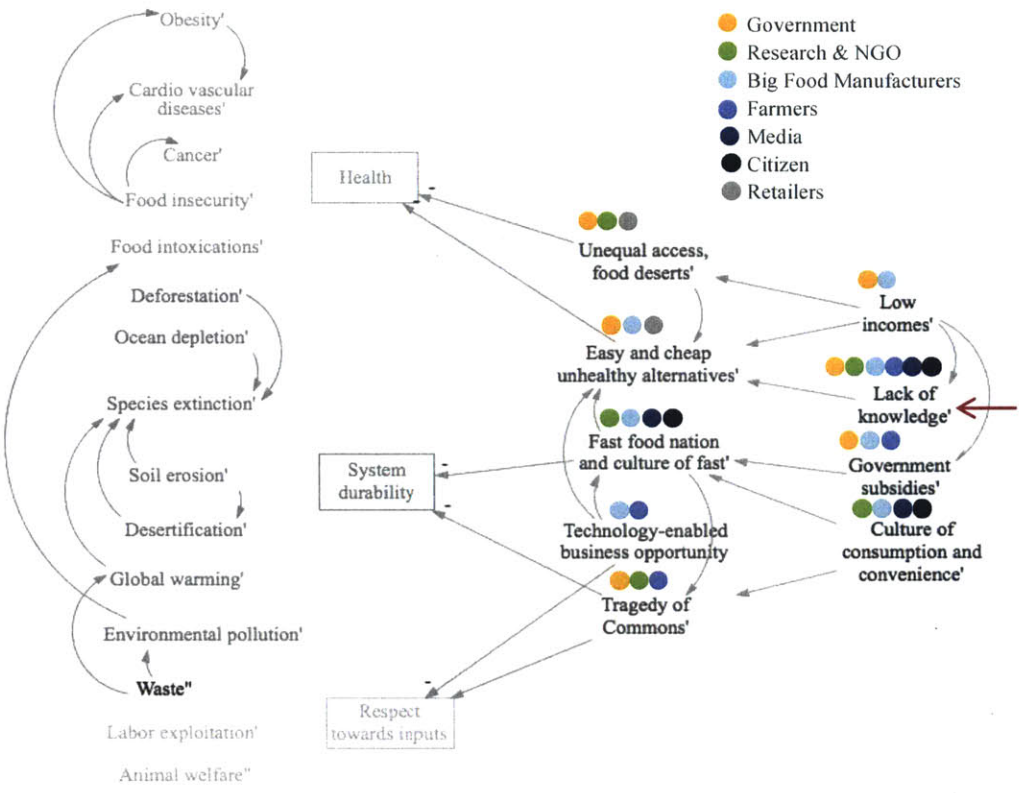


Figure 11 - Dynamic map of the system's ills, connecting voices with root causes

We want to draw particular attention to the second degree root cause "Lack of knowledge" which can be directly impacted by most voices in the system, and yet constitutes one of the key barrier to global change in our food system.

4. *All roots lead to Rome*

My take on this is that we have been missing a key root factor in our sketch of the food system symptom map – the interconnection between the two key decisional players in the system: the maker and the controller. That is the manufacturing and the controlling bodies.

It is common for executives and legal representatives in the Big Food industry to jump the border and join the ranks of the FDA (Food and Drug Administration) or the USDA (United States Department of Agriculture) – two public entities in our food system precisely in charge of controlling corporate practices in Food and Agriculture (Kenner, 2008).

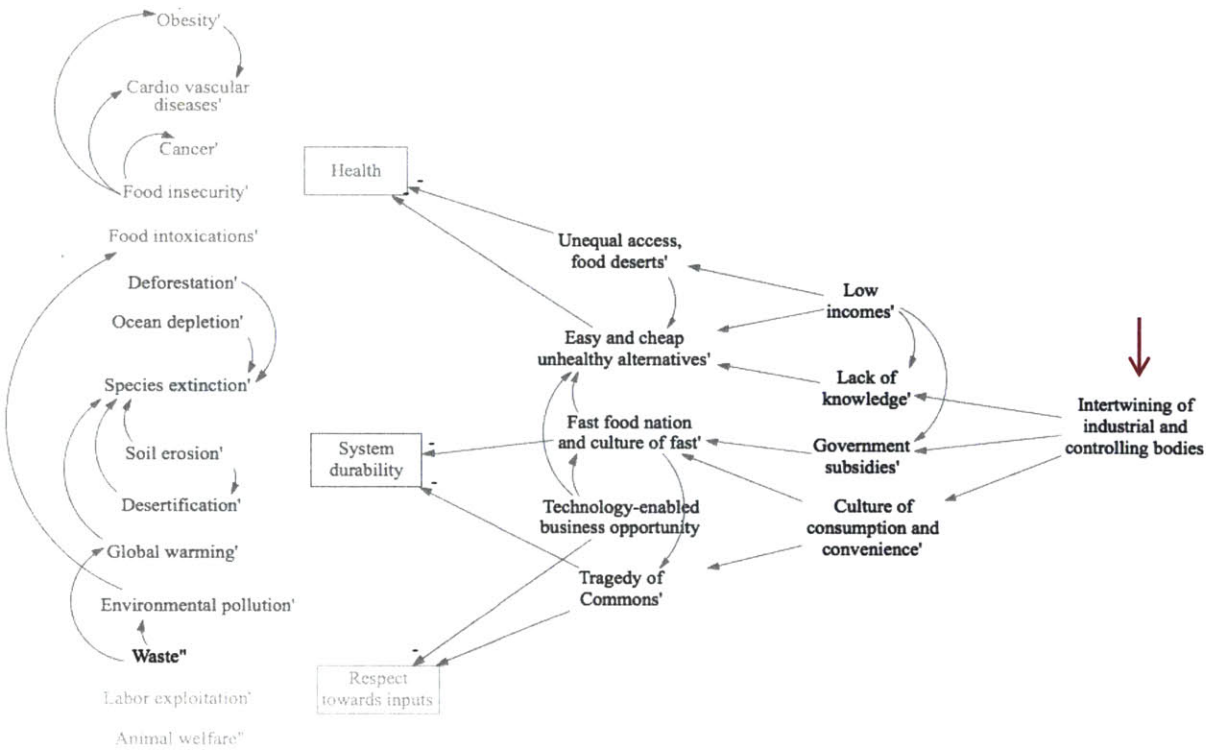


Figure 12 - Towards an ultimate root?

It seems counter-intuitive that the same people would dictate the rules behind the production practices of our food, produce the food, and control the relevancy, adequacy, morality and application of these very same rules. And yet this order has been directing and shaping our food system for decades.

The goal is not to blame "Big Bad food" and its manufacturing arm, or the half-compliant half-moralizing government for all the ills of our food system. Large scale, industrial mono-farming paired with both cutting-edge technology / scientific findings and a closely targeted public subsidizing policy has enabled the production of huge amounts of food at astoundingly low prices, vastly broadening the concept of food accessibility and yielding quantities of produced food like never before in human history. Furthermore, it was all part of a much broader movement of global mechanization, rationalization and optimization, aligned with a rising culture of consumption, convenience and commoditization.

However, one statistic is often overlooked – today, we have the ability to feed 14 billion people (Seifert, 2013), that is twice total world population. Two planets. We "grow" 10 billion animals per year (cows, lambs, pigs, chickens) worldwide. New York Times food writer Mark Bittman picturesquely points out that, strung together, this is enough material to go to the moon 5 times there and back (Bittman, 2007).

In the United states, a third of the food we produce goes to waste at the farm level, before even hitting grocery stores shelves. This does raise questions about the requirements for our current food system. Furthermore, patented, uniform, single-use GMO seeds which are at the core of modern yield increase lead to uncontrolled nature adaptation and rising resistance to chemicals, and high sensitivity to sudden changes in environmental adversity. If we factor these elements in the equation, research has shown that over time, organic farming and conventional agriculture produce similar yields (Seifert, 2013).

So how can we set about shifting the current growing and eating paradigm and drive positive, sustainable change throughout our food system? Our current system relies on:

- Stable environmental conditions (organic crops resist better to floods for instance);
- A deep information gap, particularly at the consumer level;
- Extensive upstream control over farmers' inputs and processes by manufacturers;
- Intertwined interests between producing and controlling bodies.

This permeability of interests among large actors and controllers hinders the system's ability to self-regulate to impede action that would severely harm other stakeholders in the system. The three diagrams below use system dynamics to illustrate this phenomenon through the example of the relentless diffusion of diet-related epidemics such as obesity, and the shy policy reaction.

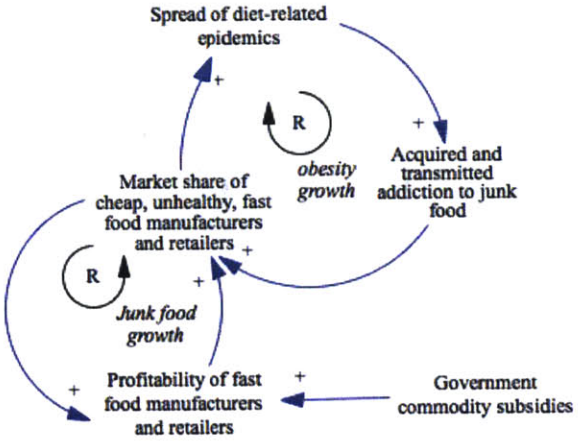


Figure 13 - The mutually-reinforcing exponential growth of obesity and junk food offerings

In part II, we explore where innovation can occur in the system to bypass this upstream blockage point and start reversing the current vicious circle that regulates our current food system. To do that, we explore the leverage points for driving innovation, and look into the change potential of players.

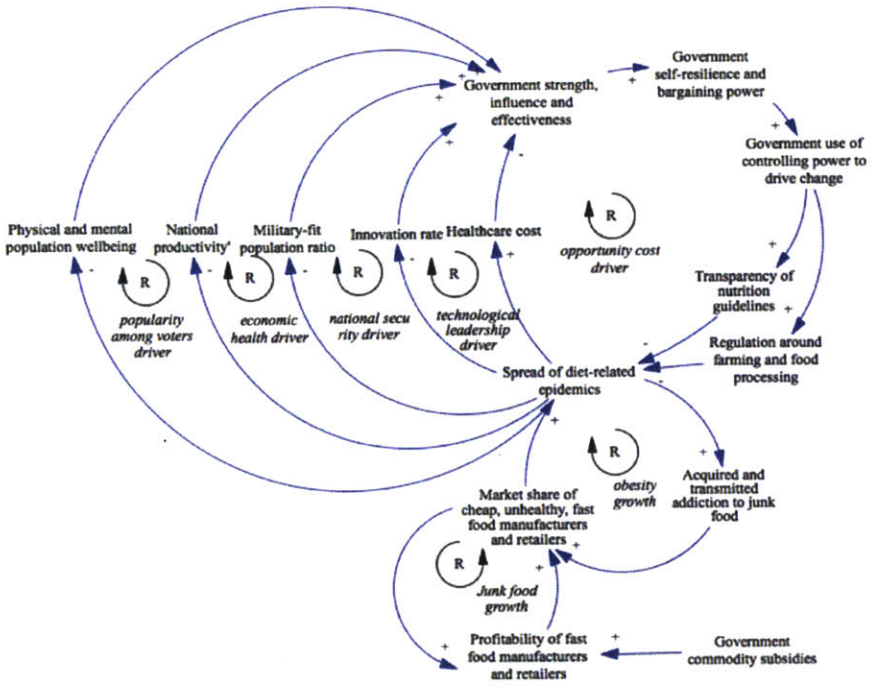


Figure 14 - The various drivers for change through policy action in a self-regulated system with no conflicts of interest

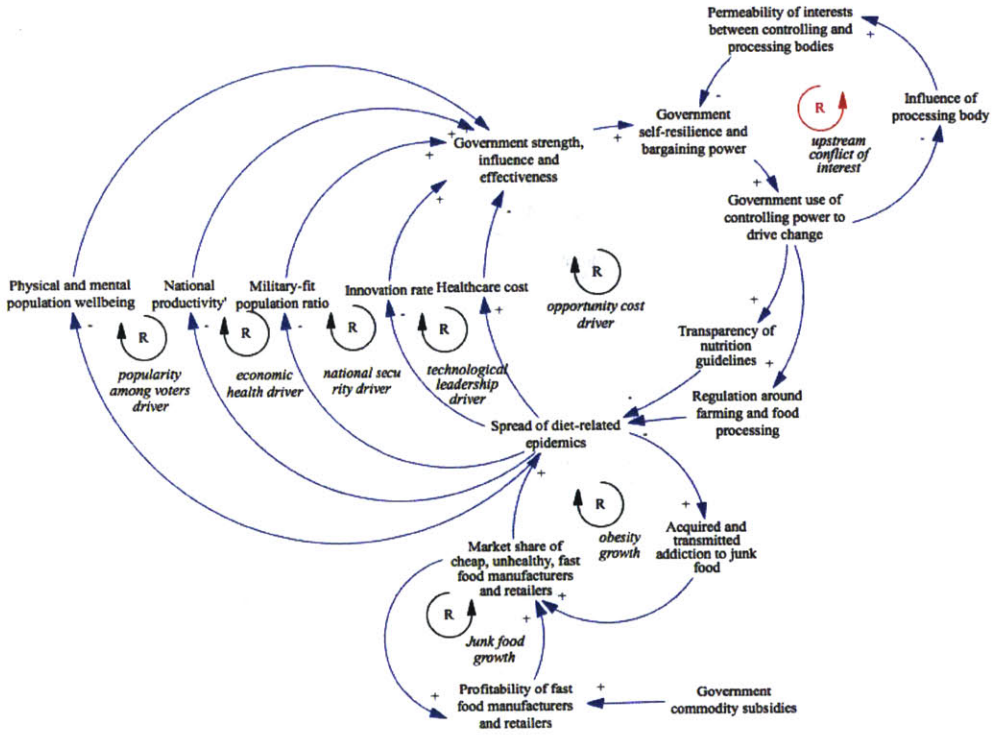


Figure 15 - The counter-acting loop impeding self-regulation in a world where production and control have mixed interests

Hacking the Food System

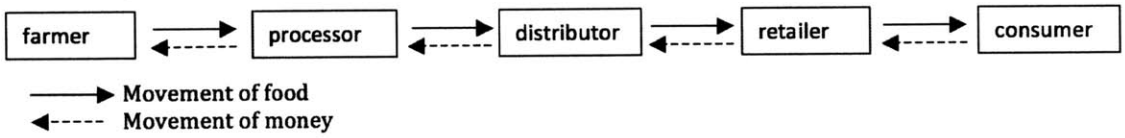


Figure 16 - Movements of food and money in a simple food supply chain

Our food goes through the hands of many different players in the supply chain before ending up on our plates. Each of these players are associated with a specific function, adding some value to products we purchase and consume. Below is a simplified, schematic representation of the split of tasks across the food supply chain and the main player associated to the realization of this task.

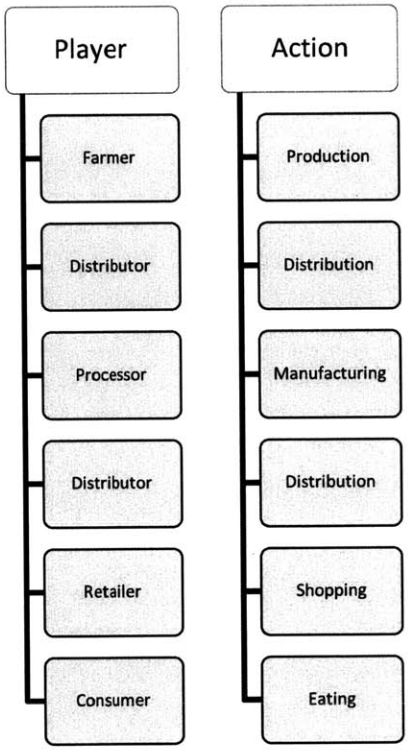


Figure 17 - Key actor and associated task at each step of the supply chain

These aspiring goals for future states of the system are currently inspiring myriads of innovators to drive change through the system at all levels of the supply chain. To understand better these companies' drive, positioning and vision, I have organized a trek to San Francisco over SIP week in Spring and embarked 13 students across MIT, MIT Sloan and Harvard on a trip behind the scene of some of the most prominent / funded / controversial / mediatized / disruptive food startups. In the five following sections, I dive into each different supply chain step previously introduced, and map visited companies along with other innovative food startups in the U.S on the food innovation landscape (see exhibits 6 and 7 in Appendix for more details about visited companies).

In the following part, I build on the Institute for the Future's Seeds of Disruption map to present my analysis of impact-driven innovation in food and agriculture (Institute for the Future, 2013).

State	Initial state of the system	Goal of step	Disruptive factor	Current state of the system	Aspiring goals for future state of the system
Production	Commoditization of food, population growth, growing social inequalities	Produce more food, cheaper; intensification and homogenization	Heavy government subsidies of crops such as corn and soy, overexploitation of soil, uncontrolled pollution, hyper concentration of food manufacturers	Eroded soils, loss of biodiversity, loss of control for farmers and financial distress, labor exploitation	Biodiversity and environment preservation, fairer split of value creation, more control back to farmers, without compromising disproportionately on yield and end price
Distribution	Centralized, intermediated system, global culture of convenience and constant supply, exploitation of worldwide products availability / price, one frictionless international food system, technology is the limit	Seamless, year-long supply of products irrespective of seasonality, facilitate frictionless and abundant supply to large food manufacturers	Hyper concentration of food manufacturers, growth of sharing economy and starting shift in collective consciousness about the carbon footprint of our food system	Restrictive contractual relationship between Big food and farmers often leading to limited distribution channels for farmers and financial distress, high carbon and food quality (nutrition and taste) impact of extensive food transportation, development of food deserts	Multiply distribution channels for farmers and empower local networks, diminish carbon footprint
Manufacturing	Commoditization of food, growing need of convenience and fast consumption, increased female employment and less time for domestic chores, growing social inequalities, scientific and technological advances opening the door to lucrative business opportunities aligned with cultural paradigm	Provide cheap, calorically dense, convenient food, maximize market share, maximize profits	Artificially cheap unhealthy food, surreal popular success of fast food, process facilitated by heavy government subsidies, very limited (or erroneous) information to consumers about nutritional guidelines and health implications, vastly adopted in schools	Chronic diet-related diseases, loss of culture of food as social binder, distancing of new generation with origin of food, global shift of paradigm around budget allocation to food	Increase global health, increase transparency, enhance responsible food processing, yield healthier food options

Shopping	High urbanization and structural centralization, culture of convenience and frictionless supply	Provide year-long supply of affordable, diverse foods, easily accessible	Cheap unhealthy alternatives, shrink in personal time	Slow drop in grocery stores popularity with respect to highly convenient alternatives, with dual shift to fast food chains for families with limited budgets and more recently to healthy subscription based meal delivery plans for wealthier individuals; huge amount of waste	More transparency at retail level, healthy and nutrition centric stores and concepts, focus on food inclusion, waste reduction
Eating	Regular home-made family meals, little processed foods, increasing popularity of sugar and limited existing and or publicly available nutritional knowledge	Reconvene as a family at the end of the day, generate both pleasure and energy	Women increasingly active, appearance and normalization of TV dinners and drive-in, global shift in culture and loss of food's characteristic as social cement	Food mostly seen as calorie-based subsistence material, highly commoditized, lack of information and know-how, allocated limited time and budget	Bringing people back into kitchens and dining rooms, shifting eating habits back to home-made food, facilitating cooking
Waste	Limited waste and collective interest and or awareness	Dispose of leftover food and packaging in a way that is both convenient and respectful of the environment	Industrialization, intensification and centralization of food system leading to high amount of waste at all steps in supply chain	Astoundingly high waste in a time of high environmental stress and resources consumption, and food insecurity, increasing collective awareness	Tend towards a zero-waste food system, by diminishing excessive production and optimizing subsisting waste management in a way that minimizes hunger and environmental damage

Table 3 - Initial state of the system, disturbing factor, current state and future aspirations

Reading guide for Part II

We provide in the table below the reasoning behind the methodology followed in Part II. The diagram illustrates the approach described in the table, and circled numbers refer to steps 1 to 4 in the table. All four steps are run through five successive times, for each of the five levels of the supply chain as described in the Institute for the Future's Seeds of Disruption map (see Appendix 1): production, distribution, manufacturing, shopping and eating.

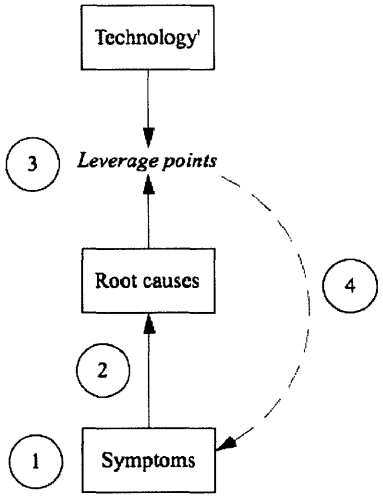


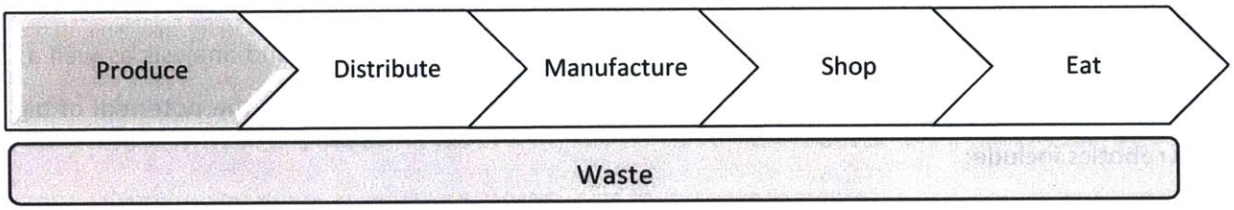
Figure 18 - Illustration of approach followed in part II

***Basic assumption throughout**: innovation targeting the root causes behind the symptoms of the food system will drive positive change. There may be other ways to mitigate symptoms, but we focus through this report on root cause-targeted innovation.*

Step	Format	Description
1		**>> Start from symptoms** Goal: mapping of key ills behind our current food system at a specific level of the supply chain.
2		**>> Induce corresponding root causes** Goal: identifying corresponding root causes by working back up the initial symptom map and reflecting on required conditions to mitigate these causes.
3		**>> Identify leverage points** Goal: understanding where technology meets root causes by deriving from reflection in (2) precise leverage points in the system where technology has the potential to drive change.
4		**>> Identify change agents and resistants** Goal: opening up the reflection to who will drive that change. To take advantage of leverage points to decrease symptoms, we must open up the dialogue to which voices in the system are advocates versus detractors, and actors versus influencers. We provide a simple tool at the end of each section to spark this conversation. *Legend – h: high; m: medium; l:low.*
5		**>> Case in point** Goal: illustrating innovation trends discussed with concrete examples.

Table 4 - Description of methodology followed throughout part II

5. *Production – Rethinking optimization*



Let's start from the problems depicted in the table above. Here is my attempt to represent the limits of the current state of the system, through the production lens.

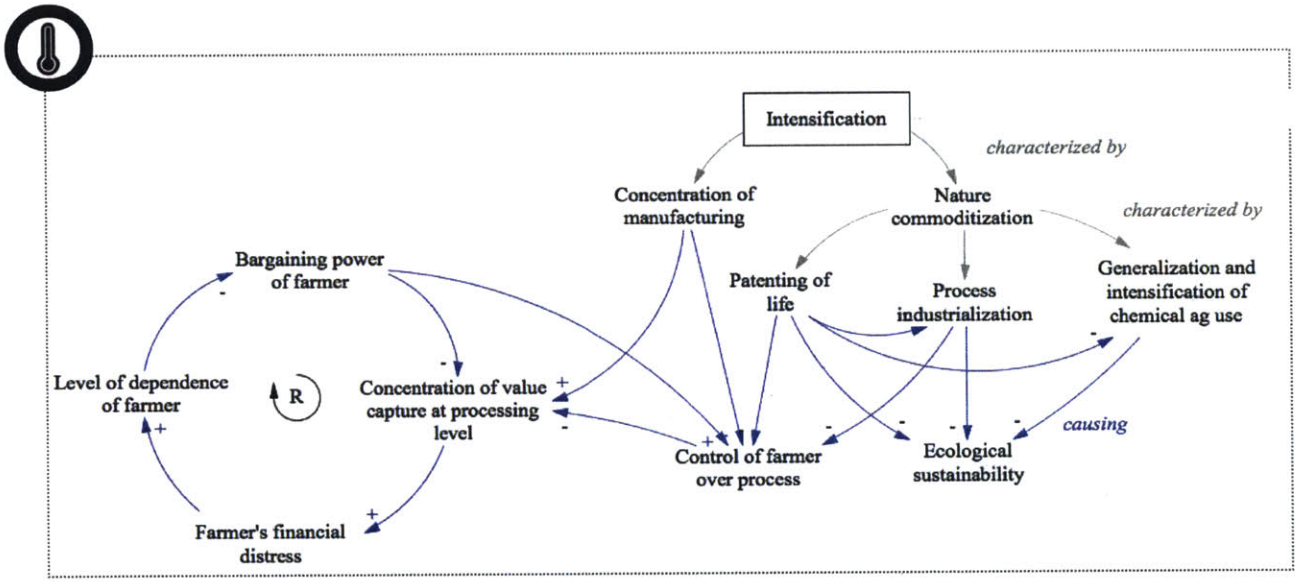


Figure 19 - Dynamic representation of system's ills, Production

Intensification has been the watchword in the industry for decades. Recently however, we have started witnessing the emergence of a new approach to optimization and the meaning it carries, characterized by a shift from a resource-intensive agriculture to low-impact alternatives. From what I observed, this shift has been mostly taking two facets:

The first facet could be summarized by a subtle transition from chemical-driven yield optimization to holistic, data-driven process optimization. The goal remains the optimize yields, but adding a series of (ecological) constraints and technological game changers to the equation while reducing process inefficiencies. This has notably been enabled by the revolution in data collection and analysis as well as the big trend towards robotization. Some interesting example of startups exploiting the potential of big data and robotics include:

Summer Technologies *| 2014 | [Pasture management] helps ranchers optimize the grazing potential of their land and perform fast decision making through digital record keeping and smart visualization.*

Cabbige *| 2014 | [Pricing management] provides farmers with pricing tool, real time inventory management and harvest / sales reporting for revenue enhancement and effective planning.*

Granular *| 2014 | [Global farm management] provides a transversal farm management software and analytics platform guiding farmers through effective planning, operations and team management, and performance analysis.*

MIT Open Agriculture Initiative *| 2015 | [Computerized precision ag] is an open source software and hardware platform often referred to as "food computers" within the MIT and broader food communities for sensor-controlled hydroponic and aeroponic agricultural systems.*

This trend has been evolving closely to robotization and the application of robotics to precision agriculture, such as the Autonomous Micro Planter (AMP) Prospero, a working prototype robot that uses swarm and game theory to automate complex agricultural tasks – this could have huge impact, allowing for automated inch by inch farming and pre-planting soil analysis, paring optimal seed varieties to each particular chunk of land (Durhout, 2011). Similarly, drones, which started as a military tool, could end up as a mainstream green-tech. With advanced sensors and imaging abilities, they are providing farmers with a new way to increase yields while reducing crop and soil damage, allowing for water usage reduction and drop in the chemical load in our environment (and food). (Anderson, 2014)

The second main facet behind redefining optimization lies behind input reduction. This can take various formats:

- No soil, low-water, less space-intensive growing, widely popularized with hydroponics (replacing soil with nutrient-rich water), aquaponics (growing fish and plants simultaneously through virtuous cycle of waste reutilization) and aeroponics (growing plants in an air/mist environment with no soil and very little water) (Iseman, 2012).

***Grovelabs** | 2013 | [B2C aquaponics] builds beautifully designed intelligent indoor gardens to reconnect people with their food in the home, the office or the classroom. The aquaponic ecosystem is equipped with sensors and wifi connectivity to track plants, microbes, and control the entire ecosystem digitally. MIT founders imagine a future where families grow 20-50% of their own food with floor to ceiling growing appliances in entire rooms in their homes which they refer to as their "Groves", and raised more than $4.4 million to make this a reality.*

◆ *Other examples*: Freight Farms, Fresh Box Farms, MIT Open Agriculture Initiative

- Redefinition of proteins, making space for countless lab-grown and plant-based meat and dairy alternatives, algae derivatives and both assumed and concealed insect-based products. These global gold rush to launching such products roots back to both their health benefits compared to animal proteins, as well as their ecological benefits – they require much fewer inputs (water and land surface) for growth, and generate significantly less carbon for similar for equivalent volumes. (add a concrete example). Traditional animal protein alternatives have been on the market for a while, but the big revolution comes from the fact that all these products are now aggressively targeting hardcore meat / dairy lovers, thus attaching tremendous importance to unanimous, unequivocal taste and texture imitation. In symbiosis, algae and insect based products are imposing themselves at a dizzying rate within informed circle as an increasingly credible edgy, highly nutritious and sustainable foods, reshaping deeply rooted cultural culinary appreciations and preconceptions. Furthermore, insects have a huge potential in terms of cheap, nutritious, ecological animal feed.

-

***Impossible Foods** | 2011 | raised more than $170 million notably from Khosla Ventures and Bill Gates to revolutionize the meat industry by making the best meats and cheeses entirely from plants, bringing the new generation of sustainable meats and cheeses to all meat lovers without the health and environmental drawbacks. They look at animal products at the molecular level, and select specific proteins and nutrients from greens, seeds, and grains to recreate the complex experience of meat and dairy products.*

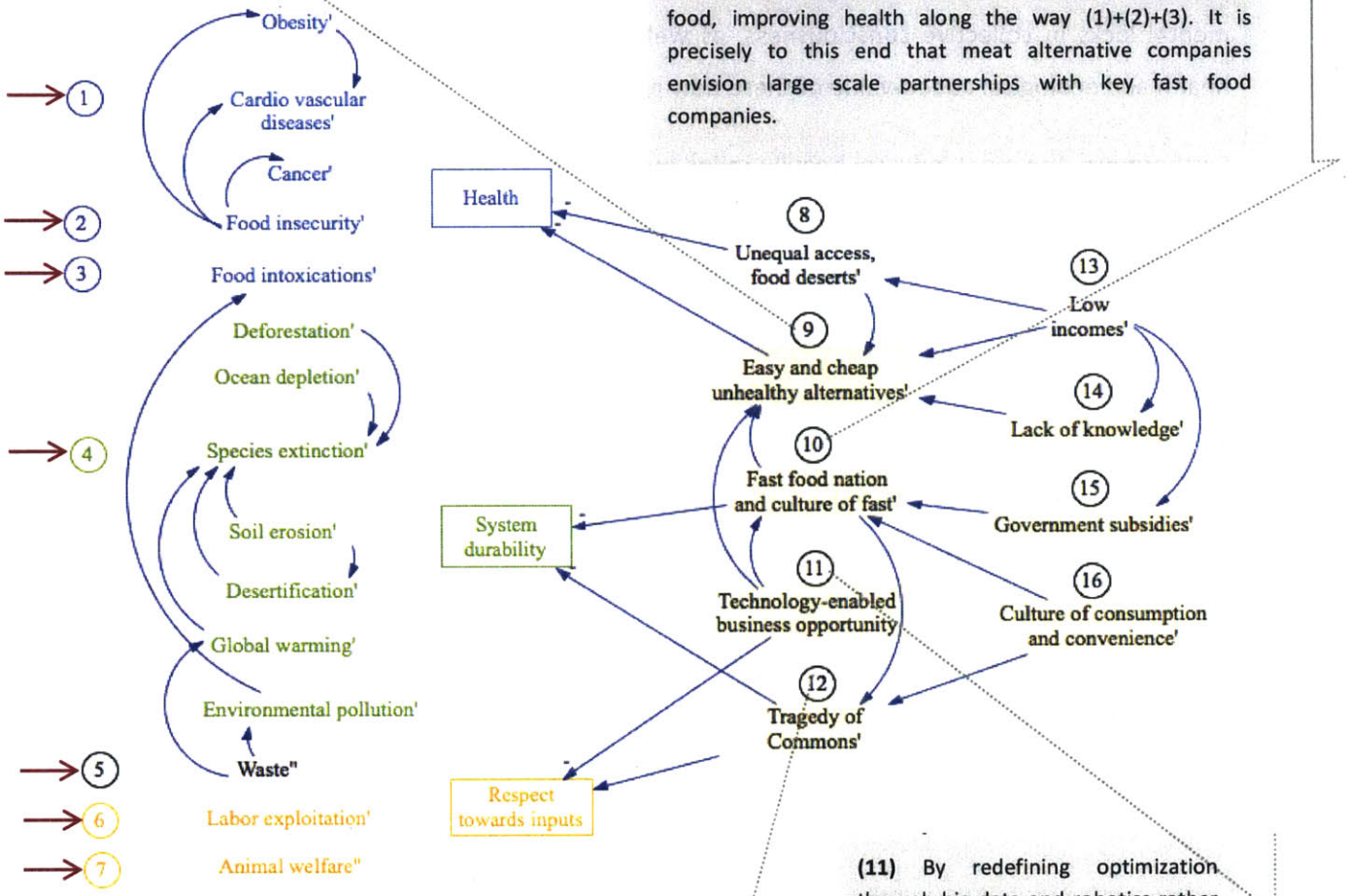
- *Other examples of animal product alternative companies: [meat] Beyond Meat, Memphis Meat, Tuforky, Modern Meadow, Tomato Sushi, New Wave Foods; [dairy / egg] Muufri, Hampton Creek, Clara Foods; [insects] Exo, Six Foods, Tiny Farms, Bitty Foods; [algae] Algama, Energy Bits, Solazyme*

Additional cutting-edge research like the one behind Indigo is also worth mentioning, as it has huge potential for disrupting conventional agriculture. Indigo researches microbes that have evolved in conjunction with plants over millions of years to optimize their health and maximize their productivity, potentially reducing the need for intensive chemical use in contemporary agricultural practices.

Let's look at our systemic representation of problems and limitations in the food system, through the production lens. We first consider root causes for the ills observed at the production level, and discuss some strains of uncertainty at the root of change. We will be replicating this approach for each of the five levels of the supply chain.

(9) The innovations outlined above at the production level allow for effective cost control for farmers, making space for potential decrease in price of organics. This could trigger wider accessibility to tasty, nutritious plant-based foods, potentially increasing their consumption across social classes (2) and diminishing chronic diet-related diseases (1). Additionally, plant-based proteins are healthier than their animal equivalent; hence the spread of alternative products would also improve global health (1)+(3).

(10) Hamburgers, hotdogs, pepperoni pizza, fish and ships - today, the fast food paradigm involves meat. The emergence of easy and cheap healthy alternatives (9) could potentially alter this paradigm by creating a new, greener type of fast food, improving health along the way (1)+(2)+(3). It is precisely to this end that meat alternative companies envision large scale partnerships with key fast food companies.



(11) By redefining optimization through big data and robotics rather than homogeneous and intensive chemical use, some control and value creation are redistributed back to farmers, increasing their margins and autonomy / bargaining power, thus limiting (6).

Furthermore, the emergence and generalization of animal protein alternatives thanks to technological advances is clearly a way to alleviate animal welfare (7).

(12) The only way to limit the effect of the Tragedy of the Commons on our system's resources is by coming up with technology-enabled alternatives (both in terms of processes and products) which in the worst scenario do not impact profitability, and has clear additional advantages (effort or time required, ecological impact, market share, brand affection etc.). This is a way to significantly improve our system's durability (4).

Similarly as discussed for (11), these alternatives have the potential to enhance both farmers' working and living conditions as well as animal welfare.

Figure 20 - System map of targeted innovation, Production

There exist however several strains of uncertainty behind these various scenarios.

Part of these innovations rely on a **shift in collective consciousness at the consumer level**. Outside of enlightened food circles, there remain strong biases against these new sustainable foods, especially in a protein-centric country built on individual freedom in which animal proteins – and meat more specifically – are associated with manliness and strength. The success of this new genre of lab-grown food companies acting as producer, processor and seller will mostly depend on their ability to break mental locks in collective consciousness, as well as communicate information effectively around the health and ecological added-value of these new products. (11)

Furthermore, the meat industry **heavily relies today on government subsidy** of corn and soy. The take-off and generalization of the more ecological insect alternative to current animal feed will probably will probably depend on the government crop subsidy policy in the near future. (12)

Last but not least, the **current paradigm of animal commoditization** to our greatest convenience will also have to evolve from the current one-sided, exploitative model to to a more collaborative and mutually valuable relationship, in which consideration (let alone respect) for animals is restored. One popular example of this philosophy is the virtuous cycle triggered by the cohabitation of grazing cattle, chickens, soil, pasture for the greatest benefit of all. (13)

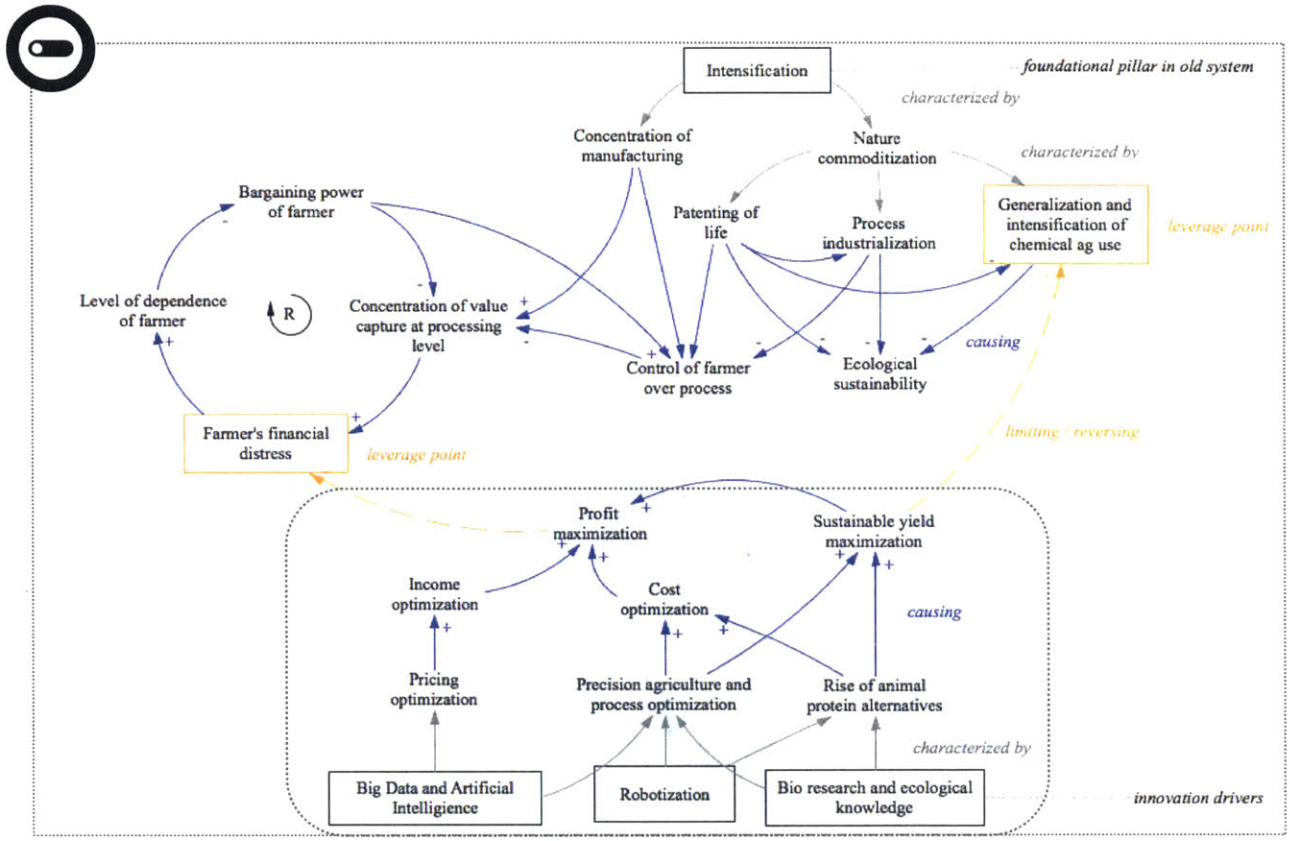
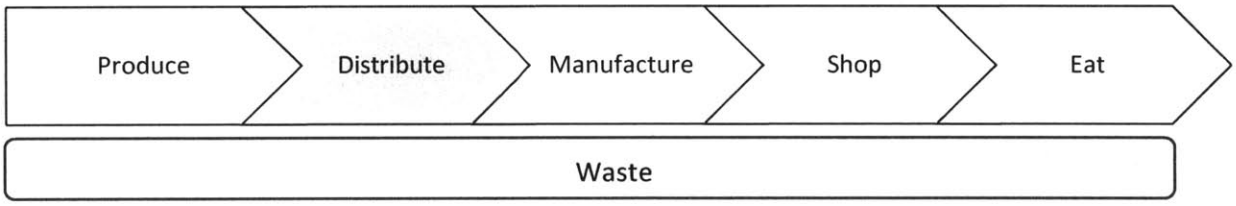


Figure 21 - Dynamic representation of innovation-driven positive change, Production

Voice	Overall bargaining power	Relevant knowledge	Will to drive change	Status	
				Influencer	Actor
Farmer	l	h	h		
Manufacturer	h	h	l		
Government	m	h	m		
Research / NGO	m	h	h		
Citizens	h	l	l		
Media	m	m	m		

Figure 22 - Voices of the system – actors and influencers, Production

6. *Distribution – Rebalancing efficiency*



The numerous symptoms previously introduced, along with amplifying factors such as the multiple food scandals that further stained our food system and its practices (mad cow crisis, e-coli and other deadly food intoxications etc.) have all been calling for more transparency.

One way to achieve a higher level of transparency is to shorten the length of the supply chain, to enhance visibility at each step, maximize control and preserve information throughout the supply chain. This is one of the main triggers of the local food trend.

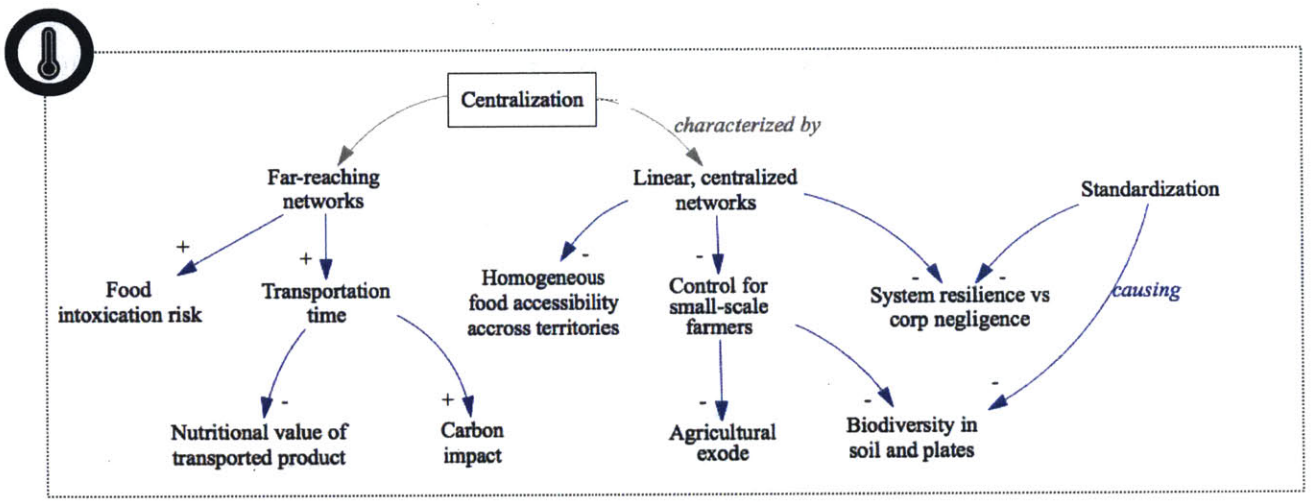


Figure 23 - Dynamic representation of system's ills, Distribution

In that sense, we are evolving from high distance, highly efficient, rather linear distribution networks dominated by large producers, to more decentralized, dispersed networks of local nodes. While high-scale, far reaching models would allow for economies of scale and high control and predictability levels through standardization, distributed models have many benefits, among which:

- Encouraging biodiversity both in our soil and our plates, assuming that smaller-scale farmers use different crops and varieties (unfortunately, a decreasing trend);
- Creating a more inclusive system where upstream labor is more respected and valued, while giving back control and bargaining power to small-scale farmers;
- Promoting a more humane, de-commoditized agriculture, in which shorter distances and tighter relationships with those who produce our foods are starting to be celebrated;
- Encouraging a profession crucial to national stability, well being, independence and security, at a time when many farmers are deterring their children from farming;
- Generating healthier practices, as a decentralized system implies more small scale actors, increasing market offering, competition and thus often better alignment with market expectations;
- Allowing for fresher (as less time on the road), and thus more nutritious produce;
- Potentially reducing waste through local optimization;

- Enabling higher resilience and adaptability, enhancing food systems' security against both corporate negligence and intentional sabotage, in a world where food systems integrate at their core hackable technologies and are highly vulnerable to intentional disruption (Institute for the Future, 2013).

This shift towards local is made possible notably by social technology platforms and optimization technologies, allowing for B2B demand aggregation, space optimization during transportation (in line with the rising trend of the sharing economy) and distribution channels multiplication.

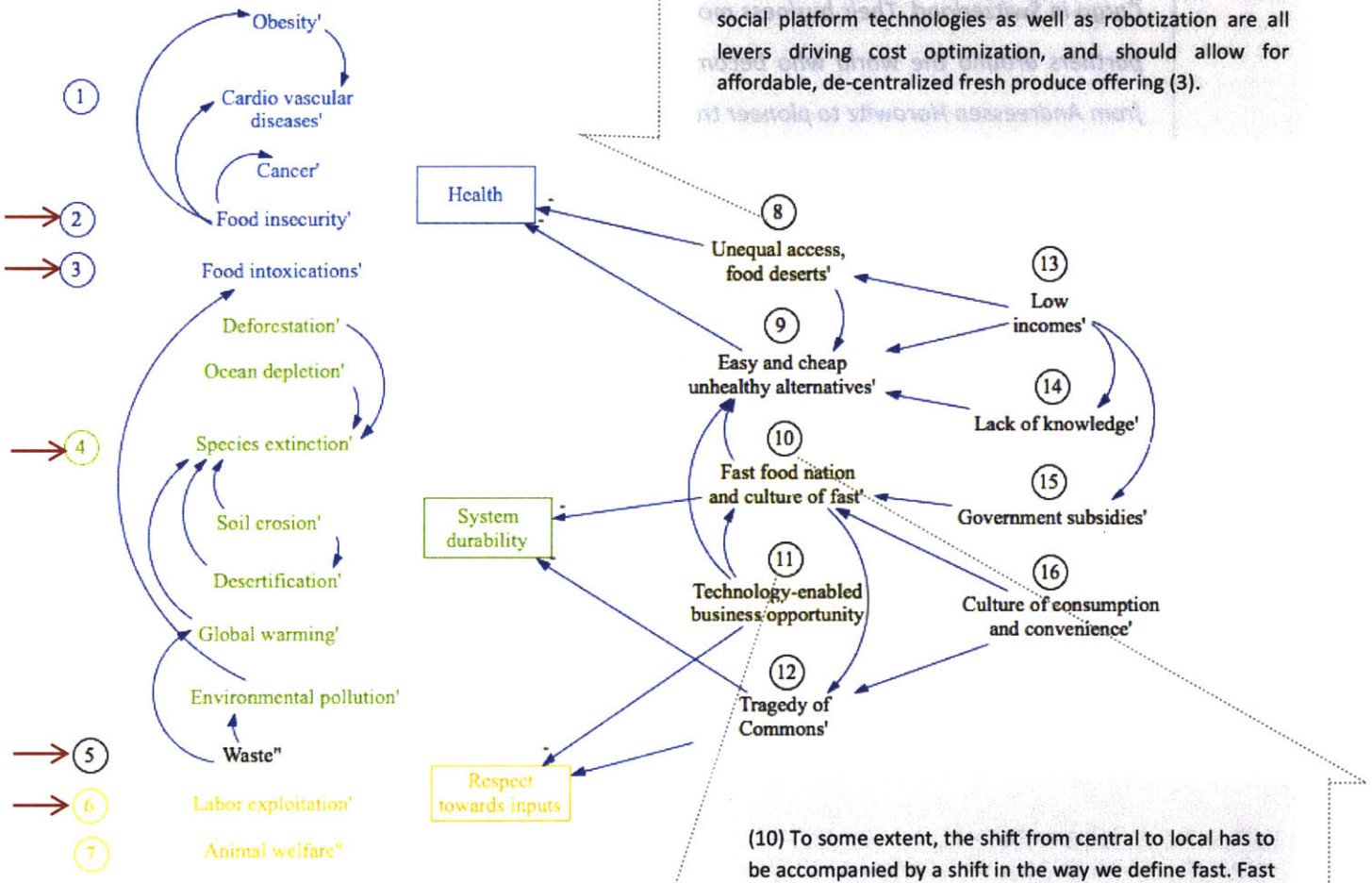
***Provender** | 2013 | is an online marketplace that empowers farmers to quantify and organize their yields, and to make that data accessible to buyers everywhere. Applying network dynamics to a traditional industry dominated by intensive hierarchies and cash-intensive, time consuming archaic processes based on phone calls and fax machines, Provender provides simple tools to support supplier-restaurants relationships through sales, marketing, invoicing and payment. They are in phase with the soaring demand for transparency among customer, and want to build a new, frictionless supply chain through technology around transparency, diversity and freshness.*

◆ *Other examples: Local Food Systems, Food Hub, Cola Life*

Robotization with drones and driverless cars also have a huge disruptive potential in food distribution. By significantly cutting on operational costs, this would go well in the way of local sourcing, dispersed deliveries and customization.

Matternet *| 2011 | is the first smart drone company for transportation. It builds drones and Cloud sowftware to enable automated logistics networks for healthcare logistics. Their first product, the Matternet ONE drone, has already been certified for beyond-line-of-sight logistics operations by the Swiss Aviation Authorities and is being deployed by Swiss Post and Swiss World Cargo in Switzerland. Their business model is solution as a service — they lease their products to partners around the world who become the operators. Matternet raised $3.5 million in seed from Andreessen Horowitz to pioneer transport automation.*

- *Other examples of transportation innovators: Local Food Systems, Food Hub, Cola Life*



(8) By creating denser, narrower, more local distribution networks, access to fresh, nutritious produce should be simplified and generalized (2). It's important to take into account areas with few or no farms, and integrating these spaces efficiently to local, regional and national solutions. In terms of affordability, space optimization, resources sharing, social platform technologies as well as robotization are all levers driving cost optimization, and should allow for affordable, de-centralized fresh produce offering (3).

(10) To some extent, the shift from central to local has to be accompanied by a shift in the way we define fast. Fast has often been associated with cheap, standardized and linear. Yet in this new model, technology allows for integration to existing infrastructure, administrative task automation and overall process optimization. Fast becomes engineered frictionless to operate sustainably within disperse networks.

Local has the potential to cut on carbon emissions and boost freshness of transported produce, but it may come at the price of more variation and unpredictability in product offerings, and slight higher premiums. It is our responsibility as citizens and consumers to redefine the just value of healthy, fair food. (4)

(11) Process optimization enabled by technology as described in (10) allows for better control over costs as well as more numerous distribution channels, and thus higher revenues. In that sense, it is a powerful lever to tackle labor exploitation and bring bargaining power back in the hands of farmers (6), on top of being a promising business opportunities for innovators in the distribution / marketplace sectors.

Figure 24 - System map of targeted innovation, Distribution

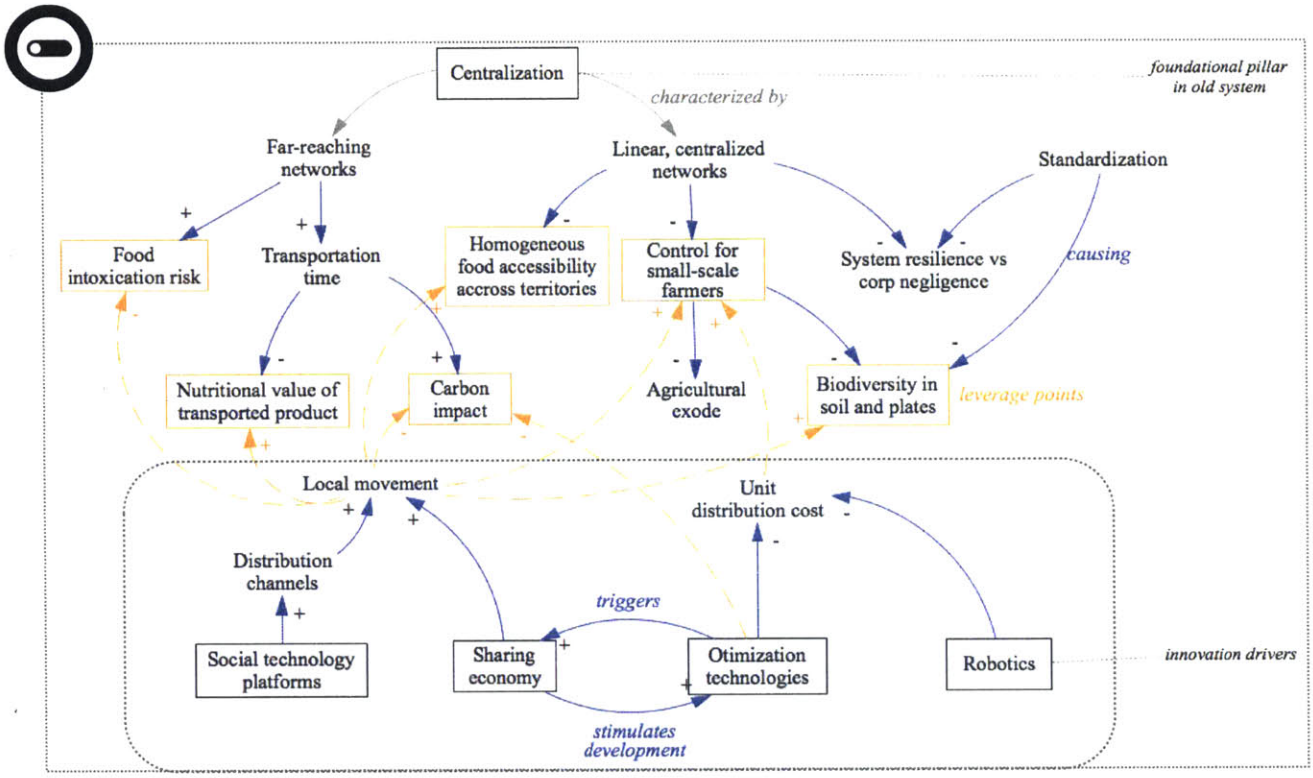
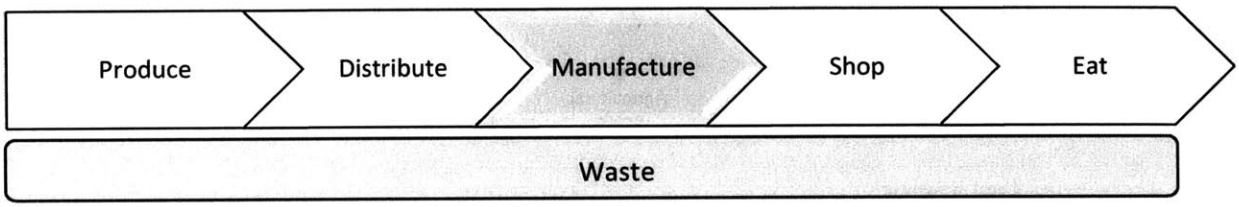


Figure 25 - Dynamic representation of innovation-driven positive change, Distribution

Voice	Overall bargaining power	Relevant knowledge	Will to drive change	Status: Influencer	Status: Actor
Farmer	m	m	h		X
Manufacturer	m	h	m	X	X
Government	m	h	m	X	X
Research / NGO	m	h	h	X	
Citizens	h	l	l	X	X
Media	m	m	m	X	

Figure 26 - Voices of the System – Actors and Influencers, Distribution

7. *Manufacturing – Challenging standardization*



At the manufacturing level, innovation seem to be pushing towards a global shrink of the supply chain length and manufacturer's functions from both ends of the supply chain. Innovators are empowering both farmers and consumers to perform tasks that used to lie under the jurisdiction of food manufacturers.

For the last few decades, affordability, convenience and cultural / chemical popularity of products have been driving profitability at the manufacturing level.

- **Affordability** – heavy government subsidies have allowed for extraordinarily cheap products, driving price expectations down, as well as budget allocation to food. To maximize market share and profit, industrial food manufacturers have been under a constant race to cost optimization to be able to keep prices as low as possible while still maximizing their bottom-line. This has had severe repercussions on farmers well being, financial stability and autonomy. Race to cheap has also accelerated the trend of standardization at all levels of the manufacturing process (inputs, risk-minimizing and other optimization practices like mass pesticide / antibiotics / growth hormone use, and thus resulting end products), which has had severe repercussions on our soil and plate diversity, on animal welfare as well as the average nutritional value of products on grocery stores shelves.

- **Convenience**, sparked by fast food chains drive-ins, was replicated in the manufacturing of food products directed at grocery stores, with a mix of controversial conservation

processes, ranging from freezing to preservatives, and high waste production. The impact on health is amplified by the natural decay of produce nutritional value over time.

- **Popularity**. Last, the focus has often been placed on unhealthy foods with high sugar and fat concentration; resulting both from cultural taste preferences and habits as well the addictive potential of substances like sugar, which has been demonstrated to be 8 times more addictive than cocaine.

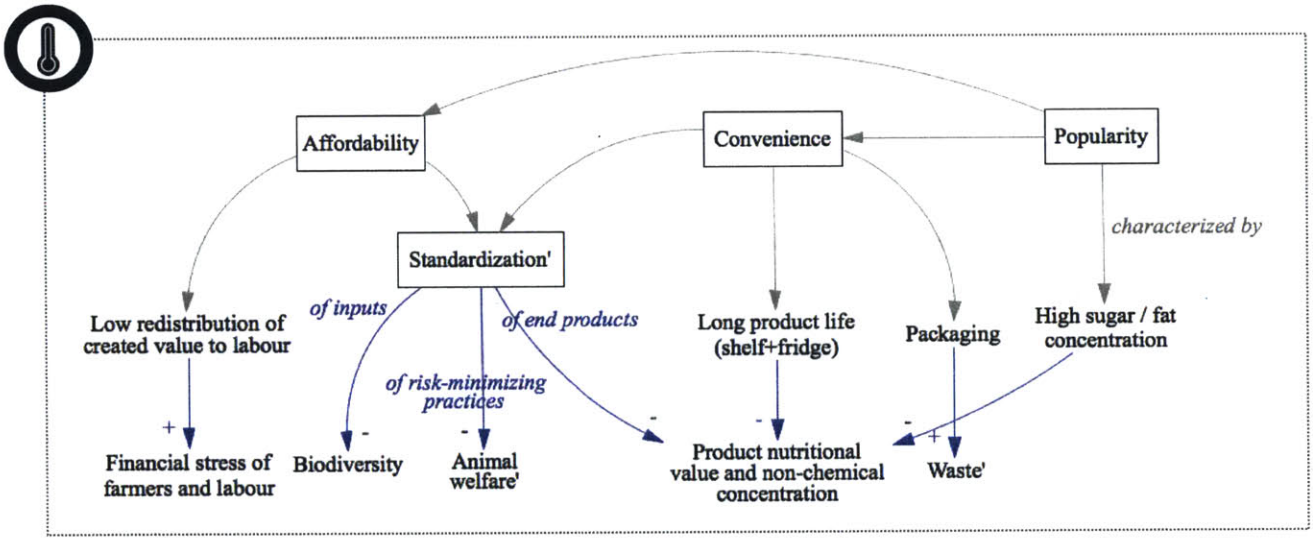


Figure 27 - Dynamic representation of system's ills, Manufacturing

This has sparked general interest and demand for more fairness and more transparency throughout the manufacturing process. Besides, making space for more fairness and transparency represents attractive business opportunities, as we have seen is the case at the production level with farmer-empowering ag-tech innovations.

And, likewise, customer-empowering food technologies are flourishing. Innovation takes time to penetrate industry mammoths at the manufacturing level, which output most of the products available on mainstream grocery stores' shelves and dictate prices lower bounds.

Thus innovators from all over the board have been taking advantage of this gap between market offerings and collective bias / consumers aspirations, bringing to the market a myriad of tools and products to decipher obscure ingredient lists, but also to bring into people's kitchens the power to process foods in ways that were until recently restricted to food professionals – lifting the veil on home-

produced soda, home-brewed beer, home-made ice cream, pasta, bread etc. Innovators have also taken advantage of the power allotted by the digital economy to engage directly with consumers to understand and collect their exact preferences, offering products tailor-made to their preferences, dietary restrictions or lifestyle.

***Sage** | 2011 | [transparency] or food labelling 2.0. Sage shows everything you wish a food label showed through simple, intuitive visualizations that help understand a product and what its data means for customers. They partner with food manufacturers which are offered a dedicated online space where they can promote transparency behind their products through engaging, centralized data.*

***Munchery** | 2011 | [customization] offers healthy dinners, handmade by local chefs for same-day home or office delivery. Munchery raised more than $120 million to pioneer the healthy meal delivery industry, and aligns with customers' demand for higher personalization and transparency by offering filtered dietary options such as vegetarian, vegan, kids, low-carb, gluten-free and dairy-free.*

- *Examples of customer empowering appliances: K-Cup (a Keurig product), Foodini (a Natural Machines product), SodaStream, Tovala, Spyce Kitchen (a Spyce product)*

This latter trend is completely in line with the booming trend of the quantified-self, according to which individuals personally monitor their health using an assortment of connected objects retrieving real-time health information, ranging from sleep quality to physical activity levels, weight evolution, UV exposure and cardiac activity. Customized nutrition aligned with data-backed health recommendations is the next step to full self-regulation of our health and well-being.

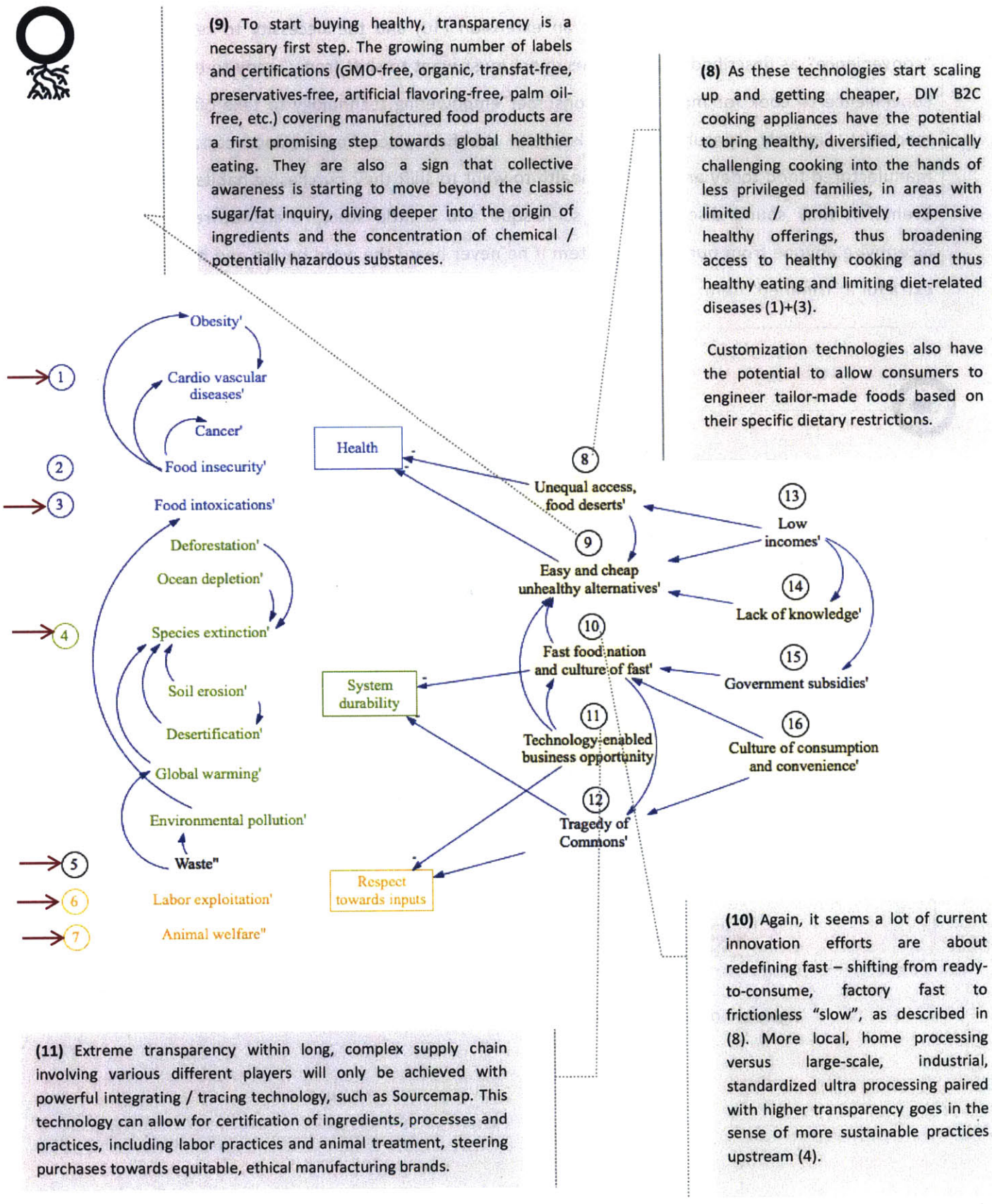


Figure 28 - System map of targeted innovation, Manufacturing

The strain of uncertainty (16) really is an extension (10) and the necessity to redefine "fast" and "convenience" as described above – consumers must want to shift from "ready-to-eat" convenient to convenience to cook for most of the consumer empowering technology to take-off in the American market(s). Similarly, consumers must know in the first place how noxious certain substances in manufactured food today are for their health to want to shift their purchasing habits in the first place. Even if it may sound disconcertingly sci-fiesque and a little scary, "trans-fat-free" is unlikely to incentivize anyone from purchasing an item if he never heard the word before and have to spend 10% extra for a "trimmed" item.

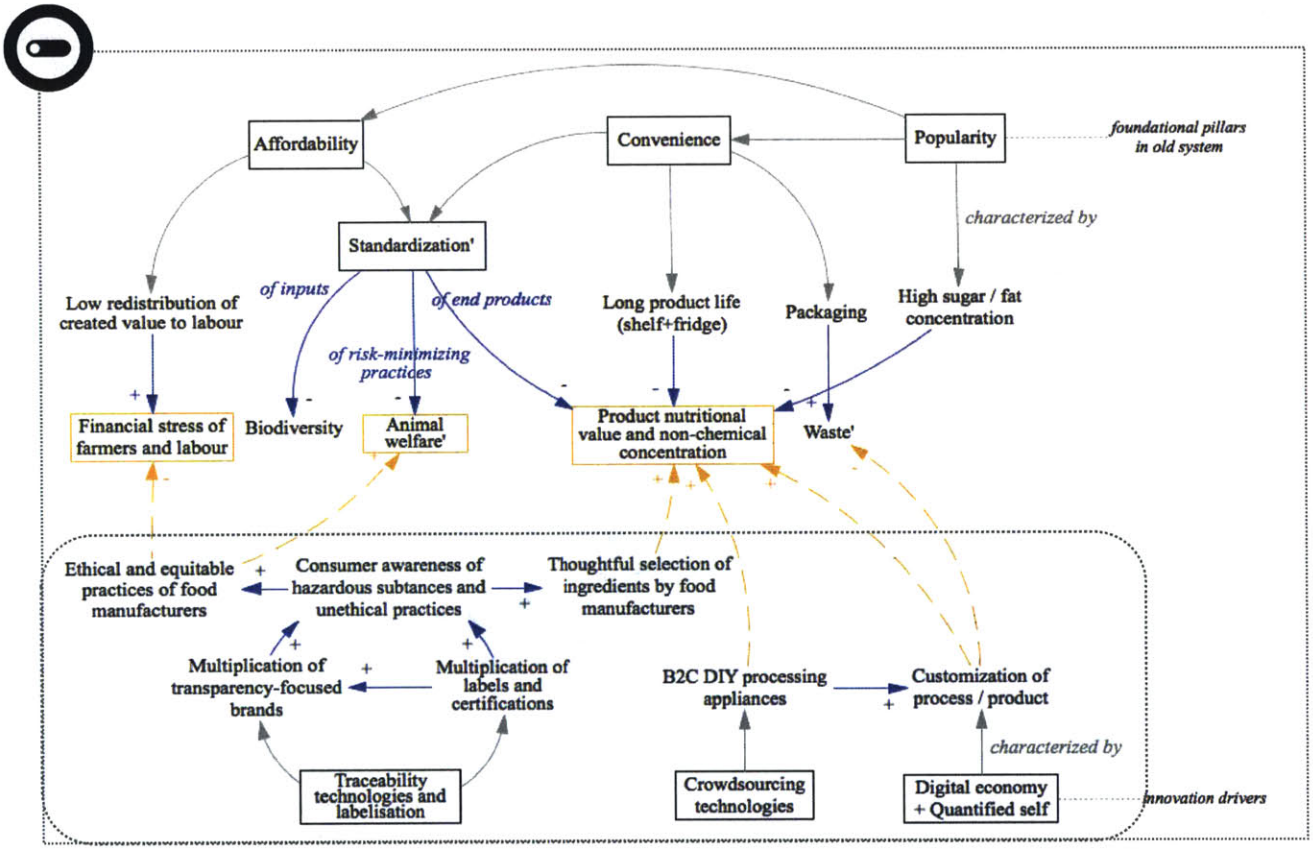
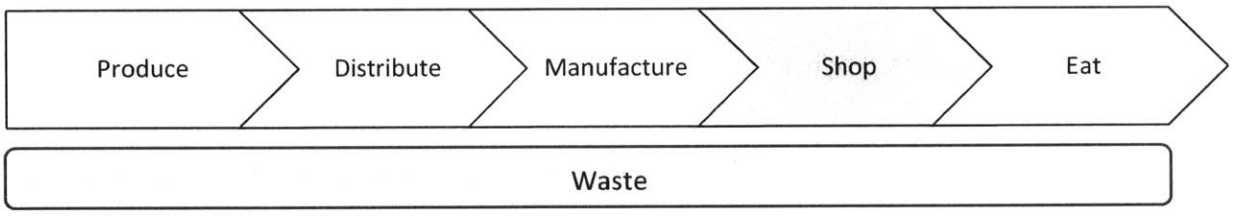


Figure 29 - Dynamic representation of innovation-driven positive change, Manufacturing

Voice	Overall bargaining power	Relevant knowledge	Will to drive change	Status	
				Influencer	Actor
Farmer	l	m	h		
Manufacturer	h	h	l		
Government	m	h	m		
Research / NGO	m	h	h		
Citizens	h	m	m		
Media	m	m	m		

Figure 30 - Voices of the system – actors and influencers, Manufacturing

8. *Shopping – Reorganization centralization*



Grocery shopping has long been characterized by centralization. This had great convenience benefits – instead of having to stop at each individual producer / manufacturer, consumers were now offered a one-stop shop, with all the weekly required grocery supply available at the same location.

The problem is that it now conflicts directly with modern technology-enabled trends and aspiring lifestyle. Supply chains have lengthened and stretched far beyond national boundaries, making on-shelf transparency a real challenge, at a time of weakening consumer trust and soaring skepticism. It is also weighing more and more heavier on consumers' chores list, as women – who have always been

historically the main grocery shoppers – are more and more numerous to integrate the professional scene, yielding a significant shrink in available time for chores. Amazon has shifted the global shopping paradigm, from online shopping / payment customer skepticism to a highly addictive cross-sector hegemonic norm. We are entering the golden age of frictionless home delivery, putting us constantly one click away from personalized orders and one day away from item reception on our doorstep.

We are also witnessing a cultural shift to an era of high degree customization in both services and products, as the digital economy allows for personal interaction with customers and highly specific profiling.

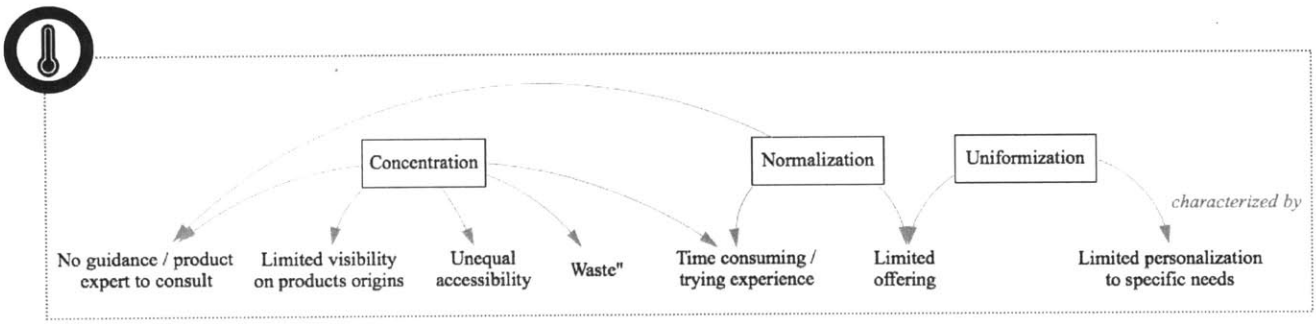


Figure 31 - Dynamic representation of system's Ills, Shopping

All this has deeply transformed the way people shop for groceries today, and their expectations towards sellers, funneling retail innovation in the two following directions:

- **The rise of delivery models**: food delivery models are booming. From holistic grocery delivery services to product specific boxes, food delivery models are redefining the way way we supply ourselves with food. And it comes with plenty of advantages, specifically in terms of time savings and customization – saving of purchasing preferences, automatic re-orders, personalized suggestions, among other smart time optimization / experience customization features.

***Instacart** | 2011 | [home delivery] is a same-day grocery delivery company delivering groceries and home essentials from a variety of local stores. Instacart has raised over $275 million in funding notably from Andreessen Horowitz, Sequoia Capital, Y Combinator, and Khosla Venture, and features over 500,000 items from local stores in its catalogue.*

***Blue Apron** | 2012 | [meal kits] is a grocery delivery service company that delivers a recipe and the required, pre-proportioned ingredients to their customers' homes. They raised more than $190 million and ambition to revolutionize the way people eat by designing a frictionless cooking experience, sparking a global movement back into kitchens.*

***Imperfect** | 2011 | [online marketplace] delivers discounted boxes of fresh and ugly produce, from farms to consumers. Bringing odd-shaped produce back into the loop allows them to combat both food insecurity and waste.*

◆ *Other examples: [specialized subscription models] Nectar & Green (almond milk), Vinebox (wine), [generalist marketplaces] Good Eggs, [meal kit subscription models]: HelloFresh, Plated, Purple Carrot, PlateJoy*

- **Rethinking the retail in-store experience:** to stay competitive face to the rising market share of delivery models, grocery stores have had to start reinventing themselves. Convenience is not a selling argument anymore. Experience though cannot be replicated into a delivery box. Many grocery stores play the experience card to incentivize shoppers not to give up hopping in their cars for regular visits by the supermarket. There are many exploration fronts – greater transparency with both inspiring and informative on-shelf labels, customer-smart space organization to maximize cart value rather than cart financial return, pop-ups and varying partnerships to introduce new products / cooking tools / producers, free produce-relevant recipes. Some stores like Whole Foods mix retail with local consumption, creating new interesting places were consumers are not only offered a great variety of novel, healthy, tasty products but also a space to sit down, sample out products, think about ingredients synergies and have a great conversation over coffee. Minimizing effort is also a way to minimize barriers with delivery models, by packing the groceries for you at check-out, or having many staff members around the store to help you with directions and product information.

We are also observing an effort to minimize waste, discounting products before they are about to expire or selling them directly through food discount apps sending alerts to local app users.

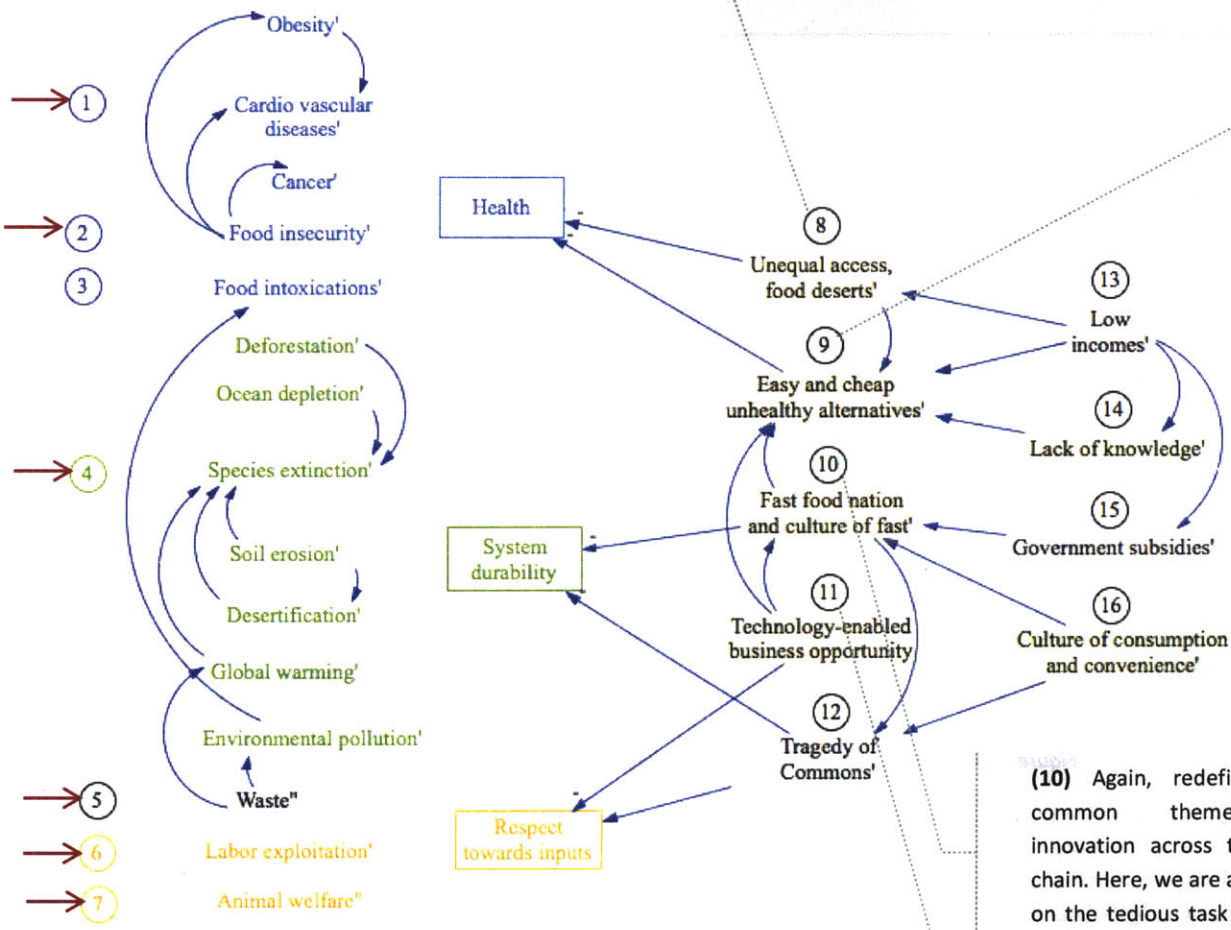
Daily Table *| 2011 | [retail] Daily Table is a clean, well designed grocery store offering healthy, nutritious produce and ready to eat meals at record low prices. Founded by ex Trader Joe's president, it intercepts food that is deemed beyond its prime and extends its life by pricing for quick sale or directing the staff's chef to prepare ready-to-eat dishes.*

Good & Gather Platform *| 2016 | is a Food+Future coLab project developed in partnership with MIT Media Lab, Ideo and Target currently being tesedt at Target which sets new standards for food packaging transparency by aspiring to be the most transparent pre-packaged food brand in mass-market grocery.It strips all imagery and logo away, featuring simple and complex products side-by-side with the ingredients on the front.*

◆ *Other examples: [retail experience] Whole Foods, trader Joe's, [waste] SpoilerAlert*

(8) Food delivery models have the potential to significantly limit food insecurity (2), by decoupling access to fresh produce from the location where you live and its proximity from healthy food retailers. This incentivizes food suppliers to maximize customer base locally to optimize delivery routes and minimize costs.

(9) Delivery models are definitely bringing easy, healthy alternatives to the table. However most of these models are not cheap enough to drive an in-depth change throughout society, and those who can afford food delivery services are usually not the ones who would need it most. In that sense, driving delivery costs down is a prerequisite to both (8) and (9). However with the drone boom / driverless car transportation revolution looming around the corner and technological costs going down every year, easy and cheap alternatives are very much graspable.



(10) Again, redefining fast is a common theme throughout innovation across the food supply chain. Here, we are after cutting time on the tedious task – shopping – to make more time for the rewarding, health-providing ones – cooking. This can have both health and waste-minimizing outcomes, such as with ready-to-cook, pre-dosed delivery services (note that high food waste is often replaced with high packaging waste, which is not much more satisfactory; this is also a space for innovation).

(11) Technology has been driving notably waste-minimizing innovation, on several fronts. At the farm level {e-subscription / delivery optimization} – companies like Imperfect ship boxes full of ugly fruits and vegetables which do not fit grocery stores aesthetic standards directly to consumers, at significantly reduced costs. At the grocery store level {network communication} – Trader Joe's ex President founded Daily Tables to capitalize on waste from the shelf, offering close-to-expiry products at a discounted price. Across the entire supply chain {online marketplace} – MIT founded Spoiler Alert connects players with excess food and food shortages, optimizing food repartition and organizing waste management.

Figure 32 - System map of targeted innovation, Shopping

Strains of uncertainties: many of these delivery models include a strong educational component. Lack of knowledge can a strong obstacle (14) keeping people away from their kitchens. Beyond the clear convenience advantage, the educational layer often brought through engaging, informative and replicable recipes, tips, and product sheets has to potential to bring long-lasting change in the American eating landscape.

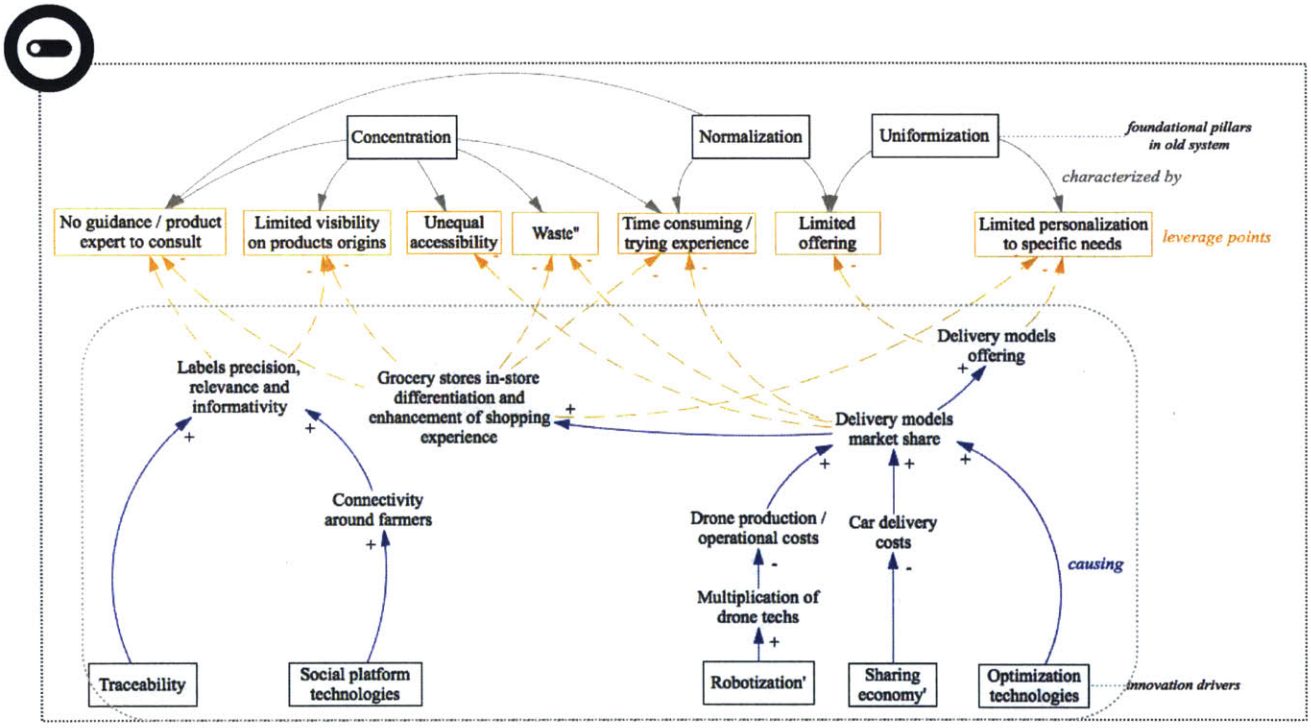
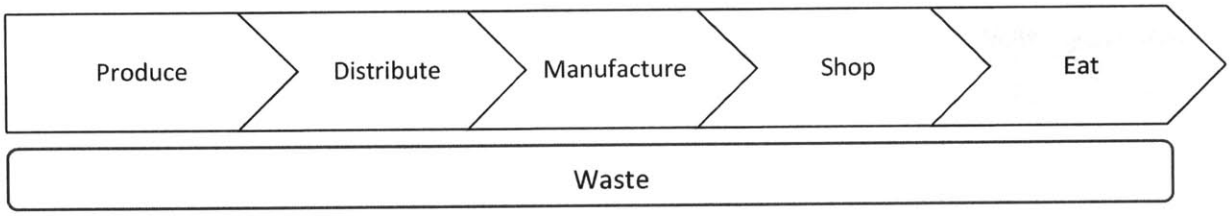


Figure 33 - Dynamic representation of innovation-driven positive change, Shopping

Voice	Overall bargaining power	Relevant knowledge	Will to drive change	Status	
				Influencer	Actor
Farmer	l	m	h	X	
Manufacturer	m	h	l	X	X
Government	m	h	m	X	X
Research / NGO	m	h	h	X	
Citizens	h	h	m	X	X
Media	m	m	m	X	

Figure 34 - Voices of the system – actors and influencers, Shopping

9. *Eating – Redefining convenience*



My theory on why eating food like we eat popcorn is both counter-productive and gangrenous

The convenience hegemony has led as we depicted previously to the commoditization of food. Through the eating lens, the latter phenomenon is notably characterized by a reduction of the duration of the act of eating, of the effort required to bring food to its ready-to-consume state, and of the exclusivity behind the act of eating, as an increasing proportion of people eat on the go, or while staring at a screen – computer, TV – or listening to someone talk – meeting, conferences. This has heavy consequences on the way we eat and the relationship we hold with our food. By shifting our focus away from what we eat

to those surrounding stimuli, we stop paying attention to our body stimuli around our eating experience. We stop fully appreciating flavors, taste becomes vastly secondary. We eat mechanically and do not feel these internal signals that point to the right time to stop eating, and often over eat. We do not pay attention to our body's rejection cues, when headaches, heavy stomachs, nausea, dizziness, tiredness, sleepiness, numbness, loss of focus are often pointing back directly to what we fueled our body with. It also takes away the time that has so long been allotted to creating social bonds across all cultures world-wide.

This mechanical eating habit also came with a rising negligence and disregard for where this food comes from. How was it produced, with what ingredients, under what labor conditions rarely crosses our mind as we eat. Yet it should not take the eye of an undercover economist to paraphrase Tim Harford to care about – let alone to know – where our food comes from. Not only does the general lack of care as end of line consumers and customers poisons our food system – it poisons it for generations to come as children seem to grow further and further away from the reality that chicken nuggets are not picked from trees and that French fries do not grow in fields.

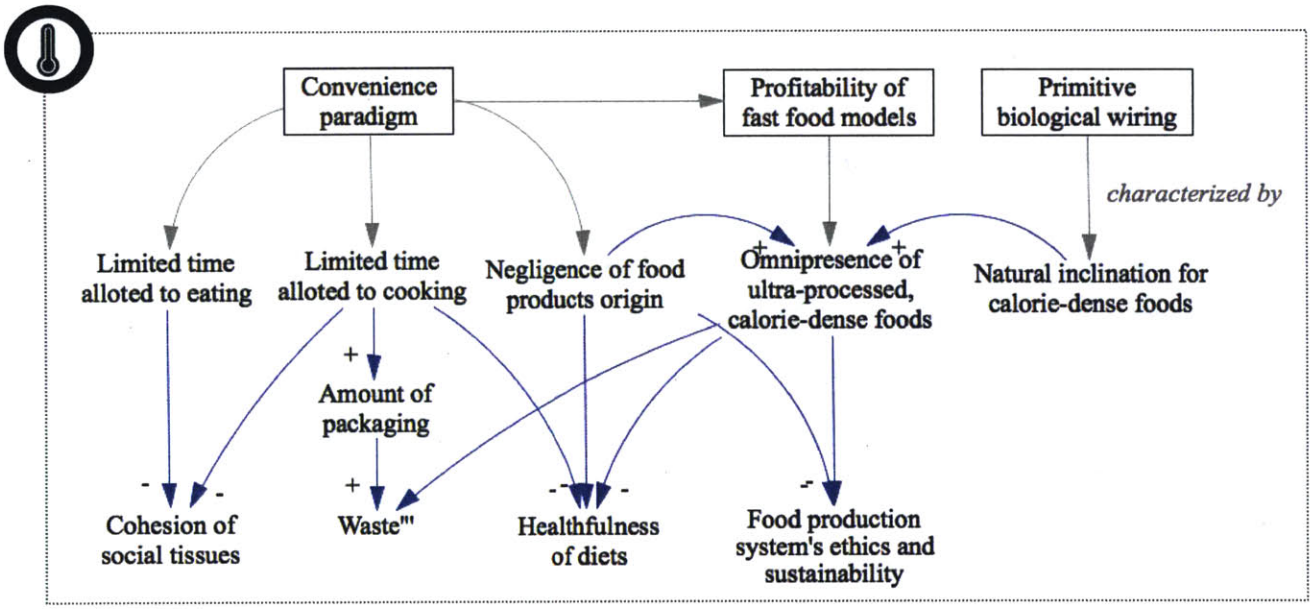


Figure 35 - Dynamic representation of system's ills, Eating

The recent nation-wide wake-up call in the face of soaring obesity gave birth to an obsessive mathematical approach to orienting our diets: a calorie-centric arbitrage model, in which the holly trinity of Fat-Carbohydrates-Protein steers the vast majority of eating decisions.

In that sense, it seems to me that innovation at the eating level is mostly represented by the two following trends:

- **The rebirth of cooking** – easy sharing of information sparked by the digital era, crossed with precise profiling enabled by digital marketing techniques has led to the spread of targeted, often customized, cheap or free cooking knowledge, and with it the global levelling up of cooking skills. With online and television tutorials, menu helpers, connected cooking appliances from refrigerators and stoves to pots, pans, cutting boards, and spatulas, cooking have never been more accessible. Cooking at home encourages social eating and bonding as well as slower and more diverse eating, driving positive change throughout the system.

***Orange chef** | 2011 | raised $4.9 million to design and manufacture hardware and software applications in order to tackle health and nutrition issues. They leverage artificial intelligence technologies to innovate in the connected kitchen category. They launched Countertop, a smart kitchen system that gives personalized snack and meal recommendations to help users eat better. It works with the appliances and fitness devices users already own to deliver customized, real-time meal recommendation.*

♦ *Other examples: [frictionless cooking] meal planners such as PepperPlate, LG's refrigerator's Smart Manager system, Blue Apron and similar meal kit services with a strong educational focus, Microsoft's Home kitchen which uses projection displays to beam information and recipes onto the countertop's surface*

- **Augmenting mindful eating** – through various ways, technology is now able to provide visual, tactile among other sensory feedback to reinforce positive habits, such as actively paying attention to the food we eat, the time we allocate to eating, body cues, and social company (IFTF).

***HAPILABS** | 2013 (HAPIfork) | launched the HAPIfork, a connected fork which monitors eating habits and alerts users with indicator lights and gentle vibrations.*

◆ *Other examples: [mindful eating] Kit Kat's "No WiFi benches" in Amsterdam, Bite Counter*

- **Rising interest for visibility over food origin** – as depicted earlier, traceability technologies have allowed for greater transparency, creating a big business opportunity and meeting a growing consumer need in the context of repeated food scandals from food intoxication deaths to animal treatment, specie extinction and man-sparked world-wide epidemics such as the mad-cow disease. This is sparking innovation around product ingredients and production process visibility. This trend is very much aligned with the eat-local movement, and enhanced by chefs' influence and their growing practice of local sourcing.

***SuperBench Platform** | 2016 | is a Food+Future coLab project developed in partnership with MIT Media Lab, Ideo and Target which envisions to become the first "ultimate truth machine" that can be used throughout the supply chain and by the end consumer. By applying visible and near-infrared spectra scans of single ingredient foods against a database of millions of data points and machine learning techniques, the platform provides users with immediate feedback on freshness, quality and nutritional composition.*

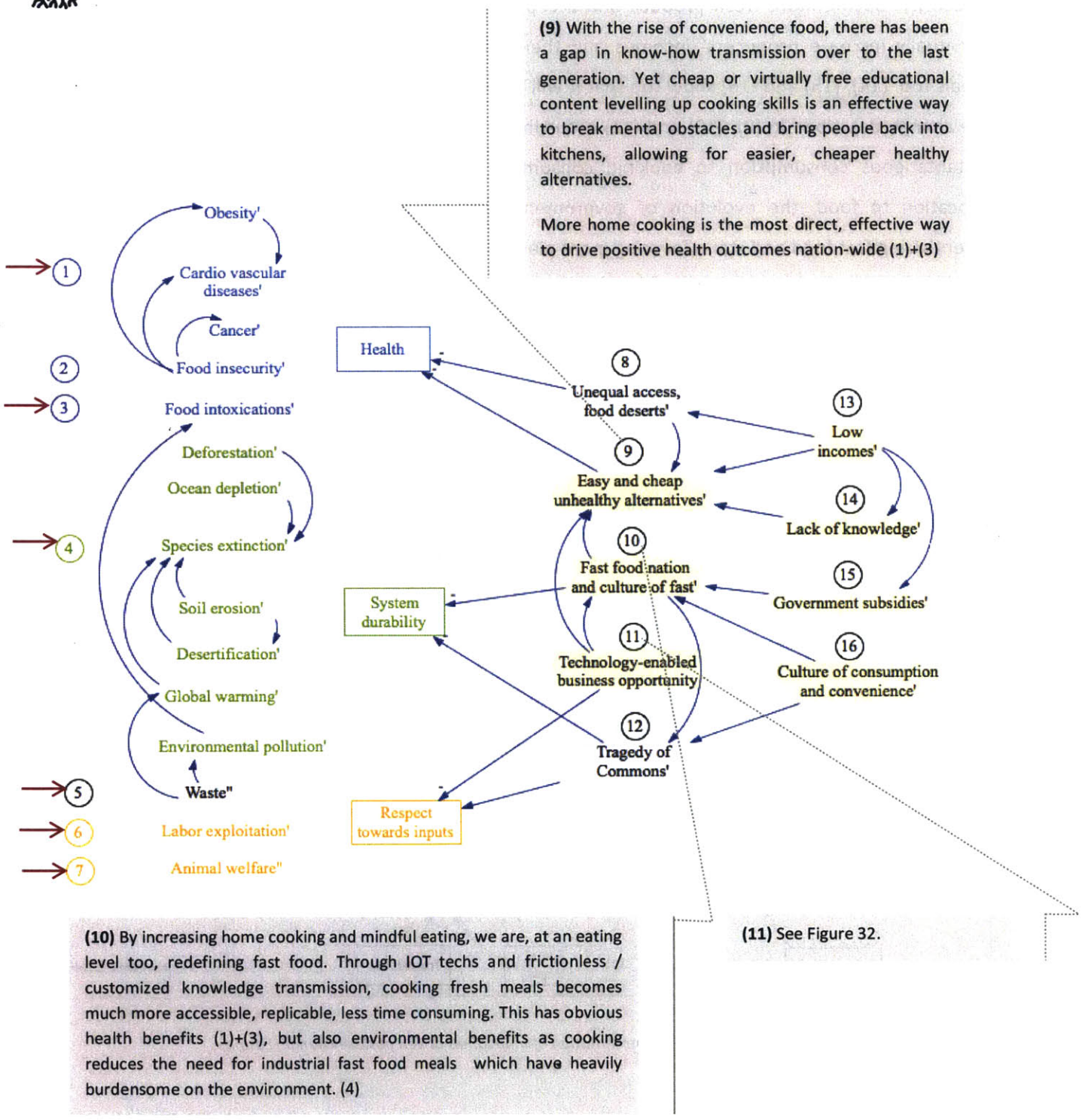


Figure 36 - System map of targeted innovation, Eating

We observe some strains of uncertainty here too: (13) global eating improvement will depend in part of how well we manage to include small scale producers to the equation, who the first to suffer from food insecurity. Buying more fresh produce and accepting to pay a higher premium for healthy foods will eventually increase producers' incomes and their ability to benefit from more complete, nutritious meals too. (14), (15) and (16) show too that it will take a global shift in mentalities and processes to see the change described in (9), (10) and (11) occurring – consumers' willingness to operate this shift from instantaneous consumption to cooking, consumers willingness to rethink their budget and time allocation to food, the evolution of government subsidizing policies towards a model that stops incentivizing fast food and starts favoring more plant-rich diets.

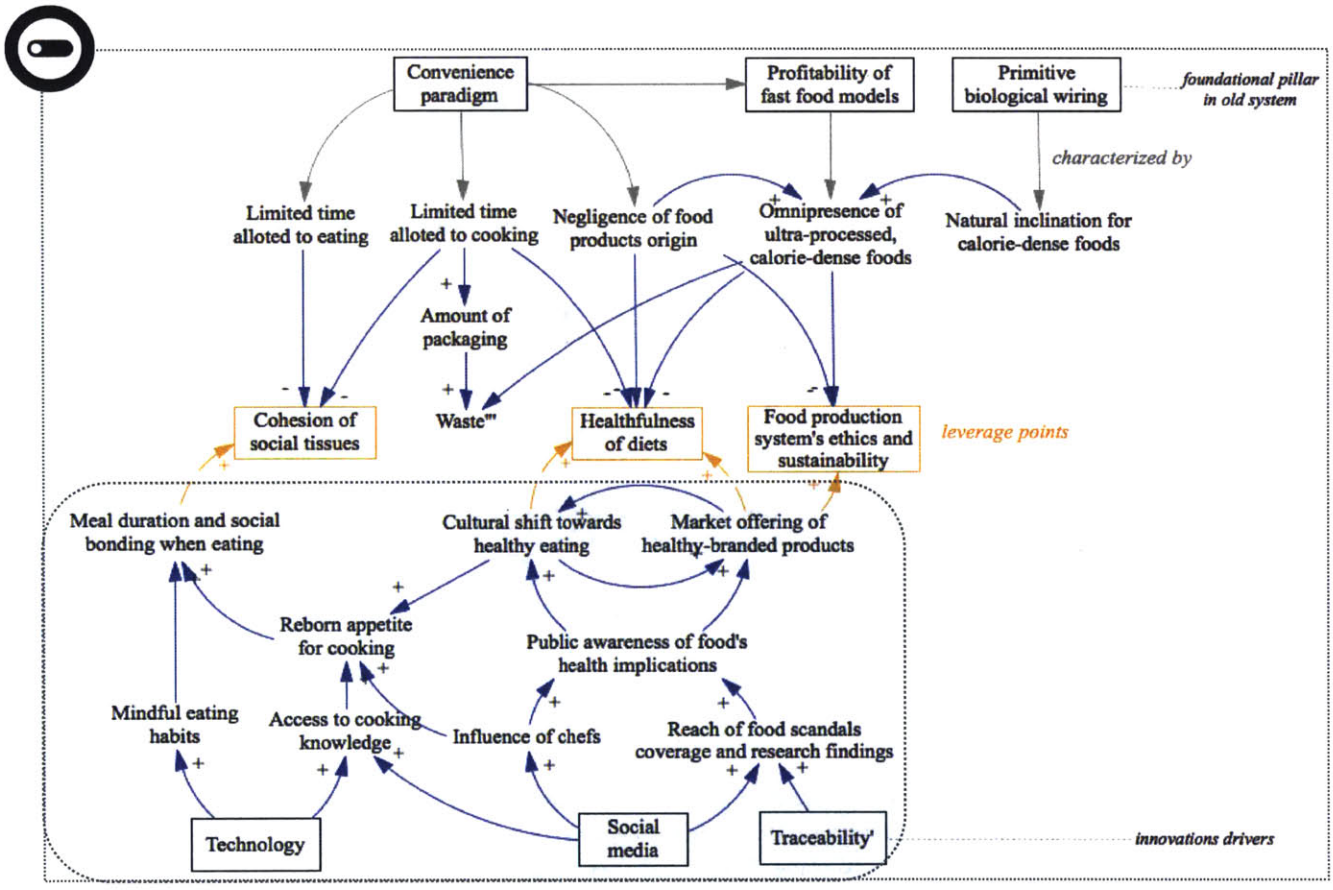


Figure 37 - Dynamic representation of innovation-driven positive change, Eating

Voice	Overall bargaining power	Relevant knowledge	Will to drive change	Status	
				Influencer	Actor
Farmer	l	m	m		
Manufacturer	m	h	l		
Government	m	h	m		
Research / NGO	m	h	h		
Citizens	h	h	m		
Media	m	m	m		

Figure 38 - Voices of the system – actors and influencers, Eating

Conclusion

From chemical intensification to digital optimization, from far reaching and centralized to local and disperse, from standardized hyper convenience to mindful customization – our food system is undergoing profound mutations across all five levels of the supply chain.

Our analysis revealed common patterns and directions which are shaping food innovation throughout the system. The following three are particularly significant:

- **Empowering the edges**: a wide part of current innovation aims at empowering through technology both ends of the supply chain – farmers and consumers. Both are overall seeking change through the food system, but lack key elements to enact this change spontaneously, most often knowledge and / or financial means.
- **Redefining convenience**: we are shifting from a fast-consuming, hyper-convenient model to a system that values slow food. Time in this context is not understood as a fixed commodity, but as a relative measure. It is not so much about allocating more time than it is about shifting priorities.
- **Fostering transparency**: this mega-trend spans the entire supply chain. We are witnessing a transverse call for enhanced connectivity, reliable traceability and systematic and honest transparency from producers, manufacturers, distributors and retailers.

These mega-trends are all driven by data and technology, and in line with building a more sustainable food system. Laying down the key root causes that gnaw the food system and fuel the many symptoms flooding the media, and setting the decor for targeted, cross-supply chain innovation – the routes beneath the roots – is a first step to asking the right questions about how to drive effective, sustainable change in the space.

This study has also shown that in depth change depends on non negligible strains of uncertainty. Collaboration is one of them. Large scale, long-term, deeply rooted change relies on our collective ability to address the collaboration gap. Industry stakeholders will have to go beyond profitability considerations, conflicts of interests and games of influence to drive sustainable change in the space.

Influence of...	over Farmer	over Manufacturer	over Government	over Research / NGO	over Citizens	over Media
Farmer	l	l	l	m	l	m
Manufacturer	h	m	h	m	m	m
Government	h	m		m	h	l
Research / NGO	m	l	m	m	m	h
Citizens	h	h	m	l	h	m
Media	m	m	m	m	h	h

Figure 39 - Relative influence of system players on one another

Culture is another key strain of uncertainty. The days of Popeye the sailor and his powering cans of spinach are long gone – as long as our youth's heroes keep luring children exclusively to chocolate bars and Happy Meals, society's mental projection behind good food will never be aligned with collective well being, let alone a sustainable food system. To achieve long term health, we have to shift our entire vision as a society of what food stands for. We have to spark the conversation to rewrite the narrative of food.

Exhibit 1 - Popeye the sailor and his empowering can of spinach

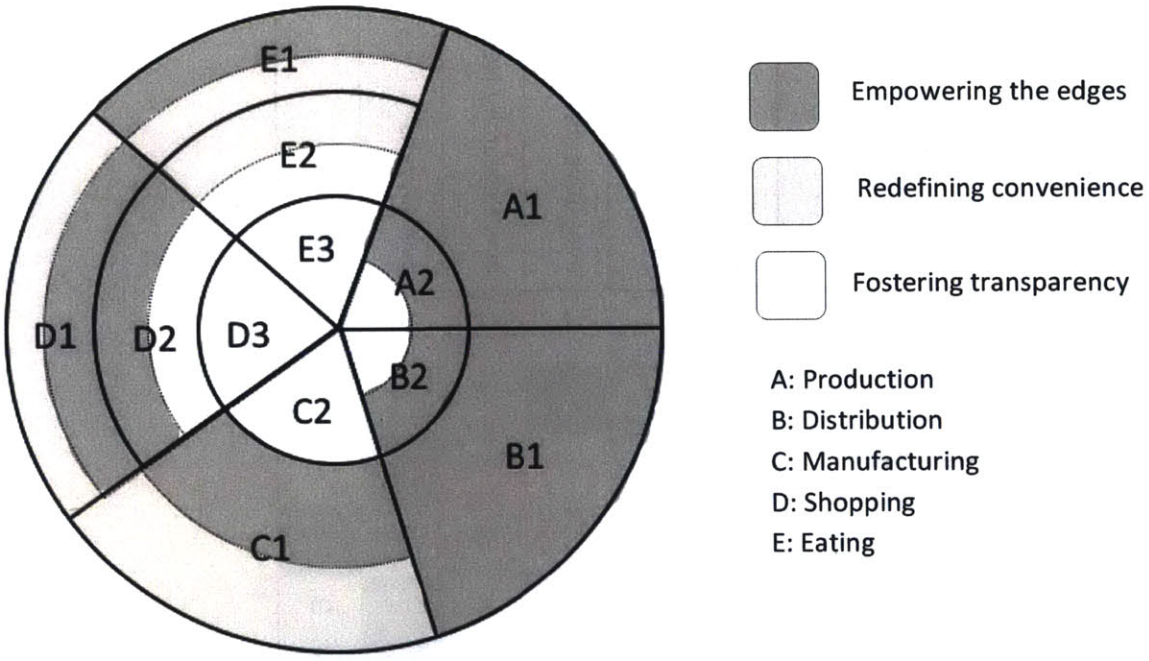


Figure 40 - A transverse map of food innovation in the United States, trends and mega-trends

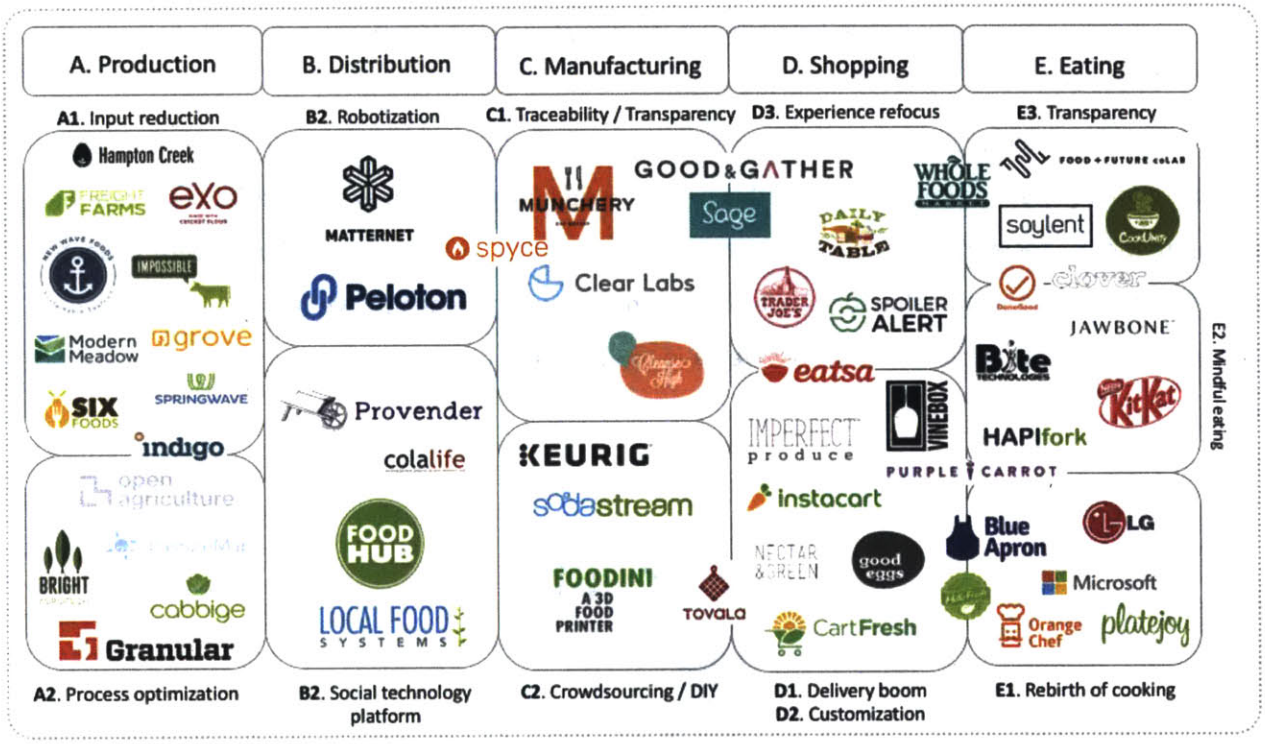


Table 5 - Food innovation map across the supply chain

Appendix

1. *Seeds of Disruption map, Institute for the Future*

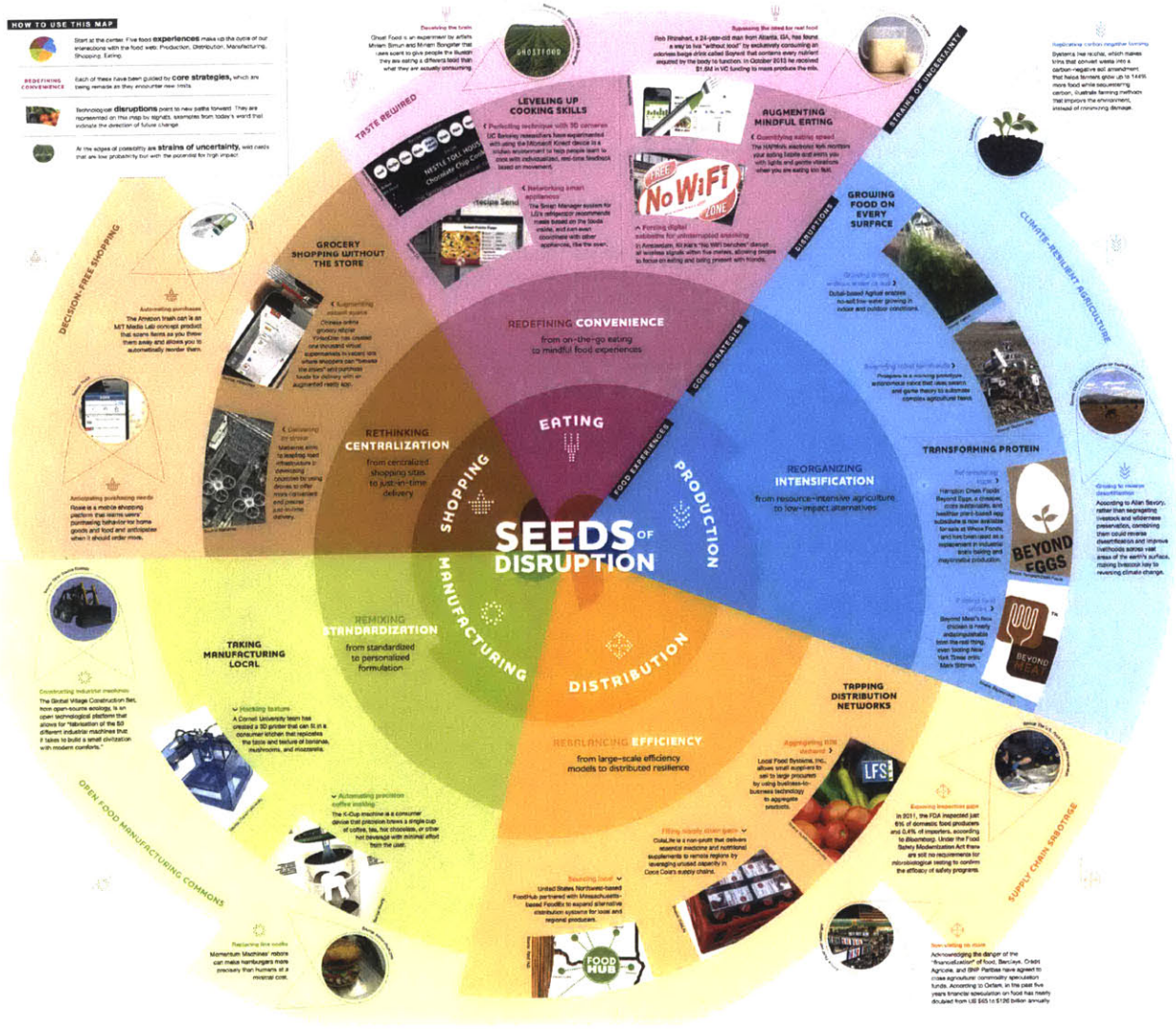


Exhibit 2 - The Institute for the Future's supply chain based innovation map (full map retrievable online; see references)

2. *Interviews of local food thinkers – excerpts*

CLOVER

Ayr Muir

CEO & FOUNDER

FOOD SYSTEM

BIGGEST PROBLEM ABOUT THE US FOOD SYSTEM

Too many people eat without tasting.

KEY LEVERAGE POINT TO DRIVE CHANGE

Individuals.

MISSION AND VISION OF COMPANY

We want to help people fall in love with vegetables again.

VISION

POSITION OF INNOVATION IN FOOD+AGTECH LANDSCAPE

We're unique at this point, nobody else is doing what we do. That said, we're less radical today than we were when we got started in 2008.

BIGGEST TRENDS IN YOUR EYES

I think we are just stepping into an era where mega-trends will change how we eat. Specifically (a) expectation of transparency and information, (b) growing attention to personal health, (c) growing awareness of link between environment and food.

YOUR FEELING ABOUT THE FUTURE OF FOOD

I'm really excited. It's a great time to be alive.

Exhibit 3 - Thoughts from Ayr Muir, founder and CEO of CLOVER

PROVENDER

Caithrin Rintoul

CEO & CO-FOUNDER

FOOD SYSTEM

THE FOOD SYSTEM IN ONE WORD

Unrealized

BIGGEST PROBLEM ABOUT THE US FOOD SYSTEM

Commodity subsidies are the root cause of most fundamental problems in US ag.

KEY LEVERAGE POINT TO DRIVE CHANGE

As Dan Barber eloquently said, "What breaks the juggernaut of the industrial food chain is diversity." leveraging economies of scope to compete with economies of scale is crucial to changing the food system.

VISION

MISSION AND VISION OF COMPANY

We believe that the internet is the greatest opportunity that agriculture has ever been presented with, and we believe that network businesses are the path to value creation for all different stakeholders in the food system. Empowering farmers through technology is fundamental to our business and the reason we exist.

Our mission is to bring farmers back to a place of primacy within food systems by empowering them through technology.

YOUR DEFINITION OF THE MODERN FOOD MOVEMENT

A conflict between very commoditized, frictionless calories delivery systems and slow, sustainable and inefficient agrarian economies.

YOUR FEELING ABOUT THE FUTURE OF FOOD

I am scared about the future of food but also optimistic that changes through technology will revolutionize agriculture.

Exhibit 4 - Thoughts from Caithrin Rintoul, founder and CEO of Provender

SEMILLERO VENTURES

Alex Borschow

PRIVATE EQUITY INVESTOR

FOOD SYSTEM

THE FOOD SYSTEM IN ONE WORD

Broken

BIGGEST PROBLEM ABOUT THE US FOOD SYSTEM

Heavily dependent on subsidized, large industrial agriculture that is completely unsustainable.

KEY LEVERAGE POINT TO DRIVE CHANGE

Consumers vote with their wallets every day. They drive change.

VISION

MISSION AND VISION OF COMPANY

Invest in growth-stage food and agribusiness companies with sustainable business models.

POSITION OF INNOVATION IN FOOD+AGTECH LANDSCAPE

We are the only fund of its kind in Puerto Rico. We are a driver of innovation in capital and financing, economic development, and job creation.

YOUR DEFINITION OF THE MODERN FOOD MOVEMENT

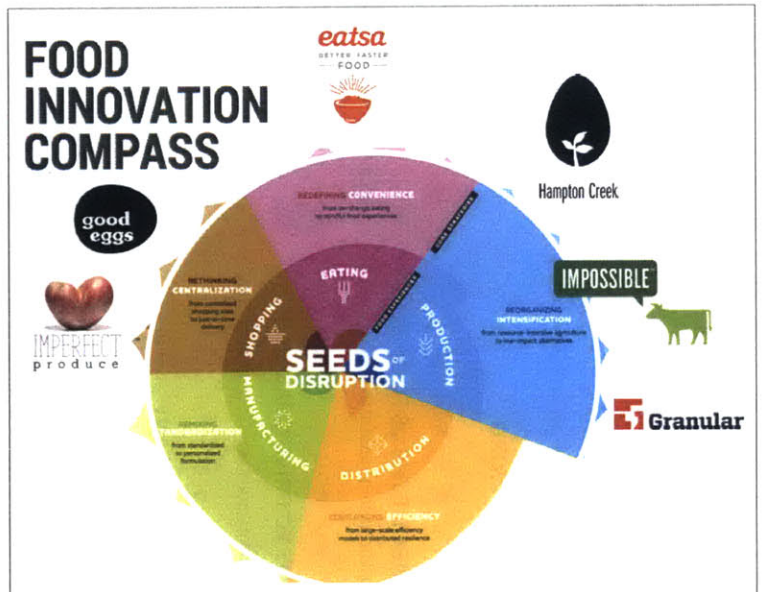
Global consumers are awakening the necessity and desire for healthful, local, and sustainable food and demanding it from companies.

YOUR FEELING ABOUT THE FUTURE OF FOOD

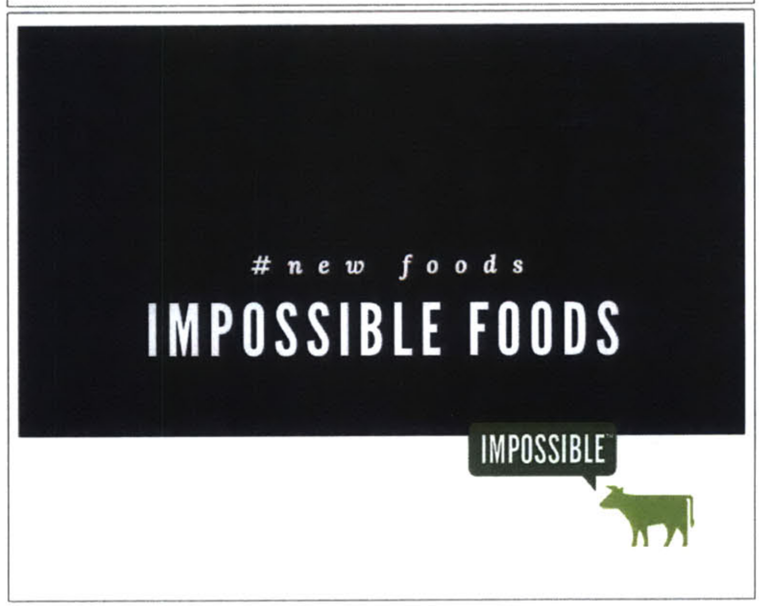
I envision every food product having a sustainability rating, tasting better, and being more nutritious.

Exhibit 5 - Thoughts from Alex Borschow, private equity investor at Semillero Ventures


FOOD+
AG+
TECH
TREK
HACKING THE US FOOD SYSTEM
MARS 2016 | MIT FOOD & AGRICULTURE CLUB
MITSloan


FOOD INNOVATION COMPASS
eatsa
Hampton Creek
good eggs
IMPOSSIBLE
IMPERFECT produce
Granular
SEEDS OF DISRUPTION
EATING
SHOPPING
PRODUCTION
MANUFACTURING
DISTRIBUTION


3 DEFINITIONS
1. Food security
Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO).
2. Food sustainability
Sustainable development is the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland report).
3. Sustainable food system
A sustainable community food system is a collaborative network that integrates sustainable food production, processing, distribution, consumption and waste management in order to enhance the environmental, economic and social health of a particular place (ASI UCDavis)


new foods
IMPOSSIBLE FOODS
IMPOSSIBLE

TEASER

MADE FROM PLANTS!

THE IMPOSSIBLE CHEESEBURGER

We love meat. We love cheese. And for thousands of years we have relied on animals to make them. Impossible Foods has found a better way. We use plants to make the best meats and cheeses you'll ever eat.

SUMMARY SHEET

PRODUCTION
X SUSTAINABILITY

2011
FOUNDED BY PATRICK BROWN

2014
1ST FOUNDING ROUND
$75M

2015
2ND FOUNDING ROUND
$108M

2016
LAUNCH OF 1ST PRODUCT

PATRICK BROWN
BIOCHEMISTRY PROFESSOR AT STANFORD FOR 25 YEARS; FOUNDER @KITE HILL; FOUNDER @IMPOSSIBLE FOODS

- **INVESTORS** | UBS, VIKING GLOBAL INVESTORS, EARLIER BACKERS KHOSLA VENTURES, BILL GATES, HORIZONS VENTURES;
- **TARGET** | ALL MEAT EATERS
- **LONG TERM VISION** | CHANGE THE WAY THE EARTH LOOKS FROM SPACE BY MAKING THE FOOD SYSTEM MORE SUSTAINABLE (DANA WORTH, COMMERCIALISATION DIRECTOR @IF)

CONCEPT

Impossible Foods produces the new generation of tasty and sustainable meats and cheeses made entirely from plants, giving people the enjoyment of food that comes from animals without the health and environmental drawbacks.
Impossible looks at animal products at the molecular level, then selects specific proteins and nutrients from greens, seeds, and grains to recreate the complex experience of meat and dairy products.

#new foods

HAMPTON CREEK

Hampton Creek

TEASER

just COOKIES
HAMPTON CREEK

What would it look like if we started over? Each batch of freshly-baked cookies would have the quintessential flavors we all love - the gooeyness of the classic chocolate chip, the salty-sweet of a peanut butter cookie, or the simple perfection of a sugar cookie. Nothing would deny us, no matter the allergies or health restrictions, the pleasure of enjoying our favorite cookies.

just MAYO
HAMPTON CREEK

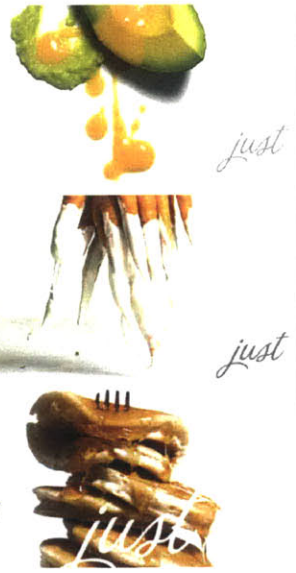
What would it look like if we started over? Mayo would be so much more than a condiment. Who would have thought you could save an entire bathtub of water all the while having the most coveted pasta salad recipe in town? Just Mayo means giving your body something that feels good, with less cholesterol, but still tastes the way you want, without ever having to break the bank. Spread on.

just COOKIE DOUGH
HAMPTON CREEK

What would it look like if we started over? You would be able to eat cookie dough right out of the container... or wait around for a warm melty bite straight from the cookie sheet. Just Cookie Dough means growing up with something better, because who said you have to bail on health in order to treat yo' self? Just the thought of that fresh-out-of-the-oven smell is enough to try your patience. So don't hold back - go ahead and eat it raw.

CONCEPT

Hampton creek is a food tech company developing new ways of producing popular, iconic products utilising plants to reduce environmental and health impact of current production and consumption of animal products such as dairy and eggs.



1. **DISRUPTION**
   What would it look like if we could start over?
2. **SIMPLICITY**
   In conception, production and consumption
3. **PLEASURE**
   3 popular products people love -
   Just Mayo, Just Cookies, Just Cookie Dough
4. **BODY & PLANET FRIENDLY**
   Healthy ingredients, sustainable process

To find out how, simply enter the number of just COOKIES you've eaten:

10 CALCULATE

By eating 10 cookies, you have...

AVOIDED EATING
117 mg
OF CHOLESTEROL

SAVED
270 qt
OF WATER

PREVENTED
350 g
OF CARBON EMISSIONS

SAVED
4 sq ft
OF LAND

just COOKIES
HAMPTON CREEK
LEARN MORE >

PREVENTED
1 egg
FROM BEING LAID

SUMMARY SHEET

PRODUCTION
X SUSTAINABILITY

2011	2012	2013	2014	2015	2016
FOUNDED BY JOSHUA TETRICK & JOSH BALK + SEED FUNDING ($500K)	SERIES A FUNDING $1.5M	1ST PRODUCT LAUNCH BEYOND EGGS + INTRODUCTION INTO WHOLE FOODS	SERIES B + SERIES C $113M TOTAL	350% SALES GROWTH	UNILEVER LAUNCHES EGG-FREE MAYO

JOSHUA TETRICK | FOUNDER & CEO

JOSH BALK | FOUNDER

- **INVESTORS** | INCLUDE - LI KA-SHING, JERRY YANG (YAHOO), KHOSLA VENTURES, JESSICA POWELL (GOOGLE)
- **R&D** | DAN ZIGMOND, "GOOGLE'S MAIN DATA GUY" (TECHCRUNCH), HIRED IN 2014 TO BUILD WORLD'S LARGEST PLANT DATABASE (NOW STRATEGIC ADVISOR)

#a g - t e c h

GRANULAR

Granular

CONCEPT

Granular is a software and analytics platform that helps farmers operate more efficiently and make better business decisions. They're pioneering software and analytics for the $3 trillion agriculture industry.

Product description:

1 PLAN & BUDGET

- *Growth model driven scheduling tools*
- *Input inventory tracking*
- *Expected profitability updated by activities*

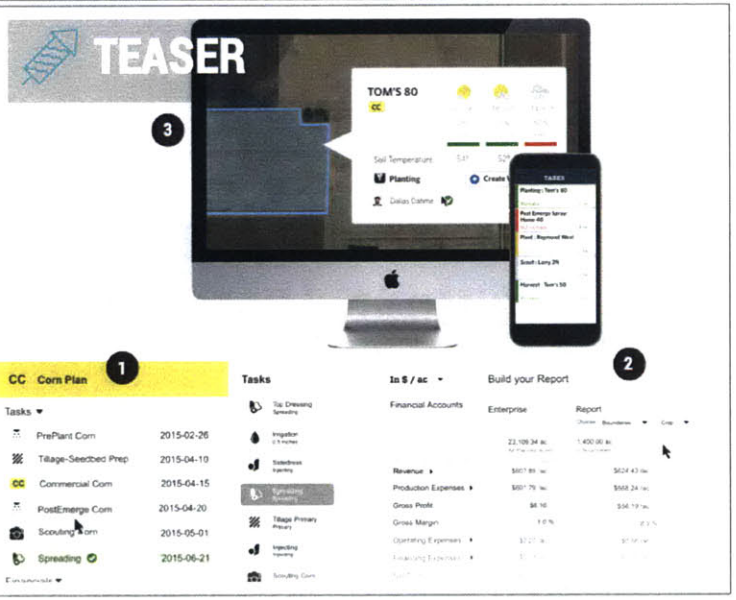
2 MANAGE & MEASURE

- *Weather and workability by field*
- *Task management via mobile app*
- *Cross-device operations progress monitoring*
- *Real-time yield and crop inventory*
- *Machine data integration*

3 ANALYZE & IMPROVE

- *Cost of production, always up to date*
- *Reports for landowners, crop insurance and lending partners*
- *Built-in benchmarking*

TEASER



SUMMARY SHEET

PRODUCTION X SUSTAINABILITY

2014 FOUNDED BY SID GORHAM & MIKE PREINER

2014 SERIES A FUNDING $6.2M

2015 SERIES B FUNDING $18.7M

JULY 2015 SIGNED EQUIVALENT OF 1 MILLION ACRES OF LAND

SID GORHAM | CO-FOUNDER & CEO

MIKE PREINER | CO-FOUNDER & PM

- **INVESTORS** | INCLUDE - ANDREESSEN HOROWITZ, KHOSLA VENTURES, GOOGLE VENTURES, TAO CAPITAL PARTNERS
- **VALUE PROP** | "RIGHT NOW FARMS UNDERSTAND PROFITABILITY AT THE TOTAL LEVEL, BUT WITH GRANULAR, THEY CAN UNDERSTAND THE PROFITABILITY OF EACH FIELD AND EACH CROP." SID GORHAM.
- $3 TRILLION AGRICULTURE INDUSTRY

#innovation hub

INDIE BIO

INDIE BIO

CONCEPT

IndieBio is a startup accelerator for synthetic biology and biotechnology start-ups.
"We are seeing that a well-stocked physical lab for startups isn't enough to take them from prototype to commercial viability. It takes more money and time, particularly in the Bay Area, to create a product,"

1 TREND
Corporate VCs poured in +$2 billion into biotech funding in the last 3 months of 2014 (PriceWaterhouseCoopers)

2 POTENTIAL
Use of biology to solve previously intractable problems

3 NEED
$200,000 in cash + $50,000 worth of co-op lab space formula to help startup go through "biotech valley of death"

TEASER

SUMMARY SHEET

FUNDING
X INNOVATION HUB

2014 FOUNDED BY ARVIND GUPTA, BACKED BY SOS VENTURES

EARLY 2015 INVESTMENT IN MUUFRI ($60K); CLARA FOODS ($50K)

LATE 2015 INVESTMENT IN NEW WAVE FOODS; MEMPHIS MEATS ($250K EACH)

2015 PARTNERSHIP WITH CLOUD-BASED BIOLAB STARTUP TRANSCRIPTIC (YC)

ARVIND GUPTA | FOUNDER & SOSV PARTNER

- **INVESTORS** | SOS VENTURES, $200 MILLION VC FUND BEHIND INDIEBIO
- **SECTORS** | AGRICULTURE, BIOTECH, ENERGY, BIOMATERIALS, CLEANTECH, HARDWARE, HEALTH/MEDICAL

RYAN BETHENCOURT | PROGRAM DIRECTOR

#waste

IMPERFECT PRODUCE

IMPERFECT™
produce

CONCEPT

In America, 1 in 5 fruits and vegetables grown don't fit grocery stores' strict cosmetic standards, causing them to go to waste.

Imperfect's mission is to find a home for these "ugly" fruits and veggies, through a discounted produce delivery subscription service in the Bay.

1 SUSTAINABLE

- *Waste - Each year, 20% of produce grown in the US is rejected from grocery stores because it has a funny shape or size.*
- *Supports local farmers*

2 AFFORDABLE

- *Gives all families the opportunity to eat healthy for cheaper*

3 CONVENIENT

- *Delivers farm-fresh produce straight to customers' doorsteps*

MORE TO LOVE

TEASER

Redefining beauty in produce.

Because all fruits and veggies deserve to be loved

IMPERFECT™ produce #loveuglyfood

SUMMARY SHEET

WASTE X INCLUSION

2015 FOUNDED BY BEN SIMON AND BEN CHESLER

2015 INDIEGOGO CROWDFUNDING CAMPAIGN ($40K)

2015 RALEY'S STEPS IN AND OUT OF PARTNERSHIP WITH IMPERFECT

2016 PARTNERSHIP WITH GIANT EAGLE AND WHOLE FOODS

BEN SIMON | CO-FOUNDER & CEO

- FROM 1974 TO 2006, THE AMOUNT OF FOOD AMERICANS WASTE INCREASED BY 50%
- "THERE IS A REAL CHICKEN AND AN EGG PROBLEM, BECAUSE RETAILERS SAY THEY WON'T SELL THIS BECAUSE PEOPLE DON'T BUY IT, AND PEOPLE SAY THEY WANT TO BUY IT BUT RETAILERS WON'T SELL IT" - JONATHAN BLOOM

BEN CHESLER | CO-FOUNDER & COO

#restaurant

EATSA

eatsa
BETTER, FASTER
FOOD

CONCEPT

Eatsa is a fast-food restaurant in San Francisco centering on a high tech automat-like ordering process, and freshly cooked bowls of Quinoa. Eatsa hopes its combination of tech and quinoa can change the way we eat.

Better

Get more from your fast food. Better protein, more flavor, and always fresh.

Faster

No lines. No cashier. No nonsense. We're engineered to get you in and out fast.

Tastier

With craveable flavors you won't believe, you can have a healthy addiction to fast food.

1 HEALTH BENEFITS

Quinoa is a complete protein, with the amino acids necessary for human nutrition. It's cholesterol and gluten-free.

2 ENVIRONMENTAL BENEFITS

Absorbs flavour and rich in protein, yet requires 1/30th the amount of energy to produce compared to animal protein production

3 SOCIAL BENEFITS

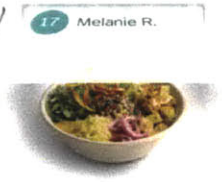
Healthy-food inclusive - automation process gives Eatsa the potential to serve neighborhoods with no sources of healthy foods

SUMMARY SHEET

HEALTHY COOKING
X INCLUSION

2015
FOUNDED BY
DAVID FRIED BERG

DAVID FRIEDBERG | FOUNDER & CHAIRMAN,
CEO @THE CLIMATE CORPORATION



#logistics

GOOD EGGS

good eggs

CONCEPT

Good Eggs is an online market that delivers good groceries to customers' homes throughout the Bay Area. It wants to change the way people eat by making it easier for customers to buy organic foods produced by local, independent farmers and vendors.

Rancho Vasquez
Organic Small Hass Avocado Trio

Hidden Star Orchards
Organic Pink Lady Apples

Cliff McFarlin Organics
Organic Lemons

1 BETTER FOOD
- *fresh produce*
- *local farms*
- *transparency behind what people eat*

2 LESS HASSLE
- *conveniency*
- *time saving*
- *rich content and online guidance*

3 "MORE HEART"
- *humane management of business*
- *personal customer management*
- *passion and drive of network*

TEASER

SUMMARY SHEET

HEALTHY EATING
X DELIVERY

2011	2013	2014	2015	DEC 2015
FOUNDED BY ROB SPIRO, BOB ZOLLER AND ALON SALANT	SEED FUNDING ($2M) + SERIES A ($8.5M)	SERIES B + SERIES C ($21M)	SHUTS DOWN OPERATIONS IN LA, NYE, NEW ORLEANS	BENTLEY HALL APPOINTED NEW CEO

- **INVESTORS** | INCLUDE - SEQUOIA CAPITAL & INDEX VENTURES

ROB SPIRO

ALON SALANT

BOB ZOLLER

Exhibit 6 - Slide deck provided to trekkers during Food+Ag+Tech trek to San Francisco

Exhibit 7 - Schedule of Food+Ag+Tech trek to San Francisco

Time	Agenda
18th March 2016 (Friday)	
7.00am – 8.00am	Breakfast @ Panera Bread
8.00am – 9.00am	*Drive to Imperfect Produce*
9.00am – 10.00am	**Imperfect Produce**
10.00am – 11.15am	*Drive to The Food Fund/Eatsa*
11.15am – 12.30pm	Lunch discussion with **The Food Fund** @ Eatsa
12.30pm – 1.00pm	*Drive to Good Eggs*
1.00pm – 3.00pm	**Good Eggs**
3.00pm – 4.00pm	*Drive to Thirsty Bear + Free time*
4.00pm – 6.00pm	**Happy Hour at Thirsty Bear**
6.00pm – 7.00pm	Grocery shopping at Trader's Joe
7.00pm - Late	Cooking + Eating + Have a good time

Time	Agenda
17th March 2016 (Thursday)	
6.30am – 7.30am	Breakfast @ Panera Bread
7.30am – 9.00am	*Drive to Impossible Foods*
9.00am – 10.30am	**Impossible Foods**
10.30am -12.00pm	*Drive to lunch*
12.00pm – 2.00pm	Lunch @ Barbacco (Italian)
2.00pm – 2.30pm	*Drive to Granular*
2.30pm – 3.30pm	**Granular**
3.30pm – 4.00pm	*Drive to Hampton Creek*
4.00pm – 5.30pm	**Hampton Creek**
5.30pm – 6.30pm	Quick bite @ Super Duper Burger
6.30pm – 9.00pm	**Indie Bio** – Future of Food: Rewiring the Food Ecosystem

Time	Agenda
19th March 2016 (Saturday)	
7.30am – 8.30am	Breakfast & Check Out
8.30am – 10.00am	Drive to TomKat Ranch
10.00am – 12.00pm	Farm Visit – **TomKat Ranch**
12.00pm – 1.30pm	*Drive back from TomKat Ranch*

Time	Agenda
21st March 2016 (Monday)	
12.00pm – 1.30pm	**Community Table: San Francisco**

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