DISRUPTION DINNER

CULINARY ADVENTURE INTO A BIODIVERSE WORLD

The demand for food around the world is increasing at the same time its supply is coming under threat. This paints an uncertain picture for biodiversity, as the agricultural system has long been its foe. In light of these dynamics, do you believe biodiversity on land and at sea will (a) decrease, (b) remain the same or (c) increase over the next 10 years? Outcome (c) may seem like a fantasy—and was until recently—but today it is manifesting around us. This adventure offers an addictive taste of the foods found along this path. Let the culinary adventure begin!

THE DISRUPTION DINNER STORY

Disruption Dinners take guests on a culinary adventure through our changing food system. Each dish and drink tells the story of future possibilities, while exploring what these changes mean for all of us and what we can do today to shape different outcomes.

Founder and curator Hannah Tucker researches how disruptive changes in climate and technology are reshaping the economy, with a focus on food. She began Disruption Dinners in 2017 when working alongside former U.S. Vice President Al Gore at Generation Investment Management. Today she enjoys hosting Disruption Dinners while working with businesses and investors to integrate disruption into their decision-making. Hannah holds dual masters degrees in business administration and international studies from the Wharton School and Lauder Institute of the University of Pennsylvania. She is a Research Fellow at RethinkX, Chartered Financial Analyst and Climate Reality Leader.

To read more about Disruption Dinners or express interest in hosting a Disruption Dinner event, please visit:

www.disruptiondinner.com
hannah@balancepointventures.com

ON THE MENU

PRECISION PRODUCTION

Beyond Meat crumbled into lettuce cups topped with crunchy peanuts

Molecular tuna salad served on cucumber rounds

REGENERATIVE FARMING

Farm Wilder beef skewers drizzled in chimichurri sauce

Crispy seaweed tartlets

ECOSYSTEM REBALANCING

Wild venison served with celeriac remoulade

Invasive jellyfish in a sesame, ginger, soy sauce

FINAL SWEET SEND OFF

Regenerative Madecasse coconut clusters with invasive dandelion root espressos

CULINARY ADVENTURE INTO A BIODIVERSE WORLD

BY 2030, DO YOU BELIEVE BIODIVERSITY ON LAND AND AT SEA WILL (A) DECREASE, (B) REMAIN THE SAME OR (C) INCREASE?

Answer (a), decrease, is a common fear and unsurprisingly popular view, particularly when considering the growing gap between food supply and demand around the world. Agriculture, our system for sourcing food from life around us, has long been at odds with biodiversity. Instead of supporting a great variety and variability of life, agriculture seeks to standardise it, favouring the cultivation of monocultures from a select group of domesticated plants and animals. Any life form falling outside of this group is considered competition for precious resources and swiftly obliterated with the use of chemicals and machinery. Today agriculture takes place on approximately 50% of habitable land on Earth, while also spanning an estimated 50% of the sea. Given these dynamics, what are the chances of actually preserving the remaining 50% of biodiverse areas?

There is certainly a case to be made for answer (b), the stabilisation of biodiversity. One way of achieving this would be to hold current levels of food production constant throughout the 2020s and beyond. We could do this by consuming less in places where caloric intake is already excessive, and also simply by reducing food waste from around 33% of total production to close to zero. Making these sorts of sacrifices to 'save the planet' has gained traction in recent years particularly among younger demographics. The other way to level off food production would be to hold the human population constant.

While we're unlikely to choose this path out of free will, the spread of conflict or disease may well result in it. Coronavirus is an apt example. Neither option is widely appealing with both painting a bleak picture of the ten years ahead. But before you head to the hills in fear of a lifetime of poisonous dumpster food in the name of biodiversity, there is a third answer.

Answer (c): an increase in biodiversity by 2030. This seems like a fantasy scenario. And until now, it has been. But that is no longer the case. Why? The catalyst is the convergence of newly competitive technologies, which today are opening up vast possibilities. These technologies include high speed computing, data storage, robotics, satellites, genome sequencing and editing, wind and solar, storage and LEDs, among many others. Together they are changing the way we do just about everything, agriculture included. In fact, we are already seeing signs of the industrial agricultural system beginning to fall away. In its place, a regenerative agricultural system is forming, one which harnesses biodiversity as means of improving, not diminishing, production. This probably still sounds like wishful thinking, which is why the pages ahead offer a taste of the ways this future path is already manifesting around us.

Each dish represents either land or sea and falls into three categories, forming the pillars of a modern, regenerative agricultural system.

A TASTE OF REGENERATIVE AGRICULTURE

PRECISION PRODUCTION

Precision production refers to the application of technologies and techniques to exponentially reduce the resource inputs for food without diminishing its appeal. Vertical farming with the use of robotics and LED lighting is one application of precision production. Another popular form is the precision production of animal-based foods without the animal. This process leverages advances in computing and synthetic biology to analyse the molecular make-up of foods and then replicate them using comparable molecules derived from non-animal sources, such as plants and fungi, and increasingly even microorganisms, such as yeast and bacteria. The resulting reduction in resources, land included, takes the pressure off of conservation areas while freeing up agricultural land for regeneration opportunities.

REGENERATIVE FARMING

Regenerative farming refers to the application of technologies and techniques to regenerate biodiversity as a way of improving food production from both a quality and cost perspective. On land, this begins with the restoration of the soil, such as through repopulating microbe communities, while also planting pioneering tuber crops to drive back in water and air. At sea, seaweed is a cornerstone species, as it not only deacidifies ocean waters saturated with carbon emissions, but also serves as a safe-haven habitat for a variety of life. In this system, the value of a species does not come solely from its use as a food source, but rather more broadly from the role it plays in contributing to the health of an ecosystem.

ECOSYSTEM REBALANCING

Ecosystem rebalancing follows regeneration as a way of sustaining healthy ecosystems. It refers to the application of technologies and techniques to monitor and manage biodiversity, ensuring no one species dominates or disappears. These range from modern, such as using drones and satellites to monitor soil composition and species health, to ancient, such as hunting and fishing of overly populous species in order to restore balance.

PILLAR ONE

PRECISION PRODUCTION

In precision production, technologies and techniques are used to exponentially reduce the resource inputs for food without reducing its appeal. In the case of precision producing animal foods without the animal, companies are scaling many different approaches. What unites them are three common steps all leveraging modern technologies.

STEP ONE

The first step is to develop a precise understanding of animal foods at the molecular level, going far deeper than the simple make-up of proteins, glucose and fatty acids, down to the thousands of individual types of nutrients falling within each category. For example, identifying the ß-hydroxy fatty acid giving butter its buttery smell and taste or the combination of as1, as2, b and k casein proteins giving milk its clotting properties. This level of understanding was not possible prior to being able to sequence and upload genetic information onto computer systems. Today, we have access to digital food twins, revealing the role of each molecule.

STEP TWO

The second step is to apply computer software to mimic or improve the design of foods using molecules from non-animal sources. While most companies are sourcing these molecular ingredients from plants, others are venturing into the world of fungi and microorganisms, such as yeast and bacteria. This too is a new development, as genome sequencing has enabled us to identify new microorganisms based on the molecules they produce. When combined with genome editing, we can go one step further to modify those microorganisms to produce the molecules we desire. For example, Impossible Foods designed a type of yeast to produce heme protein at commercial scale. Perfect Day also 'domesticated' a variety of yeast to produce whey protein. Aside from harnessing single-celled organisms, we are able to isolate single stem cells from animals and cultivate them into fat and muscle tissue. This is another source of ingredients, although not yet commercially available. Memphis Meats is pioneering this approach across animal types, such as beef, chicken and duck. Wild Type and Blue Nalu are doing the same in fish.

Overall, molecular design capabilities are enabling food producers to tap into an infinitely diverse pool of ingredients with greater functionality and lesser cost.

STEP THREE

The third and final step is to build these foods from the molecule up. This can be as simply mixing ingredients together. Beyond Meat does this primarily with ingredients derived from peas, potatoes and beets. Impossible Foods does this with soybeans while adding its proprietary yeast-heme. Other companies use extruders to replicate the texture of meats, particularly chicken and even shrimp. 3-D printing is also coming into play and likely will increase in use as the cost comes down with scale. In the case of stem cells, or cultured meat, the secret is in scaffolding. Today companies are working on designing scaffolding from microbial-produced proteins to achieve precise design specifications at affordable costs.

> PRECISION NUTRIENT PRODUCTION REQUIRES A FRACTION OF THE RESOURCES OF ANIMAL-BASED PRODUCTION, EVEN WHEN RELYING SOLELY ON PLANTS, SIMPLY BY VIRTUE OF PLANTS' LOWER RANKING ON THE FOOD CHAIN. WHEN INGREDIENT SOURCING COMES FROM CELLS DIRECTLY, RESOURCE REQUIREMENTS DROP EXPONENTIALLY.

This not only takes the pressure off of the remaining 50% of biodiverse areas on land and at sea, but also frees up existing agricultural areas. How we then use these areas will depend on what alternative income streams are available, but regenerating and rewilding these areas, particularly with the aim of carbon capture, is certainly one possibility.

To learn more please see Rethinking Food and Agriculture 2020-2030 (https://www.rethinkx.com/food-and-agriculture)

A TASTE OF PRECISION PRODUCTION

TASTE ON LAND

Beyond Meat crumbled into lettuce cups topped with crunchy peanuts

TASTE AT SEA

Molecular tuna salad served on cucumber rounds

ON LAND
A CLOSER LOOK AT BEYOND MEAT

Beyond Meat is a Los Angeles-based producer of plant-based meats founded in 2009 by Ethan Brown. It is one example of a company leveraging technological advances to abundantly produce protein-rich foods with a fraction of the resources. It utilises computer software to iterate constantly meat on a molecular level and reconstitute it with plant-based ingredients to achieve superior tastes, textures and smells.

These ingredients include proteins from mung beans, fava beans, brown rice and peas; carbohydrates from potato starch and a plant fibre derivative known as methylcellulose; fats from cocoa butter, coconut oil, sunflower oil and canola oil; in addition to flavours and colours from beet juice extract, apple extract and other naturally-derived sources. The company uses heating, cooling and pressure to create the fibrous texture of meat from plant-based ingredients. It iterates constantly to find the highest performing recipes and techniques across a variety of metrics.

> WHILE PRODUCING MEAT WITH A FRACTION OF THE RESOURCES, INCLUDING LAND, HAS THE POTENTIAL TO BE GAME-CHANGING FOR BIODIVERSITY AND CONSERVATION ALIKE, UNINTENDED CONSEQUENCES WILL INEVITABLY ARISE FROM THIS SHIFT.

For example, the potential impact on health is not yet known. Beyond Meat contains a fraction of the antibiotics and hormones of industrial beef, while also delivering a comparable macronutrient make-up in terms of protein, fat and carbohydrates. Where it differs, however, is in the underlying types of nutrients.

For example, canola oil is primarily monounsaturated fat, whereas beef fat is mostly saturated, containing Omega-3 fatty acid and a host of fat-soluble vitamins; likewise, pea protein contains globulin, albumin, prolamin and glutelin proteins, whereas beef protein is myelin sheath (muscle tissue), which can be less irritating for the gut lining and easier for the body to absorb.

As we learned from the prior widespread adoption of high-fructose corn syrup in place of sugar and seed oils in place of animal fats, differences in molecular structure, although imperceptible to our senses, can lead to major differences in health outcomes. Ultimately how we design modern foods—for nutrition or solely for sensory delight—depends on our choices today.

PILLAR TWO

REGENERATIVE FARMING

In regenerative farming, technologies and techniques are applied to regenerate biodiversity as a way of improving food production from both a quality and cost perspective.

> IN REGENERATIVE FARMING SYSTEMS, THE VALUE OF A SPECIES DOES NOT COME SOLELY FROM ITS USE AS A FOOD SOURCE, BUT RATHER FROM THE ROLE IT PLAYS IN CONTRIBUTING TO THE HEALTH OF AN ECOSYSTEM.

Compared to conventional farming, regenerative farming has the potential to return higher profit margins, stemming both from increased revenue and decreased costs. On revenue, this comes both from the higher quality of outputs, as well as greater diversity outputs, such as different types of food and also complementary services, including carbon and water capture, not to mention ecotourism.

On costs, healthier, balanced ecosystems greatly reduce and even eliminate the need for outside inputs, such as water, fertilisers, insecticides and pesticides.

A TASTE OF REGENERATIVE FARMING

TASTE ON LAND

Farm Wilder beef skewers drizzled in chimichurri sauce

TASTE AT SEA

Crispy seaweed tartlets
(See Climate Foundation example)

ON LAND
FARM WILDER BEEF

Britain's countryside may look green and beautiful, but this hides a different reality. Many areas are devoid of wildlife and managed in a way that threatens biodiversity. Numbers of bees, butterflies and birds have plummeted. Hedgehogs, tree sparrows and turtle doves were once common but have all declined by over 90%. Not-for-profit Farm Wilder is changing this by teaming up with an unlikely ally: cows.

Cows are often cast as enemies to the environment, particularly as they emit heat-trapping methane as part of their digestion. But whether or not cows are net-emitters of greenhouse gases overall depends on the system in which they are raised. In industrial agriculture, they add, but in regenerative agriculture, they serve as a force for sequestration. This comes down to the role their grazing activity—movements, manure, saliva and all—play in soil restoration.

> SOIL HOLDS VAST AMOUNTS OF CARBON—INDEED THERE IS FAR MORE CARBON IN THE WORLD'S SOILS THAN THERE IS IN THE ATMOSPHERE. THESE CARBON STORES HAVE HUGE BENEFITS NOT JUST FOR THE CLIMATE BUT ALSO FOR SOIL FERTILITY AND BIODIVERSITY.

But carbon oxidises when exposed to air, meaning that each industrial harvest progressively depletes stores. Yet this can also work in reverse–where animals graze, especially in rotational systems on diverse, uncultivated pastures, these reserves can be quickly restored. A number of peer-reviewed studies show that this carbon sequestration can outweigh the emissions from methane, making beef net negative.

With the ambitious aim of restoring Britain's natural meadows while producing food and sequestering carbon, Farm Wilder is collaborating with the Pasture for Life (PfL) certification scheme and a group of farmers committed to moving to this 100% pasture-fed system over three years. As part of this transition, farmers do not plough, but instead sow pastures with deep rooting grasses, herbs and legumes, which quickly increase organic matter through the soil strata. Herbs and legumes such as chicory and bird's-foot trefoil contain condensed tannins, which means they also reduce methane emissions from the livestock. Legumes also eliminate the need for artificial fertiliser, which itself has a high CO2 footprint. Farm Wilder farmers also commit to planting seven additional trees per acre while increasing the size of their hedgerows, other critical means of reduction. All of these efforts are coming together to regenerate Britain's natural meadows, supporting hundreds of species of wild birds and insects, not to mention plants and animals on land and microorganisms in the soil.

To read more, please see: https://www.farmwilder.org

AT SEA
THE CLIMATE FOUNDATION KELP

Despite being linguistically cast as inferior, seaweed is not only a superfood but also a super-species when it comes to regenerating ocean ecosystems. Various types of seaweed from kelp to kombu, wakame to nori, have long featured in Asian diets, providing vital nutrients, including antioxidant vitamins A, C and E and thyroid-supporting iodine and tyrosine. But today the value of seaweed comes not just from its use as a food source, but also as a technology for deacidifying ocean waters, which are rapidly turning into lifeless deserts due to their increasing levels of carbon combined with warmer surface temperatures

These changes are contributing to the drop in the global supply of fish. Over the past 25 years, catch per person has declined 23% and today over 80% of the world's fisheries are either considered fully exploited, with no room for safely increasing the catch without restoration. This problem is deeply linked to the decline we have experienced in the ocean's productivity rate, or at the rate at which ocean life coverts carbon into organic matter through photosynthesis. By some estimates, this has dropped by as much as 40% since the 1950s. Much of this drop in productivity is thought to be caused by the warming of the oceans. Over 90% of global warming today occurs in the world's oceans in the form of a thickening layer of warm water near the surface. This layer creates an unnatural barrier to the upwelling of nutrients vital for carbon-consuming phytoplankton to grow.

If we could restore the natural level of upwelling, however, we could bring back the natural level of upwelling, we could restore primary production in the oceans, in turn replenishing ocean fisheries as well as populations of carbon-trapping phytoplankton. For the past decade, Dr. Brian von Herzen at the Climate Foundation has been working on bringing this solution to life in the form of marine permaculture. In 2008, he demonstrated the use of wave-driven pumps to upwell nutrients and grow plankton north of Hawaii. Just 57 hours after deployment, the system sparked plankton growth. Shortly thereafter, these blooms attracted various species of fish. Two weeks later, a 17-foot long whale shark was still circling the area feeding on plankton that had started blooming.

Building on that success, the Climate Foundation team has developed larger marine permaculture systems. These floating platforms use wave energy to restore nutrient upwelling to pre-global warming levels. While the nutrients encourage plankton and kelp growth, the platform provides a structure onto which kelp attach. In essence, this forms a mini ecosystem. The kelp forest provides a habitat for forage fish, who feed off the replenished plankton. Game fish, in turn, forage these fish, and on up the food chain to tuna and sharks. What was once an aquatic desert thrives again with life. These platforms are be placed at a depth of 25 meters, making them safe for navigation and adverse weather. After an initial maintenance period, the marine permaculture platform is designed to operate without human intervention for up to three years at a time. The resulting kelp can be harvested to be used as biofuel, fertiliser, livestock feed, superfood and countless biomass applications and high-value extracts. This technology is now being deployed in the Philippines, Australia and Indonesia. Read more at www.climatefoundation.org.

PILLAR THREE
ECOSYSTEM REBALANCING

In ecosystem rebalancing, healthy ecosystems are sustained through the application of technologies and techniques to monitor and manage biodiversity, ensuring no one species dominates or disappears.

A TASTE OF ECOSYSTEM REBALNCING

TASTE ON LAND

Wild venison served on crostini with celeriac remoulade

TASTE AT SEA

Invasive jellyfish in a sesame, ginger, soy sauce

AT SEA
SPOTLIGHT ON JELLYFISH

Jellyfish—survivors of all six mass extinctions—are thriving in increasingly acidic, hot, stagnant ocean waters. Meanwhile, the vast majority of ocean species are sinking fast in the face of conditions never before experienced. While jellyfish pose many dangers as an invasive species, they do offer some productive uses. In China and Korea, many of the 25-30 types of edible jellyfish are considered a delicacy, and a healthy one at that, with each mouthful containing lean, collagen-binding proteins—good for our skin, brains and joints. In Europe, E.U.-backed project GoJelly are taking the uses of jellyfish one step further by harnessing their mucus as a way of capturing nanoparticles, including microplastics.

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