

The Provision Problem:

A Conversation About Food and Fiber Production in the Climate Emergency Era



by
Bob Saul

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Love and Gratitude to my wife, my children, my friends, my mentors, and my advisors. Without you, there is no way this project could have taken shape or been completed.

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1. Introduction

As climate change accelerates and the human population inexorably climbs toward ten billion souls, wealthy, developed nations face a critical challenge: how to sustainably feed and house the global population while simultaneously moderating CO2 emissions and stabilizing the decline in biodiversity? This is the *Provision Problem*.

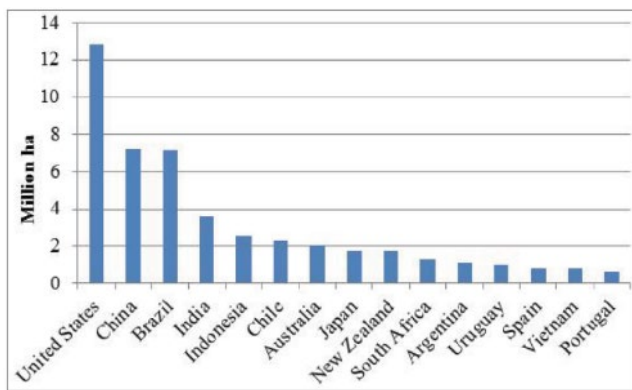
I constructed the following panel discussion of this *Provision Problem* from thirty-five interviews with expert climate scientists, natural resource investors, venture capitalists, conservationists, environmental activists, farmers, and foresters. I conducted these interviews over a two-year period during my time as a Bullard Fellow at The Harvard Forest. I initially transcribed and abstracted the interviews, and then distilled the ideas and perspectives into nine *fictionalized* characters. Each character represents a particular perspective on the important issue of how to reconcile humanity's need for the commodities produced by soil and photosynthesis (food and wood products), and the imperative to mitigate the negative environmental externalities that come along with this production.

I have put *my* nine characters (mine in the same sense that Frankenstein's monster belonged to Dr. Frankenstein) in front of an imaginary audience in a public space modeled after the Forum at my alma mater, the Harvard Kennedy School of Government. This unusual format is purposely designed to yield a liberal-arts, interdisciplinary-style discussion that ranges across disciplines from philosophy to soil science.

Although I have fact-checked the panelists' declarations and updated those facts with the latest research, this is *not* a project where the academically-oriented reader will find each issue explained and debated using formal citations. Instead, it is a staged "play" designed for the non-expert with the intent to highlight and inspire ideas about how science, activism, and money might coalesce around meaningful policy initiatives and land use operational adjustments to address the food and fiber provision issue.

I respectfully ask the reader to approach it with both a sense of humor and a critical mind.

Our panelists generally agree that the U.S. is the country best positioned to contribute disproportionately to providing *Provision Problem* solutions. The U.S. has the academic, financial, and entrepreneurial systems in place to put the technological pieces of the sustainability revolution in place. The U.S. holds 10.7 percent of the global arable land area, slightly more than India, and substantially more than Russia and China. And, the U.S. also has the most well-developed plantation forestry system in the world.



International Forestry Review, 2020

How the U.S. manages these domestic assets will affect global food and fiber supplies especially as India and China cope with impending water shortages.

Our panelists also agree that policymakers must set the ground rules for carbon markets and Environmental, Social, Governance (ESG) investment criteria, and create incentives that encourage more sustainable food production practices. The discussion also touches on more philosophical and futuristic issues regarding: demand reduction, the forever growth paradigm, rewilding, “late stage” capitalism, and population migration.

Although the *Provision Problem* is manifesting itself in the driest, poorest parts of the globe (which unfortunately overlap to a large degree), the dearth of solutions to the *Provision Problem* threaten to become graphically apparent in the decades to come. A crowded planet means less arable land and increased deforestation. Deforestation

means less CO2 sequestration. Less sequestration means more climate disruption. A disrupted climate means inconsistent food production. Food shortages mean more human migration. More migration means more political reactionism. This is not Cassandra-ism. This is just the math when ten billion people cohabit a planet with finite land, water, and forest resources. And finally, although the U.S. might seem isolated from some of the more dire consequences associated with the *Provision Problem*, our panelists agree that these climate and provision issues will wash up on our domestic shores as surely as sea level rise will submerge Miami Beach.

2. Setting

Bob is in a hurry as he walks down Brattle Street toward The Humphrey School of Government (HSG). The Red Line stalled at the Charles Street station, and now, after a year of preparation, he's late. The hurried walk thru Central Square in the February heat has him sweating like a sow, and perspiration plasters his Oxford shirt against his back underneath his blue suitcoat.

It's been a gray, snowless winter, more like a long November. The ground never froze, and the granular, grimy snowdrifts never accumulated on the curbs of the city streets. Today, February 15th, spring is in the air. The sidewalk is crowded. The weather is warm and humid, and it is easy to imagine that yellow daffodils will soon be bursting through the brown soil in the gardens on the south side of the street.

A game of Ultimate Frisbee is in process on the Humphrey Common near the river. Exuberant screams from the players punctuate the low traffic hum that moves in waves across the Charles River from Storrow Drive. The sidewalks along the river are crowded, and the swampy reek from the tea-colored river mixes with the astringency of diesel exhaust from the trucks that idle on Brattle Street.

Two runners in brightly colored spandex weave around Bob, and then run in place until an opening appears between the cluster of men in cowboy hats and flannel shirts that block the bricked hillocks of the colonial sidewalk. Bob eavesdrops on their boisterous conversation. They are, as it happens, headed to Bob's panel. They've been attending the National Farm and Forestry Conference and Machinery Expo at The Hines Convention Center in downtown Boston and they've made the trek from Boston to downtown Cambridge, and now, toward the HSG building to meet a friend who's in the mid-career HSG Executive Management Program.

As Bob approaches the HSG entrance, a group of well-dressed women in multi-colored suits breeze in just ahead of the men. The women chat happily among themselves about the ag-tech seminar they've just attended at the Harvard Business School. One of them says, loudly, "If this panel sucks, we can duck out and go for cocktails at the Charles Hotel." One farmer turns to his friend and says, "Sounds like a plan."

Bob hasn't been inside this building since he graduated with his Master's in Public Policy forty years ago. "The ExxonMobil Forum," he mutters to himself. "Wow. Reagan was president, and Jimmy Carter gave our commencement speech. My parents were still alive, my kids unborn. It all goes by so quickly. Climate change was just a twinkle on the distant horizon. Will my grandchildren forgive me, forgive our generation, for our obliviousness?"

Just inside the entrance, three wooden easels hold the posters announcing the Bob's panel.

*The Harvard Humphrey School of Government Presents a Panel Discussion:
Growing Food and Fiber for a Hot, Crowded Planet*

Tonight: 4:00 p.m. to 6:00 p.m.

Featuring:



Ismael



Gordon



Jude



Levin



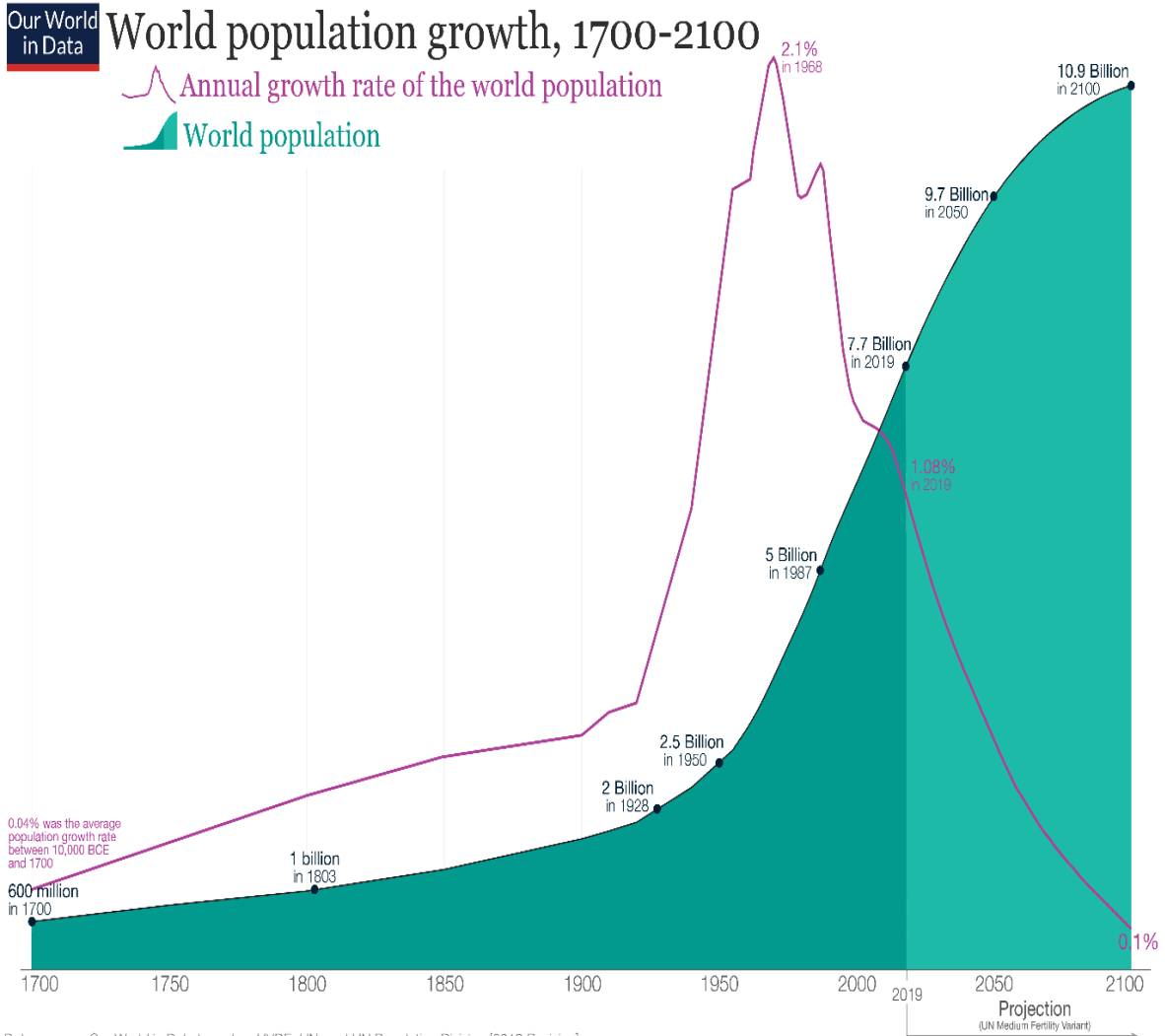
Leslie

Moderated by:



Bob, HSG Class of '85

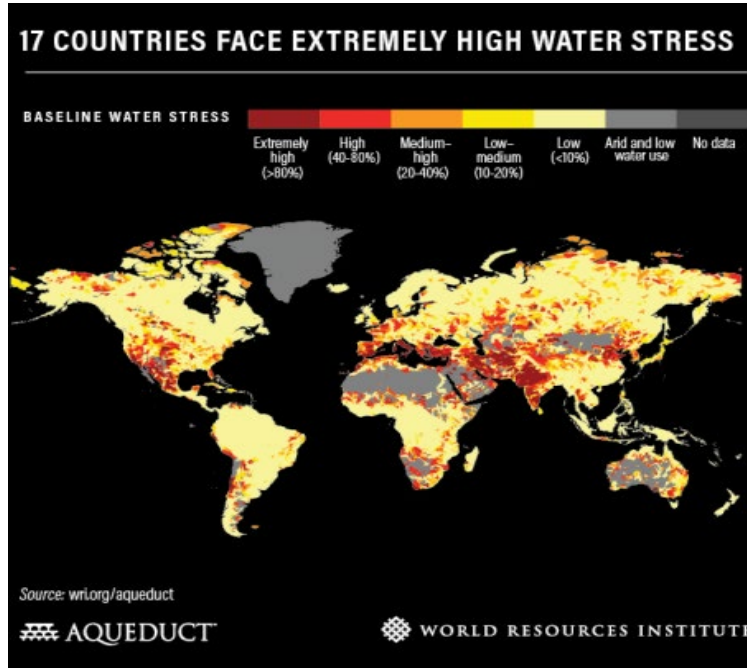
Population



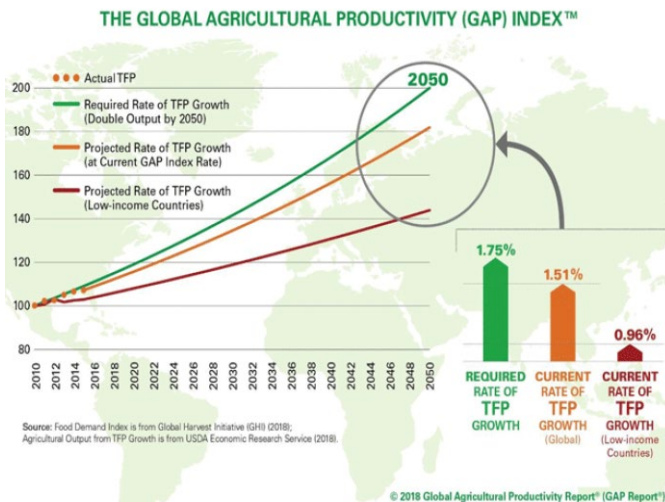
Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2019 Revision]
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

Licensed under CC-BY by the author Max Roser.

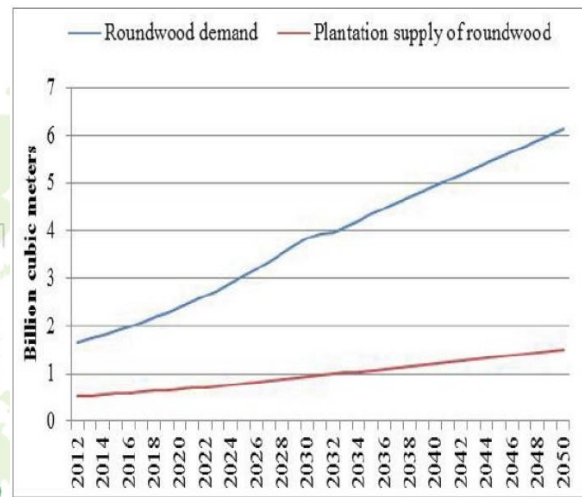
Water



Wood Fiber



Total Food Productivity



April 2020, International Forestry Review

On the dais at the front of the Forum sit Bob's five panelists. They've all arrived early and this makes Bob happy. It's taken almost a year to organize this event and Bob's relieved they've all made it here safely. They wait stoically for the crowd to seat itself. Bob is concerned that they don't seem to be interacting. He wants a lively panel.

"They seemed to get along well enough during the prep calls on Zoom," he thinks, "except for Ismael. He's the wildcard. Has he offended them already?"

Folding chairs have been brought in to accommodate the overflow crowd. As the people arrange themselves, the sound of the screeching metal chair legs on the tile floor bounces off the ceiling five levels above. Bob hopes the crowd will settle down. The atmosphere is boisterous, and Bob is concerned that he may not be able to call the crowd to order at the appointed hour, 4:00 p.m. The HSG Security detail has been given strict orders to clear the room by 6:05. The Forum needs to be cleaned and then prepared for a HSG fundraiser in the adjacent ballroom at 7:30. Rumors abound that a Saudi delegation is in Cambridge to endow ten new HSG faculty positions to found a new HSG department to teach and research Energy Transition Studies.

Each upper deck inside the Forum cantilevers farther over the floor below it, until the highest deck, the fifth, leans out menacingly above the dais. Bob tilts his head upward. He sees several male students on the top-level drinking beer and laughing. There is a loud peel of laughter that rings down after one of the beer drinkers says, "that guy with the beard...Moses?"

Bob can imagine himself forty years ago as a twenty something sitting among his comedic friends, peering down onto the bald spots and colorful scarves of the elders on the ground floor below. He's been concerned for months about the timing of this panel: late Friday afternoon, butting up against the fundraiser. There seem to be distractions all around. The springlike weather hasn't helped. The audience exudes a restless energy liberated from the dreariness of the grey winter.

After he steps up on to the dais, Bob shakes the hand and greets each panelist. "Thanks, appreciate your coming all the way from...Maine, D.C. Geneva, Seattle, Rio...." And then he returns to his seat, puts on his reading glasses, and clears his throat. He taps the microphone, and feels the HVAC system's exhaust fans suctioning the lonely hairs on the top of his scalp toward the ceiling. He pats them back down, and starts his opening remarks.

3. Panelist Introductions

Bob: Welcome! Great to see you all. Glad you could make it and thanks for being here late on a Friday afternoon. I'm Bob Saul, MPP class of 1985, and I'll be your moderator this evening. My bio is in the program. I hope you've memorized it.

Polite laughter.

It's an honor to return to my alma mater. HSG is an amazing institution, and it's playing an increasingly important role in the conversation about climate change by bringing diverse voices to events like this one.

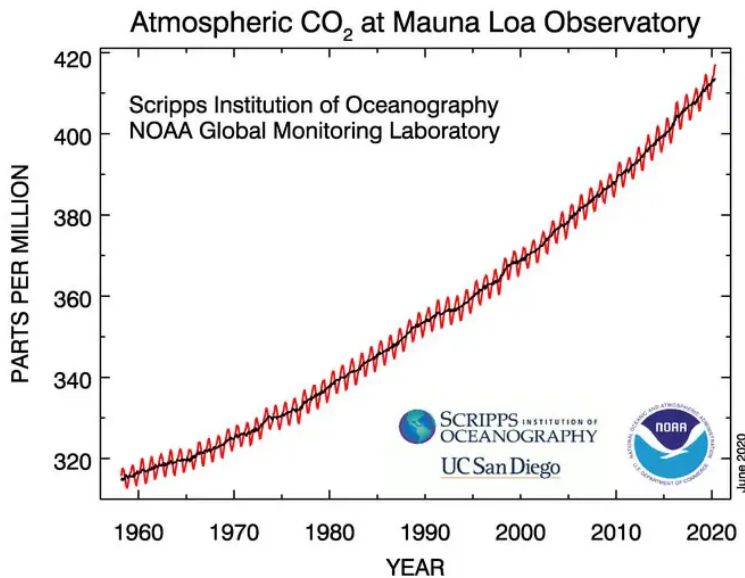
We're trying something new this evening. We have a voice recognition app tied in to this conversation and when a phrase or concept comes up, the app will search the web for appropriate images and bring them up automatically on screen. This might seem a bit cavalier, or even dangerous, but my assistant will be curating these images with discretion. Some of our subject matter is a bit dry and I want to keep you all engaged. Think of yourselves as part of an experiment.

Bob picks up a napkin from dais and wipes forehead.

Whew, it's already hot in here. Feel free to roll up your sleeves and take off your coats. We've set the AC at a balmy seventy-eight degrees. We obviously feel it's important to do what we can to reduce the carbon footprint of this event. Seventy-five degrees outside in February! Who could've imagined?



Ismael: Is that a rhetorical question? We *all* could have imagined. It's no surprise. It's atmospheric carbon that's creating this wonderful early spring here in this most privileged part of the globe. Elsewhere it cooks the innocents, melts the icecaps, and floods the shorelines. This CO₂ has been building up in the atmosphere for decades, and it will remain there for millennium.



Ismael's corduroy overalls are held up with red suspenders. His hands roam around inside the bib like rats under a rug. They emerge when he pulls out a bottle of pink kombucha and places it on the table.

Ismael: And I also take issue with the implication that it's *our* responsibility to adjust the AC and take personal action to reduce *our* carbon footprint. It's the System's fault. There are one hundred companies out there doing **seventy percent of the global carbon polluting**¹. Corporations are animals motivated by profit and they are virtually unfettered in their extractive, carbon-polluting activities. We have a system set up to protect and encourage the private sector to do what it does so well: make money and grow, grow, grow, for the benefit of the few and the suffering of the many. The planet and the underprivileged pay the price. We all know the capitalist model is driving us toward extinction, but we're social animals who mimic one another and fall prey to

these powerful but largely invisible forces. We act with our own interests in mind while the larger interest—the planet’s interests—are ignored and degraded.

Ismael’s leg twitches underneath the table. Bob reaches over and puts his hand on Ismael’s knee to calm it.

Bob: Ismael, great to have you here, but can we all just hold our fire until we get past the introductions. Since you have the floor, let’s start with your bio. Give a quick outline of your background and expertise?

The knee-piston slows, then stops. Bob removes his hand.

Ismael: Sure, and I didn’t mean to be rude, although no promises as the conversation gets going.

I live off the grid. My house, which I built myself, is heated with wood. I have a scrubber that removes the soot. The rest of the house is powered by solar. I’ve held many jobs over the decades. Logger, organic farmer, and even postmaster at my local post office. I’ve been active in my community as a selectman and served five years as the town administrator. I spent a year in a federal penitentiary for my role in shutting down the Vermont Yankee Nuclear Power plant, although recently I’ve been having second thoughts about that. I’ve written and published three books on conservation and the important role it plays for species migration. I pride myself on my balanced perspective and thorough research when it comes to taking on complicated issues relating to land use.



That said, my work and my observations during seventy years on this planet have pushed me to become a devout socialist. That seems to me to be the only political philosophy that's socially just. I acknowledge that socialism's application since Marx originated the modern socialist idea has been flawed, but I believe that systems evolve, and we haven't yet found a way to apply the distributive and socially just principles of socialist policies in an effective manner. I hope we will, although I'm not optimistic I'll see this in my lifetime. It is hard to imagine the momentum of capitalism losing steam anytime soon, but I believe that the market-based system is a sham that delivers a main course of material plenty with a side order of misery and despair.



I'm a Buddhist and believe that getting what you want, or think you want, or are told to want, only leads to more wanting, and wanting more is what we all have to stop ourselves from doing.



Bob: Thanks for that Ismael. Gordon, would you go next?



Gordon is a distinguished, well-preserved, energetic elder who speaks very quickly and very authoritatively. He punctuates the end of each sentence with a quick smile.

Gordon: You're a tough act to follow, Ismael. Honored to be here at Humphrey. Great place. My background is not nearly as colorful. I've been a professional natural-resource academic for most of my forty-year career, but in the last two decades I've been enlisted to consult for large global pension funds on their farm and forestry investments. I've also done stints as the dean of two schools of forestry and environmental studies on both coasts. I like to think my experience makes me a moderate on natural-resource issues.

Ismael proclaims his adherence to research and facts, but as a veteran of the academic world where every person in the room thinks that their facts are *the* facts and that they are smarter than you are, I take the view that facts are mere assertions and assertions don't automatically lead you to the best outcomes. Even the most sacrosanct scientific

truths fall away over time. Einstein's General Theory of Relativity, for example, can't explain dark matter and dark energy, and it's incompatible with Quantum Mechanics. It will be replaced or modified in time, and I'd bet we'll see that pillar of pillars begin to crumble before our younger audience members have grandkids. Nothing lasts forever in science, civilization, or in the natural world.



Since you mentioned Buddhism, I'll represent that, like you, I'm deeply agnostic. I hope you'll acknowledge that Buddhism and agnosticism are the same side of the coin? They both begin with the precept that we, as humans, can only know our own minds. The Universe is, and will be ever thus, unknowable. That, to me at least, is a good enough reason to believe in something greater than ourselves. Call it God if you have to give it a name, but its shape and form is a mystery to us. Those who claim to know the truth of it are full of it.

Bob: We're diving right in and diving deep. Jude?



Jude's warm smile gives the impression that he's ready to engage, question, and debate. His carriage is upright, almost rigid. His large hands wave around him like tethered birds. Ismael, who sits to Jude's left, leans away to avoid contact. Jude seems oblivious to the mannerism although at the end of each

spoken paragraph, one of his hands stops in front of his face, and he rotates it, inspects it, and smiles as he admires it.

Jude: I've run one of the world's largest land-conservation groups, and, as a result, I am sadder but wiser. I'm a progressive but also a believer in the market. Does that make me an enlightened progressive or one that has fallen from grace? Not sure. I disagree with Ismael about capitalism for reasons we can discuss as we get going.

I pride myself on my negotiation skills, and my ability to bring disparate groups together and coalesce around policies they can all agree upon. I live in Seattle, Washington but I've traveled all over the world and did a stint in Ghana as a Peace Corps volunteer. I am deeply concerned about sub-Saharan Africa but also concerned that the fabric in our rural communities in the U.S. is fraying. I do not believe in the terms *open space* or *resource extraction*. Nature must pay for itself in the Anthropocene era, and, as we grapple with that reality, land use must evolve toward optimization. Preservation has its place but even preservation pays for itself in the sense that wild spaces recreate the human spirit and supply scientific data that will over time benefit humankind. Behind closed doors in D.C. when I worked in Obama's Department of the Interior, these were the themes I stuck to. I have a spiritual life but that is a personal issue and not something I'm willing to share in public.

Levin: My turn?



Bob: Yup, go right ahead Levin.

Levin's carriage is upright, his body taut and strong underneath the white shirt. He keeps his hands on the dais as he speaks. His nails are manicured, but his hands are not on the dais to show off his

fingernails. Instead, one has a sense that he's anxious, prepared to take a blow, but not sure when that blow might come. His face is handsome but grim, reinforcing the impression that he is uncomfortable, possibly regretting what he has gotten himself into.

Levin: Great to be here and thanks for including me. I've had a similar trajectory professionally to you, Bob. I now manage the country's largest natural-resource investment firm, with more than five million forest and farm acres under management in the U.S. In the last several years, I've been quite outspoken about the need to regulate carbon markets and certify Environmental, Social, Governance (ESG) investing. I think much of the latter and the former are shams, and although my investors might benefit from the laxity of criteria for carbon offsets and ESG² flavored investments, I feel a moral obligation to blow the whistle on what I know are disingenuous efforts to represent climate-neutral investments as climate-positive ones. If we continue to allow that to happen, the battle against climate disruption will be lost. Like Jude, I'm a believer in the market but only if the market is managed and regulated.

I don't have any spiritual beliefs to add to the mix but if I examined my internal life closely, which I rarely have time to do unless I'm on a long flight and the cloud formations are magical, I might conclude that I'm a devout atheist. I believe we are here as humans to support and love one another above all else.



Bob: Well, let's start there because even that statement, "we are here as humans to support and love one another above all else," contains a tempest in a teapot.

Levin's brow knits itself into a vertical wrinkle. Without knowing it, he has invited hostility.

Bob: In the Anthropocene, that humancentric idea seems to be the clear late-stage capitalism imperative. "Humans above all else" might be defined as putting human priorities ahead of natural systems and biodiversity that lie outside systems that benefit homo sapiens. In other words, Levin, are you saying that all efforts that go toward supporting human thriving are fine with you?

Levin: Uh, no, not really. Unsustainable practices that harm biological systems that we as humans rely upon, I certainly don't support. And I'm not a climate denier. On the ground, I see climate change increasing risk in real time for my investors. There are high-speed wind events that threaten perma-crop productivity by knocking over trees and hampering bee pollination. And the warmer weather is reducing the **chilling hours**³ needed for the production of permanent crops like juice oranges and almonds. So, I'm not advocating for human endeavors that put more greenhouse gases into the atmosphere. We're only hurting ourselves when we do that.

Ismael: I'm happy and surprised to hear you say that.

Levin: It's hard not to judge a book by its cover. I may wear a tie. I may make good money, but I have kids, I'm a global citizen, and I'm as concerned about climate change as anyone on this stage.

Bob: But I'd contend that you've staked out a humancentric view that ignores issues about the rights of species that cannot represent themselves. Are the Earth's food and fiber production systems just here to support humanity? This sounds like pre-Galileo-type thinking, with human beings at the center of the universe.



After correcting a few constants in the formula, Dr. Rubinstein discovered that the center of the universe is - him.

Ismael: I can already tell that this will be a totally humancentric discussion. Then it will narrow further and become investment-centric, because as we talk about the risks of climate change, the presumption in the word *risk* is that something needs protection which in this instance is commercial-scale timber and food production, and the economy in general. We worship economic growth and those are the metrics that justify both evil and good. The professionals up here know a lot about this topic, and I already sense that you will generally coalesce around a presumption that commercial-scale timber and food production are good things that require protection. You all generally operate within a field of specific competency, in the sense that you understand a lot about agriculture and forestry, and this gives you a sense of authority that reinforces your confidence that your collective “value”—commercial production—is good and necessary, and that your values are generally right. This, in turn, gives you a sense of belonging which quickly devolves into a form of tribalism.

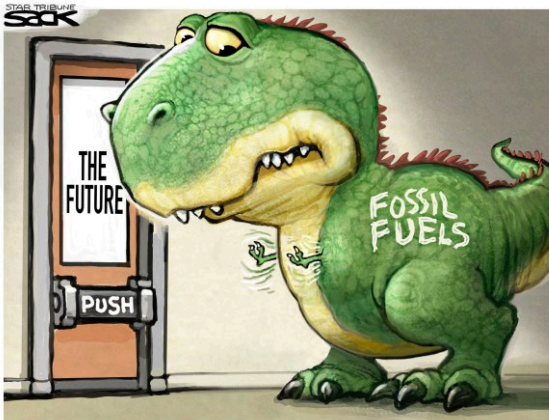


Bob: Ismael, we're here to talk about commercial production to feed and house an increasingly crowded planet.

Jude: We'll keep finding it hard in this discussion to get away from the people vs. nature conundrum, and that debate is really about fossil fuels and the fossil fuel industry.

Bob: I don't follow.

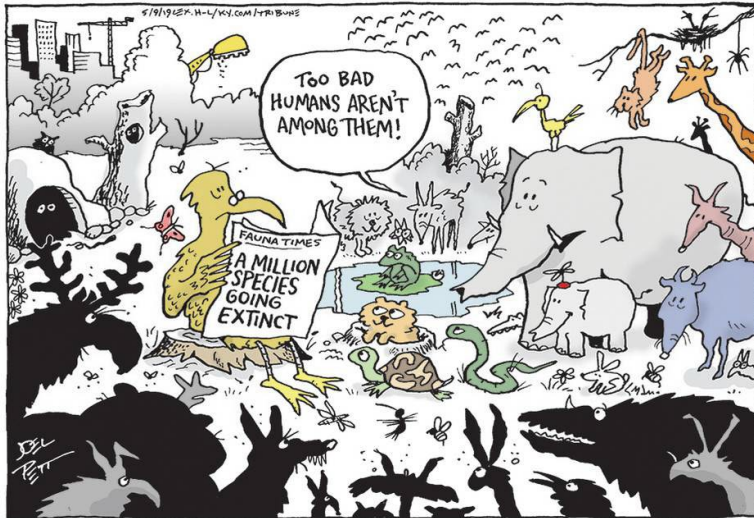
Jude: Isn't that the dinosaur in the room? I worry that fossil fuel is still the easiest way forward and that the fossil fuel industry will exploit that advantage as long as it meets its corporate goals. The oil companies have no interest in saving the planet. Their interest is in saving themselves. Oil executives have compensation tied to their share price and compensation equals status, country club memberships, and high-profile political contributions. Maybe the occasional dollar to The Nature Conservancy for good measure, which in turn is tied back to personal status, compensation, and back to share price.



Bob: It's tempting to rail against the fossil fuel industry, but we're here to think about land-based solutions and consider the full land-use spectrum, from rewilding to working forests to organic agriculture to traditional agriculture to intensive agricultural production.

Jude: The order implies moving from ecologically “good” to ecologically “bad.” Was that intentional?

Bob: If you use net carbon as a proxy for *good*, then I think it does. I include rewilding because in both agriculture and forestry, it’s a hot topic that serves to heighten the debate of human survival vs. species survival and global ecosystem health.



Ismael: Aren’t they really the same thing?

Levin: They might be, but the jury is still out on that one.



Leslie: Excuse me, I think you forgot about me.

Bob (to himself): I’m an idiot.

I'm so sorry. You're down there at the end and we got off to the races. My deepest apologies. So, so embarrassing. Leslie, please introduce yourself.

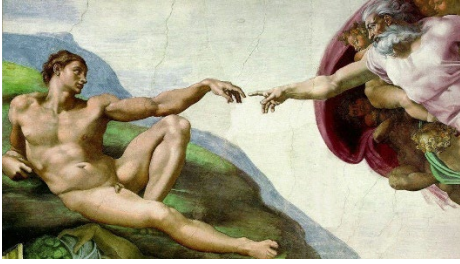
She looks more like an art curator than a climate scientist. As she leans forward to peer down the dais toward Bob, she places the length of her forearms on the table. This gives the impression that she is setting up shop, happy to be here, and anxious to share her opinions, a person comfortable in her own skin. Levin, who sits next to her, benefits from the vibe, and offers his hand in greeting. She grips it warmly, and Levin looks relieved.

Leslie: No worries. I wanted to impose some scientific order upon this discussion before we go down the philosophical rabbit-hole.

Bob: Please introduce yourself first?

Leslie: Sure. Honored to be here like the rest of you. I'm a climate-science generalist. I study, develop, and integrate holistic models of the global climate. I began my career as a soil scientist but quickly realized that soil quality, and more importantly, soil sustainability, were a function of both operational practices and climate factors. So, I worked to incorporate the changes in soil quality and productivity into some of the early climate modeling. This proved to be quite complicated because the distance between soil and global warming—that is, linking the two—could only be covered by understanding all the photosynthetic processes in between. Trees, grasses, fungi, bacteria in the soil biome, etc., and by the time I'd covered all that distance, I'd morphed into a climate-science generalist. So, I know a lot about a lot of things, and I hope that makes me a good person to explain some of the complex scientific processes that are changing and will change our planet.

And if we are getting spiritual, I am a devout Catholic. I believe life on this earth is a test, a test of our worthiness in the eyes of the Creator. We are not here to experience happiness, we are here because God is testing our natures, the quality of our characters, and he will judge whether we are worthy for heaven...or not.



4. Discussion Part One: The Cause and Effect of the Provision Problem

Bob: Okay, it seems we have a diversity of spiritual and subject specific expertise up here on stage so I'll begin again. Leslie, since I left you out, do you have any comments on this concept of human-centrism?

Leslie: Maybe just to keep things in perspective, and to turn human-centrism on its head: for the vast majority of our natural systems, climate change—global warming—is a secondary or tertiary issue when compared to the effects of human activities like forest conversion, the intensity of land management, the fragmentation of forestland, and the acidification, compression, and simplification of our agricultural and commercial forestry soils. The real mystery is understanding the processes that allow natural systems to adjust to and recover from these manmade stressors. Most organisms will adapt to climate over time, but the climate is changing so fast, we've been forced to take *time* out of the equation. We just can't predict an individual species' adaptation during this accelerated warming period, especially in a landscape that's been chopped to pieces.

Ismael: If you ask a wolf or a dragon fly, "What do you really need out of life?" they're going to give you some variant on, "I need my freaking habitat, and if you're going to make habitat hard-to-find, and then heat the goddamn planet, I'll need a lot of connectivity so I have some flexibility when it comes to moving around."



Leslie: Agreed.

Bob: It's interesting that humans are arriving at a place both philosophically and scientifically where they accept that other species have a perspective. **Panpsychism**⁴, this concept that all living things are in a conversation with one another, is developing some traction.

Ismael: It's not just interesting, it's essential. If we don't see ourselves in every dragonfly or tree or fungus, we're missing the big point. Life is not an exclusively human endeavor. We're part of a system. "The goal of life is living in agreement with nature." The Buddha said that 6,000 years ago. Maybe it's time we listened. We've only removed ourselves from our conversation with nature in the last ten thousand years. We're now suffering the consequences of that, and it's time to start believing and living as if every living thing has rights and a purpose on par with the human purpose...

Ismael takes a quick sip of kombucha.

...or else.

Bob: By “or else,” I assume you mean that it will have implications for humanity? There is good scientific work out there that traces biodiversity collapse to a chain reaction that upsets the basic systems that support life. Extreme heat on land and in the ocean kills organisms that support the food chain that supports humans. It also accelerates the rate of carbon release which only exacerbates the heat and biodiversity collapse. This is the “or else,” I assume?

Ismael: Yes, human survival. The discussion about biodiversity often focuses on how hidden plants in the rain forest will provide medicines that can cure cancer, but the problem is much more fundamental. I disagree with Leslie on this. The hotter climate especially when organisms can’t migrate is existential. Human activity and human interruption of species adaptation and migration are intertwined.

And, I’ll also add that I know we’re here to talk about the U.S.’s role when it comes to helping humanity thrive, but there is an unresolvable conundrum. If you harness the sun and soil to solve this cleverly named *Provision Problem*, you’ll do more harm than good. The more you increase the intensification of energy production, any kind of energy production harnessed in the name of growth, the more you destroy the web of ecosystems that support life on earth in the first place. You can’t supply enough material to make a planet with ten billion people livable, you just can’t. We have to reduce demand and we have to discipline ourselves to want less.

Bob: I apologize. I didn’t make it clear that we’ll be taking questions throughout. We have two microphones set up in each aisle. Sir, introduce yourself and ask your question.

Corie: I’m Corie.



I'm a farmer and do farm consulting all over the West. In the Central Valley, my company farms citrus, almonds, and walnuts. I have my own cotton farm in Northern Arizona, and I work for investment landowners in Chicago who own wheat farms in Nebraska and Oklahoma. I'm in town for the Expo and a bunch of us came over to see our friend who's a big deal at Cargill. He's taking courses here at the university. I hope he's in the crowd somewhere because he'll have a lot to say.

"Up here Corie!" a voice shouts out from an upper balcony.

Corie: Get your ass down here, Dave!

Bob: Corie, who's your question for?

Corie: I wanted to respond to Ismael. He talks about people wanting more, and that offended me. I'm growing food, being a good citizen, and providing for my family. I'm not buying a new truck every year because I've been brainwashed by F-150 advertisements during a football game. I'm on this earth to help and support others, not to consume excessively. Where I live, out on the plains, we're in touch with nature in a very real way. We recycle everything—manure, tractor parts, old plywood—because you have to. Rachel Carson said it very well: "Humans are part of nature." I think that means we have to work with nature in a real way, conserve resources as best we can and that includes water, old plywood, and shit from farm animals.

And you talk about loving the planet? What does that mean, Ismael? It's so abstract. I love my soil. I have no choice. It sustains me and my family. Like Kahlil said, folks like you, Ismael, want to peel off humans and put us aside. We can't be put aside and you

can't claim that the most intelligent species on the planet is equal in financial or spiritual worth to the bacteria in the manure I put on my fields. We have a moral obligation to advance and sustain the human race, and yes, at all costs, and I see growing food as God's work of the highest order.

Bob: Corie, if you have the time, maybe you'd join us up here on stage?

Corie: It would be an honor, sir.

Corie puts on the hat he's been holding in his hand and walks down the aisle, the brass heels of his cowboy boots "tap, tapping" until he steps up on to the stage. A sprinkling of applause inspires him to look out on the crowd and smile. He moves down the row shaking hands and greeting each panelist. He grabs a chair with his extra-large hands, and, in one motion, shakes it to unfold it and places it in the space between Ismael and Jude. He wipes his forehead with a red kerchief pulled from his back pocket and puts his hand on Ismael's knee which immediately stops shaking.

Bob: Welcome.

Ismael: Corie, with all due respect, that is a complete misreading of Rachel Carson. She was highlighting how chemicals, specifically DDT, implicitly ignored the idea that humans are a part of nature. The fertilizers and chemicals you're using to produce your wheat are part of the same slow-motion tragedy.

Corie: With *more* due respect, you're barking up the wrong farmer. My wheat and cotton are produced organically with no chemicals and only organic fertilizers. I use manure from my grass-fed cows and hybridized seeds from heirloom varieties developed by this brilliant kid up at the university. Sure, it's different than my dad's way of farming, but you have to adapt.

Corie gestures toward the crowd.

Corie: The demand from all you vegans trickles down to me.

People blame every headache on climate change, and then they fool themselves into thinking they can fix it. We're a species that's had a good run. And Ismael, you and I can agree that it's not our responsibility to fix the problem by changing our personal behavior, but when you blame the "system," you lose me real fast. This system built this building, this system grew the food that's served in that kitchen.

He gestures toward the kitchen door which has just swung open. A male waiter dressed in a crisp white shirt carries a tray above his shoulder and quickly disappears into the adjacent door that leads to the ballroom.

Corie: This system, this freedom we enjoy in this country, gives you the choice to live off the grid, to choose how you want to be a member of your community in whatever little town you choose to live in.

Someone yells, "You tell 'em Corie!"

Ismael: I assume your pickup spews smoke?

Corie: Hell, no. I let my friends' trucks do that for me.



Crowd laughs.

Jude: Your friends' smoke spewing pickups are exercises in personal power against all opinions and debate. It's saying, "I've made my decision about the climate and about

how you're telling me to behave. Conversation over. I choose my freedom over your condescension." The left is saying the opposite. I choose my condescension over your freedom, but freedom has limits. This is what Garrett Hardin named the Tragedy of the Commons. It was based on the neoclassical economic assumption that individuals are simply rational and selfish. If everyone is rational and selfish, the individual perpetuates the Tragedy of the Commons. This is what drives the need to regulate, to govern, and negotiate among stakeholders. Purposely degrading the Commons with black exhaust is certainly exercising freedom. To the rational observer, it's an irrational act, but to the actor, it's a rational, and largely unregulated act that generates personal, psychic benefit by showing personal agency to a public that wants to take that agency away.

Gordon: But then, Elinor Ostrom⁵ modified this Commons problem by observing that we know how to communicate with one another. She won the Nobel prize in economics with an approach called New Institutional Economics. A lot of her work rejected Garrett Hardin and his ideas about the Commons. She postulated that, "We know how to make deals. We know how to set up plans and to monitor efforts to make sure that people are following the rules. When we do that, we can actually solve some problems that otherwise seem unsolvable." Ostrom's approach to these Common problems would begin with the question, "Can't those people who are degrading the Commons, the smoke spewers, maybe talk to non spewers and work out a deal?" Which is to say, "We can still assume that people are rational. We can still assume that people are selfish. All we have to do is slightly tweak one of our assumptions about economics to make the outcomes improve." That tweak is that people generally know how to work together in groups.

Gordon: This deal that Ostrom wants us to work out is going to involve incentives. Some landowners might be incentivized to change one way, and some the other way.

Levin: Incentives are necessary because externalities are not the private sector's problem, and government's *only* role is to create the rules of the road that the capitalist economy can operate within.

Ismael: Business gets minor speeding tickets on this road of yours when they should be thrown in jail.

Levin: I think this idea that business is *bad* is something that holds the liberal progressives back. Business is the only thing that can save us. It's the only institution with the resources, the creativity, and the freedom to innovate truly revolutionary solutions to problems. Yes, money corrupts, and the search for every holy dollar can undermine social and community values, but it's been my view that all the do-gooders in the world, nonprofits, and even government with all of its power, are no match for capital resources and the entrepreneurial spirit with all that problem-solving energy that the private sector brings to the table on any particular problem.

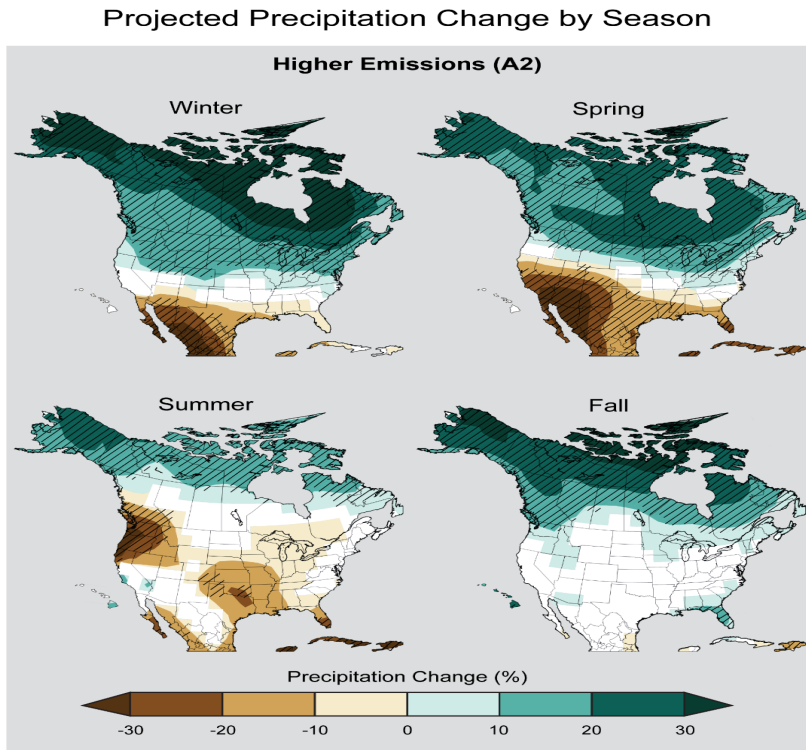
Bob: Before we digress too much...

Heads nod, but not Ismael's. He tilts back in his chair and stares at the ceiling. The knee begins to hammer again. Bob reaches out but thinks better of it.

Bob: We have these rapidly changing growing conditions across the U.S., with warmer winters, hotter summers, severe drought, torrential rain events, ice storms, increased hurricane intensity, and more intense wildfires. Are the modeling projections regarding the future state of the U.S. climate influencing public policy, private investment, and the land management process in any real way?

Gordon: I don't think so. There is still so much we don't understand about climate change, and part of the problem is that the climate models have been, until recently, not very specific. The only thing that you can really say with regional certainty for the

U.S. in particular is that the Pacific Northwest and the western part of the South⁶ are probably going to keep getting drier.



6

Leslie: But the models are improving rapidly. Our latest models have incorporated sea currents, atmospheric moisture, forest-carbon cycles, and changes in arctic ice cover and ice thickness, as well as a host of new data, to gain precision over the last two decades. We're now combining different climate models and we're understanding the thresholds and feedback loops better every year. Still, it's difficult to model an array of potential environmental conditions driven by poorly understood interconnectedness. For example, we obviously understand the cause of the greenhouse effect, but we don't completely understand the math behind the correlation between carbon emissions and warming, except that there is one. Is it exponential or linear? That is still unclear.

Aromas from the kitchen escape into the Forum as the kitchen begins preparations for the ballroom dinner. The swinging door opens and closes with waitstaff moving in and out of the kitchen and ballroom doors.

Jude: Climate modeling certainly highlights the threats, but these models are essentially public relations tools to illustrate and dramatize the symptoms of climate change. You obviously have to face the problem head on, and maybe even scare folks a bit, before policy changes are enacted. The climate models perform that function quite well. We used it quite effectively as a fundraising tool at my conservation group.

Gordon: But that's a different issue than an investment or commodity production issue. I think Leslie is saying that these models don't have the predictive accuracy yet that can drive public environmental policy or the investment process.

Leslie: That's not what I'm saying at all. I'm giving you updated information that these models are developing fast. And as for investing decisions in particular, the modeling requirements for farming and forestry are very different. Farmers are generally nimbler with crop and seed selection. There is work going in agricultural universities all over the country, for example, to develop climate resilient seed stocks and new grain varieties that are more productive and better for the soil. Farmers can more or less adapt to these climate trends. They've been doing it for thousands of years.

Jude: I think you both highlight a nuanced risk that I would label *scientific certainty risk*.

Bob: You mean scientific uncertainty risk?

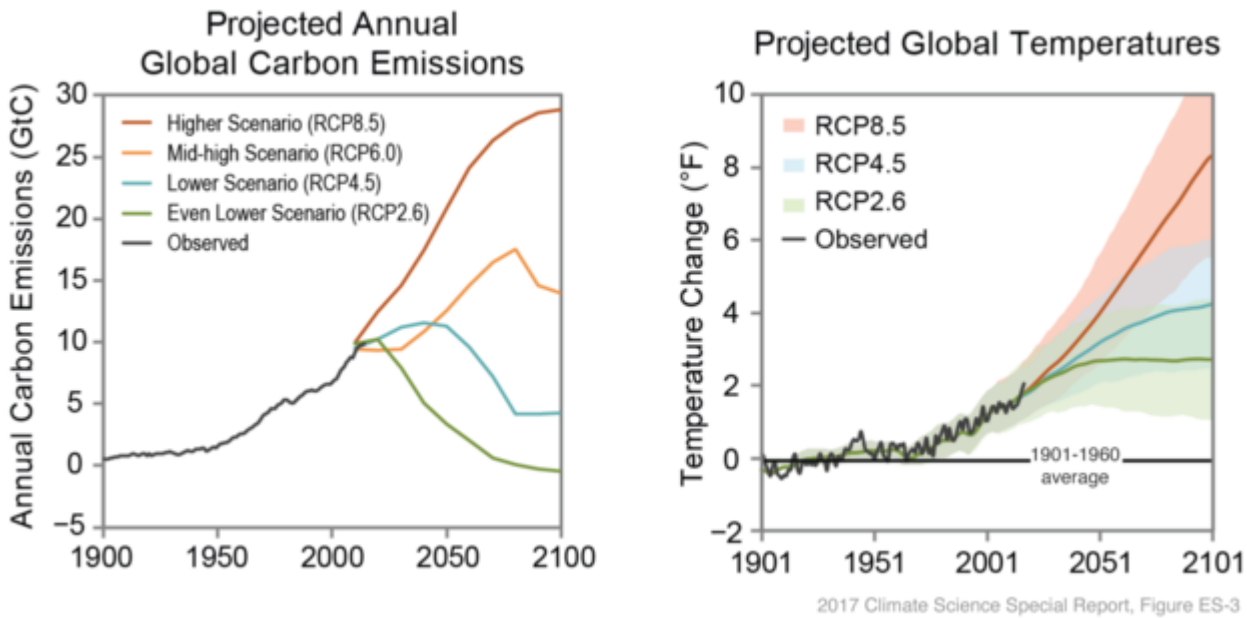
Jude: No, I mean certainty. Gordon implies that investors and policymakers both want certainty from these models, but the need for Grade A scientific certainty gets in the way as we try to deal with runaway climate change. Our affection for scientific certainty often delays our action. When we were making policy decisions in real time at the Department of the Interior, or even The Nature Conservancy, we'd rarely wait for the science to be as conclusive as the scientists wanted it to be. Our decisions were made on seventy five percent confidence or less all the time. But most scientists don't

share their information until it's ninety five percent. Science seeks certainty and replicability, but those aspirations handicap it when it comes to supplying the rapid advances required by the pace of commercial activity, and now, the pace of climate change. Real decisions in the real world get made faster with much less precision than science allows. Scientists are busy trying to get more precise about something where the overall story isn't changing, but real actors just want to make decisions based on what they have to work with. So, the models, such as they are, provide some helpful input, albeit not precise input.

I'd suggest that during a climate emergency period, where the risk is existential for billions of people and who knows how many species, we need to relax this religion of scientific certainty that has Western society by the intellectual short hairs.

Bob: I think your uncertainty point also brings up the issue of *career risk* which disincentivizes certain types of unorthodox decision making. Hunches and intuitive decisions, contrarian decisions, are not usually rewarded because even if you're doing something for the right reasons based upon partial information, and you get it wrong, you'll always be the gal who guessed wrong. Your career might be ruined. Folks often wait for data and science to cover their asses. "The algorithm told me to do it!"

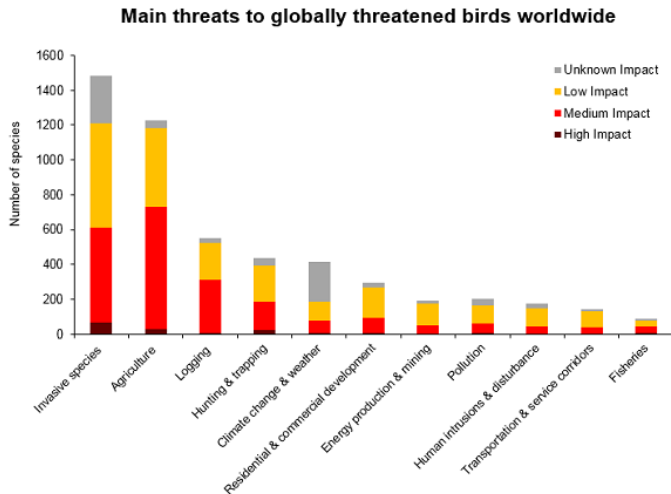
Leslie: I'm of two minds on this certainty idea. Many climate scientists already understand the world is going to blow past three degrees Celsius of climate change, and extreme measures and hypothetical solutions will become necessary. Big experiments need to be tried, and some of this experimentation might be based upon partial information and less rigorous thinking. This puts scientists in an awkward circumstance since we try to base our hypotheses on the best existing, verifiable science. Yet, we're in a climate emergency and we need to address it by pushing out of our comfort zone into more unproven theoretical territory.



Bob: I think you're referring to carbon capture and reflective systems that bounce the sun's rays back into space?

Leslie: Yes, but this gets me out of my comfort zone. I know there are folks working on this. I applaud their efforts because although I'm disappointed, to put it mildly, that we've exhumed carbon that's taken eons to build up in coal, oil, peat, you name it, and spewed it into the atmosphere without discretion or concern. Unlike Ismael, I also acknowledge that it's an emergency created by humans that will have to be solved by humans

Gordon: Bird species show us how immediate this emergency is. Their decline, thirty percent over the last few decades by some estimates, is a grim example. Birds are one of the most adaptable biological families on earth and they are clearly not doing well. Do you explain the decline in numbers by a loss of habitat at both ends of their migratory routes? Or the fall in insect populations? Or some interaction of these factors with something else?



Bird Life Data-zone, 2017

Leslie: What we see as conditions become hostile is that some species retreat or adapt to some new ecosystem. Some species disappear. We don't really understand it, and even when we do, where do we as humans intervene to improve the situation, to keep our farms and forests productive, let alone stop the extinctions?

Ismael: Productive? Improve the situation? Human solutions? Is the idea that because humans have already intervened and created a manmade environment, that it's up to our ingenuity to fix it? So, when some natural disturbance happens, we say to ourselves, "Now we really need to roll up our sleeves and manage the resource for the future." We're chopping up the landscape and it's this direct impact by people and human infrastructure that is the real disruptive effect for species migration. It creates even more stress than the stress from the extraordinary climate change that we're expecting.

And the bigger problem...

Ismael takes another quick sip of kombucha, then rummages in his overalls for a tissue to clean his glasses. Gordon watches impatiently.

Gordon: Ismael, you've got us on the edge of our seats. What is this bigger prob...

Ismael: timeframes. If we want to be sustainable for hundreds of years, not a few decades, we need to stop intervening in natural processes. It's human hubris about our ability to interpret what nature should do and how to fix it that's screwing up the planet. People have pushed ecosystems pretty damn far, and the whole landscape pretty damn far over only a few hundred years. By contrast, the results of nature repairing itself are really quite miraculous.

Loud applause.



Ismael: We're jumping to the conclusion that we have to actually do something, and that we can somehow scientifically calibrate our interventions to consider climate change, and somehow, that this human intervention going to put us on a healthy trajectory in the future. This is just crazy talk. Confucius says, "Unless we change our direction we will wind up where we're headed," and where we are headed—if you have unlimited growth in the limited world—is not even part of the discussion, and it should be.

Bob: Question from the audience?

Kahlil: My name is Kahlil



I'm a post-doctoral student in the Philosophy department here at Harvard. I have a statement not a question. First, I understand why this crowd might applaud Ismael. It's easy to talk about changing the system and throwing humans under the bus when you're not the humans getting run over by the bus. I'd like to point out that innovation, changing the environment to suit the human condition is what humans do. Humans are creatures who create technology, fire, the wheel, the silicon chip, so Ismael, if you're asking humans to turn their back on humanity by ceasing to try and improve the ecosystem, an ecosystem they've created, then I think you're just part of a destructive trend. Human self-loathing psychology, if you will. It's not productive.

Ismael: I'm not saying that I look forward to the day when people disappear from the planet. Human beings are wonderful creations, especially when we love one another and by extension, love the planet. But we've lost the trail. We've created a system that caters to and encourages our worst behaviors, a system that's dependent upon our wanting more, and then more again.

Kabli: We can agree on that, but criticism of the system is just the first step. If you're not going to offer an alternative to monopoly capitalism, then you need to think deeply about how we can create a system that creates desired outcomes like climate-warming mitigation and habitat restoration. You don't just put up a stoplight on the civilization road, and then tell human beings to eliminate their desires to innovate and improve. It won't happen.



Bob: Kahlil, why don't you join us up here on stage as our resident philosopher and we can explore these questions as we progress?

Kablil runs down the aisle. His youthful athleticism is clear as he jumps up on to the dais in a single bound. He sits next to Ismael and shakes his hand vigorously. Ismael's expression stays grim t, and when Kablil settles down and crosses his legs, Ismael leans back in his chair and inspects the young man's loafers and bright blue socks.

Bob: Jude, you had a comment?

Jude: I think we were supposed to be talking about farmland and forestland's role when it comes to feeding and housing the planet?

Jude leans over and says to Gordon in a fake whisper, "I think that's what this panel is about?"

Audience laughs.

Leslie: I still don't think scientists, planners, or politicians have answered the most basic land-use modeling question. What's the right mix of preservation, conservation, and food and fiber production acres to optimize our domestic production on the best soils in the best growing regions with the best crops using the best protocols, while maximizing the carbon that's being stored in the soil and forest? That simple landscape-level geographical calculation hasn't been made. If we're going to step up

and do our part for the globe, we'll need to get our act together. There's an answer to the question and it should drive some of our climate mitigation policies.

Gordon: Whatever the land use mix, we're going to need commercial forests. They'll play a key role by providing wood fiber products that can replace materials like concrete, aluminum, and steel.



Jude: We want conserved land to hold the landscape together and keep habitat intact, but also to contribute, maybe less intensively, to sustainable wood production. And, we'll want pure preservation to hold the big, old-growth trees and create habitat benefits by creating wild places that have unknown benefits that we can't even anticipate. With our computing skills and optimization models, we could coalesce around a national plan for the optimum land use for food and timber production, carbon farming, habitat, and rewilding.

Levin: To do that, you'll have to have public entities compensate landowners to manage for optimum benefits within the rubric of that plan.

Bob: That would take the kind of federal policy coordination that we haven't seen in this country since the construction of the interstate highway system.

Jude: I'm skeptical too. We can proselytize about turning it all into an optimized checkerboard, but that's completely irrelevant. The federal and state governments could never pull that off. The way our market actually works is that there are a bunch of people, some small owners and some large landowners, making individual decisions based on their own economic and market incentives.

Levin: Our firm is one of those landowners, and we're certainly interested in climate change's implications and the future of humanity, but my investment time frame as a fund manager is a decade, maybe two. And if you told me what the optimized land use for my forests "should" be, you'll have to pay me to implement it, because it's got to directly benefit my investors. That's my one and only responsibility, to benefit my investors. It's their money after all.

Corie: And, in the case of smaller landowners, it's their legacy and a source of pride and satisfaction. Those are the landownership principles that built this country.



Kablil: What's certain is that governments acting *now* to reduce carbon has infinite value into the future, and to inspire that, we need to foster a new sociological view toward longtermism, a social view that moves us away from selfishness and considers the welfare of the generations to come. It addresses the time frame issue Ismael mentioned. If we can adopt that, encourage that, we might survive climate change and all the other perils that threaten the species because we'll be mindful that our actions today reverberate into the future.

Someone drops a beer can (by mistake?) from the fifth level, and it hits the floor in front of the panel. “Tink, tink, tunk.” It rolls against the curtain below the dais. With the grace of a Wimbledon ball girl, a white-shirted attendant darts out and plucks it off the tile floor with a flick of the wrist. Bob eyes the upper deck warily.

Bob: I’d like to quickly cover the Environmental, Social, Governance investing movement and how it relates to fiduciary responsibility?

Kahlil: I think about the adage that “science progresses one funeral at a time,” and there is a generational shift driving the rigor about the criteria to judge what a climate positive service or product is. It’s a good thing, it’s a new thing, and it is *not* something that pre-existed our generation. My younger colleagues are really sharp on the authenticity criteria for something that claims to be positive simply as a branding objective.

Levin: That might be so, but it will be difficult to stop businesses from capitalizing on ESG branding.

Jude: I like to think that businesses weren’t created to make money per se. Instead, they were created to solve problems, and the profits that businesses generate are a measure of how successful and efficient they are in solving that problem. If you accept that premise, then the ESG movement looks like a development designed to solve a problem and the companies that are *really* solving these problems will emerge. I do agree with you Levin, in the sense that negative outcomes happen when businesses are left unfettered with no guideposts, no policy, and no incentives to behave, and ESG needs public oversight and certification otherwise, greed, ESG-greed, if you will, will take over without that oversight.



Bob: Now might be a good time to read Blackstone’s 2020 call to ESG arms?

Jude: If you must.

Bob: Here goes.

Clears throat.

“I believe the decarbonizing of the global economy is going to create the greatest investment opportunity of our lifetime. It will also leave behind the companies that don’t adapt, regardless of what industry they are in. The next 1,000 unicorns won’t be search-engines or social media companies, they’ll be sustainable, scalable innovators—startups that help the world decarbonize and make the energy transition affordable for all consumers.”

Levin: I think he’s right, but given the backlash in places like Texas and West Virginia against the ESG movement, I wonder if he regrets saying this publicly?

The opportunity, I think, extends well beyond decarbonization. In agriculture, ESG and optimizing returns are not mutually exclusive. It’s easy to find projects that improve sustainability with high rates of return. Shade cloths on orchards, camera sprayers for row crops, new rootstock for tree nuts, better irrigation systems, for example.



I think what's more difficult is when people want to see carbon-footprint savings. There are so many imperfect ways of calculating that. I try to educate. I try to tell investors that they're often asking the wrong questions and asking about the wrong metrics. I want them to get the honest answers to the right questions.

Bob: Have they learned?

Levin: Not yet. They still just want to check a box and ESG, to a degree, is an important box, but often a black box.

Bob: Clever.

Levin: I write poetry. Keeps me busy on those long plane flights.

Kablil: I thought it was the clouds?

Levin: One of my poems was actually pub....

Kablil: I'm happy for you...but when it comes to land use and ESG investing, I think there are some contradictions. There's already, in theory, a special social contract between a property owner and the rest of society that precedes ESG branding. As a landowner, you should automatically accept certain responsibilities. I'm of the mind that the privilege of owning property comes with obligations and responsibilities.

Levin: It wasn't about clouds.

Kablil: What?

Levin: The poem, it was a meditation on human fr....

Jude: I think that's a theme that will reassert itself globally.

Bob: What theme? Human frailty or clouds?

A napkin falls off the railing above Bob and it drifts behind the dais and then rises on the thermal created by the crowds' body heat and respiration. Bob watches it climb and the crowd follows his gaze until the renegade napkin pins itself against the exhaust grate in the ceiling.

Jude: The theme of a landowner's social contract. As climate disruption and the "Provision Problem" become more obvious and immediate, the private landowner will need to acknowledge that within the social context of a climate emergency the definition of the landowners' fiduciary responsibility is changing to include obligations to the global climate as well as her family or investors.

Levin: I'm not so sure. I think that's a bit starry-eyed, and neglects that property rights in the U.S. are very strong and part of the DNA that built this country.

Gordon: There's a middle ground that acknowledges these responsibilities. This new category of capital—catalytic capital, comes in with a different return expectation compared to your more traditional, institutional-based return expectation. If climate benefits or social benefits are valued as an objective by the consumer or the investor, or the taxpayer for that matter, and they're being measured, then executing on operational practices that derive these benefits may be easier to justify either by sacrificing higher returns or using tax dollars.

Levin: I have a little different view. As an investor, I'm charged with *not* hurting the environment insofar as doing that will hurt my investors' returns. I am not charged with saving the planet. It's our responsibility to make our investments more resilient only because that will improve long term returns.

Jude: So, we're once again left with our capitalist faith that capital will find the right destinations where it can generate returns for investors with the positive externality/byproduct of cleaning up the environment. I'm not sure we can bet the planet's future on that alone.

Ismael: What happens when the early opportunities to invest in the best ESG strategies diminish? Will there still be ESG investors willing to accept lower returns to help the planet? I doubt it. ESG will become just like forest certification⁷. It will most certainly get subsumed for some greater corporate branding purpose, and its impact as a change agent will be rapidly diluted.

Gordon: I think an entire industry in carbon exaggeration has been spawned by the greedy power brokers of Wall Street and it's bailing out these lucky institutional forest owners who've been misrepresenting their investment returns for decades.

Jude: I've reconsidered a lot of the land deals I've put together over the years. The idea was to sequester carbon and preserve habitat, but at some level, they are ill-conceived when you consider our global predicament from a human perspective. I love other creatures, I love nature, but I am most concerned about human suffering. If we continue to take some of the most productive acres out of the mix, where does the food and fiber come from to feed, house and supply green infrastructure for ten billion people?

Khalil: The U.S. has a moral obligation to export its better practices and better products overseas. We screwed over the world with the fossil fuel revolution and the agricultural revolution, and we owe it to the world to export something good, maybe a new green revolution?

Levin: Your ESG bar is set so high that I doubt the reality on the ground would match your expectations.

Corie: ESG certainly makes it harder to do *my* job. Sometimes I feel like directions come from outer space. For example, on the farms I manage, we grow several crops. The managers would like them grown organically, but citrus, for example, is plagued by a bunch of pests and if you don't apply insecticide, the crop quality and the crop yield will really suffer. It's not an easy discussion. These are smart people, but they always seem a bit disappointed with my answer. I sense they made promises to their investors without realizing how difficult it was to keep them.



Another example is the fifteen-thousand-acre wheat farm I manage in western Nebraska for a hedge fund owner who wants to change the world. The owner wants the farm to be totally organic, but the harvest process kills about forty mice per ton of production. The hedge fund owner wants us to find a way not to kill the mice, but it's just not possible. There's no perfect ESG solution to any problem. You solve one, you're probably creating another.

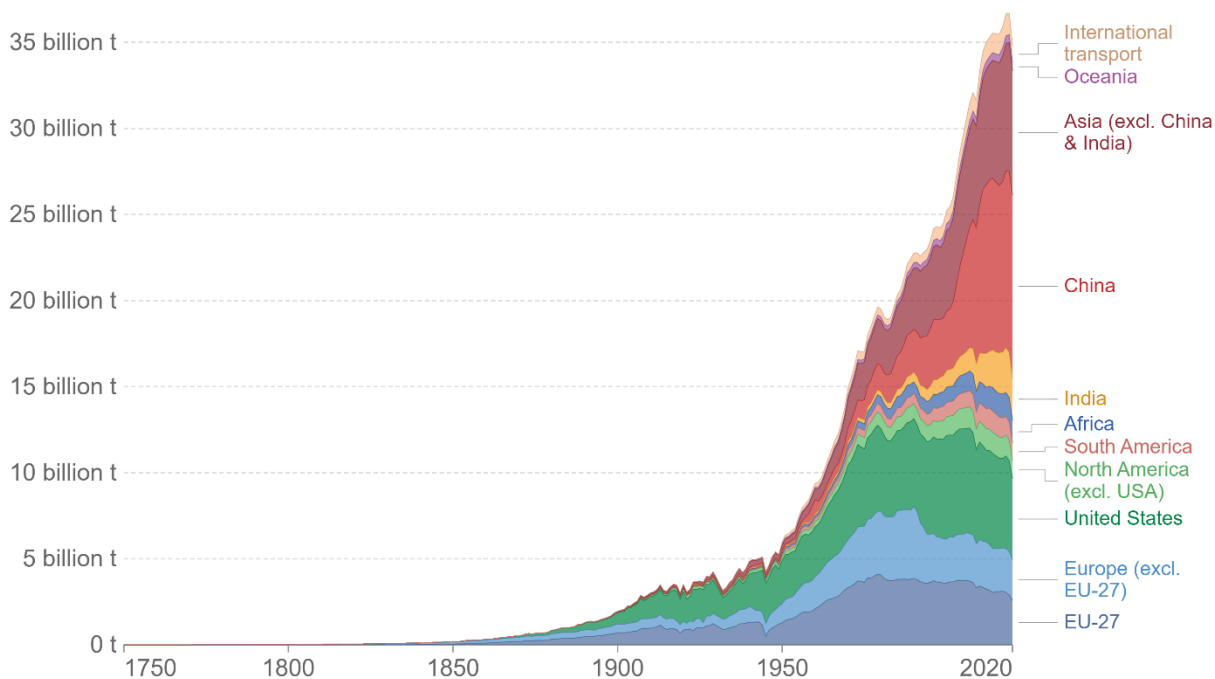
Leslie: Gordon made the point that climate consideration doesn't seem to influence political or any other decisions in any real way yet, but it should and it will. The scientific reality is that carbon dioxide stays in the atmosphere for thousands of years. Every year we add another two parts per million on top of the four hundred and twenty ppm we have now. The climate is going to change. There is no avoiding that, and we have a pretty good idea of what going beyond four hundred and fifty parts per million will do. Temperatures will warm dramatically and sea levels will rise a lot, and that will cause dislocation and political disruption just when we require coordinated political conviction.

Someone on the upper balcony lowers a plastic mouse on a string with knot around its neck into the airspace just above the dais. The panelists do not see it, but the audience does. They giggle, and then someone yells, "Hey, stop it!" and the toy is reeled back up. A security guard speaks into the radio on his lapel and dispatches himself up the back stairs.

Leslie: And keep in mind, here in the U.S., many of the climate burdens will not fall upon us. It is an odd and unfair circumstance that the U.S. essentially created the carbon problem by driving this consumptive system forward, and yet we'll bear little of the hardship.

Annual CO₂ emissions from fossil fuels, by world region

Our World
in Data



Source: Global Carbon Project

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions • CC BY

Note: This measures CO₂ emissions from fossil fuels and cement production only – land use change is not included. 'Statistical differences' (included in the GCP dataset) are not included here.

Jude: The U.S.'s CO₂ emissions are actually dropping as overall world emissions increase because we have more domestic wealth and a financial system that delivers capital to good ideas like green energy and battery powered cars.

Kahlil: The U.S. absolutely must lead this greening effort. That is distinctly *our* moral obligation since we've contributed most of the carbon into the atmosphere.⁸

Gordon: I agree, and we are uniquely positioned to do it, and it's in our own self-interest too. climate refugees are already emigrating to the U.S., a trend that will continue to accelerate. Improving their living situations in situ can relieve this impending immigration pressure. And third, we have the financial and research systems in place to innovate and show the critical production pieces the world will require to implement the next food and fiber growing revolution.

Jude: I think it's premature to look outward until we solve our own domestic problems, and the transition to renewables has got to be the priority. Solar panels are a great example of one of the ways the U.S. system works well. Sure, the panels reduce the demand for coal and oil, but the consumer is really responding to a lower electric bill, not the abstract social good. The government and a lot of nonprofits knew affordable solar created a better carbon outcome, and they worked hard to bring the solar industry to a place where it's competitive with all other forms of power. We're seeing the same happen for electric cars. The technology has been subsidized and promoted by the public sector for decades. The private sector is highly influenced by policy and direction from the public sector. The consumer buys what the private sector provides if it's a superior product at a competitive price. In the case of solar, its electric power. There's no regulation in play in this case, and very little education. The real power is just the market power of a better product, but you don't always get these positive outcomes without the deliberate input from government and non-profit sectors. It relates back to Gandhi, and creating a system where people don't need to be good. They act in their own self-interest and the outcomes are positive.

Ismael: Too little, too late. We're already marinating in our own stew. The climate is warming by the minute and by the time we're finished with this panel, a hundred more species will go extinct⁹. We've already destroyed so much biodiversity and we don't

even know what species we've lost. We'll be surprised when we find out how important they were. Nothing will prevent future generations from a degree of cataclysm, and while everyone talks and talks about reversing climate change because they hope, and I mean just hope, that it won't be as bad as the science tells us it will be, it's evident that what's already in the atmosphere will cause the displacement of billions of humans and destroy habitat for millions of species. It's going to be a royal mess because it's going to be several thousand years before we can reclaim the biological diversity we've lost. Climate change, of course, scrambles that egg. What's the species mix going to be? We've chopped up the landscape pretty badly.

Bob: Ismael, I can't tell if you want to save these species because you want to save humanity or

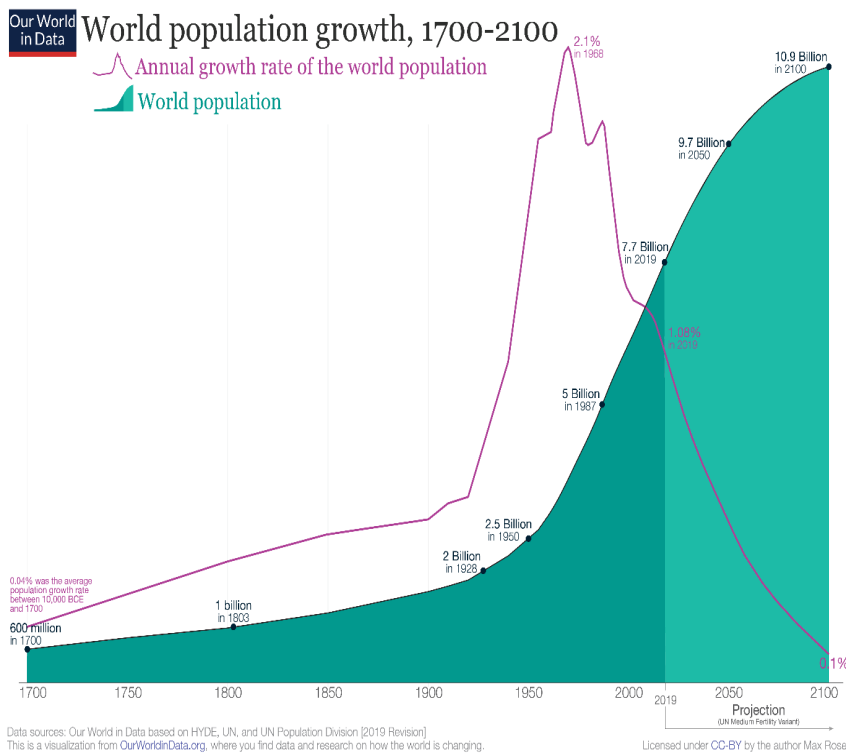
Ismael: I've been accused of "being part of the human-loathing project," so I plead the Fifth. Biodiversity and human survival are intertwined, but our politicians won't even acknowledge that the U.S. created the CO2 problem, so they don't believe that the U.S. has to solve it. Instead, they think we'll figure out a way to build sea walls or close the border, so we don't have to deal with the consequences. In the meantime, they're so busy getting re-elected that hurting their constituents to help future generations isn't politically palatable. We've created a culture of immediate satisfaction that discourages discipline.

The backdoor entrance to the Forum opens. There is a scream of delight or distress from the street. Three men in white turbans and robes take seats against the back wall. A siren wails in the distance.

Gordon: Or maybe things aren't changing culturally or scientifically as much as we think they are. **Thomas Kuhn**¹⁰. The science philosopher, postulated that there is no such thing as "new science," just the phenomenon of people recognizing science that has been extant in our society for many decades.

A generation ago, no one thought about climate, and now the climate science is becoming more refined. It's not new science, just new tools and data to calibrate the existing phenomena. We've simply arrived at the moment when, according to Kuhn, we're recognizing the climate risk, a risk that has been there for a century and half, and now, developing tools to measure it and eventually respond to it.

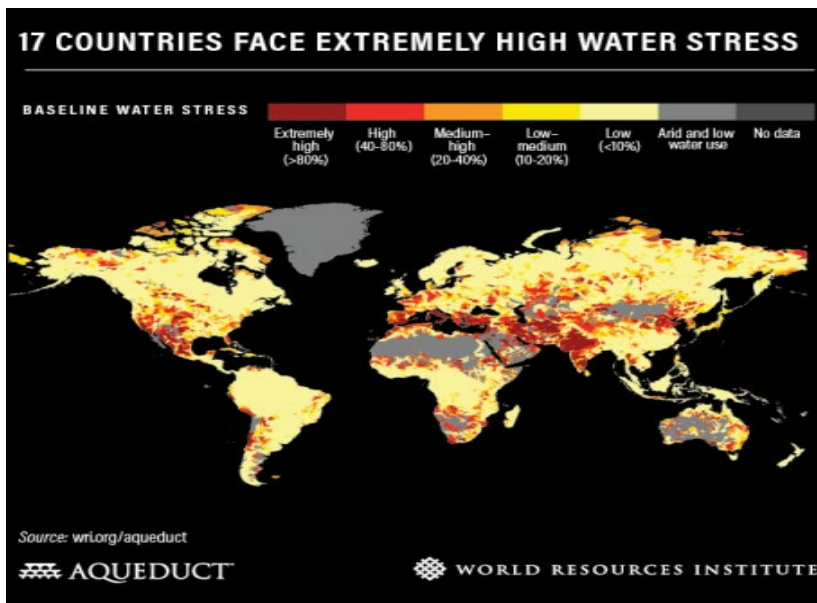
Kabli: I'd suggest that the paradigm shift is different, or at least more dramatic. Our generation is finally recognizing that the market is not going to overcome certain immutable mathematics about human impact as we degrade the climate. As Ismael notes, this projected population growth can't be supported by the current capitalist paradigm that perpetuates the myth that global economic conditions will continue to lift everyone to a higher standard of living.



Three years ago, the International Monetary Fund¹¹ published a paper that acknowledged that the risk of catastrophic disaster from the intersection between

population growth and climate change is rising, and one of those disasters included the possibility of *human extinction*.

Bob: The math is pretty stark. First, there isn't enough water, and that's pretty important. Exponential economic growth to support this population just can't be done without degrading the planet to the point where the billions yet to be born will have their health and longevity severely compromised by food shortages, bad air and water quality. It's not difficult to extrapolate the implications of this water map. Note India's water issues, and then imagine the global repercussions that this issue alone will create in the near future.



Another question? Please introduce yourself and ask your question, thanks.

Indra: My name is Indra.



I'm an agricultural technology venture capitalist and I wanted to point out to Ismael in particular that if you're waiting for people to change their behaviors or their appetites to solve the climate problem, then you don't understand people. Gandhi talked about his dream of setting up a system that was so effective that people didn't have to be good. They just made their own choices and those choices happened to be good for society. The market will eventually create that kind of system.

Bob: That's a hopeful perspective.

Indra: Venture capitalists must be hopeful. I also wanted to say that Ismael can't just dismiss economic incentives and economic growth as unimportant. The world's population will continue to grow throughout this century, and to keep up with that, we'll need economic growth to keep billions out of poverty. The zero-growth economy is a great idea if you're already wealthy. If you're poor, it's a horrible idea because it limits your upward mobility, even your survival.

I'd also like to point out that the unfortunate fact is that cheap energy underlies every burst of economic expansion. Whale blubber to coal to kerosene to fossil fuels, and like Jude said, our fossil fuel economy will be around by necessity until it's uneconomical, which will likely be decades from now.

Boos from the upper floors.

Bob: Indra, would you have some time to join us up here?

Indra: Sure.

The sound of Indra's high heels, "tap, tap, tap," punctuate her walk down the aisle. A "Go, Indra!" from one of her friends follows her as she steps on to the dais and sits down between Gordon and Jude.

Indra: To the boo-ers in the crowd, if you want things to change tomorrow energy-wise, then the lights go out, this university shuts down, financial aid disappears, and you'll become overeducated, underemployed people without purpose or meaning in

your lives. During this energy transition, the stakes are high and not just for the climate, but for the quality of life we take for granted. I'm Indian, and I have a mission. I'm working to bring better food systems to my country so that people don't starve. You can boo the oil companies because your friends will think you're cool, but fossil fuels will continue to fuel the innovations that are happening here and at my alma mater down the road at MIT.

Levin: I agree, Indra. Adam Smith was right in the sense that individuals acting selfishly is the engine of social progress, although I'm pretty sure he'd be appalled with himself that he didn't fully consider the environmental externalities that the market has generated over the last two hundred years. Nevertheless, the market does what the market does and that means that things change fast.

Indra: This is a good point. I disagree with Gordon about Kuhn. I often ask myself, "Why should I listen to an old-timer about public policy, or ESG criteria or carbon credits when they don't even know how to use the Uber app?" A lot of the people at the top of the management structure are older and have different attitudes toward issues than the up-and-comers within those same firms who are, on the whole, much more informed.

Awkward silence as Jude, Gordon, and Ismael stare down at the tabletop.

Bob: Anyone have a comment?

Gordon: I know how to use the Uber app.

Indra gently taps him on the arm. Gordon blushes.

Gordon: Things are changing so fast that only the mental facility of younger people can keep up.

Bob: Leslie, you also helped develop climate models on a grander scale that try to combine environment and economics.

Leslie: Yes, these are big macro models that relate to the concept of longtermism. They aren't strictly climatological in nature. They're called **Integrated Assessment Models**¹², and they address Indra's point about the interaction between climate change mitigation and human welfare. IAMs try to combine our best climate models with economic growth models to look out into the future and decide how our actions today will affect the future welfare, broadly defined, of the generations to come. It's a new but rapidly advancing science and it's important because the interplay between climate mitigation strategies and economic impacts are inseparable. The obvious example, is that weaning ourselves off fossil fuels will have some negative implications for economic growth.

Jude: Many green energy advocates don't admit that, but you just can't replace a liquid, energy-dense fuel that lubricates the entire economy without hurting a good chunk of that economy. That likely means, as Indra mentions, that many of our politicians will fight to prevent the rapid transition to renewables. We'll be using fossil fuels until they become uneconomical and that might be decades.

Leslie: That's the idea behind these IAM's. To try and determine the implications of certain policy decisions. **William Nordhaus**¹³, Nobel winner in Economics, originated these IAMs to try to factor everything into a grand equation because he imagined that politicians would want to understand how present actions and expenditures will create costs and benefits in the future. The big issue with projecting fifty years forward is that the model's output becomes a slave to the **discount rate**¹⁴. So, we argue a lot about that number. If the overall discount rate is greater than zero, for example, we are mathematically valuing the *present* human condition *higher* than the *future* human condition, and many have a problem with that.

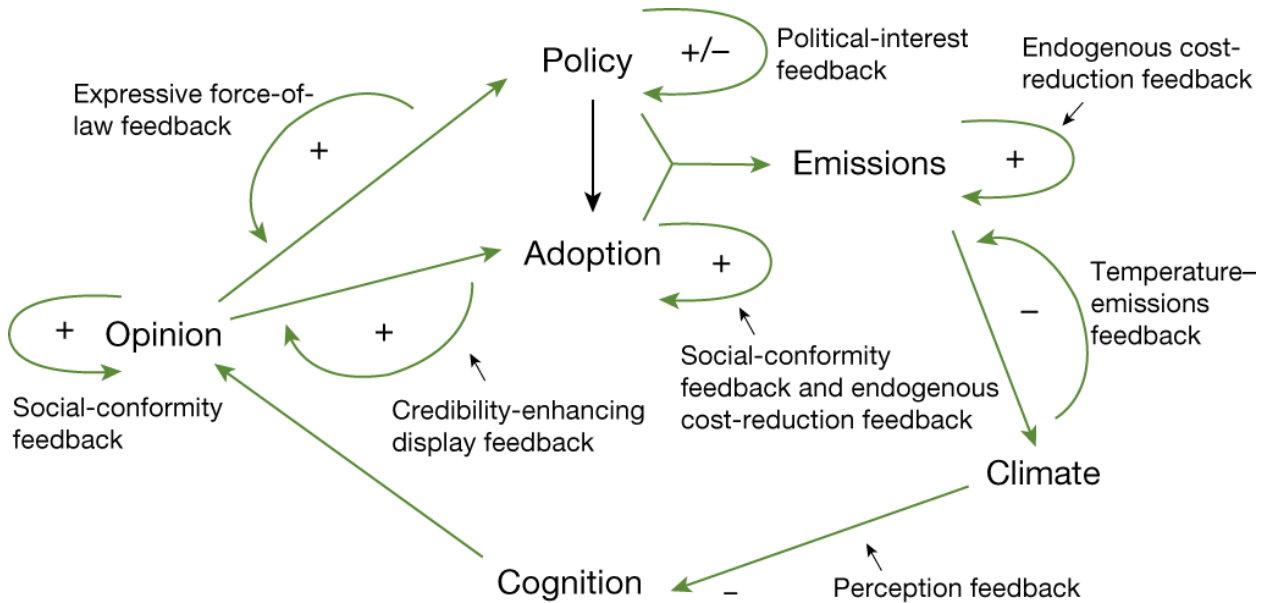
Bob: What is your opinion about the discount rate?

Leslie: First, let me be clear that I am NOT an economist, and I am a firm believer that straying outside of one's discipline is a recipe for disaster. However, I see the argument that if present day humans are actively striving to make the world a better place in the future, call it longtermism for lack of a better term, then the value of future human welfare might be discounted because it will be made better—that is to say, less challenging—by the advances we are investing in now, but since we are generally busy making the world unlivable and doing little to stop it, then a higher discount rate seems ill-conceived. A higher discount rate implies a mathematical and philosophical stance toward selfishness and shortsightedness and we should be discouraging that not baking it in to our policy decisions.

Indra: I think you're unnecessarily hard on present-day human efforts to improve our environment, and also unnecessarily pessimistic. You as well as anyone should know that there are billions of research dollars—academic, public, and non-profit—looking at everything from geo-engineering to carbon capture and more effective soil sequestration and agricultural strategies. This is not humankind sitting on its hands waiting for the world to end. This is humanity garnering its resources to respond to a global crisis.

Ismael: You're ignoring the absolute need to overhaul the entire system. The real opportunity is for all of us to recognize our responsibility in turning the bus around before it's too late. Capitalism needs increasing demand to thrive, and demand thrives in periods of economic stability and falls when chaos ensues. This climate will unleash political chaos, which will hurt demand. Climate and its risks are bigger than the market. We'll see climate disruption upset the "forever growth" model that capitalism has promulgated for the last two centuries, and it's our own fault. To regulate a general system, such as a society, in accordance with the narrow purposes of one of its sub-systems, such as business, is to narrow the range of conditions under which the broader system can survive.

Gordon: I'm going to rain on your rainy parade, Ismael, and suggest the necessary adjustments are happening by increments. There is some new modeling on climate that offers a bit of hope. This new model shows that human feedback, mostly psychological systems relating to behavior change, can accelerate positive outcomes when you factor in social, political, and technological feedback. It's not all gloom and doom. Humans have a way of muddling through.



Source: Moore et al. (2022), Nature).

Ismael: This certainly looks like muddling.

Gordon: If you follow the logic, it's extraordinary that a model incorporates human behavior into emissions and temperature projections. Apparently, at an individual level, they've named factors like social conformity, climate change perception, and political interest as affecting social and economic behaviors. The most influential factor is how people change their behaviors once a climate event directly affects them or someone they know. Really an amazing leap forward in the modeling.

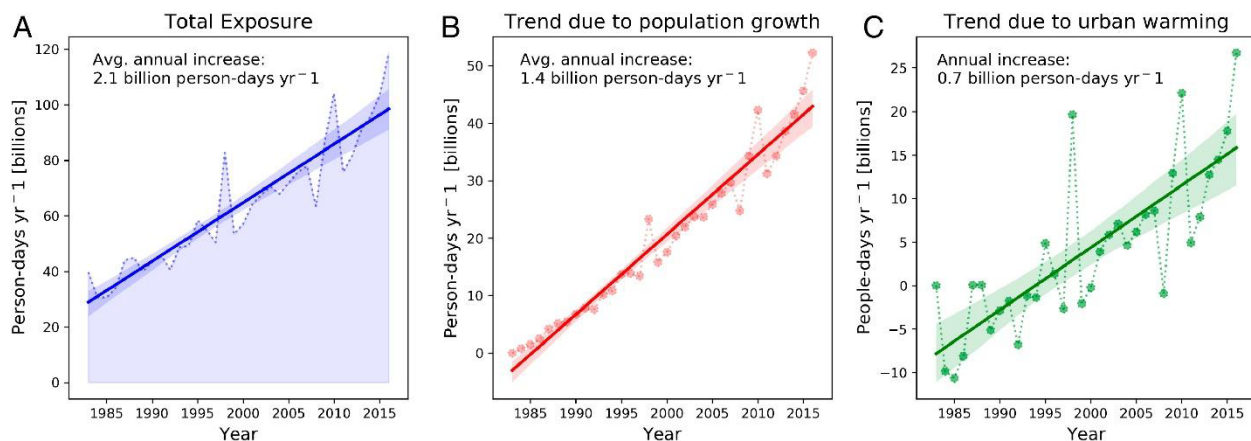
Khalil: One could interpret Moore's model as trying to quantify our political and psychological ability to adapt. Or, it could have a deeper meaning.

Bob: Deeper?

Kahlil: I'm reluctant to say this because I can already feel Ismael about to pounce, but Moore's model attempts to get at the idea of human exceptionalism. We are the only species that can see our circumstance and then work to improve it. When you peel back the layers, you see Moore trying to define this self-perceptive process. It's not perfect by any means, but it's a start.



Jude: But there are still sociological and demographic factors that just cannot be modeled with any accuracy. For example, there is a lot of talk these days about aging Chinese, American, and Indian demographics and the negative implications for global growth, but there is much less public discussion about the demographic migrations to come in the next two decades as the world becomes uninhabitable for more than a billion people. Because of climate warming, drought, and flooding, certain highly populated places will become unlivable and large numbers of people will be forced to move.

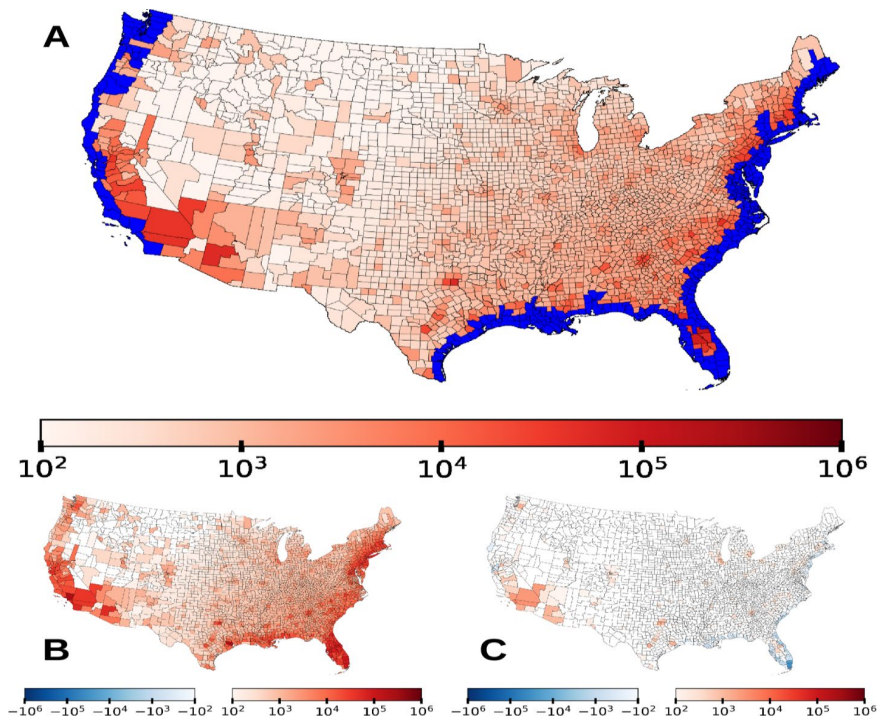


Global urban population exposure to extreme heat October 4, 2021, <https://doi.org/10.1073/pnas.2024792118>

Kahlil: We don't fully know how these migrations will affect our social systems at a local and regional level. That's something that handicaps our ability to respond and adapt, but I would offer that no amount of investment capital is going to lead to enough efficiency or positive externalities to offset the coming impact to our social systems as millions are forced to migrate.

Jude: If I understand Levin's investment world at all, you Wall Street types don't like uncertainty, so I think you'll need to consider the bigger sociological risks today not tomorrow. We'll all need to prepare for a world flooded with climate refugees and a world in which climate stability, market stability, and political stability will no longer be reasonable expectations.

Gordon: I think we'd all agree that global political stability is already in disarray and refugees are a factor even inside the U.S. in the near future. If you then layer over the water and heat issues we'll be facing in the Southwest, and then consider the immigration pressure at the southern border from the **thirty million** _____, you can see the pending destabilization even in the most stable country in the world.



PLOS is a nonprofit 501(c)(3) corporation, #C2354500, based in San Francisco, California. The map represents the U.S. spatial distribution of the direct and indirect effects of sea level rise (SLR) on human migration. The top panel shows all counties that experience flooding under 1.8m of SLR by 2100 in blue. The remaining counties are colored based upon the number of additional incoming migrants per county. The bottom left map shows the number of additional incoming migrants per county in the SLR scenario from only flooded counties. The bottom right map shows the number of additional incoming migrants per county in the SLR scenario from only unflooded counties. Color gradients are implemented in a log scale.

Levin: Before we decline into apocalyptic scenarios, I can tell you that if you were on an investment committee and voted against an investment because you speculated that the climate crisis would destabilize the U.S. with a flood of climate refugees and citizen dislocation, you'd risk being voted off the committee altogether.

We know the climate is disrupted, and that's somewhat helpful information by itself. Our company has been concerned about changes in U.S. drought and storm patterns, as well as fire, wind, and ice damage, but it's always tempting to extrapolate the general from the specific, but there is no way to tell if those events were directly spawned by climate change, and even if they were, no way to insure against these events to any degree.

Bob: It's also tempting to ignore the general while focusing on the specific.

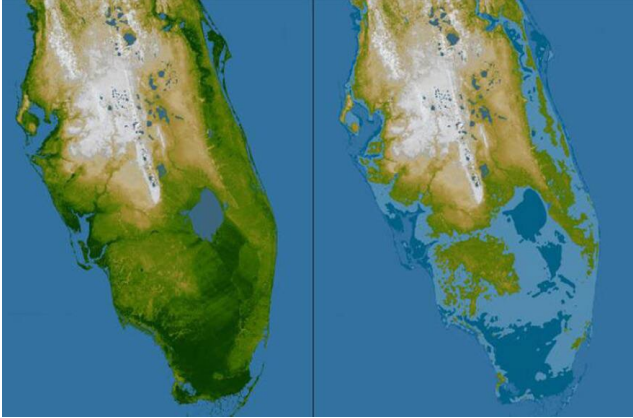
Jude: That's the essence of why this climate problem is so difficult for humans to tackle. The general, which is global warming, is abstract, and the specific, which is the stream in your backyard flooding your kitchen. This kind of disaster may be concrete, but it still may not be convincing enough or frequent enough to make the connection between the water on the kitchen floor and CO2 in the atmosphere. I think Moore's model is on to something in the sense that if minds are going to be changed, they get changed through direct and repeated experience, not panels like this one where we preach about events that might or might not happen in the near or distant future.

Someone exits through the heavy fire door that leads into the stairwell. The loud "whack" startles Bob and he ducks.

Bob: Jeez! Can we be a little more considerate?

Gordon: I want to go back to Levin's issue about being voted off the investment committee if he dared to acknowledge the impending climate reality. It's sort of contradictory. The financial industry wraps itself in the mantle of risk-taking when the industry is really risk averse to the point where they often have their head in the sand when it comes to these bigger issues. Investors have a difficult time discounting macro risks like climate change because to do this outside of traditional investing and due diligence rubrics is anathema to the faith in the market to solve all problems. If, as Levin said, you considered climate refugees as a risk factor, you're perceived as disloyal to the religion of capitalist, progressive, innovation aka the religion that believes the "market will provide."

Jude: There are exceptions, of course, and there has been a lot of talk about the insurance industry, property and casualty insurance specifically, in places like Florida as a bell-weather for the financial world's accommodation of climate change into discount rates. But, as Levin implies, when your industry is a slave to short-term-return results, and your compensation is tied to profit generation, ignoring the big picture pays better at least for now.



2020 NASA Jet Propulsion Laboratory

For the view on the right, elevations below 16 feet above sea level have been colored dark blue, and lighter blue indicates elevations below 33 feet.

Leslie: But the market is failing us. Business is responsible for baking so much climate change into the current atmosphere that just decarbonizing won't be enough to stop the worst effects. We'll almost certainly have to resort to extreme measures like geoengineering in the relatively near future. It's easy to forget that our personal habits are manipulated by corporate values that encourage consumption. That's what business does: it makes us want more. And can you say that a system that causes mass extinctions and human suffering is a successful system?

Ismael: We should all be personally responsible for resisting corporate stimulation for more stuff. We have to learn to want less, especially here in the First World, because it's the only way the planet survives. We've been poisoned by this neoclassical economics perspective that says everything we need to know about society can be explained by a person's rational self-interest. It essentially erases one of the core elements of being human, which is that we're social creatures who care for one another. Social influences are so important in how we see the world, how we interact, how we create our values, how we make decisions to sustain the things we care about. When we focus so much on the individual, on rationality, and on selfishness, we miss some important things—maybe the most important.

Bob: Most important things? Isn't some of that captured in Moore's modeling which Gordon just discussed? Peer pressure, personal experience?

Khalil: I'm not sure Moore's model fully captures all of it. Truthfully, I follow the concept but not the application, but at least it tries to incorporate these social pressures. The larger point that Moore is getting at is that economics has failed us by not supplying a vocabulary to explain some of the things that are most important to us. Social relationships, our connection to place, our values—all those things exist somewhat outside the realm of rationality, and in some ways outside the realm of individuality, even selfishness. If some economist found a way to translate those values in a way that made sense, then investing in the environment and communities might be as important as cash flow.

Bob: I think we all accept to some degree that capitalism has a creative destruction element that creates a lot of human hardship along the way.

Ismael: I'd say with capitalism you get more destruction and less creativity.

Bob: We have another question? Introduce yourself and ask your question?

Ned: Sure. I'm Ned.



I came in with Corie and some guys from the Expo. I run a forest management firm that works on forests in nearly every region of the states. But what I wanted to say is that when it comes to economics, I disagree, Kahlil. Traditional economics deals with social relationships well. Thriving communities with a strong economic heartbeat have attracted investment, and that allows them to generate tax revenue to support educational investments in our young people which I think would qualify as one of those “most important things.” And when it comes to education, we need a

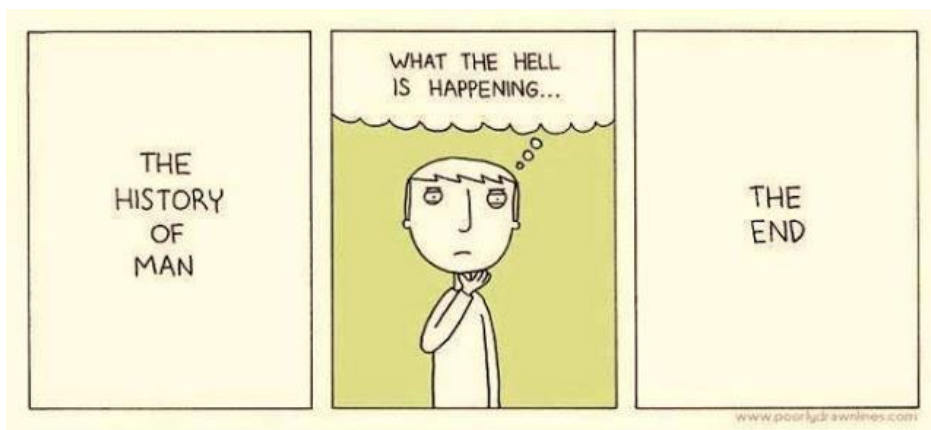
curriculum that fosters more engagement with the complexity, wonder, and also with the hard science of the natural world. I see the first signs of it in my kids and their friends. Nature interests them even if it's from an abstract, hands-clean perspective.

Bob: We'll need a forester as we get deeper into this discussion. Can you join us up here?

Ned: Sure.

Ned moves toward the dais but stops midway down the aisle to listen to Kablil.

Kablil: On your last point Ned, I notice it in younger people too, but here's the danger. Their interest in nature does not come from the perspective that "overall, things are getting better," or, that even though there are all these challenges, essentially "we're going to continue to progress." There is a certain **existential nihilism**¹⁶ in their world view. I don't want to be bleak about it, but many of my students imagine a world that, in their lifetime, will turn into a heaping pile of ashes. I grew up in farm country and used to teach high school. I had "smoke-spewing pickup" drivers in my classes. They weren't bad human beings. In fact, many of them were good citizens—involved in 4H and volunteering—but they've just landed on a coping mechanism, a world view that helps them navigate the confusion. They take their skepticism to an extreme. I'm not a psychologist, but if I do a deeper dive into their psyches, I'd say they're attuned to a cognitive dissonance. "The earth is crashing, no one is doing much about it, it's hard to know what we can do about it." They see their fellow students changing their behavior a bit, but that seems useless. They know that most carbon comes from fossil fuels, and yet they need fossil fuels to get to school and heat their homes. The message is, "Change your behavior to save the planet, but we'll give the corporations a pass until the market solves the problem." The world, the leadership, makes no sense to them, or at least it's too confusing to figure out.



And if you want to piss off a millennial, tell them that their generation has to figure out how they adapt to climate change. Nihilism allows them to put a stake in the ground when it comes to their own self-respect. They can say, “The world is crazy, impossible to understand, impossible to fix, and it’s not my responsibility to fix it. I’m going to try to love my family and friends, define my own meaning for my life, and ignore the rest of the noise.”

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Ned arrives on stage and sits down between Indra and Kablil.

Bob to himself: “The stage is full. Stop it with the “will you join us up here?” Too many voices! This second half is going to be a free for all.”



Gordon: I'm not as cynical about the generations that follow us. They've grown up with climate change. They'll have to live with it longer. It's in their bones. I see it in the new people coming into our industry already. They're adapting to this world we're leaving them, and they're encouraging us to look the problems in the eye before we sail off into the sunset.

Ned: I don't think we need to complicate this issue. Everyone is a human being and trying their best to improve the lives of their families and themselves. Folks in my community who work on the land, or with their hands, or in hourly service jobs, are conservative because they want the dysfunctional government to leave them alone so they can provide for their families and get things done. It's not a red or blue thing. It's about competency, and our government is not competent. If you want to complicate it, you can say that we've lost faith in government except at the local level, and we've replaced it with faith in community.

Bob: But Ned, if you're ready to chuck out the federal system, then where do you turn?

Ned: You double down on local, on family and community. Kahlil, you said it yourself when you were talking about your students and their families. Church, 4H, local charities—folks commit themselves to activities close to home. You create your own like-minded community.

Khalil: But it's mostly a response to the fact that outside government and outsiders are screwing up your lives, and whether you know it or not, you're working hard to either sabotage the system or circumvent it when the current system needs your involvement to fix it.

A voice from the top balcony yells out, "Jesus Christ! Gimme a freakin' break!"

Ned: Sabotage is a strong word.

Khalil: Let me soften that a bit. I understand there is a residual sense of commune and cooperation in rural communities and a lifestyle and culture linked to the land. The temptation is strong to withdraw from the chaos of urban life. I have a theory that rural communities derive their philosophical system from a combination of Native American beliefs and John Locke's¹⁷ original theory that says, "Yes, we didn't make this land, but we mixed our labor with it so now we get to call it ours." Locke was trying to justify a somewhat novel concept of individual private ownership that had nothing to do with the British Crown, nothing to do with the traditional feudal hierarchy. It was revolutionary in the sense that it fought against the entrenched interests at the time. I'd suggest that what you describe, Ned, borrows from this rural revolutionary tradition.

Bob: The idea of ownership rights derived from labor input into the land has been diluted at best.

Khalil: Adapted may be a more exact term. The idea of labor engendering a sense of ownership is still part of the rural land ethic, and the roots of the rural hostility toward outside money. The negatives associated with the financialization of nature¹⁸ idea derive from the absentee landowner's violation of the original Lockian concept of ownership earned by labor. Buried in that hostility is a reverse condescension toward

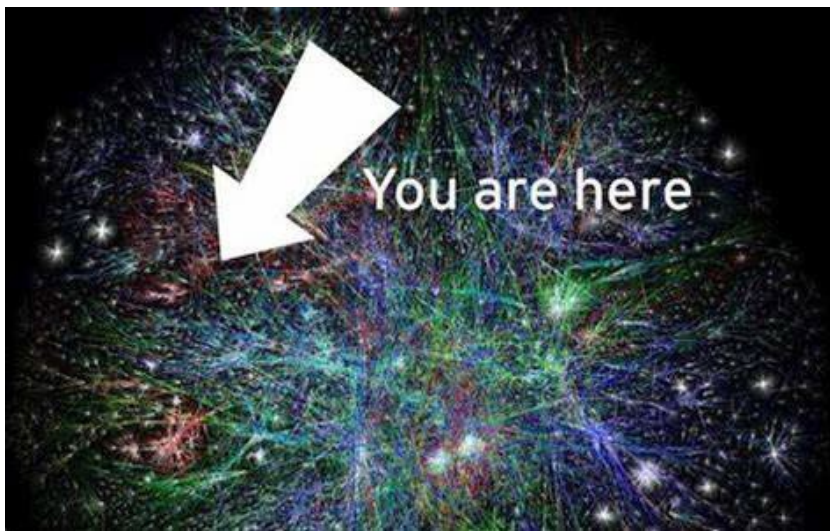
capital. “I work the land. I don’t own it, but I know more about it than the owner ever will.” I’m sensing some of that in the crowd.

A man in the back row yells, “Damn right!”

Khalil: Functional rural communities are about a connection to the land and about social reciprocity.

Ned: I guess you could reduce it to that, but no community likes to be told by an outsider whether it’s functional or not. If reciprocity means that folks try to love thy neighbor, then that’s getting closer to what I was trying to describe.

Kahlil: One of the questions we debate in environmental philosophy is whether humans can transcend their human-centered perspective on the world and return to a Native American mentality? Can humans understand themselves as part of the whole, not the nucleus that the whole supports?



Gordon: You’re going to be waiting a long time, Kahlil. It’s human nature to be self-centered and to want more, and this fundamental condition of human nature is going to put pressure on our technology and our innovation to solve this climate problem while still delivering “more.”

Kablil: “More” is a recent capitalist construct to keep demand increasing. “More” was not a Native value. “More” is assumed to be part of *human nature* but it’s just a concept to justify the current system. “More” is the current “human condition,” but not human nature. Native cultures created a culture to support the land so it could keep on providing. The Commons allowed them to survive. Today, most people don’t think about the Commons. We need to rewire ourselves to imagine what the implications of what we do today will be in a hundred, a thousand years. This longtermism mentality has to take hold. It’s beyond me how any individual with kids can’t respect and provide for their unborn great grandkids in the same way they do for their living children.

Bob: You don’t have kids, do you?

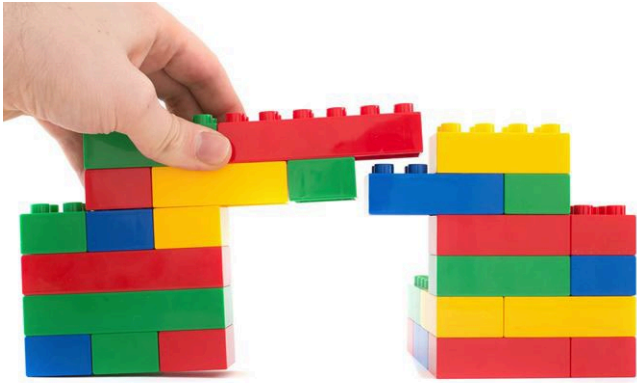
Kablil: No, why?

Bob: Because if you did, you’d understand that if you extended a parents’ responsibility that far into the future, their heads would explode.

Ned: Kids do take all you have to give, that’s for sure. My kid was cut from the travel soccer team last week and I haven’t been able to sleep since.

Jude: So, back to the topic at hand? Let’s at least agree that we’re all caught inside the *current* human condition, and in that condition, we’ll always want more. More is better, right?

Bob: There was a recent book by the behavioral scientist Leidy Klotz entitled *Subtract: The Untapped Science of Less*, where he documents this modern human tendency to add, not subtract. He highlights one particular experiment where almost every subject added a block to an uneven Lego bridge to level it when removing a block would have served the same purpose.



Ned: And I'll be the first to admit that there's an innate arrogance in that modern human tendency. It's a point that Ismael and I can agree upon, "I'm going to add one Lego block here because I have the perfect answer for this equation, and it's to add a Lego block." It's just the way we think. There's an arrogance that we can change things for the better with our science, with our intellect, and with our technology. So, I find myself agreeing with Leslie and Ismael on human arrogance, but I'd say that we need to encourage the human impulse toward efficiency and waste reduction.

Bob: I'll try to draw some of these threads together. First, we live in this incredibly complex world where the truth, even absolute scientific truth is both relative and fleeting. The complexities of our modern, global problems have grown beyond the comprehension of most individuals. This feeds into this skeptical nihilism in our culture because the individual loses a sense of their own agency. "How can I save the world if I can't understand it?" or, "I understand it absolutely because I just read this guy's blog and he seems to know." Both are reactions to complexity. Even experts who spend their lives studying a single topic disagree on the details of that topic, and even worse, no one listens to what they have to say. Their expert opinion is drowned out by "common sense" or the louder voices of misinformation. Expertise is discounted as though it's just another opinion. This makes me fear that the danger we have ahead of us is that the *truth* might be imposed by an authority that sees nature only as a resource that serves human appetites, someone who just wants to keep the spigots open to keep the majority happy. Economic populism, if you will. Truth will become homogenized and simplistic, and the climate will continue to degrade when

simple ideas are imposed upon this complex problem. Developing the solutions to improve our circumstance requires nuance, expertise, and thoughtfulness.

Ismael: Or, it requires blunt force trauma. The climate revolution should have started decades ago. We need to start a revolution.

Bob: A revolution requires disruption, and most of us have been lulled to sleep by a system that supplies an endless stream of material pleasure and preoccupation.

Leslie: But warming to **three degrees Celsius**¹⁹ by the end of this century will create that disruption. This system we've created here in the U.S., and then distributed to the rest of the world, is on the march toward that three-degree outcome.

Ismael: I hear everyone up here expressing a level of concern and care about the issues at hand, but I'm the only one to describe a real change in the way we need to react. Markets, incentives, regulations? Totally inadequate.

Bob: I think there is a case to be made that we have no choice but to use the market-based tools we already have.

Kahlil: It's such a powerful, insidious system because it appeals to our wallets which are just proxies for our appetites. One could argue that we've created a materialistically-based system because at some level, human instinct desires Klotz's "more" and the more we want is comfort and security. Cooked meat is better than raw meat, seasoned meat is better than unseasoned meat, animals we can kill at will are better than animals we have to hunt. Our problem-solving instincts want to solve the comfort-convenience problem, but for the reasons Jude described, our instincts are not well suited for solving the climate problem. It relates to the idea that our ancient selves needed to store energy and that allowed us to survive, and now that we are surrounded by calories, that ability to store energy is killing us. We are killing ourselves with our own cleverness.

A security guard opens the back entrance to let in a latecomer. Outside, in the February gloaming, the sidewalks are still crowded with passersby who crane their necks to see into the open door. The cool evening air spills into the Forum's humid, hothouse atmosphere, and with it, the aroma of thawed earth, river stink, and bus exhaust.

Khalil sighs.

Kahlil: Lovely. It would be nice to be outside today.

Bob: You just proved your point. Either we want what we cannot have, and go and get what we want. Nothing is good enough for the human being!

Kahlil rises from his chair and takes a step as though he intends to walk off stage.

Indra pulls at the back of his shirt. He sits back down. The audience laughs and applauds. Even Corie breaks into a smile.

Gordon: In my optimistic moments, I think to myself that we've overcome a lot of the worst impulses of human nature, and we ought to be able to adjust to the new reality that will result from a century and half of heating the planet. But other times, I think that modernity is just a passing illusion.

Being a human being is challenging enough, but being a human being in this kind of uncertain environment is especially challenging. I hope I'm wrong. I would love to be wrong. I'd love to find out that the world keeps getting better and that we're passing through this challenging period where we'll emerge as a better version of ourselves.

Jude: I know this human moment feels fragile, menacing. Dreadful. So many things are in motion that can't be unwound. In my more pessimistic moments, I say, "Maybe we ought to just change our attitude entirely and live like we're in hospice, in palliative care. The world is dying, and we're not going to fix this, so let's just do the best we can." BUT! I listen to my fellow human beings up on this stage, and I hear concerned,

Careful, thoughtful, and sincere considerations of these big, complicated problems, and I feel heartened. We are actively finding the issues and the pressure points, and this panel, in some small way, proves humanity's greatest asset: a big collective brain that tries to solve problems through cooperation and debate.

Ismael: I have faith in the pre-wired instincts of my three-year-old grand-daughter. The other day, I took her out and turned her around toward this waterfall which was pounding away. For about 30 seconds, there was no real reaction and then she started going “ha, ha, ha,” and she wouldn't stop. We have a visceral connection to nature, to wonder, and I hope that in the long run, that will save us.



5. Discussion Part Two: What to Do About the Provision Problem

Bob looks at his watch.

Bob: 5:17 folks. We had an intermission scheduled but we don't have time. We're going to press on and address the state of our U.S. farms and forests and explore ideas about how here in the U.S. we can balance commercial production with all the other competing land uses while also improving practices to mitigate carbon emission and habitat degradation. And once we've accomplished that small task, maybe we can figure out how to ship our excess production and our brilliant solutions overseas!

Gordon: I hope we can address the actual challenges and then the potential solutions? This abstract stuff gets tiring.

a. Agriculture, Water, and the Provision Problem

Bob: I agree, so let's start with the soil which supports photosynthetic production. Leslie, does climate change pose any risk to our soils here in the U.S. and can soil be part of the solution?

Leslie: There are plenty of soil risks insofar as climate change and population growth—and the fossil-fuel consumption that goes along with food production to support that population growth are all part of the same puzzle. A heated climate doesn't directly affect soil productivity except that it makes rainfall more sporadic which makes yields more volatile. A hotter climate requires crop adaptation by farmers which can take some time to implement successfully and lead to short-term yield volatility. And with respect to climate change specifically, modern agricultural practices that involve plowing, harrowing, etc., to allow crops to grow more readily, cause erosion and release **carbon stored in the soil**²⁰ into the atmosphere. That doesn't even consider the fuel burned by the machines that do all the work. It's a very cost-effective way to produce food except when you consider the externalities to the environment.

The good news is that our soils here in the U.S. are young and still pretty carbon rich. We've only been farming them here for a century and a half in the Midwest and the West. The wildfires on the plains over millennia have built carbon richness into these soils, and a few decades haven't damaged them beyond repair...yet.



Indra: The bigger issue is that our soil and our soil biology are not only at risk, but also at a tipping point. **Acidification**²⁰ across US farmland from excessive chemical use and more fertilizer inputs with diminishing productivity should be at the top of the list when it comes to global food supply. By 2050, we'll have those 10 billion people just as the green revolution is slowing down, and we'll need a lot more food. **The World Resources Institution**²¹ estimates 56 percent more food to feed these 10 billion people, and we have to find a way to produce it.

Leslie: And we've barely scratched the surface on understanding the soil microbiome. We know that all over the world, it's dying in the soils on our row crop land. The biome is the key to regenerating our soil productivity. Unfortunately, the soil science behind the decline of the microbiome isn't even clear yet. Soil is still fifty percent "dark matter" when it comes to understanding the science.

Bob: I'm stunned that we're still in the early days of understanding how soil works and what's in it. Aren't there a hundred PhD candidates working to find soil's Dark Matter?

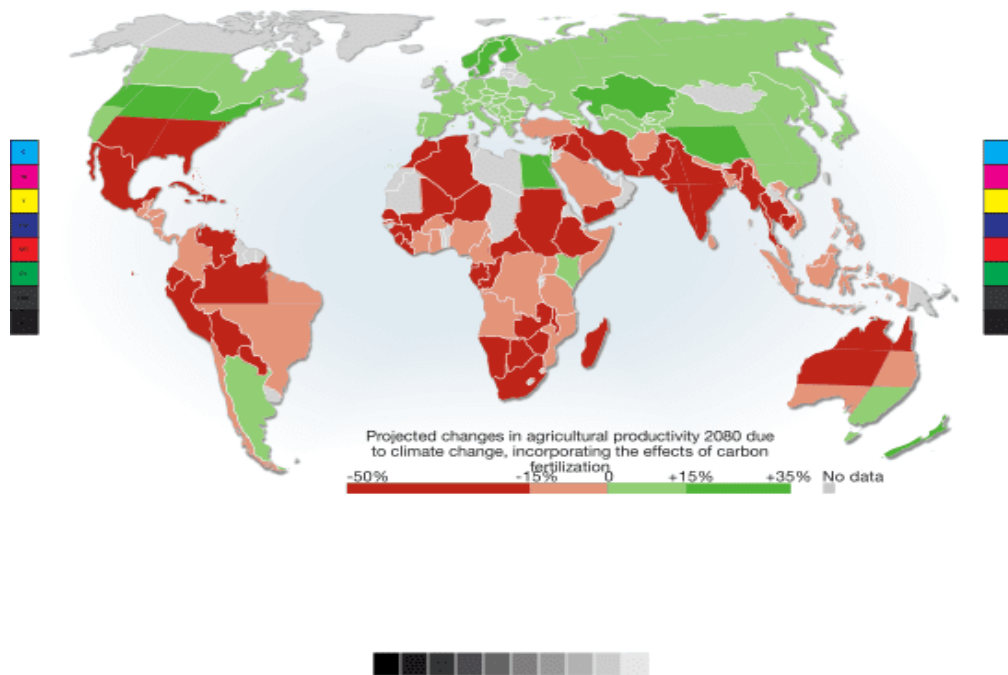
Leslie: Soil science isn't sexy. There aren't a lot of National Science Foundation grants that go toward that kind of research. It's odd since soil is our biological equity. How we treat it matters a lot. If we want to survive on this planet, we need to see everything we do to the dirt as an investment in humanity's future sustainability. I see

opportunity in how little we know and how much we might discover about the way soil works. If we could understand the soil microbiome—and, let me be clear, it's as complex as the microbiome of your gut—we could tell a farmer exactly how to feed it, which would allow us promote resiliency.

Indra: We do know that dumping a lot of foreign substances on your soil to get more yield gives your soil less long-term resilience and more dependence on artificial inputs. The complexity created by organic matter disappears as inputs increase, so to produce more food, healthier food, we'll need to understand soil much better.

The thing we don't talk about much is that nutrition is mediated by soil microbial activity, so nutrition suffers along with the microbiome. Higher levels of microbial diversity and a better microbiome will function a lot better in organic-rich, mineral-rich soil to create nutrition-rich food. Right now, our current agricultural methods are actively killing this microbial diversity.

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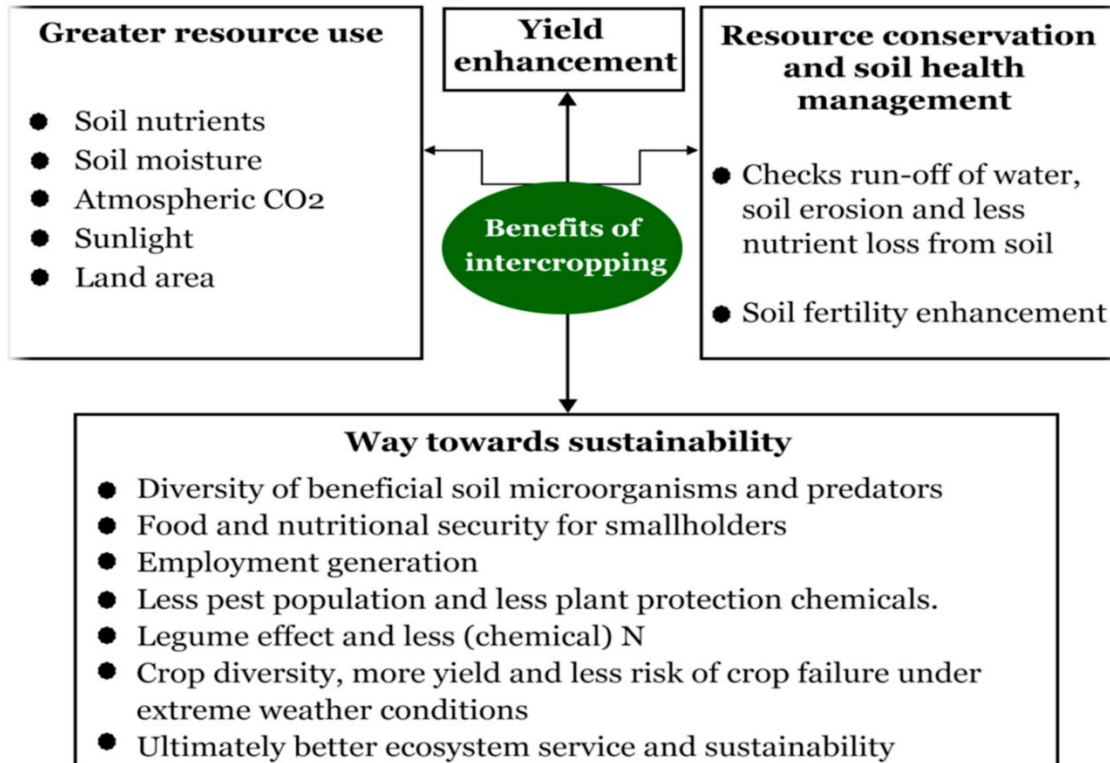


Bob: Maybe we should grow our food in the forest where the soil quality is better, and we can sequester carbon simultaneously?

Leslie: There is some very serious research being done on **intercropping**²² now.



The results aren't definitive about the food nutritional levels, and the systems are still inefficient because we don't have the right equipment yet, but the science to support it is coming. It's moving out of the hippy realm into the scientific realm. This may be one of the answers to the provision problem. The challenge is pioneering the agricultural protocols and the equipment design and then exporting it to regions of the world that will receive help from it.



Ismael: I think big agrobusiness needs to be interrogated about their role in screwing up our soils.

Indra: Corporate agriculture isn't responsible for the death of the soil biome. Corporations respond to demand with the best technologies and products available. Ammonium-based fertilizers, GMOs, even herbicides and pesticides have been a huge boon for food production, and, yes, we'll have to cope with the externalities, which have taken decades to manifest themselves. There's a lot of work to be done in soil science, and we'll get there because we must, but blaming corporations is counterproductive.

Bob: This will be the last question we have time for. Sir, introduce yourself?

George: My name is George. I'm a senior executive at Louis-Dreyfus, the agriculture company. I'm here with the HSG mid-career program and I'm friends with Corie.



Loud boos.



George: Well, that's uncalled for.

Corporate ag is not oblivious to these trends in soil degradation and food shortages, and we're pivoting away from the old model, but it doesn't happen with a wave of the hand. We're focused on sustainability, and to us that means instead of mining the soil or water resource, you adopt a long-term perspective. Conservation in the literal sense: to conserve by being efficient and to change slowly when you have good evidence-based data. Right now, I'm not trying to create a new agricultural revolution because I'm just trying to remove fossil fuel input from both our product lines and our supply chain.

We're responsible to our farmers and our shareholders, and they're asking for resource-efficient technologies. Things like new rootstocks, new seed varieties, new farming practices and products, etc., that increase productivity, reduce water use and production volatility.

Levin: Glad you spoke up, George. Farmers are smart, but they work in a thin margin business. Adaptation will be expensive and therefore slow. Food production is in the spotlight and, truthfully, that infuriates farmers, who feel not just underappreciated but vilified. Farmers often can't afford to pivot because they're undercapitalized. Adapting takes time and a lot of work.

George: In the meantime, farming has become the new tobacco industry. How ironic is that?

Indra: It's because the demand is changing, and farmers are caught in the middle. Players like McDonald's want to know how their cows are treated because the consumer cares. The same thing with eggs and chickens. Soon, everything—wheat, vegetables—will come with information attached.

Levin: That's a great vision of the future, and in your venture capital world, you invest in the future, but I'm only responsible for enhancing environmental sustainability if it enhances returns. If McDonald's wants to buy our products, that's fine, but they're just another customer. I'm mostly concerned with crop yield consistency.

Bob: But without precision climate modeling, is there any way to anticipate climate disruption that might affect crop yield? You might improve your irrigation system one year and then get ten years of monsoon.

Outside, thunder rumbles. A lightning flash brightens the window. Rain spatters against the glass.

Leslie: I think we all agree that the potential upsides in agricultural resiliency and productivity are huge, but it's going to take some time before we have those operational and modeling options dialed in.

Indra: Artificial intelligence is going to speed that process along if we ask it the right questions, like, "How can we encourage soil resiliency and food quality?" And then, "How can we find applications that will allow a farmer to follow those optimization paths?"

Ismael: But right now, we're subsidizing bad behaviors that are making soil health worse. A farmer gets paid for producing more low-quality crops. Quality is not even part of the equation.

Leslie: We know that a soil's organic level is correlated to its microbiome health, and we know that microbiome health correlates with higher nutritional content, which seems to be a result of microbial diversity in the microbiome. It seems to pull in minerals from mineral rich soil better than low organic soil, and this creates food with higher nutritional content. I'll also guess that what you'll be tasting in this "better" food is microbial diversity. *Terroir*²³ might eventually become an important word in the commodity food world.

Levin: But before we can supply the world with more of the commodities and systems they require to survive, we have problems of our own here in the U.S. The agricultural regulatory system, for one, still has this Depression Era hangover, where old-fashioned social objectives are in conflict with each other. We want to supply cheap food to support middle and lower-class Americans, but we also want to pay working wages to field laborers. Then there's the issue of our collective social desire to create a healthy environment and healthy food, which further confuses these affordability issues. We're pushing prices on U.S. products up, pushing U.S. farmers out of the market and we're buying our "food affordability" overseas from places like Peru.

Bob: What do you suggest?

Levin: It's easy to diagnose the illness but harder to prescribe a cure. We might put a floor under agricultural commodity prices for starters. Give farmers some breathing room so they have the financial wherewithal to become more eco-friendly.

Jude: If you really want to help the environment and human health in this country, you should stop subsidizing traditional farming and start subsidizing organic practices. We know that producing an organic product is healthier for the consumer and the

ecosystem, but our system puts those products beyond the buying power of the majority of Americans. Organic requires more manual labor because you can't use as many chemicals. That chemical input is replaced with manual input, and, as we pay our laborers more, the health benefits of organic food move further out of reach for most Americans.

Leslie: I think you're just scratching the surface here. First, let me make the point that organic food really doesn't have any special nutritional benefits. The actual nutritional content of organic food is pretty much **the same as conventional**²⁴. **Organic certification**²⁵ was driven by concerns around toxicity. It's a process-based, not a quality-based certification. Organic was meant to be better for the soil and to use fewer chemicals, but the food it produces is **only slightly less toxic**²⁶ than conventionally produced food.

Bob: So, now that we've lost organic production as the thing that was supposed to fix agriculture, what do we do now?

Indra: We need to promote better agricultural policy as better social policy to create diversity, resiliency, and localization. We're losing a "biodiverse" farming ecosystem as **farms get larger**²⁷ and more specialized. And we also need to encourage better consumer buying habits by supplying better information.

Bob: It sounds like agriculture suffers from Ismael's earlier criticism about simplifying a system to encourage higher production.

Indra: It's identical, and it relates back to Leslie's points about soil and about the human desire to measure with a bias toward "more." What we're after, and what the Federal government should be subsidizing, is nutrient density and food quality. Instead, we're still incentivizing calorie volume on top of a commodity farming

system, and we're driving prices down in this commodity system. So, farms need to scale to keep operating margins positive. Inputs need to increase, and the intensification happens on more acres not less. It's the same old story of capitalism encouraging scale, and consolidation, and driving prices down. Farmers must farm more acres more intensively to stay afloat.

Bob: I'm still a bit confused about how this revolution happens.

Indra: Policy needs to create incentives that will lead to better food quality. With these public policies in place, markets will find and fund the tools and technologies that can make the transition to a better food producing future at the lowest possible cost. "Regenerative agriculture" is a literal term, encourage agriculture to do what it was meant to do, which is to supply enough affordable food and healthy food. It will require new equipment and technical knowledge, but there's no reason we can't scale that up through innovation, entrepreneurship, or everything we, in our domestic capitalist system, do well.

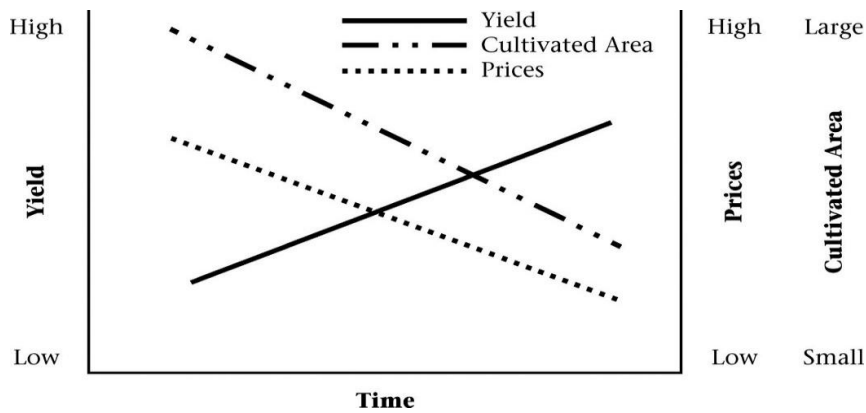
I'm also very confident in our technology adoption rate. We'll find ways to allow the same farmer to farm, but with different tools and practices, and she'll get paid more to produce higher quality food. That's an outcome-based approach. The farmer can farm however she wants to farm, but we're going to look at the thing that people care about most, which is the quality of the food—defined as nutrition and taste. Then the subsidies come in by providing the dollars that will help the transition to this new system. That will require research grants and transition payments for farmers to adopt new equipment and other technology.

Then, AI comes in. It will allow us to see data in ways we could never see it before. In agriculture, we have these large state and federal data sets available, and the data will tell us why one farmer is getting one result while others are getting another. As the data becomes better and the learning models get better, we'll be able to pull that through the system in a way that generates recommendations for better practices and productivity. That will eventually concentrate more production on higher quality soils. Farmers will be paid more to produce better quality food that will feed healthier people who'll have less obesity and lower levels of diabetes.

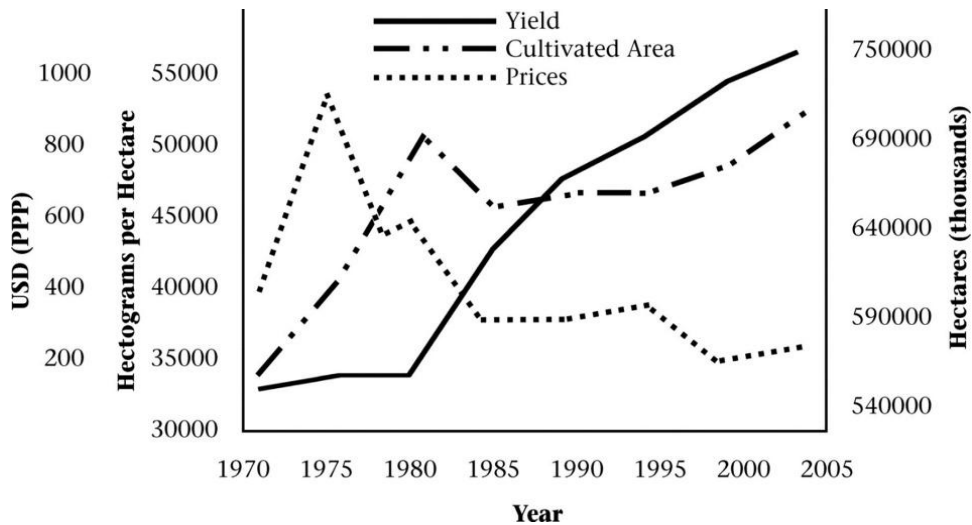
We must prepare for this population growth. Growth is hard thing to stop.

Leslie: In the meantime, the agricultural revolution started by Mr. Borlaug has gotten out of control and needs modification. Borlaug's agricultural intensification²⁸ adds to most of the problems with soil, water, and fossil fuel use.

The Borlaug Hypothesis



The Borlaug Outcome



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Jude: The loss of resiliency can be seen in food-price volatility, which derives from a production system that's lost its diversity. Ukraine equals wheat, for example, which is not good for global market price stability, not good for Ukraine, and not good for the soil. Without a diverse eco-system of crops and producers, you get a race to the bottom in a commoditized system.

Leslie: Indra had a good point about AI helping us sort through these giant USDA datasets. That might allow us to pinpoint specific practices that have wide applicability. There are so many soil types and micro-ecosystems, and it will be up to each farmer to farm their own way. That would not be a bad outcome. Diversity based upon soil and crop type. Our farms here in the U.S. have kind of steamrolled soil diversity into uniformity. As George said, the big corporate agricultural companies are not asleep at the wheel about the limits of the current commercial food production model. I'm limping along in my lab with grant-based resources, but the big guys are going after new technology and chemistry at scale and devoting a lot of financial resources to it. Contrary to popular opinion, they may be the place to look for the big fixes for food production and soil resiliency.



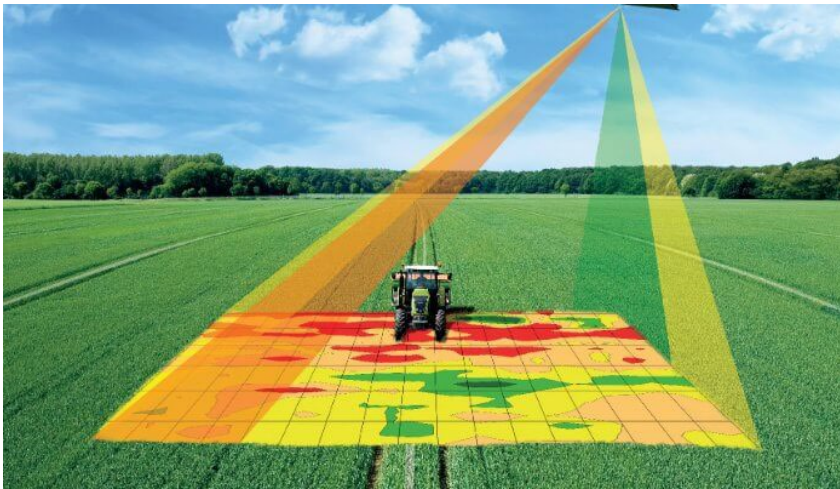
Indra: Our group is working on it too. One of our companies has had some exciting developments with micro-biome bacterial soil additives that reverse a lot of the trends that you've described. And I'm sure you've all heard about the breakthroughs in photosynthetic efficiency³⁰ funded by the Gates Foundation? This technology points the way to the next agricultural revolution, and by moving away from food commoditization and toward food product differentiation that uses nutrition and taste as the differentiators, you get decentralization, you get decarbonization, you get democratization, you get community, and sustainability. You get more people working in the landscape, because differentiation is less about efficiency and scale and more about precision and care. You have everything that is the antithesis of our current system, and you introduce diversity and *resiliency* back into the system.

Bob: You sound more like Ismael than Indra.

Indra: Except that I believe in the market. I believe in technology. My main point is that a food production system that gives people nutritional food, not just calories, has other positive externalities, and most important among them is that it mitigates this subtle inequality where you have poorer people in richer countries eating cheap food that makes them sick.

Levin: This food production system has its flaws, but you make it sound like it's the oil industry. We're all just coming to grips with the negative externalities of a system that produces food that is unbelievably cheap. There's a huge ability to produce more of it to keep it cheap. That's the social benefit that goes largely unrecognized. In the future,

we're going to need a lot more of it, and I'll be the first to admit we need to think very carefully about where and how that food is going to be produced. Most farmers are still a generation or more behind where the most modern farmers are, but now the day is coming when farmers won't have a choice but to innovate with lower inputs of chemicals or else the government is going to shut them down. **Precision agriculture**³¹ was the beginning of the revolution. It works to reduce inputs per unit of production and this trend is accelerating.



No till farming³², is another good example. It wasn't really a thing twenty-five years ago and now a third of all farmers have switched, largely because they realized they didn't need to till. It was just an added expense, but not tilling also had the benefit of sequestering more carbon and firming up soils so that they didn't erode off the hillsides in rainstorms.



It was a step forward, a chance to do something better, but also a step backward to an older practice that worked better. When you limit deep plowing, you allow carbon to build up in the soil instead of blowing away. The Dust Bowl³³ proved that lesson once and for all, let's hope.

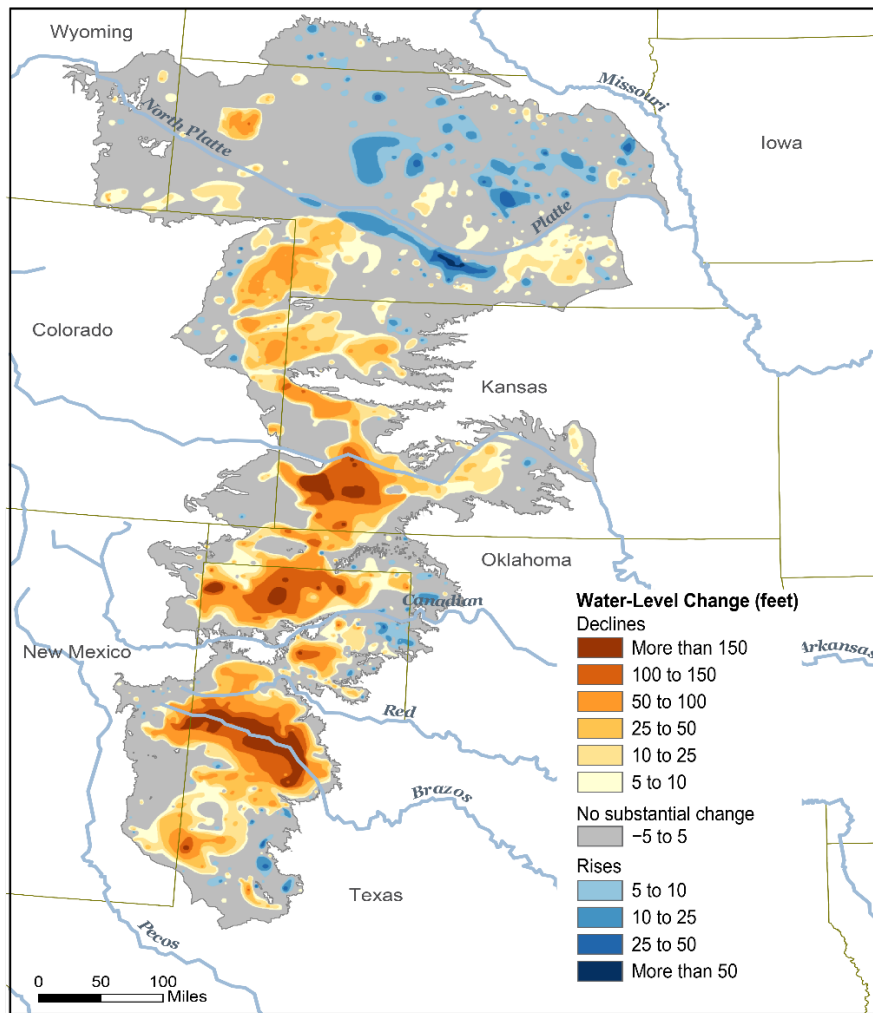


Corie: We have these amazing food and fiber production systems that are relatively safe, efficient, and fair, but all we do is criticize it. I'm all for the idea of subsidizing U.S. products to encourage better practices, higher production, and more export.

Jude: Levin was talking about quasi-slave labor in places like Peru, and one way we can fulfill our global responsibility is to export our "better labor practices" overseas. We do this by exporting more domestic production but first we need to educate the U.S. consumer to demand food or wood from responsible operators. If the US consumer knew that the fruit that they're buying from Peru was picked by someone who makes

eighty cents an hour, it would engender more public confidence in the idea that, “Oh, actually, I’m going to buy this thing from the U.S. and I’m happy to pay more because it’s being produced in a free but regulated market.”

Corie: There will be a lot of political push back on the issue of exporting too much actual food overseas. Better practices, well that’s fine and above my paygrade, but food is essentially water, and our resources are limited here in the U.S. Some of my wheat farms use water from the Ogalala Aquifer. The soil in that part of the country is great and supports some of the most productive farm acres in the nation, but as the aquifer dries up, irrigation well depths down to 2000 feet (about twice the height of the Empire State Building) aren’t economical.



Khalil: These Ogallala farmers must see the implications of a dwindling water resource? Communities will disappear. Those folks will be some of the domestic refugees. This is just another example of the future we'll be living in.

Corie: With aquifer depletion, folks can see it coming and adjust. I've moved my clients in to dryland wheat. More profitable since you don't have to pump that deep water but riskier since you must count on the rain. Farmers have been dealing with climate disruption since the beginning of agricultural time, so they are well prepared to adapt.

Levin: It's investors and policymakers who may be less adaptable.

Corie: Most folks, like your investors Levin, don't understand how many moving parts there are when it comes to growing food, and determining what's the "best," most environmentally responsible way to cultivate a crop. It's difficult, and on the ground, it's not easy to get to the better outcome. It's hard to measure and define. The farmer is just trying to get by. Saving the world from itself is not their concern.

Bob: But it's their world, too.

Corie: Sure, but saving the world seems to be your full-time job.

Corie arches his arm across the crowd from right to left.

Corie: Getting by is a farmer's primary concern. I admit this sounds conservative, even old-fashioned.

Kablil: I think it sounds honest, and embedded in this conservativeness you mention is a point about the definition of the word "conserve," the root word for both conservative and conservation, which in both cases is an attitude, culture, and practice that looks to slow things down as a way to keep things going.

Corie: I'm just saying that changing the world is a nice idea, but wishing doesn't make it so, and a lot of you urban folks seem to make it your primary concern. The world will be fine with or without us.

Can I make a few more points about water?

Bob: Sure.

Corie: If I drink a glass of dairy milk that was produced from a Wisconsin dairy farm where there's more water than they know what to do with, it's not coming out of a depleting water source like the Central Valley aquifer. It's not going to hurt the environment to draw that water out of Wisconsin dairy-land, and, by the way, the water is ultimately going to end up back in the hydrological system because these are

grass-fed cows feeding out in the field, eating grass that grows when it rains, pissing most of it back into the soil, providing manure to make the grass grow. Grass-fed dairy is a beautiful, circular system. Whereas almonds are produced in one of the most water-starved places in the world. The point being that climate change and water shortages should eventually lead to incentives to drink Wisconsin dairy milk instead of California almond milk.

Bob: But you're an almond farmer?

Corie: I see what's happening.

Avoiding cotton is another example of something that makes folks feel good but does more damage than good. What's the problem with cotton? It's a very water-intensive crop. What do we use cotton for? Well, we use it mostly for clothing. So, what are our alternatives for clothes? Well, we could use synthetic fibers, but we're now finding that these synthetic fibers are ending up in our water system and they're ending up in our bodies, in our blood even, and it's increasingly proven that it causes some forms of cancer. Are we going to wear paper bags? Or, are we going to wear cotton, which is water-intensive, or wear synthetic fibers, which pollute our water and cause cancer?



No perfect solution there, right? But you hear everyone hammering on the cotton industry, “You use too much water.” Okay, well, you're wearing clothing, right? What clothing are you going to wear? Well, maybe cotton from somewhere else. Cotton

from Kazakhstan, which is literally picked by children? Literally. So, are you willing to pay more for American or Australian cotton, or do you think we should just switch away from cotton altogether and accept these microplastics in our water?

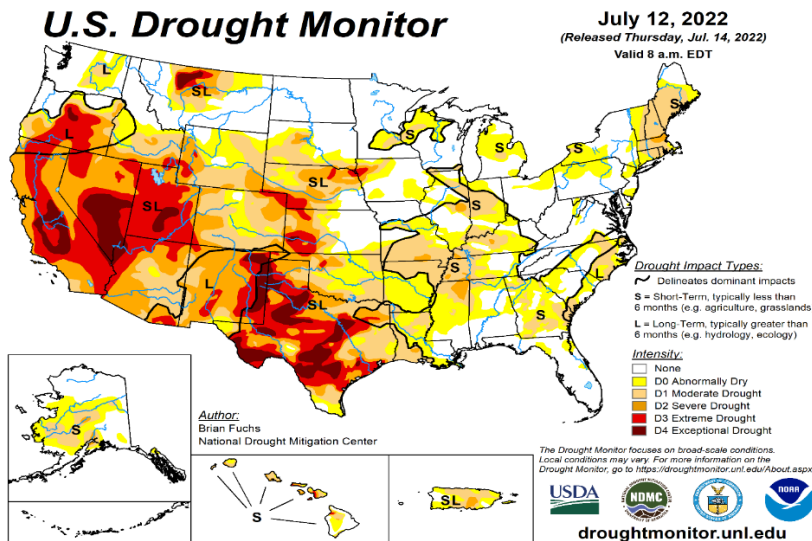
Gordon: These are tough questions with no clear answers. Water, generally, is a complicated issue. We've built a society that is as much founded on cheap water as it is upon cheap energy and we need to reform our counterproductive water regulations. In the U.S., we're caught in a system that incentivizes water waste. We have this **use it or lose it**³⁴ system, which is the absolute worst kind of incentive. This is one of those legacy historical imperatives that doesn't translate into the modern age. Back in the early 1900's when most of this water law was conceived, agriculture was very inefficient and unprofitable, and regulatory bodies wanted to make sure farmers farmed. So, the policy became "use your water or lose it," and this policy kept farmers producing through thick and thin. There were lots of reasons for the Dust Bowl but this policy certainly didn't help.

Corie: Right now, all the regulators do is scare and confuse users with regulatory threats. With little natural rainfall, the Southwest region relies upon the Colorado River and an **extensive catchment and manmade conveyance**³⁵ system of reservoirs, including Lake Mead and Lake Powell, to store and distribute each acre-foot³⁶ of water. Back in 1922, the year **Colorado River rights**³⁷ were allocated, it was a different world. Farmers ruled, and now, urban dwellers rule, so all that water that belongs by rights to farmers will need to be reallocated by paying farmers for the rights they're willing to sell.



Lake Mead, 2022

Jude: Not all acres, not all drops of water, are created equal. It's where that drop of water flows, and the productive potential of the acre it flows to. The U.S. is not technically running short on water in aggregate. The biggest issue is that the U.S. is running short of the most valuable agricultural water in the places where it's also the most socially useful water.



Bob: Socially useful water?

Jude: When I worked at The Nature Conservancy, I did a lot of work in California, where you have multiple uses for a limited resource. Habitat uses, industrial and municipal users, and farmers all vying for their share of a diminishing resource. This water is very, very socially useful water. There's a lot of competition for it and it

should be very expensive. Perhaps a true market pricing of water in the Central Valley might push water use toward intensive crop production in California, and relocate less intensive production to Canada or other regions of the U.S. They still grow corn in the Central Valley, irrigated corn. Come on, you can grow corn in Wisconsin and get the rain for free.

Corie: The key challenge in the region is conveyance, which simply means a channel or a river or ditch that can get water from one place to another. These Western states will have a lot of infrastructure spending ahead of them to get water from one place to another and to store it. And, this trading from field to faucet will inevitably reduce food production and increase prices here in the U.S. A farmer might get a slug of cash from that kind of a water-right sale, but then, that water is gone forever and no longer available for food production. We'll be sorry someday that we sacrificed urban sprawl at the expense of food production. We talk about the global need to export our good practices overseas to help the world, but the irony is we're systematically hurting production here in the U.S. to keep unsustainable cities alive.

Jude: This will sound melodramatic, but you could say we're killing kids in Africa to keep the lawns green in L.A. The Central Valley produces a third of the vegetables, nuts, etc., in the U.S. If we get water regulations that roll production back by even 10 percent, food prices worldwide will be affected. More than 40 percent of the state's available water is used for agricultural production, but folks lose sight of the fact that this is *food*. It's not just another consumer good.

Bob: Wouldn't a water-trading system solve the "water" Commons problem by pushing water prices higher in places where it was in greater demand? A la Elinor Ostrom, people would "talk" to each other via the market.

Levin: It could, but first it requires a re-negotiation of these baroque water laws in multiple western states. And then it requires the political will to make it happen, because you need new public investments in storage facilities like reservoirs and more extensive conveyance systems. The price per acre foot of water would have to be high enough to encourage farmers to sell their water rights and, in some cases, fallow their

land. Then the state needs to establish a groundwater regulation that is fair and certain so that the farmers who sell their surface rights don't mine the groundwater resource instead. It's going to be a mess. The government doesn't have the resources for the infrastructure or the political intelligence to put a workable bureaucratic system in place.

There is a loud "bang, bang!!" A truck outside has backfired, and the audience, who, until now, had remained attentive despite the distractions, squirm in their seats, murmuring about the source of the clatter. Gunshots? A dropped tray in the kitchen? A few folks near the exit stand up to leave.

Bob: Hey, everyone. We'll be done here in fifteen minutes or so. I know it's late but please remain seated.

Kahlil leans over and asks Gordon, "Was there any kind of metal detector at the entrance when you came in? I came in through the back so I didn't see the set up." Gordon replies, "Nothing at the entrance, but don't worry, the place is crawling with security."

Gordon: It does sound impossible, but if it doesn't happen, this could be just the beginning of a certain Mad Max quality to the lives of future generations. It will make worrying about the Federal Reserve's interest rate policy irrelevant. As Corie notes, there are forces at play that will lead to food shortages and price inflation, and there is also an appetite for water to support excessive urban growth. In the West, it's easy to imagine that there will come a day when residential and commercial development eventually reaches the limit of its expansion even after it grabs as much excess water from farmers as it can. Globally, as climate warming accelerates and we hit ten billion people, these court battles over California water will seem tame. The global resource conflicts, water first among them, are just beginning.



Jude: If you get a functional water-trading system, the market might save us from that Mad Max future state by smoothing the allocation transition. However, there are so many places where enlightened government should be stepping in, and it's not, so it's easy to conclude that our public polarization—driven by idiotic, reactionary, populist policies on both sides of the aisle—will be our undoing.

Gordon: As an older person heading into their final chapter...

Kabli: You've got another book in you at least...

Gordon: Thanks. A few paragraphs, maybe. So many medications. Medicare is great but...

Bob: Gordon? Final chapter?

Gordon: Sorry. I was going to say that I'm not sure which of the existential risks I fear most. AI, water shortages, nuclear war, pandemics? They all require global, national, and local public regulation, and functional public agencies to set and apply sensible ground rules so the market can function effectively without negative externalities that leave us living like cave-dwelling Neanderthals in a world run by robotic dictators.



Khalil: Nature abhors a vacuum, and recently, we're seeing private companies filling a vacuum left by our political inability to develop meaningful climate policy. Powerful people on this planet are taking matters into their own hands. Half measures by politicians and our bureaucracies are quickly being replaced by corporate initiatives. Global corporations need to save the planet to save their markets and they are using their capital to accelerate the process, at least what saving means by their own corporate definition.

We all know that corporations are self-serving entities responsible only to their shareholders. They're interested in making money, not saving the planet. We need, as Gordon noted, dispassionate, functioning public entities that report to taxpayers and voters. We don't need Microsoft mapping the world so they can be the monopolistic market maker for ecosystem services. We need the federal government doing that. Public entities are waking up slowly but it's a push and pull. We have a sclerotic federal policy-making mechanism so the U.S. leans on market-based solutions.

Bob: I'm hearing over and over that we need functioning public institutions to implement enlightened practices. Private markets alone will devolve toward self-interested outcomes that may have some positives, but do not have the staying power of public policy supported by the voters, legislated by their representatives, and administered by professional civil servants. If that is one conclusion we can agree upon, we're in the right place here at the Humphrey School of Government to reach that conclusion.

b. Forestry and the Provision Problem

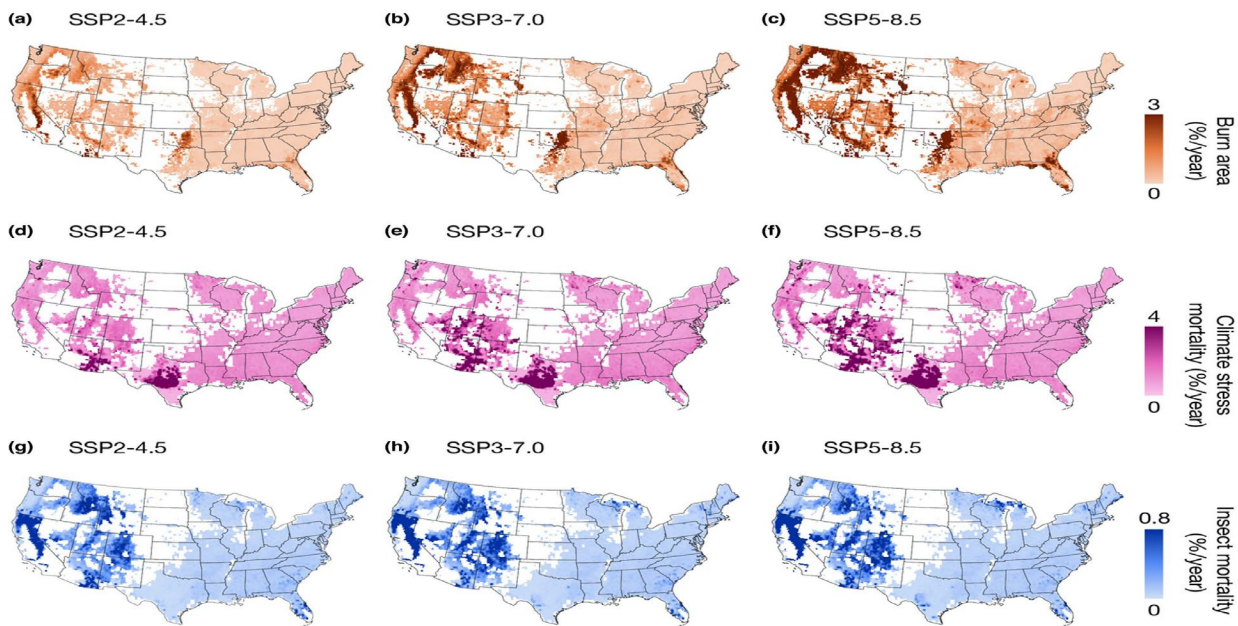
Bob: And with that, I'd like to finish up by talking about forests as they relate to the Provision Problem in the climate emergency era.



Gordon: The climate modeling we were talking about will eventually be able to guide us to plant or manage more resilient dynamic forests. Ismael won't like the human intervention here, but humans intervene. It's what we do. With the CO₂ build up and the climate change we've created, we know that growing seasons are generally longer, and tree crop suitability frontiers in the Northern Hemisphere are moving northward. But with trees, how can we extrapolate over decades? Right now, we're not even sure if trees will grow faster as the climate warms, or if there's some complex interactivity between temperature and soil moisture that will diminish tree vitality and cause additional mortality.



As Leslie has described, nature is hard to model even if conditions are stable, and right now, they're changing fast. In the inland west, for example, are you going to plant Ponderosa pine where the precipitation models predict it will only rain 20 inches a year? And then, if you're in a region where the fires are getting bigger *and* there's going to be more drought, you have fire risk plus the fundamental risk of lower biological productivity if you get less rain. And I won't even mention the new risks around insects.

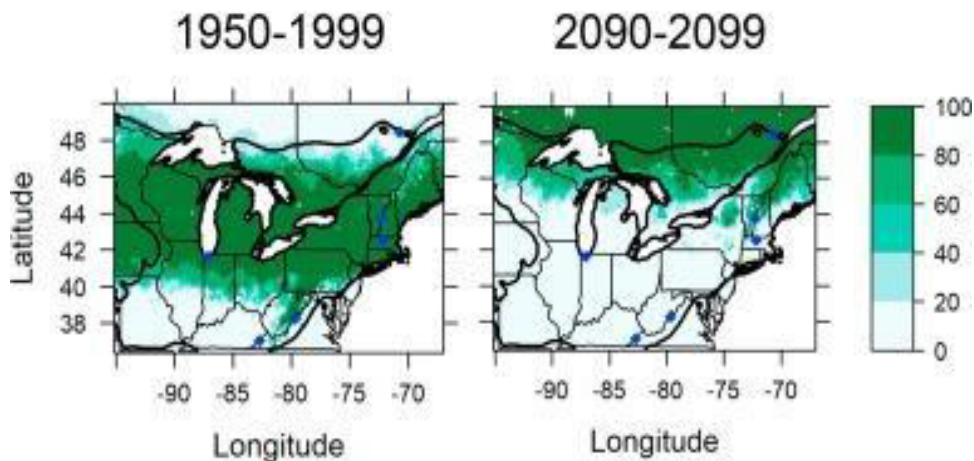


Climate scenario outputs from six climate models to project forest climate risks across the U.S. for three future climate scenarios for climate stress-driven tree mortality, and insect-driven tree mortality (rows) averaged over the period 2080–2099. Ecology Letters, Volume: 25, Issue: 6, Pages: 1510-1520, First published: 11 May 2022, DOI: (10.1111/ele.14018)

However, I will agree with Ismael on the human intervention issue in certain circumstances. Sugar maples are a good example. They are one of the few tree species we can watch in real time as the habitat border moves northward. Maple syrup production is a proxy for maple health. Sugar in the sap is the tree's lifeblood, and it's certainly become lower at the southern edge of the maple's range. This is a sure sign that the trees aren't healthy. Warm winters and unfrozen ground don't allow the tree to rest. It loses its stored sugar over the winter, so it doesn't have the juice to fully develop its leaves. Less leaf surface area means less sugar production and over a decade or two, the tree loses its vitality. Insects invade, and the tree doesn't have the reserves to fight them off.

One could say that we shouldn't worry about maple's long-term future because the range will just migrate north, but as you get into places like northern Quebec, those heavily glaciated soils aren't suitable for maple because the fertility's been scoured out. So, even if you planted sugar maple further north as the climate warms, the soils wouldn't support new establishment because other better-adapted species would outcompete them.

Projected maple syrup (L/tap)



38

Ned: We've seen the same thing. Not just in maples, but across the board with invasives making it harder for trees to regenerate, and insects like the Emerald ash borer and lantern flies are just eating away at the native forest. We feel sort of helpless, so we've tried to take the approach in the forests we manage to prepare for negative impacts. In plantations it's fire, so we keep the understory clean to limit the fuel load, and in the natural forest, we're more prepared to spray insecticide.



Boos from the crowd.

Ismael: Aerial insecticides kill all kinds of beneficial insects, and insecticide production is chemical and energy intensive. You're just adding to the problem. The trees will eventually recover on their own. Stop intervening. You just make the problem worse.

Ned: You're certainly free to have your opinion, but I'm not sure you really know what you're talking about. Most people don't know what they're talking about when they stray outside their expertise, so no worries, Ismael. Your assertions are quite typical, typically wrong.

As with most things, it's complicated. Insecticides have come a long way since the DDT days, and with global trade, the threats to our native species just keep coming. The insecticides we use are organic in the sense that they target specific bugs and specific physiological processes within those bugs. Digestive disruption, for example, is a common strategy to target a *single* species. The other point you made about the trees "being okay" without intervention is wrong, idealistic, and what I call an urban-dweller idea. Hemlocks, ashes, oaks, would all go the way of chestnuts and American elms without intervention. The forest would be filled with Russian olive, mountain

laurel, sumac, Hay-scented fern, and a host of other invasives that I haven't even learned the names of yet. My job is to make our commercial forests more resilient and that includes insecticide use and the forest-road infrastructure. We're upsizing culverts and bridges as well as other drainage-system components to address the increased number and intensity of big storms. To put the best climate interpretation on it, we're preventing soil erosion, maintaining water quality, protecting wetland habitat, and doing what we can to save the apex species in the forest. To me, this seems like our own combination of fiduciary and climate responsibility.



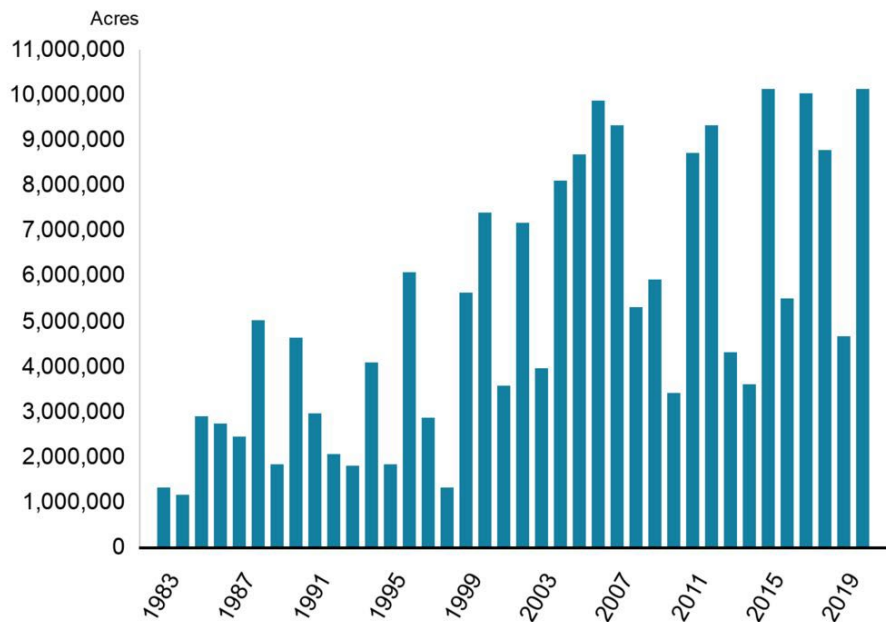
Leslie: Gordon, I want to return to my point about climate change as a secondary issue for most species. There are certainly open questions about forest migration, but that is a species-specific issue, not a climate modelling issue. We can all guess about how maples will react, but that is sort of up to maples, not climate change. Look at how well oaks adapted as they moved north. They began as a tropical species a few million years ago, and now they have a range that extends from Mexico to Canada. Many other species couldn't adapt over this period and went extinct, but it's hard to predict, and the real action happens at the genetic mutation level and that's random. We do know that when niches open up, species fill them, and we also know that when it comes to building material humans work with what they have. Chestnuts disappeared in the Northeast at the turn of the century, and we seem to be doing fine with the oaks that replaced them.

Gordon: I'll agree with you on species adaptability, and yes, forest health is a complicated regression that changes with insect pressure, precipitation variation, and

temperature. If you had more modeling certainty or better AI to figure out the forest health equation, you could spend your resources with more certainty.

Jude: I'd suggest that you don't need ironclad science to see that we're in a defensive position in terms of our forest management in the U.S. So much of our management activity is driven by trying to prevent disasters. Our first priority right now is not to lose the forest to fire or insects, and then to turn them from a potential liability into an asset. After that, maybe we can think about how we would ideally manage for climate benefits like carbon sequestration.

US land burned by fires (1983-2020)



Source: National Interagency Fire Center



The kitchen door opens, and a meaty aroma wafts over the crowd. Some glance at their watches. Stomachs gurgle.

Bob: Leslie, you and Ismael are concerned with fragmentation, and advocate for preservation as the solution. Would you talk about how you see the value of biological preserves when it comes to mitigating ecosystem risk? And then, maybe we should

address the net effect conservation easements have had on some of the issues that Ismael raises.

Leslie: Preserves have multiple benefits. One is as a control for an experiment that allows us to see how nature manages itself without us. It's an attempt to have a little humility and realize that even if we do manage, we probably don't know enough to know what we may be interfering with. Preserves are precautionary in the sense that we don't know the full effect of what we're doing to the forest or to the soil.

Preserves are also about minimum human harm. The more preserves we have, the less harm we're going to do to the areas that are left alone. With a forest, the capital is biological: it's in the big trees, it's in the big, downed trees, and even in the mycorrhizal fungi that connect trees to each other.



There are things beyond our imagination going on in these preserved forests, and we have already depleted a lot of that biological capital. It's going to take hundreds of years to bring that back. I don't think we even know how much natural capital we've lost. There's a lot to be learned from preservation.

Levin: Like what? What is to be learned from nature's ability to rebound when humans leave it alone except that nature will rebound? We live on a crowded planet. As compassionate human beings, we need to work to feed and house the people we share

that planet with. All of this talk about preserving for unknown benefits of unknown species is frustrating. It's way down the line on a humanitarian's list of concerns.

Gordon: I mostly agree. I think the forest rewilding movement misses the point about the recent renaissance in regulatory restrictions already placed upon private landowners, and it also doesn't consider the consequences of rewilding, like intense wildfires. It's also easy to ignore the millions of federal and state acres that are, in effect, rewilded. Taxpayers indirectly pay for all that public rewilding. You've had a systematic regulation-driven disassembling of the timber and lumber milling industries. These industries have largely moved overseas where the operating environment is friendlier. This has forced many private landowners to rewild, not by choice, but by necessity.

Ned: I think rewilding is an extreme idea. And back to the matter at hand, if we're going to save the world by producing more wood and food for a crowded world, how do preserves make any sense? It's economically harmful and offensive because embedded in that preservation attitude is this idea, "We know what's best for you. Just trust us." The part that no one understands is that right after the "we know what's best," is this: "Yeah, we may put your industry out of business, you may be thrust into poverty, but we can retrain you. We can make you an Amazon delivery person."

Levin: Thanks for the support, I was expecting boos again.

Hisses from the crowd.

Levin: Or hisses.

Jude: I'm also pessimistic about these rewilding initiatives, and I worked at the Nature Conservancy for three decades! I'm afraid that leaving nature alone in a controlled experiment is just not a realistic or even productive project when we're caught in this climate conundrum. Here in the U.S., we have an obligation to optimize our production of food and fiber domestically. We have enough wild land, but we could find a middle ground if we developed a market-based incentive system for landowners

to create their own rewilding projects. It gets back to the earlier point about a master plan for national land use.

Ismael: Preserves cannot be discounted simply because they create negative, short-term, human externalities. The least we can do for the nature we've bulldozed is to supply some connectivity and habitat migration. And, to be clear, the rewilding movement does not choose its preservation targets randomly. It tries to locate them in places that optimize non-human species benefits. Rewilders are merely advocating for those beings that don't have an advocate. Humans have advocated for themselves since time began. If some small fraction of the human-altered landscape is removed from the extraction economy to help other species and, in the process, some human beings are harmed, the ethical, moral balance in the universe has moved incrementally in a more balanced direction.

Cheers from the crowd.

Ned: This kind of democratic support...

Gestures toward the crowd.

Ned: Has already created mandatory rewilding. Because of over-restrictive regulations, one of our tree farms has about 27 percent of the land base off-limits. It's off-limits due to **Stream Side Management Zones**³⁹ or habitat setbacks, or some really steep areas. All these trees are left behind in the woods. We own the trees, but we cannot cut them, and we can never harvest them. Guess what they're doing? They're trapping carbon, but doesn't that count? They're creating habitat but that doesn't count. We're paying directly for rewilding, but we're painted as villainous because we kill trees on the remaining land. Why can't we as an industry monetize the ecosystem and carbon benefits? We've given that up to the regulatory agencies and got nothing in return.

Private forests in my state, sequester over twelve percent of the state's emissions. In thirty years, once the grid is powered by renewables, the sequestration from forests will account for over eighty percent. Just try meeting a state's carbon goals without commercial timberland, and you'll never get there. Most unmanaged, rewilded timberland just becomes decadent forest that eventually dies faster than it grows.

Commercial forestry is the only path to carbon neutral, and landowners should be compensated for this valuable environmental service. It's ludicrous and insulting that in order to get paid for it, we must do something beyond what we would normally do. Forestland owners should be paid for both the carbon sequestered as the plantations grow and develop, but also paid a premium when those logs are turned into lumber or other wood products, which trap the carbon for decades. The renewability and cycle of carbon capture is undeniable and should manifest itself in financial returns for our industry. This should happen without forcing change on a system that is already functioning to benefit the health of the community, society, and the world. Commercial forests, well managed forests, are a gift to the environment.

Ismael: You go ahead and tell yourself that story so you can keep extracting and make yourself richer while you make the world poorer. The forest ecosystem needs the very big trees, very old trees, but they will always be too valuable for you *not* to remove them. Intensive management practices of any natural resource strive to simplify, fragment, and convert habitats to try to meet demand that has grown beyond sustainability. That's what has happened across the country over the last century. Economic activity should not destroy the biological systems we depend upon.

Bob: Ned, if I hear you correctly, you seem to be arguing that commercial timber production is in some ways the inverse of the fossil fuel industry. It has positive externalities that haven't been fully recognized, and you seem to be in favor of a system that credits the industry for producing a sustainable material that locks up carbon in the products made from that sustainable material.

Ned: That sums it up. But I also wanted to make the point that these private initiatives to encourage rewilding are overkill. They are misspent dollars. There is a lot of rewilding already happening as a byproduct of regulatory policy overreach.

Ismael: Those trees you're leaving behind, Ned, may be sequestering carbon and promoting rewilding, or a weak permutation of it, but the regulations weren't originally about carbon, they were about habitat and erosion and reducing the harm caused by these repeated intrusions into the forest. The regulations, in effect, give you the social license to operate.⁴⁰ I might even go further and say that as the climate crisis accelerates, your *good* behavior will give you a broader, more important license, the *license to invest*.

Ned: Ismael, your sanctimonious tone is testing my patience. My good behavior is already enshrined in the regulations. The point you're missing is that commercial timberland is a "good" endeavor, end of story!

Bob: I think you've made that clear, but the operating restrictions are part of the deal if you're operating in a stable, fully functioning civilization like the U.S. And, if we're exporting overseas better practices, and commodities that have been produced in humane and sustainable conditions, we can't lead the globe toward a sustainable future if we don't set an example.

Ned: Agreed. But to do it better, and to keep these industries sustainable, we need subsidization and encouragement. In the future, the commercial timber industry will need to supply sustainable building products and inputs for alternatives to energy-rich materials like concrete and steel. If you are going to approach a zero-emission economy, you need wood, you need trees, and you need a vibrant wood-products industry to process the raw material into higher value products that lock up carbon.

Someone from the audience yells, "Trees are the answer!"

The crowd cheers.

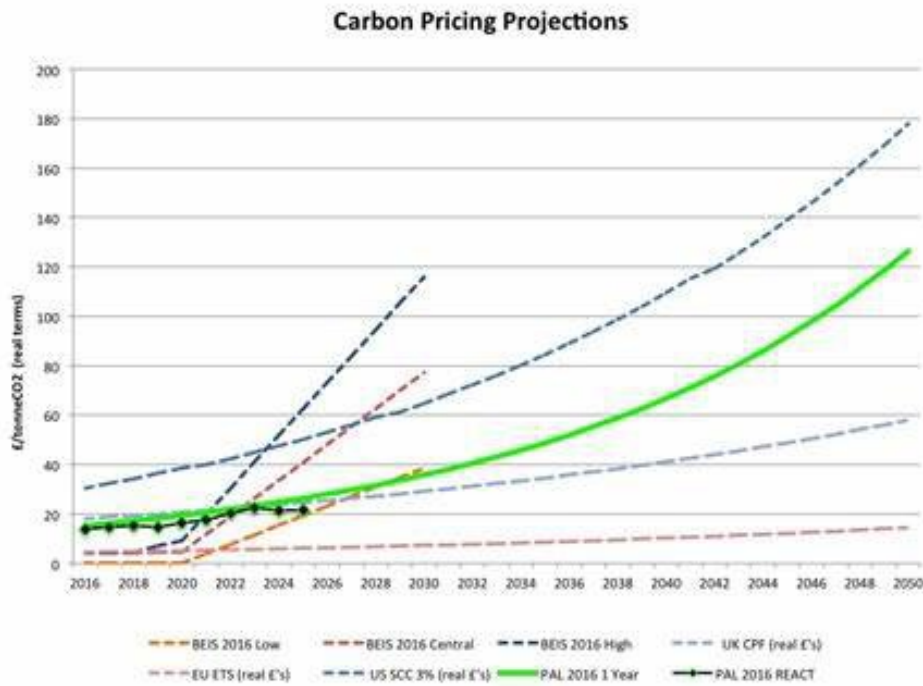
Another voice adds, “Growing trees and harvesting them for building products is the real answer.”

A smattering of boos.

Bob: Folks, please calm down. We’re almost done here. Maybe we’re starting to get to the core issue about wood fiber? Trees are the best way to sequester carbon, and if we use wood fiber to lock up carbon in building and infrastructure materials as well as all the other conventional uses, we can sustain growth while also mitigating some of the climate externalities. And if those materials come from the regulated U.S. wood production system, we’ll be exporting products that have been produced more efficiently and in an eco-friendlier process?

Leslie: I’m not so sure. Industrial landowners claim that each rotation locks up more carbon, so more rotations are good. But doing short rotations with plantations, using herbicides and thinning, ignores the fact that for a whole decade or more after a clearcut, logged forests are net carbon emitters, as all that slash and organic matter decomposes faster than the young plants and trees are taking up CO₂. They also ignore the externalities of soil erosion and chemical use.

Gordon: Maybe there is a middle ground. I’ll concede to Leslie and Ismael that from a climate perspective, from a policy standpoint, the world needs some forests to just grow carbon. An increase in carbon pricing for nature-based carbon would have a transformational impact on forests by decreasing log supply and thereby increasing log prices and land prices, and permanently taking millions of commercial acres out of production. That would be a great outcome because it would concentrate timber production on the most productive acres.



Jude: I think what Gordon is really saying about carbon pricing is that we've got to make polluting more expensive. Now the polluters can do the calculation and say, "All right, we can emit this much pollution and we can buy that for ten bucks a ton, so we are not going to stop polluting because we can buy pollution cheap."

Bob: From a purely commercial perspective, we have been almost too good at managing our forests, especially in the Southeast where you have this huge oversupply that just keeps growing. We've built a pine plantation infrastructure in this country designed to supply two million new houses every year but those kinds of annual numbers are unlikely to ever come back. In the meantime, the trees keep growing.

Ismael: It's interesting to me that too much wood and not enough demand is discussed as a problem. They're capitalist problems, but they're not natural problems. The market in all its wisdom overinvested in forests that grow wood that the market doesn't need, so now you have an oversupply of trees? Too bad. This is a hopeful development. Less demand for houses and for timber, more efficiency in lumber production, and less waste. It would be a great natural outcome to see these artificial forests become natural forests because the market *never* came back.

Jude: I agree with you, to a degree. If decarbonizing the economy is a social objective, these large-scale pine plantation investments might be a casualty from an investment perspective, but part of the solution from a natural-capital perspective. I also think you'll see that decarbonizing the economy will reverse this temporary Covid-driven move to the suburbs. City life is just more energy efficient, and if we want to make a dent in our carbon problem, we've got to limit commuting, so urban living at some point will make sense in the context of decarbonization policy. And, also, our income inequality here in the U.S. is not a positive for wood consumption because the bread-and-butter households can't afford to create a traditional household with a house as the home so it's unlikely housing starts will ever recover to the levels that are in balance with wood supply.

c. The Financialization of Nature and Conclusion

Bob: Now, I'd like to conclude by discussing this idea of "the financialization of nature," and the financial ownership of the *means* of food and fiber production, to paraphrase Marx.

Gordon: I take issue with the derogation implied by the term **financialization of nature**⁴¹. Nature has always been financialized to a degree, and mitigating climate disruption will also be a financialized act insofar as landowners will have to be incentivized if we want them to respond.

A strong gust of wind against the plate glass makes it shake and whistle. Lights outside in the dark February night shimmer and vibrate. The temperature outside has dropped. February has reasserted itself. A few folks exit out the back door and a frigid gust blows in and down the aisle.

Bob: A climate change?

No laughter from the crowd.

Jude: But the short time frame for these new owners is hurting, not helping, the sustainability situation at an operational and community level.

Gordon: I'm not so sure about that. Levin talks about bringing capital to better practices. That's not going to happen without some of this financialization. I'll grant that we need to know how our U.S. policies and actions fit into a global "provision" strategy. It could be as simple as meeting as much of the demand for food from U.S. farms or wood from U.S. forests as our global environmental responsibility. As we've all acknowledged, our operating standards are far superior to what's going on in other parts of the world, and the more we can increase production intensity on domestic commercial acres, the more we take demand away from offshore countries with destructive practices in places like Latin America, Russia, and parts of Asia. If we accept that, then we should subsidize our natural resource sector so we can export our products, and the better practices used to produce these products to offset some of the horrible environmental and human costs in other countries. I'd suggest we need more financialization, not less.

Bob: In our final minutes, I'm going to ask the group to put their optimism hats on and describe some positive trends and possible positive climate outcomes and answers to the *Provision Problem*.

Ismael: Not me. I still hear people trying to bring ten billion people to a standard of living that the earth can't support.

Khalil: At the heart of this debate is this "man vs. nature" battle we just can't get past. The "jobs equal self-respect equal increased consumerism equals keeping the merry-go-round going." This is the cycle that fuels our degradation of the planet.

Ned: That's easy for an academic to say, but when you destroy an economy with policies that don't support industry or the economy, diversified or not, you're left with a lousy economy and a rural opioid epidemic with a lot of depressed people with little to do. Meaning for most folks is related to productive work, and to contributing to their communities.

Bob: Can we end on a hopeful note? I hear a bunch of folks, including you, Ismael, trying to think about the climate and the *Provision Problem*. So, I'll keep asking the question, "What trends are encouraging?" Are there signs that human ingenuity, the human ability to adapt, might outpace the human extraction externalities that have created our climate crisis? And simultaneously provide enough food and material for the souls that will follow us.

Jude: Well, one positive is these large companies pledging themselves now to net zero. These are largely voluntary pledges, but with the corporates, they are also pledges of a *brand*, and if they're violated, these companies will face negative public scrutiny. That's another term for ridicule, and ridicule is the psychological antidote to poor behavior. Brand degradation when a company violates its public promises to a group of young consumers who are cynical and looking for every chink in the corporate armor to corroborate their cynicism—that is *worse* than ridicule. It's a potential loss of market share. It's a huge off-balance-sheet liability and must be realized.

A plume of black smoke escapes from the kitchen door as a waiter pushes through.

Khalil: I'll close by saying that the world is full of surprises. Yes, there are a lot of people fleeing drought, and soon, rising seas. And, yes, people are being pushed off their land, and, yes, the population trickle from Syria, Ukraine, Afghanistan, and sub-Saharan Africa is turning into a steady stream, but I still have hope that we can handle it. I try to take an historical view. Humans have done some awful things to one another. Slavery and the Holocaust and native people genocide, and children working in mines, but I try to believe that the world is getting better. We also have all these countries coming into the modern age, replacing cars with high-speed electric trains.

I'm trying hard to keep my progressive narrative front and center for my students and my family. I'll admit that it's easy to blame capitalism for promulgating the idea of *more* and creating the externalities that degrade the Commons, but it's also going on in fascist, communist, and socialist countries as well.

Bob: Thanks, Kahlil, and thank you to all of our panelists. I hope we have shed light and some non-CO2 emitting heat on some of these topics. Here are certainly no quick fixes technologically, systemically, or psychologically, but it seems clear that homo sapiens must continue to strive to reintegrate themselves back into the natural systems that balance and sustain the globe.

Especially, thanks to our audience for staying attentive throughout. Not easy with all the distractions....

The fire alarm goes off. Audience members stand up with panic in their eyes. A Harvard security guard steps up on stage, and pulls Bob's microphone from its stand.



"Folks, calm down. CALM DOWN! It's a false alarm. Smoke. No fire. Take your time."

Relieved laughter and loud conversation punctuate the alarm's disturbing "beep, beep." The crowd exits in good spirits.

Bob and Ismael walk together toward the back exit side by side.

Bob: I'll admit we're slow out of the starting blocks, but you've heard a lot of ideas today about how we can make some advances. Yes?

Ismael: Debatable.

Bob: But maybe a debate for the next panel? I hope you'll agree to be there?

Ismael grins.

Bob: I'll take that as a "yes?"

The three men in turbans and white robes walk by Bob and Ismael in the opposite direction. They disappear into the ballroom.

By 6:15, the Forum is empty except for the security guard. The black smoke from the kitchen continues to leak from the swinging door. Another smoke alarm triggers, and the staccato "beep, beep" of the first alarm becomes a nearly constant "beeeeeeeep."

Fireman rush into to Forum dragging a canvas sheathed hose. When they open the kitchen door, flames shoot out of the threshold and climb up the wall inside the Forum.

Thunder booms outside.

The security guard sits in Bob's seat on the dais and watches as he sips his coffee.

6. Afterword

Although manufacturing a fictionalized conversation based upon real interviews is unorthodox, the process of gathering qualitative data through interviews supplemented by fact checking is consistent with a method called Data Source Triangulation⁴². Triangulation licenses the researcher to investigate complex issues through an iterative process that juxtaposes ideas and opinions against one another. The Data Source Triangulation research method is designed to capture “*social complexity*” when addressing questions that relate to multifaceted problems.

7. About the Author

Your panel's moderator, me, Bob, has enjoyed a twenty five-year career in agricultural and forestry investing for pension funds, endowments and insurance companies. The academic community defines my profession as the "financialization of nature" and I confess that I have been an agent in this process. I've worked on investment projects all over the United States and in Central America, and I've managed a diverse array of land-based investments that include plantation and natural forests, water right monetization, aquifer development, as well as greenfield establishment of citrus, almonds, and maple syrup companies. I have also partnered with renewable energy firms to develop carbon and wind projects. For the last thirty-plus years, as an avocation, I have been a tree farmer growing two hundred acres of black walnut plantations in the Connecticut River Valley. I currently serve as senior agricultural advisor for Fiera Comox, a Canadian-based agricultural investment manager, and as an advisor for the Grantham Foundation for the Environment. This project is the result of my time as a Bullard Fellow at the Harvard Forest, which helped to fund the thirty-five interviews that create the foundation for this panel.

8. Acknowledgements

I stand, or stood, on the shoulders of giants. Without Eric, Eva, Jeremy, George, Charlie, Joe, Clark, Jeff, and Tom, during phase one of my career, and Nick, Antoine, and Matt in phase two, I'd have been profoundly under-qualified to undertake this project.

Also, a heartfelt thank you to my subjects! You agreed to participate and offer your frank insights about *Provision Problem*. It was a delight connecting with all of you.

9. Footnotes

¹ Doing 70% of the global carbon polluting- The Toxic 100, Political Economy Research Institute (PERI), the University of Massachusetts

² ESG- Environmental, social, and governance (ESG) investing refers to a set of standards for a company's behavior used by socially conscious investors to screen potential investments. Environmental criteria consider how a company safeguards the environment, including corporate policies addressing climate change, for example. Social criteria examine how it manages relationships with employees, suppliers, customers, and the communities where it operates. Governance deals with a company's leadership, diversity, executive pay, audits, internal controls, and shareholder rights.

³ Chilling hours-To maintain enough vitality to produce leaves, flowers, stem growth, and a crop, certain permanent crops (almonds, oranges, walnuts, pecans, maple trees, etc.) need a minimum period of complete dormancy where none of its reserved carbohydrates are in demand.

⁴ Panpsychism-The view that all things have a mind or a mind-like quality. The word itself was coined by the Italian philosopher Francesco Patrizi in the sixteenth century, and derives from the two Greek words pan (all) and psyche (soul or mind).

⁵ Elinor Claire "Lin" Ostrom- An American political scientist and political economist whose work was associated with New Institutional Economics and the resurgence of political economy. In 2009, she was awarded the Nobel Memorial Prize in Economic Sciences for her "analysis of economic governance, especially the commons," which she shared with Oliver E. Williamson. She was the first woman to win the Nobel Prize in Economics.

⁶ Pacific Northwest and the western part of the South-The four panels illustrate average projections from two general circulation models [Hadley CM3, DOE Parallel Climate Model (PCM)] as well as average projections (GCM3 Avg) from three models (Hadley, PCM, and Geophysical Fluid Dynamics models) under high- and low-emission scenarios. Credit: Adapted from A.M. Prasad, L.R. Iverson, S. Matthews, and M. Peters, USDA Forest Service.

⁷ Forest certification- Forest certification originated in the early 1990s, after the United Nations Earth Summit in Rio de Janeiro, Brazil, as a means to protect tropical timber from deforestation and forest degradation. By certifying the management of certain tropical forests, wood products made from that timber could be labeled as "certified" to track the sources of wood products and to ensure consumers that the products are from sustainably managed lands. Forest certification has since been implemented in North America and virtually all timber-producing regions across the world. Three certification schemes—FSC, SFI, and The Tree Farm System—dominate the certification space. About 1 billion acres, or 11 percent of the world's forests, are certified. In the United States, recent data shows that about 95.4 million acres, representing about 13 percent of total forests, have been certified with at least one certification system (Alvarez 2018). About 39 percent of those 95.4 million certified acres are in the southern U. S. Despite several ongoing efforts in landowner outreach and stakeholder engagement, net certified forest area in the United States has remained relatively stable for the past decade (Alvarez 2018).

⁸ We've contributed most of the carbon into the atmosphere-First, in a 2014 article, "Counting carbon: historic emissions from fossil fuels, long-run measures of sustainable development and carbon debt," J. Kunnas et al., in the *Scandinavian Economic History Review*, detail the legacy fossil fuel contribution of the four countries (U.S., China, Russia, India) with the largest historic carbon footprints. This article laid the groundwork for assessing legacy responsibility for climate change as a possible formula for assessing the cost of mitigation. More recently, and, more ambitiously, in the October, 2021. issue of the *Canadian Institute of Mining, Metallurgy and Petroleum*, an article by a Chinese team (no attribution),

⁹ **A hundred more species will go extinct:** Estimates vary widely. In the article, “The Sixth Mass Extinction: fact, fiction or speculation?” Robert H. Cowie et al. published January 10, 2022, in the *Biological Review*, the authors estimate about 1.4 species go extinct per day, but in his recent book on the insect crisis, Oliver Millman estimates that 135 rain forest species alone go extinct every day.

¹⁰ **Thomas Kuhn-***The Structure of Scientific Revolutions*, 1962, 1970 by The University of Chicago. In his essay, “Second Thoughts on Paradigms,” Kuhn observes that his book has been hijacked by the imposition of the word “paradigm” onto his observations about the scientific community. “A scientific community consists of the practitioners of a scientific specialty. Bound together by common elements in their education and apprenticeship, they see themselves and are seen by others as the men responsible for the pursuit of a set of shared goals, including the training of their successors. Such communities are characterized by the relative fullness of communication within the group and by the relative unanimity of the group’s judgment in professional matters. To a remarkable extent the members of a given community will have absorbed the same literature and drawn similar lessons from it. Because the attention of different communities is focused on different matters, professional communication across group lines is likely to be arduous, often gives rise to misunderstanding, and may, if pursued, isolate significant disagreement.” As with most of these footnote topics, the literature on this is copious and varied.

¹¹ **International Monetary Fund (IMF)-**How to Mitigate Climate Changes. IMF Fiscal Monitor. Washington: IMF, 2019

¹² **Integrated Assessment Models-** For a more robust discussion of IAMs and discount rates, see Stanton, Elizabeth A., Frank Ackerman, and Sivan, Kartha. “Inside the integrated assessment models: Four issues in climate economics.” *Climate and Development* 1.2 (2009): 166-184.

¹³ **William Nordhaus-** Nordhaus, William. 2019. “Climate Change: The Ultimate Challenge for Economics.” *American Economic Review*, 109 (6): 1991-2014.

¹⁴ **Discount rates-**Discount rates *discount* expected future benefits (usually cashflows). The higher the discount rate, the lower the value of future cashflows or other types of benefits that are expected to materialize in the future. A higher discount percentage, say 8% vs. 2%, indicates that there is a higher perceived risk of receiving the future benefits and hence a lower net value in the present (the present value). The math is straightforward. The discount rate is the denominator and the cashflow/benefit, the numerator, and hence, the higher the denominator, the lower the resulting present value of the asset that is expected to generate those cashflows or benefits. Discount rates are inherently paradoxical since the “market” does not have a uniform perception of risk at any given time.

¹⁵ **New York Times, and Abrahm Lustgarten.** The great climate migration. *New York Times Magazine*, 2020.

¹⁶ **John Locke-**

¹⁷ **Existential nihilism-**The philosophical theory that life has no intrinsic meaning or value. With respect to the universe, existential nihilism suggests that a single human or even the entire human species is insignificant, without purpose and unlikely to change the totality of existence. According to the theory, each individual is an isolated being born into the universe, barred from knowing “why.” The inherent meaninglessness of life is largely explored in the philosophical school of existentialism, where individuals can potentially create their own subjective “meaning” or “purpose.” Of all types of nihilism, existential nihilism has received the most literary and philosophical attention. In his essay *Existentialism is a Humanism*, Jean-Paul Sartre wrote, “What do we mean by saying that existence precedes essence? We mean that man first of all exists, encounters himself, surges up in the world—and defines himself afterwards. If man as the existentialist sees him [he?] is [or as?] not definable, it is because to begin with he is nothing.”

¹⁸ **The financialization of nature-**The process of replacing environmental regulation with markets. In order to bring nature under the control of markets, the planet’s natural resources need to be made into commodities that can be bought and sold for a profit.

¹⁹ **Three degrees Celsius of warming-**The popular and scholarly literature on the “degrees” of climate warming is vast. These two articles are representative. Tollefson, Jeff. “IPCC says limiting global warming to 1.5 [degrees]C will require drastic action.” *Nature*, vol. 562, no. 7726, Oct. 2018, pp. 172+. *Gale Academic* The world is on track for around 3 degrees of warming by the end of the century if it doesn’t make major reductions in greenhouse-gas emissions. It could breach 1.5 °C sometime between 2030 and 2052 if global warming continues at its current rate.” *The Economist*, Oct 30, 2021 “A rise of 3°C in global temperatures above pre-industrial levels by 2100 would be disastrous. Its effects would be felt differently around the world, but nowhere would be immune. Prolonged heatwaves, droughts and extreme weather events could all become increasingly common and severe.”

- ²⁰ **Acidification-** Gillespie, C.J.; Anton Kahlilo, J.A.; Zhang, H. The Response of Soil pH and Exchangeable Al to Alum and Lime Amendments. *Agriculture* **2021**
- ²¹ **The World Resources Institute-Research** presented by Janet Ranganathan, December 15, 2018.
- ²² **Intercropping-** food or feed crops planted between trees. Trees provide organic material (leaves, twigs) and crops provide food and near term cashflow.
- ²³ **Carbon stored in the soil-** The Earth's soils contain about 2,500 gigatons of carbon—that's more than three times the amount of carbon in the atmosphere and four times the amount stored in all living plants and animals.
- ²⁴ **Nutritional content of organic food is pretty much the same as conventional -**In a survey of the literature entitled "Organic and conventional food: Comparison and future research," in *Trends in Food Science & Technology*, Volume 84, 2019, Pages 49-51, the authors concluded, "No weighty nutritional differences between organic and conventional food were scientifically demonstrated."
- ²⁵ **Organic certification:** Mie, A., Andersen, H.R., Gunnarsson, S. *et al.* Human health implications of organic food and organic agriculture: a comprehensive review. *Environ Health* **16**, 111 (2017). <https://doi.org/10.1186/s12940-017-0315-4> provides an overview regarding the debate over organic certification's health benefits or lack thereof.
- ²⁶ **Only slightly less toxic-** "Organic *vs* conventional plant-based foods: A review." Francesca Giampieri et al, *Food Chemistry*, Volume 383, 2022. This article details both sides of the debate. "Organic farming is characterized by the prohibition of the use of chemical synthetic fertilizers, pesticides, feed additives and genetically modified organisms and by the application of sustainable agricultural technologies based on ecological principles and natural rules. Organic products are believed to be more nutritious and safer foods compared to the conventional alternatives by consumers, with the consequent increase of demand and price of these foodstuffs. However, in academic circles there is much debate on these issues since there is no clear scientific evidence of the difference of the environmental impact on the nutritional quality, safety and health effects between conventional and organic foods."
- ²⁶ **Terroir-Indra's speculation** is discussed in detail in this 2022 publication. PARKER, T., 2022. Reverse-Engineered Terroir: Reimagining Taste and Identity. *Food in Memory and Imagination: Space, Place and, Taste*
- ²⁷ **Farms get larger-**The article, "The average size of farms in the U.S. 2000-2020," published by [M. Shahbandeh](#), showed that the average size of farms in the United States has seen a steady increase over the last decade. In 2020, the average farm size reached 444 acres, up from 418 acres in 2007. Additionally, the number of farms over this period dropped by about 10%, from 2.2 million to 2 million.
- ²⁸ **Agricultural intensification-**The charts illustrate the original intensification theory, the Borlaug Hypothesis of agricultural intensification, the concept of concentrating more production on fewer acres. An article by Emily K. Burchfield, et al, "The impact of agricultural landscape diversification on U.S. crop production," *Agriculture, Ecosystems & Environment*, Volume 285, 2019, discusses in detail the productivity losses that have resulted from the move toward intensification.
- ²⁹ **Source: FAOS, 2008:** The first chart illustrates the micro economic prediction regarding yields, prices, and acres planted (The Borlaug Hypothesis). The concept that increased yield would cause a fall in prices and a reduction in acres planted has proven partially incorrect. Prices did fall, but farmers reacted by planting more acres.
- ³⁰ **Photosynthetic efficiency-**This breakthrough is discussed in detail in an article in the *New Phytologist*, by Christine A. Raines, "Improving plant productivity by re-tuning the regeneration of RuBP in the Calvin–Benson–Bassham cycle 20 July 2022. A major focus of efforts to improve photosynthesis is the enzyme Rubisco, through the application of protein engineering strategies and also via manipulation of its expression in transgenic plants.
- ³¹ **Precision Agriculture-**This article, Radočaj, D.; Jurišić, M.; Gašparović, M. "The Role of Remote Sensing Data and Methods in a Modern Approach to Fertilization in Precision Agriculture," *Remote Sens.* **2022**, *14*, 778. <https://doi.org/10.3390/rs14030778> describes the benefits to the farmer and the environment of precision agriculture.
- ³² **No till farming-**A practice where farmers plant their fields without plowing them first, and leave the chaff from the previous season in the field to compost over the winter. The article by Powlson, D., Stirling, C., Jat, M. *et al.* Limited potential of no-till agriculture for climate change mitigation. *Nature Climate Change* **4**, 678–683 (2014). <https://doi.org/10.1038/nclimate2292> discusses the limitations of the benefits of no-till farming in detail. The abstract states, "The Emissions Gap Report 2013 from the United Nations Environment Program restates the claim that changing to no-till practices in agriculture, as an alternative to conventional tillage, causes an accumulation of organic carbon in soil, thus mitigating climate change through carbon sequestration. But these claims ignore a large body of experimental evidence showing that the quantity of additional organic carbon in soil under no-till is relatively small: in large part apparent increases result from an altered depth distribution. The larger concentration near the surface in no-till is generally beneficial for soil properties that often, though not always, translate into improved crop

growth. In many regions where no-till is practiced it is common for soil to be cultivated conventionally every few years for a range of agronomic reasons, so any soil carbon benefit is then lost. We argue that no-till is beneficial for soil quality and adaptation of agriculture to climate change, but its role in mitigation is widely overstated.

³³ Dust Bowl- Wikipedia describes the Dust Bowl as a period of severe dust storms that greatly damaged the ecology and agriculture of the American and Canadian prairies during the 1930s; severe drought and a failure to apply dryland farming methods (no-tilling) to prevent the aeolian processes (wind erosion) that caused the phenomenon.

³⁴ Use it or lose it- In many states, if farmland is fallowed for more than several growing seasons, the water rights on that farmland can be reallocated to other farms.

³⁵ Conveyance- Water legally titled to an agricultural acre usually makes its way through a series of concrete or earthen channels to reach the acre it belongs to. A water trading system must have the capacity to convey water to buyers who may be distant and disconnected from the ag acreage to which the water belongs.

³⁶ Acre foot- The amount of water to flood one acre to a depth of one foot, 326,000 gallons of water

³⁷ Colorado River rights- Joe Gelt's article, "Sharing Colorado River Water: History, Public Policy and the Colorado River Compact, August, 1997, vol. 10, no. 1, Water Resources Research Center, Tucson, AZ.

³⁸ Rapp et al, *Forest Ecology and Management*, Volume 448, 15 September, 2019

³⁹ Stream Side Management Zones- Setbacks from streams and other wetland areas where harvests are either restricted or prohibited altogether.

⁴⁰ Social license to operate: In the June 15, 2017 article in the CPAC Journal, "Legitimacy by another name?" Joel Gehman, et al discuss the legal and social complexities of natural resource extraction and the social license to operate.

⁴¹ The financialization of nature- The process of replacing environmental regulation with markets. In order to bring nature under the control of markets, the planet's natural resources need to be made into commodities that can be bought and sold for a profit.

⁴² Data Source Triangulation- One of three types of qualitative research triangulation types as described by Corie et al in *Methods and Meanings*, September, 2014, Volume 41, Issue 5, *The Use of Triangulation in Qualitative Research*. The Data Source Triangulation research method is designed to capture "social complexity" when addressing questions that relate to multifaceted problems. Corie et al go on to note that "Interviews allow for spontaneity, flexibility, and interviewer responsiveness to the individual."