

OPENING SESSION

TRANSLATING CLIMATE SCIENCE TO ACTION

Speakers: Barbara Stinson, The Honorable Al Gore, Dr. Rattan Lal

October 12, 2020 - 9:00-10:00 AM

Welcome

Hello from Des Moines, Iowa. We are pleased to welcome you to the 2020 International Borlaug Dialogue, an annual convening of food security experts and champions building collaborative solutions to the most pressing challenges associated with increasing the quantity, quality and availability of food for all. We are so pleased you have joined us from all over the world to address urgently important challenges.

Barbara Stinson

President - World Food Prize Foundation

Welcome to the International Borlaug Dialogue. Good morning, good afternoon and good evening. My name is Barbara Stinson, and I'm the new president of the World Food Prize Foundation. It is my honor to welcome everyone joining us from around the world today.

We are over a thousand people gathered together to advance resilience in our food system. Hailing from six regions around the world from academia and research, government and multilateral organizations of all types, the private sector, so many companies, and a quarter of us coming from nongovernmental organizations.

I want to start by thanking the World Food Prize Board of Directors and your Council of Advisors for their support and guidance in developing this dialogue. And I want to begin today with a land acknowledgement.

Today is Indigenous Peoples Day in the United States. I acknowledge the first nations of the land on which we all stand here in the U.S. I'm speaking to you from the World Food Prize Hall of Laureates in Des Moines, Iowa. These are the ancestral, unseeded lands of the Bahkhoje or Ioway, the Meskwaki, the Sac, and the Ho-Chunk peoples. We at the World Food Prize stand as a global community in solidarity with the U.N. Declaration on the Rights of Indigenous People.

So this is the 2020 International Borlaug Dialogue – Breaking New Ground: Building Resilience Today for Improved Global Food Systems Tomorrow. In this unusual year of 2020, I want to start reflections on our inspiration, Dr. Norman Borlaug. At this, the 50th anniversary of his Nobel Prize, I believe Norm would still support the Green Revolution. But he would agree with the global call that has emerged that we all hear. He would support “Evolution of the Green Revolution.” Agriculture is evolving beyond the practices and technologies of his early years, focused on the increases in crop yields with inputs and irrigation – that was the history then.

Now, we have a global mandate to provide safe, affordable, nutritious, sustainable, and equitable access to food year around. We have to do it all, especially now with the possible doubling of those facing hunger and malnutrition this year due to the global pandemic. This daunting and complex task must involve stakeholders of all levels and for all types of food systems around the world.

In the giant global pause that we're all experiencing, where travel, meetings and therefore all kinds of interactions are limited, work is proceeding, platforms are being elevated, research is advancing, new projects are launched. My hope is that we will all look back on this time and say – In 2020 in the face of global pandemic, the food security community pulled together, initiating significant action to improve food systems, repairing the cracks that were already there, and leaping forward to action. That's our focus today.

As we launch this week, I want to note that the International Borlaug Dialogue is intentionally scheduled adjacent to the meeting of the U.N. Committee on World Food Security. Those are taking place Tuesday through Thursday this week and starting in advance of our start each day.

So much work is needed to build resilience in our food systems. There's so much to discuss. But this week we've decided to focus on four major areas for action: Climate Change, Finance and Investment, Nutrition, and Equity and Access.

So check out the agenda right before you, and the four interactive roundtable discussions that are going to go on, on all these topics. Notice the diverse representation that we're trying to offer in all of those discussions and throughout the week. And give a special welcome to the stage to our youth and your young professionals. They're being featured in each roundtable, and they are coming through our Global Youth Program in most cases.

I want you to also check out all the resources that we have and networking opportunities available on Whova. Post your favorite social media at #FoodPrize20 or @WorldFoodPrize.

And now I have the honor of launching our opening session, Translating Climate Science to Action – a discussion between the Honorable Al Gore and the 2020 World Food Prize Laureate, Dr. Rattan Lal. Dr. Lal and Vice President Gore share long standing commitments to addressing anthropogenic climate change. They're here to discuss climate-positive agriculture, its emergence and the actions needed to elevate soil health for mitigating climate change and for sustainable agriculture.

Let me start with Mr. Al Gore. As you can see, just below, a full biography, Al Gore is the cofounder and chairman of Generation Investment Management. He's also the founder and chairman of the Climate Reality Project. His long work history is outlined right there on your livestream, and so it is my pleasure to introduce Mr. Al Gore.

The Honorable Al Gore

Former Vice President of the United States

Well, thank you very much, Barbara. And to you as president of the World Food Prize Foundation, thank you for inviting me. It's an honor to be on the same program with Dr. Rattan Lal. I've congratulated him already on the World Food Prize the day the announcement was made and since. And he's a longtime friend and a mentor to me. And I want to thank the World Food Prize Foundation for the invitation here.

This dialogue, and especially the recognition of the longtime leadership of Rattan Lal is incredibly significant and relevant to this moment in time. We are at an inflection point in our global effort to solve the climate crisis, as the COVID-19 pandemic has both exacerbated and reinforced many of the longstanding challenges that this crisis presents. That's certainly true when it comes to our global food systems.

The U.N. World Food Program estimates, as you mentioned earlier, Barbara, the number of severely food insecure people in the world is due to increase. It had already risen nearly 70% over the past years before the pandemic hit, largely because of the impacts of the climate crisis. And it projects that, due to the pandemic and other causes, the number of people globally suffering from acute hunger will increase another 82% to 270 million people. While the pandemic continues to spread, the climate crisis is still worsening faster than we're developing and implementing solutions for it.

We're gaining some momentum, and I remain optimistic. But last year the Intergovernmental Panel on Climate Change issued a special report on land, which warned us that the climate crisis is already having a negative impact on agricultural production all around the world. And the potential risks across multiple food systems and bread baskets are multiplying. Extreme and unpredictable weather, rising temperatures, more plant and animal diseases, and increased CO₂ itself in the atmosphere all continue to strain crop yields and food production while wreaking havoc on farmers' ability to produce the food that we eat and thus maintain their livelihoods.

Much of the focus has been on rising temperatures and extreme weather events, the disruption of the water cycle. But I want to mention briefly that the huge increase in the concentration of CO₂ in the atmosphere, is itself having an impact, reducing plants' resistance to pests and diseases, reducing levels of nutrients, according to new, relatively new studies, and reducing yields.

Interestingly, during the pandemic, some good news: Many more consumers are buying local – in part due to shortages in the grocery stores when the institutional food chain broke – but also because they want to ensure the food that they put on their tables is safe, healthy and nutritious. During the pandemic, there have been these serious breakdowns in conventional food systems; but local, more diversified food systems have proven to be more resilient and scalable. Sales through Community Supported Agriculture (or CSA) programs and other local meat sales have flourished. Online shopping direct from farms has increased ten times compared to 2019.

All of this is part of the reason why I'm so excited about regenerative agriculture to meet this growing demand, foster healthier and more connected communities, all while being one of the key solutions to the climate crisis. Regenerative agriculture has tremendous promise to be scaled as the science further develops and as demand for locally grown food and regional food networks also only grows. Many farmers are leading this effort as a means to confront the

impacts of the climate crisis, maintain yields and production. And some of the early adopters of regenerative ag have seen surprisingly significant increases in soil carbon sequestration on their farms while improving their overall resilience and the fertility of their soil, sharply reducing erosion and benefiting their economic bottom line. And all of this is occurring in a time of more frequent and devastating extreme weather events driven by the climate crisis.

A decade ago, I began transitioning my family farm here in Tennessee to a regenerative farm, and so I have just a little bit of personal experience about how promising these practices are; and I've learned a lot more from pioneers who were into it long before I was. As part of this program, I've been learning from some of the most impressive scientists, researchers and other experts about soil science and of course Rattan Lal is at the very top of that list. He's been here to my farm several times, and I've had a chance to visit him at Ohio State, and we've worked together for many years.

Many farmers across the world are realizing the increasingly clear benefits of regenerative ag, a healthy approach that rebalances farming with the earth that we depend on for resources and life. And the momentum behind this work is why this dialogue, as well as another event I'm hosting next week, a much smaller version of this, called The Climate Underground, and the U.N. proceedings underway right now – they're all increasingly significant.

We need deeper connections and better collaboration so we can develop solutions further, and all of that's key to scaling these practices across the global food and agricultural landscape.

So thank you again. It's a great opportunity to join you and to recognize the wonderful work that Rattan Lal has done. I'm excited for the discussion.

Barbara Stinson

Thank you so much. Tremendous remarks, and we'll reflect, as we go into our discussion, on a lot of what you offered. Right now I want to offer Dr. Rattan Lal, the 2020 World Food Prize Laureate and a distinguished university professor of soil science, to the stage. He is Director of Carbon Management and Sequestration at The Ohio State University. Sorry, go ahead.

Dr. Rattan Lal

2020 World Food Prize Laureate

Thank you, Barbara, and it's a great honor to follow Mr. Al Gore, who as you know, has taken the lead in demonstrating the importance of adapting and reversing climate change by agriculture. I'd like to add what he has already said, that it's critical that we make agriculture both part of the solution for the restoration of our planet Earth and an engine of economic development.

Food production systems must restore natural environment while feeding a growing population, especially now. As Mr. Gore said, the pandemic may add several million more to already those suffering from malnutrition and hunger. Improved agriculture and soil management provides us an opportunity to a greener recovery from the pandemic crisis by following the strategy of a resilient food supply chain supported by healthy soil. Sustainable soil management that restores the soil through restoration and sequestration, atmospheric CO₂, is the important starting point. Practices of soil restoration, such as regenerative agriculture,

conservation agriculture, cover-cropping, are important tools already available that can reduce carbon and ecological footprint of agriculture, preserve biodiversity, protect the environment, and enhance human and planetary health.

Restoration, careful management of soil based on transformative innovations since 1990s are also critical to realizing the Sustainable Development Goals of the United Nations, including food and nutrition security, climate action, land degradation neutrality, human health, social justice, and above all, the world peace and harmony. The technical potential of sequestration of soil organic carbon, as Mr. Gore mentioned, can be as much as two and a half gigaton of carbon per year for the next 80 years. And this potential is inspired by eco-innovation powered by known carbon energy, driven by circular economy and green infrastructure and supported by recarbonization of the terrestrial biosphere as the bedrock of sustainable development. Soil, the essence of all life in the terrestrial biosphere, is the most critical component of the atmosphere, biosphere, hydrosphere, lithosphere nexus. It forms indeed the basis of critical ecosystem services essential to human wellbeing and also nature conservancy.

There has been a paradigm shift over the last decade, I'm very pleased to say, especially since 2015, the COP 21 regarding the realization of the importance of soil to addressing global issues and making soil and agriculture integral to national and global policy design. Examples includes 4 per 1000 program of COP 21 in Paris, adapting African agriculture at COP 22 in Marrakech, the platform for climate action in agriculture adopted at COP 25 in Madrid, Santiago, and many others. And these initiatives are based on the premise that the health of soil, plants, animals, people, ecosystem, and the planet, and especially the planet, is one and indivisible. These initiatives also realize that soil and other natural resources are finite and, more important, not free. And because they're finite and not free, they must be managed judiciously, because they are fragile and prone to degradation, the land misuse and soil mismanagement.

Developing linkages between the universities and industry on the one hand, and policy and decision-makers on the other, is the need of the hour and essential to translating, industry, to promote farming carbon so that the growing act of the Climate Solution Act of 2020 is really a step in the very right direction, and I'm very glad that it recognizes that 10-dollar ton of CO₂ is really the most cost-effective option to do that.

I think with that, I would like to indicate that, similar to other living things, soil also has a right to be protected and restored and used and managed. It must not be considered as a property with no rights. It must be used, improved and restored for generations to come. And thank you for the opportunity to talk to you.

Discussion

Thank you so much to both of you. So now we're going to move into a discussion on just a few topics. Let's start with you. I think we're all going to come onto the screen now.

Barbara Given the clear and constantly developing state of climate science, what are the most needed climate action priorities for the next several years? Al.

Gore Well, the world's climate scientists, through their work in the IPCC, have told us unmistakably, we need to cut global greenhouse emissions in half by the end of this decade and then reach net zero emissions no later than 2050. We need to make sharp

reductions in global warming pollution from every source, including the roughly 25 to 30 percent of emissions that come from all of the components of the global food system. That means we need to change policies, and that often starts with electing new policymakers and get ones that are committed to taking action on the climate crisis and who are committed to implementing solutions that are job-creating and save money and save the environment. I mean what's not to like when you really dig into the substance of it.

So government should chart the course for a sustainable and inclusive food justice-oriented recovery from the COVID-19 pandemic through a green stimulus and through sensible climate policies. I want to cite a recent study in the Oxford Review of Economic Policy, which includes the Nobel-winning economist, Joe Stiglitz, and Nick Stern and others as co-authors. That study shows that green stimulus measures have both short-term and long-term job creation advantages and economic advantages, three for one in job creation. On the whole, we need to focus more attention on natural climate solutions, nature-based solutions like regenerative agriculture and sustainable forestry that represent major opportunities for emissions reductions but are sometimes overlooked. And Rattan Lal is one of the main reasons why there is a new focus on the tremendous potential for pulling CO₂ out of the atmosphere into good, healthy topsoils all around the world that give us all these other benefits at the same time.

Barbara Great, thank you. Rattan, your reflections on this.

Lal Well, thank you. I fully agree with what suggestion Al just made. I think in addition to that, to implement, we must empower farmers. Farmers are the largest stakeholders and stewards of natural resources. Empowering them to do the right agriculture as we know it is greatly a very high priority. And any policy incentive that promotes farmers to adopt, improve agricultural practices, and empower them, that is really a very important step in the right direction.

Barbara Great. So actions that really need to be taken at all levels, particularly what countries can do in the policy arena and policy actions, let's talk about the role that carbon sequestration really poses in terms of the actionable steps towards sequestering 150 parts per million of carbon by 2100. Taken what you just said, reflecting, Dr. Lal, on the soil quality, soil health that you've worked on for so, so many years, what are some of the incentives we need for this? Just a bit more.

Lal Thank you. Well, the soil is like a bank account. If you want your bank account to go up, increase, that means what you deposit into the account, you must deposit more than what you withdraw. Soil is exactly the same. Carbon being the currency that we're talking about, the amount of biomass carbon that goes into the soil must always be more than what you withdraw from the soil. And what we withdraw from the soil as a carbon is by erosion, decomposition, leaching. We must stop erosion and moderate decomposition, reduce leaching, and increase the input of farmers' carbon into the soil. If we did that, we can create a positive soil carbon budget. And with a positive soil carbon budget it is possible to [inaudible] as much as two and a half gigatons per year. Now, at this point I must say that there are two types of carbon. We have always been talking about organic carbon, which is very important to soil health and productivity, and it is a food for the microorganisms and biota. But there's another kind of carbon – it's inorganic carbon. In the arid and semi-arid climates such as Southwestern United States and elsewhere in dry regions, inorganic carbon is also

important. So sequestering inorganic carbon, that's secondary carbonates, leaching it with good water to irrigation of bicarbonates, is another mechanism sequestration. And the weather will really provide a very important land-based natural solution. Now, it is true that we can only really offset maybe 20, 15% of the anthropogenic emission, so this definitely does not mean that the known carbon field sources should not be identified. That still remains a priority number one. Over and above that, if we can improve carbon sequestration in soil, that has many additional side benefits. Therefore, it's a win-win-win situation. It buys us time until the known carbon field shortage take effect. And that's the window of opportunity which you must not own it.

Barbara Al, your thoughts on this?

Gore I always learn so much from Rattan. The urgency of the climate crisis should lead us to do everything we can to not only reduce the source of emissions, which is priority number one – we've got to stop using the atmosphere as an open sewer – but to encourage as much carbon sequestration as we possibly can in soils, vegetation, and trees. Of course, we need to do more R&D, but we also need to build upon the work that Dr. Lal and others have already done. We know a lot. We need a greater focus on regenerative agriculture, like of course reducing or eliminating tillage, planting, cover crops, and much greater diversity and cross rotation, increased use of compost, agroforestry, including Silvopasture, multispecies and rotational grazing, and reducing synthetic inputs. And we now have the opportunity to reduce a lot of the synthetic nitrogen that's now being spilled all over land where it doesn't really do much good and increases nitrogen oxide emissions and other greenhouse gas, and of course contributes to the dead zones and also threatens water supplies in neighboring towns. There's a variety of ways to encourage all this. We're long overdue for national legislation that supports healthy soils. We have a Clean Water Act and a Clean Air Act – why not a Healthy Soil Act? And we can learn from some of the state programs that are in their early stages. I personally am a big fan of Congresswoman Chellie Pingree's Agriculture Resilience Act, which continues emissions reduction targets with incentives for farmers and the food system as a whole to transition to regenerative agricultural practices.

Barbara Great. Thank you so much. Well, this is an open invitation to you, Dr. Lal. The Soil Health Act.

Lal Thank you. Excellent. I'm really very glad for what Al said. We have Clean Water Act. We have Clean Air Act. It is not possible to have clean water and clean air until we have a Soil Quality Act that protects, restores, and improves soil quality, so this is the right time. And, Al is very right, if we adopted a healthy soil act and if we adopted practices which we already know, 200 million tons of fertilizer used globally now can definitely reduce no more than half of that by the time we sequester the carbon we are talking about. 700 million hectare of land in the cereals, we can reduce it to 500 by bridging the yield gap. We don't need extra land. We really know how to produce more from less. So that soil health act, soil quality act, whatever we would call it - this is the right time for that.

Barbara Right. Thank you so much. Well, let's talk about another mechanism in addition to federal legislation, which really might help. We talk a lot about, and we hear about, this other important ingredient to achieving climate mitigation and adaptation, which

is carbon credit. How do you effectively develop carbon markets? What is most needed in terms of the science, the policy, carbon pricing?

Al To me?

Barbara Let's start with you, Al.

Gore Okay, well, an effective, verifiable carbon market that provides an economic incentive to reward farmers for sequestering soil carbon could be hugely significant. This is not a pipe dream; it's already being developed, and a lot of people are out there trying to push it along fast. But the key is verifiability. I used to work on nuclear arms control, and one of the first lessons I learned – this was back in the early '80s and since – and verifying arms control agreements turned out to be the key.

Now, for some time the soil carbon sequestration challenge has been discussed, but we have lacked the sufficient scientific tools to precisely verify and monitor soil organic carbon in a scalable, affordable way, without surging lots of resources to every farm at a time. However, some of the world's leading scientists in this area, some of whom I'm happy to say are doing research in this area on my farm here in Tennessee and other farms in other parts of the country, they're now approaching some genuine breakthroughs in the combination of satellite imagery, analyzing with artificial intelligence the 45 years of landsat data. Every field on every farm on the planet, we can get a record in good years, medium years and poor years and really look very carefully field by field, every field in the entire world. It's amazing what artificial intelligence and machine learning can do, combined with ground-based sensors and the ability for farmers to verify their own soil carbon buildup.

I'm hopeful that we will soon see the emergence of a significant carbon market for agriculture the way we have seen for forests. After all, for all the focus on trees, which I support. There are four trillion trees in the world. We can definitely plant another trillion and maybe another two trillion, but there's more than three times as much carbon in the topsoils of the world as in all of the four trillion trees plus all of the vegetation put together.

So we need to change our current incentives and reward farmers for sequestering carbon and providing other so-called ecosystem services, a phrase that's getting some attraction now, for example, protecting water quality. And we also need to put a price on carbon, directly or indirectly, and carbon markets do put it on indirectly. And that would leverage market forces to help encourage the structural changes we need. A proper carbon pricing system or a reformed agricultural subsidies program fashioned in close consultation with farmers, ranchers and foresters would ensure that they're compensated for verified, audited carbon sequestration. That would incentivize the kinds of sustainable practices we need to proliferate throughout the agricultural sector without putting an unfair burden on farmers, to the contrary giving them an extra source of income.

And if I could just add this – I'm also encouraged by the prospect for carbon markets that incorporate agriculture with some of the new, emerging science that's being done to verify accurately the long-term soil carbon sequestration. Again, I'll say it's not a pipe dream – it can be done. The demand in global markets for carbon credits is much larger than the supply on offer now. There have been some people trying to go into the

for-profit space and accumulate all this data. I think the data should be in a non-profit format where we're not monetizing information on farmers and all their fields and everything. It needs to serve the larger purpose, including the farmers who are switching to regenerative agriculture and could make good use of that extra stream of income the way the owners of timberland do now.

Barbara Well, you're putting forward so many important propositions and elements. I know, Dr. Lal, you have a lot of thoughts, particularly around the verification that's needed, the technology contribution that's critical for effective carbon markets. Talk to us a little bit about the potential for full ecosystem services and the difference in subsidies.

Lal Thank you. First of all, I'm really very pleased that Al mentioned progress being made by the remote sensing techniques to monitor carbon. And that's excellent. I've been in discussions briefly with Microsoft group to develop a handheld tool to be able to assess carbon as you walk over the land - something for the future that will happen. I want to also mention, yes, it's very correct all biota, all trees keep about 620 gigaton of carbon globally, compared with the soil to 3-meter depth, organic carbon on 3,000 gigatons. And that does not include inorganic carbon, and that does not include the thermofrost carbon. So soil really is a very large carbon reservoir which has to be used properly.

In terms of the cost, we are talking sometimes about \$10 a ton of CO₂. The Euro market had 25 Euro a ton of CO₂. In 2014 I calculated the cost, what I call the societal value of carbon, not the market value based on demand and supply, come to about \$35 a ton of CO₂. Undervaluing a resource can lead to tragedy of the commons. And we want all farmers to adopt regenerative agriculture that may bring some reduction in yield during the transition period. It's very important that we compensate farmers for ecosystem services justly, fairly and transparently. That's very important, not under changing any part. And that is about \$30 to \$35 a ton of CO₂. That is for ecosystem services. It's very important to understand that that's not a subsidy. That is what we are asking them to do for the community, for the world, for the planet. And they must be rewarded very fairly and very justly. And that will get all farmers, farmer in the Midwest United States, developing country farmers, 500-700 millions of them who currently farm two-acre, five-acre, energy acres. Giving them something like \$20 per acre per year as a payment for ecosystem services would be a great start to revolutionize agriculture, to address food security, to mitigate and adapt climate change, to improve biodiversity and to increase the value of the property by itself.

Thank you.

Barbara Fantastic. Valuing the resource, critical. Valuing it properly, absolutely critical. How will the farmers engage otherwise? Let's go to a different topic, one of, I think, your favorites in terms of your work. Rattan, the nutrition benefits of improving soil health, creating high-quality soil – it's central to improving the overall nutritional content of our food and human health on the planet. Tell us more about your work and how this has turned out.

Lal Thank you, Barbara. That's a very good point. We have 700 million people which are already undernourished and the number increasing because of the pandemic. We have two billion people or more suffering from malnutrition. Malnutrition means deficiency of protein in the diet and deficiency of essential micronutrients, 17 of them. Those

micronutrients and other commodities that are essential by human health, they really have to come from a healthy soil. Soil degradation is the cause of global malnutrition problem. When soils are degraded, people are the mirror image of the land they live upon, and therefore soil is translated into human health. Soil has provided the fingerprint of the human health. And I think that's where the slogan, *The health of soil, plants, animal, people, ecosystem and the planet* is all interconnected, that nexus. So for a good health, we must have a healthy diet. If the diet is healthy, medicine is not used. If the diet is good, medicine is not needed, and that the diet is the medicine and that good diet comes from healthy soil. We must go back to improving soil health so that the human health and the health of the planet and the environment, water and air, can also improve.

So a Healthy Soil Act would be really the first step also in improving the global human health – they are interconnected. They cannot be separated.

Barbara Thank you for mapping that out. Al?

Gore Well, Hippocrates famously said, *Let food be thy medicine*, so I endorse everything my mentor, Dr. Lal, just said. There is also an emerging body of research on how healthy soil positively influences the flavor and taste of the food as well as the nutritional qualities of the food. It's increasingly understood that healthy soils have a better structure, make the land better able to hold water during these rain bombs that we had. You know, last year 20 million acres couldn't be planted because of the rain bombs and the flooding, a few years before that, the drought, the derecho this year. But healthy soils can hold more water, reduce erosion, cycle and recycle more nutrients and grow healthy plants that are beneficial in keeping people healthy. And at a time when we're seeing rising levels of obesity in the wealthier parts of the world and rising levels of malnutrition and hunger in the lower-income parts of the world with increasing CO₂ as a key driver, this is an increasingly important topic.

And also related to this is the emerging issue of "food apartheid." That's a relatively new phrase for me. I've heard the phrase "food deserts." And food apartheid speaks to the lack of access to nutritional foods among low-income and discriminated peoples across the world. And we have to address this, and we have to put the food justice and food security concerns right at the heart of any agenda related to agriculture and/or climate.

Barbara And that gets right at our entire discussion throughout our week. We want to focus on equity and justice in the food security. I want to turn just one more minute to the topic that you've both discussed – regenerative agriculture. We hear so much about it. But I'm going to ask a challenging question. Since you've already talked a bit about the context of it, really, can farmers make a living practicing regenerative agriculture? Is it profitable? Starting with you, Al.

Gore Well, some of the early adopters... I've been speaking to an awful lot of them, and some of the early adopters of these practices have seen surprisingly significant increases in the fertility and the soil carbon sequestration in their soils, while at the same time improving the overall resilience of their soil, reducing both wind and water erosion and benefiting their economic line. They also save money, of course, by avoiding some of the inputs that are unnecessary, wasteful and even harmful.

In the face of the mounting impacts of the climate crisis, a holistic regenerative farming system can improve efficiencies like reducing inputs – pesticides, fertilizer – and that decreases costs while improving outcomes. More soil organic matter can lead to a more resilient farm, sustaining the soil, making it more resilient during the downpours or rain bombs and during the more frequent and deeper droughts.

Last year in the U.S., as I've mentioned, there were 20 million acres that couldn't be planted because of what happened the last year in the Midwest, the rainfalls and the flooding. The economic damages totaled \$20 billion, including almost 6½ billion dollars in federal crop insurance payments, the highest-ever federal flood-related payments, and 2019 was the wettest year on record ever measured in the U.S. Midwest.

But here is a key point, Barbara – one team of researchers looked carefully at several of the areas in the Midwest that were affected, and they found that farms with a greater ability to plant in the face of this extreme weather were the farms that had adopted more regenerative practices like sharply reduced tillage, diverse cover crops, and keeping roots in the soil, keeping the soil resistant and resilient. So we've now got economic evidence that in the wake of these more common, extreme weather events, farmers can improve their bottom line and make their farms more resilient with regenerative agriculture practices.

Barbara Thank you. Rattan, your thoughts on this.

Lal Thank you, thank you, Barbara. I totally agree with what Al said on his own experience when I visited his farm. He said, "I do make money on my farm." So that's a very good example. I want to add to it that increasing carbon in the root zone – that's some kind of organic carbon by one ton per hectare with the same level of inputs of fertilizers and other inputs – can increase crop yields, corn, for example, as much as a hundred to three hundred kilograms per hectare that would be a hundred to three hundred pounds per acre. Soybean, maybe 20 to 50, wheat maybe 50 to 70. All crop productivity goes up. In fact, increasing carbon concentration in soil also saves nitrogen use of fertilizer, because if fertilizer is used, efficiency has gone up. Soil becomes disease oppressive. That means the organisms in soil can predate on pathogens and pests. So the need for pesticide becomes less. So a healthier soil does not require as many inputs as the other soil, especially the energy to plow the field. So the profitability of the farm operation is much better. The total yield may not be sometime, but the profitability is better. And that's an important part to understand.

One other thing which I want to emphasize, but Al mentioned very nicely – to me, drought and flood are the two sides of the same coin – and the coin is mismanagement of soil health. When soil is mismanaged, soil structure is destroyed, it's infiltration capacity for water is minimized. During the rainfall, like he called "rain bomb," you have runoff, tremendous runoff, floods. And during the drought you have a serious drought. So on the one side you suffer from floods. On the other side you suffer from drought because the soil was not managed properly. The solution lies in improving soil quality, which is an important part.

The other part of regenerative agriculture, I want to mention it. I do hear many times, "It does not work. It does not produce high yield. It does not sequester carbon." The question is no longer that it does not work. The question is how to use our science to

make it work. That's a very different approach. We know that we have to reduce input. We know that we have to sequester carbon. We know that we have to minimize pollution. Therefore, we have to make it work. Soil has to be kept covered. We have to grow cover crop. We have to minimize the tillage. It's not a question of it doesn't work. It is up to us to make it work. And there are many examples that show if properly done, it works and it's profitable; it earns money. It needs to be done.

Barbara Great, thank you so much. We're going to proceed talking about all of these topics further in our next roundtable discussion. But, Al, we only have you for a short time longer, and we have a question from our audience. Among our 1,000 people with us are over 200 youth – kids that are part of our Global Youth Institute, and they want to ask you: What do you see youth needing to do to advance climate science? What is their role?

Gore Well, every great, morally based revolution in the history of human civilization has begun to succeed and turn the corner when young people got deeply involved. We saw that in the Civil Rights Movement in our country. We saw it in the Abolition Movement long before. We saw it in the Women's Suffrage Movement and Women's Rights Movement, the Anti-Apartheid Movement, and more recently the LGBTQ Rights Movement. Young people are less encumbered by some of the mistaken views based on prejudices and legacy, wrong-headed attitudes of the ones who came before. And when there is a crystal clear case to be made that illuminates the difference between a big right and a big wrong, young people have the key role to play. Look at Greta Thunberg and her generation right now. We are right at this moment, Barbara, crossing the political tipping point on the climate crisis. China just made a very helpful, big announcement. I won't go through the list, but last year 80% of all the new electricity generation built in the world was from wind and solar. The electric vehicles will soon begin displacing entirely internal combustion engine vehicles – we're seeing hyper-efficiency.

Young people can help to move all those good developments forward in the marketplace with their choices, in the political system with their votes, and end the thinking of our world as a whole through their passion and their advocacy. We are still putting today more than 150 million tons of manmade global warming pollution into this thin shell of atmosphere surrounding our planet – we're using it as an open sewer. The cumulative amount now traps as much extra heat every day as would be released by 600,000 Hiroshima-class atomic bombs exploding every 24 hours. That's what's disrupting the water cycle. That's what's causing these atmospheric rivers to overflow and the rain bombs sucking the moisture out of the first several centimeters of the soil, causing stronger storms. We just had another one day before yesterday hit the Gulf. The fires out in California, Washington, Oregon, and the ten times as many fires going on in Siberia that don't get covered by the media; the melting ice and the sea level rise.

But we can solve this, and agriculture can be a very significant part of the solution for this crisis. We have to cut down on emissions – that's job number one. But then we have to pull as much out of the atmosphere as we can with the regenerative agriculture management of topsoils and soil carbon sequestration, planting more trees, and all the other things that we can do.

So I just want to say before I conclude, Barbara, thank you for inviting me. Thanks again to the World Food Prize Foundation, and thanks again to Dr. Rattan Lal. And if I

can just leave with one message to take home with you – the climate crisis is here right now. It's getting worse. We have the solutions. It is already drastically affecting farmers. And regenerative agriculture is an increasingly promising and effective approach to addressing a meaningful part of the solution. And this is especially true during the pandemic where large, conventional food systems have broken down, but local, more diversified food systems have proven to be more resilient. This movement is being led by farmers, and together with great scientists like Dr. Rattan Lal and experts across the food system, regenerative agriculture has tremendous promise to be scaled far and wide. And if it happens, it will happen – and I believe it will happen because of the people in this virtual room, including the young people – forging deeper connections and working with one another on developing the science and translating it into action. You all, particularly the young people, give me hope that we can and we will solve the climate crisis. And thank you again for having me play a part in this.

Barbara Absolutely our pleasure. Thank you so much for those closing remarks as well. And we are going to move on to Dr. Rattan Lal's closing remarks.

Lal Thank you. It's really great to hear Al say that the younger generation really address the issue battle through proper education, and they can make it work.

I would also like to add that we need to develop very close relationship with the industry and private sector. In fact, we are talking about carbon farming, and industry can play a very big role, talking about developing cost-effective tools to monitor soil carbon; again industry and private sector cooperation can be excellent. Talking about creating innovative value addition products that will reduce the food waste and prolong shelf life. Again partnerships with industries and private sector is very critical. Innovating eco-efficient soil amendments, organic-based, fortified fertilizer. Again industry can be tremendously important to us, helping that.

I think one other part which we have not discussed is that the regenerative agriculture we have talked about, we are really talking about farming soil rather than farming crops or farming animals or farming trees. We are actually farming soil. The objective is sustaining, restoring, enhancing soil health, through farming soil. And that is what the soil-centric agriculture is – focuses on sustaining soil health for generations to come. That's the question to help our younger generation, what they can do. Restoring the soil so that we give them back better than what we received from our forefathers. That's the goal that we have to do.

And then farmers should be paid just and fair price. Growing Climate Solutions Act 2020 is really most welcome. I'm very glad to see it. But it needs to be translated into actual action so the farmers are not at \$10 per ton of CO₂, but hopefully \$35, \$40, which is the actual societal value. And that again combined with soil quality act to complement the water quality and air quality would really be a tremendous input.

I'd like to mention one thing very quickly. We are now having fertilizer use on 200 million hectares, we should certainly aim to reduce it by half but increase the efficiency use double. We have so many hectares of cropland, rather than bringing more land, let's bridge the yield gap and reduce the acreage. The idea to share extra land, water resources with nature - return it back to nature. Do not take it more for nature. This is

the time to give back. And the discussion today with Al and you, Barbara, is a step in the right direction. And thank you for taking the lead in it.

Barbara Thank you both so much. Well, what a charge from both Mr. Gore and Dr. Lal. Translating science into action – there is so much work to do. But now we continue with our global call to action to increase the resilience in food systems for other topics as well. For the rest of the week you can enjoy roundtables and keynote speakers, two workshops on Wednesday, and your award ceremonies, Thursday morning and Tuesday morning for our Borlaug Field Award. On Friday, on World Food Day, we're going to welcome the remarks of King Abdullah II of Jordan, followed by deliberations on the 2020 U.N. Food Systems Summit. So post on your social media, tag us on Twitter and Instagram, and check out all the features of Whova. The community section has so many resources. We are going to begin in a few minutes at 10 A.M. really with a continuation of these topics. So go to your session on your agenda, click on that Roundtable, and we'll see you in just a few minutes. Thank you.