AN AGRICULTURAL ECOLOGIST'S JOURNEY

Sir Gordon Conway

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Introduction

Ambassador Kenneth M. Quinn
President - World Food Prize Foundation

Please find your way to your seats. I've got the law right here at my side in case we need to, you know, anybody move in quickly. So this is Officer Scott Baker. Scott, come here. And Scott has been working with the World Food Prize for 15 years. Yeah, and takes care of our building, the Hall of Laureates. He's here for all of our events, and we are so fortunate to have a relationship with the Des Moines Police Department through him. And he's part of the family, so I wanted you to know, and, thank you, Scott, for all that you do for us.

So now to get everybody's eyes open and your blood flowing, we have a wonderful, but for me a bit bittersweet moment. Gordon Conway has been a member of our Council of Advisors for about 15 years plus. I met him at the symposium. I heard him talk for about a minute, and I said I've got to have him on our Council of Advisors and convinced him. And he has been such an incredible source of wisdom for me. And he's now stepping back from being on our council but is going to always be a member of the World Food Prize family. So this is his valedictory from the World Food Prize.

The title of his remarks are "An Agricultural Ecologist's Journey." So here Gordon Conway, an incredible iconic figure, young man. He goes to Cambridge to PhD at California Davis and goes off to Borneo and Malaysia in the early 1960s and begins this journey. (Somebody's going to make a movie, Gordon, of you. I don't know will be playing you.) And takes him to India, to Africa with the Ford Foundation, president of the Rockefeller Foundation, president of the Royal Geographic Society, Royal Society Fellow at Imperial College, is scientific advisor to IFAD in the UK Government, is Knight Commander, invested by Her Majesty, and has set the agenda with his books, *The Doubly Green Revision* and *One Billion Hungry: Can We Feed the World?*

And so, like Dr. Borlaug who gave his 60 years of fighting hunger address, this is a moment for Sir Gordon to give his remarks and to share with all of us what that journey has been about. So he's going to come up and do that. And then, because I thought there might be some questions, another extremely distinguished member of our Council of Advisors, Ismail Serageldin, will be here, and they will continue with a fireside chat. We're almost going to have a fire because it was so cold a couple days ago—it was snowing. But they'll be here and continue that conversation. Ismail Serageldin is like Gordon Conway. He was head of the CGIAR system, Vice President of the World Bank, the founding director of Bibliotheca Alexandrina. He is the emeritus librarian of Alexandria. And I think if you were to say—who are the two premier, top

international development specialists in the world today, their names would be right at the top of the list.

So let me welcome Sir Gordon Conway and Ismail Serageldin.

Sir Gordon Conway
Member of the World Food Prize Council of Advisors
& Professor of International Development, Imperial College of London

Thank you, Ken, very much for those words of introduction. I'm delighted to be on this stage with my good friend, Ismail, and we're going to have a chat, as you gather, later on. I'm just going to start with some of the things of my life that I thought you'd be interested to see. The title is slightly changed, but there it is.

When I was nine years old—that's when it really started—I was taken up into our school playground by our teacher. And she threw a quadrat onto the grass. A quadrat is an ecological tool. And what we all had to do was to get on our hands and knees and look at the different things we could see—different grasses and flowers and everything else. And I got excited because I found a ladybird, and I showed her the ladybird. "Very good," she said. And that was my beginning. It was then on, and believe it or not, the kids used to call me an ecologist [inaudible] the kids from then onward. And I always tell this story when I go to schools and give addresses, because I always like to say this and say, "You teachers, you know what you can do."

Anyway, my first job was in Borneo. I went there. I was about 23 years old, and I was the entomologist for a whole country. And when I got there, the director said to me, "We want you to go over to the East Coast, because we've got problems with our cocoa." So I went over to the East Coast, and they're growing the cocoa under the secondary forest that's grown up. They cut down the main trees. They've got the other trees. But as you can see, on the right, that's what the cocoa looked like—hasn't got a leaf on it. Thousands of hectares were like that. And there were pests that were causing that damage, one of them called a bagworm. You could see up in the top left—it's a little caterpillar that covers itself with the leaf that it eats. So it's protected by this leaf, and it walks around under the leaf. And another one was called the ringbark borer, which was a caterpillar there that manages to go all the way around the tree, and of course it kills the tree. And there were other pests, too.

But one of the things I noticed was that there were parasites, too. I really was trained as an entomologist. And so you can see two of those parasites there, and I thought, that's significant—we've got the parasites there. I decided that probably what was happening was that the spraying with the pesticides that you can see here… You see all those classes in 1961, the Endrin, Dieldrin, DDT, BHC. And they were spraying the maize, and I talked to the planters, and they said, "Oh, we're doing a great job." They said, "We spray at least twice a week with mixtures of all of those." And you just think… Today you look at that and think, but don't forget even Rachel Carson's *Silent Spring* hadn't been written then. She didn't write it until 1962. And that's what they were doing. And it just seemed to me that all that spraying was killing all the parasites. And so I decided we had to stop spraying.

And I got the Director of Agriculture to come and see me, and he came over and looked all around. And I said, "We've got to stop the spraying." He said, "That's all right. I'll do that."

And so he issued a decree—this is sort of the Trumpian era in which you could actually say, "Stop all spraying!" and everybody did it. They stopped all the spraying. And you can see on the right there the spraying was stopped except for a very selected pesticide called Trichlorfon at the bottom that killed the bagworms. And that's what happened to the pests. You can see by the middle of 1962 all the pests had come under control, and that lasted for nearly 40 years.

It was one of the first examples really of integrated pest management. It had been done before, as many of you know, in California with alfalfa and also in Peru with cotton. But basically what I did then was the other example of integrated pest manage.

When I was at Davis, I basically learned about mathematics and computing. That's really why I went to Davis in those days. And one of the bits of work I did was with a colleague, a professor in the University on Aedes aegypti. Aedes aegypti, you all know carries yellow fever. It carries an awful disease called Gongong where your knees seize up. But it also carries Zika virus, and that's how all of you know it these days because Zika has come back.

And we went to Dar es Salaam, the two of us, and we went into a used car dump where there were tires with water in them where the mosquitos were breeding. And we sat there like this. So the mosquitos came to feed on us—right? We caught the mosquitos, and we either put them on our ears or on our knuckles so they could have a good meal. They had a full meal—right? And then we marked every single mosquito that we could. With a very fine hair with different paint colors on the back of the mosquito, we marked every single one. And over three weeks 12% of the mosquitos that we marked came back, which was very high. And we discovered that they came to feed every four days. And yellow fever and Zika and other viruses take about seven days to mature inside the mosquito before they can be passed on to a human being. And so you've got to go through two cycles for the mosquito to be able to pass the yellow fever on. And actually you can easily work out on your paper about all of this—if you've got about a 50% insecticide that kills about 50% of the mosquitos, you get rid of it virtually altogether over that time. It was a very good example of learning about modern mathematical models applied to a particular problem.

I then however decided I was going to spend much more of my time not on big computer models or even analytical models but on as it were conceptual models. And this is a conceptual model. It's a diagram of a rice field with all the different elements in the rice field, called an agroecosystem. But what is interesting about it is there are deliberately included human beings in the diagram. All right? So there's an ecological, physical boundary around the system. But there's also a socioeconomic boundary around it, and that together creates an agroecosystem.

And that system—and I use this in lots of other examples—is the basis for acquiring information and then building up your understanding of what's going on. And a little of what I did was with farmers. In that sense, I've got some kinship way back there with Norm Borlaug. By the way, Norm was just starting on his career when I was ten years old, learning about ecology. And so the interactions between farmers and people is very important. This is not exactly the ideal way in which experts should be talking to farmers.

I was much more interested in finding out what farmers know. And one of the most remarkable things that happened to me was in Ethiopia. Four years after the great famine, I sat down with some farmers. And we sat down for two hours, and I got them to work out the number of days of rain each month for the previous ten years—and extraordinary. It worked primarily because in those days the land was being allocated each year to somebody different. So they could

remember they were on that area there, that year they were there, over there. And they'd say, "Oh, yes, I remember that September when I was there, there were probably about three or four days of rain." And that's what happened. And so you've got this fantastic piece of information out farmers' minds. And of course you can see the draught year—no rain whatsoever; that one was easy to fill in.

And I a number of other people started working on getting farmers to draw maps and diagrams. And you can see on the left there is a map of a farm area, a village, and they've used different colored powders, maybe even brought some of the plants to stick in the ground. And you can actually, if you look hard, you can see there's a hill in the middle of the diagram, and you can see the real hill in the background there. So you've got models that farmers can use to communicate with you. Sometimes they're a bit ephemeral.

And here's some farmers, I think in Haryana. They've drawn a map of their environment, of the watershed where they live, and they've used colored powder and chalk to delineate different parts of the environment. What is significant is that bottom right-hand picture. The farmers on the left, the person on the ground sitting, arguing with them, debating with them, is the Chief Conservator of Forest for the whole state of Haryana. And that's a dramatic transformation of the way in which farmers and experts speak to each other. And you can go further, and here for example some villagers. They've done their own map. They've described the map, and in the bottom right they've got a list of all the things they want to have done, ordered by priority.

So you can take these things all the way through. And that gets you quite a long way, but it doesn't get you all the way; because first of all, they've got all these ideas here, but you need to ask—Are their ideas sustainable? What they recommend, what they'd like to do—is it going to be sustainable? And that opens a whole, big area of discussion.

First of all, what is sustainable agriculture? And I know in this room all of you will decide it's this and this and this and that and not this, and it's okay—gluten-free foods are in, but GM crops are out, or whatever it is. So we all believe that, but in fact you can have a much more precise definition of sustainability. I used to think I'd invented the term *sustainable agriculture*, because I actually ran workshops on sustainable agriculture in the '70s in Indonesia and the Philippines. Then I discovered that I was really a latecomer to the idea. There's a man called Varro, a Roman called Varro in the 1st century B.C. And he, like me, was 80 years old, and he married again. That's not been my case, but it is in his case. And he thought—Well, I'll give my wife, my new, lovely, young wife—I'll give her a book to describe how she should run the estate. And so you can read it. It's in Latin, but we've got English translations, and it's available now everywhere. You could sit and read what he gave her as advice.

And there's a wonderful passage in there which I've described. It talks about agriculture not only being an art but an important art and it's also as well as science but then which teaches you what crops are to be planted in each kind of soil, what operations to be carried out in order that—This is a key bit—the land may regularly produce the largest crops. You can just see the Latin at the top… That the land may produce yield with fructose maximally perpetual, I mean perpetuity. And that's by far the best definition of sustainability that I've ever seen, and it lasts for me, and now it should last for everybody else.

There are of course enormous challenges to achieve sustainable agriculture. I've got a book coming out next year with my colleagues, Barney and Catherine, called *Food for All in Africa.* And we've got a whole chapter on the challenges. Soil erosion is one of them—25% of Sub-

Saharan Africa soils are seriously eroded, not just eroded but seriously eroded. And of course we've also in Africa got this big problem of population growth. Just look at that right-hand graph. The bright red is East Africa. The sort of purple at the bottom is West Africa. Huge population growth, and Africa is becoming highly populated by young people. And we need to intensify production. I know many people say—Oh, there's plenty of food in the world; we just need to share it more evenly. I say, yes, that's true. It's like money. There's plenty of money in the world; we just need to share it more evenly. But there's just usually sort of a few obstructions in the way.

We need more food, particularly in Africa. Africa imports 40 billion dollars' worth of food every year. And you can see the bottom of the graph on the right—they're only producing about 1 ton of maize per hectare on average in Africa, 1 ton of maize. Over there in Europe we've got about 4 or 5, 6 tons. Here in Iowa do you know what the average yield of Iowa corn is? Well, I can't talk in bushels. I'm a Brit. So somebody said 9. It's actually 11—11 tons per hectare is the average yield here in Iowa, compared with 1 in Africa. But of course the point is that the intensification that we've got to do has got to be sustainable. It means that you've got to use inputs that are very prudent. Why? It means you have to minimize the emissions of greenhouse gases, particularly methane and nitrous oxide, because they're very powerful greenhouse gases that come from agriculture. We have to improve the natural capital, like the soils and the water. We've got to strengthen resilience and reduce environmental impact. And that's what we call sustainable intensification. And that's what I'm passionate about.

We know what can be achieved. This is in Ethiopia. The woman there has but a hectare of land. She has a draught-tolerate hybrid, corn, and she adds boron as well, because that's what's missing there. And she has appropriate blended fertilizer. In the foreground on the left there, that's just any old stuff. That's diammonium phosphate. That's where everybody loves. They always put diammonium phosphate on everything. But in the back, there's great big maize plants; and you can see that behind her, have got two or three cobs per plant. And she's getting 4, 5, 6 tons per hectare. And that is not just true there, it's true around the rest of Africa. If you go to Mozambique, for example, you get the same thing but if you add lime instead of adding boron. And it's… You've got to put yourself in the mindset of a poor farmer who he and his parents and grandparents and others way, way back in distant history have all been getting, if they're lucky, about one ton per hectare. And he or she wakes up in the morning, and they've got four or five or six tons. Just think about that. What a miracle that is, or apparent miracle.

And I think sustainable intensification has got three approaches, really. One is ecological, one is genetic, one is socioeconomic. And I go through those rather quickly. First of all, the ecological is using ecological principles. Now the principles I started to learn at the age of 9, that's how we use them in agriculture. A good example is conservation farming, which many of you are very familiar with. This is in Zambia, and there the farmer, the woman there on the right is the farmer, she cuts down the maize when it's mature. She lays it on the ground so it rots into the ground, and then in this case her husband comes along, and he digs the little holes to put the seed in. And ideally with conservation farming you do that, and then you follow it with keeping that cover of the maize stalks on the ground for a period, and then you usually rotate it preferably with a legume. It's a brilliant way of doing things, and it's catching on quite fast now in Africa.

The other is agroforestry, and this is a rather special example. The trees are Faidherbia—it's a form of focaccia—and they have a curious habit of shedding their leaves in the wet season. And under those bare-leafed trees, the maize is producing three tons per hectare without any

fertilizer, because of the nitrogen is coming down the leaves onto the ground. And they can sequester up to ten tons of carbon per hectare under those agroforestry systems.

And then there's genetics. We talk about sustainable genetics. It's the same principle—you try and pack more things into what you're doing. In this case, it's packing in more genes, whether you do it through natural selection or for artificial selection or you do it through some form of biofortification or whatever. The picture there is one that I think you all know. That's the results of Monte Jones' work with the new rices for Africa. I often show those in Africa, and the African boys say, "What are all these boys doing in an Asian rice field?" and I said, "No, it's not. It's an African rice field."

And then there are lots of ways of breeding into the future. Orange flesh sweet potato, and I can see at least two of the pioneers of orange fleshed sweet potato here in the audience, done without GM but done brilliantly by the teams there. In the middle is golden rice, which everybody knows about. It was funded originally by the Rockefeller Foundation when I was there. It's got to the stage now where the amounts of vitamin A in the golden rice are really very high. I think it's going to be commercialized in Bangladesh next year. Got close to that.

Another example is what happens in Uganda. Uganda is the Pioneer of genetically modified crops in Africa. They've got about 15 growing on a field scale. The one on the right there is against wilt disease, and you can see what wilt disease does to a banana. And the bottom picture there is of GM bananas. What is important about that is that it is all funded by government. It's funded by the British Government, it's funded by the American Government, and it's funded by the Ugandan Government. And President Museveni is very, very keen on all this happening.

And then there's intensification of socioeconomics. When of the most important things are the links between farmers, particularly within farmer associations and savings and loans associations. But perhaps even more significant is getting farmers linked into value chains. Value chains here go all the way up from the research at the bottom to the markets at the top. You can actually draw the value chains if you like from the plant molecule to a human molecule. This is an extraordinary way, first of all, of organizing your knowledge about what's going on. It's also extraordinary because it forces you to think about how you add value along the way. And it's a way in which farmers literally can get involved in markets and capture some of the value for themselves. It's partly about inputs. The top left there is my grandfather. He ran a little co-op in Kent, selling seed around the farms. The bottom right there is sort of his descendant, not real descendant but sort of figurative descendant, a woman running a little agro dealerin a shop, I think in Tanzania.

Also, at that stage in the value chain are youthful entrepreneurs. This is a good example—young boys in Kampala who have learned how to make cob shellers, and they make these cob shellers. They sell them or they lease them or they carry them from village to village and get them to do the work. That kind of thing is what young African boys like to do. We just need much, much, much more of it.

Food prices are also important. This is the beginning of food processing. I saw it in Thailand many years ago where snacks are the first thing you get onto the market from the farms. In this case, they're making snacks in Uganda, and beyond that it builds up into a larger food processing activity.

And now, just the last few slides. This is where I'm at now. And about, I don't know, seven or eight years ago, I created something called the Montpellier Panel. We were funded by the Gates Foundation, and the idea was to start to write about all these issues around agriculture in Africa in a fairly straightforward way that would be accessible to government leaders. And we wrote… There's one there on soils, there's one on climate change, there's one in French on Lender, sustainable intensification, resilience, and so on. If you go on that particular Web, look at Montpellier Panel, you'll find there's about 15, 20 of those reports. And I've written in a way that makes it very accessible.

You know, you always have to remember about the people you need to influence, which are government ministers, maybe even prime ministers or presidents. And they've got a very short attention span, I mean, really short attention span. And this is where this little, the elevator conversation comes in. And I used to be chief scientist at DFID, and I used to do this. I'd get a hold of a minister in an elevator and I'd say something on that—bang, bang, bang—and he'd pick it up. I remember one of them said to me, he said to me, "Gordon," he said, "Is there any country in the world that's developed without an agricultural base?" I said, "Yes." He said, "Oh, really?" He said, "What is it?" I said Singapore. And that was enough. I mean, that was all I had to do. That was all I had to say, and the message got through.

And then three years ago we morphed this panel into the Malabo Montpellier Panel. It's got an African base. Members of it are primarily Africans. It's based in Dakar and Senegal under the directorship of Ousmane Badiane, and Ousmane and Joachim von Braun in [inaudible] are co-chairs. And I've got a unit at Imperial College as well. And we all work together to produce these new star reports. And we've got two out already, one called "Nourished," another called "Mechanize." The Nourished one is really quite interesting, because… (Oh, I've got to stop.) The Nourished one is interesting because we've discovered that the way to reduce child mortality was to get across departmental committee and make it responsive there. And there's one called "Mechanize." The next one's on irrigation. And I'll stop there. Sorry. I ran on too long.